Transmission Development Plan (TDP 2013 – 2022)

Public Presentation

23 October 2012

Overview and Purpose

The Objective of the presentation is to:

- Address feedback from the previous engagements (DPE / NERSA / Public Forum)
- Contextualise the planning timelines relating to the demand forecast and generation patterns
- Share assumptions and results from the Transmission Development Plan 2013 – 2022
- Share information on the process for the Transmission Refurbishment and Capital Spares Plan
- Share information on the estimated Transmission Capital Investment Requirements for the period 2013 – 2022
- To solicit comments and inputs from stakeholders on the Transmission Plans

Feedback from previous TDP discussions

Main topics relate to:

- Integration of TDP with Key stakeholders (eg. Distribution, Munics, other Government Departments etc.)
- Distribution Master / Development Plans
- Transmission Refurbishment Plans
- Integration of Renewable Energy (Wind / Solar), distributed generation and IPPs in general
- Synchronisation of planning timelines to cater for the IRP
- Achieving Grid Code compliance

TDP discussions undertaken to-date

Since April 2012 Transmission has been involved in joint discussions with Eskom Distribution and local Metros with the main purpose of the engagements “to seek alignment of the TDP with the Provinces’ security-of-supply aspirations”

The following meetings have already taken place:

Gauteng:	13 April 2012
Mpumalanga:	28 June 2012
Northern Cape:	10 July 2012
Northwest:	20 July 2012
Western Cape:	6 August 2012
Eastern Cape:	8 August 2012
KZN:	13 August 2012

Some of the concerns raised at the above meetings include:

- A need was expressed to pursue N-2 in Gauteng, due to the non-availability of servitudes and the concentration of load in a small geographical area.
- A need was expressed to integrate distribution and transmission plans and investigate the migration from 66kV to 132kV in the North-West Province.
- Some alignment gaps were identified between transmission plans and distribution plans
- Servitude challenges across all provinces

- **Engagements with RE stakeholders (Wind, Solar)**
- **Involvement in the Presidential Infrastructure Coordinating Commission (PICC) / Strategic Integrated Projects (SIP) Program**

Planning for the South African Integrated Power System

The different plans

Integrated Resource Plan

- 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.

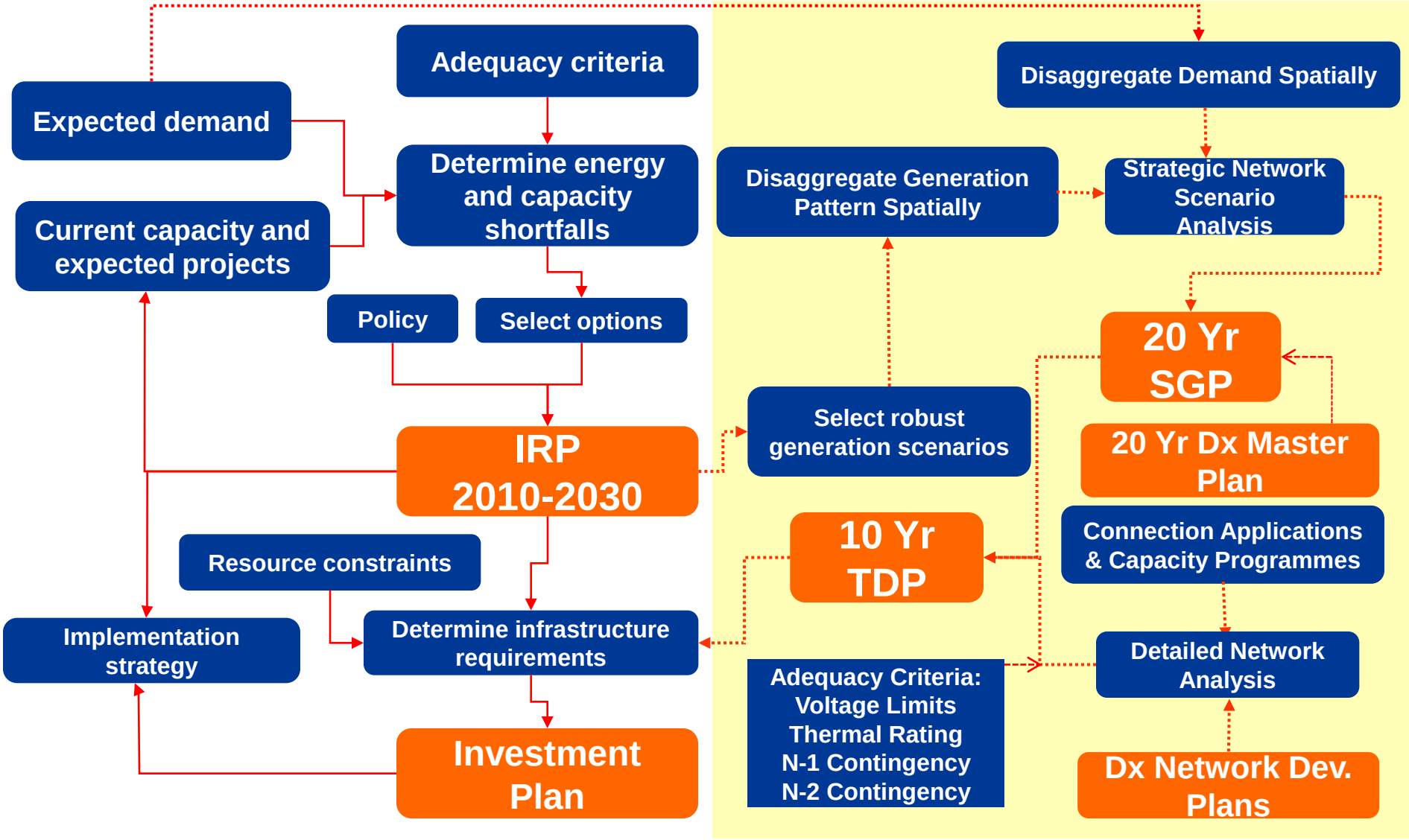
Strategic Grid Plan

- 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

- 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

Linkages between the various plans



Strategic Grid Plan
TDP 2013 – 2022 (2012 TDP)

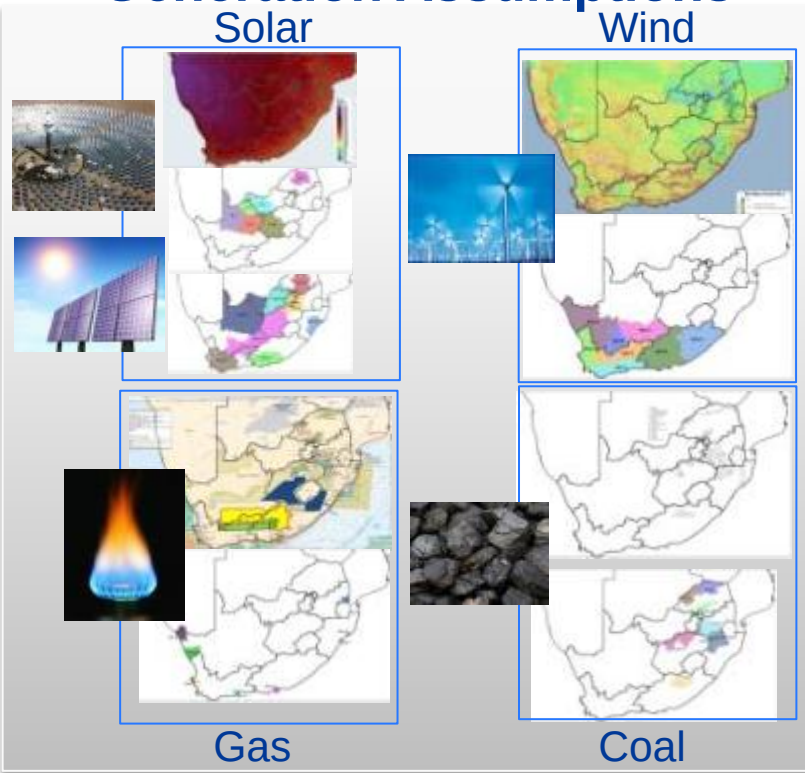
Process for the Strategic 2040 Network Study

Eskom

Approval process → Engagement & Assumptions Development → Approval → Scenario Network Evaluation & Review → Approval → Stakeholder engagement

Q1/2011	Q2-Q3/2011	Q4/2011	Q1-Q4/2012	Q1/2013	Q2/2013 ongoing
Develop & Strategic Grid Study Scenario Approval process	Generation & Load Scenario Engagement & Assumptions Development	Scenario Development base on IRP 2010	Approved Assumption & Study Scenario's	2040 National Network Evaluation	2040 Scenario Network Evaluation	Draft SGP Stake holder review	Approval of SGP	Stakeholder engagement

Generation Assumptions



Generation Scenarios

The IRP 2010 base Scenario (BASE IRP)

- IRP will be extended to 2040
- Coal will be fixed at 2030 level
- Balance in similar ratio to 2030 mix

Increased Renewables Scenario (GREEN)

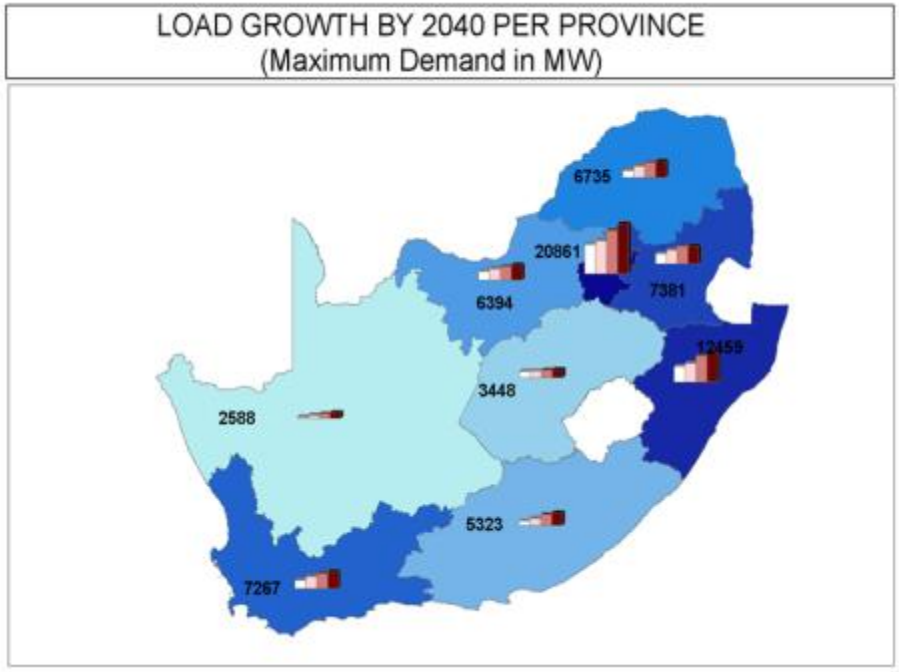
- Replace nuclear component with RE base generation equivalent
- CSP (with storage) / Wind with CCV of 30% / Natural Gas

Increased Imports Scenario (IMPORT)

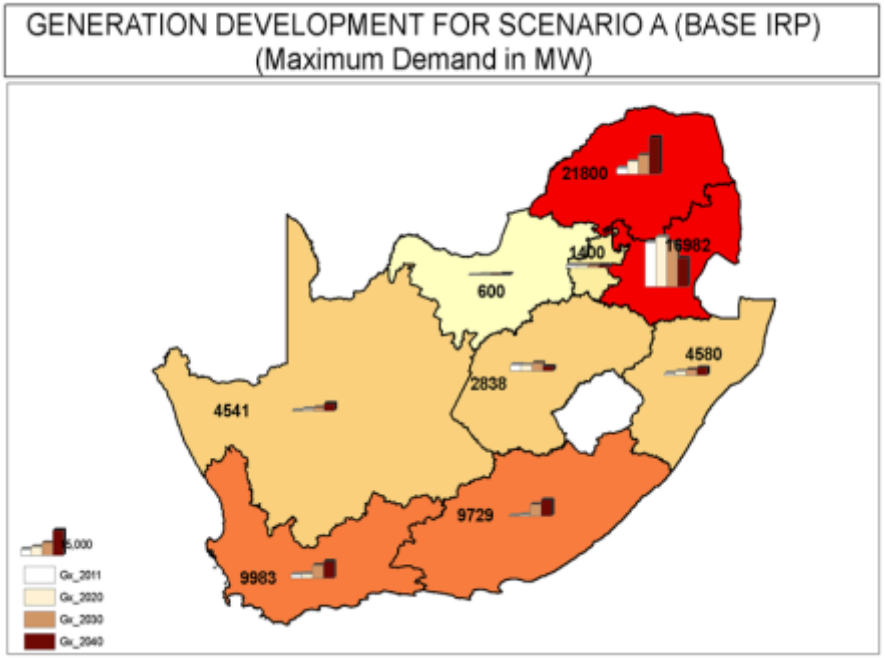
- Double imported power by 2030
- Reduce coal & nuclear

Mapping the Demand and Generation

- First the Demand is allocated to each Municipal Area and then summated by province to get the total Load Demand for each province
- The Bars represent the relative Demand for 2011, 2020, 2030 and 2040 with the 2040 figure shown

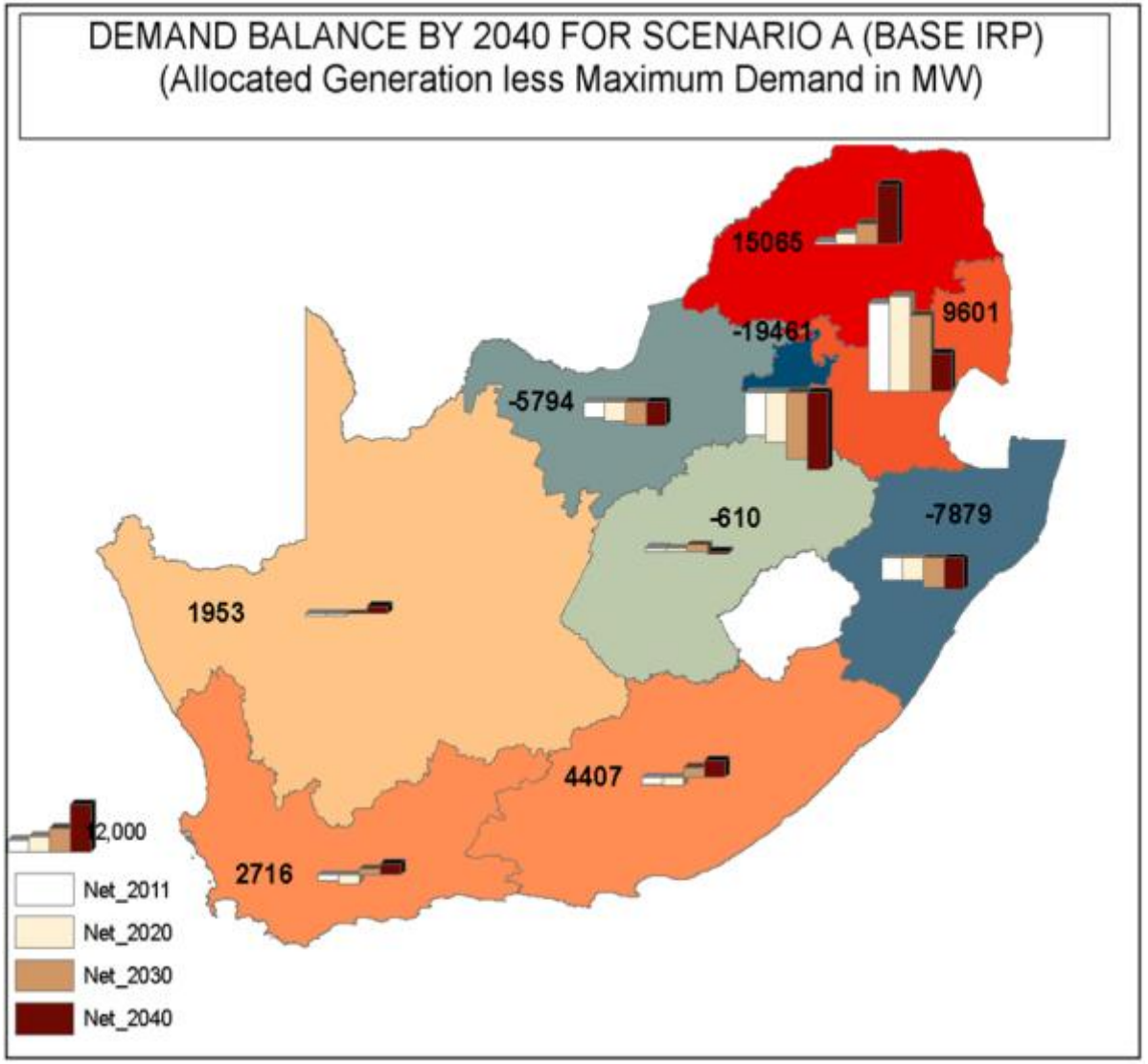


- Secondly the Generation is allocated to each Municipal Area and then summated by province to get the total Generation for each province for each Generation Scenario
- The Bars represent the relative Generation for 2011, 2020, 2030

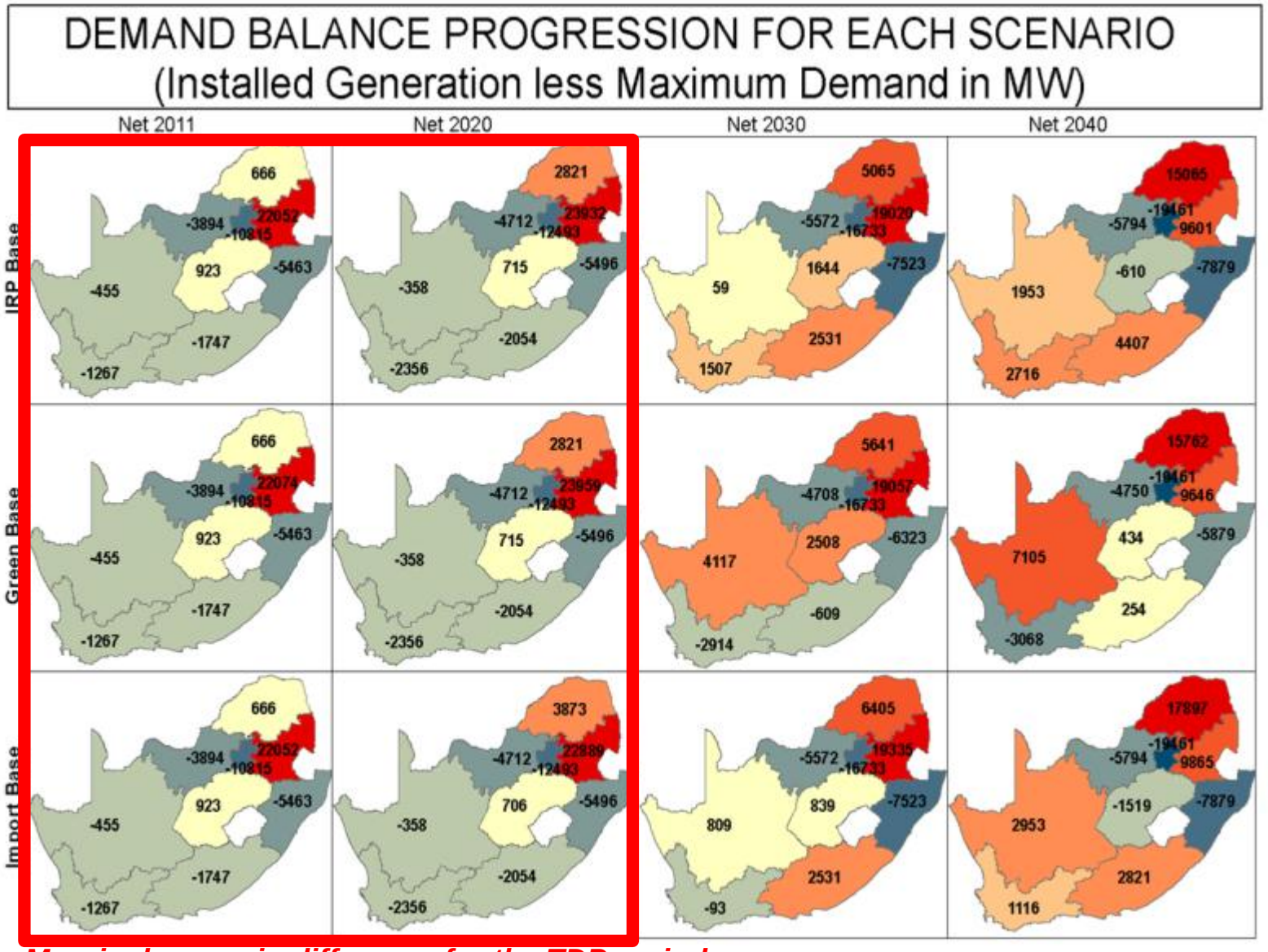


Mapping the Demand Balance up to 2040

- The Supply and Demand Balance value is then calculated for each Generation Scenario for each year to 2040 to determine the change over this period
- The 2011, 2020, 2030 and 2040 scenarios are presented in the report to illustrate the change over each decade
- The Bars represent the relative Demand Balance for 2011, 2020, 2030 and 2040 with the 2040 figure shown for Scenario A in this case
- All three Generation Scenarios can be mapped and compared to show the differences between the scenarios over time



Comparing Demand Balances for each Generation Scenario

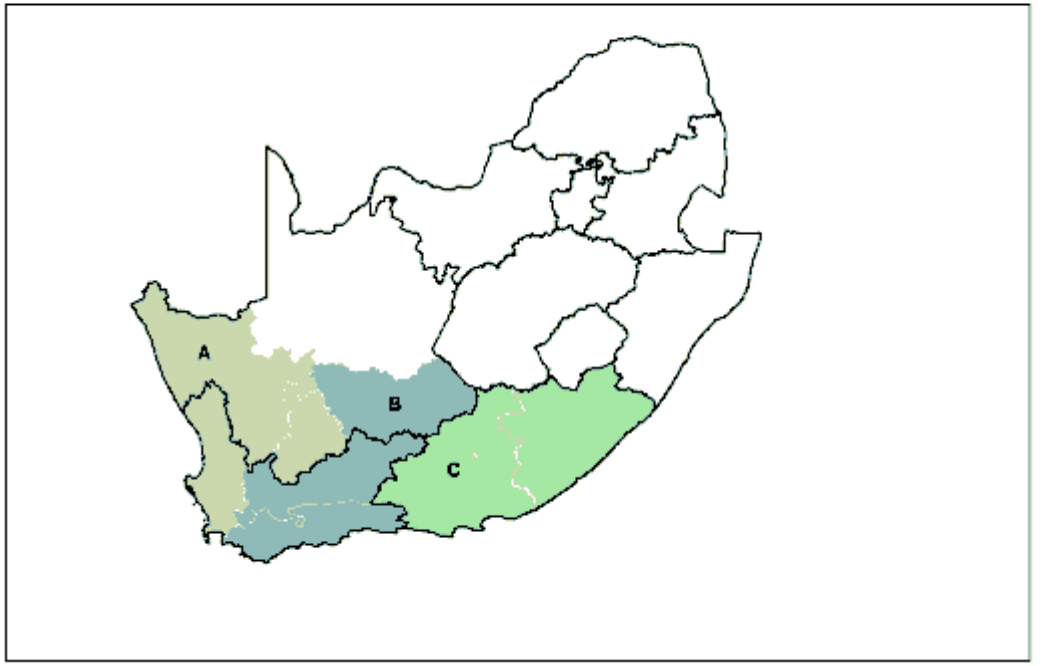


Marginal scenario difference for the TDP period

Impact of variance of wind output

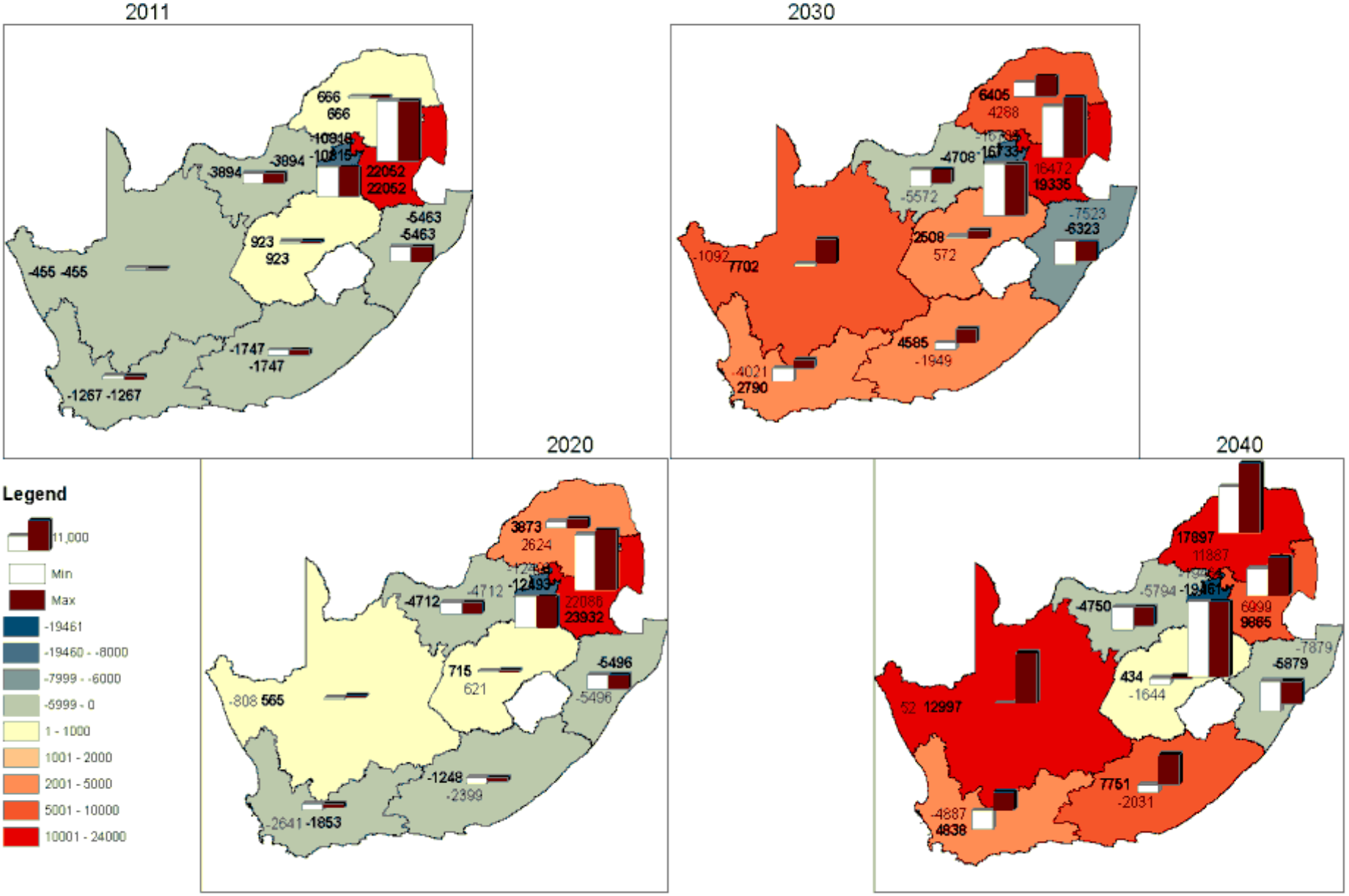
- Large installed wind generation can lead to large variation in wind output
- Considered 30% & 60% output of area totals – assumed even spread
- Also considered impact of wind patterns – wind can blow from west to east zones (ABC) or east to west (CBA)
- High wind at Low Load can also impact on excess or deficit power values in areas

Wind Zones for estimating wind pattern impact



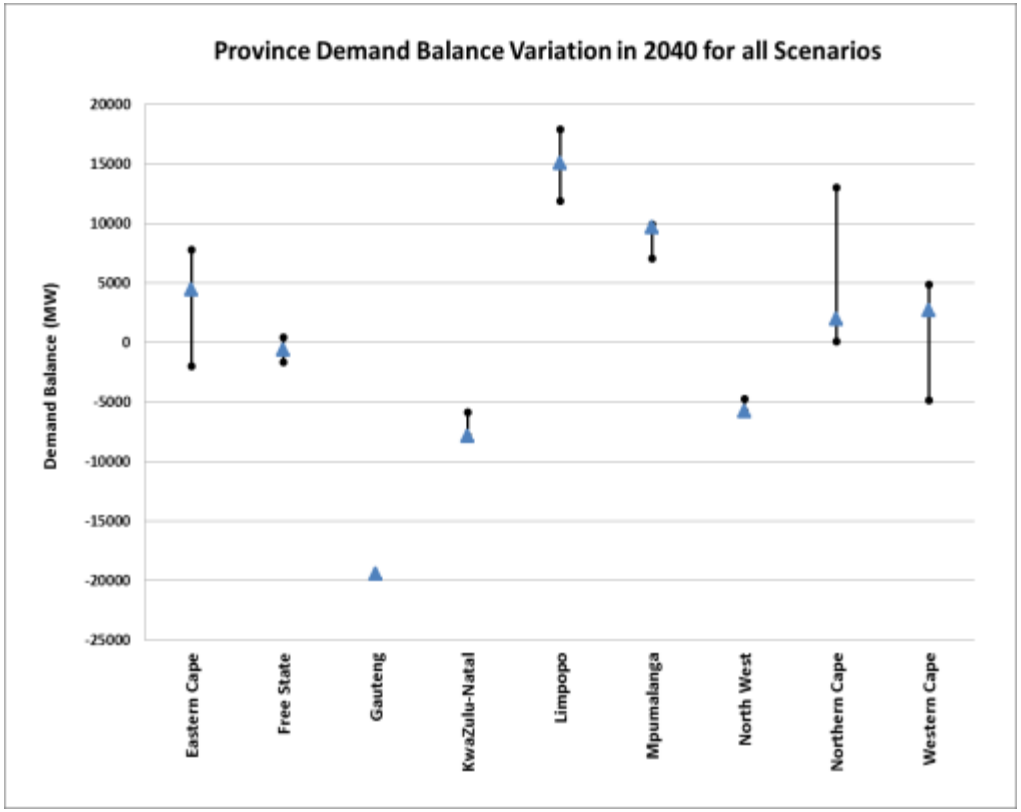
- Considered variations in wind patterns at *Peak Load* and *Low Load* to determine **the *range between maximum and minimum power excess or deficit*** for each scenario
- Identified the largest range variations under all scenarios to highlight areas of highest risk

MAX & MIN DEMAND BALANCE PROGRESSION CONSIDERING ALL SCENARIOS
(Allocated Generation less Maximum Demand in MW)



Analysis of Demand Balance Results – all scenarios

- E. Cape: Wide range due to wind variation & nuclear commitment
- Free State: Small range – no Tx issues
- Gauteng: Constant deficit – need large Tx delivery infrastructure
- KZN: Large deficit only offset by gas gen – need extra Tx infrastructure
- Limpopo: Large excess dependant on coal & int. imports – can build Tx as needed
- Mpumalanga: Reduced excess as coal reduces – Tx essentially adequate
- North West: Constant deficit – will need more Tx infrastructure
- N. Cape: Wide range due to large CSP rollout & wind variation – will need extra Tx
- W. Cape: Wide range but within a 5GW excess or deficit range – Tx target



Main Observation

The Cape provinces pose the highest risk in terms of future Tx needs – very scenario dependant – therefore opportunity to accommodate or limit power transfer ranges with good and appropriate generation strategies.

Renewables - GCCA Study

- Eskom Grid Planning undertook a study to determine the available connection capacity for new generation at Transmission substations in the Cape area for the integration of renewable energy generation. (*Note that Transmission refers to voltages > 132kV*)
- The objective of the study was to determine how much generation could be connected at each substation based on the expected 2012 network under three conditions:
  - **Level 1: (As quickly as possible – REBID)** No additional plant or lines on the transmission network to connect the generation at the 132kV busbars of the substations
  - **Level 2: (Targeted projects: 2014 - 2018)** Localised Transmission network extension to collect the potential generation at 275kV or 400kV and connect to existing Transmission substations
  - **Level 3: (Strategic)** Potential future generation connection capacity with the extension of the Transmission Grid including main corridors in the longer term beyond 2018.

Progress to-date

The following clarifications are presented:

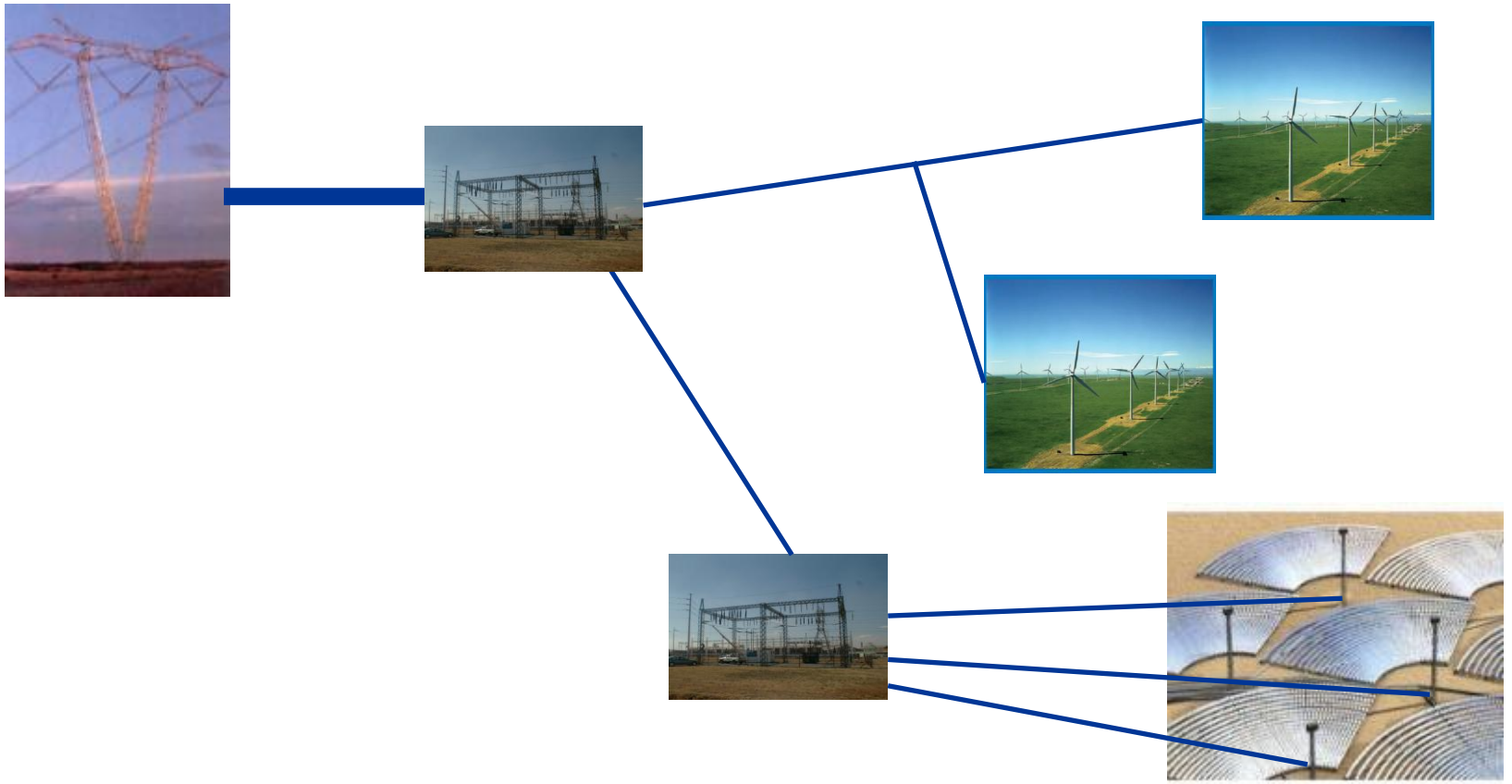
- Generation Connection Capacity Assessment (GCCA) - 2012 (Steady State and Dynamic) completed determining the existing network capacity.
  - All RE generation for the REBID or otherwise will be connected at distribution level, i.e. at 132kV or lower.
  - This means that security of supply is only N-0 not N-1 as this is the distribution standard.
  - Once the power reaches a transmission level substation only then it is on a N-1 system.
  - If a N-1 level of supply is requested by the generator then they will have to pay for a second direct connection with sufficient capacity to the transmission substation.
- GCCA-2016 (Steady State) completed and currently being validated with the TDP to determine network capacity
- GCCA-2016 (Dynamic) to be completed by Quarter 4 2012.

Renewable generation will be integrated into the transmission grid at distribution voltage levels (132kV or lower)

The collated output from multiple generation sources are then transported on the transmission grid

The output from the distributed farms are collected at the distribution substation

Individual turbines are widely distributed and the output needs to be collected

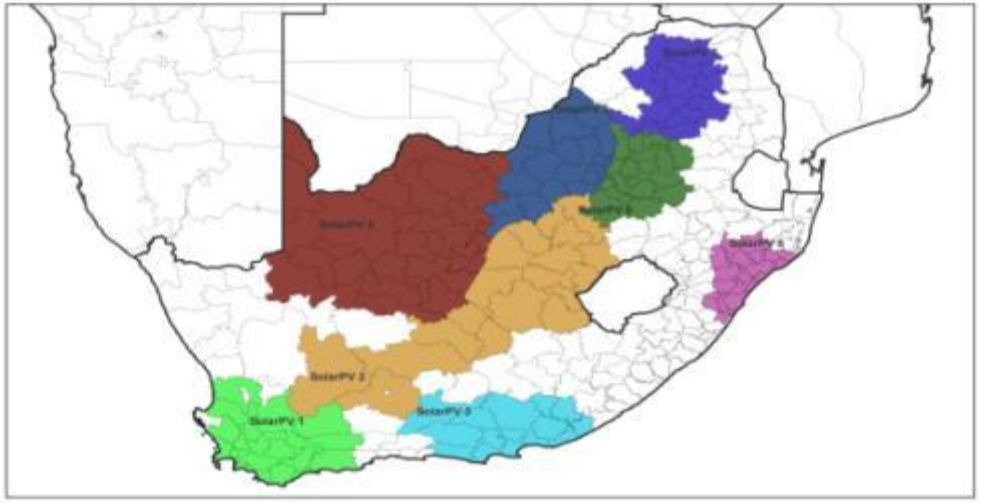


Generation Mix and Renewable Energy Resource Map

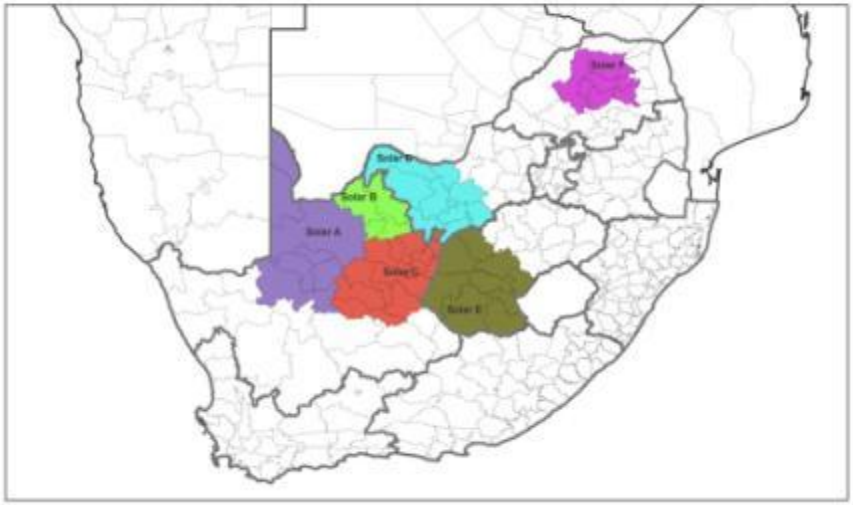
Applications received till March 2012

Technology	MW (Max)	%
Landfill	13	0.0%
CPV	30	0.1%
Biotherm	36	0.1%
Biogas	51	0.1%
Hydro	122	0.4%
Biomass	229	0.7%
Gas	332	1.0%
Steam	350	1.0%
Co-Gen	373	1.1%
CSP	1534	4.5%
Coal	4870	14.3%
PV	9606	28.1%
Wind	16615	48.6%
	34160	100%

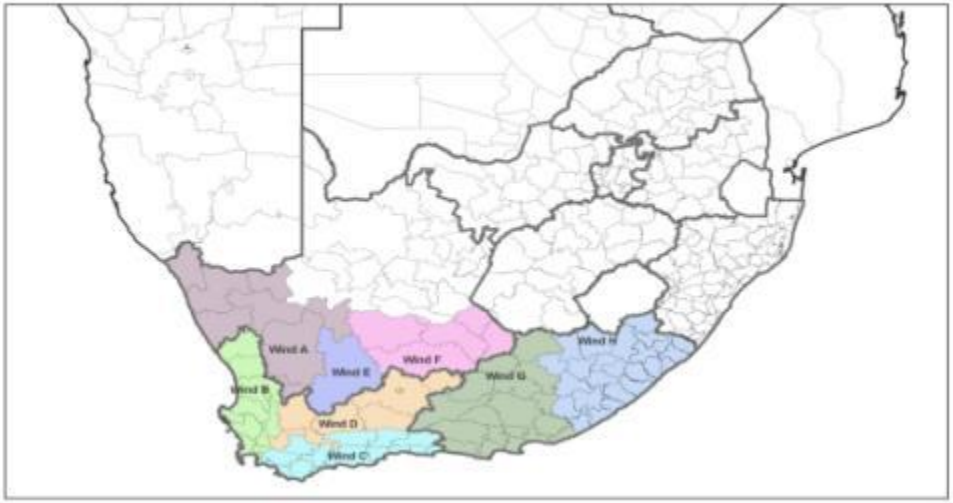
SOLAR PV GENERATION AREAS



SOLAR CSP GENERATION AREAS

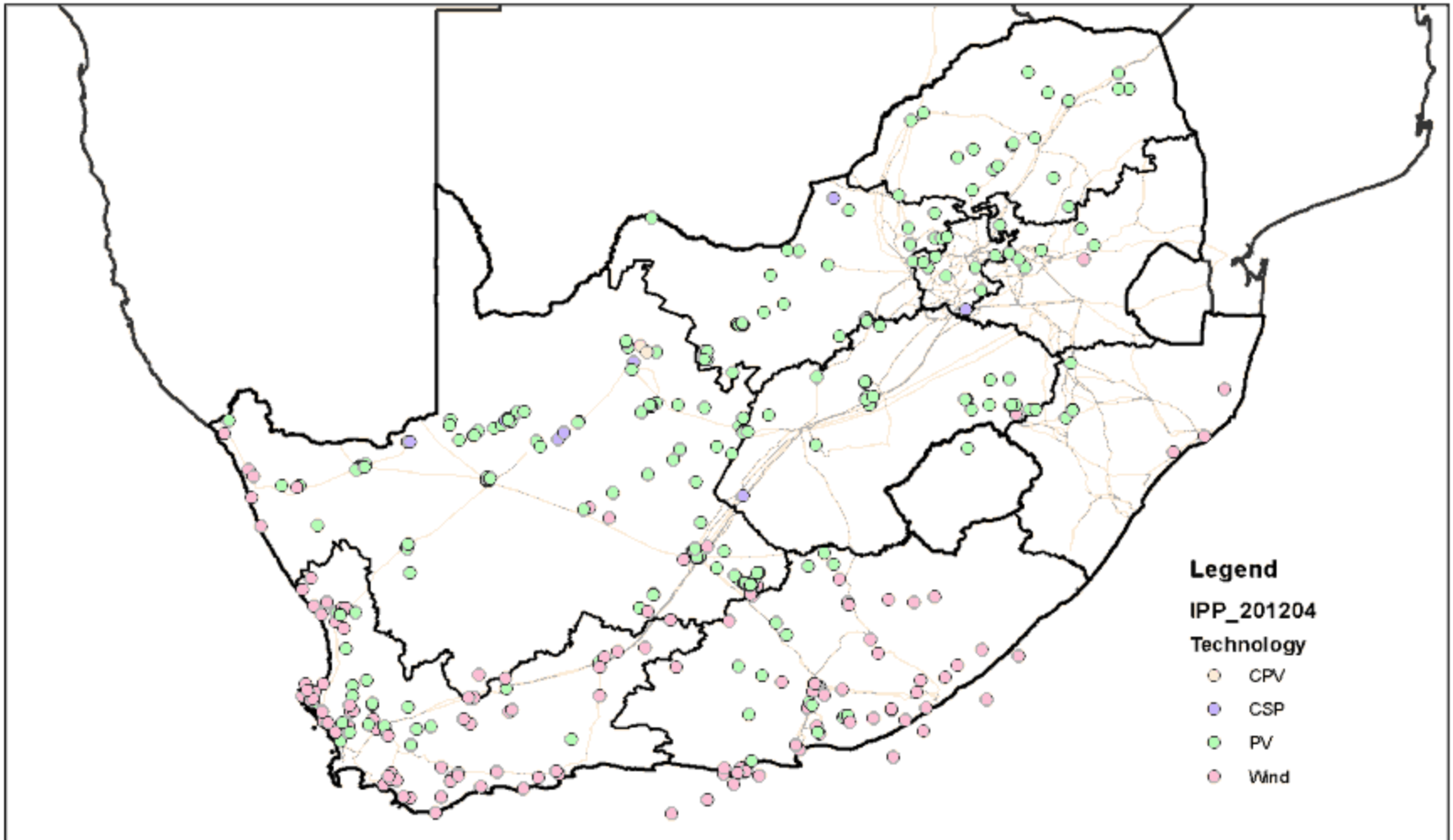


WIND GENERATION AREAS



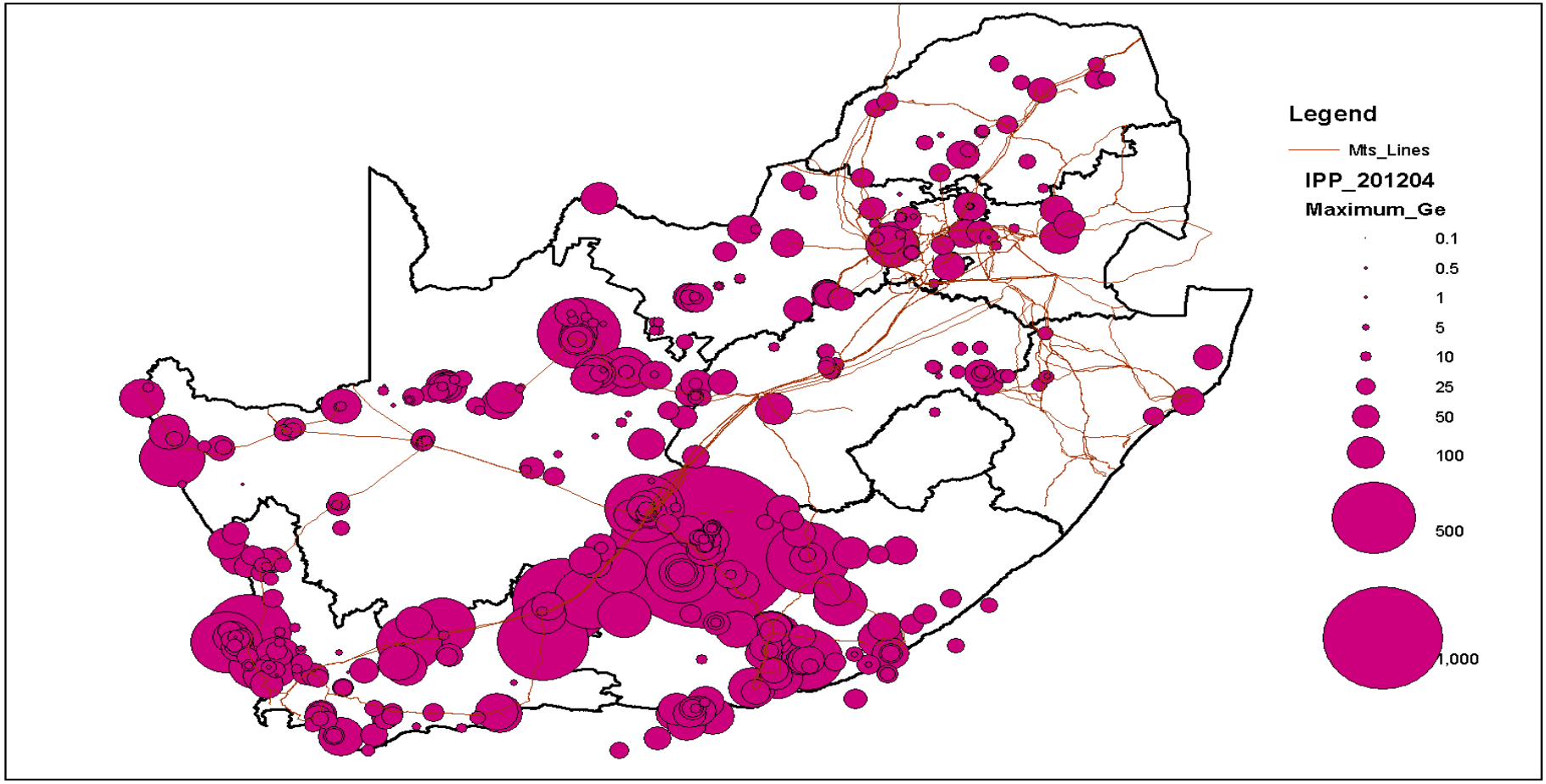
Renewable Energy Applications

Renewable Generation Application



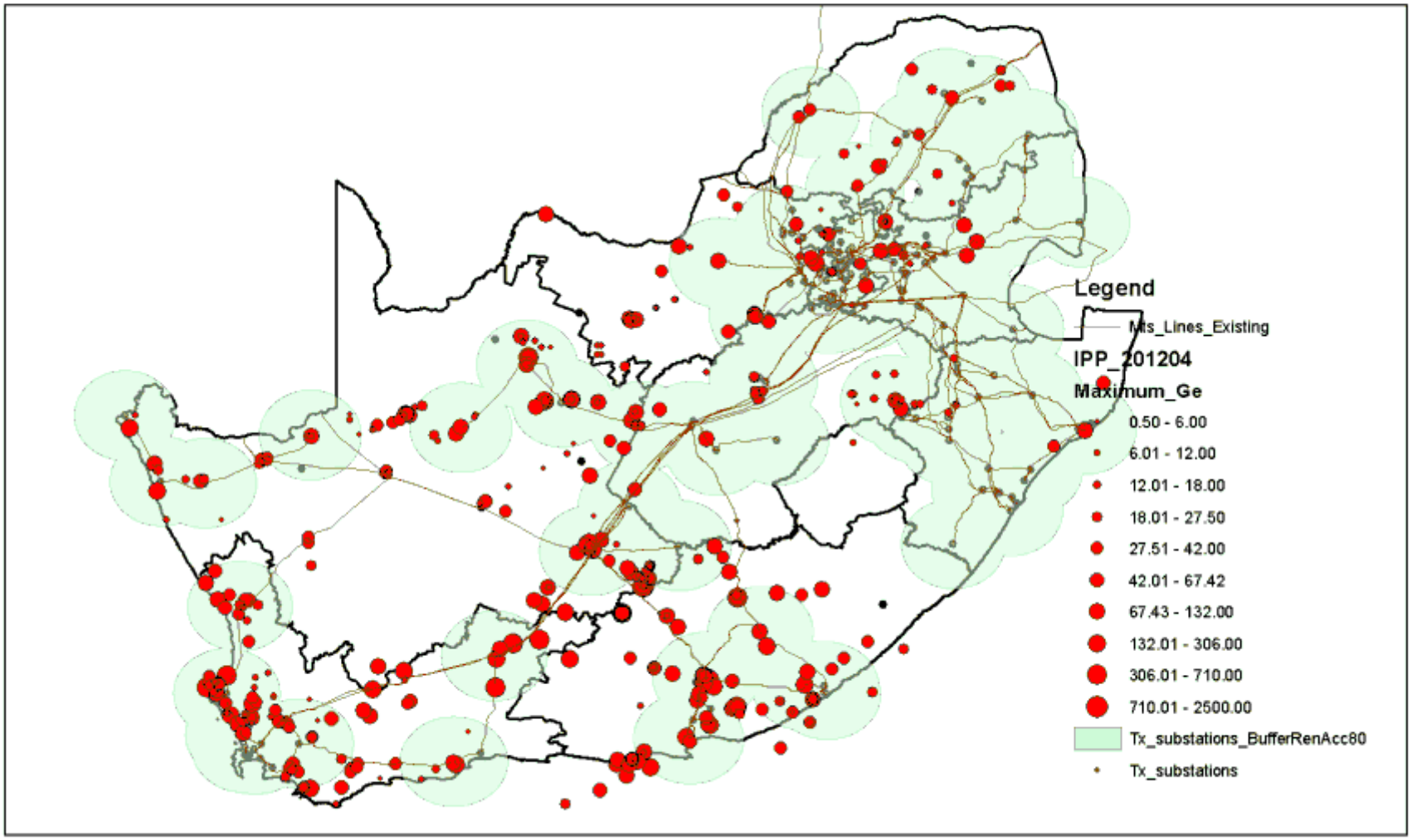
Details of Level 2 Study – relative size of applications

Renewable Generation Application



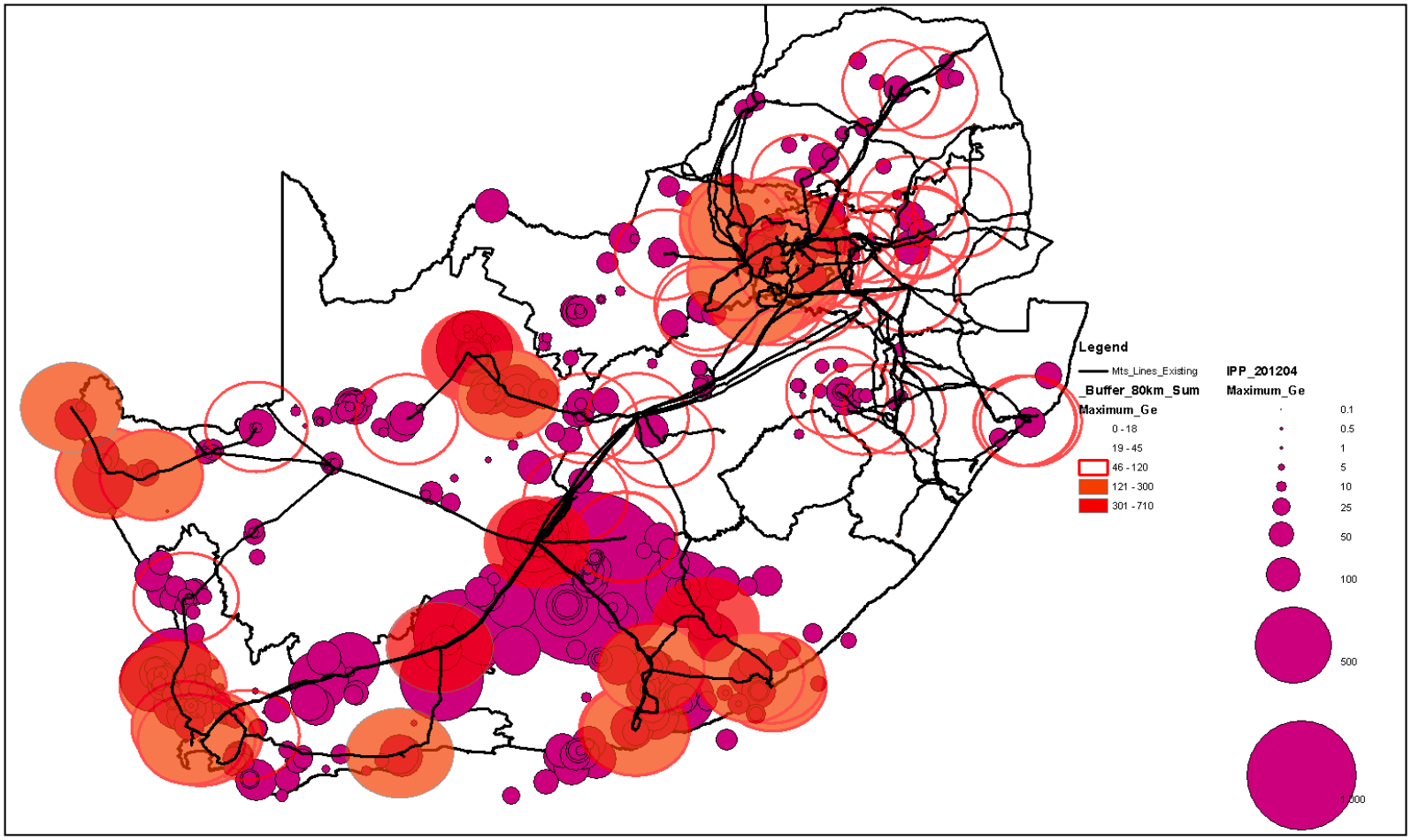
Details of Level 2 Study – cumulative size of applications

Transformation Substations 80km Buffer



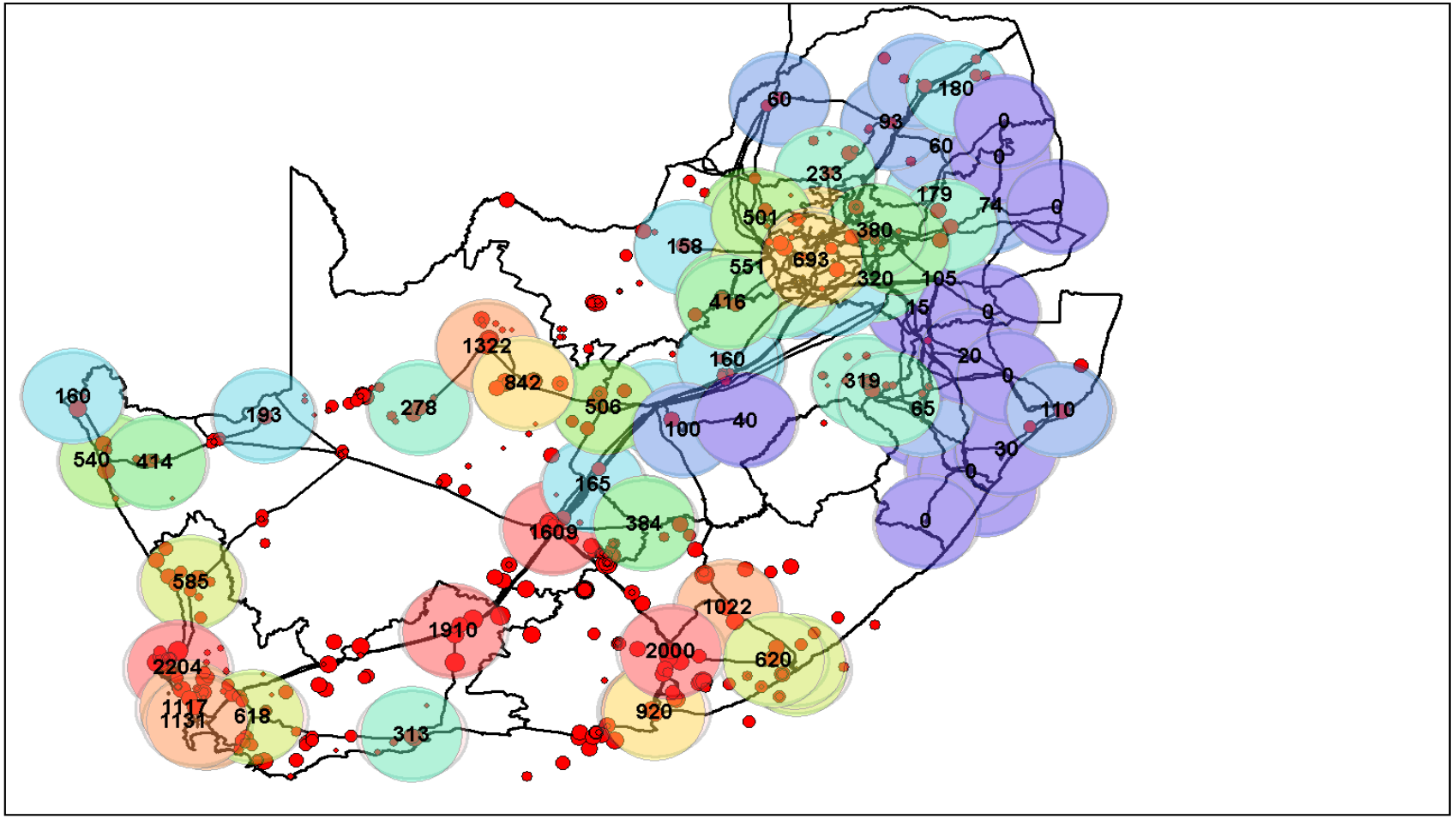
Details of Level 2 Study – cumulative size of applications

Transformation Substations 80km Buffer



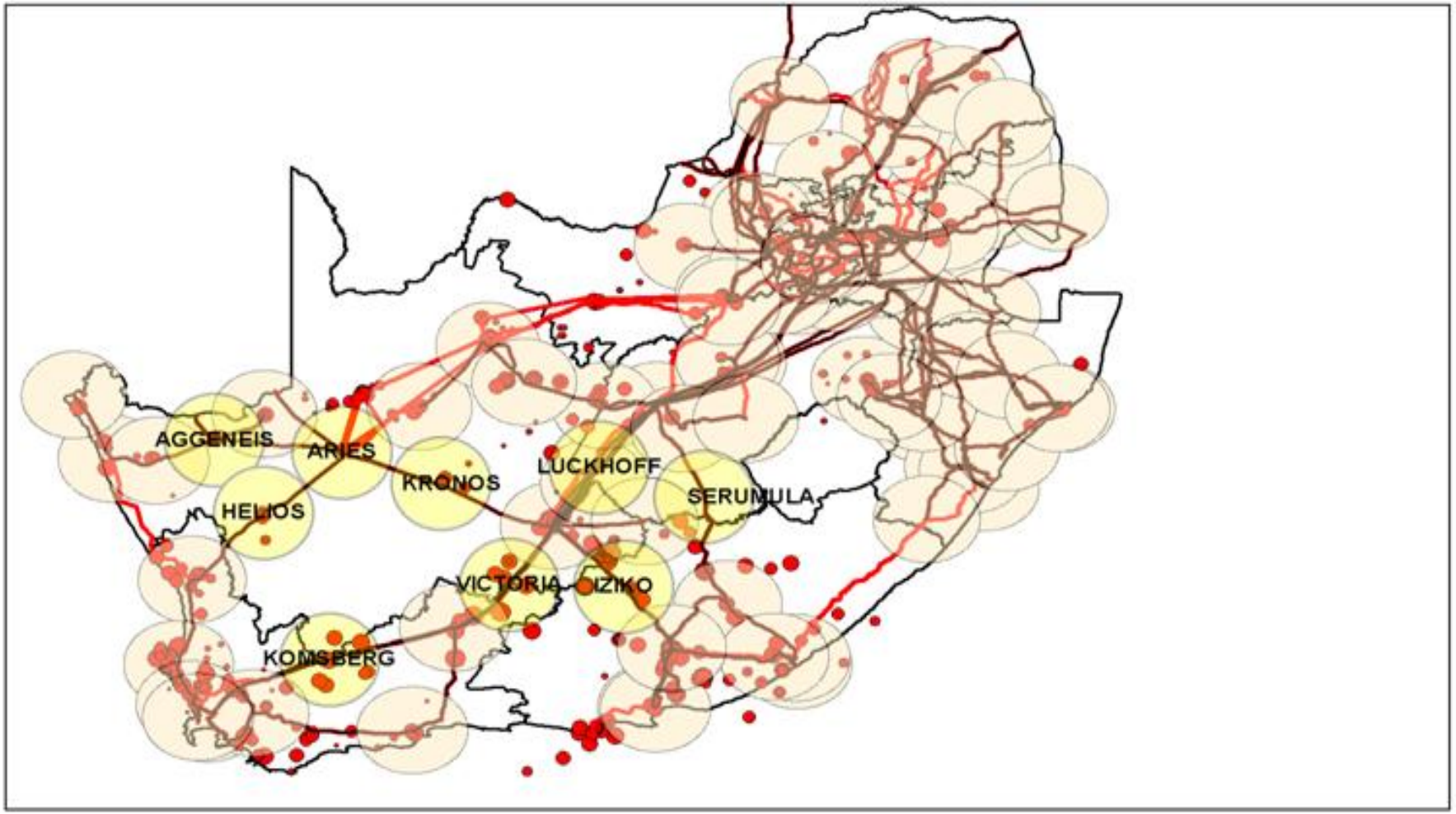
Details of Level 2 Study – cumulative size of applications

Sum of Application in Transformation Substations 80km Buffer



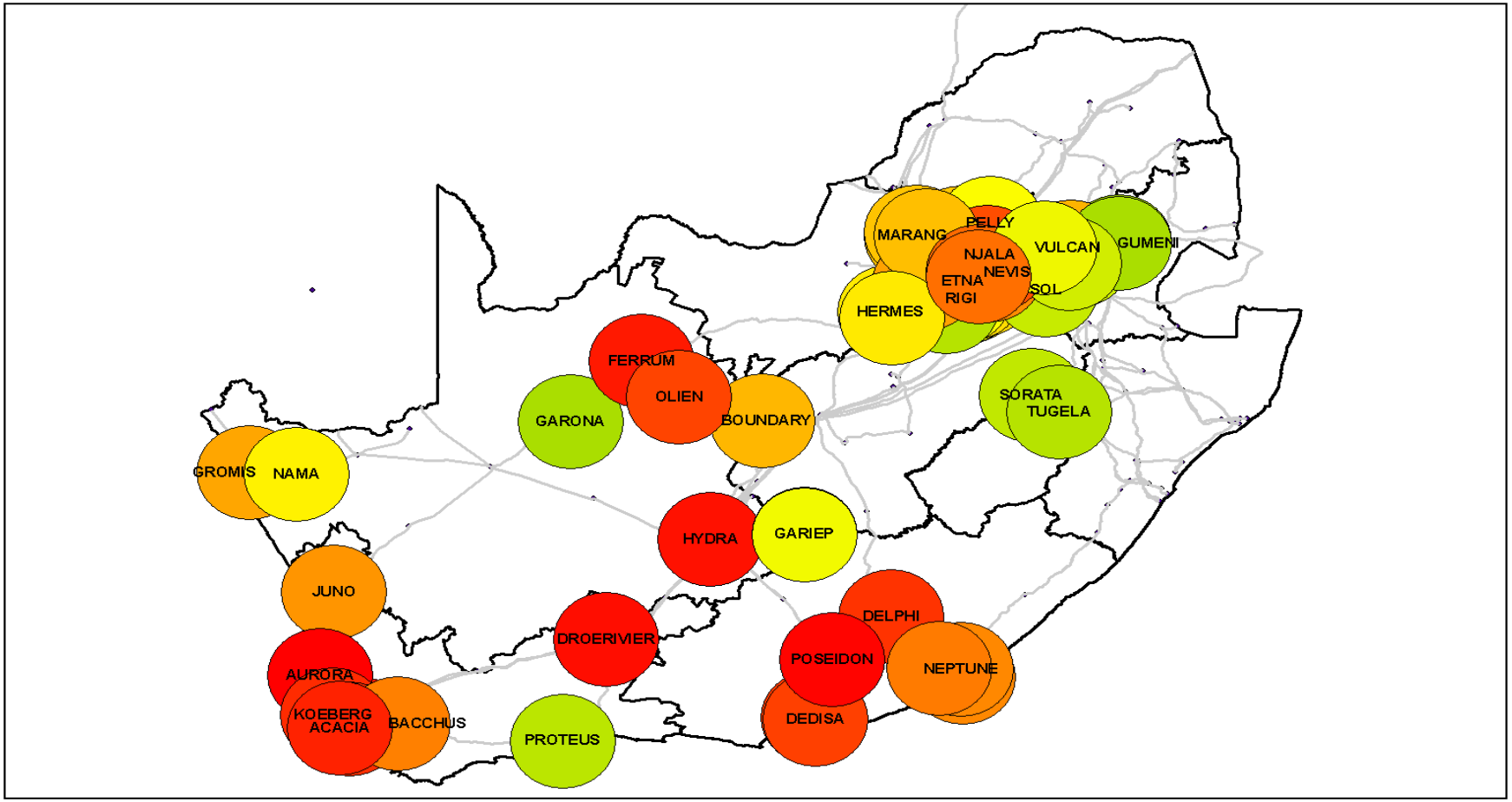
Details of Level 2 Study – require Tx TDP strengthening to enable REBID connections

Accelerate Expansion of Transformation Substations 80km Buffer



Results of the Level 2 Study

Increase & Investigate Existing Network Transformation Access



Summary

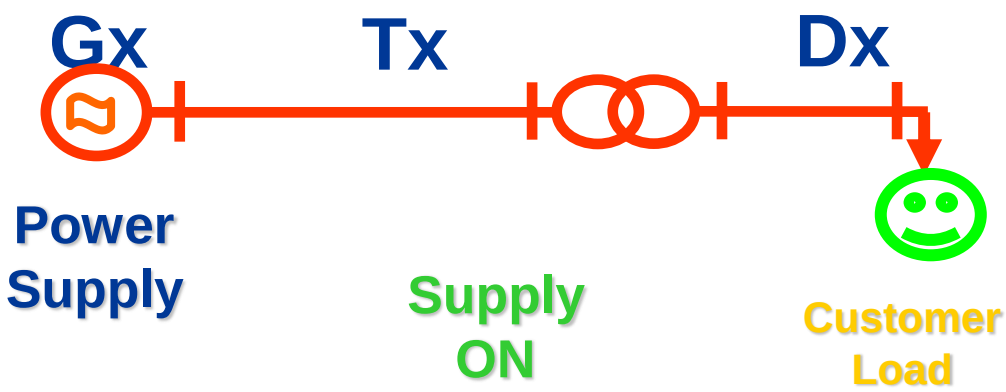
- The TDP assumptions cater for all scenarios within the TDP time frame
- Short listed REBID renewables are included in the TDP and the remainder of IRP renewables are diversified and allocated
- GCCA 2012 stability studies concluded
- GCCA 2016 to be concluded Q4 2012 release Q1 2013
- GCCA 2012 – Level 2 analysis and project initiated

Transmission Development Plan
TDP 2013 – 2022 (2012 TDP)

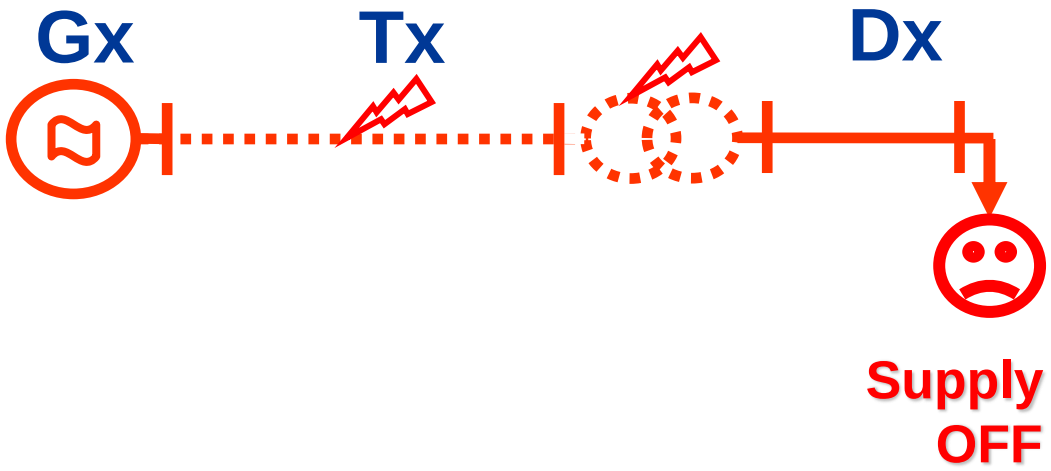
Transmission System Planning

- **The purpose of the transmission system is to optimally and reliably transport the power from the source of generation to the location of the load**
- **Role of Transmission System Planner (TSP) is in accordance with the Eskom Transmission License issued by NERSA. TSP is required to conduct the following activities for the *electricity supply industry:***
  - To plan and augment the Transmission System
  - Planning and augmentation to be in accordance with the Grid Code
  - Customer connections to take place subject to a connection agreement
  - Compliance monitoring is part of the Eskom Transmission license
- **Network Code of SAGC specifies the following for transmission planning**
  - ***Technical criteria***
    - Voltage and thermal limits, **reliability criteria (N-1)**, generation integration, etc.
    - Generator connection conditions (Protection, Islanding, Governing, Black Start, etc.)
    - Connection conditions for generators, distributors and end-use customers (Protection, Power Factor, Fault Levels, etc.)
  - ***Planning Process***
  - ***Investment Criteria***

Network Reliability:
Unfirm Electricity Supply (N-0)

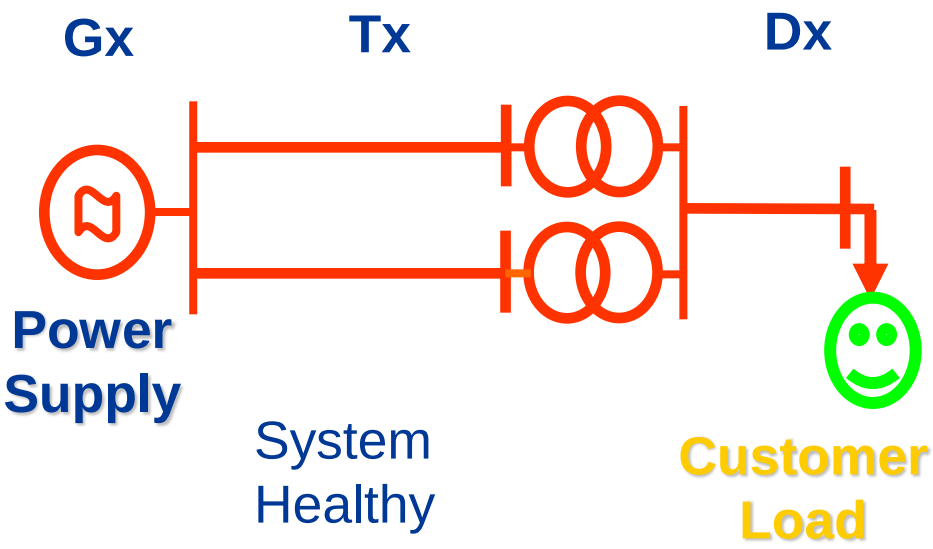


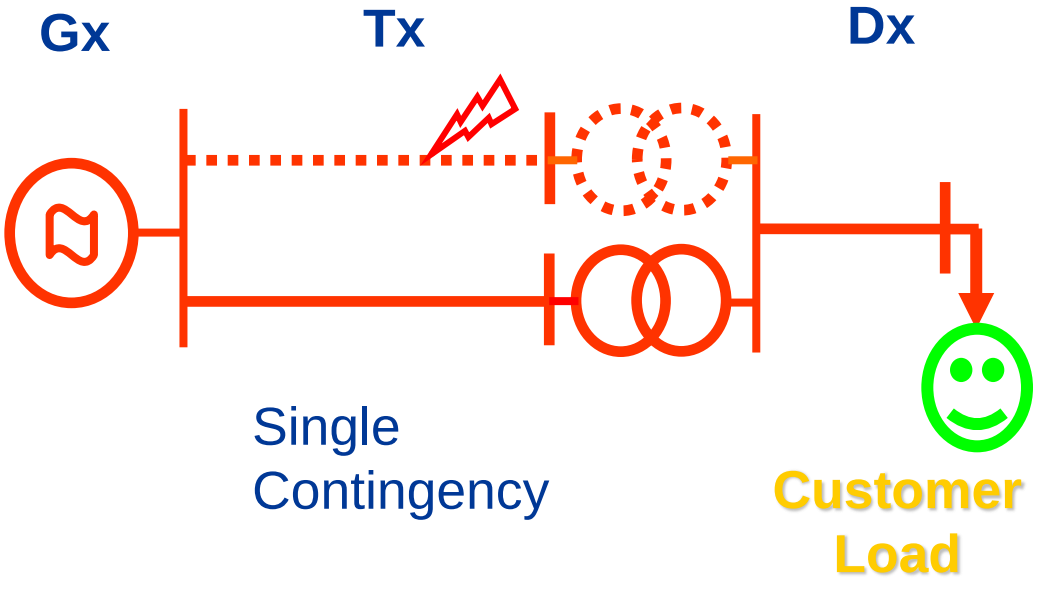
System Healthy



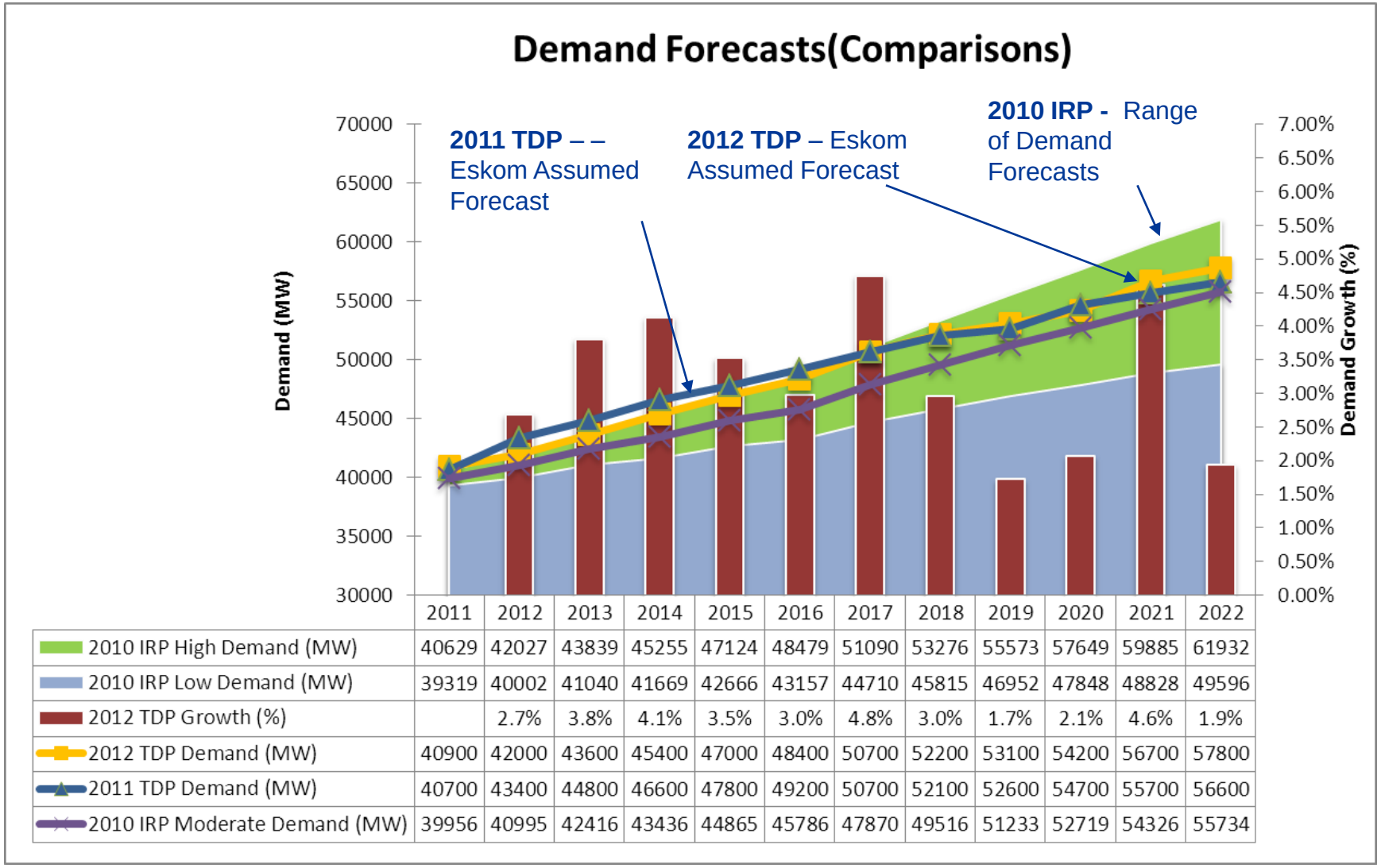
Single Contingency

Network Reliability:
Firm Electricity Supply (N-1)





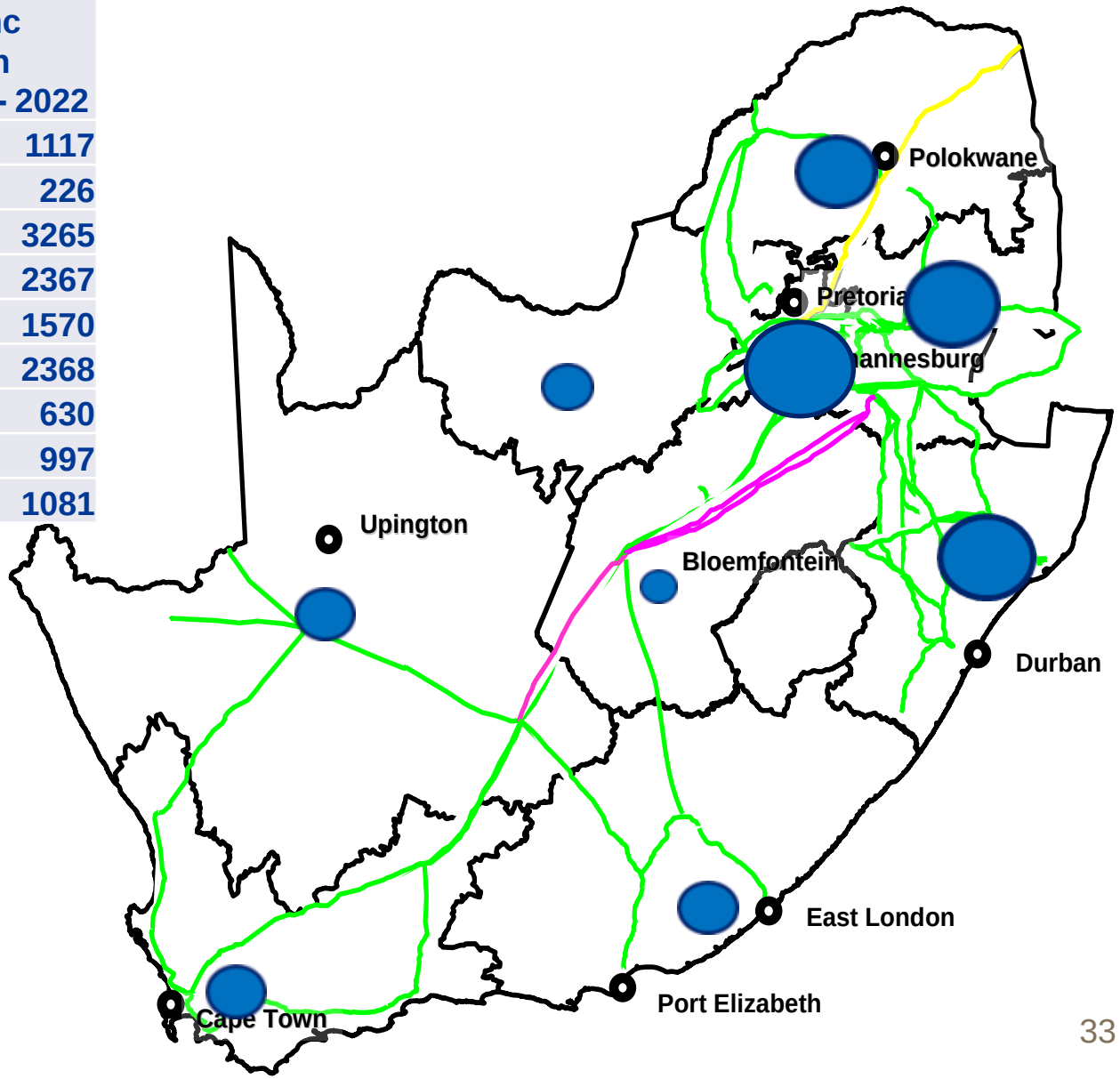
Assumed Demand Forecast and Comparisons



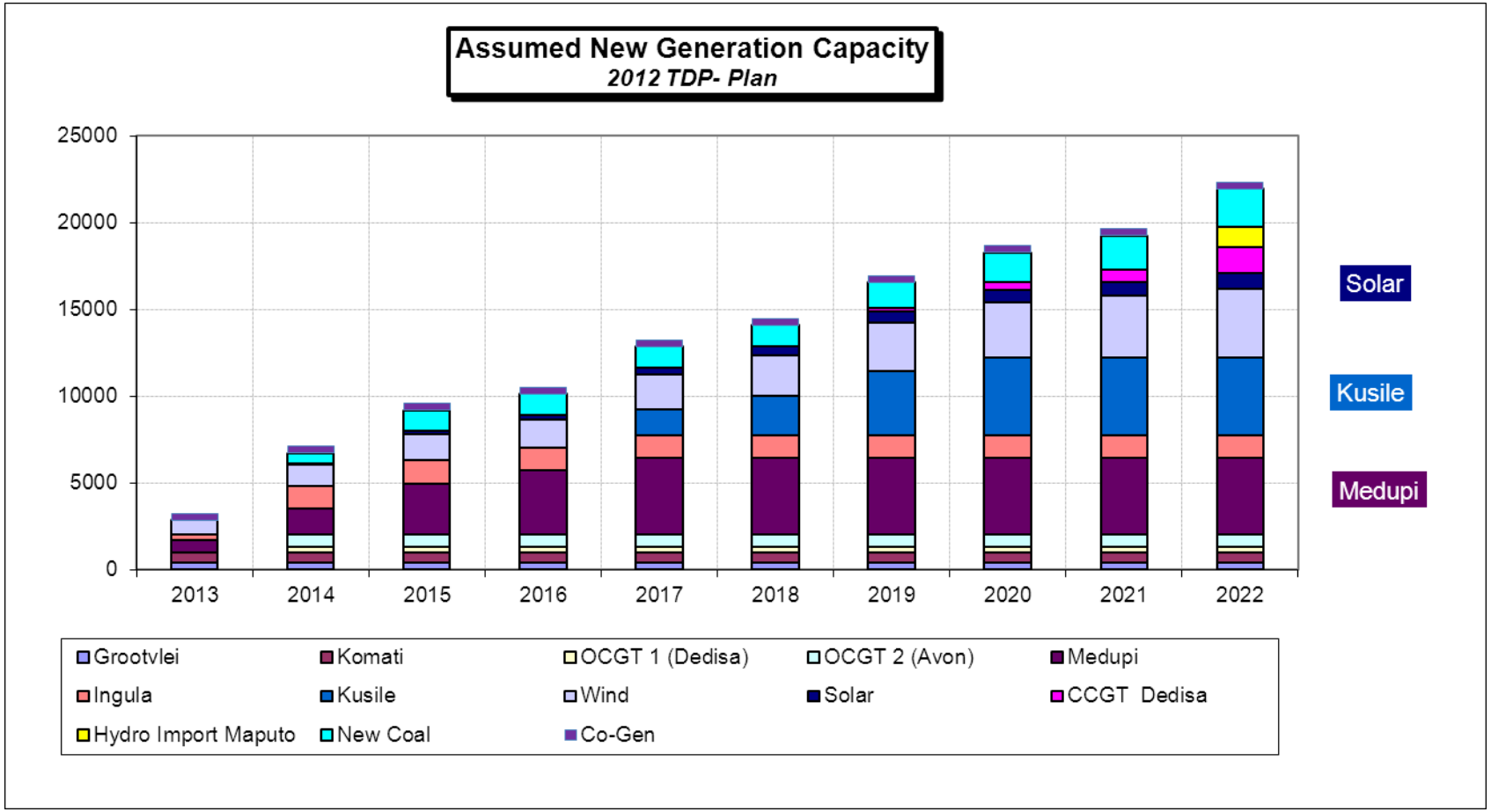
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2010 IRP High Demand (MW)	40629	42027	43839	45255	47124	48479	51090	53276	55573	57649	59885	61932
2010 IRP Low Demand (MW)	39319	40002	41040	41669	42666	43157	44710	45815	46952	47848	48828	49596
2012 TDP Growth (%)		2.7%	3.8%	4.1%	3.5%	3.0%	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
2010 IRP Moderate Demand (MW)	39956	40995	42416	43436	44865	45786	47870	49516	51233	52719	54326	55734

Assumed Distributed Incremental Load Growth (2013 to 2022)

Province	Provincial Inc Load Growth (MW) 2013 – 2022
Eastern Cape	1117
Free State	226
Gauteng	3265
KZN	2367
Limpopo	1570
Mpumalanga	2368
North West	630
Northern Cape	997
Western Cape	1081

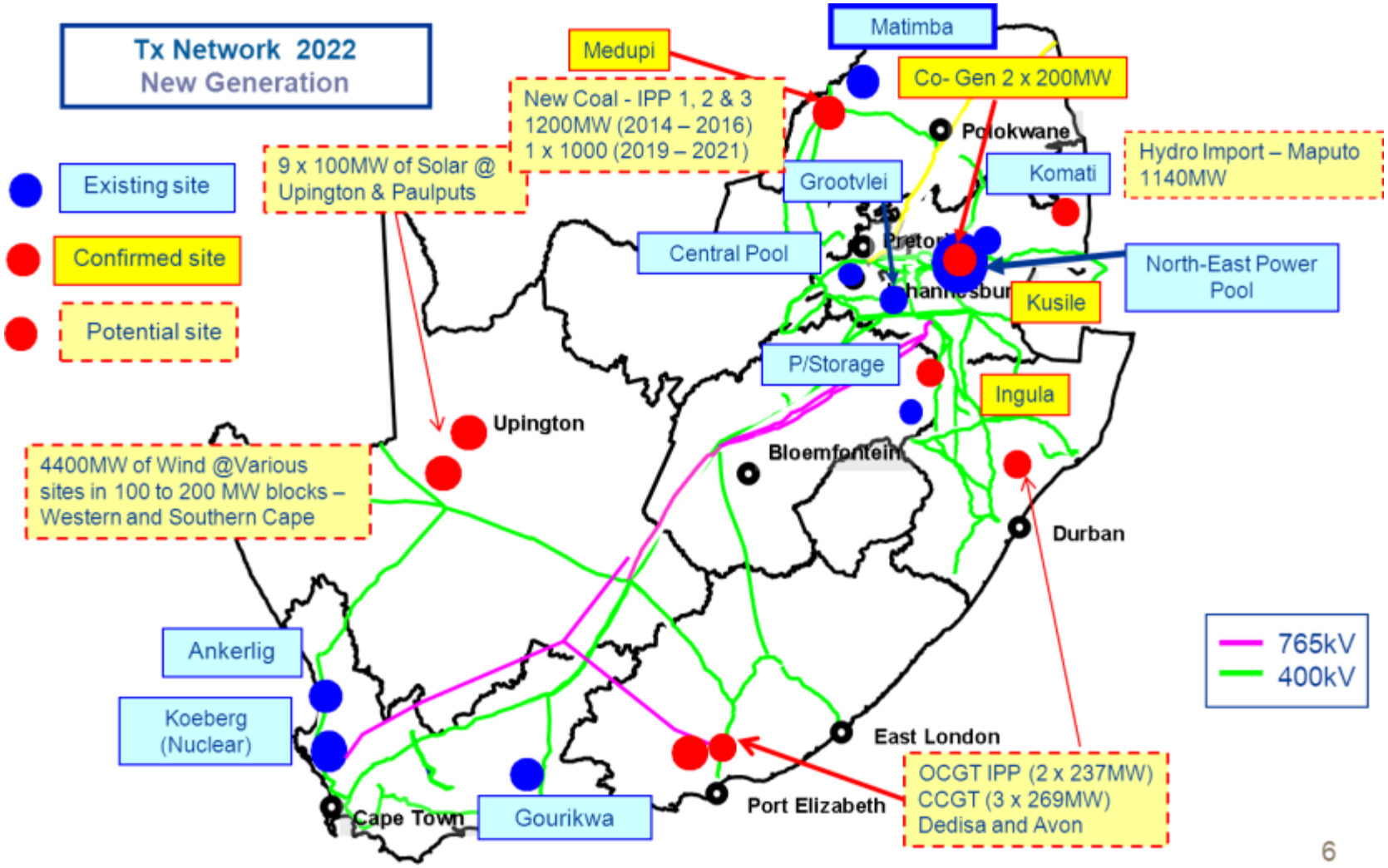


Assumed Generation Capacity Plan



- **The above assumptions are based on the IRP 2010-2030 in terms of the planned generation in the next 10 years**

Assumed Generation Pattern



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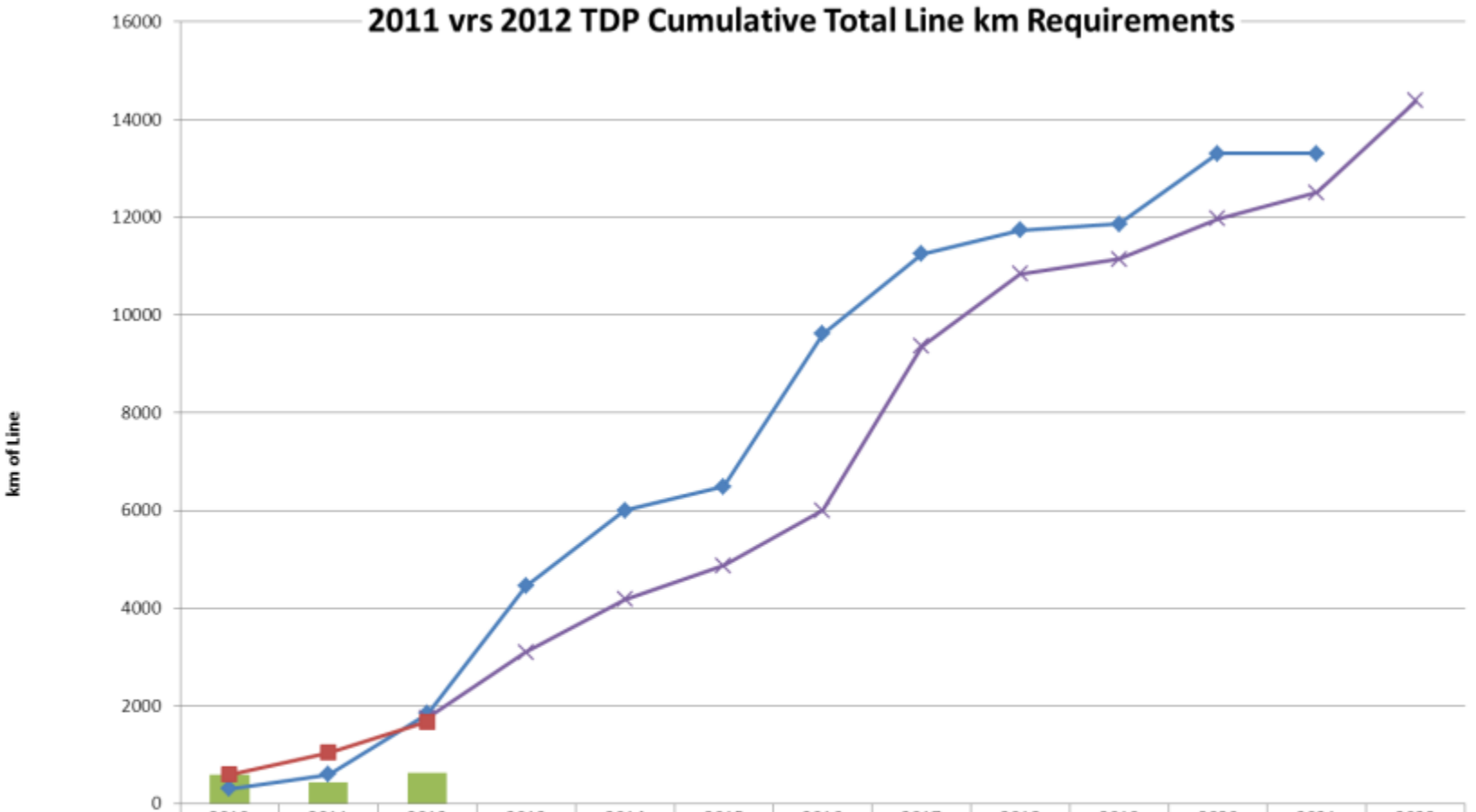
Summary of Transmission Infrastructure Requirements over the TDP Period

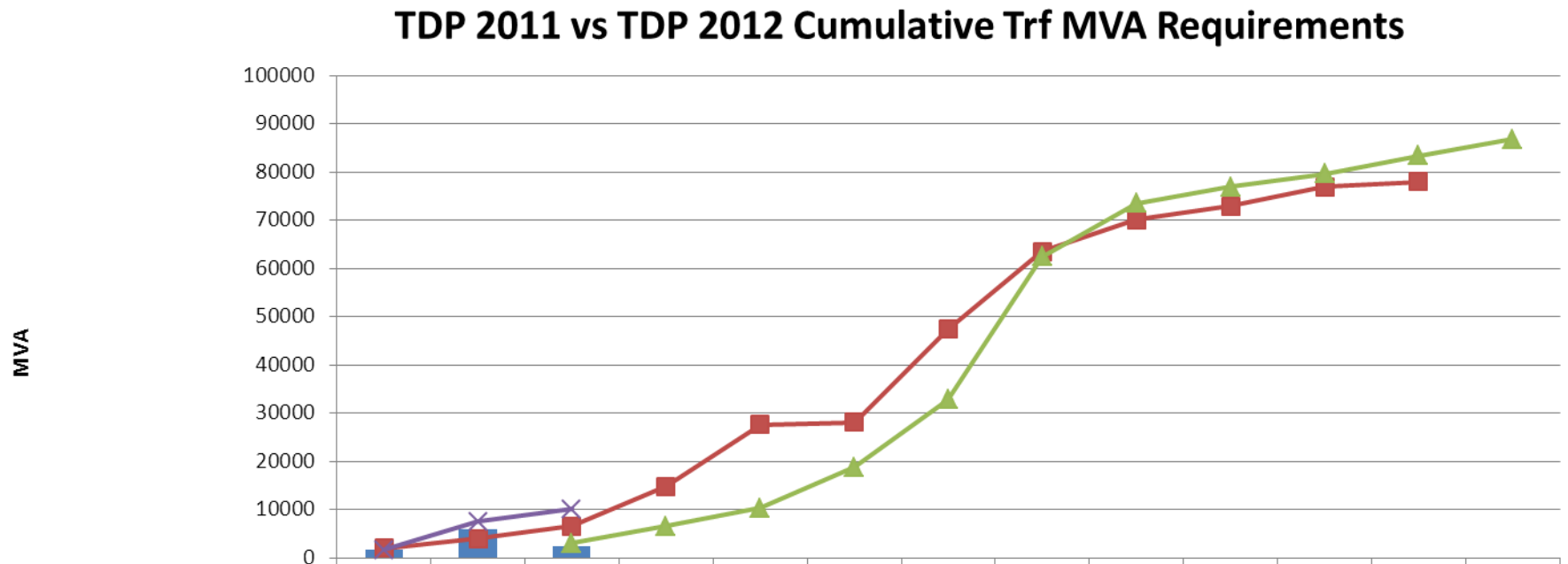
Transmission Assets	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	7,610	5,123	12,733
HVDC	0	0	0
765kV Lines (km)	1,890	1,810	3,700
400kV Lines (km)	5,668	2,963	8,631
275kV Lines (km)	52	350	402
Total installed Transformer MVA	59,365	24,360	83,725
Transformers (no. of)	115	50	165
Capacitors (no. of)	20	6	26
Reactors (no. of)	30	21	51

Cumulative Transmission Lines Requirements



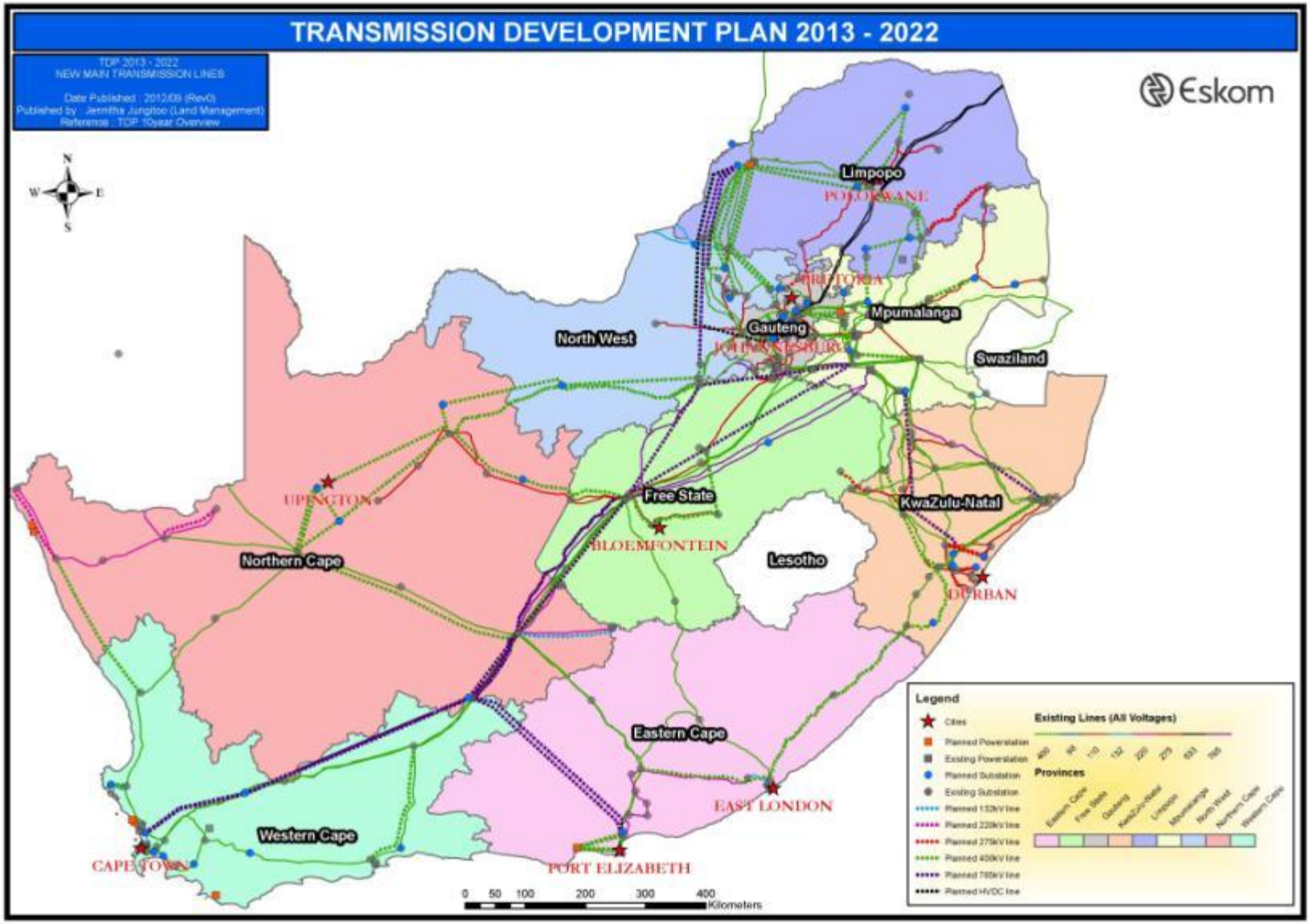
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Actual built	600	443	631										
2011 TDP	305	599	1847	4452	6004	6491	9618	11249	11735	11860	13310	13310	
2012 TDP			1756	3103	4183	4875	5999	9366	10846	11141	11967	12507	14389
Actual Built Acccumulated	600	1043	1674										

Cumulative Transformer Requirements

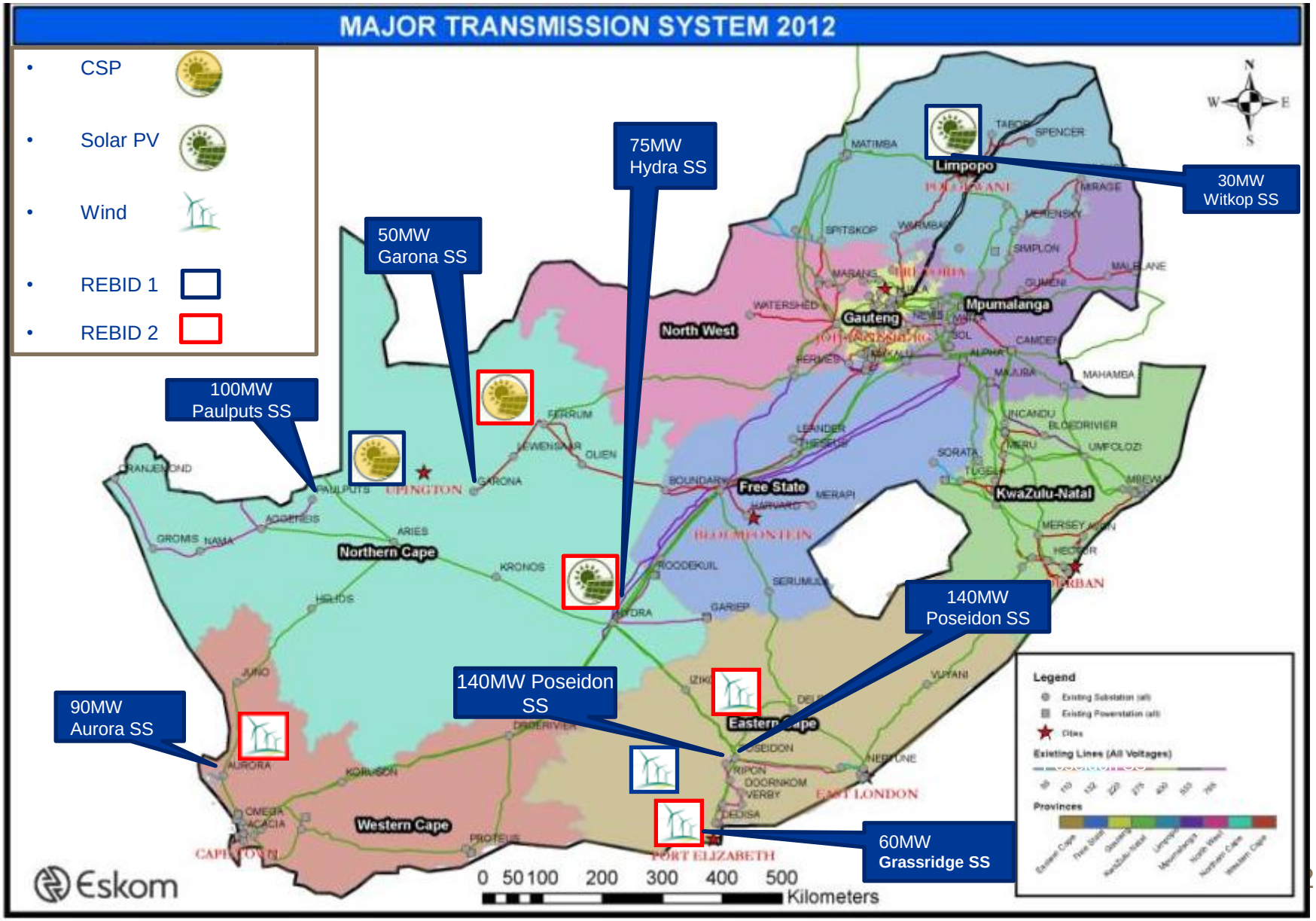


	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Actual Installed	1630	5940	2525										
2011 TDP	2050	3975	6605	14855	27645	28145	47375	63545	70160	72960	76960	77960	
2012 TDP			3130	6630	10315	18865	32805	62495	73560	77000	79625	83440	86855
Actual Installed Accumulated	1630	7570	10095										

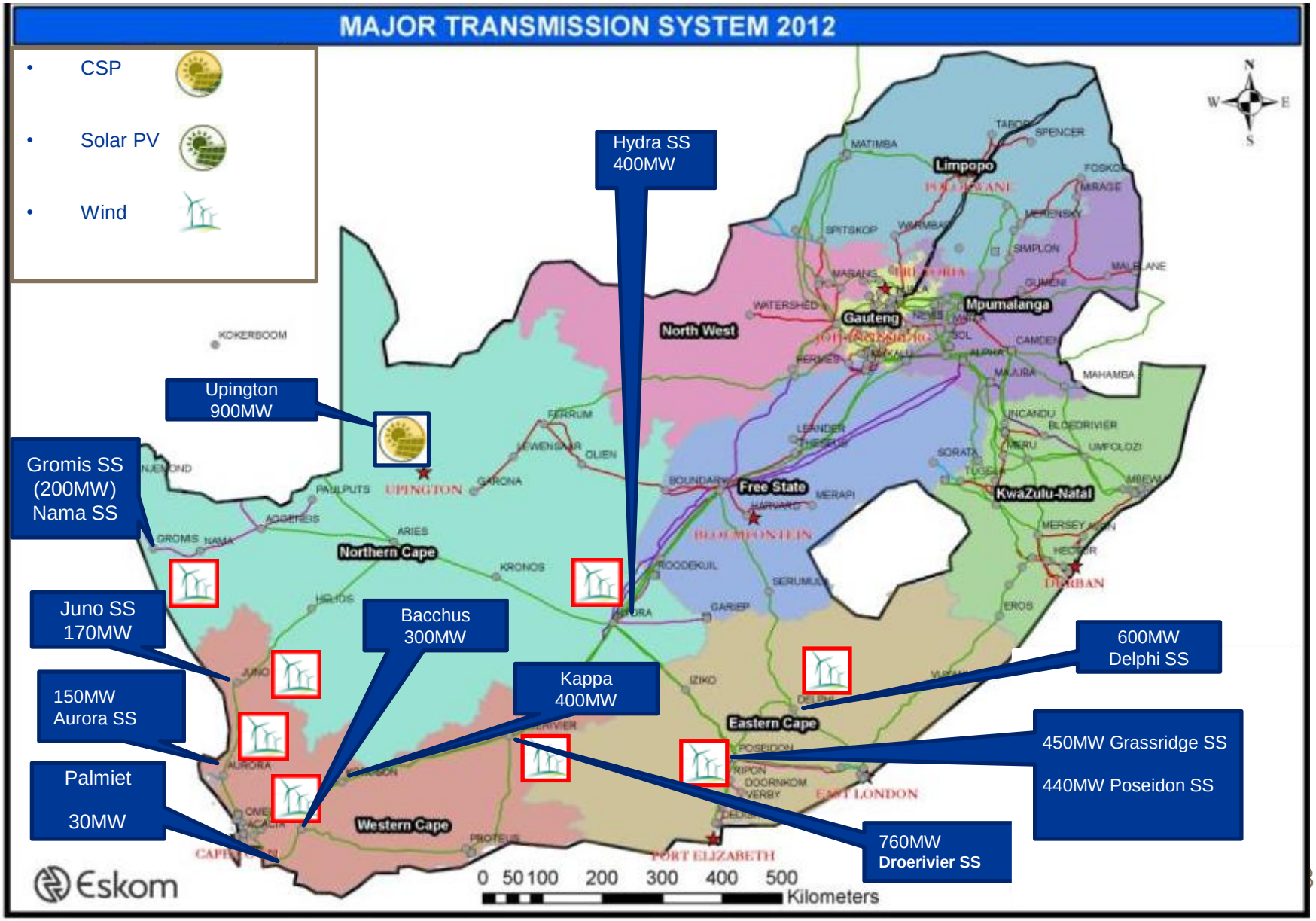
Transmission Plan Overview



Transmission Connection Requirements: DoE RE Program 1 & 2 - (Successful Bidders)

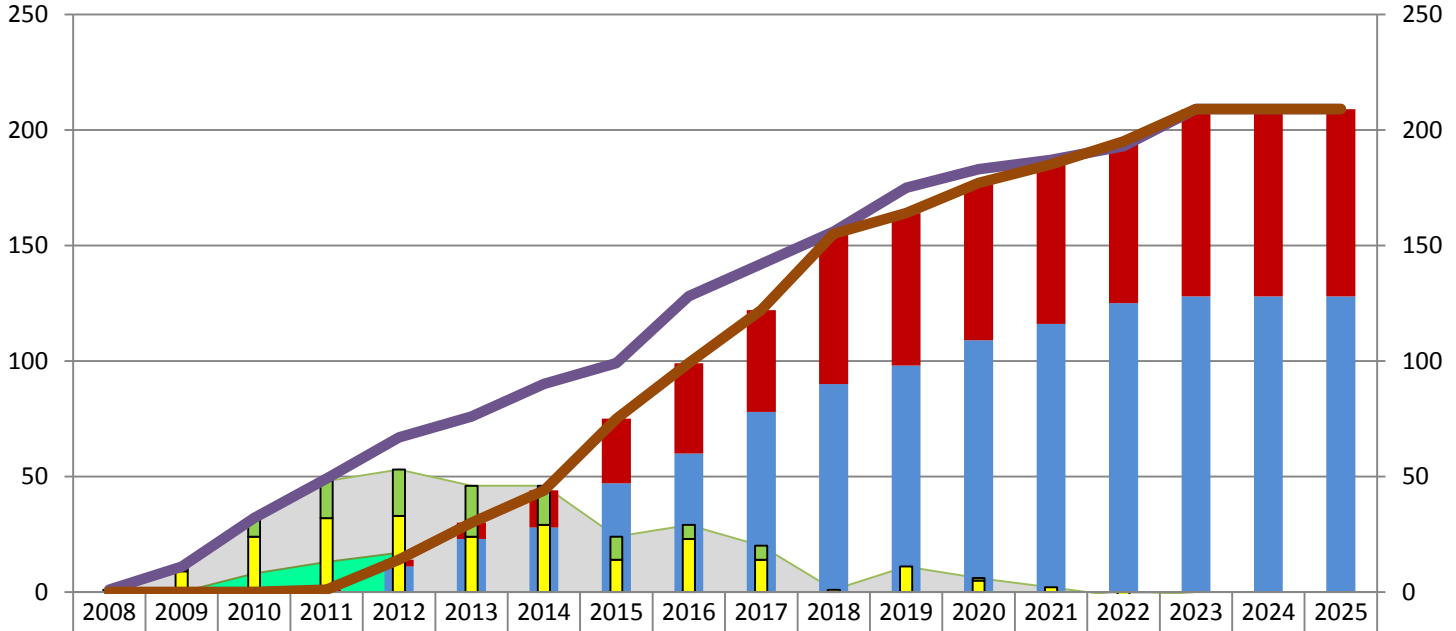


Transmission Assumptions based on IRP and applications received for RE



N-1 Grid Code Reliability Outlook

Transmission Projects Implementation Schedule

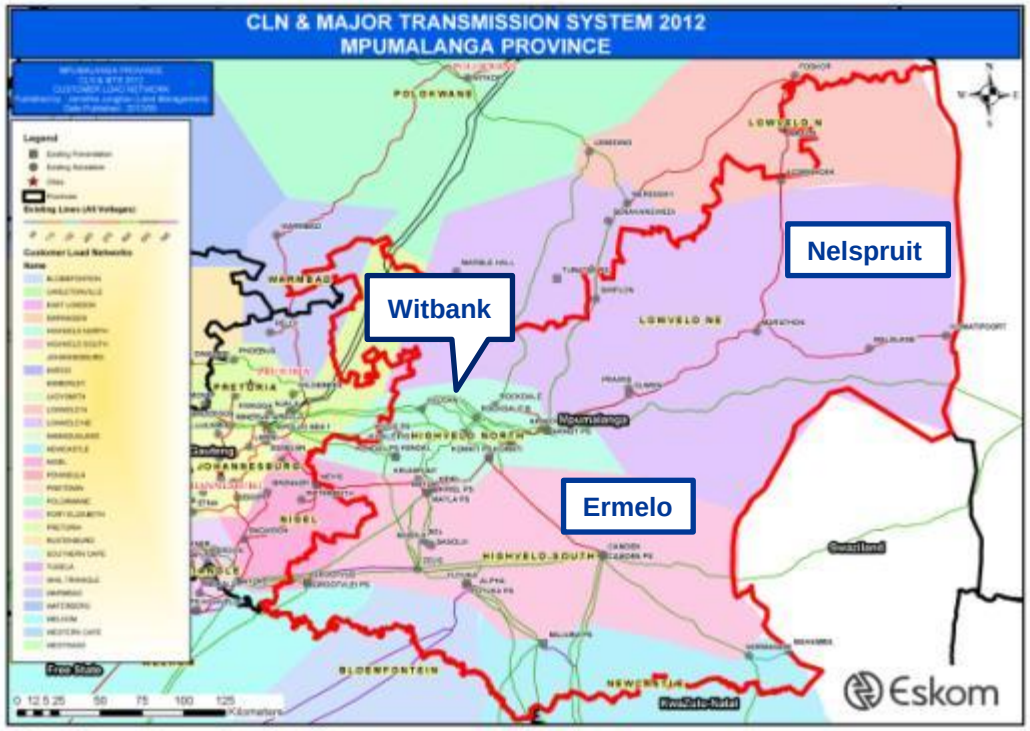


	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Net Total Deficit	1	11	32	48	53	46	46	24	29	20	1	11	6	2	-2	0	0	0
Completed Projects	0	0	8	13	17													
Substations (Expected Date)	0	0	0	1	3	7	16	28	39	44	65	66	68	69	70	81	81	81
Lines (Expected Date)	0	0	0	0	11	23	28	47	60	78	90	98	109	116	125	128	128	128
Net Substations Deficit	0	2	8	16	20	22	17	10	6	6	0	0	1	0	0	0	0	0
Net Lines Deficit	1	9	24	32	33	24	29	14	23	14	1	11	5	2	-2	0	0	0
Total (Required Date)	1	11	32	49	67	76	90	99	128	142	156	175	183	187	193	209	209	209
Total (Expected Date)	0	0	0	1	14	30	44	75	99	122	155	164	177	185	195	209	209	209

Transmission's Provincial Strengthening Plans

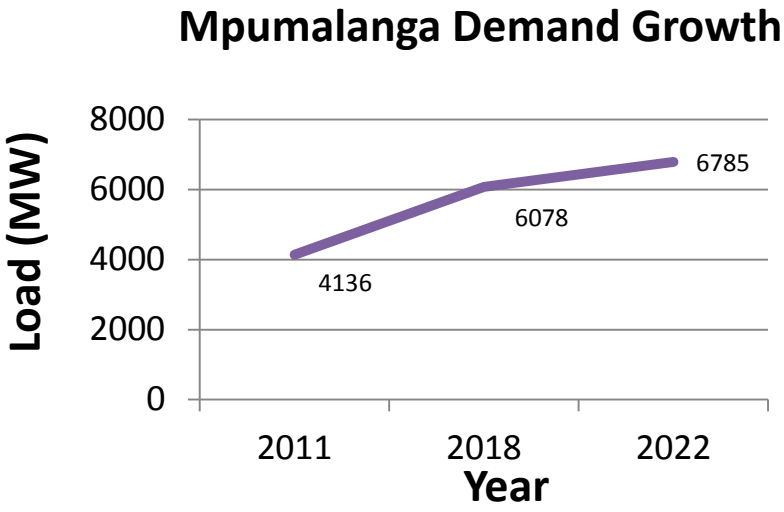
2013 - 2022

Mpumalanga Province Profile

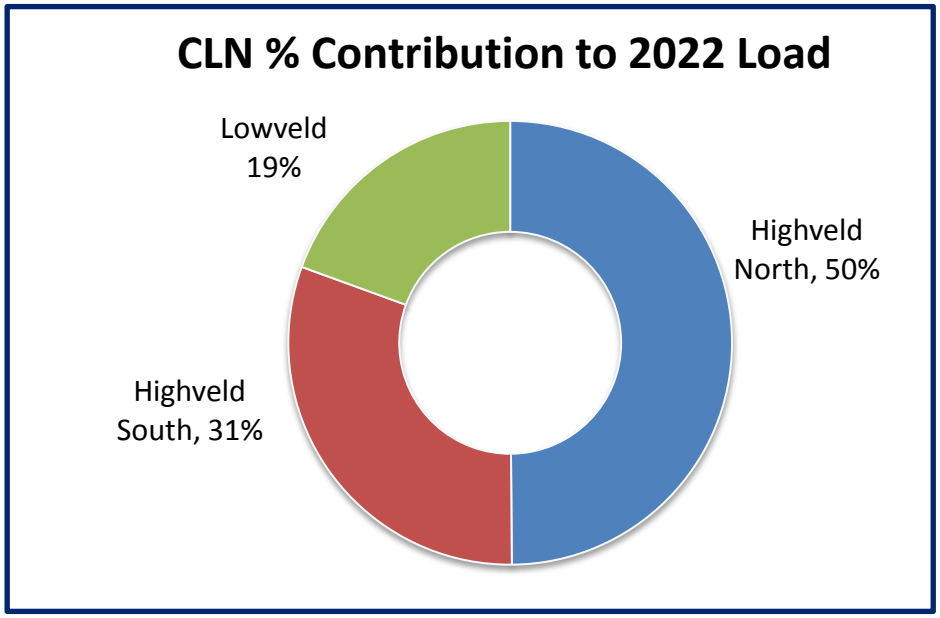


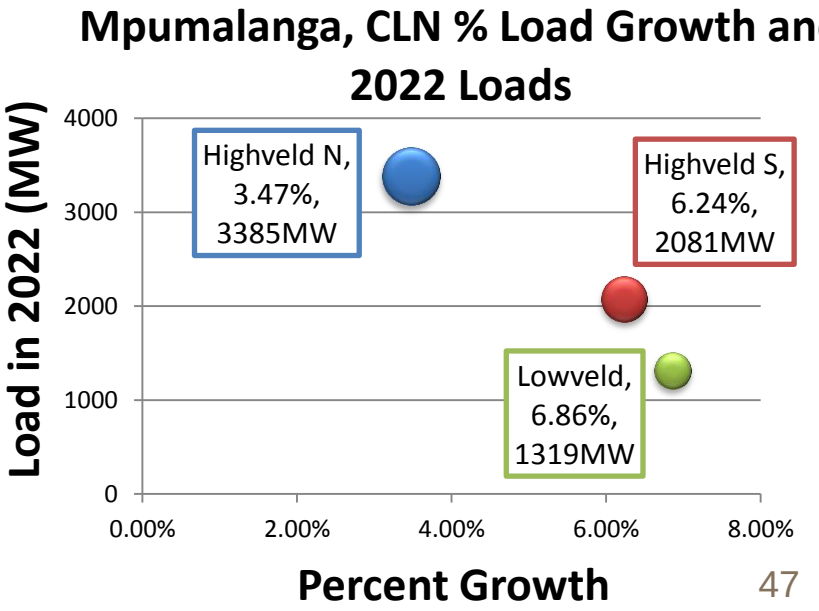
- **Generation**
  - Power Stations = 11
  - MW installed = 22 704MW
- **Transmission**
  - Load demand = 4136MW
  - Number of MTS = 22
  - km of EHV lines = 3 724 km
  - Number of CLNs = 3
- **Distribution**
  - Economic activity - Industrial (38%), Mining (32%), Commercial (5%), Residential (3%), Agricultural (7%) & Re-distributors (13%).
  - No. customers served = 625 661
  - Number of substations = 227
  - Km of HV, MV and LV Lines = 41 041km
  - Geographic Area = Witbank, Tubatse Nelspruit, Groblersdal & Secunda

Mpumalanga Province Expansion Drivers

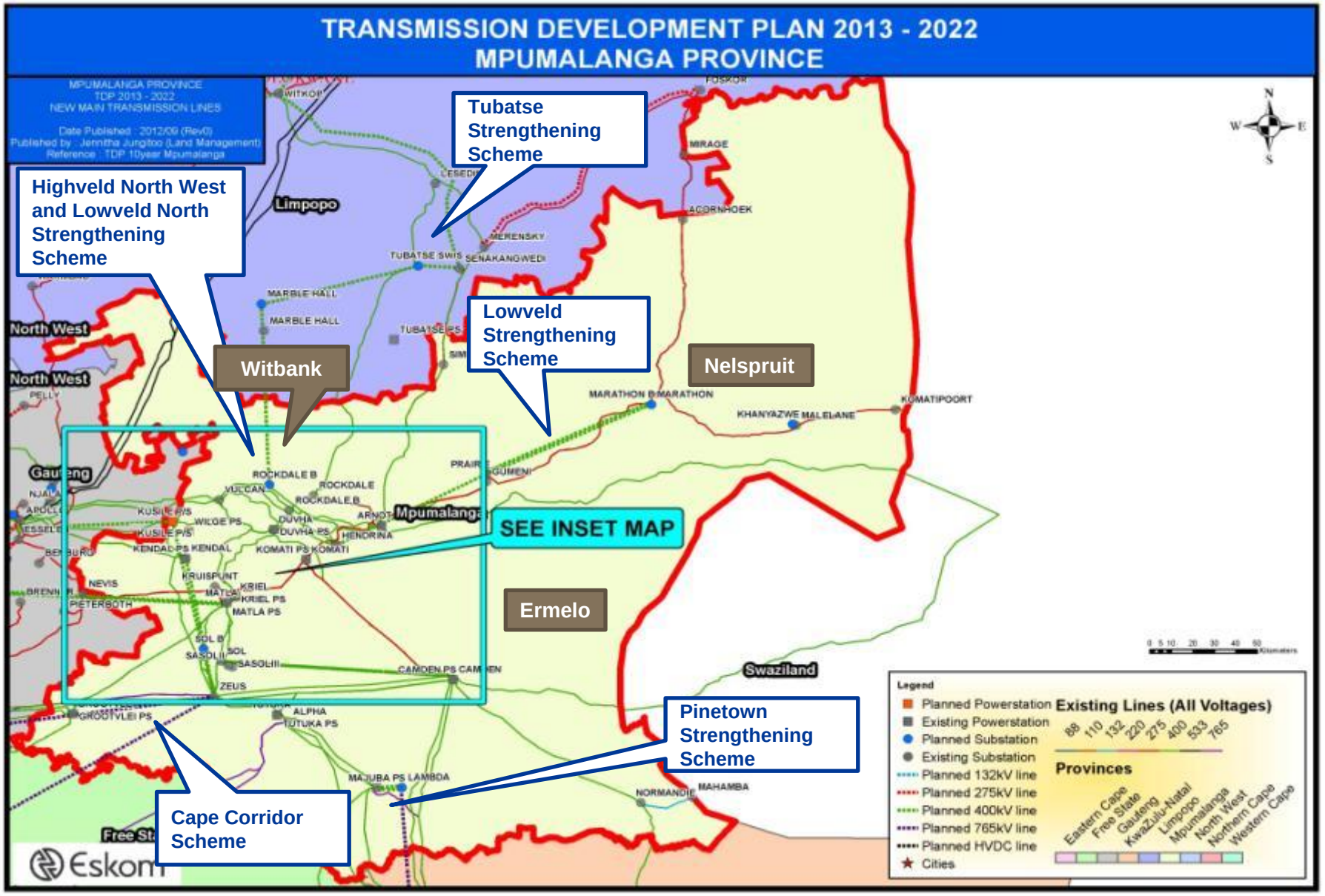


CLN	Percent Growth	2013 (MW)	2018 (MW)	2022 (MW)
Highveld North (Witbank)	3.47%	2223	2806	3385
Highveld South (Ermelo)	6.24%	1430	2051	2081
Lowveld (Nelspruit)	6.86%	763	1221	1319

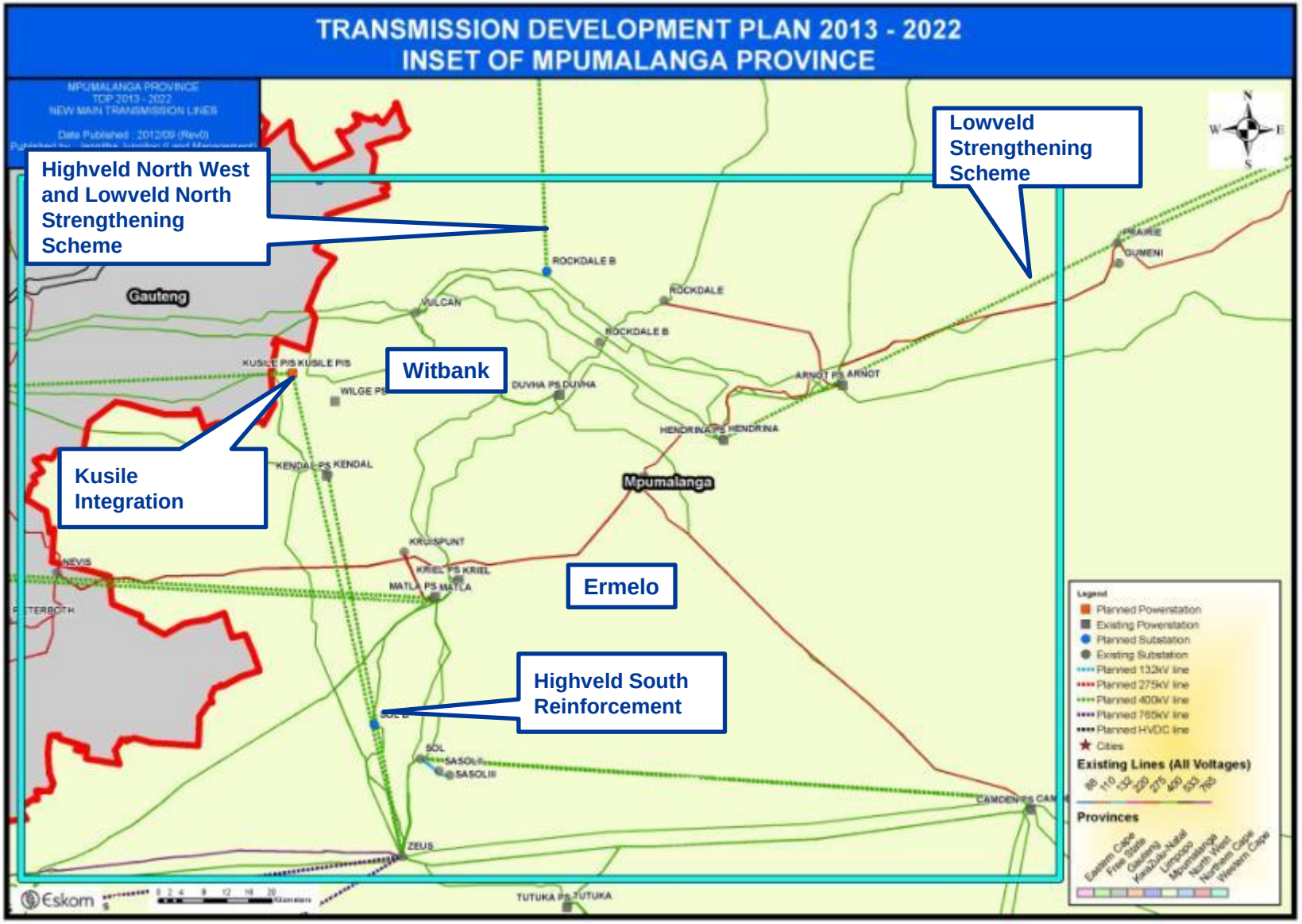




Mpumalanga Province: Development Plan



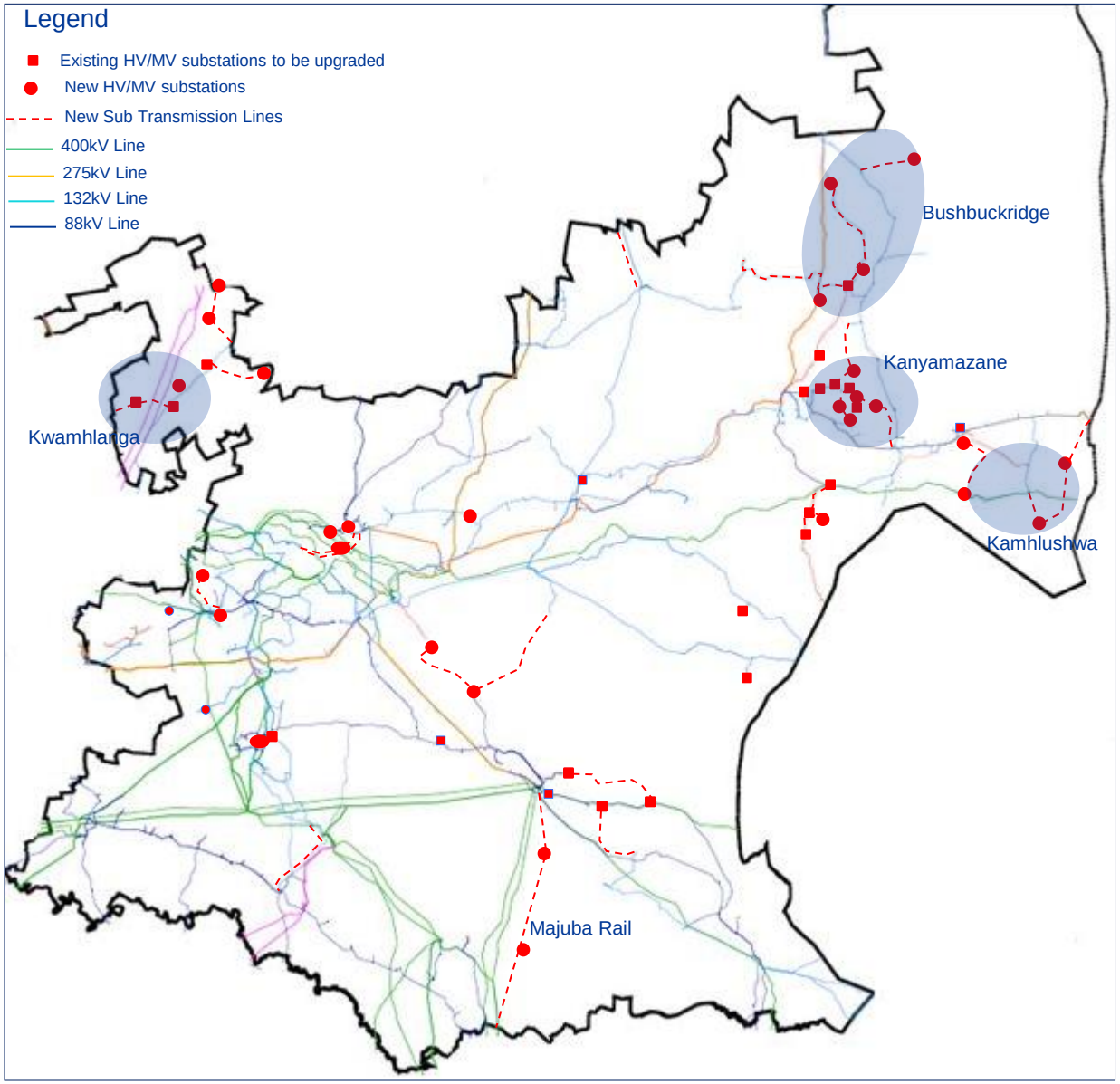
Mpumalanga Province: Development Plan



Mpumalanga Province Major Infrastructure Additions

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 planned 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

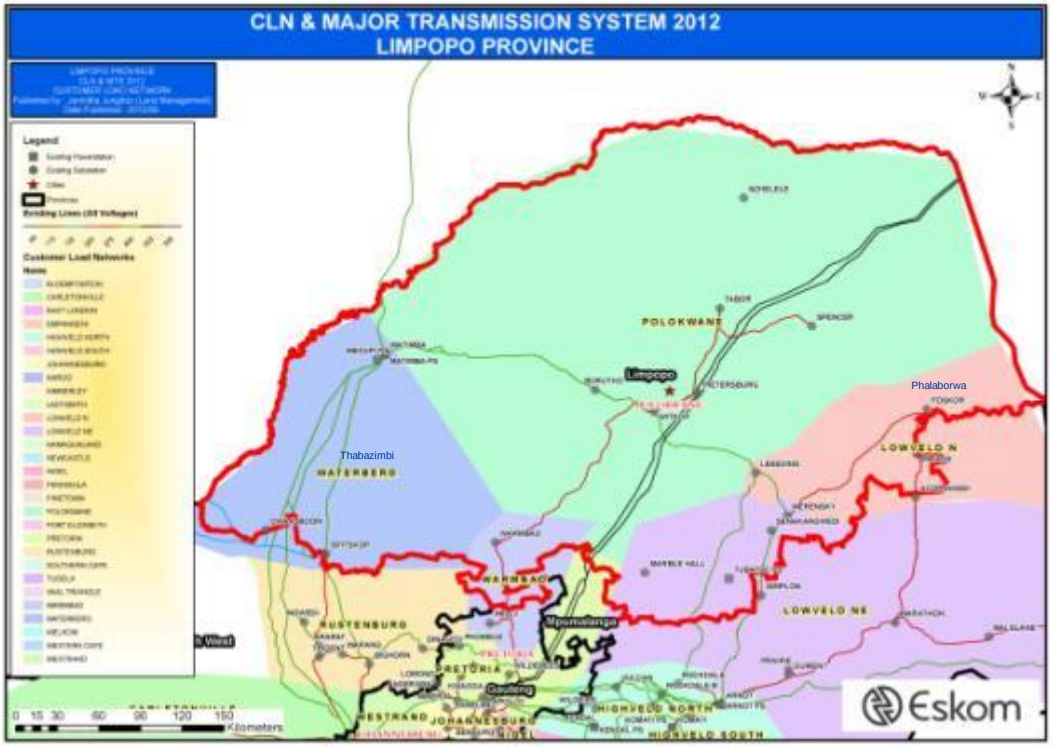
Mpumalanga Province Distribution Plan (Summary)



Summary of Physical Quantities

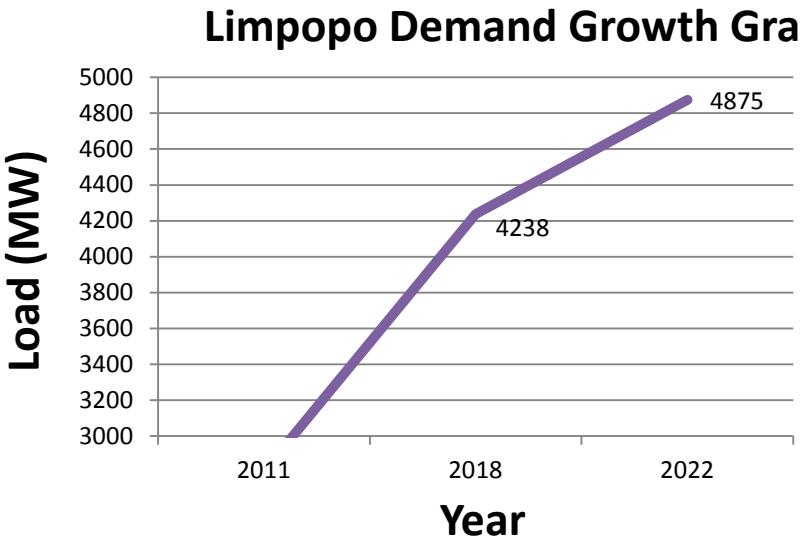
		HV Lines (km)	MV Lines (km)	Transformer Capacity (MVA)
Commissioning year	2013/14	83	120	50
	2014/15	259	339	170
	2015/16	307	530	780
	2016/17	194	48	200
	2017/18	132	545	220
	2018/19	172	115	120
	TOTAL	**1,146**	**1,696**	**1,540**

Limpopo Province Profile

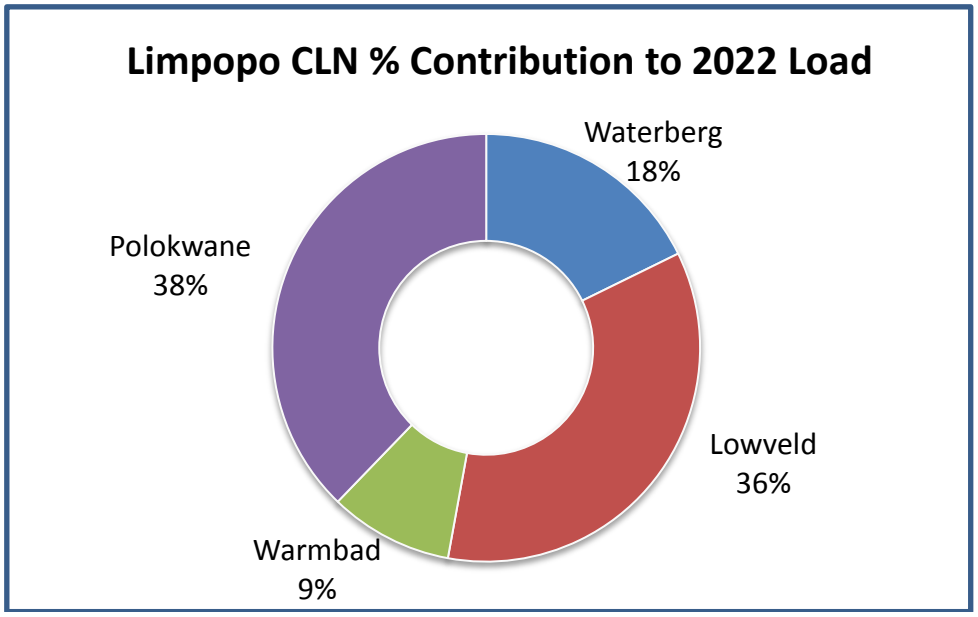


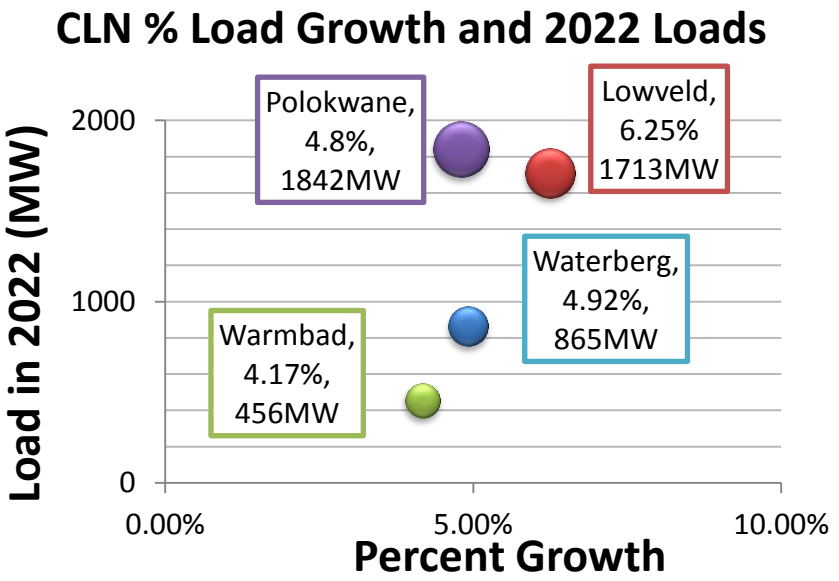
- **Generation**
  - Power Station = Matimba – (Medupi in progress)
  - MW installed = 3690MW
- **Transmission**
  - Load demand = 3068MW
  - Number of MTS = 9
  - Number of CLNs = 4
- **Distribution**
  - Economic activity = Mining (30%), Industrial (30%), Re-distributors (10%), Commercial (5%), Agricultural (5%) & Residential (20%).
  - Geographic area = Lephalale, Bela Bela, Polokwane, Thohoyandou & Phalaborwa,
- **General**
  - Economic mix - Platinum mining, Coal, high concentration of Electrification, Game Farms, Industrial, Farming, Residential & Commercial, International Tie Line - Botswana

Limpopo Province Network Expansion Drivers

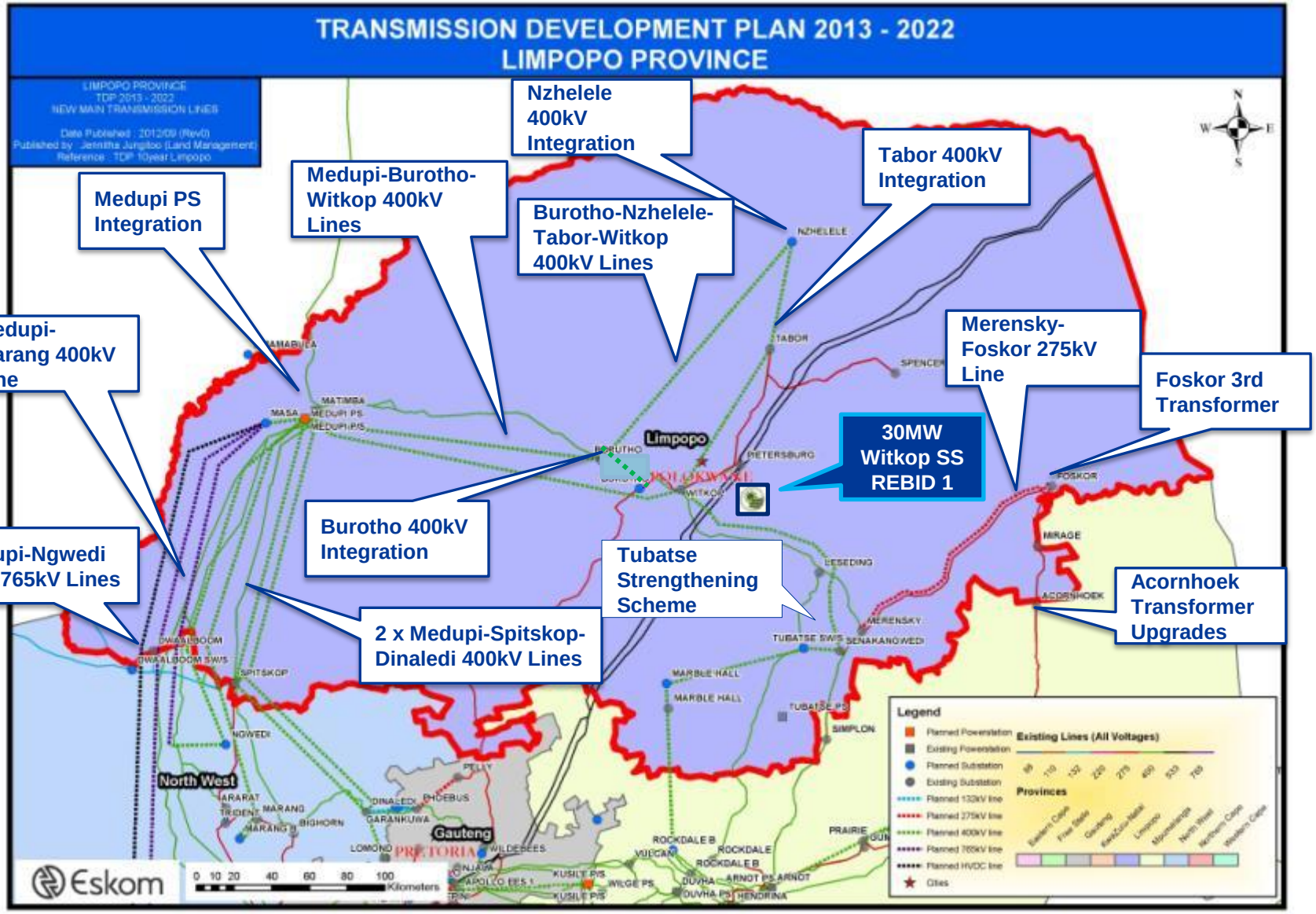


CLN	Percentage Growth	2013	2018	2022
Waterberg	4.92%	534	704	865
Lowveld North	6.25%	1112.9	1528	1713
Warmbad	4.17%	329.5	424	456
Polokwane	4.80%	1328.5	1582	1842





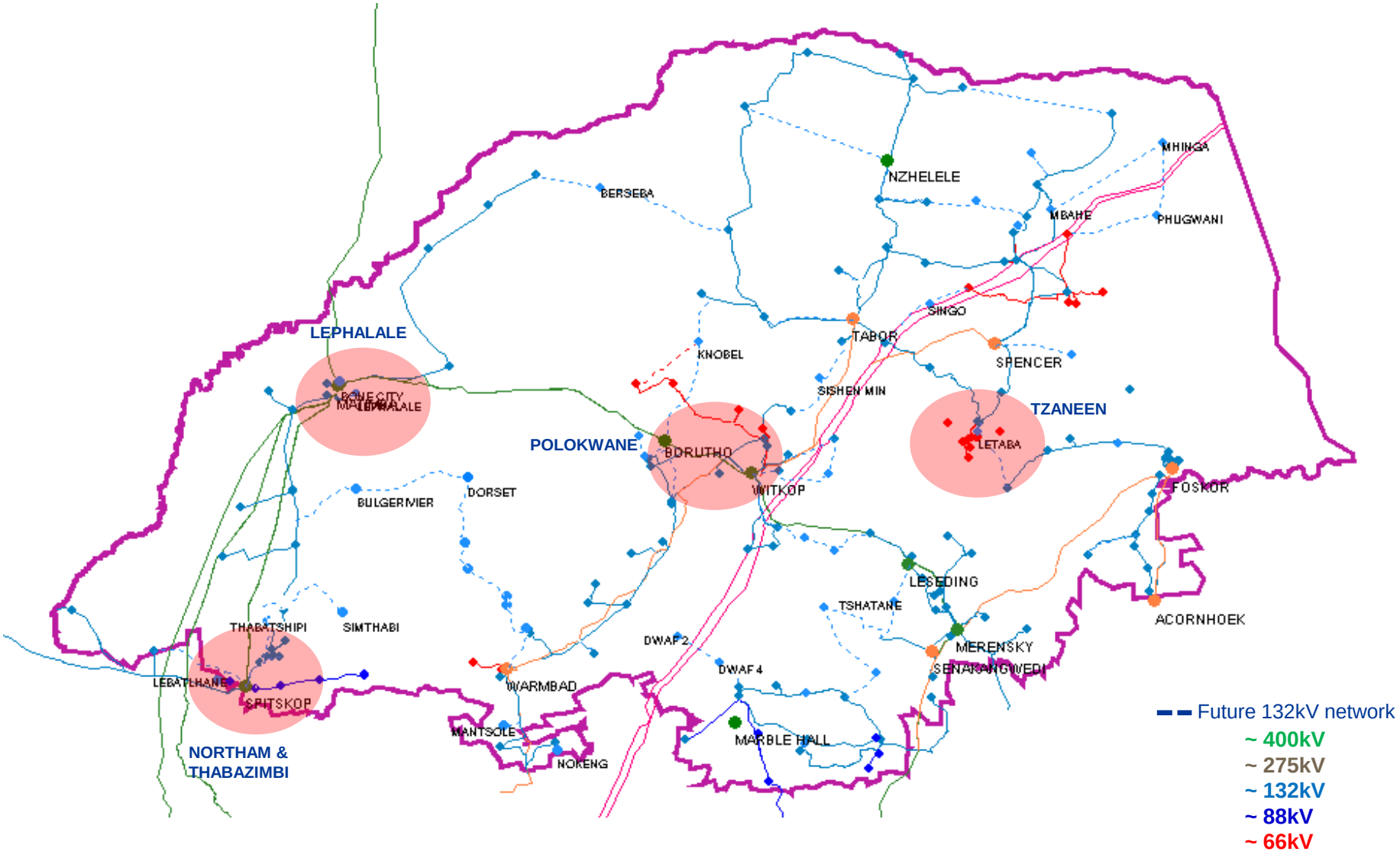
Limpopo Province: Development Plan



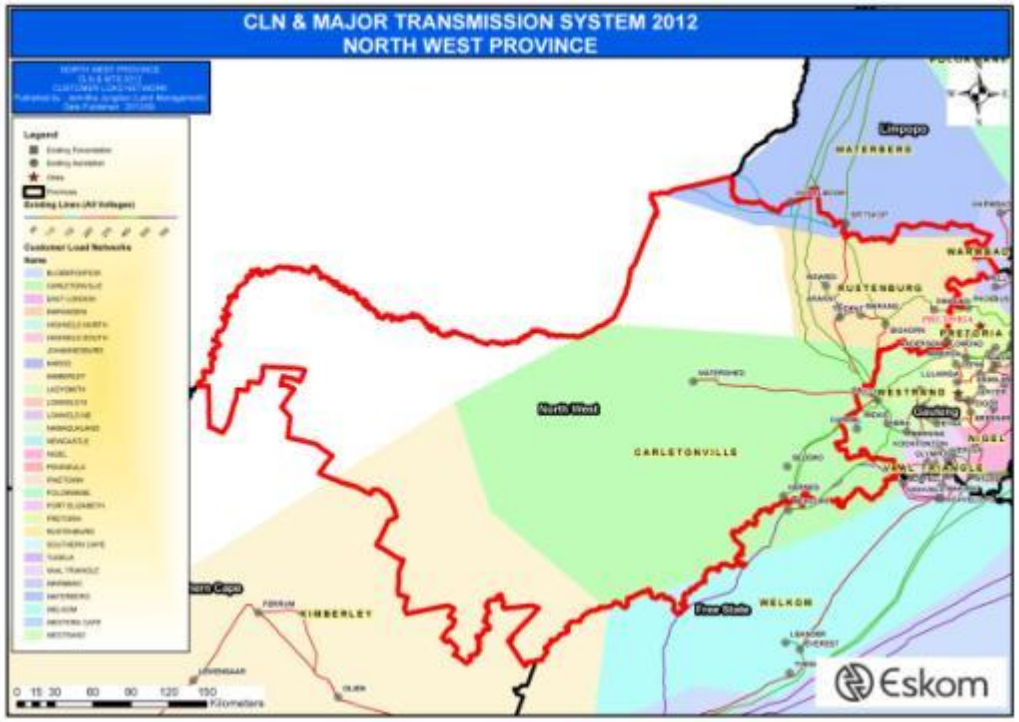
Limpopo Province Major Infrastructure Additions

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 planned 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

Limpopo Province Distribution Plan (Summary)



North West Province Profile



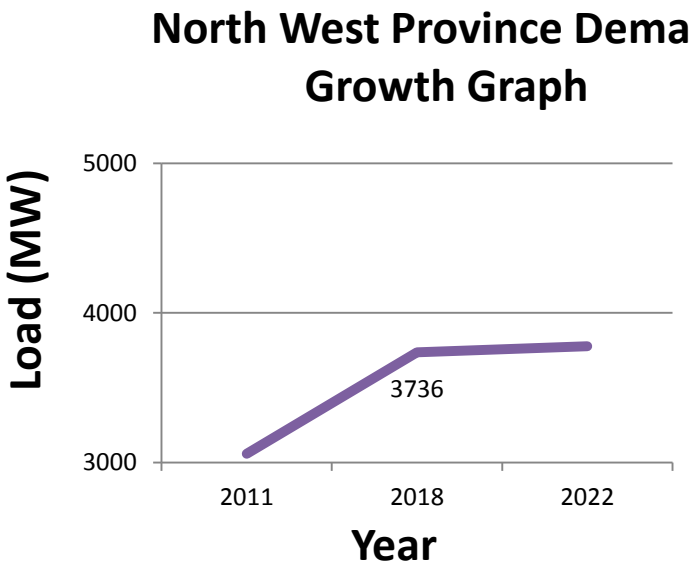
- **Generation**
- None
- **Transmission**
- Load demand = 3304MW
- Number of MTS = 11
- Number of CLNs = 2

- **Distribution - North Western Province**
- Economic activity = Mining (30%), Industrial (30%), Re-distributors (10%), Commercial (5%), Agricultural (5%) & Residential (20%)
- No. customers served = 620 679
- Number of substations = 352
- Geographic area : Mahikeng, Zeerust, Klerksdorp and Vryburg
- Total km's of line (Dx & Tx) = 33 624 km

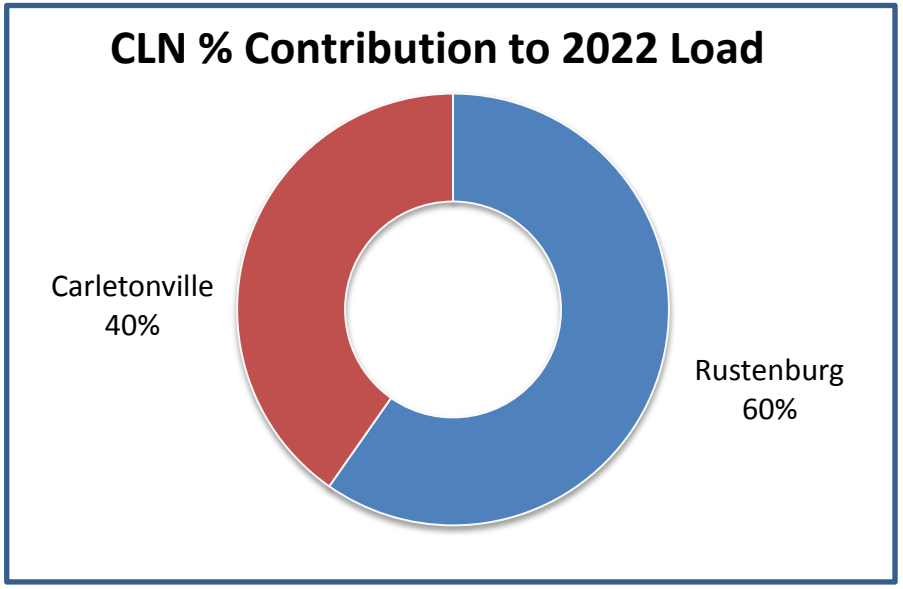
- **General**
- Economic mix - International Ferro Metals SA (Pty) Ltd

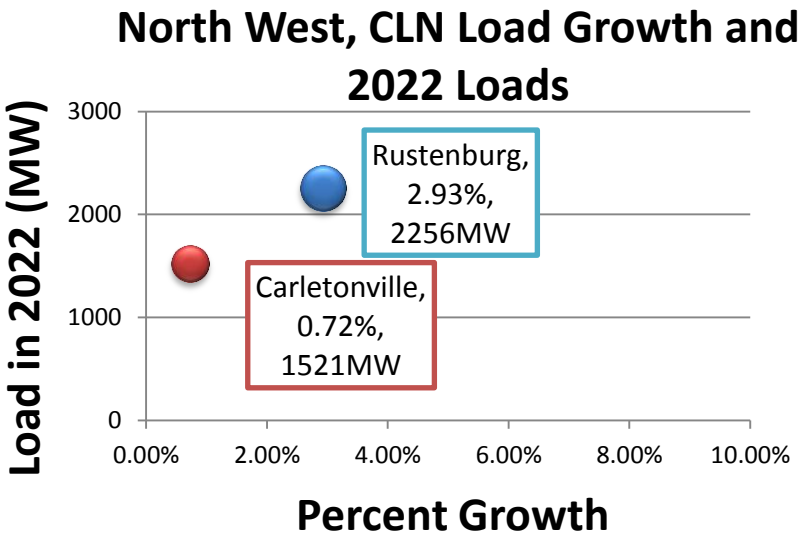
  Hernic Ferrochrome (Pty), Ruukki SA, Impala Platinum (Pty) Ltd, Afplats (Pty) Ltd, Water Board

North West Province Expansion Drivers

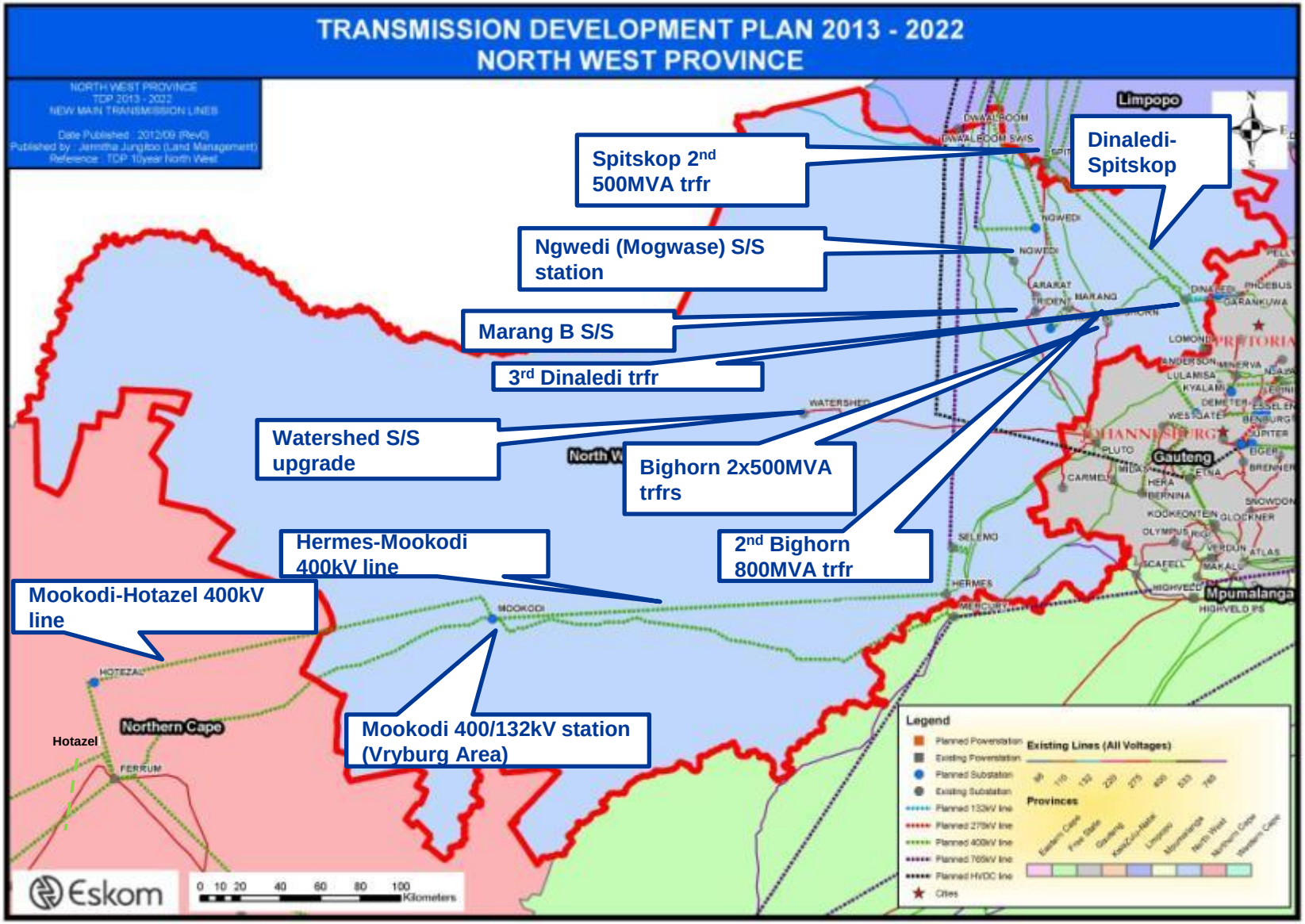


	Percentage Growth	2013 (MW)	2018 (MW)	2022 (MW)
Rustenburg	2.93%	1713	2252	2256
Carletonville	0.72%	1433	1484	1521





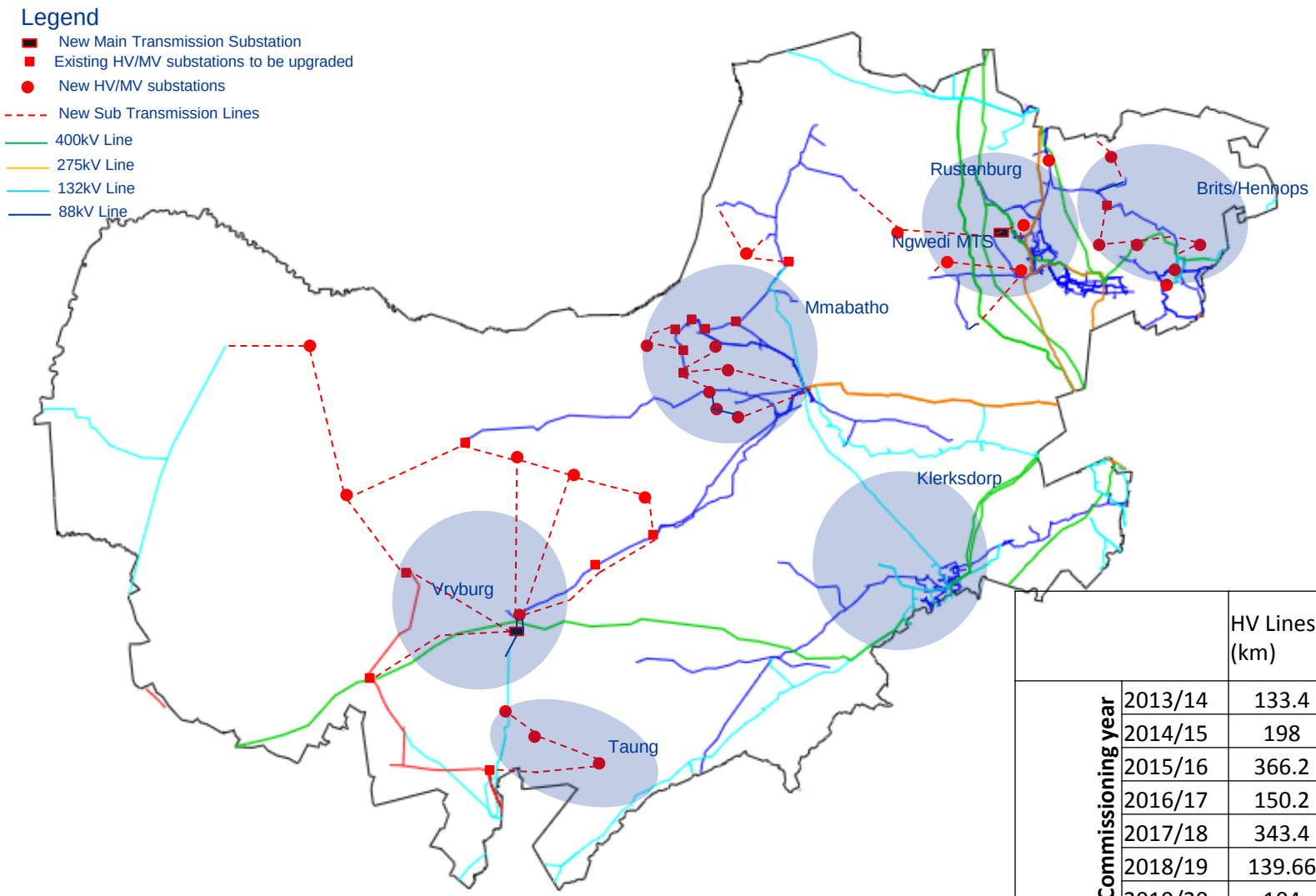
North West Province: Development Plans



North West Province Major Infrastructure Additions

Transmission Assets for Northern 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 planned 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

North West Province Distribution Plan (Summary)



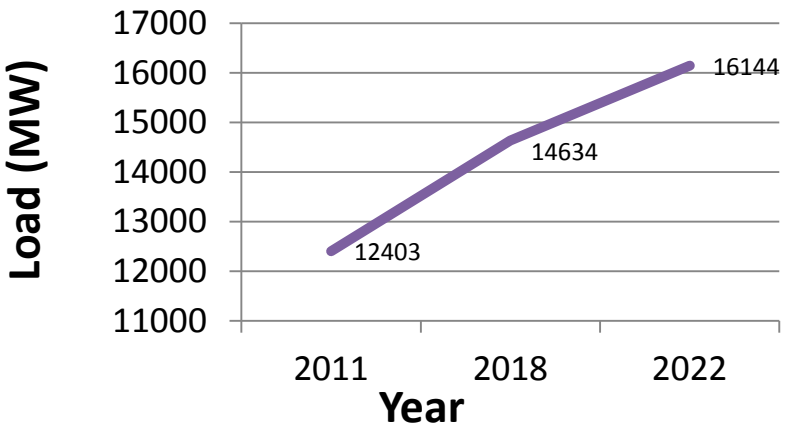
		HV Lines (km)	MV Lines (km)	Transformer Capacity (MVA)
Commissioning year	2013/14	133.4	345	200
	2014/15	198	295	220
	2015/16	366.2	454	450
	2016/17	150.2	484	380
	2017/18	343.4	286	240
	2018/19	139.66	234	190
	2019/20	104	105	80
	TOTAL	**1,586**	**1,743**	**2,045**

Gauteng Province Profile

- **Generation**
  - Power Stations = 600MW (Kelvin PS)
- **Transmission**
  - HV / DC converter station = 1800MW
  - Load demand = 12 403MW
  - Number of MTS = 35
  - Number of CLNs = 6
  - No. of Tx lines =72
  - Km of Tx lines = 2 501km
- **Distribution**
  - Economic activity - Industrial (1.7%), Mining (1.5%), Commercial (10%), Residential (9.8%), Agricultural (1.9%) & Re-distributors (75.1%)
  - No. customers served = 757 000
  - Number of substations = 562
  - Km of Dx lines = 25 000km
  - Geographic area = Nigel, Vaal Triangle, West Rand , Johannesburg, Pretoria and Warmbad
- **General**
  - Economic Mix: Re-distributor, Gold mines and Commercial, SCAW Metal, SAPPI, SASOL, Natref, Anglo Coal

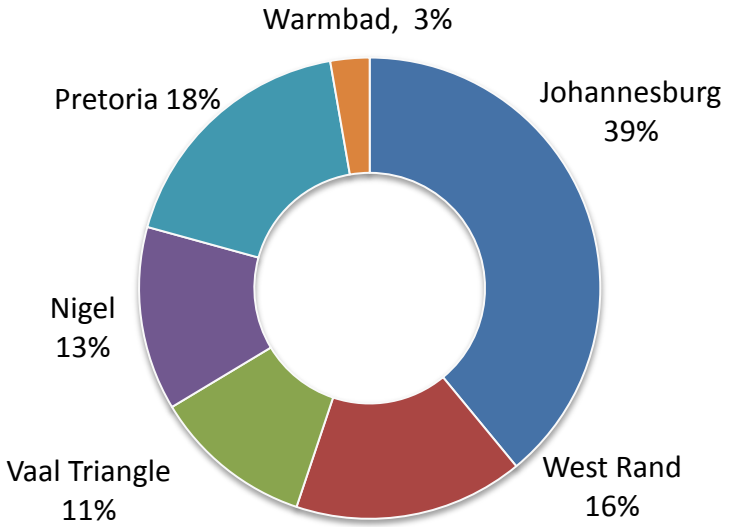
Gauteng Province Expansion Drivers

Gauteng Demand Growth Graph

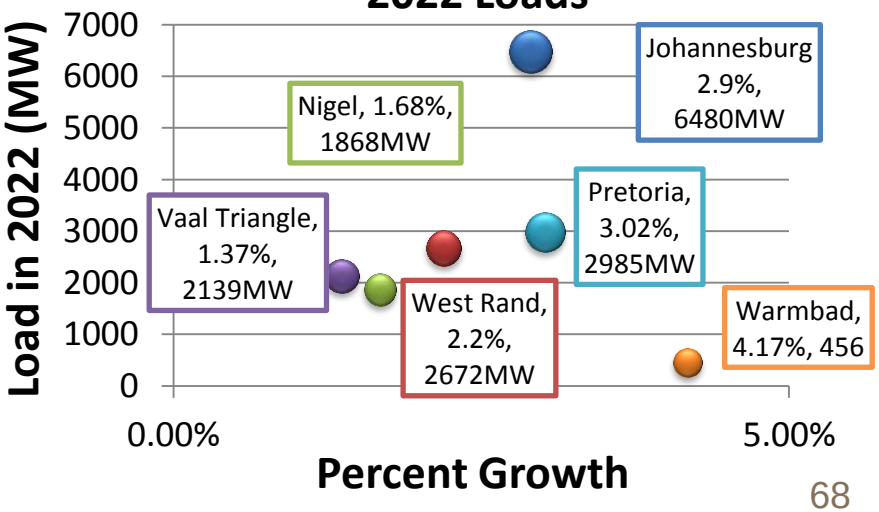


	Percentage Growth	2013 (MW)	2018 (MW)	2022 (MW)
Johannesburg	2.90%	4974	5887	6480
West Rand	2.20%	2100	2435	2672
Nigel	1.68%	1709	1791	1868
Vaal Triangle	1.37%	1859	1977	2139
Pretoria	3.02%	2236	2543	2985
Warmbad	4.17%	329	424	456

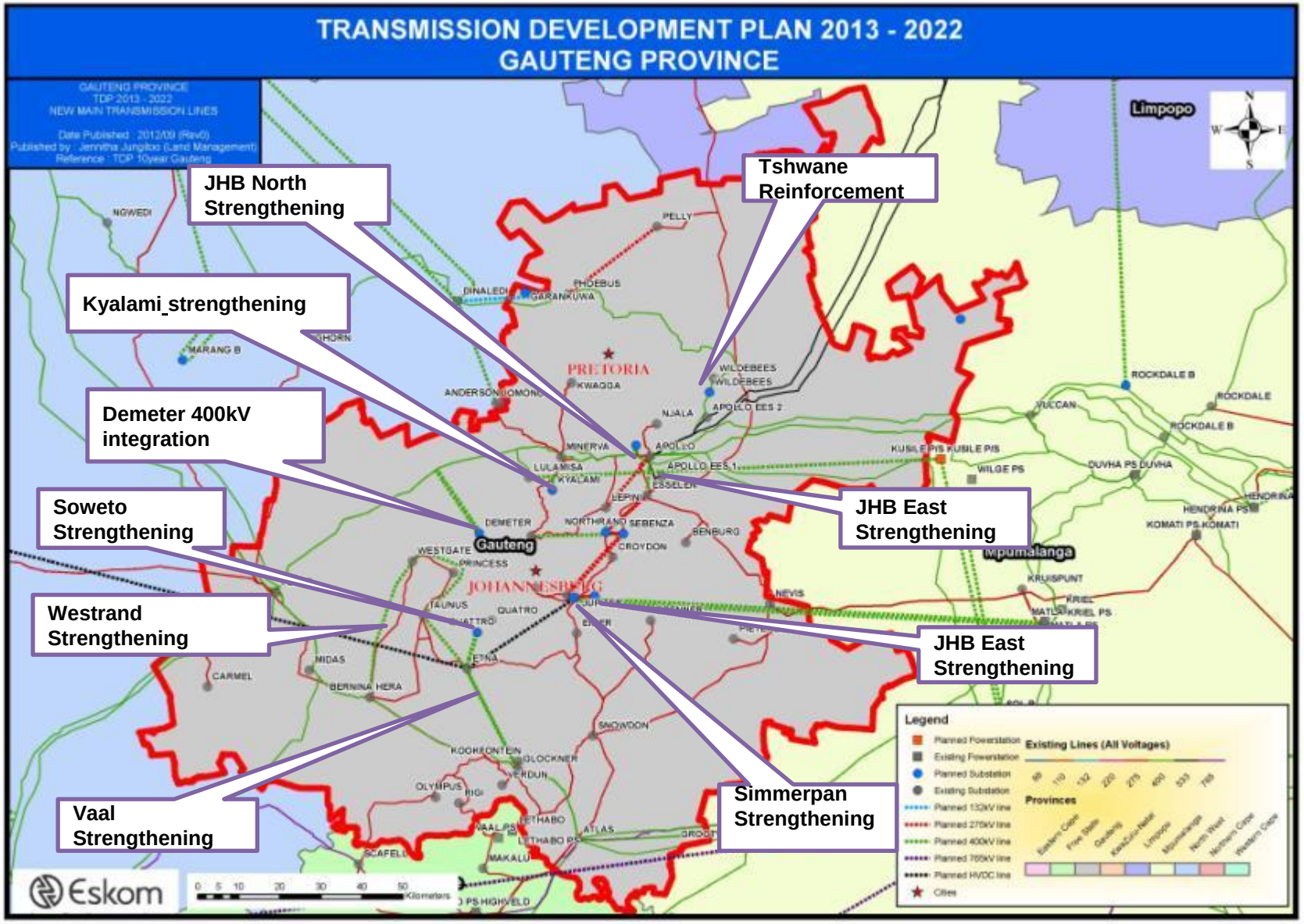
Gauteng CLN % Contribution to 2022 load



Gauteng CLN % Load Growth and 2022 Loads



Transmission Development Plan – Gauteng Province



Gauteng Province

1. Increase Capacity and Reliability:

- Address current network thermal constraints
- To increase transfer of power

2. Network System Integration:

- New 400kV into 275kV

3. Strategic Network Establishment:

- Convert the existing 275kV networks to 400kV
- Acquire strategic power corridor routes into major cities

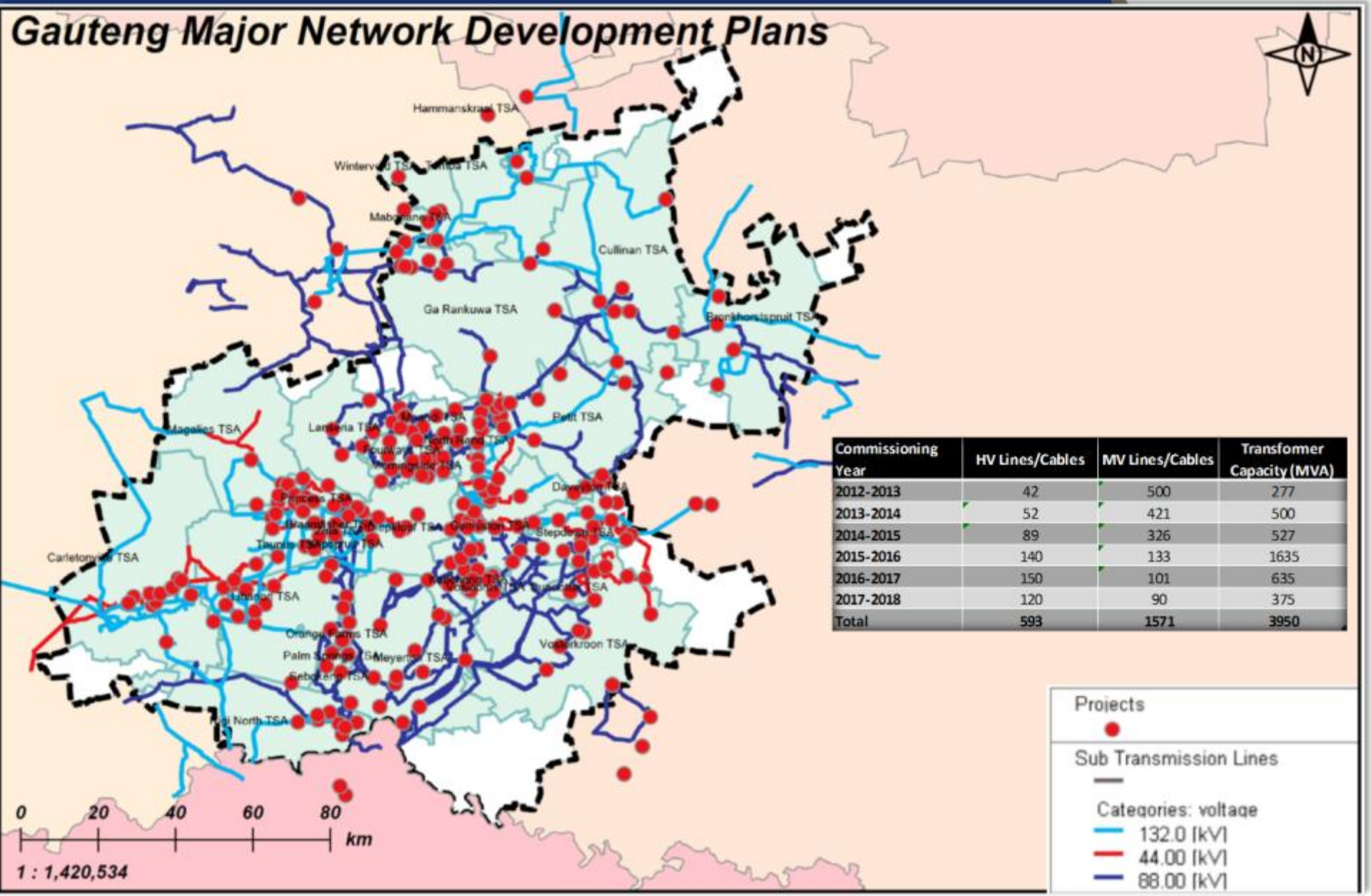
4. Challenges:

- Servitude acquisitions

Gauteng Province Major Infrastructure Additions

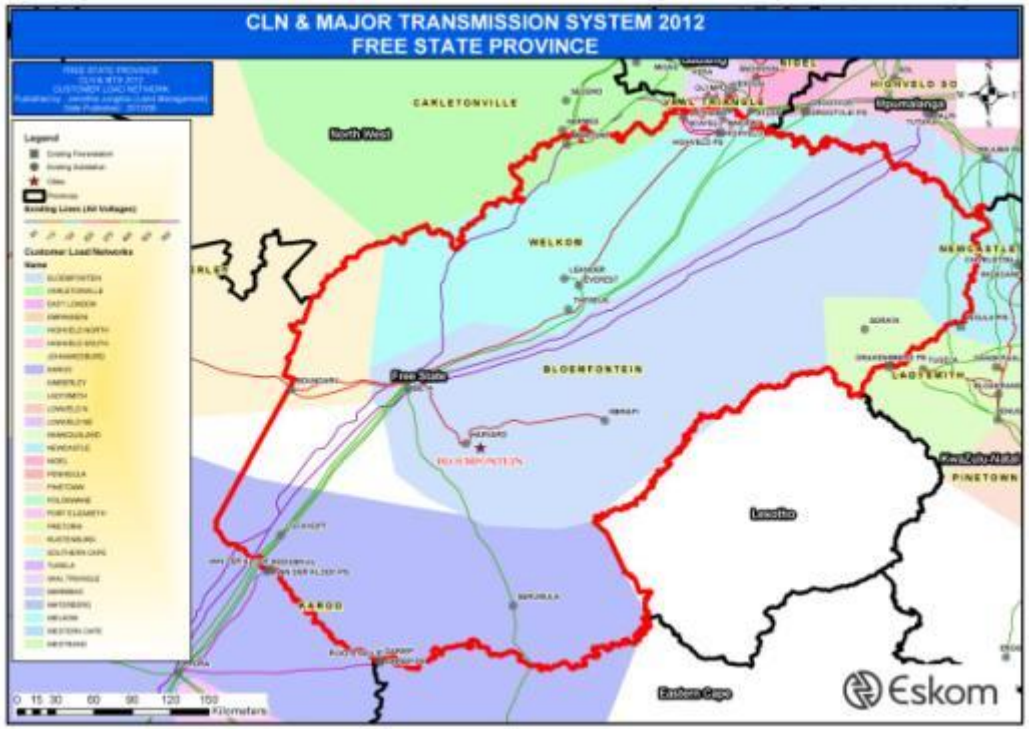
Transmission Assets for Gauteng Province	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	813	91	904
765kV Lines (km)	0	0	0
400kV Lines (km)	763	59	822
275kV Lines (km)	50	32	82
Total planned Transformer MVA	5,390	5,215	10,605
Transformers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

Gauteng Province Distribution Plan (Summary)



Commissioning Year	HV Lines/Cables	MV Lines/Cables	Transformer Capacity (MVA)
2012-2013	42	500	277
2013-2014	52	421	500
2014-2015	89	326	527
2015-2016	140	133	1635
2016-2017	150	101	635
2017-2018	120	90	375
Total	593	1571	3950

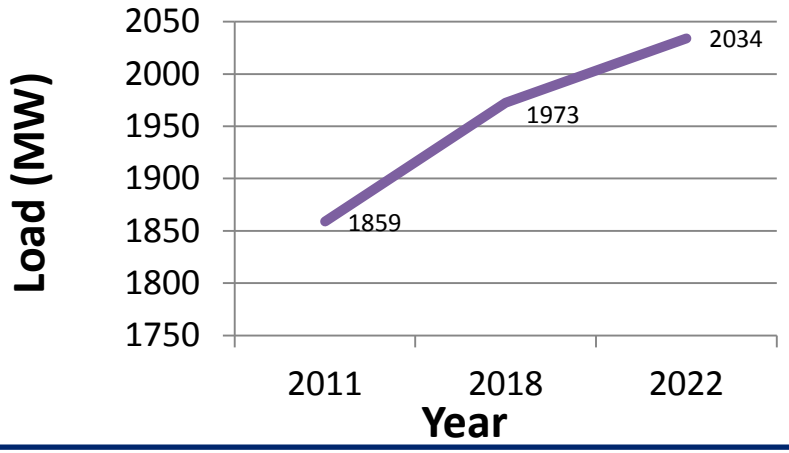
Free State Province Profile



- **Generation**
- Lethabo Power Station
- Generation: 3 558 MW
- **Transmission**
- Load demand = 1 859MW
- Number of MTS = 11
- Number of CLNs = 4
- **Distribution - Free State Region**
- Economic activity = Mining (3.2%), Industrial (3.4%), Re-distributors (76.4%), Commercial (3.9%), Agricultural (4.4%), Prepayment (3.2%), Residential (1.3%), Traction (0.8%) & International (3.4%).
- No. customers served = 233 115
- Number of substations = 284
- Geographic area: Bethlehem, Bloemfontein, Welkom
- Total km's of line (Dx & Tx) = 44 480 km

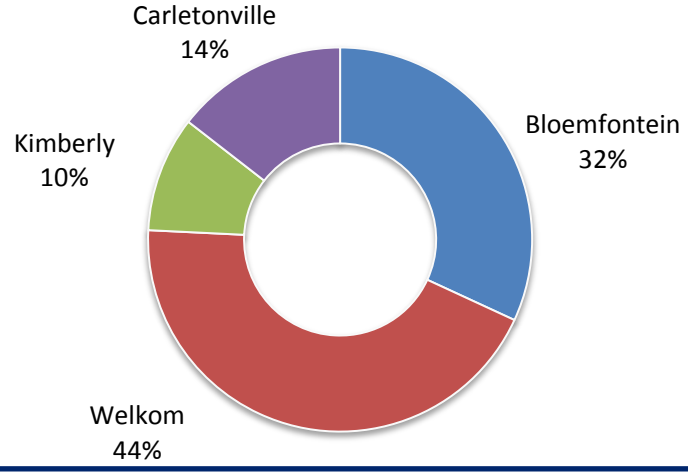
Free State Province Expansion Drivers

Free State Demand Growth Graph

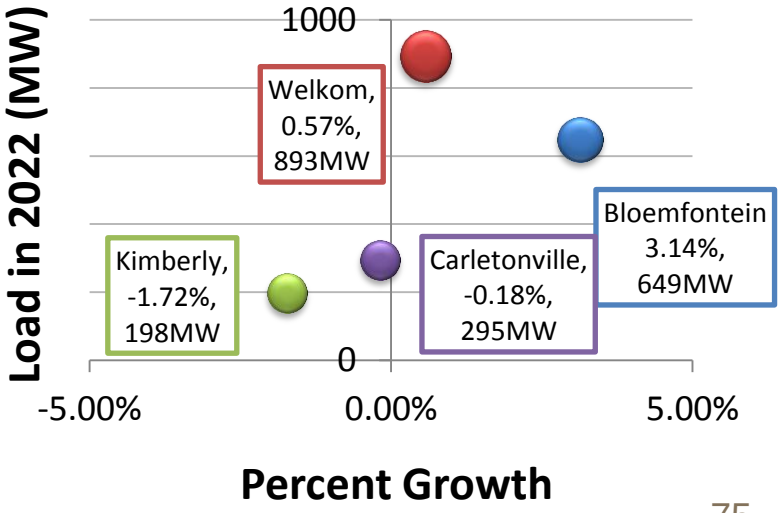


	Percentage Growth	2013	2018	2022
Bloemfontein	3.14%	486.6	615	649
Welkom	0.57%	848.7	874	893
Kimberly	1.72%	181.6	191	198
Carletonville	0.18%	290.8	293	295

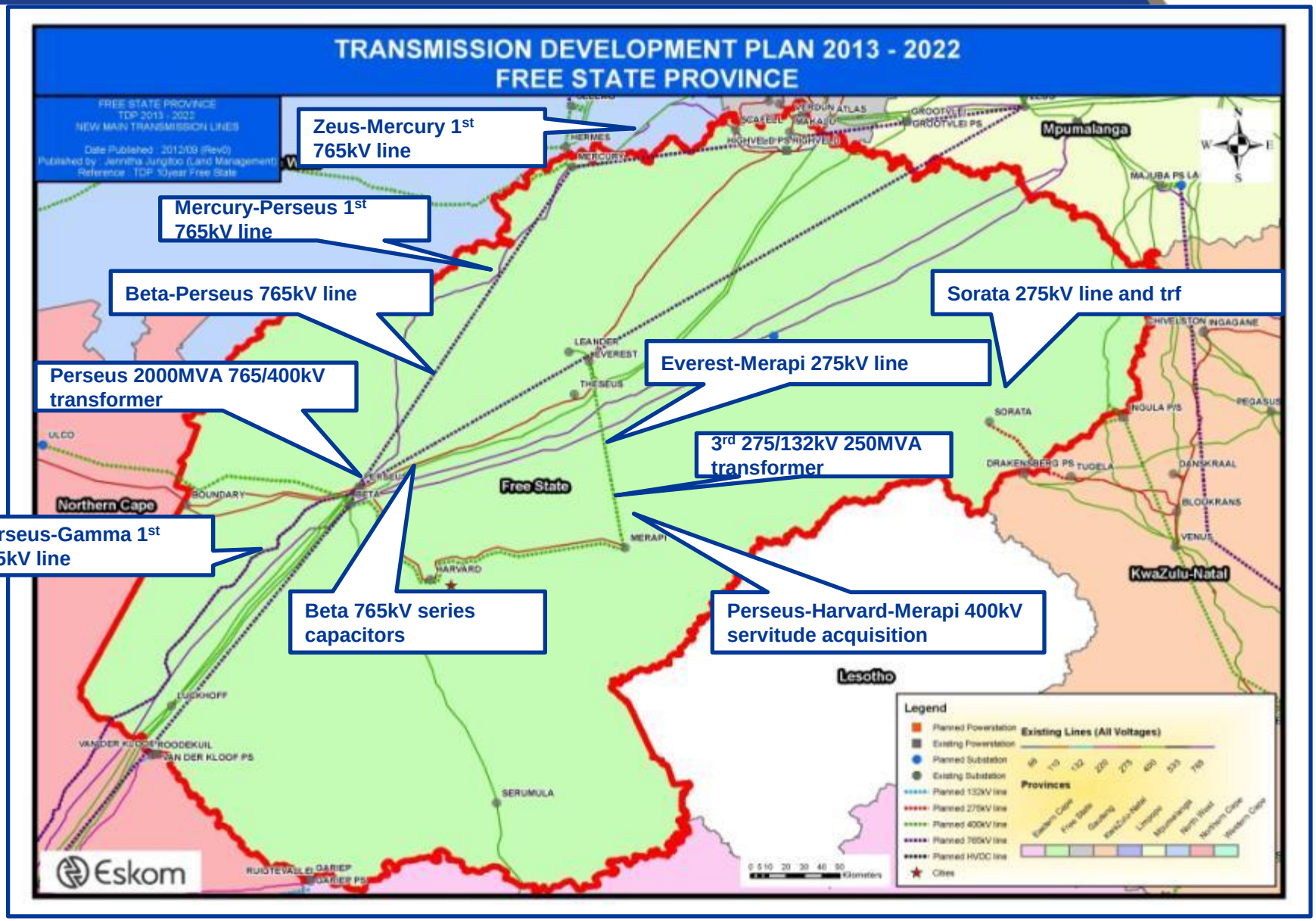
Free State CLN % Contribution to 2022 Load



Free State, CLN % Load Growth and 2022 Loads



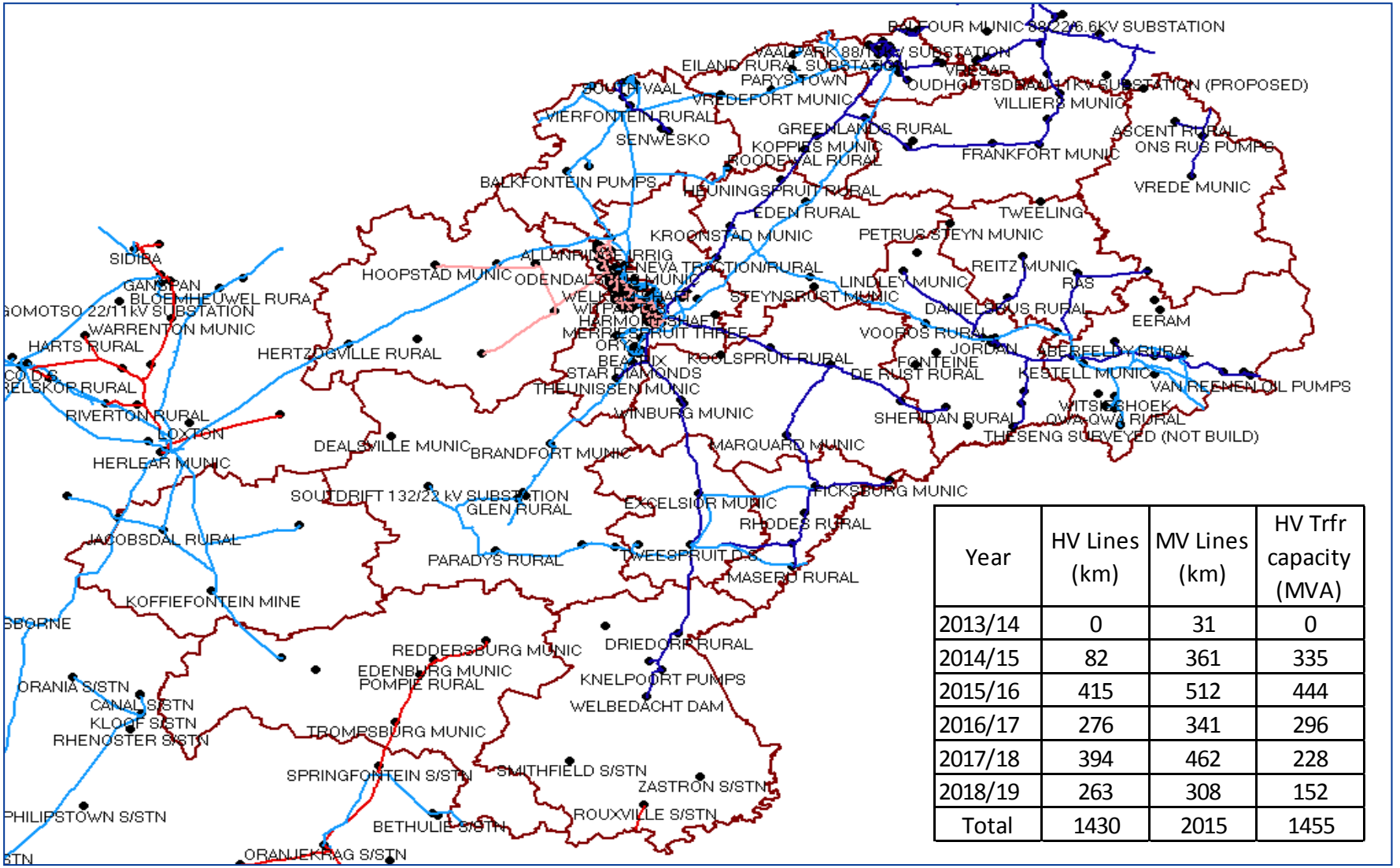
Free State Province: Development Plan



Free State Province Major Infrastructure Additions

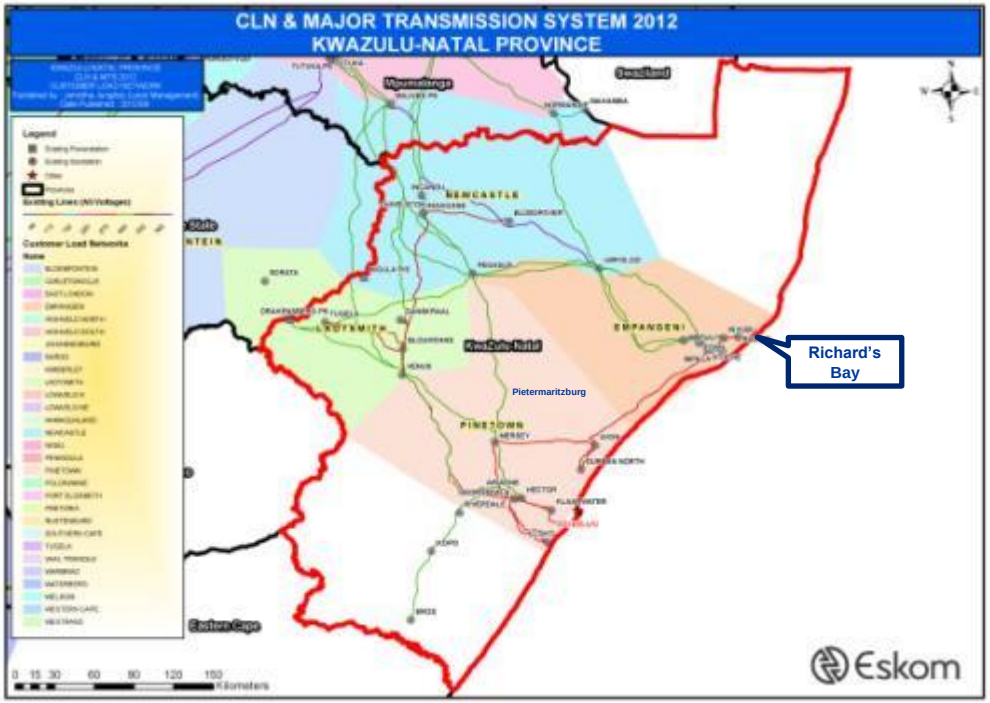
Transmission Assets for Free State Province	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	110	663	773
765kV Lines (km)	0	430	430
400kV Lines (km)	110	233	343
275kV Lines (km)	0	0	0
Total planned Transformer MVA	250	1,000	1,250
Transformers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

Free State Province Distribution Plan (Summary)



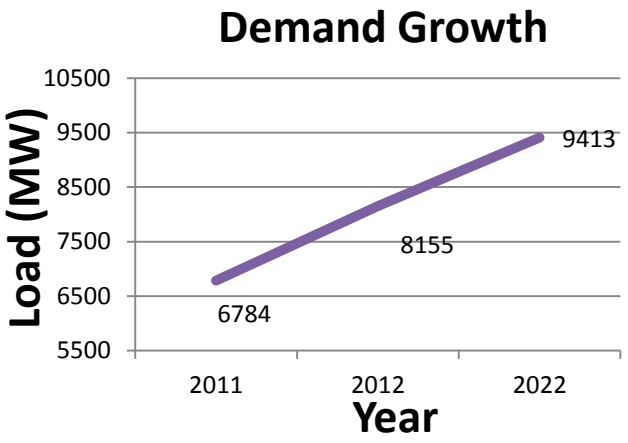
Year	HV Lines (km)	MV Lines (km)	HV Trfr capacity (MVA)
2013/14	0	31	0
2014/15	82	361	335
2015/16	415	512	444
2016/17	276	341	296
2017/18	394	462	228
2018/19	263	308	152
Total	1430	2015	1455

KwaZulu-Natal Province Background

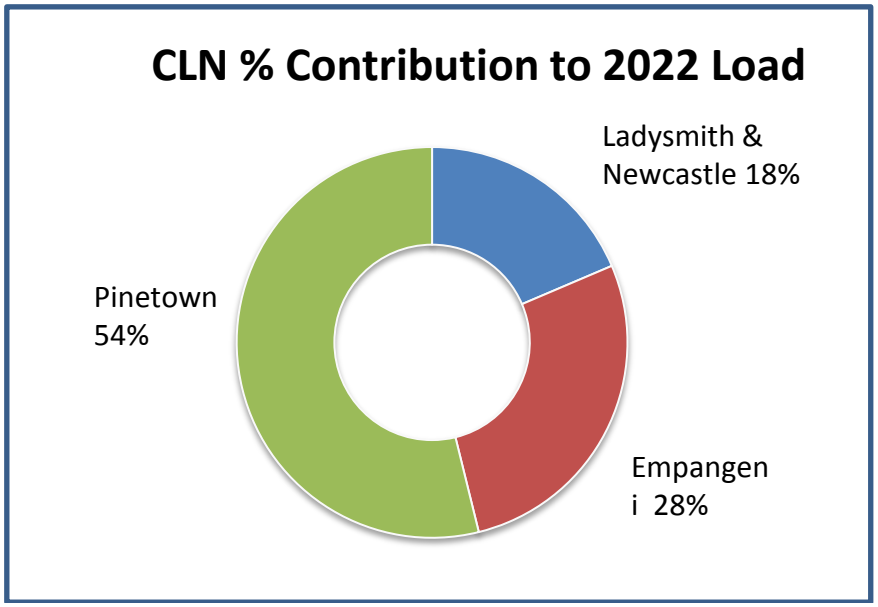


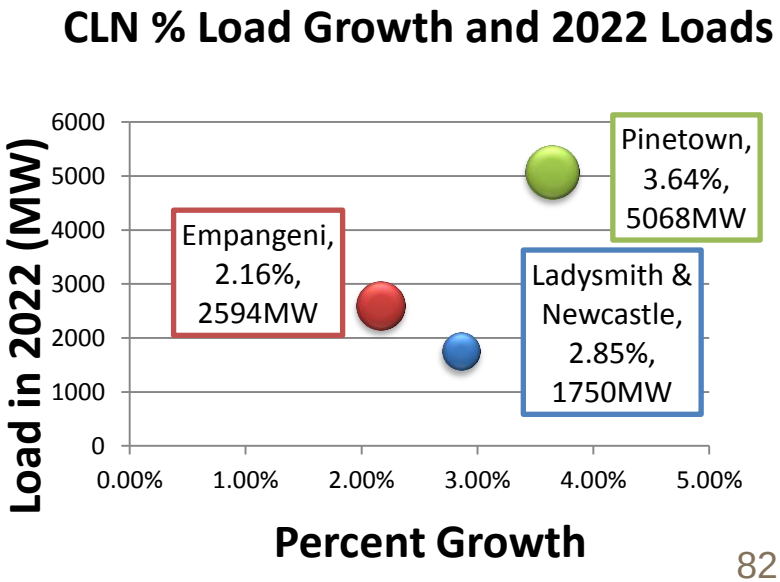
- **Generation**
  - Drakensberg Pumped Storage with 1000MW installed capacity
- **Transmission**
  - Load demand = 6 784MW
  - Number of Substations = 21
  - Number of CLNs = 4
- **Distribution**
  - Economic activity - Re-distributors (80.6%), Commercial (5.1%), Mining (1%), Industrial (3%), Residential (3.6%) & Agriculture (2.9%), Prepayment (3.3%), Traction (0.5%)
  - Number of substations = 443
  - Km of lines (incl. Transmission) = 56 610 km
- **General**
  - Economic mix - Mining, Agriculture (Sugar Cane & Timber), Residential, Commercial & Industrial.

KwaZulu-Natal Province Expansion Drivers



CLN	Ave. Annual Growth (%)	2013	2018	2022
		(MW)		
Ladysmith & Newcastle	2.85	1351	1568	1750
Empangeni (incl. Richard's Bay)	2.16	2090	2439	2594
Pinetown (incl. Pmb, Dbn)	3.64	3603	4148	5068





KwaZulu-Natal Province Major Schemes

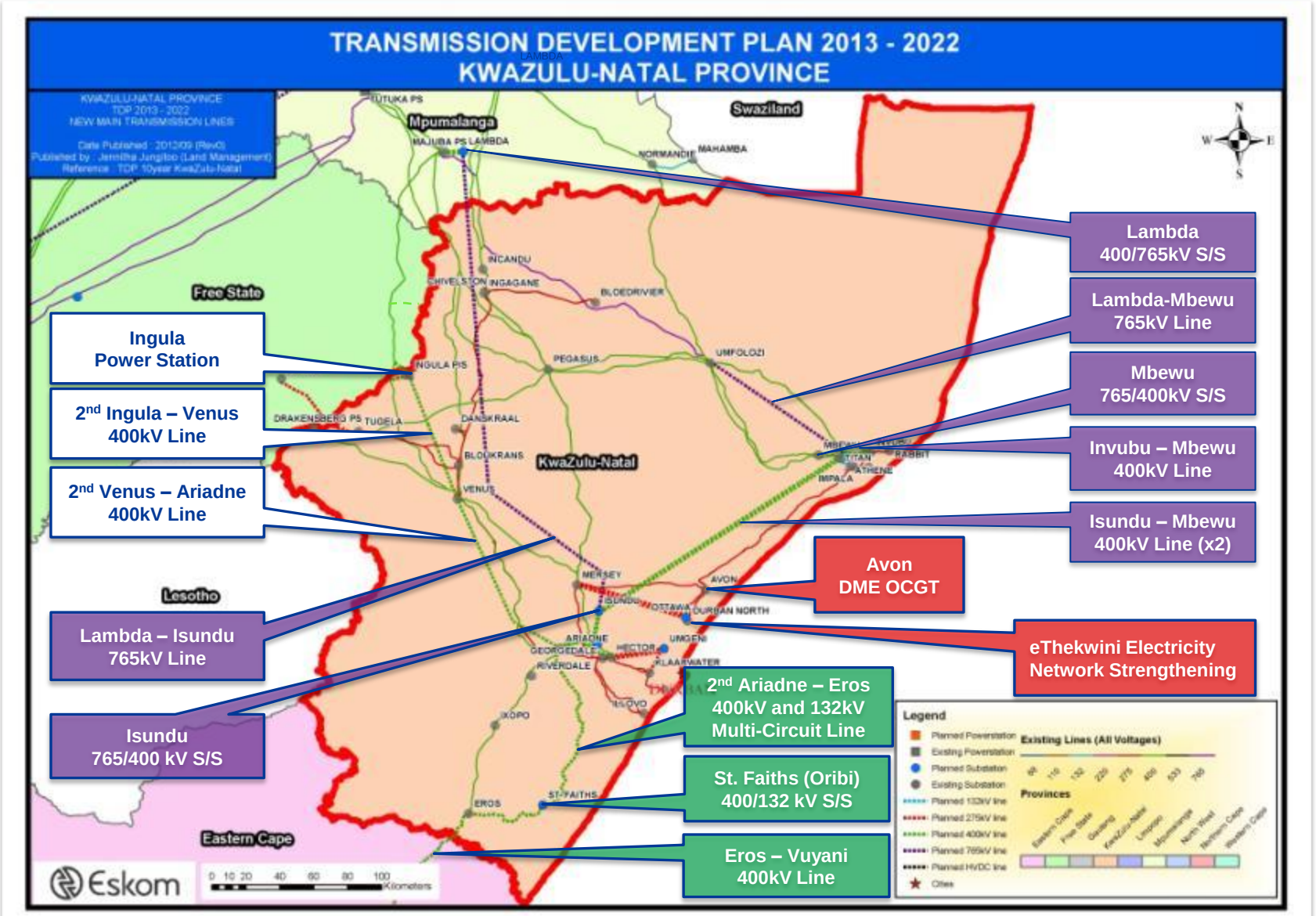
1. Increase in Capacity

- Ingula Power Station - A pumped-storage scheme that is under construction, spanning the escarpment of the Little Drakensberg straddling the provincial boundary of Free State and KwaZulu-Natal within the Ladysmith CLN. Ingula will have a generating capacity of 1 330 MW.

2. Network System Integration

- **KZN 765kV Strengthening -** Establishing 765kV in the Pinetown and Empangeni areas which will run from the power pool in the north and integrating it into the 400kV network in both areas.
- **South Coast Strengthening -** Construction of a 2nd 400kV line from Ariadne (near Pietermaritzburg) to Eros (in Harding) and a 400kV line from Eros to a new Vuyani substation (in Mthatha) to address the electrification load demand along the KZN south coast towards the Eastern Cape Province.
- **eThekwini Electricity Network Strengthening -** Extension of Umgeni substation (in New Germany) to include 275/132kV transformation and firming up the 275kV supply into Ottawa Substation (near Veralum).

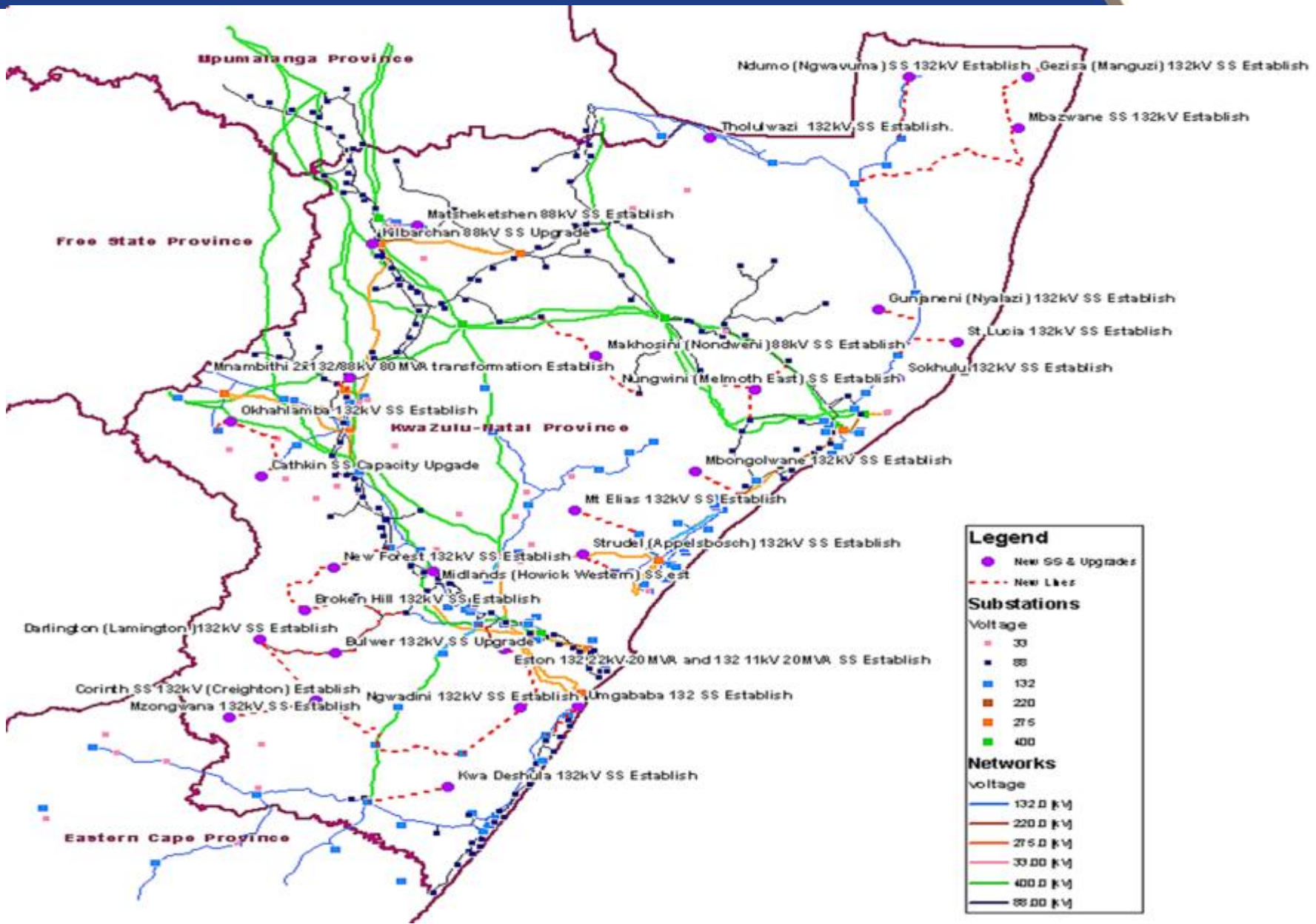
KwaZulu-Natal Province TDP Overview



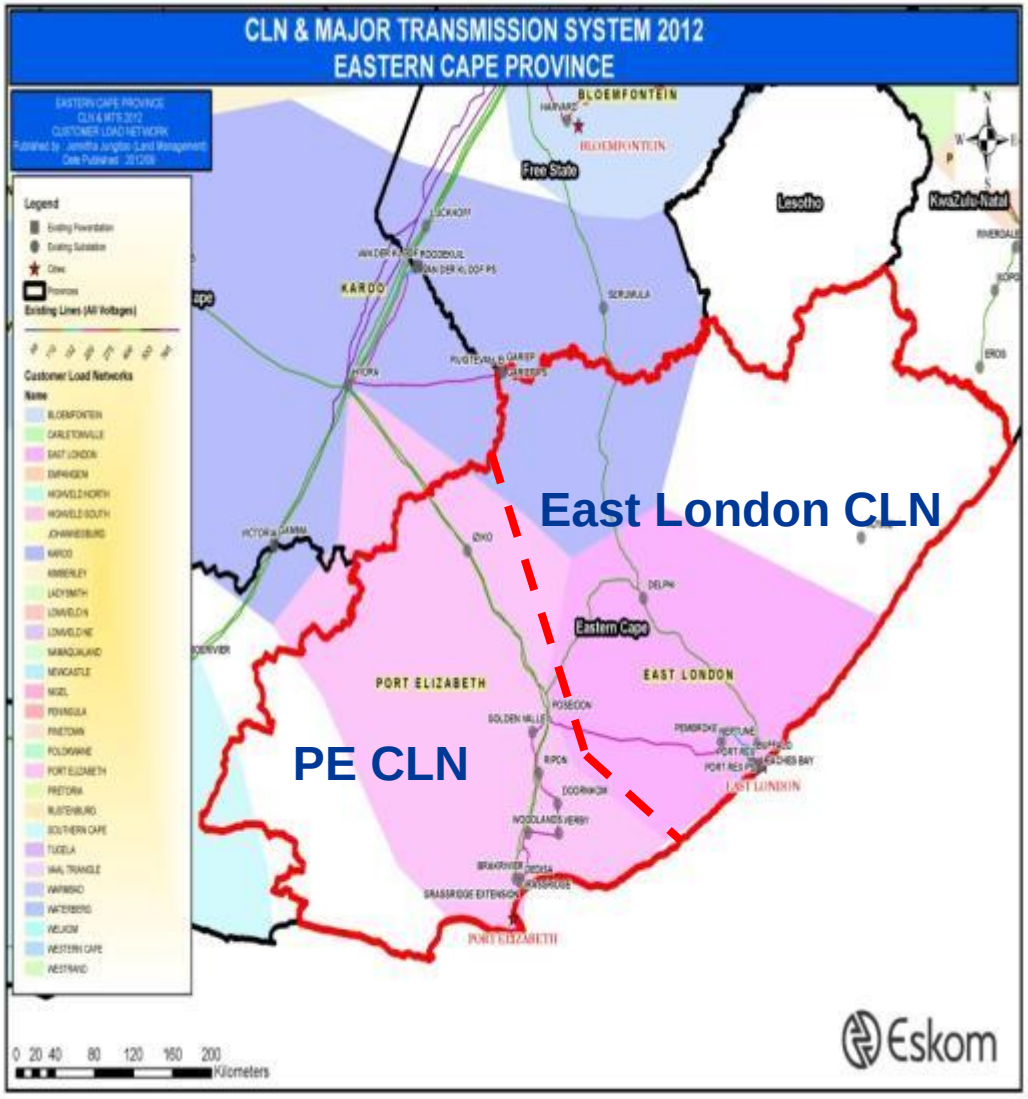
KwaZulu-Natal Province Major Infrastructure Additions

Transmission Assets	2013-2017	2018-2022	Total
765kV Lines (km)	80	300	380
400kV Lines (km)	505	450	955
275kV Lines (km)	0	68	68
Total Lines (km)	585	818	1,403
Transformers (no. of)	9	5	14
Capacitors (no. of)	0	0	0
Reactors (no. of)	1	6	7

KwaZulu-Natal Province Distribution Plan (Summary)



Eastern Cape Province Profile



Transmission Network

- Geographic Area = Nelson Mandela Metro, East London, Buffalo City Metro, Mthatha
- Number of CLNs = 2
- Number of Substations = 9
- Load demand = 1 627 MW

Distribution

- No. customers served 638 187
- Load Composition:
  Residential - **37%**, Commercial - **20%**,
  Industrial - **34%**, Agricultural - **6%**, Traction - **3%**
- Number of Substations ≈ 173
- Length of lines ≈ 40 147km

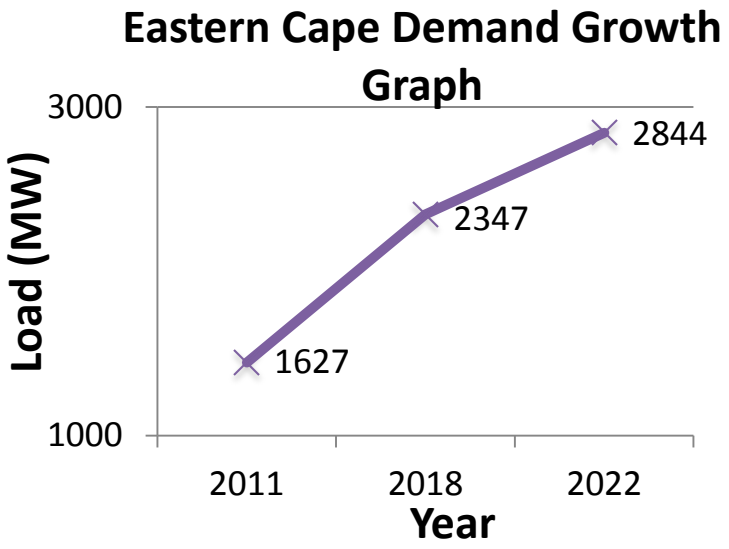
Generation in Eastern Cape

- Gariep 4x90MW
- Port Rex 3x57MW
- Distribution Embedded Hydros

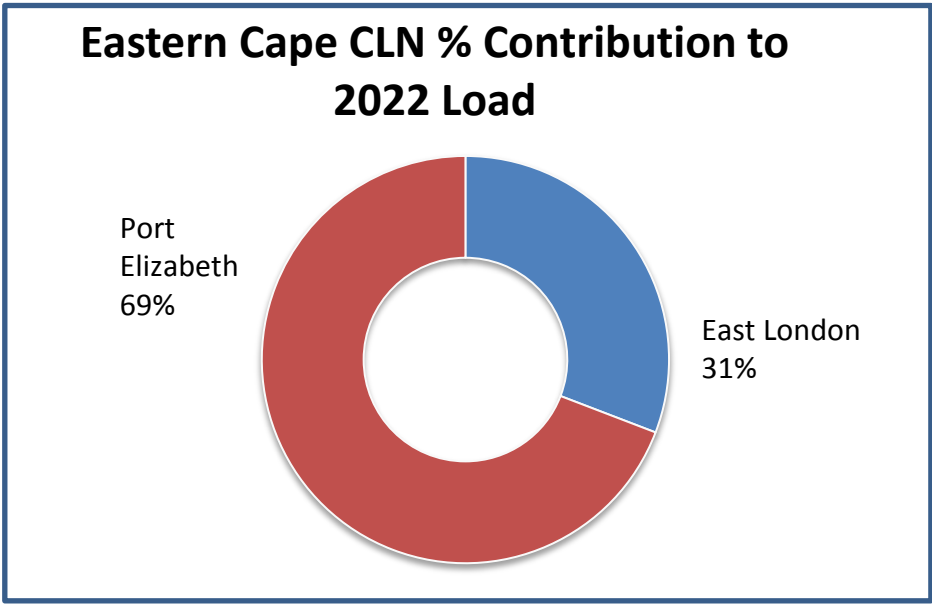
General

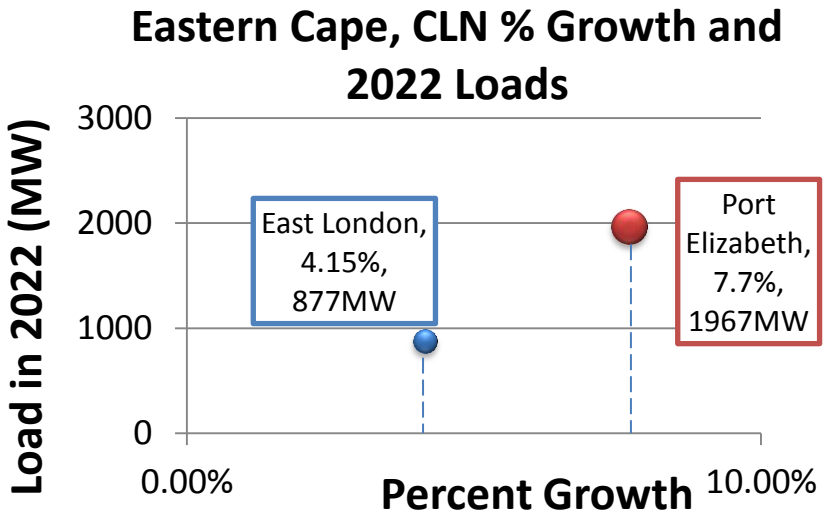
- Economic Mix – Motor vehicle assembly industry, light industry and foundry, textiles, farming, residential and commercial

Eastern Cape Province Load Forecast



	Percentage Growth	2013 (MW)	2018 (MW)	2022 (MW)
East London	4.15%	685.3	791	877
Port Elizabeth	7.70%	1042	1556	1967





Eastern Cape Expansion Drivers

1. **Resolve current constraints:**

- Electricity Infrastructure in the Mthatha Area is depleted and barely meet required reliability levels
- Integrate the KZN and East London system to enhance reliability

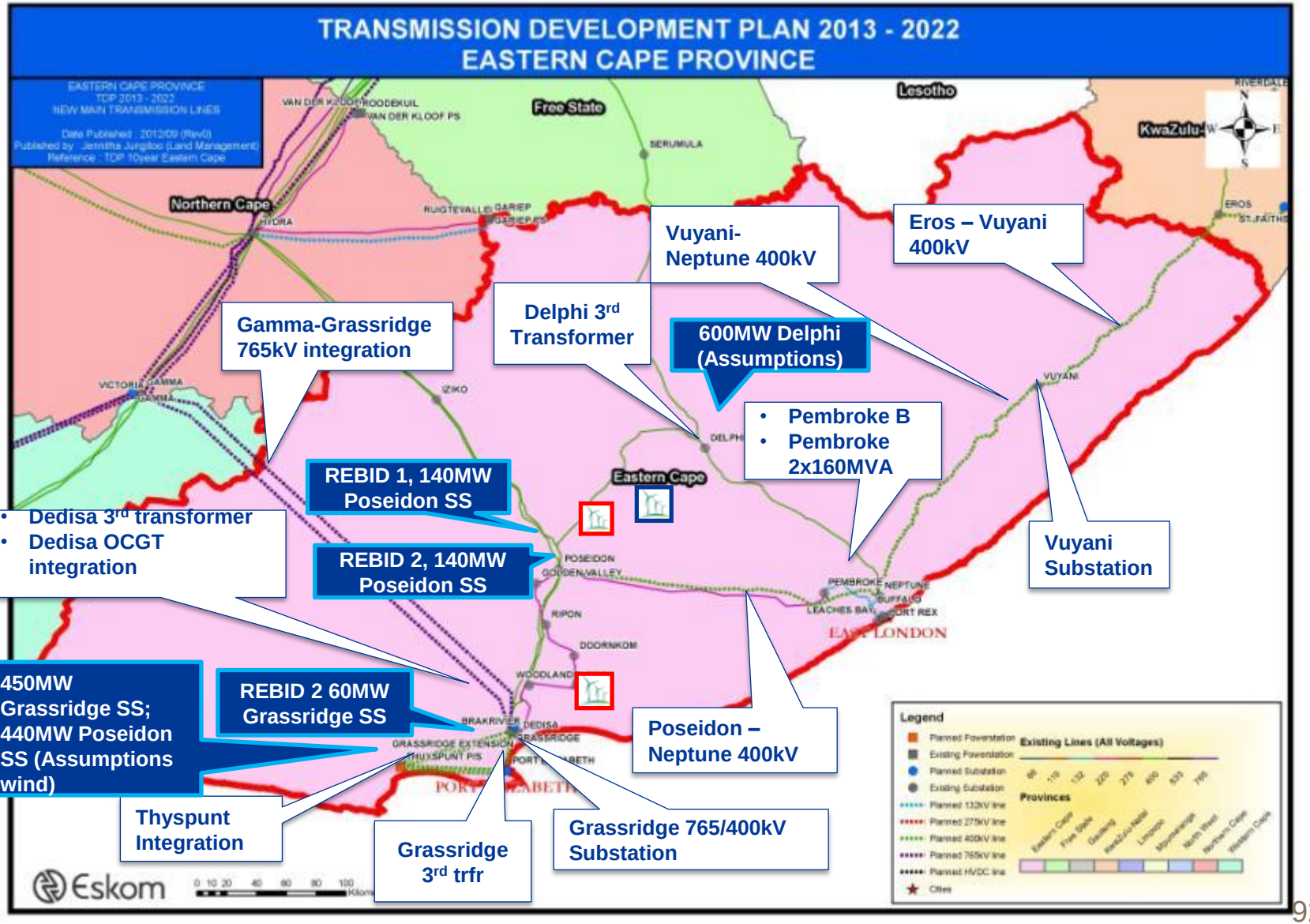
2. **Meet the anticipated load demand:**

- Load in both CLNs anticipated to increase particularly around the Coega IDZ

3. **Integrate renewable energy:**

- Significant Renewable Energy interest in response to Government Renewable programme (mainly wind)

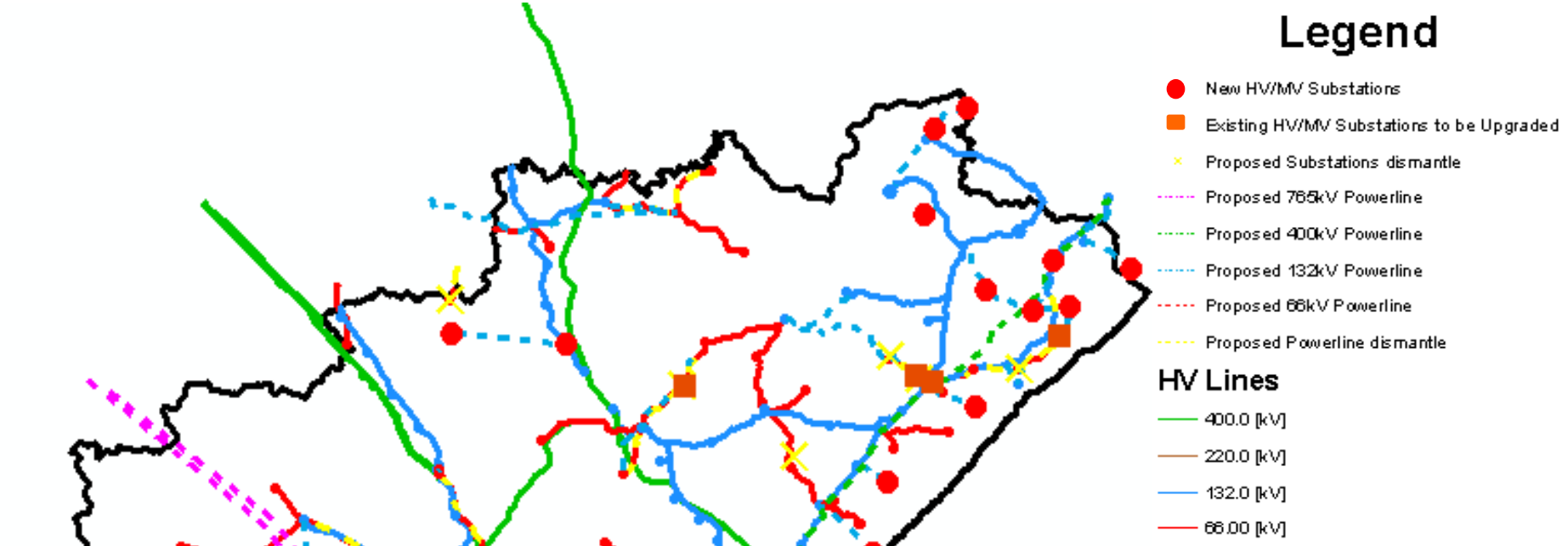
Eastern Cape Province: Development Plan



Eastern Cape Province Major Infrastructure Additions

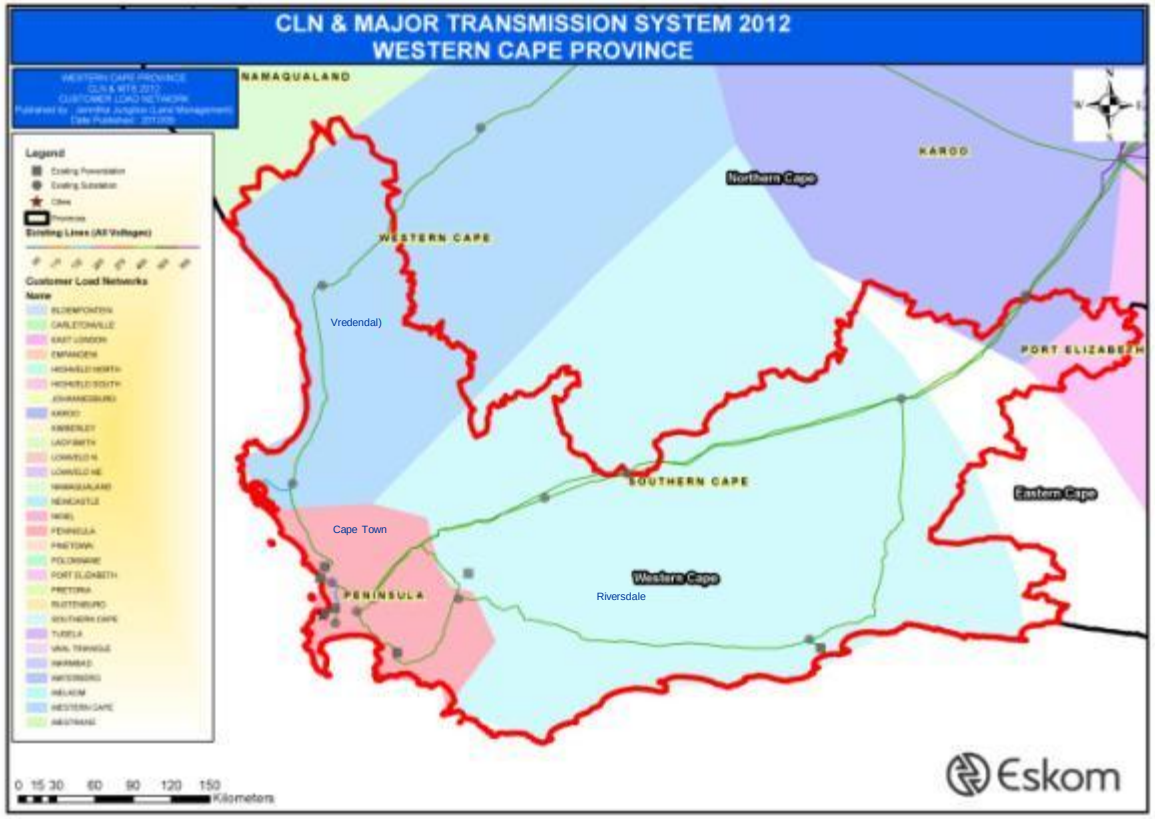
Transmission Assets for Eastern Cape Province	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	886	541	1,427
765kV Lines (km)	350	350	700
400kV Lines (km)	536	191	727
275kV Lines (km)	0	0	0
Total planned Transformer MVA	6,080	2,215	8,295
Transformers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

Eastern Cape Province Distribution Plan



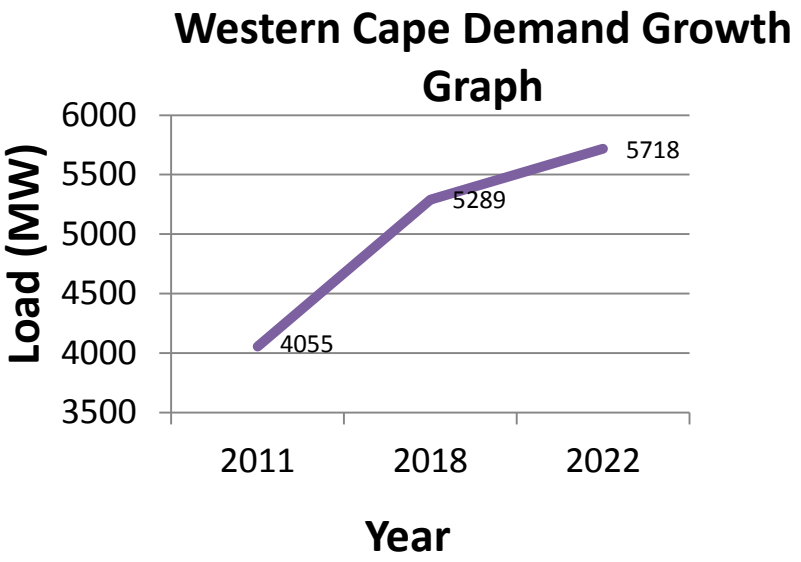
Commissioning Year	HV Lines (km)	MV Lines (km)	Transformer Capacity (MVA)
2013/14	332	270	330
2014/15	446	340	585
2015/16	530	150	240
2016/17	207	125	100
2017/18	189	110	100
2018/19	68	100	80
TOTAL	**1772**	**1095**	**1435**

Western Cape Province Profile

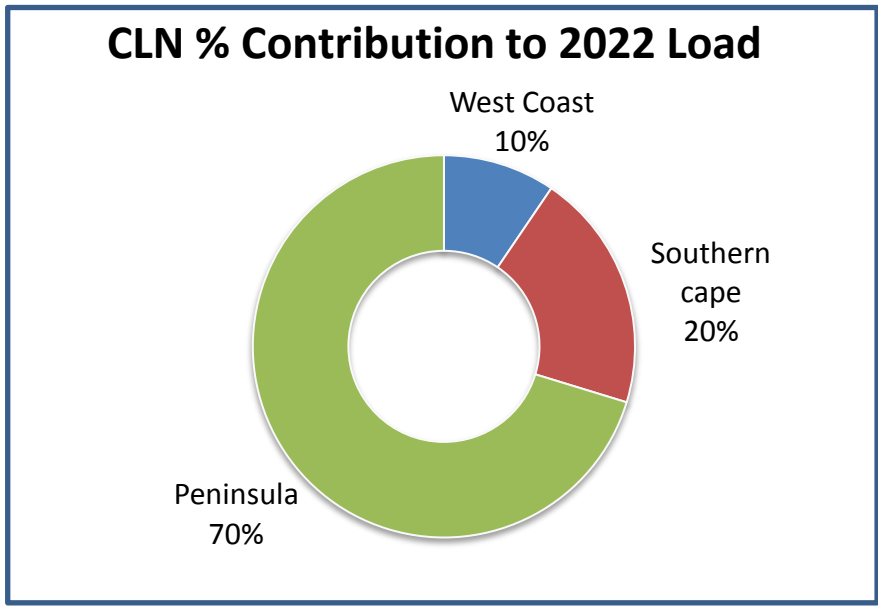


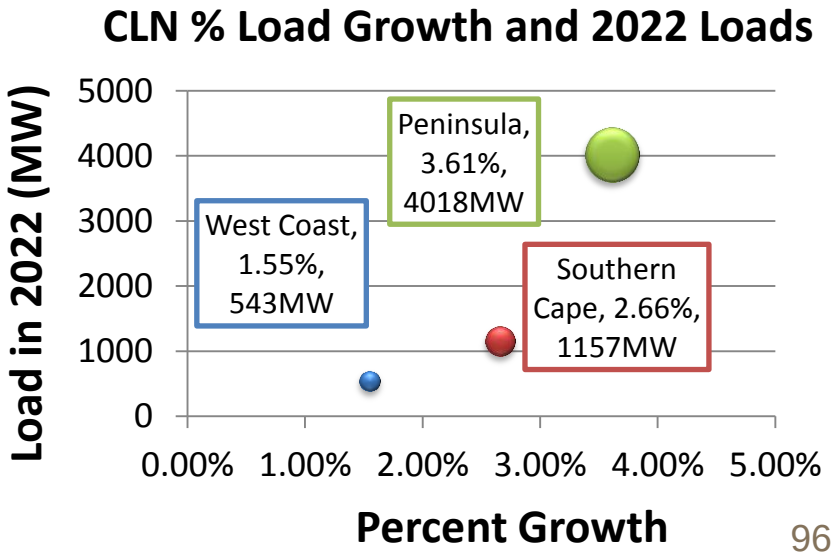
- **Generation**
- 1 nuclear, 3 gas power stations, 1 pumped storage
- 4 471 MW generation capacity
- 11% of total Eskom generation capacity
- **Transmission**
- 4205MW (Regional peak)
- Number of MTS = 13
- Number of CLNs = 3
- **Distribution**
- Customers connected =324 000
- Substations =269
- Geographical area: George, Bellville, Koeberg
- **General**
- Economic mix: Commercial (67%) Mining (15%), Agriculture (18%)

Western Cape Province Expansion Drivers

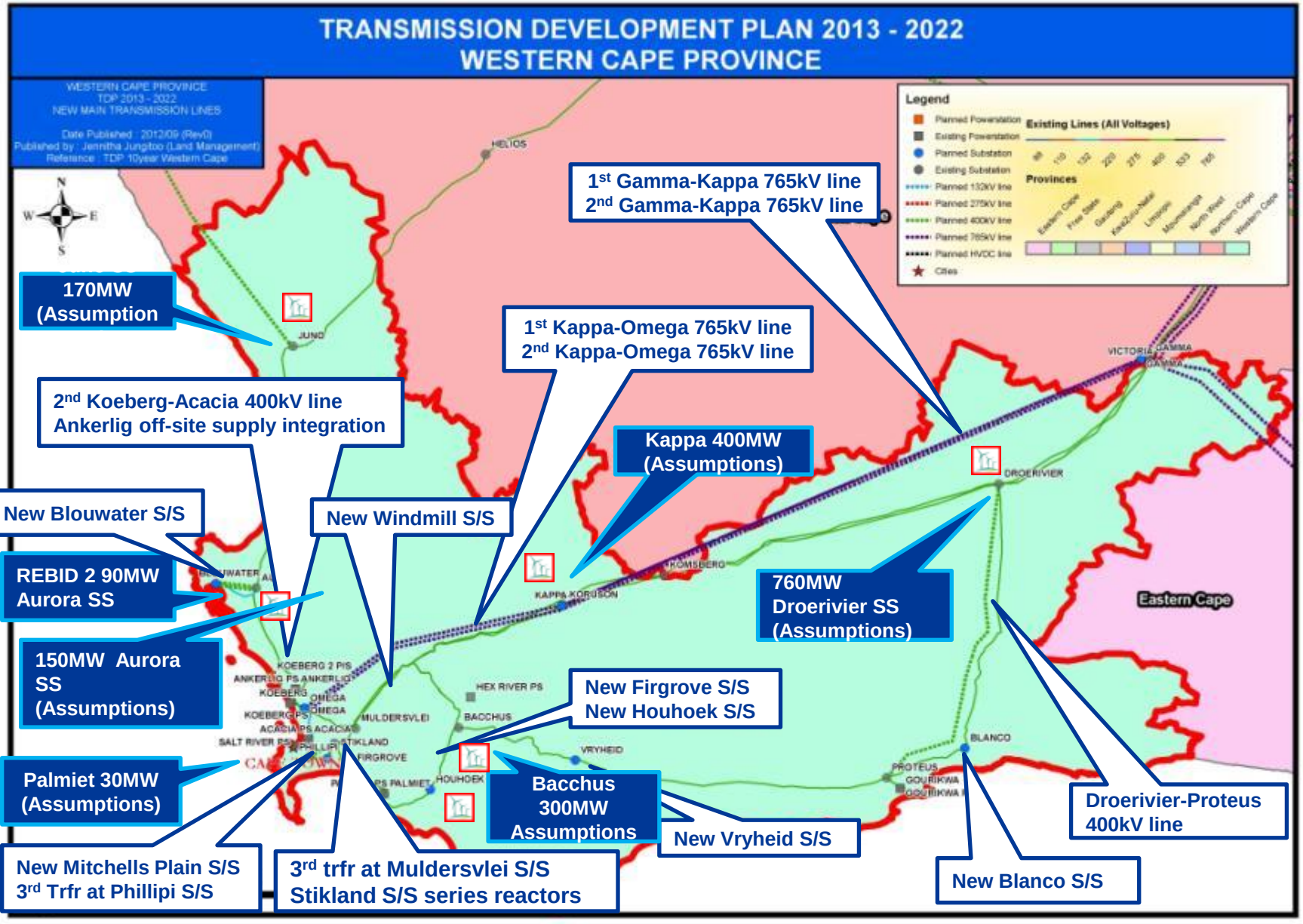


	Percent Growth	2013	2018	2022
West Coast (Vredendal)	1.55%	474.3	519	543
Southern Cape (Riversdale)	2.66%	945	1052	1157
Peninsula (Cape Town)	3.61%	3218.1	3717	4018





Western Province: Development Plan

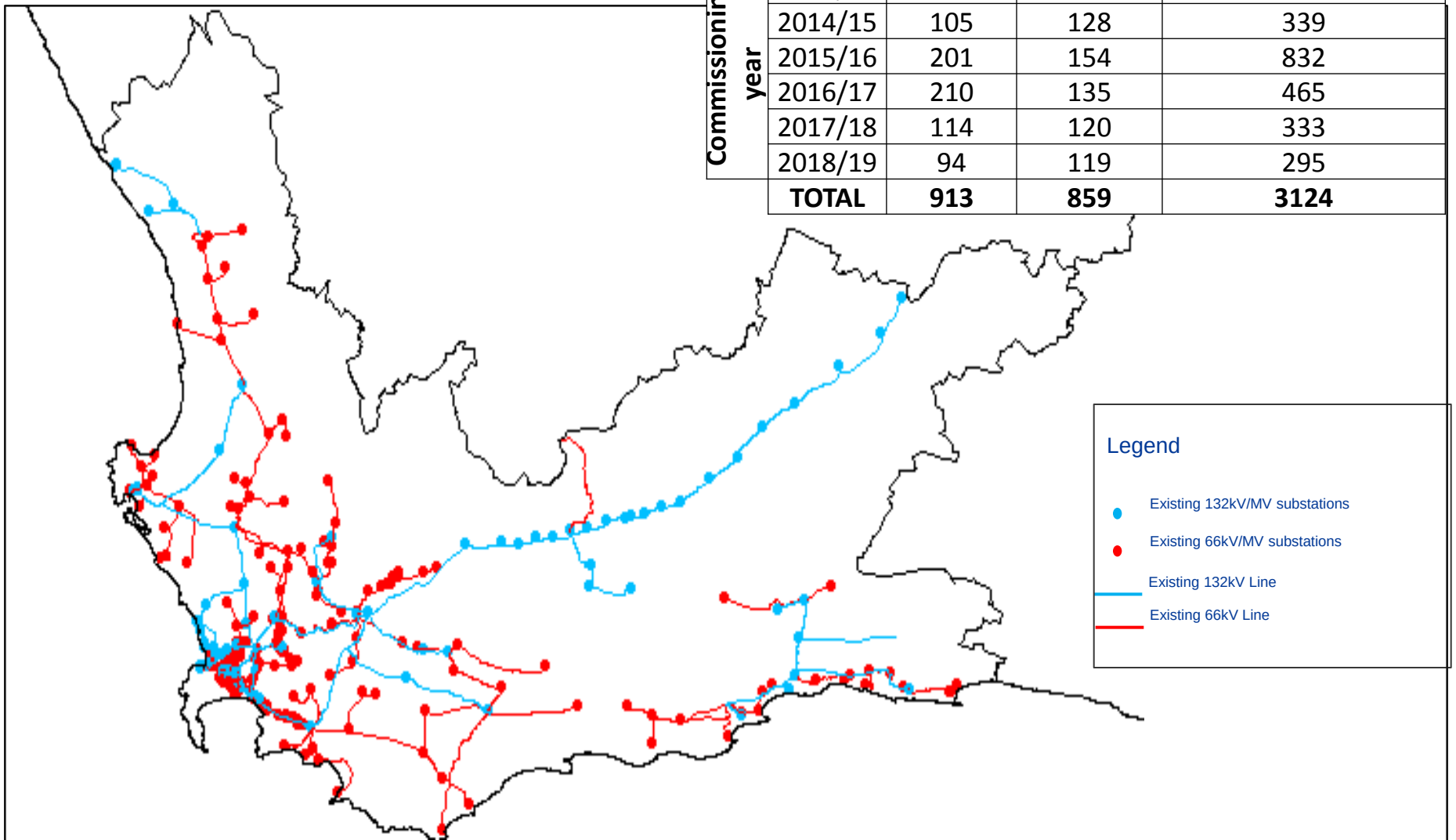


Western Cape Province Major Infrastructure Additions

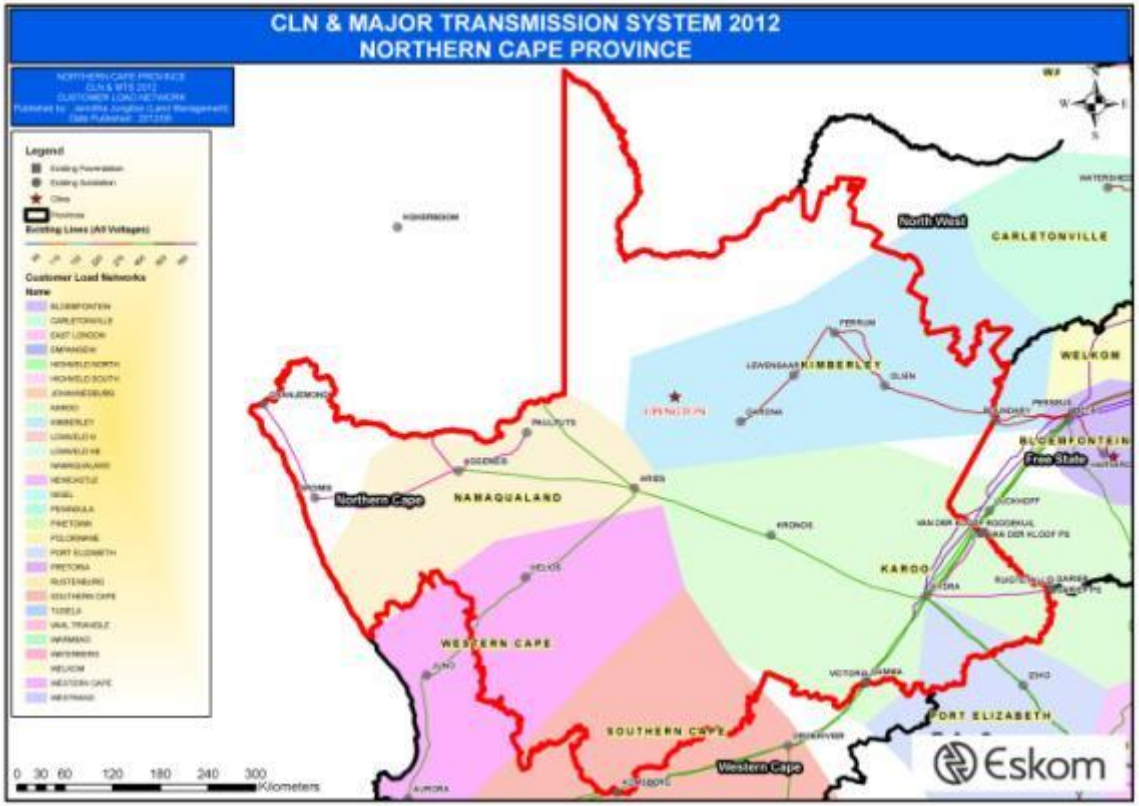
Transmission Assets for Western Cape Province	New Assets expected in 2013-2017	New Assets expected in 2018-2022	Total New Assets expected
Total kms of line	590	943	1,533
765kV Lines (km)	560	560	1,120
400kV Lines (km)	30	383	413
275kV Lines (km)	0	0	0
Total planned Transformer MVA	9,660	7,000	16,660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

Western Cape Province Distribution Plan (Summary)

Commissioning year		HV Lines (km)	MV Lines (km)	Transformer Capacity (MVA)
	2013/14	189	203	860
	2014/15	105	128	339
	2015/16	201	154	832
	2016/17	210	135	465
	2017/18	114	120	333
	2018/19	94	119	295
	TOTAL	**913**	**859**	**3124**

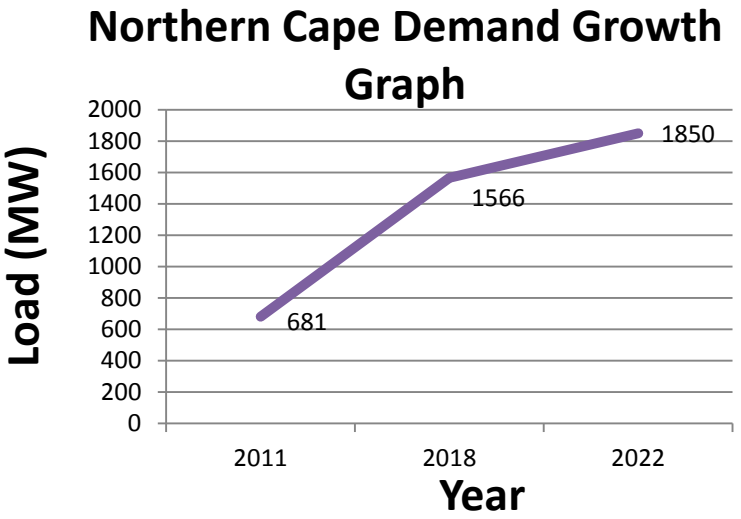


Northern Cape Province Profile

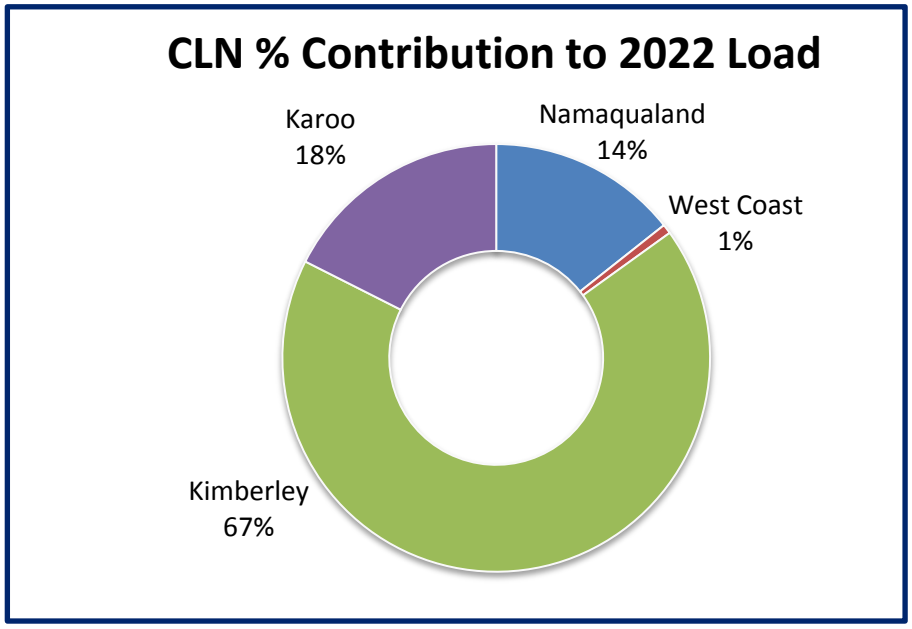


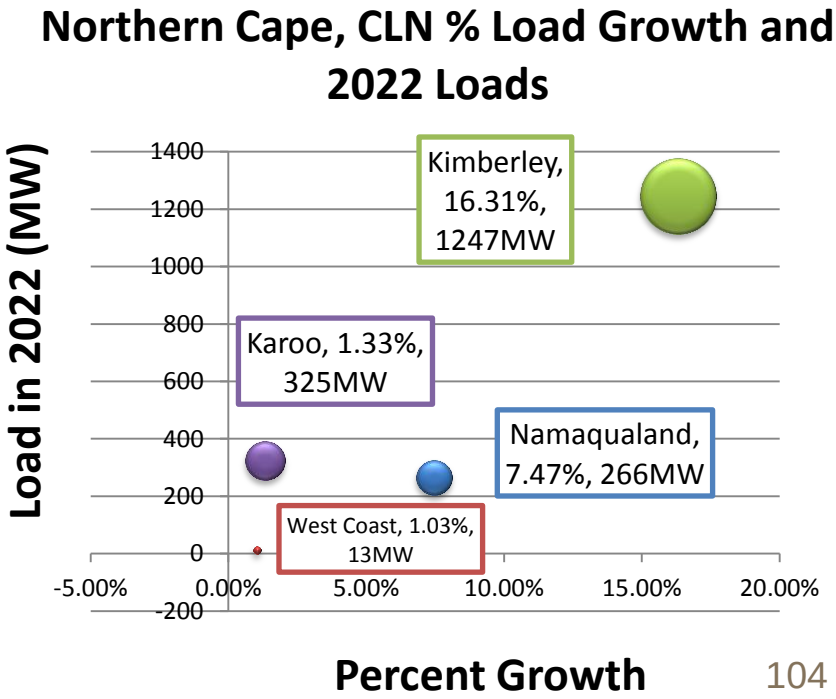
- **Generation**
- Vanderkloof Power Station is located at the Vanderkloof Dam wall.
- It has a generating capacity of 240 MW (2 x 120 MW) into the Eskom Grid.
- **Transmission**
- 681MW (Regional peak)
- Number of MTS = 16
- Number of CLNs = 5
- **Distribution**
- Customers connected = 67 601
- Substations =191
- Geographical area: Kimberley, Upington and Namaqualand, 15 Customer Network Centres from Springbok, Calvinia, De Aar to Jan Kemdorp.
- **General**
- Economic mix: Commercial (21%), Mining (52%), Agriculture (27%)

Northern Cape Province Expansion Drivers

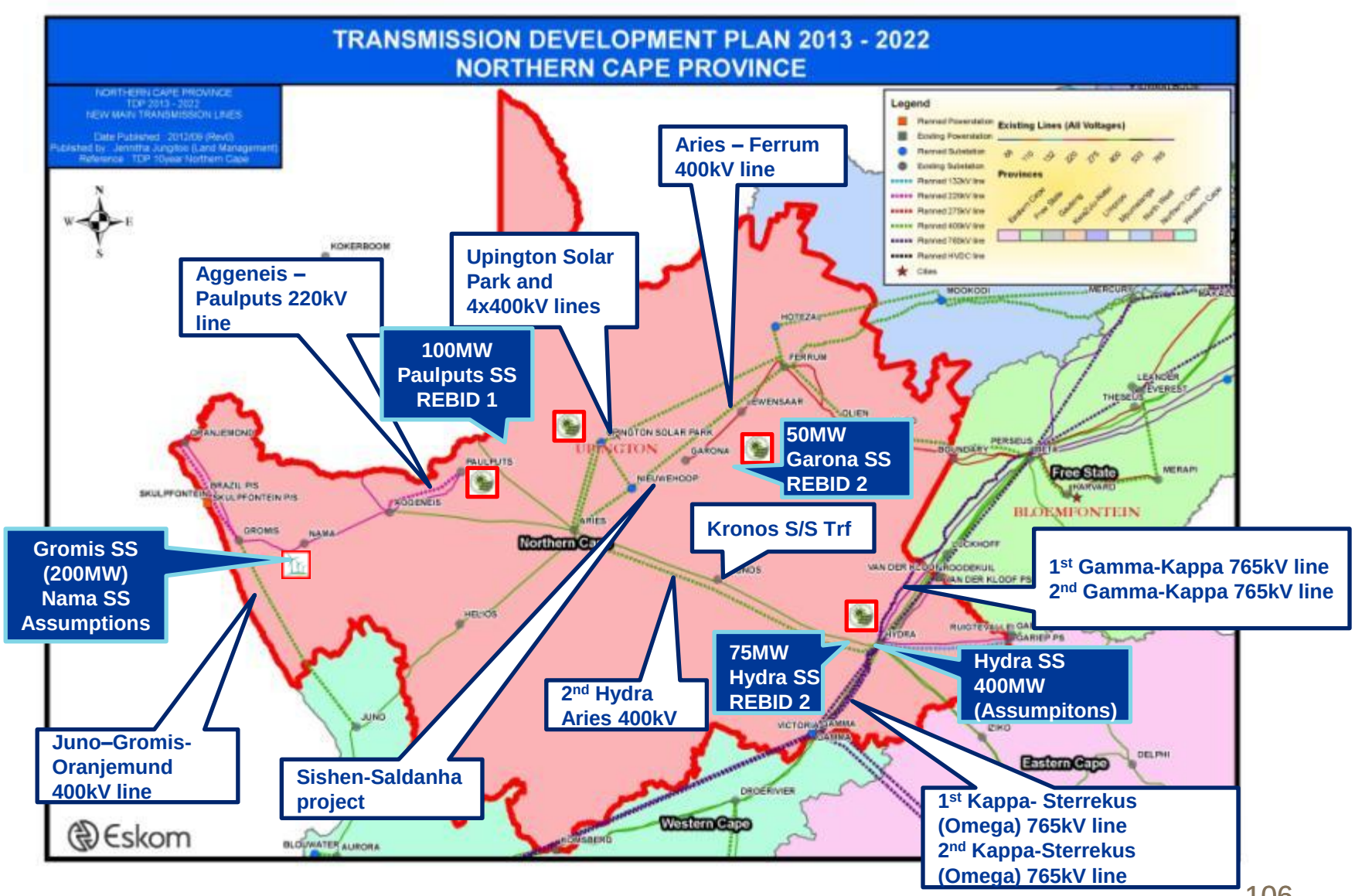


	Percent Growth	2013 (MW)	2018 (MW)	2022 (MW)
Namaqualand	7.47%	136.3	263	266
West Coast	1.03%	12.1	13	13
Kimberley	16.31%	406.8	981	1247
Karoo	1.33%	297.9	309	325





Northern Cape Province: Development Plan



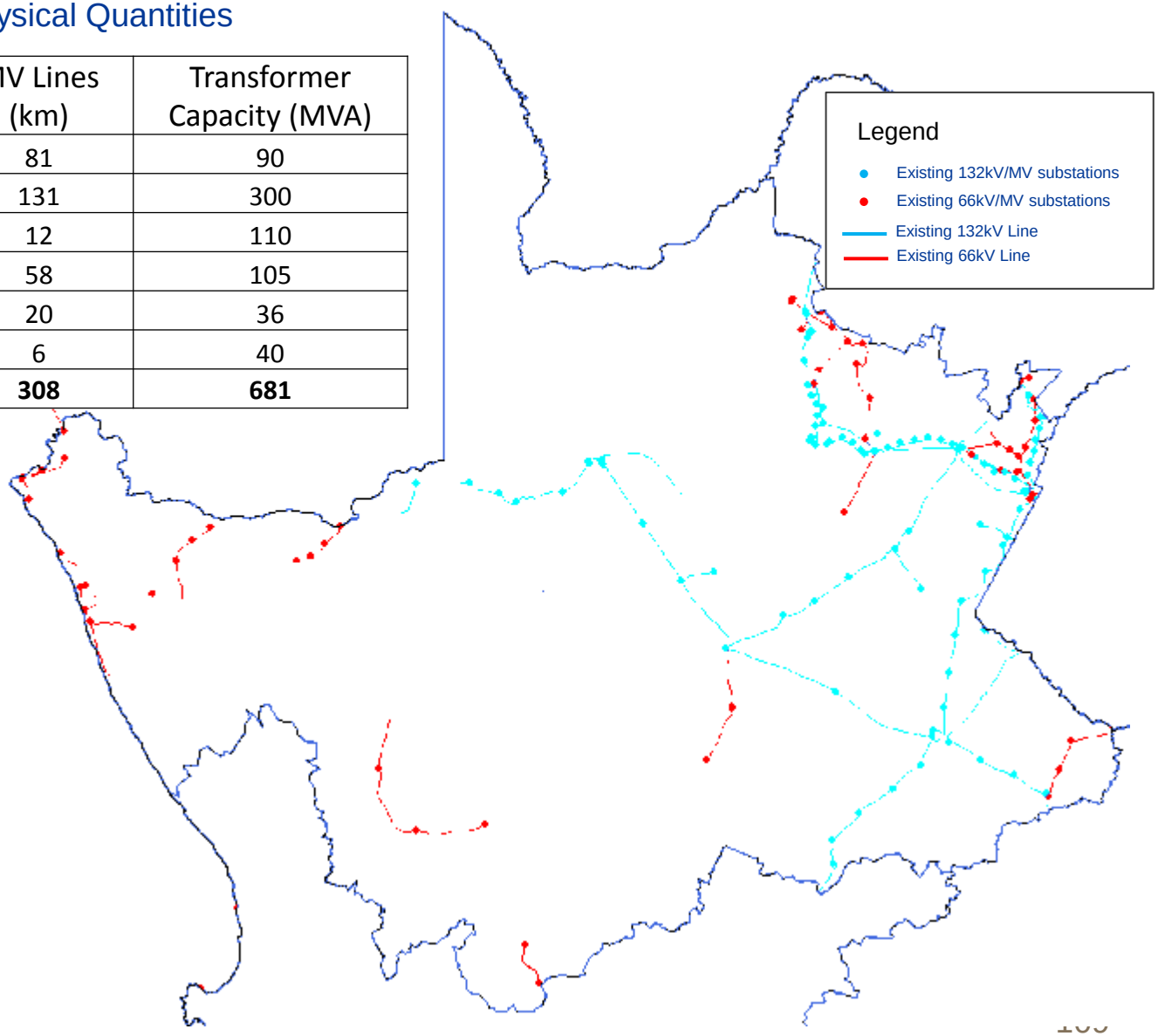
Northern Cape Province Major Infrastructure Additions

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 planned 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

Northern Cape Province Distribution Plan (Summary)

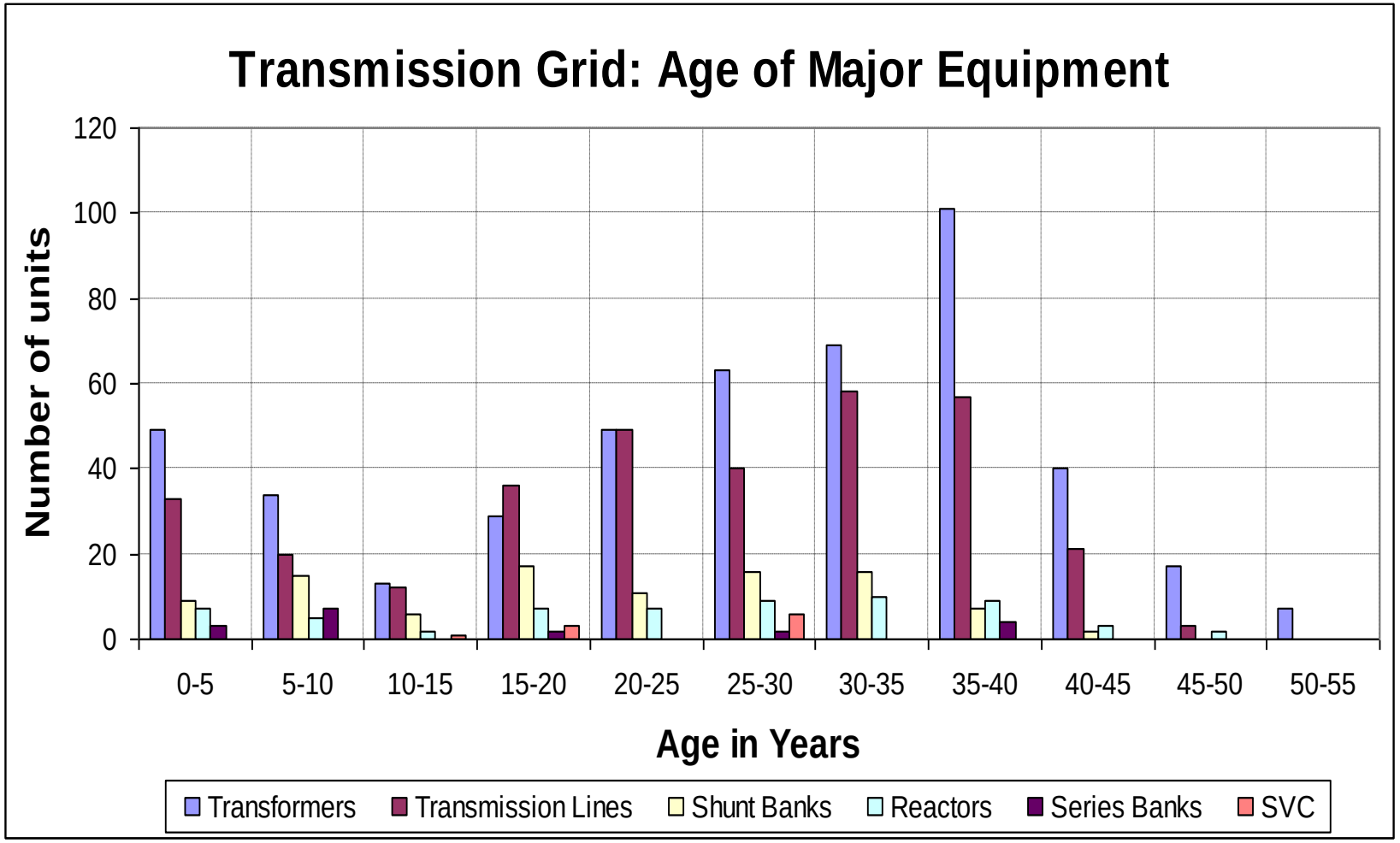
Summary of Physical Quantities

		HV Lines (km)	MV Lines (km)	Transformer Capacity (MVA)
Commissioning year	2013/14	14	81	90
	2014/15	126	131	300
	2015/16	159	12	110
	2016/17	159	58	105
	2017/18	114	20	36
	2018/19	0	6	40
	TOTAL	**572**	**308**	**681**



Refurbishment and Strategic Spares Principles and Plan

Equipment Age Profile



Refurbishment - General Principles

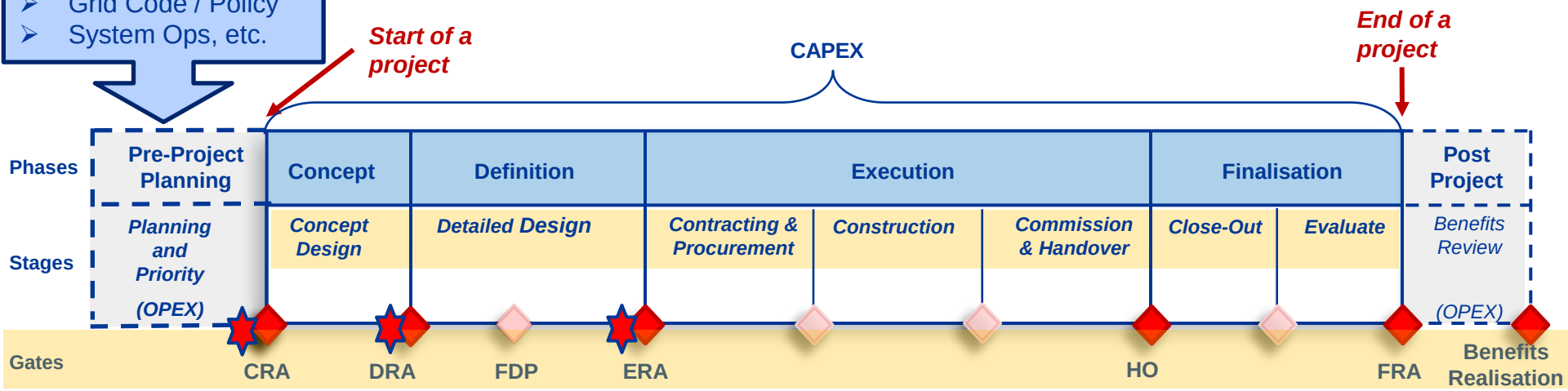
- Eskom project life cycle model to be followed.
- Investment justifications to be based on following criteria:
  - Statutory
  - Strategic
  - Least Economic Cost
  - Operating Cost Reduction
- Assets to be refurbished in accordance with asset life-cycle management plans (LCMPs).
- Condition, criticality & risk assessment (CCRA) principles to be used for refurbishment investment decisions. (Likelihood of asset loss vs. criticality of the asset to the network)

Complying to the Wires Business PLCM

Inputs from
- Grids
- Performance
- Engineering
- Grid Code / Policy
- System Ops, etc.

Wires Standard Projects Process

Project Definition Readiness Assessments (PDRA)



Planning or Originator's Report (per project)	Approved SURS	Acquired servitudes	Constructed /Refurbished Asset	Contracts closed out
User Requirements	Approved Asset Specification	EMP Submission	Asset in CO	Project Closed out
Refurb Plan	SLD	Detailed Eng Design	As built drawings	Review meetings held
Expansion Plan	Station Layout	Project Execution Plan		
Plans Costed & Prioritised	Conductor & Tower selection			

Key Deliverables per Phase

Reasons for refurbishments

- The bulk of the Transmission network (>100 substations) were constructed between the years 1960 and 1980. This means that from now onwards Transmission will need to cope with substation plant, equipment and infrastructure that has been in service for 40 years and longer.
- Equipment, like the substation batteries and electronic components of protection and control systems, corroded conductors etc. are not repairable and replacement is the only option and is essential to sustain the Tx network.
- “Aged” equipment like CTs, VTs, Surge Arresters, H.V. Circuit Breakers and Power Transformers apart from the risk of supply interruptions also can fail violently and poses a safety risk to staff. These need to be removed from the system, if identified as a risk, and can not always be run to failure.
- Grid Code and the Transmission Licence require certain performance and quality standards, where plant and equipment do not meet these requirements, replacement or upgrading is required.
- Deferring investments in replacing “aged” equipment will:
  - increase maintenance requirements
  - Increase emergency repairs
  - Overall result is higher operating expenditure and unplanned maintenance costs

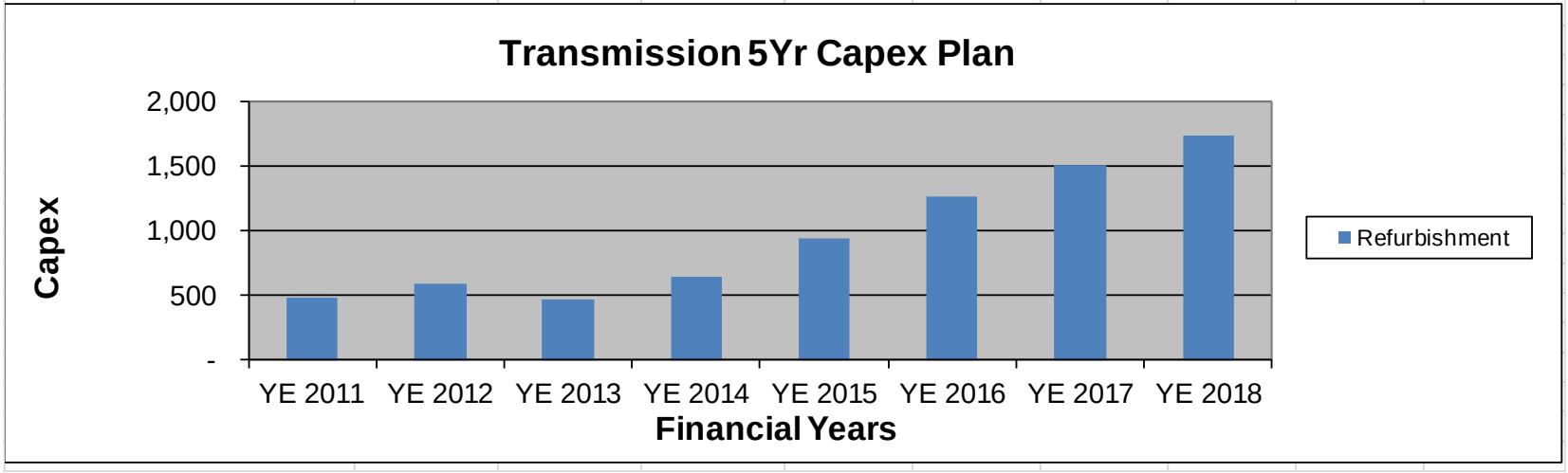
Refurbishments - Prioritisation

- Combine refurbishments with expansion
- Corridor refurbishments
- Substation refurbishments
- Bay refurbishments (e.g. transformers)
- Component refurbishments - i.e. component refurbishments are only remaining after packaging into above priorities

Refurbishment 5 Year Plan

R' millions

Categories	YE 2011	YE 2012	YE 2013	YE 2014	YE 2015	YE 2016	YE 2017	YE 2018	5Yr Total
Refurbishment	489	589	477	652	948	1,265	1,510	1,745	6,120



- The plan from and including YE 2015 is based on the expected refurbishment requirements due to the aging network
- The bulk of the transmission network will be older than 40 years within the next 10 years.
- The details of the future refurbishment projects will be identified through a structured "asset condition assessment" program.

Top Refurbishment Projects for FY14-18

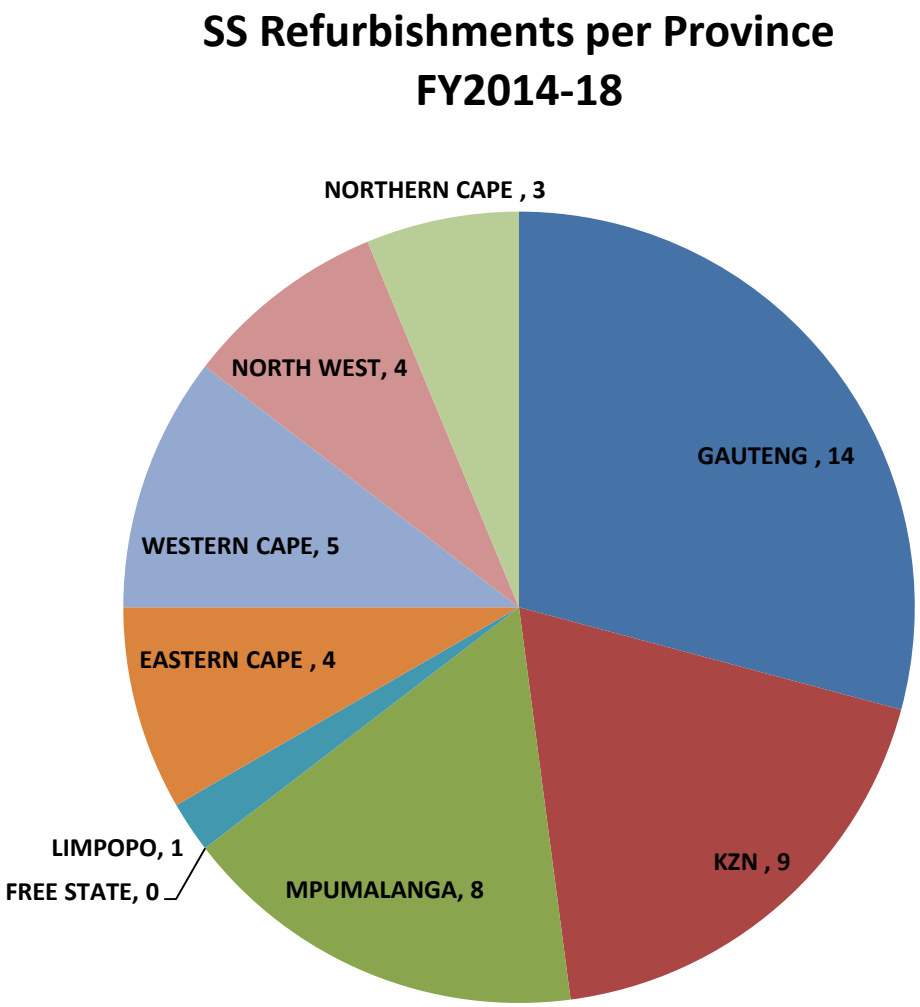
No	Supply Plan Name	Current Stage	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	TOTAL F Y14-18
1	Phased Replacement of High Risk TRFRS	ERA	104	101	280	111	-	-	**491**
2	Acacia SS : Refurbishment	DRA	-	1	25	42	48	48	**165**
3	ERTU REFURBISHMENT (Combined FY2010_11-FY2019/20)	ERA	7	12	37	31	39	40	**158**
4	Georgedale Refurb Phase 2	DRA	1	5	23	34	39	40	**141**
5	Gromis Oranjemond No1 220kV Line Re-conductor & replace Earthwire (ERA)	ERA	11	61	50	-	-	-	**111**
6	Alpha Beta 1&2 Beta Hydra 2 Foundation Ref	Pre CRA	3	15	24	20	28	28	**116**
7	Glockner SS Refurbishment	DRA	-	2	25	21	36	31	**115**
8	Apollo (AC) SS Refurbishment	Pre CRA	-	-	9	28	38	38	**113**
9	ABB Refurbishment Reactors	ERA	25	28	33	26	-	-	**87**
10	Scafell Refurbishment (Phase 2)	CRA	-	12	19	19	28	30	**108**
11	Muldersvlei SS Refurbishment Phase 2	DRA	0	4	11	36	44	9	**105**
12	VULCAN SS : REFURBISHMENT	Pre CRA	-	2	3	28	30	32	**95**
13	Westgate SS Refurbishment	Pre CRA	-	-	2	12	31	42	**87**
14	Apollo CS: HVDC Refurbishment Phs 2 (ERA)	CRA	-	-	5	5	38	38	**85**
15	Eiger SS Refurbishment	Pre CRA	-	0	2	14	28	38	**82**
16	Drakensberg Refurb GIS & supports	DRA	-	3	16	28	28	-	**76**
17	Apollo CS : Upgrade the Apollo DC Harmonic Filters	Pre CRA	-	0	4	7	24	40	**74**
18	Replacement of under creepage equipment in heavy pollution substations (Western Grid)	Pre CRA	-	3	9	19	19	18	**67**
19	North Grid: Anti Climb devices on Various Lines	DRA	0	3	11	14	19	19	**66**
20	Nevis SS Refurbishment	Pre CRA	-	-	1	9	21	34	**65**
	Sub Total		**150**	**251**	**589**	**503**	**537**	**525**	**2,405**

SS Refurbishments per Province FY14-18

GAUTENG PROVINCE	Benburg SS Refurbishment	1
	Brenner SS Refurbishment	1
	Eiger SS Refurbishment	1
	Esselen SS Refurbishment	1
	Fordsburg SS Refurbishment	1
	Glockner SS Refurbishment	1
	Jupiter SS Refurbishment	1
	Kookfontein SS Refurbishment	1
	Nevis SS Refurbishment	1
	Princess SS Refurbishment	1
	Prospect SS Refurbishment	1
	Scafell Refurbishment (Phase 2)	1
	Westgate SS Refurbishment	1
	Apollo (AC) SS Refurbishment	1
Gauteng Total		**14**
KZN PROVINCE	Bloedrivier SS Refurbishment (73)	1
	Chivelston SS Refurbishment	1
	Danskraal SS Refurbishment (110)	1
	Drakensberg Refurb GIS & supports	1
	Georgedale Refurb Phase 2	1
	Hector SS Refurbish Kiosks	1
	Impala SS Refurbishment	1
	Incandu SS Refurbishment	1
	Ingagane SS Refurbishment - Phase 2	1
KZN Total		**9**
MPUMALANGA	Komatipoort SS Refurb	1
PROVINCE	Kruispunt SS Refurb	1
	Malelane 132kV SS Refurb	1
	Marathon SS Refurbishment	1
	Merensky SS Refurbishment	1
	Prairie SS Refurbishment	1
	Rockdale SS Refurbishment	1
	VULCAN SS : REFURBISHMENT	1
Mpumalanga Total		**8**

FREE STATE PROVINCE		
FREE STATE Total		
LIMPOPO PROVINCE	Spitskop SS Refurbishment	1
Limpopo Total		**1**
EASTERN CAPE PROVINCE	Buffalo SS Refurbishment	1
	Grassridge 132kV Refurbishment	1
	Grassridge SS Refurbishment	1
	Pembroke SS Refurbishment	1
Eastern Cape Total		**4**
WESTERN CAPE PROVINCE	Acacia SS : Refurbishment	1
	Aurora SS Refurbishment	1
	Bacchus SS Refurbishment	1
	Muldersvlei SS Refurbishment - HV Plant	1
	Muldersvlei SS Refurbishment Phase 2	1
Western Cape Total		**5**
NORTH WEST PROVINCE	Hermes SS Refurbishment	1
	Watershed SS Refurbishment	1
	Ararat SS Refurbishment	1
	Trident SS Refurbishment	1
North West Total		**4**
NORTHERN CAPE PROVINCE	Boundary SS Refurbishment	1
	Ferrum SS Refurbishment	1
	Helios SS Refurbishment	1
Northern Cape Total		**3**
Grand Total		**48**

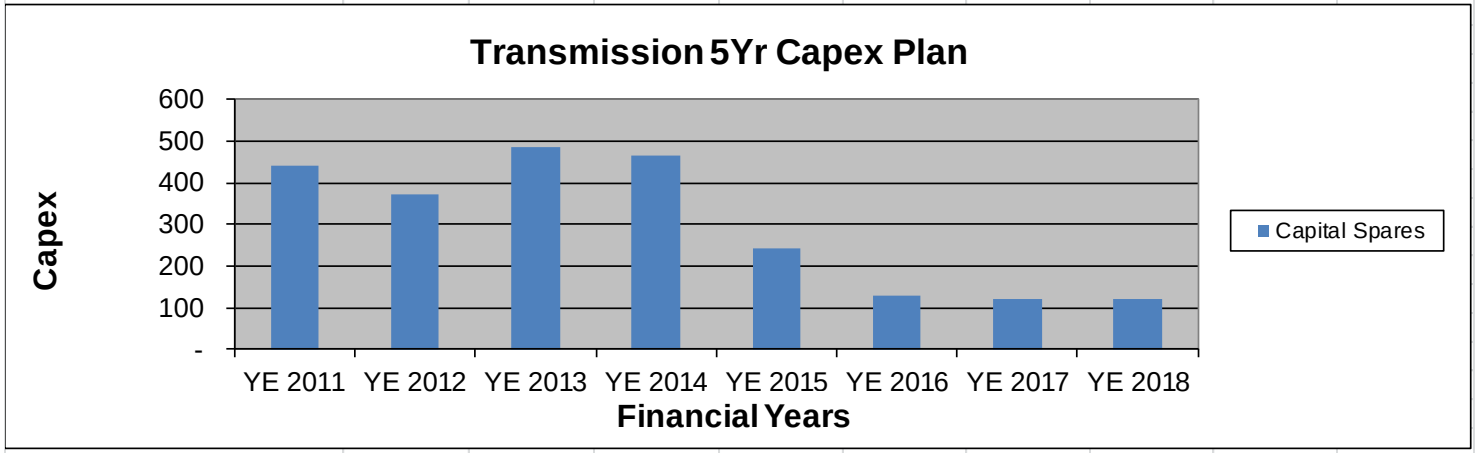
SS Refurbishments per Province



Drivers for capital spares

R' millions

Categories	YE 2011	YE 2012	YE 2013	YE 2014	YE 2015	YE 2016	YE 2017	YE 2018	5Yr Total
Capital Spares	441	374	484	466	244	129	119	119	1,078



- From 2013 we will be fulfilling the spares policy in accordance with the increase in the installed transformer base.
- From 2015 onwards, majority of provisions are for stores replenishments.
- High risk transformer replacement project will assist in reducing replenishment numbers.
- From 2017 onwards, all stations to be firm (n-1), reducing risk & dependence on capital spares.

Transmission Capital Expenditure Plans

2013 - 2022

The Drivers for Capex

- Asset Management Philosophy
  - Life Cycle management of assets
    - Ageing infrastructure
    - Strategic Spares to ensure minimum requirements are met
    - Our historical underinvestment as related to benchmarked refurbishment levels
  - Specialised equipment to enable optimised outage management i.e. live line equipment
  - Physical Site Security and Monitoring
- Ensuring the adequacy and security of the existing network installation
  - To ensure existing customer base continues to have a secure supply and enable continued growth in these areas

The Drivers for Capex (Expansion)

- Strategic Servitude Acquisitions
- Funding requirements for new customer connections
- Network Strengthening
  - Minimum Grid Code Requirements set
  - Ensure reliability and security of supply
- New Generation Connections
  - To ensure the evacuation and transportation of power to the load centres
  - To facilitate construction supplies for the new power stations and for auxiliary supplies

10 Year Transmission Capex Summary Excluding IDC

Categories	FY13-22 (Rm)
Capacity Expansion	149,259
Refurbishment	12,194
Capital spares	2,349
EIA and servitudes	4,696
Strategic	1,749
Production Equipment	4,537
Total	**174,763**

5 Year Distribution Capex Summary Excluding IDC

Categories	FY14-18 (Rm)
Direct Customers	13 130
Refurbishment	11 966
Strengthening	24 826
Reliability Capex	3 091
Asset Purchases	1 988
Eskom Funded	**55 001**
Electrification (DoE Funded)	9 766
Total	**64 767**

TDP Observations - Conclusions

- The most visible difference between this TDP and the previous year's TDP is the increase in the amount of transformation (MVA) by approximately 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 been added in the new planning period.
- There has been re-phasing of the existing projects using more realistic completion dates.
- 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 RE integration that is the same as last year's plan.
- The resultant is an improved and more realistic or achievable spread of the transmission line projects and transformer installations. The result of the slower rate of completion of the transmission lines and new transformers increases the overall risk to the network.
- The conclusion is that the transmission projects in this TDP (all projects) will result in the overall network becoming Grid Code compliant, while catering for increased load growth and integration of new generation.

Thank you