The Eskom Transmission Development Plan 2018 to 2027 (TDP 2017)

Public Forum

19 October 2017

Keynote address and setting-the-scene

Presented by: Thava Govender
Group Executive: Transmission
Acting Group Executive: Risk and Sustainability

Objective

The Objective of the presentation is to:

- Contextualise the planning timelines relating to the demand forecast and generation patterns
- Share assumptions and results from the Transmission Development Plan 2018 – 2027
- Share information and results relating to the integration of RE as per the DOE IPP programmes and address future requirements as per the IRP
- Share information on the estimated Transmission Capital Investment Requirements for period 2018 – 2027
- Solicit comments and inputs from stakeholders on the Transmission plans for improvements

The different 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 2016 - draft).
- 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

Basis of the TDP 2017

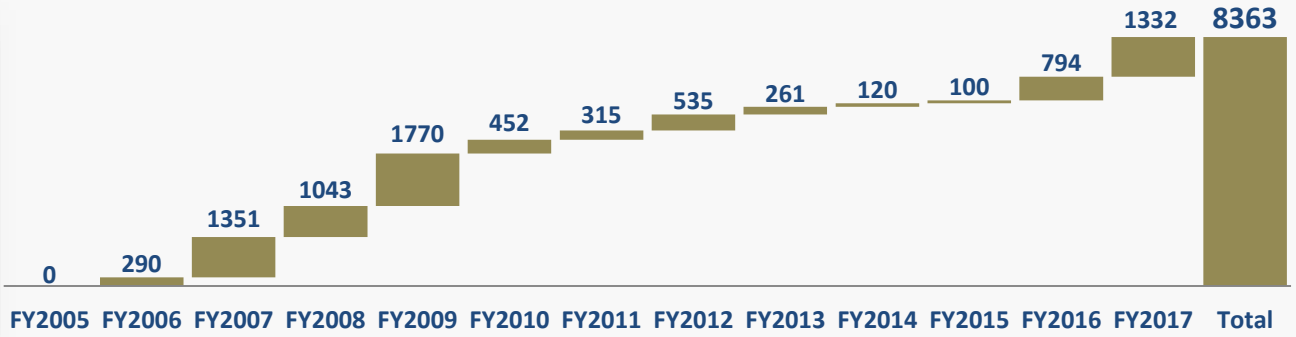
The TDP 2017 was formulated to address the following:

- Attain Grid Code compliance by resolving both substation and line deviations
- Determine new network infrastructure requirements to sustain and allow for future demand growth
- Determine new network infrastructure requirements to integrate new generation (Eskom and IPPs)

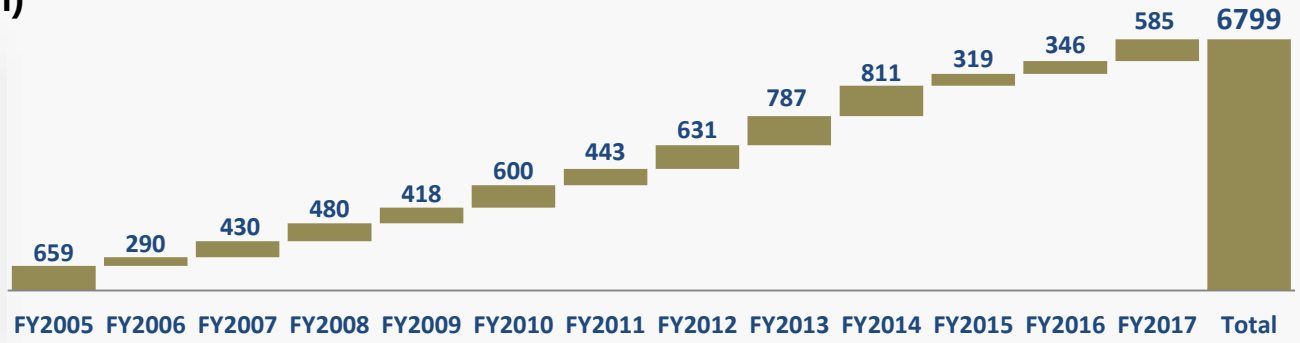
Recent Achievements

To date, a large amount of construction work has been completed, adding ~8.363 MW, ~6.799 km of transmission network, and ~33.59 GVA sub-stations…

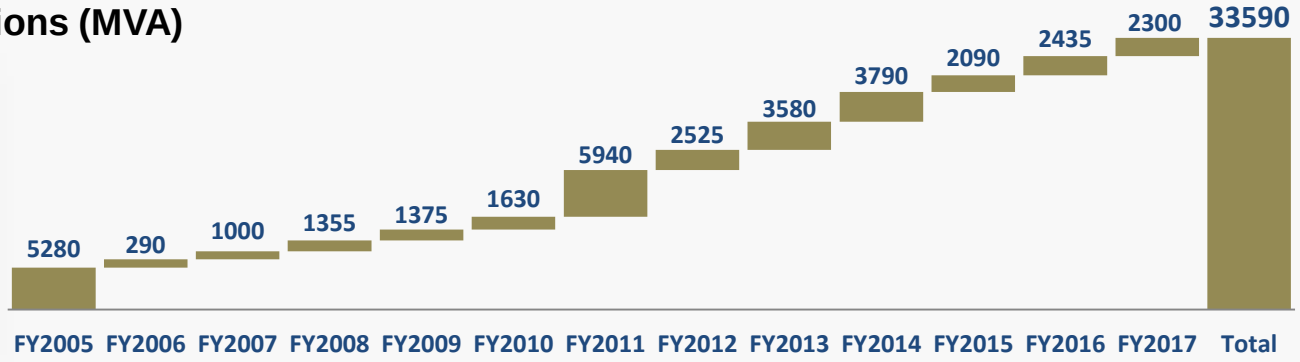
Generation (MW)



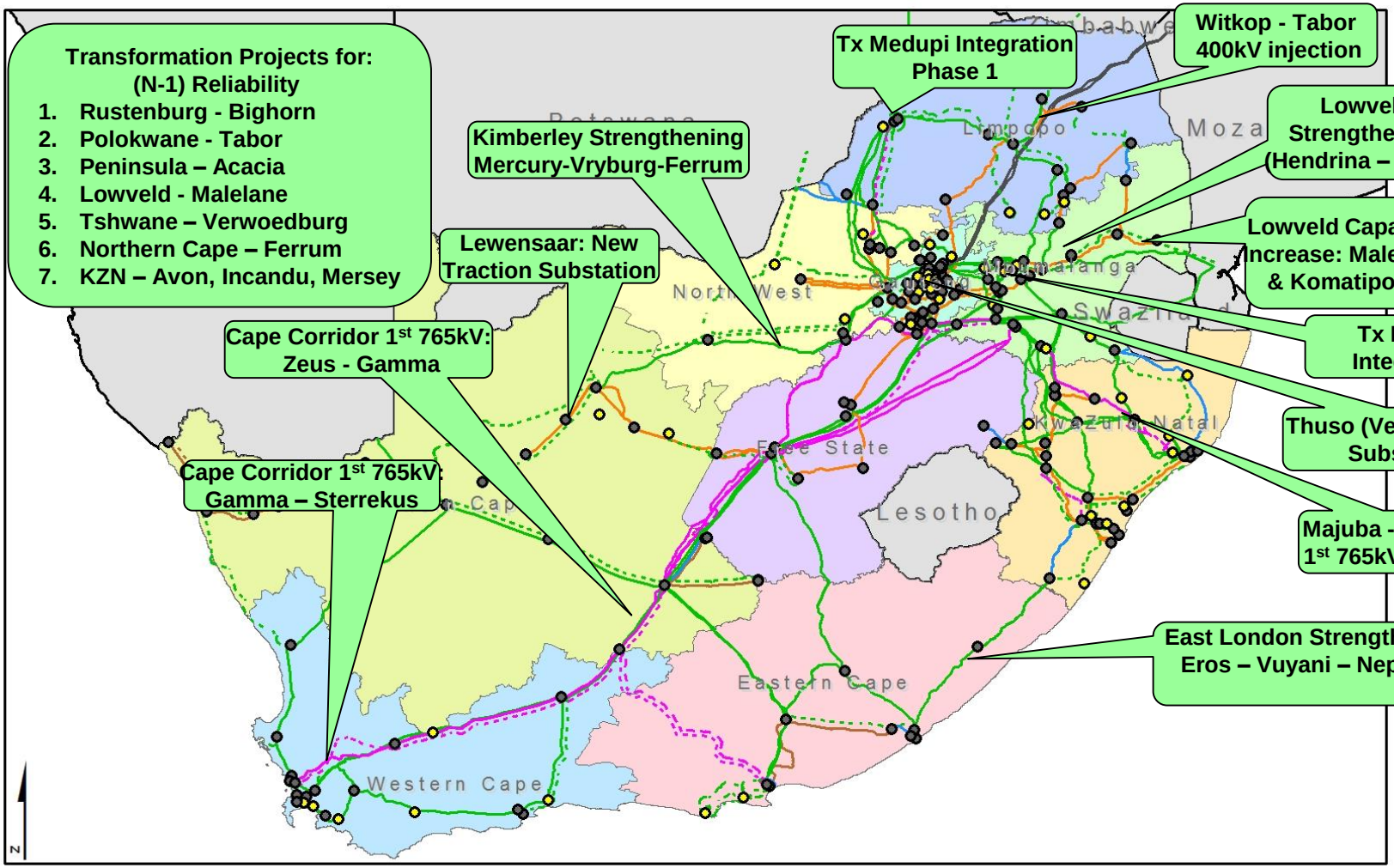
Transmission lines (km)



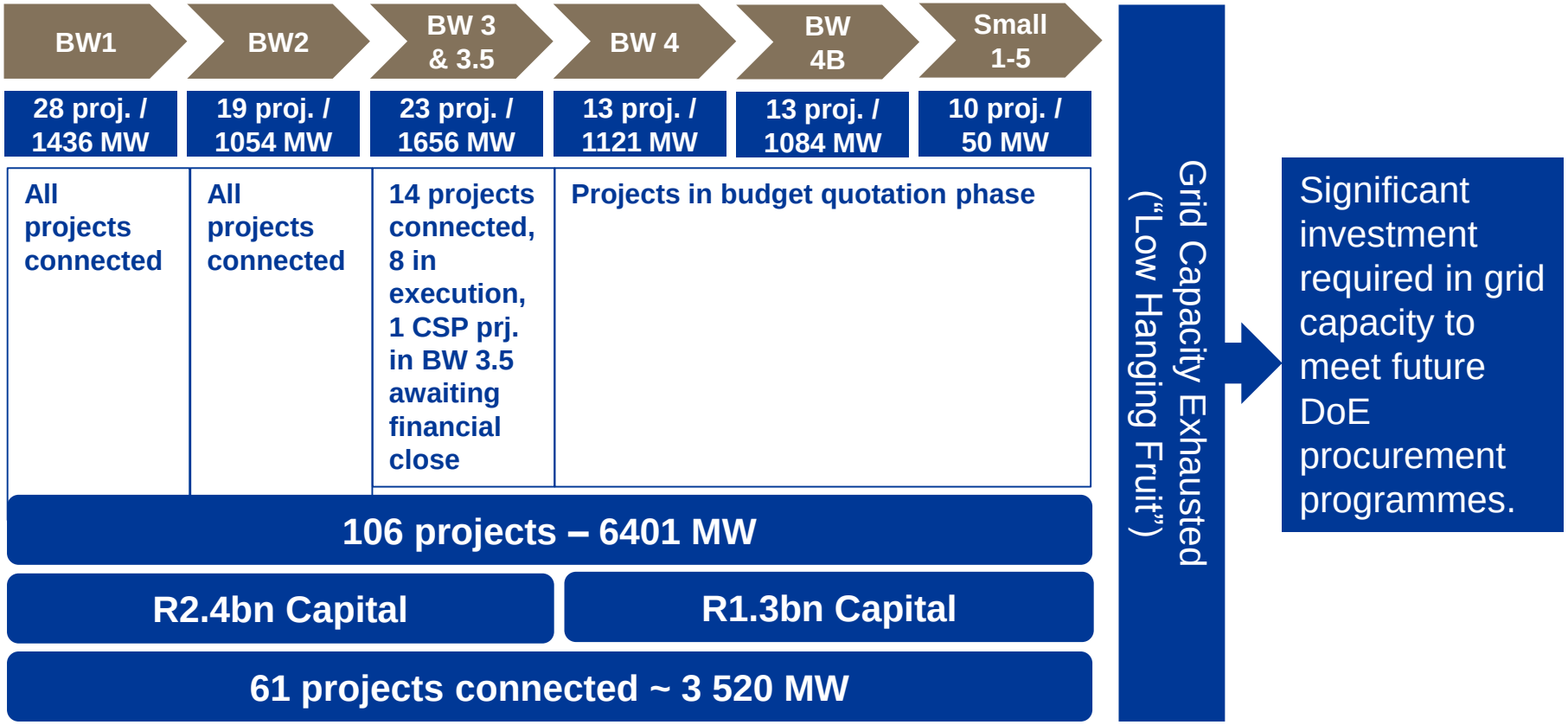
Transmission Substations (MVA)



Major Transmission Projects commissioned in the last 5 years



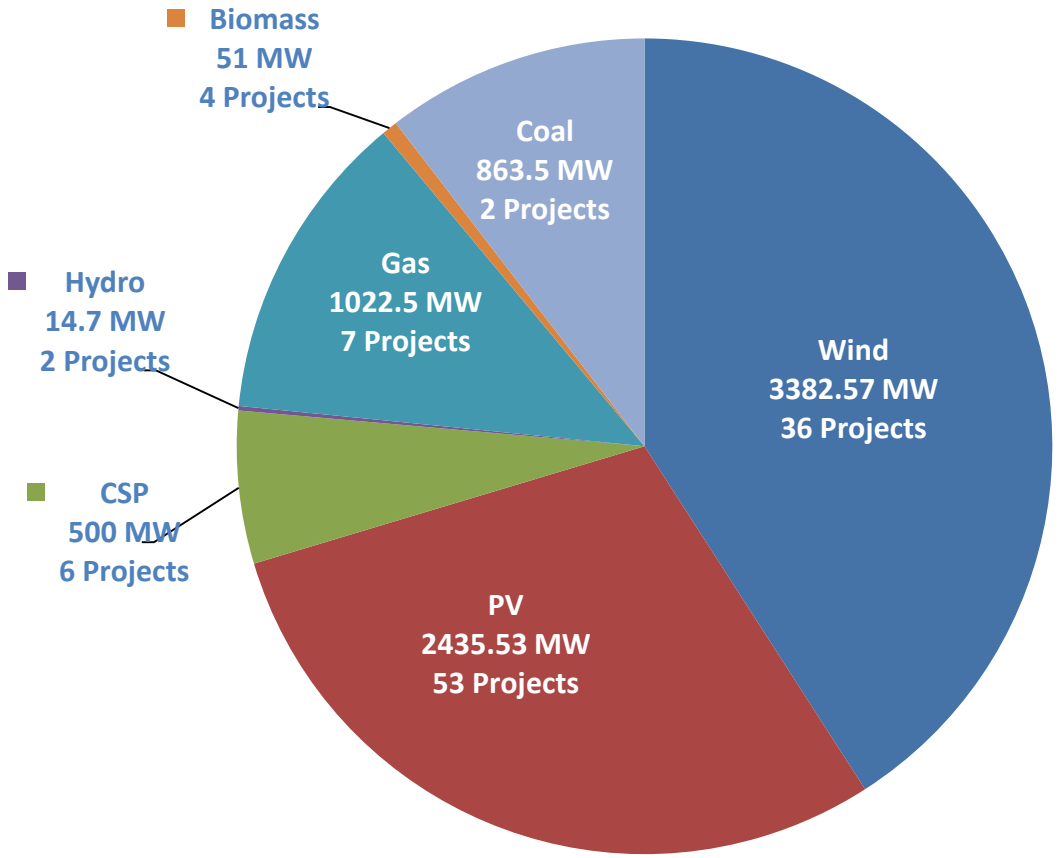
REIPP Programme Overview – end August 2017



Eskom has committed capital to enable the integration of successful bidders (Bid Window 1 – 4B, including Smalls) into the National Grid.

Distribution of approved IPP projects to date:

Total approved capacity: 8 269 MW



Status to date:

- 3 520 MW of REIPP, commissioned and in commercial operation
- 1 004.5 MW of DoE Peakers commissioned and in commercial operation

Total IPP Generation in commercial operation: 4 524.5 MW

Salient facts concerning future IPP integration:

- Much of the capacity in high interest areas is depleted
- Extensive network development will be required to enable integration of future IPPs
- EIA, Servitude requirements, licensing requirements and efficient project execution are critical for future IPP integration

Planning for the South African Integrated Power System

The TDP Assumptions

Presented by: Ronald Marais

The different plans

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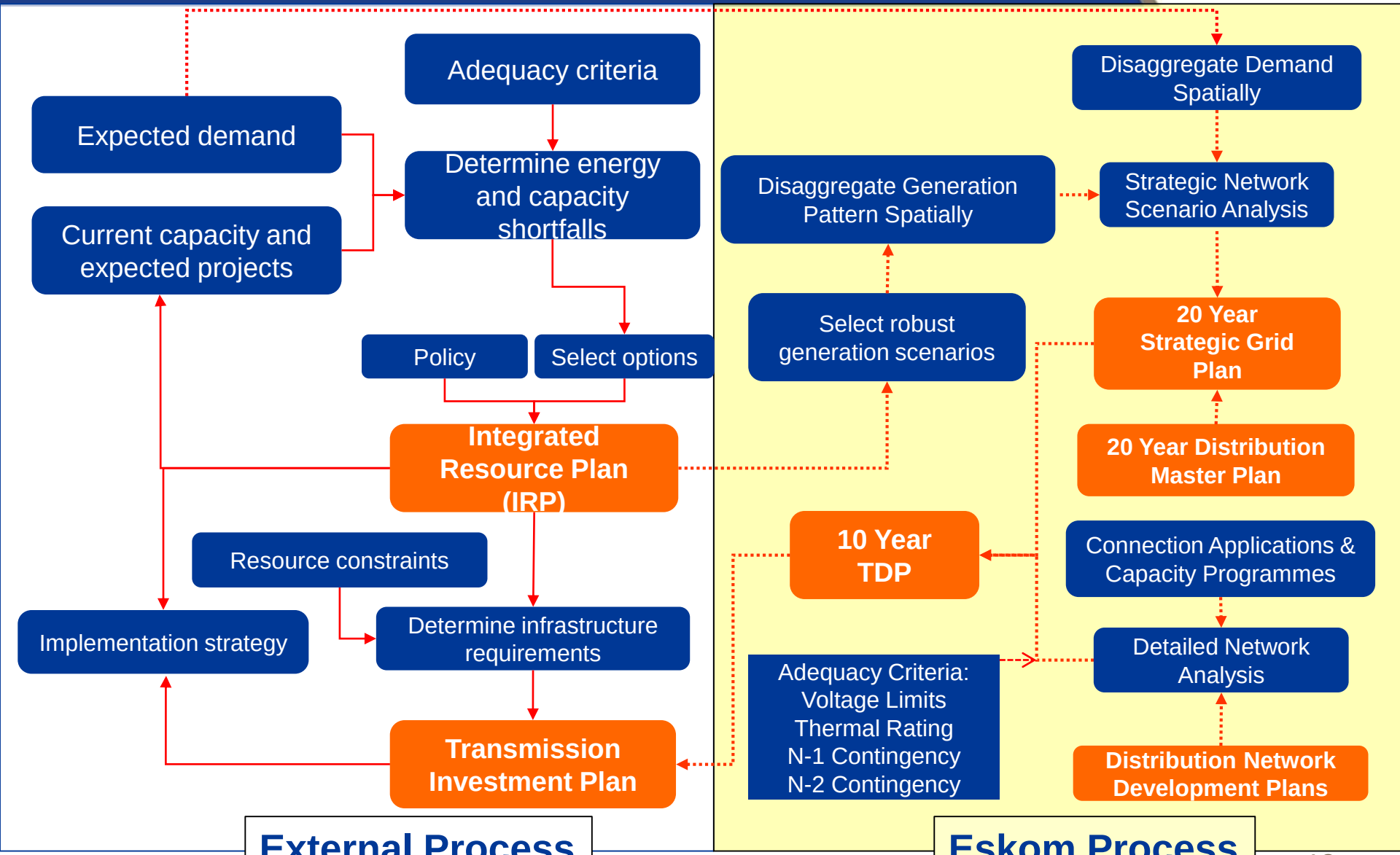
Linkages between the various plans



TDP Timelines

Licence obligation & Grid Code compliance

Open access & Reliability

TDP Ten Year Period

TDP Scenario Assumptions

Strategic Grid Plan

Stakeholder Engagement

Assumptions Generation & Demand

TDP 2018 - 2027

2018----------2022----------2027

1 - 3 | 4 - 6 | 7 - 10

Implementation & Preparation

Detailed studies & Business case

Uncertainty & Readiness

EIA & Servitude to enable, robust and flexible speed of implementation

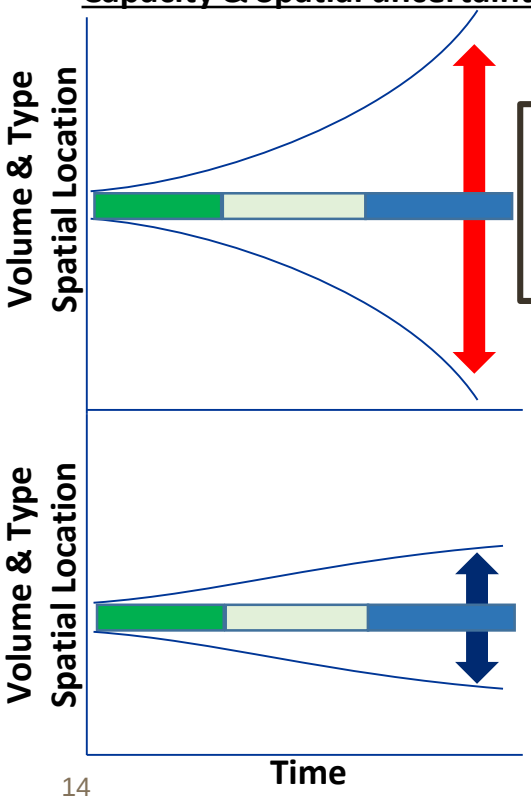
Annual TDP Update

1 - 3 | 4 - 6 | 7 - 10

Review and adjusting uncertainty

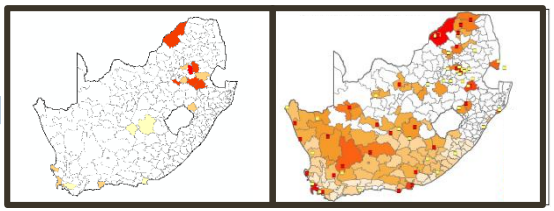
1 - 3 | 4 - 6 | 7 - 10

Capacity & Spatial uncertainty



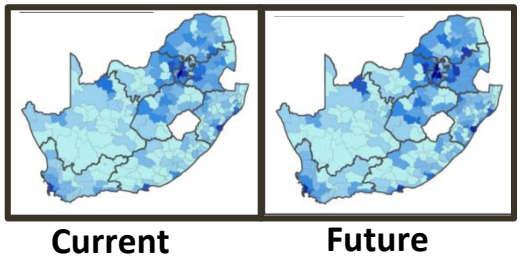
Generation

High spatial and capacity risk

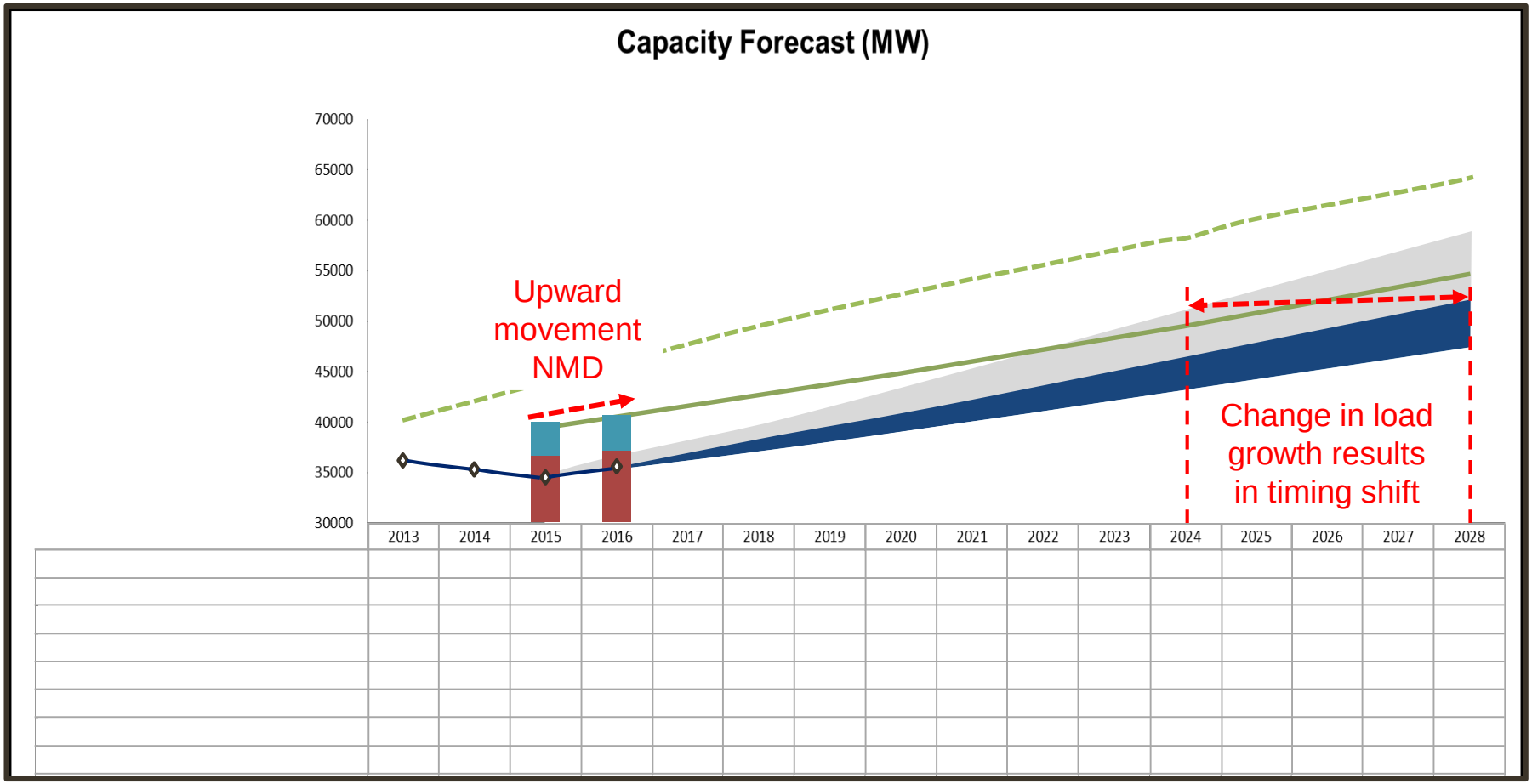


Demand

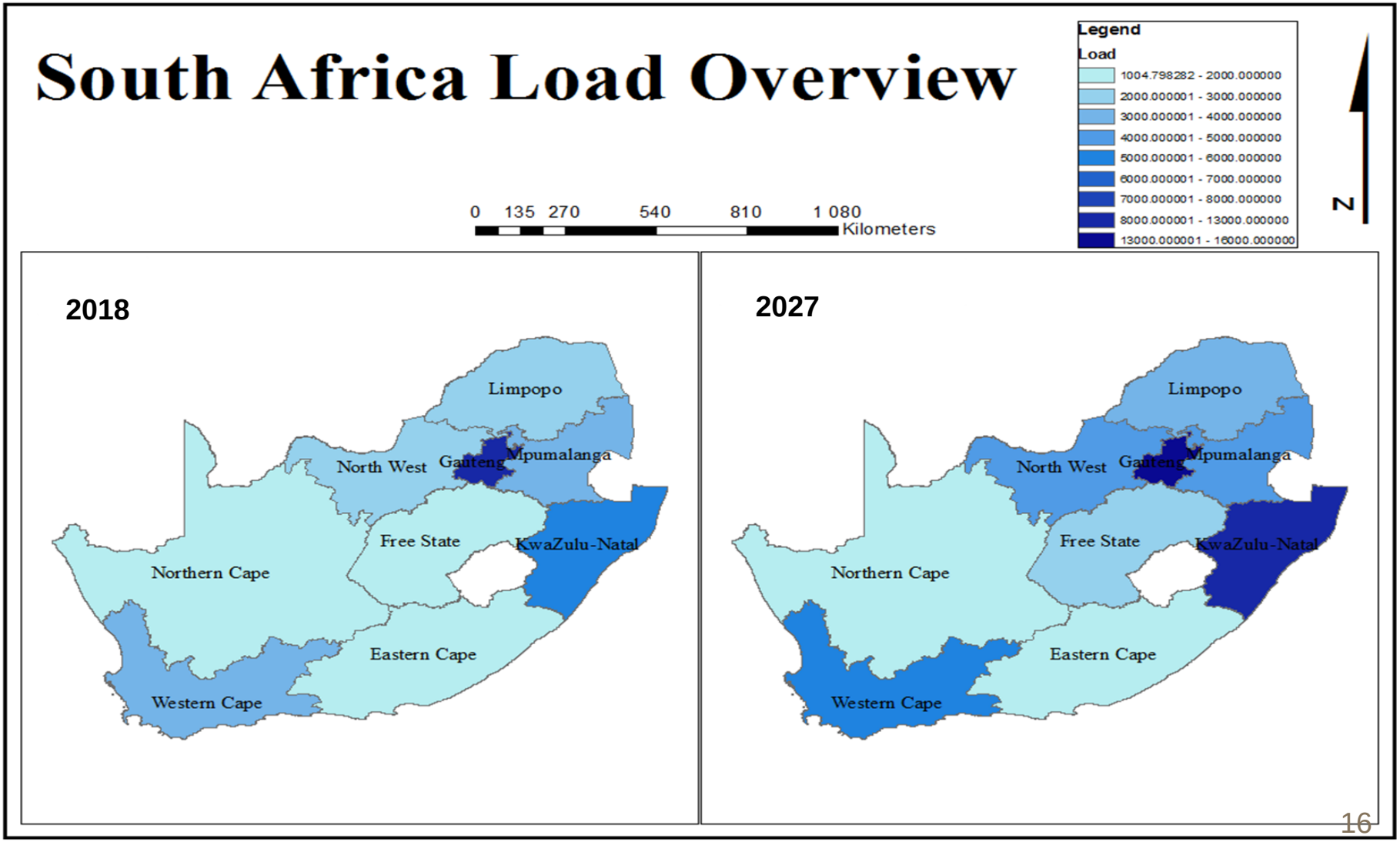
Low spatial and capacity risk



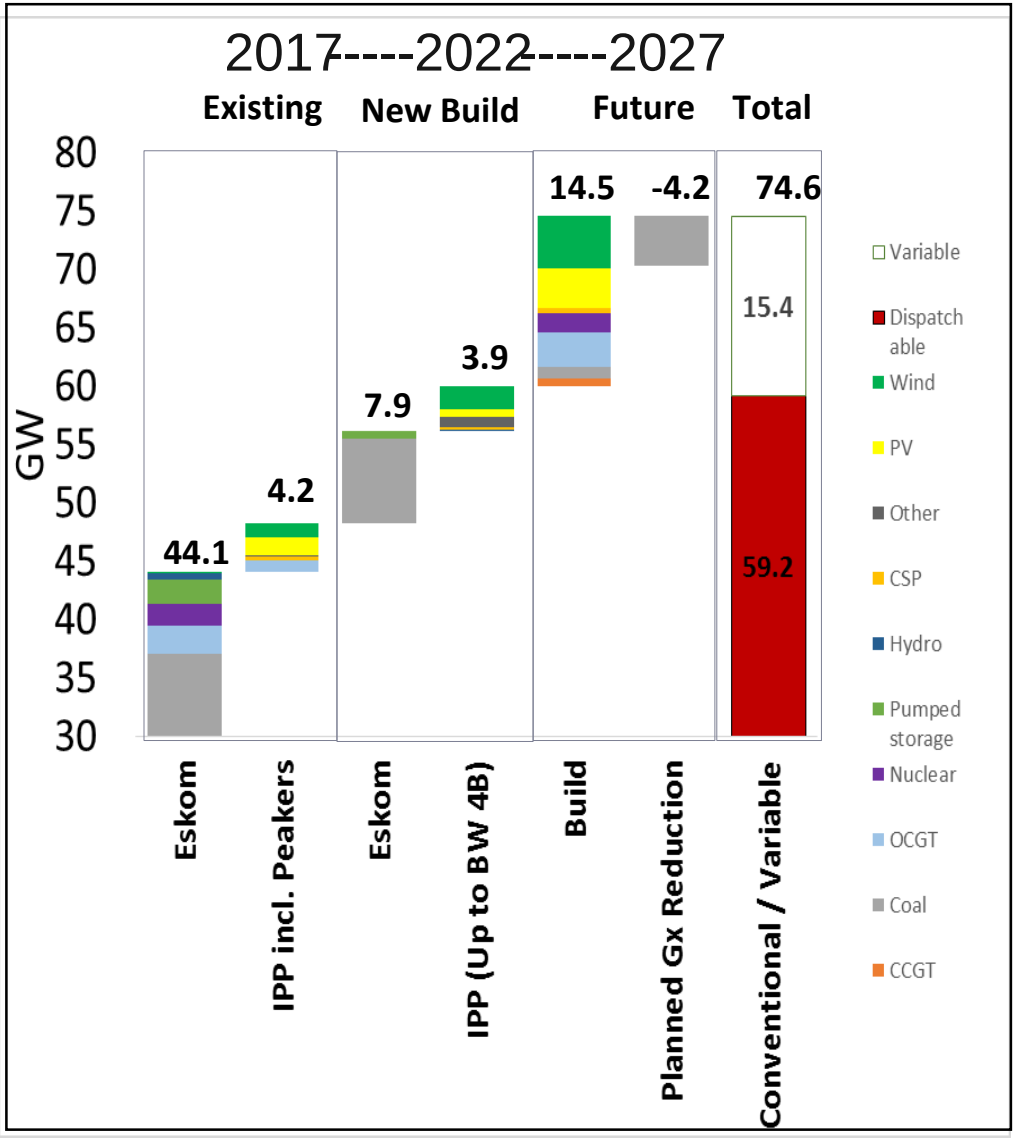
Assumed Transmission Capacity Forecast and Comparisons

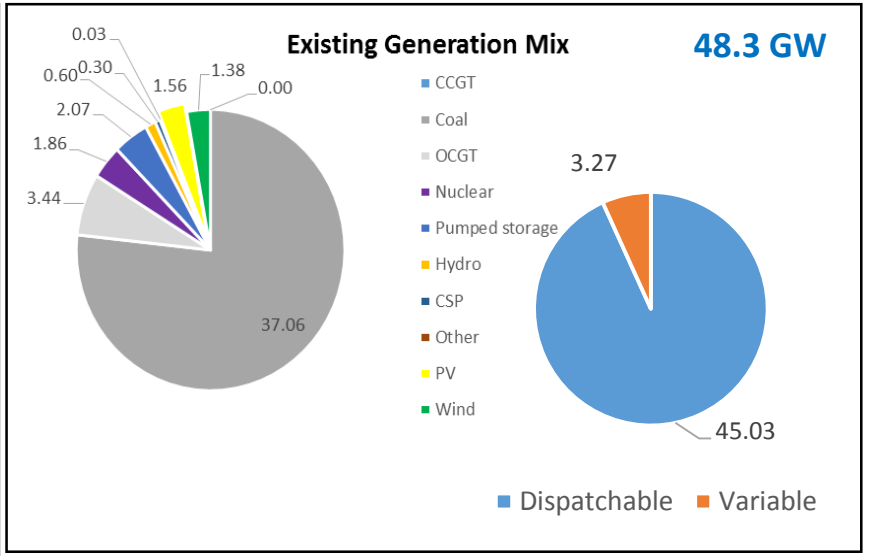


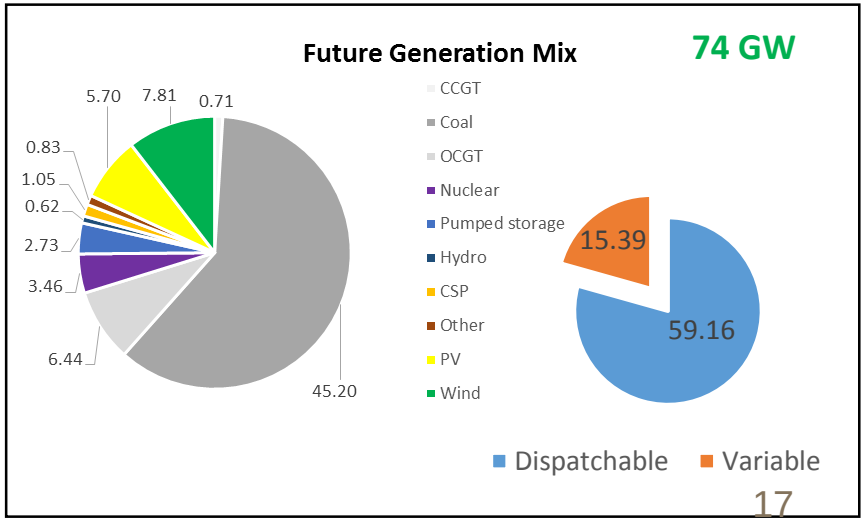
Demand Growth – RSA 2018 vs 2027



TDP Generation Base Scenario

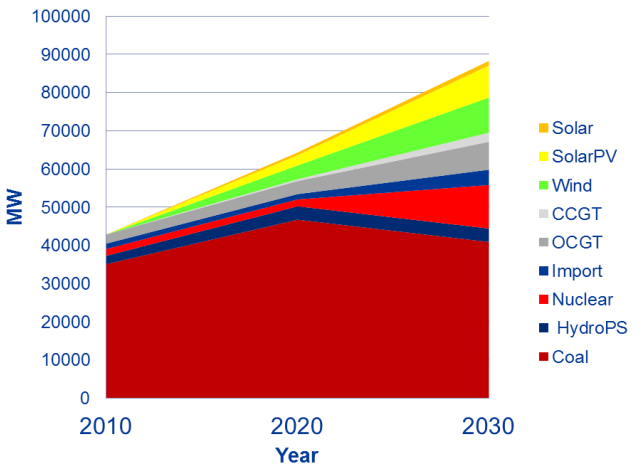






2040 Tx Study – Generation Spatial Allocation

Transmission to enable IRP requires Spatial Information

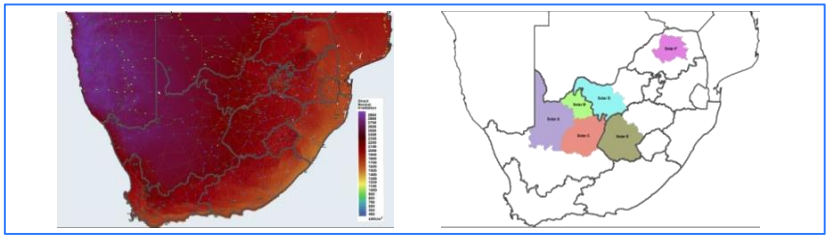


However, there is uncertainty in terms of:

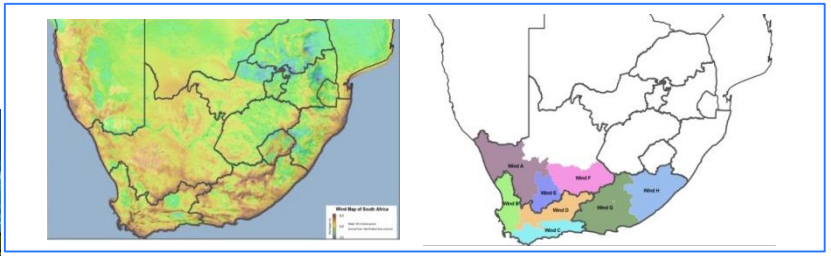
- Where is the location?
- What is the size?
- What is the type?

Generation Energy Resources for Electricity

Solar

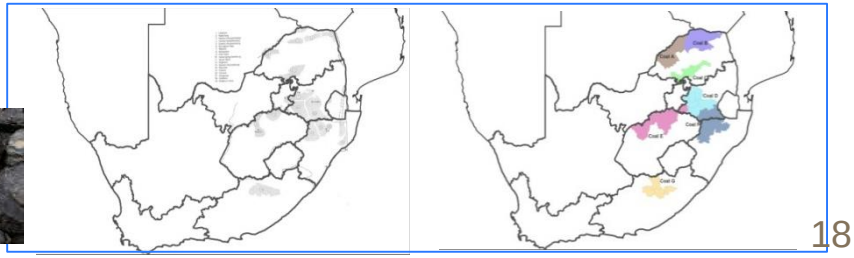


Wind

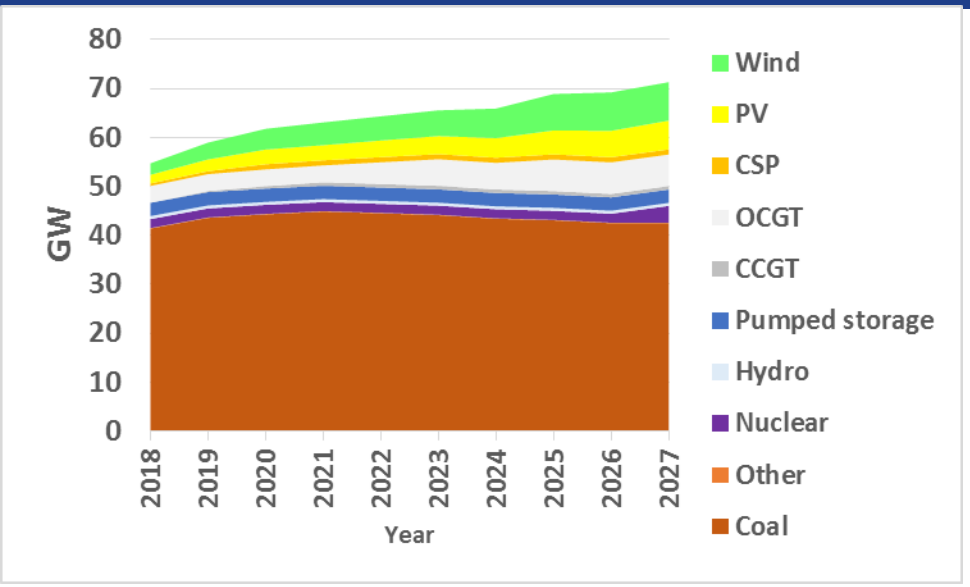


Gas

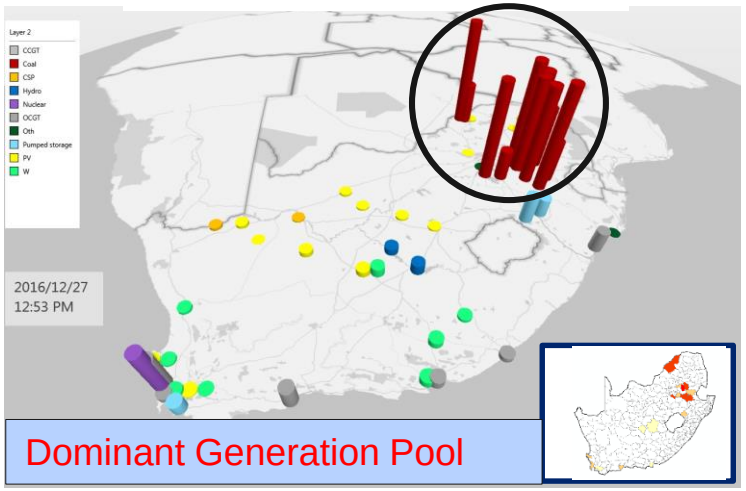
Coal



TDP – Base Scenario
Generation Spatial and Temporal Allocation

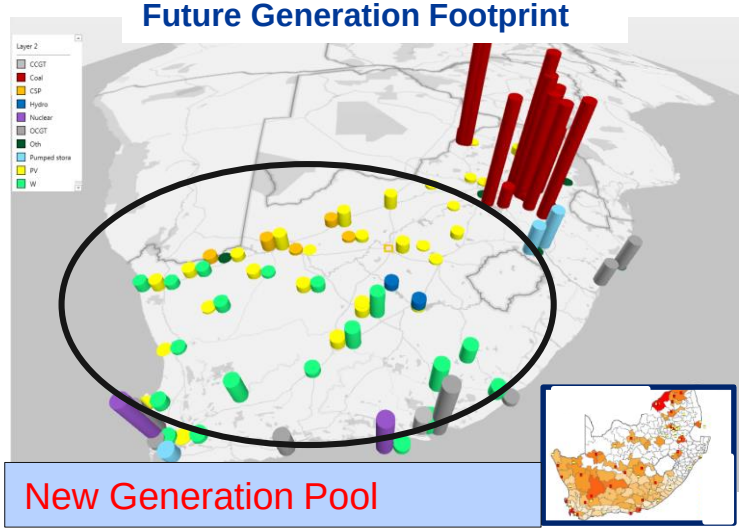


Current Generation Footprint



Dominant Generation Pool

Future Generation Footprint



New Generation Pool

The new Generation Pool drives significant new Transmission Infrastructure over long distances

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

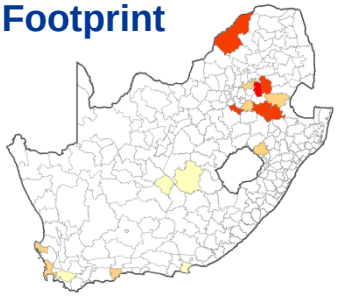
- Grid Access – Increased connection capacity needed in new areas (delivery time > 8yrs)
- On Time Connection – Smaller IPP generation plant can be constructed faster (delivery time <5yrs)
- Unknown locations - Multiple unspecified IPP sites require market access for best price

Change in Location - Spatial Footprint

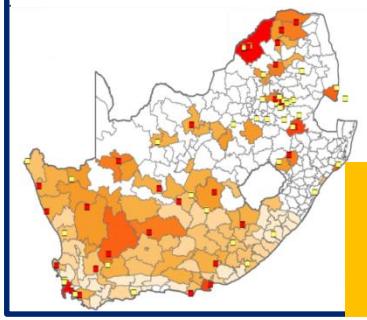
Change in Construction 3yr - 5yr Speed of IPP plant rollout

Strategic EIAs & Servitudes can enable faster grid development

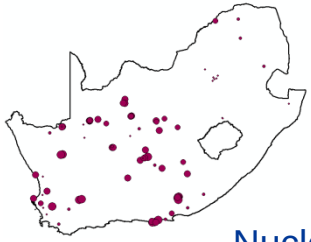
Current Generation Footprint



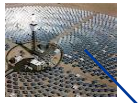
Future Generation Potential Footprint



Current Eskom Wind, Solar & REIPP 1.2.3.4



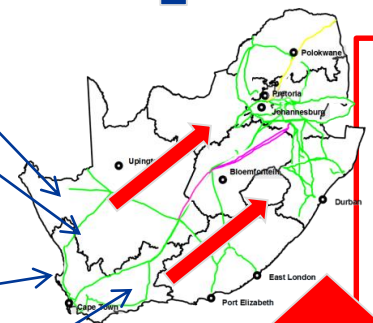
Solar



Wind

Gas

Nuclear



Transmission Line Project Timeline

Eng	EIA & Land Acquisition	Construction
1yr	2yr + >3yr	3yr

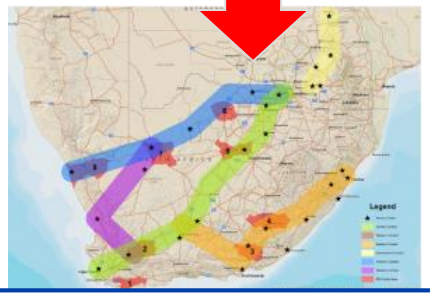
1. Strategic Investment in the EIAs & Land acquisition is critical to meet future IRP connection timeframes

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

Beyond 2020 Demand Balance significantly changed by dispersed generation inSouth

Significantly More transmission corridors and grid access required

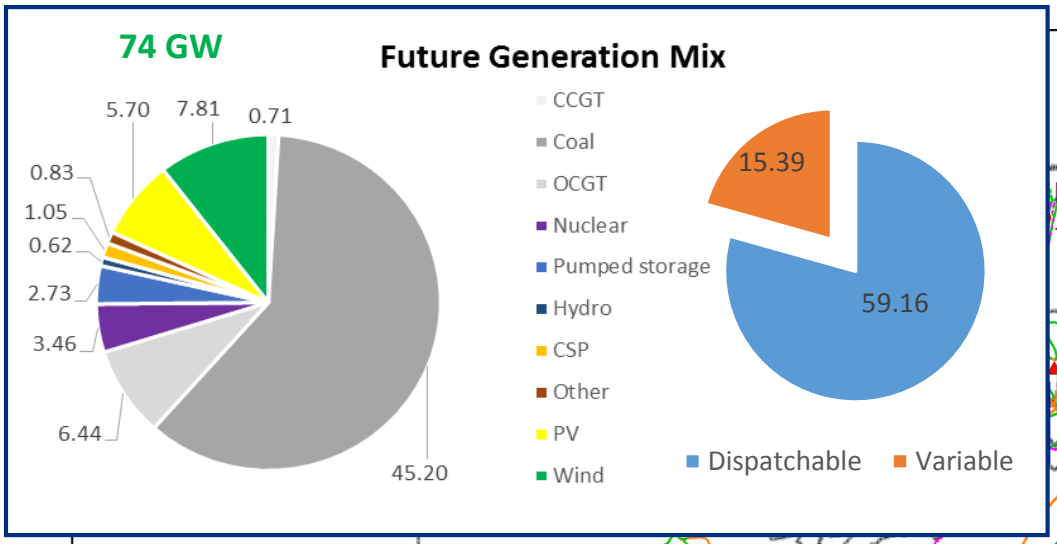
SEA Corridors



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

Assumed Generation Pattern for the TDP 2017



Questions?

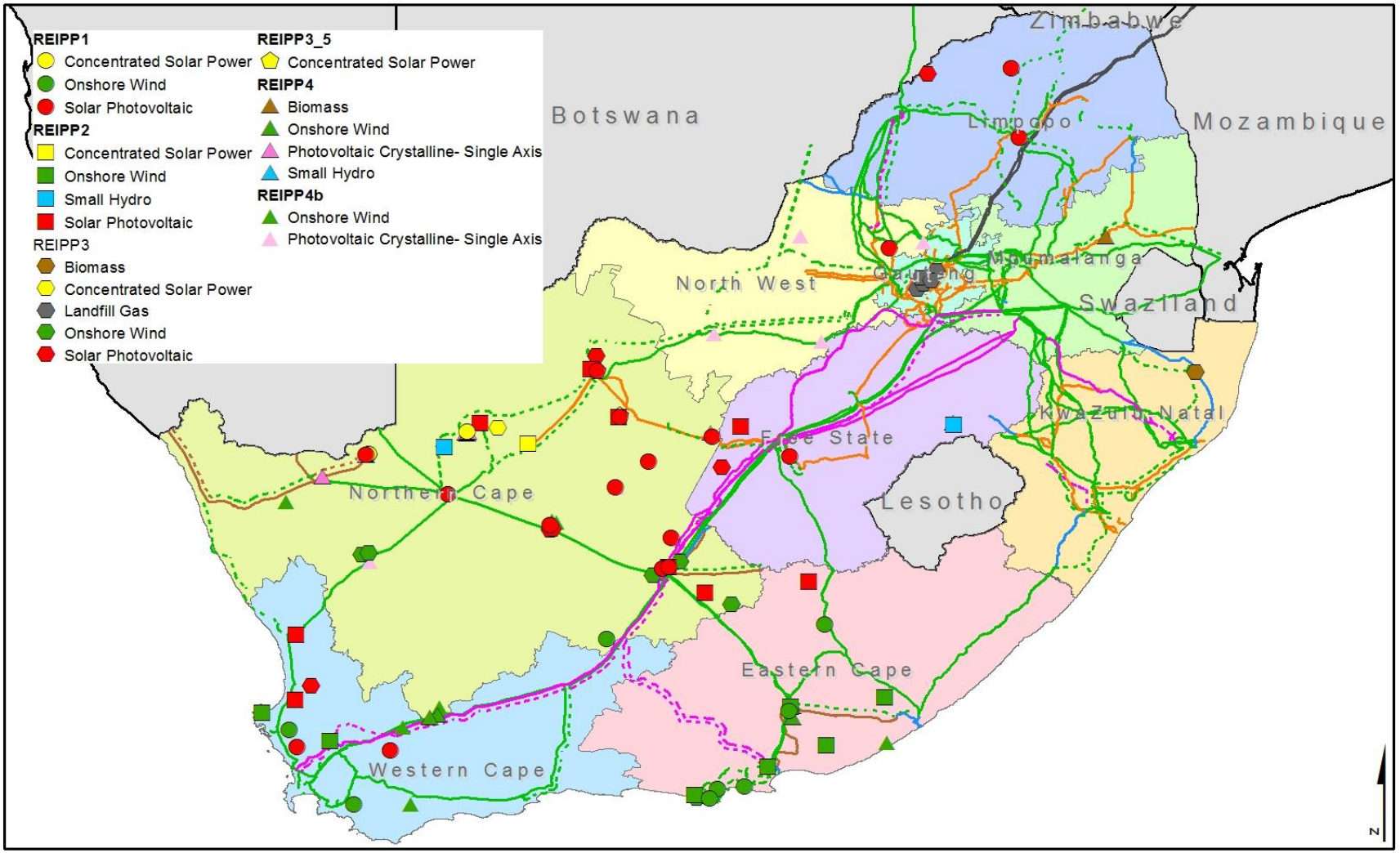
Planning for the South African Renewable Energy IPP Integration

Presented by: Makoanyane Theku

Independent Power Producer (IPP) integration Status to-date (end August 2017)

Program	No. of Projects	MW Contribution	Current Status
REIPPPP BW 1	28	1 436	All projects connected
REIPPPP BW 2	19	1 054	All projects connected
REIPPPP BW 3&3.5	23	1 656	14 projects connected, 8 in execution, 1 project in BW 3.5 awaiting financial close
REIPPPP BW 4	13	1 121	Budget quotation phase
REIPPPP BW 4B	13	1 084	Budget quotation phase
Smalls (1-5 MW)	10	50	Budget quotation phase
DoE Peakers	2	1 004.5	All projects connected
Coal Baseload	2	863.5	Budget quotation phase
Total	110	8 269	

Successful Bidders: REIPP Bid Window 1 - 4B



Planned Lines: 132 220 275 400 765

Existing Lines: 132 220 275 400 533 765

IPPs Bid Window 1 to 4b

Created by: Sonja Ferreira
Date: 2017/09/15

0 90 180 360 540 720 Km

This map has been compiled by ESKOM Grid Planning department to the best of their knowledge. However, since various data sourceshave been used Grid Planning departmentcannot accept responsibility for any inaccuracies.

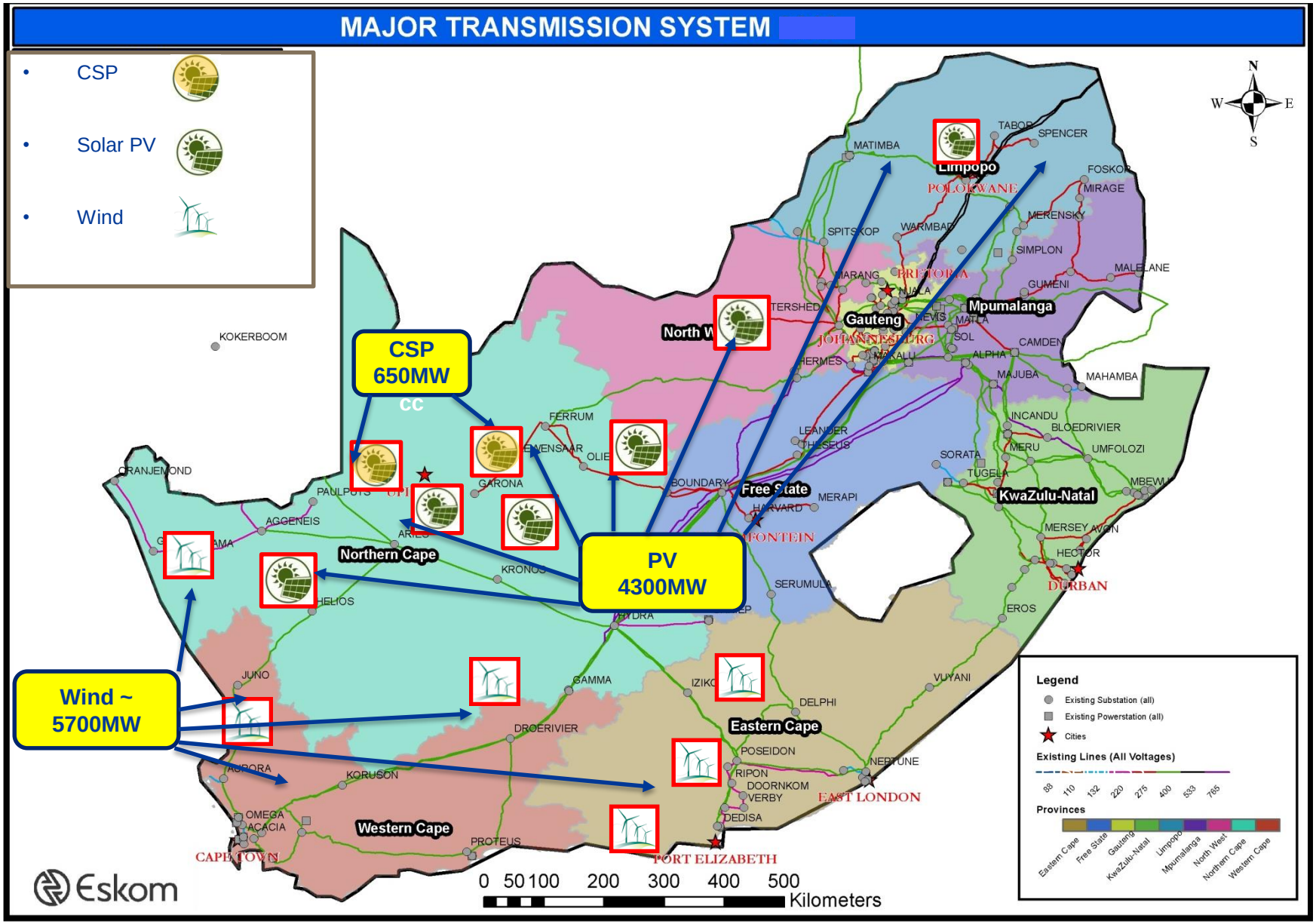
Grid enablement for IPP integration in the medium to long term (2018 – 2027)*

- **Most of the available grid capacity will be exhausted beyond BW 4B**
- **TDP assumption for IPP programmes beyond REIPP BW 3.5 are shown below:**

IPP Bid window / Projects	Total allocated / Assumed capacity (MW)	Total cost estimates for Infrastructure requirements included in the 2018 – 2017 TDP
REIPPPP BW 4 & 4B	2205	✓
Coal Baseload (Khanyisa and Thabametsi)	900	✓
New OCGT / CCGT generation Dedisa and Athene Substations	3732	✓
Future REIPP (Solar PV)	3500	✓
Future REIPP (wind)	4400	
Future REIPP (CSP)	450	

*** Assumptions as per the IRP Baseline Plan**

Transmission Connection Requirements: Future DoE RE Programme (Wind, CSP, PV)



Risks to Grid Access

Issues to Consider

- Servitude and EIA restrictions
- Lead times:
  - Long Tx lines: 6 - 8 years
  - Large Power stations: 8 - 10 years
  - Distributed IPP plants: 2 - 5 years
- Use all appropriate proven technology available:
  - HVDC, EHV AC, HVDC conversions of existing AC lines, multiple circuit AC lines
- Transmission technology choice must be compatible with strategic power system development plan

RE Grid Access issues

- IPP developments tend to be in close proximity of Eskom substations. This sometimes restricts access to other RE IPP participants due to limited power line corridors through IPP properties.
- Subsequent to REBID 1 - 4 there is limited spare capacity on the Distribution networks and in some cases, Transmission networks.
- Due to uncertainty of allocation of Preferred IPP Bidders, quotations are issued on an individual basis i.e. no other application is considered in the quotation. This potentially raises / reduce the cost of connection per quotation.

Grid enablement initiatives to expedite future IPP integration (Strategic IPP Masterplan)

- The Grid Enablement team was established (under the auspices of Eskom and DoE IPP Office). The following grid enablement initiatives are in progress:
  - Conduct joint Distribution & Transmission infrastructure masterplan to enable future IPP integration. (Complete)
  - Identify strategic development corridors to enable speedy integration of future IPP (Complete)
  - Investment approval for EIA, servitude acquisition and required licenses (Pending)
  - Align the timetables of the IPP programme to the timetables of the grid plans (Pending)

IPP Connection Framework
Basis for enabling future IPP programmes

Eskom

Assumptions setting → Review & Refine → RFP → Bids Subm. → Pref. Bids → Fin. Close → Const. → CO

Requirements Capture → Concept Analysis → GCCA → CEL → Final review → BQ → Const. → CO

Factor of uncertainty

Stakeholders engagement ✓

Formulate Assumptions ✓

Risk Analysis ✓
- Define controls and mitigations

Produce Integration Master Plan ✓
- Determine Grid connection requirements and costs

Refine & prioritize Planning requirements

Development
- EIA
- Acquisition
- Licenses
- Design (Prelim)

IPP connection feasibility assessment

Refine connection SOW

Costing

CEL

Optimisation of the connection SOW

Detailed design

Specialized studies

Governance approvals

Costing

BQ

Execution

Testing

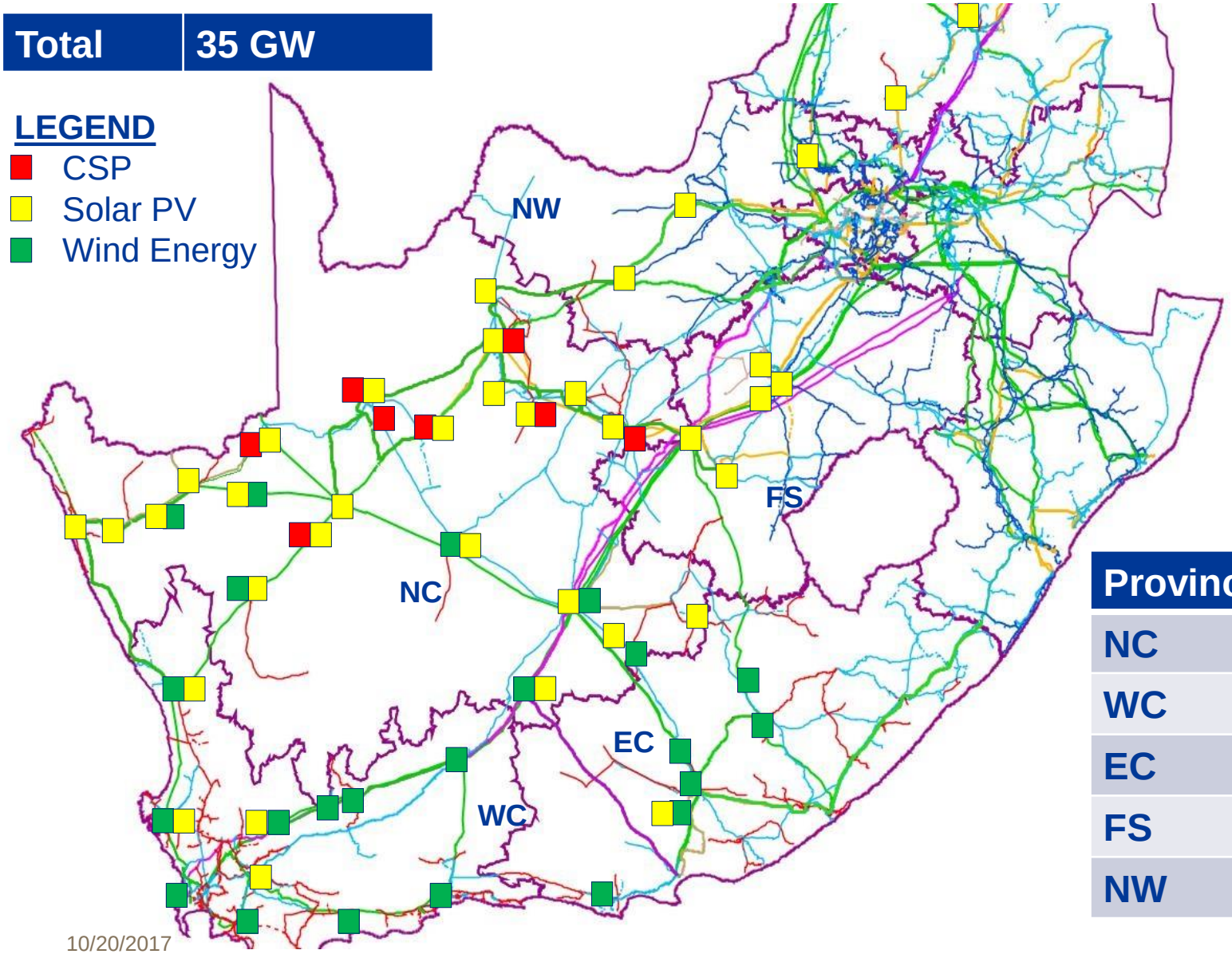
Review / Evaluate

Improve

Spatial locations of identified REIPPs Long term

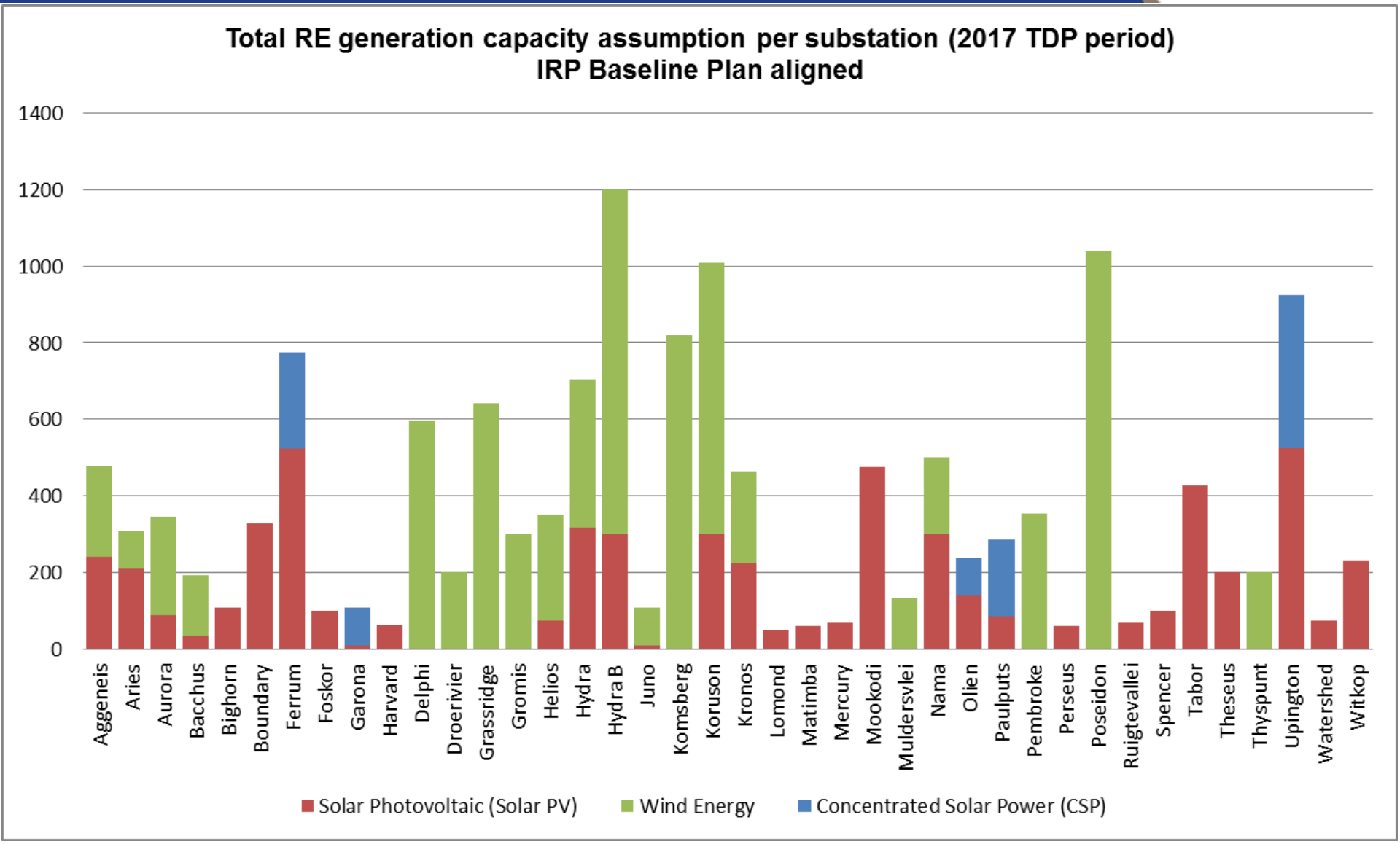
Total	35 GW

LEGEND
- CSP
- Solar PV
- Wind Energy



Province	Total
NC	19 GW
WC	6.6 GW
EC	5.2 GW
FS	3.2 GW
NW	1.1 GW

REIPPs - TDP Assumptions



TDP plans for IPP Integration

LEGEND

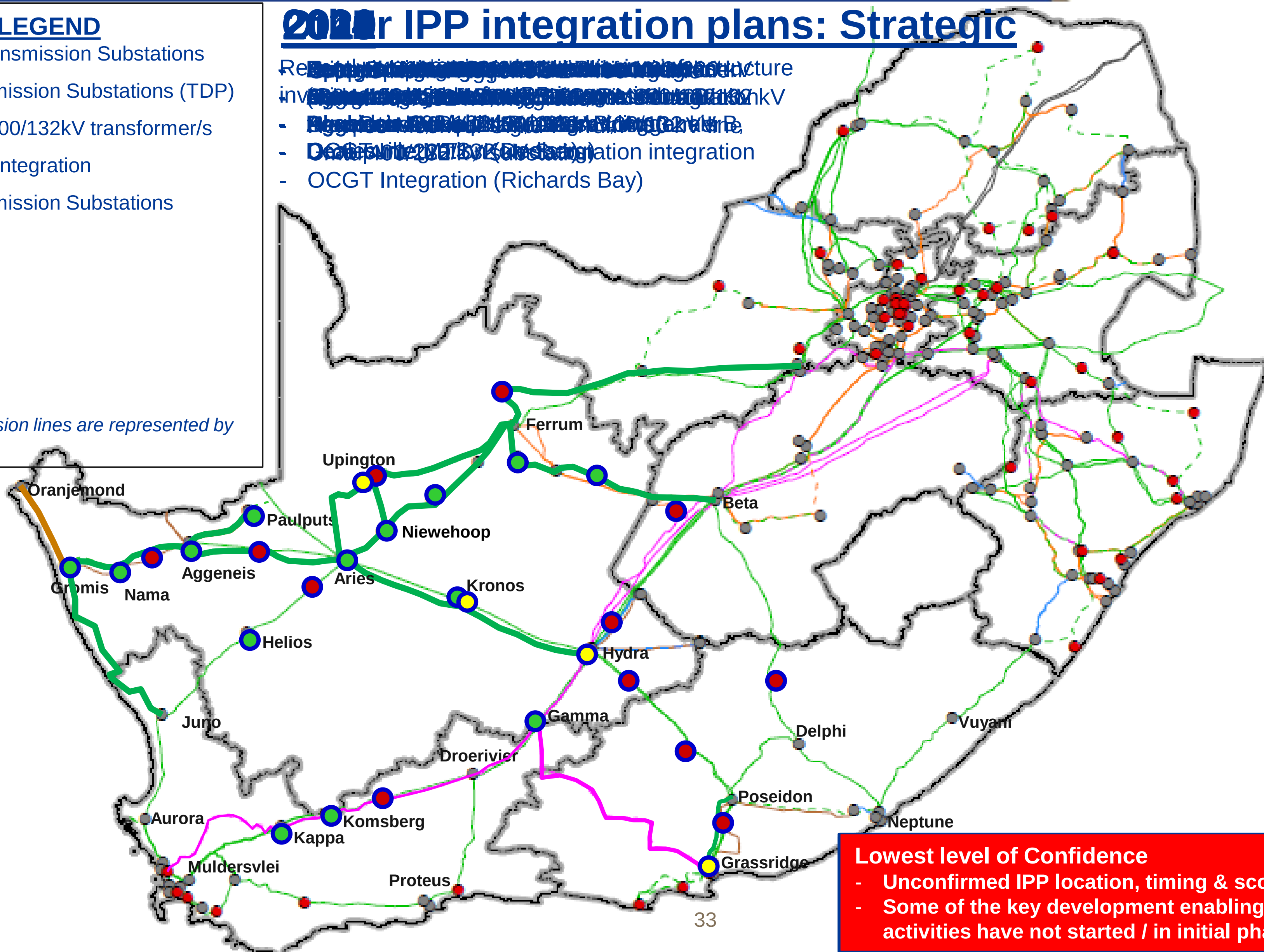
- Existing Transmission Substations
- New Transmission Substations (TDP)
- Additional 400/132kV transformer/s
- 400/132kV Integration
- New Transmission Substations
- 765 kV line
- 400 kV line
- 275 kV line
- 220 kV line
- 132kV line

Planned transmission lines are represented by dotted lines

[illegible] IPP integration plans: Strategic

[illegible]

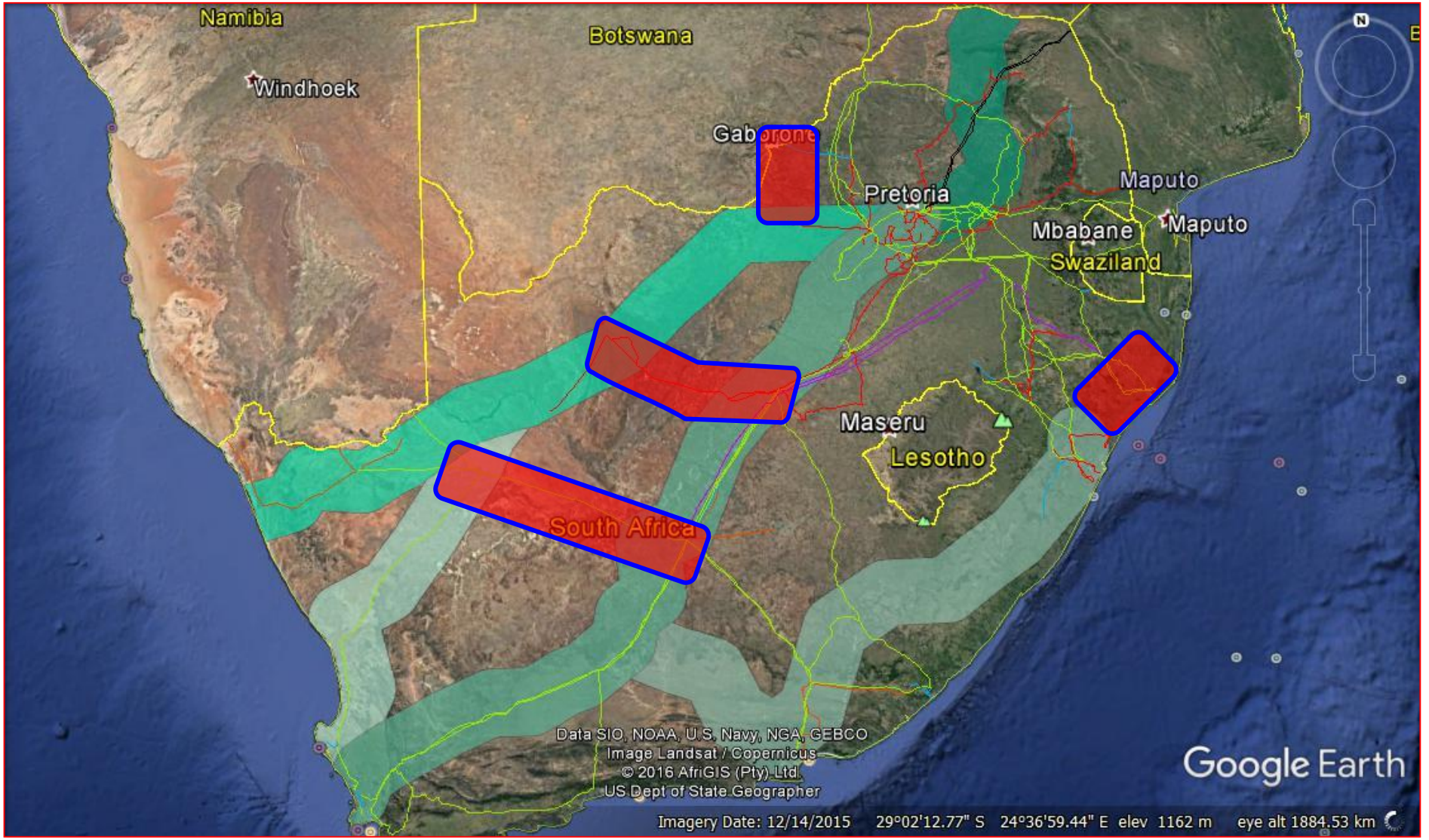
- [illegible]
- [illegible] ation integration
- OCGT Integration (Richards Bay)



Lowest level of Confidence

- **Unconfirmed IPP location, timing & scope**
- **Some of the key development enabling activities have not started / in initial phase**

Main corridor EA / servitude requirements supplementary to the SEA (Proposed modification)

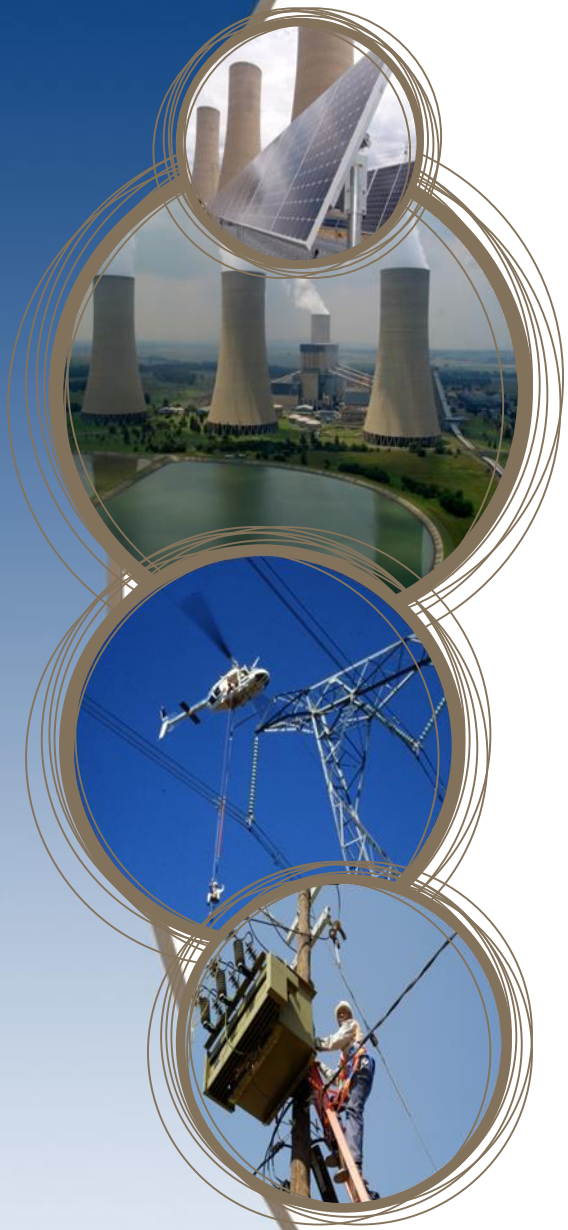


Conclusion

- Grid Enablement team feedback:
  - Provided valuable insights and skills, which has enriched the infrastructure development process
  - Engagements are paramount in improving process effectiveness, quality of input assumption, connection criteria fundamentals as well as continually improving plans as necessary.

- Potential opportunities for future initiatives
  - Optimize integration process between DOE IPP and Eskom network development plan by:
    - Recommending IPP procurement programme towards areas where network capacity is available.
    - Target specific geographic areas for IPP projects to optimize on timelines for readiness of the grid infrastructure

Questions?



Provincial Plans
TDP 2018 – 2027

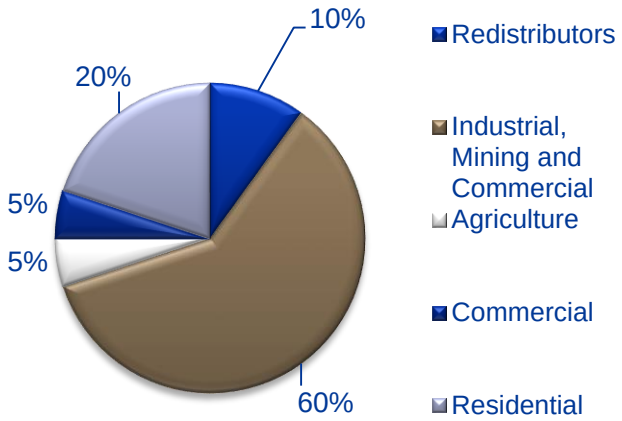
North-West Province

Presented by: Queen Melato (Planning Engineer)

North-West Province Profile

Load

- **Peak load of 3171MW: 16 Nov 2015**



Generation

Type		Name	Output
Base Load	Coal	Matimba	3360 MW
		Medupi	1588 MW
Renewable Energy	PV	RustMo1 Solar	7 MW
Total			**4955 MW**
Approved REIPPPP Projects		PV	225 MW
REIPPPP Total			**225 MW**

Achievements in the Platinum Province

Carletonville Customer Load Network (CLN)

- **Unlocked capacity for electrification and industrial activities.**
- **Created capacity for connection of RE plants in and around Vryburg.**

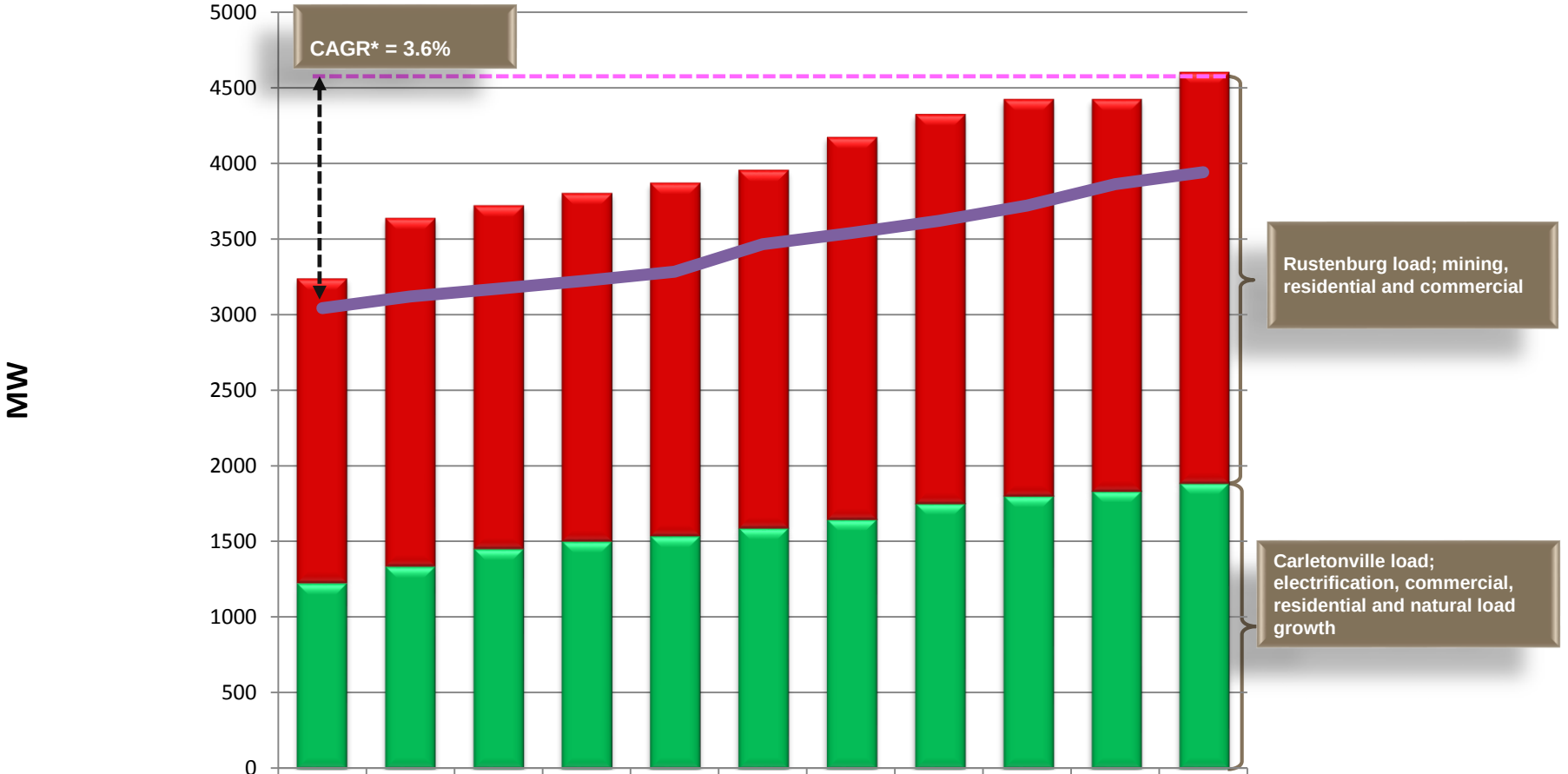
Rustenburg Customer Load Network (CLN)

- Dinaledi-Spitskop lines
- Dinaledi 3rd transformer
- Medupi-Marang 400kV line
- Ngwedi 1st 500MVA transformer

- Unlocked capacity for mining, industrial activities and tourism.

Load Forecast

North-West Province Load Forecast



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Rustenburg	2013	2302	2270	2300	2333	2366	2526	2572	2621	2590	2716
Carletonville	1225	1336	1451	1500	1536	1587	1644	1750	1799	1830	1883
North West @ TOSP	3043	3120	3170	3225	3284	3465	3540	3619	3720	3863	3941

*** Compound Annual Growth Rate**

Generation Forecast

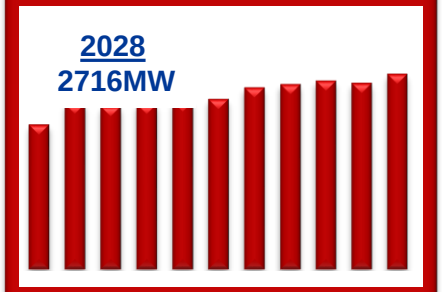
Renewable Energy in North-West Province

RE Projections (10 year):

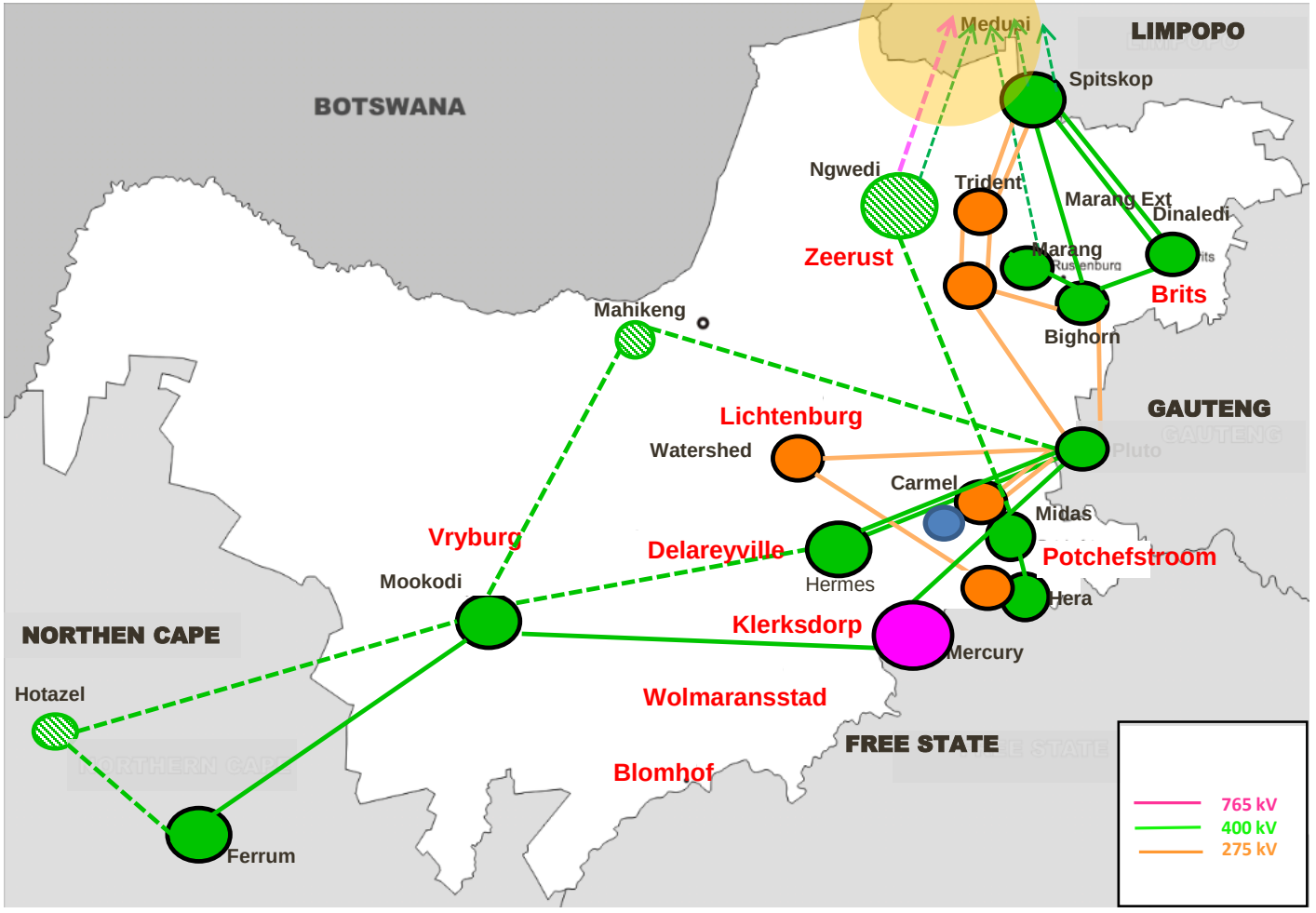
- **Approximately 0.55 GW**
- Mookodi Substation: **475 MW**
- Watershed Substation: **75 MW**

Network Development Plan

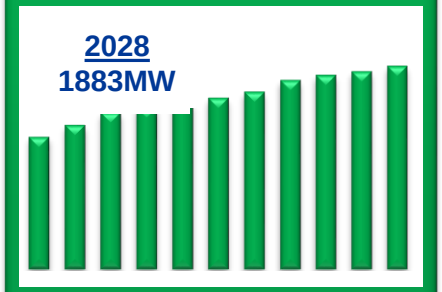
Developments in the Rustenburg CLN



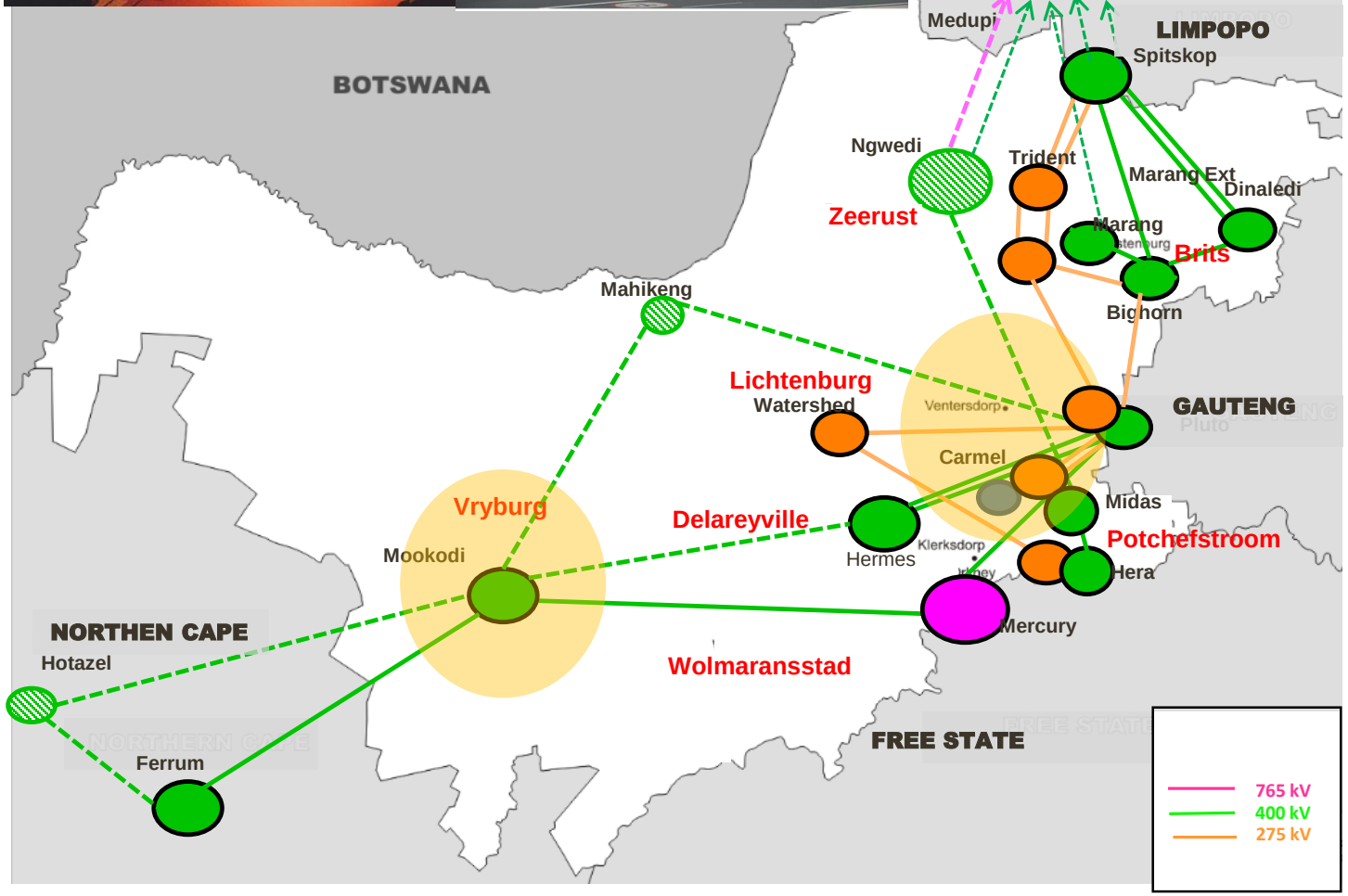
- 2x Medupi-Ngwedi 400kV lines (1x 765kV design) - near Mogwase
- Ngwedi substation - around Sun City
- Marang Extension - next to Rustenburg Municipality
- Bighorn Extension – near Marikana
- Dinaledi 3rd Transformer in Madibeng / Brits



Developments in the Carletonville CLN



- Pluto-Mahikeng 400kV line
- Mahikeng substation
- Mookodi-Mahikeng 400kV lines
- Hermes-Mookodi 400kV line
- Mookodi-Hotazel 400kV line



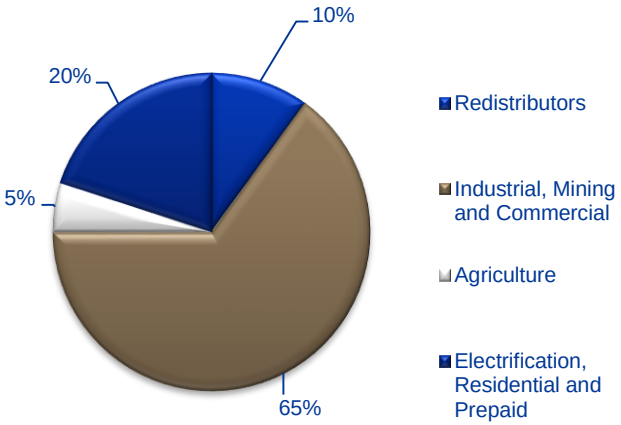
Limpopo Province

Planning Engineer: Dalton Matshidza

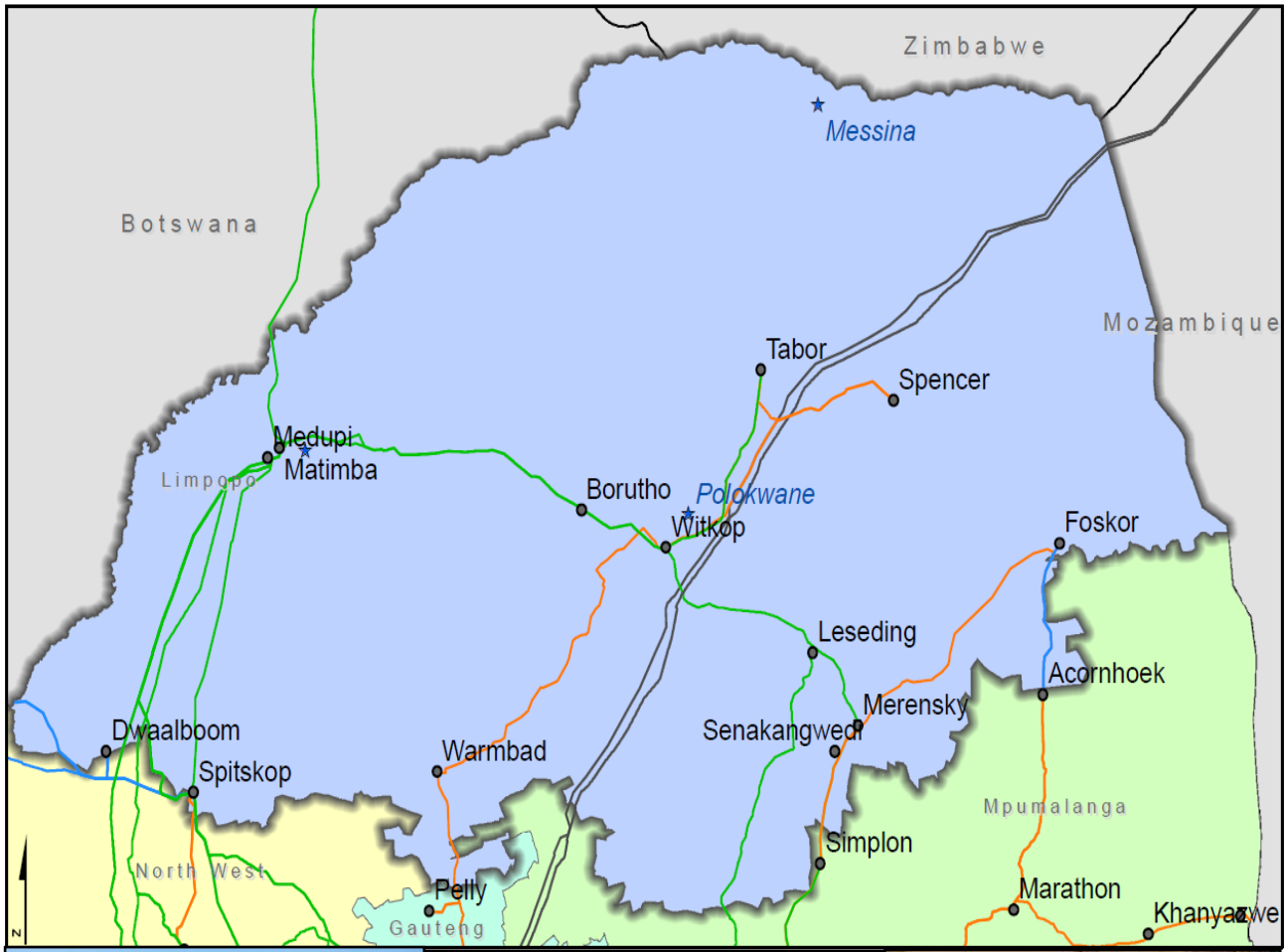
Presented by: Queen Melato

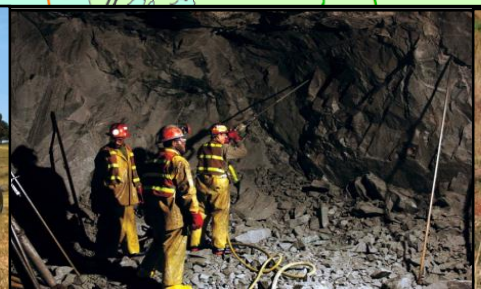
Limpopo Province Profile

- **Peak load of 2960 MW : 19 October 2015**



Type		Name	Output
Base Load	Coal	Matimba	3990 MW
		Medupi	1692 MW
Renewables	Photo Voltaic	Witkop	30 MW
		Soutpan	28 MW
		Villa Nora	60 MW
Eskom Total			**5800 MW**
Approved REIPPPP Projects		PV	118 MW
		Coal (Future)	**600 MW**
REIPPPP Total			**118 MW**

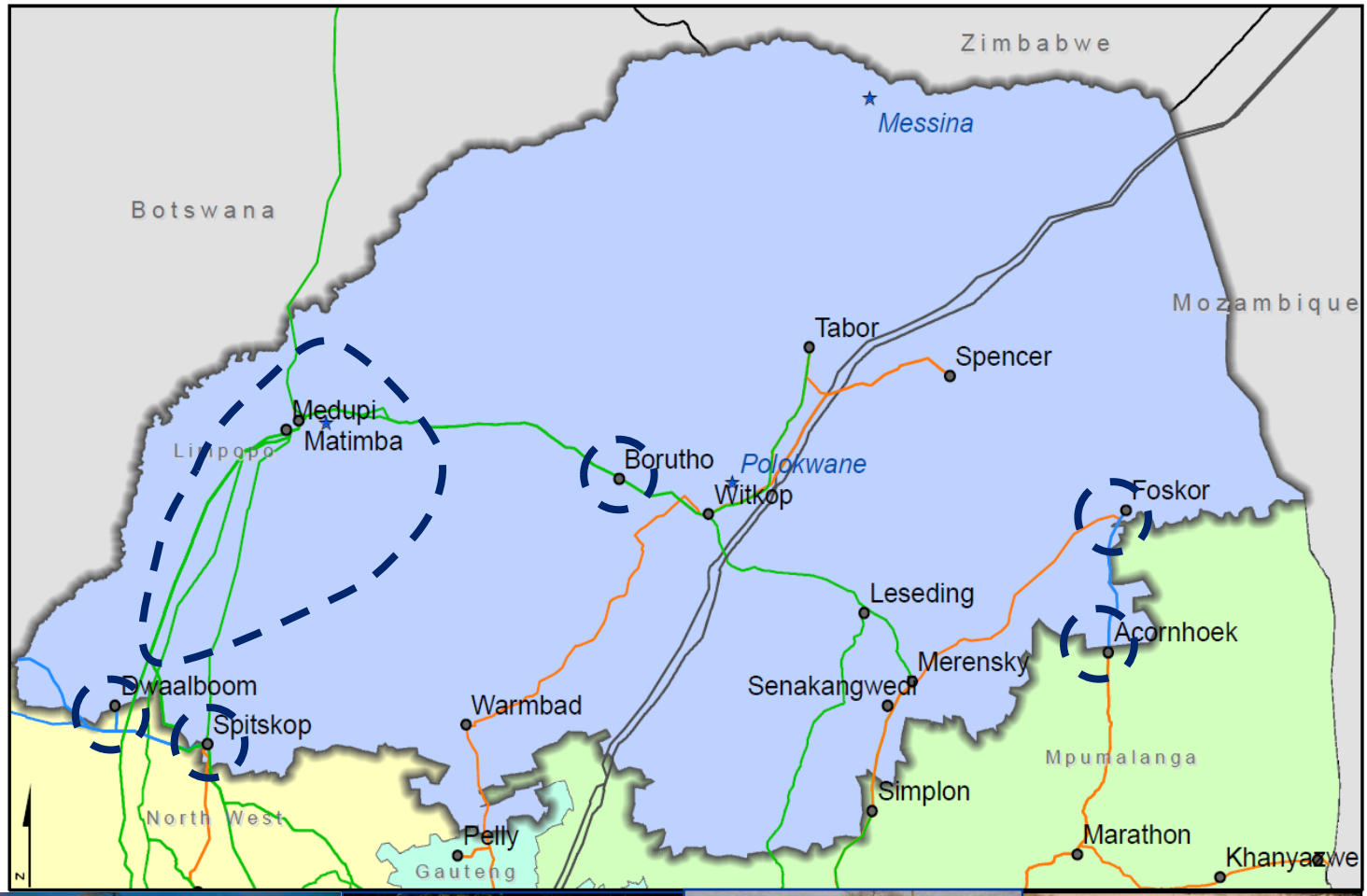




Achievements

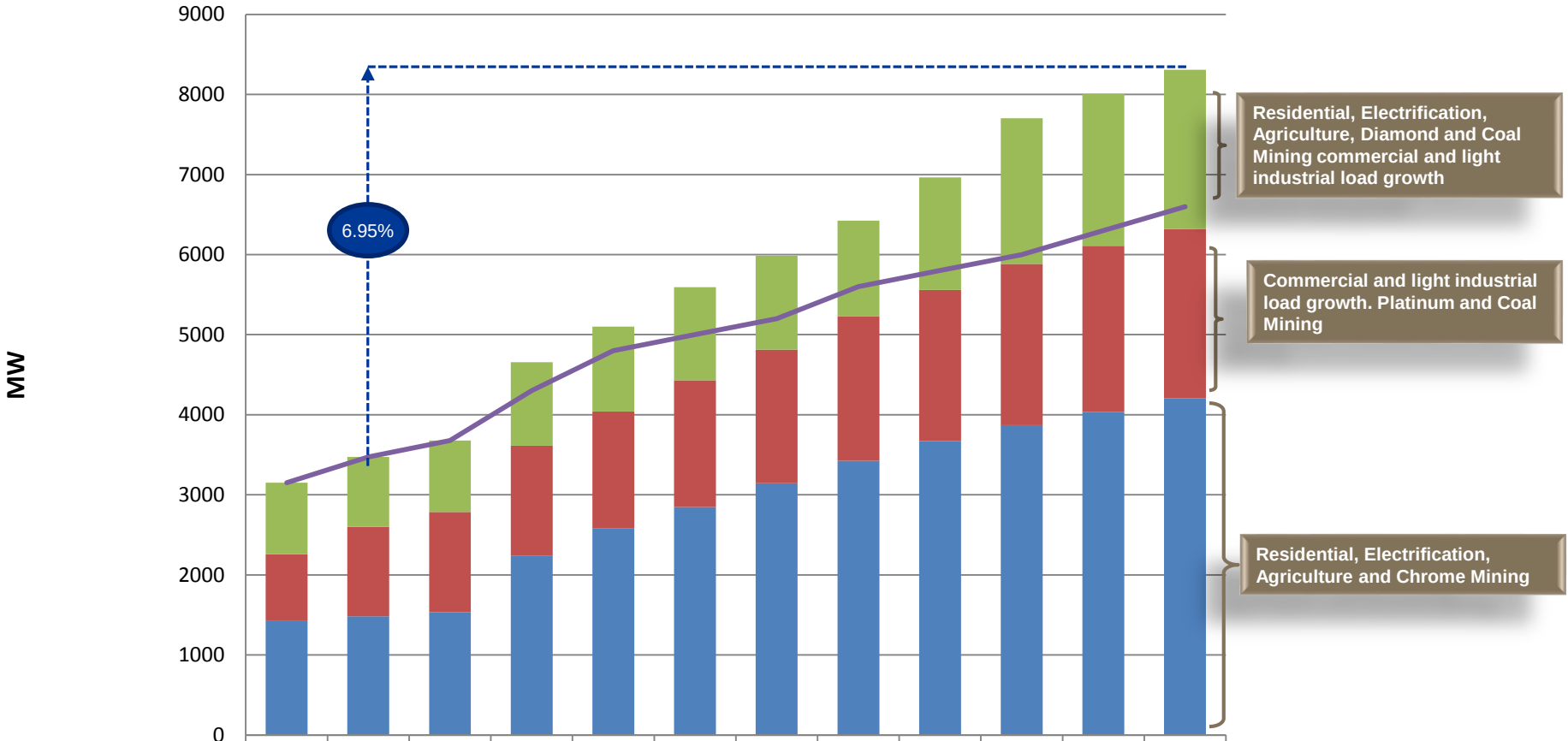
Achievements

- **Borutho 400kV Integration**
- **Foskor 3rd 250MVA Transformation**
- **Acornhoek Transformation Upgrade**
- **Spitskop Transformation Upgrade**
- **Dwarsberg 132kV Switching Station**
- **Medupi Transmission Integration**



Load Forecast

Limpopo Province Load Forecast



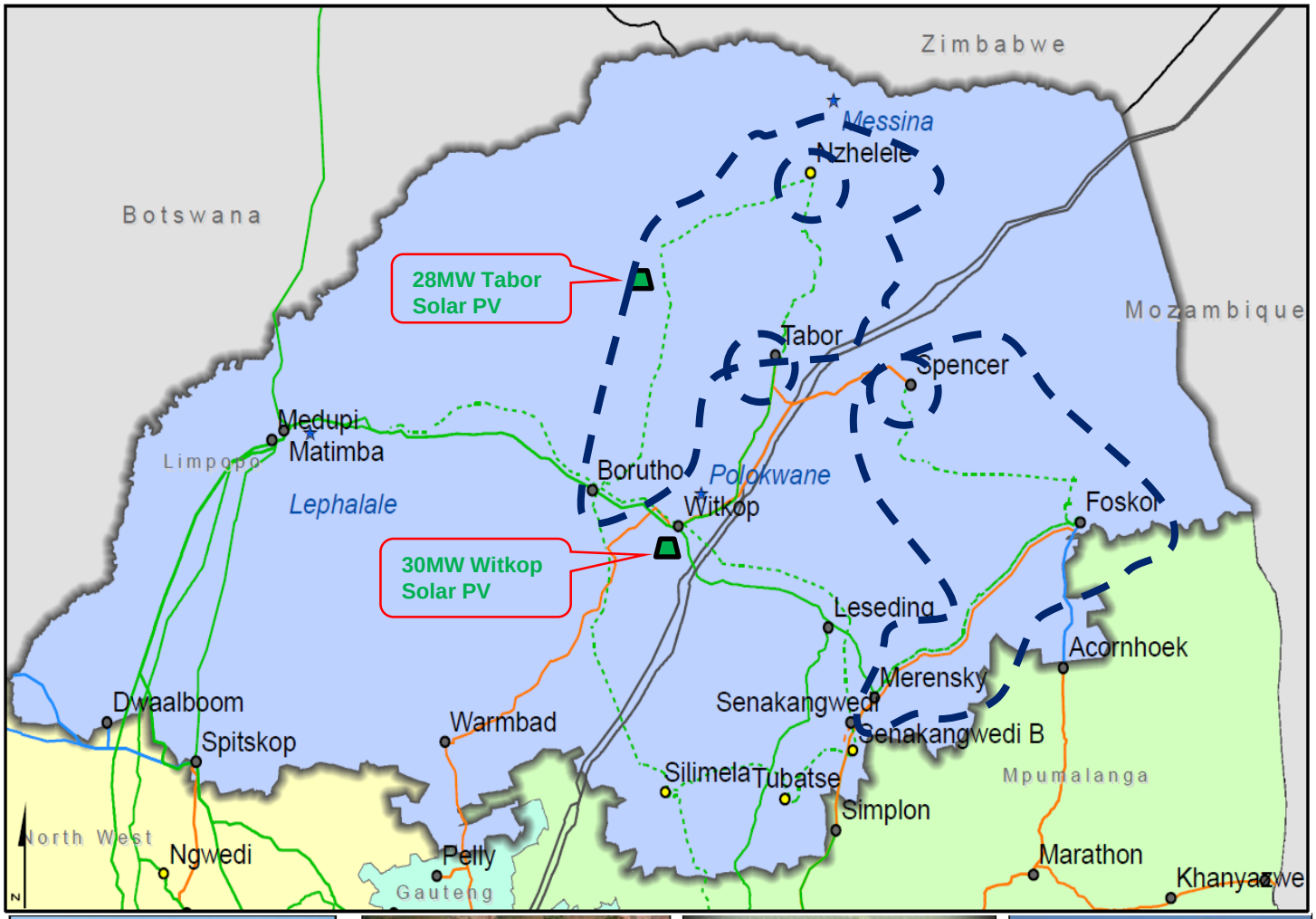
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Polokwane	894	873	895	1041	1059	1161	1170	1197	1406	1820	1894	1991
Lephalale	826	1118	1252	1371	1457	1584	1671	1801	1889	2012	2075	2113
Phalaborwa	1433	1484	1534	2243	2583	2847	3144	3426	3670	3871	4032	4204
Limpopo Grid Peak	3153	3474	3680	4300	4800	5000	5200	5600	5800	6000	6300	6600

Network Development Plan

Developments in the Polokwane CLN

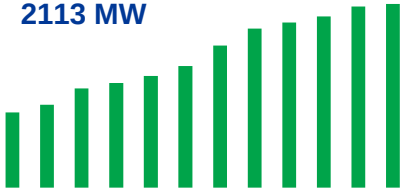
2020
1162 MW

- **Nzhelele 400kV Integration**
  - **Nzhelele 400/132kV substation (1st and 2nd 250MVA)**
  - **Tabor-Nzhelele 400kV line**
  - **Borutho-Nzhelele 1st 400kV line**
- **Limpopo East Corridor Strengthening**
  - **Spencer 400/132kV Transformation (1st 400MVA 400/132kV Transformer)**
  - **Foskor-Spencer 1st 400kV line (110km)**
- **Install Capacitor Banks at:**
  - **Tabor MTS**
  - **Spencer MTS**
  - **Nzhelele MTS**

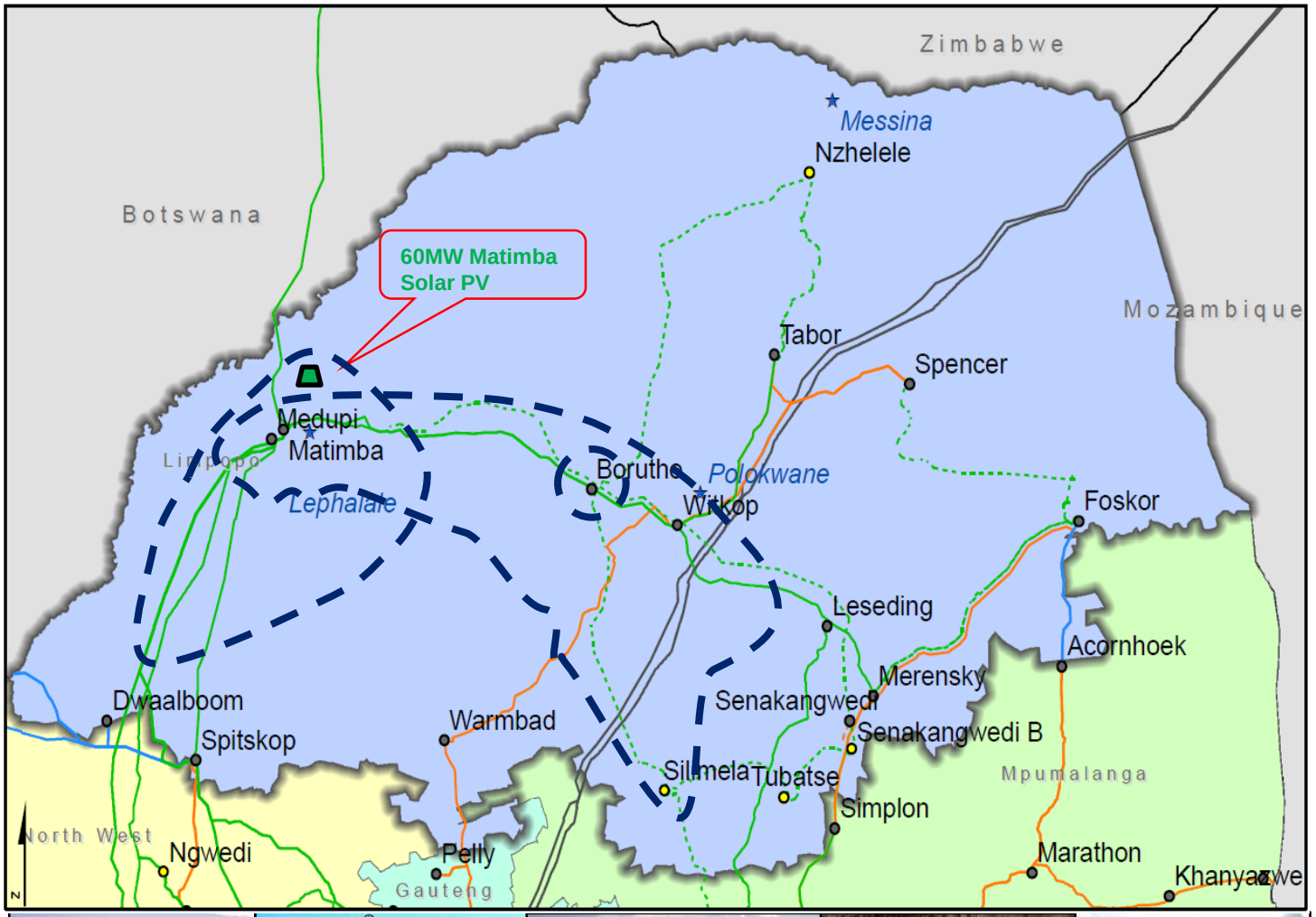


Developments in the Lephalale CLN

2027
2113 MW



- **Medupi Transmission Integration**
- **Waterberg Generation Integration at 400kV**
- **Borutho 3rd 500MVA 400/132kV transformer**

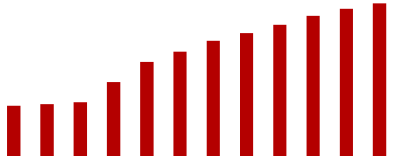




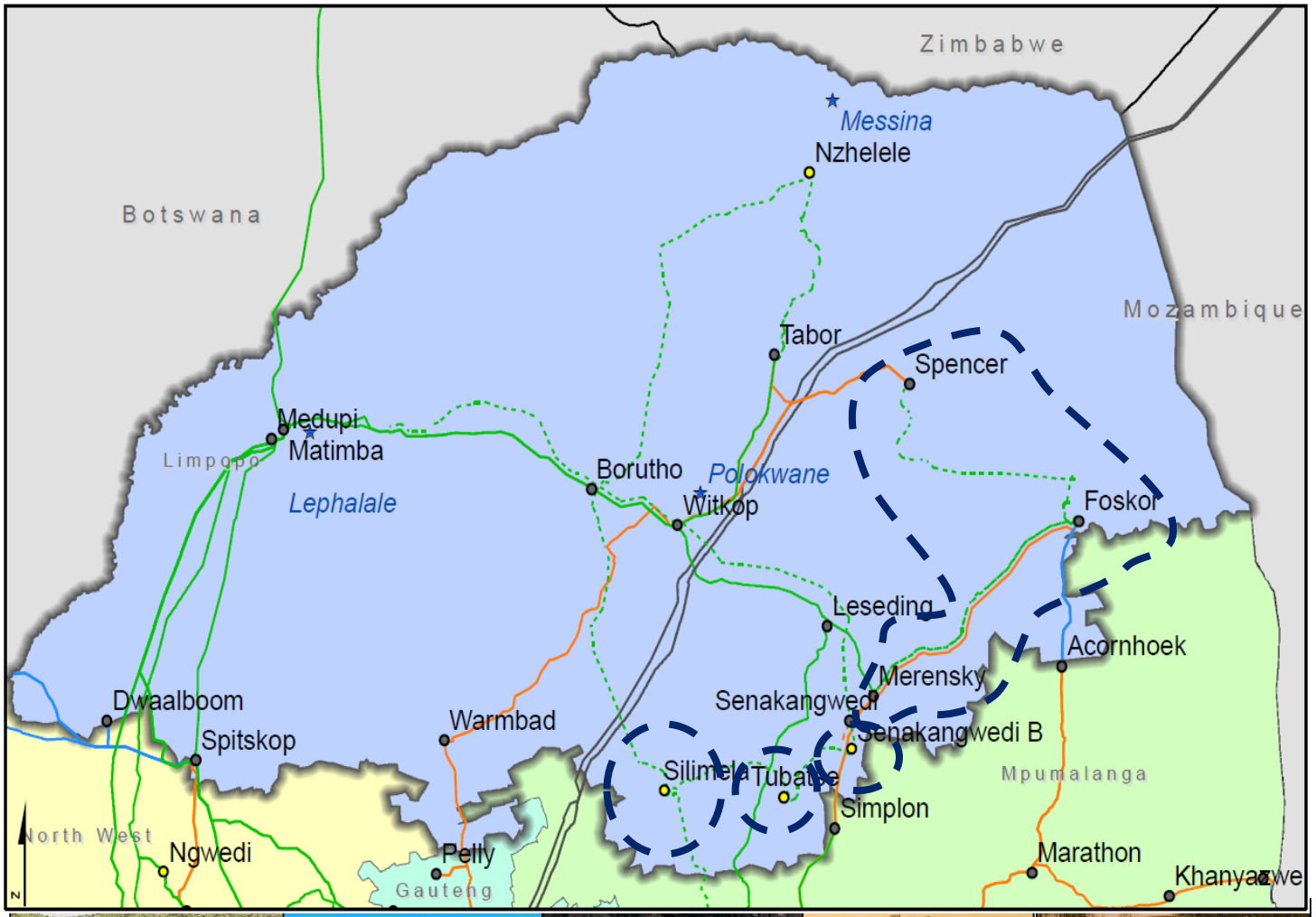


Developments in the Phalaborwa CLN

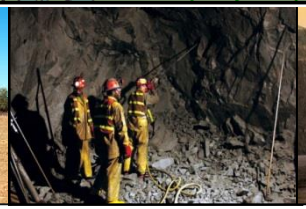
2017
1484 MW



- **Highveld North-West and Lowveld North Reinforcement-Phase 2**
  - **Silimela 400/132kV substation**
  - **Manogeng Switching Station**
- **Tubatse Strengthening Scheme Phase 1**
  - **Senakangwedi B MTS) 400/275kV Substation (1st 800MVA 400/275 kV transformer)**
- **Foskor & Acornhoek 275/132kV Transformation Upgrades**
  - **Foskor-Merensky 2nd 275kV Line (400kV)**
- **Limpopo East Corridor Strengthening Tabor MTS**
  - **Foskor-Spencer 1st 400kV line**







Mpumalanga Province

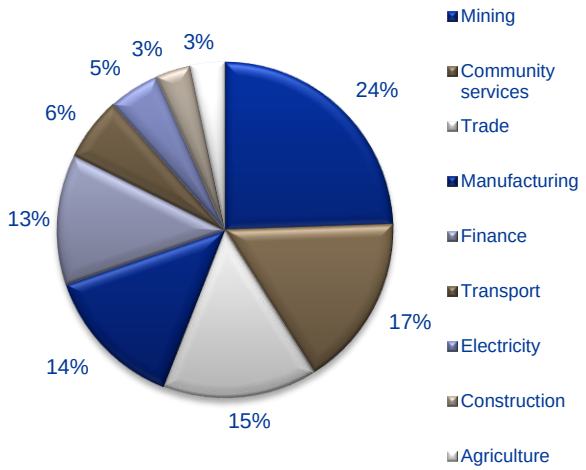
Planning Engineer: Kabir Singh

Presented by: Thamsanqa Ngcobo

Mpumalanga Province Profile

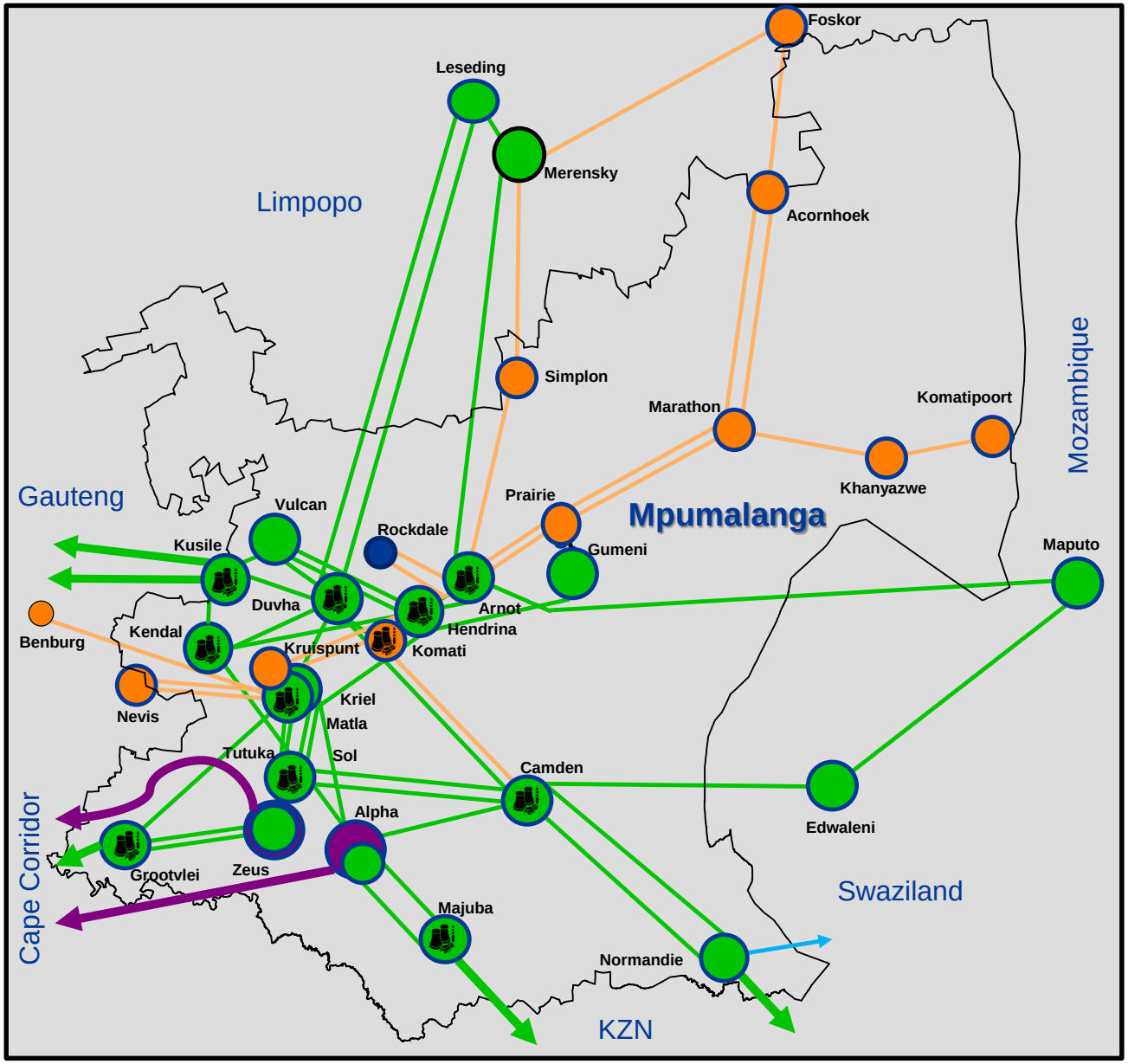
Sector Breakdown

- 2016 Peak load of 3934 MW



Generation Capacity of ~30 GW

	Power Station	Capacity
1	Arnot	2250
2	Camden	1520
3	Duvha	3600
4	Grootvlei	1200
5	Hendrina	1900
6	Kendal	4400
7	Kriel	3000
8	Komati	1000
9	Majuba	4000
10	Matla	3720
11	Tutuka	3600



Achievements

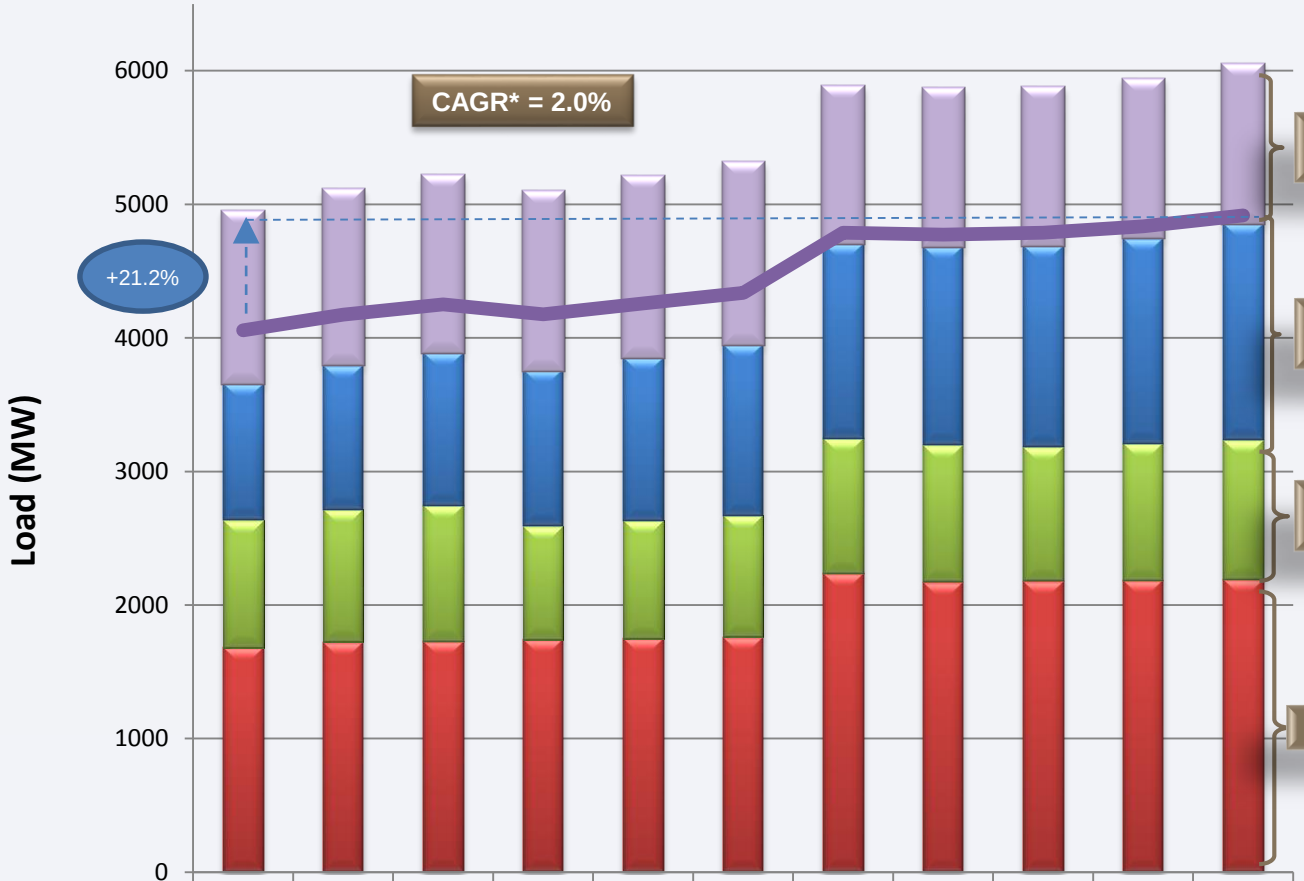
Completed projects

- **Gumeni 400/132 kV 500 MVA substation**
- **Hendrina-Gumeni 400 kV line**

- **Kusile 400 kV HV Yard**
- **Minerva - Duvha and Kendal – Apollo 400 kV lines loop in and out**

Load Forecast

Mpumalanga Load Forecast 2018 - 2027



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Witbank @ Grid Peak	1292	1312	1324	1333	1351	1364	1175	1179	1185	1189	1194
Middelburg @ Grid Peak	1020	1084	1144	1168	1219	1276	1462	1485	1505	1539	1621
Lowveld @ Grid Peak	956	992	1017	853	883	912	1009	1027	1007	1024	1042
Highveld South @ Grid Peak	1680	1723	1729	1739	1750	1760	2236	2171	2179	2186	2194
Mpumalanga @ Grid Peak	4056	4173	4249	4175	4257	4337	4788	4774	4788	4835	4915

Growth Drivers

*** Compound Annual Growth Rate**

Generation Forecast

Generation Forecast

Commissioning schedule

Station	Kusile		Khanyisa IPP	
Year	Unit	MW	Unit	MW
2018	1	722		
2019	2	722		
2020	3	722		
2021	4	722	1	150
2021			2	150
2022	5	722		
2023	6	722		

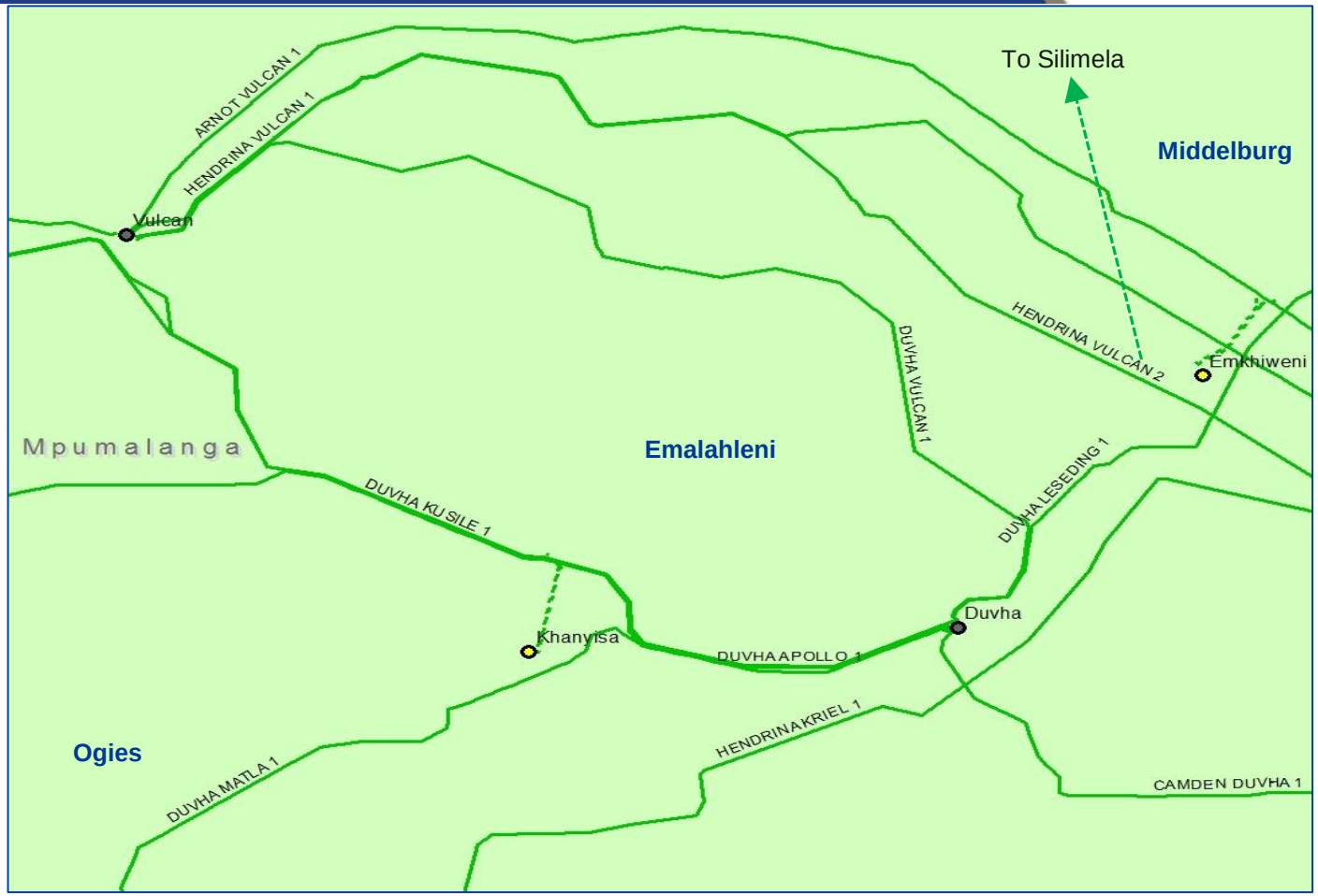
Network Development Plan

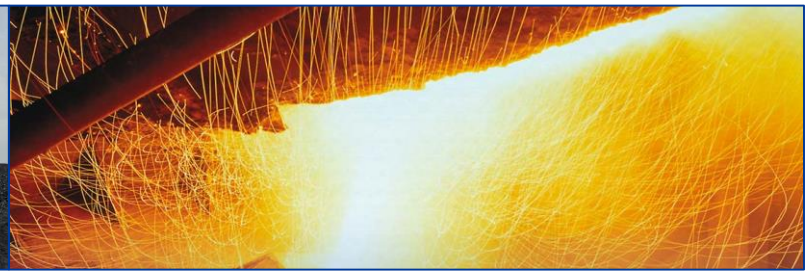
Developments in Witbank

- **Kusile Integration**
  - **Kusile-Duvha 400kV line**
  - **Kusile-Minerva 400kV line**
  - **Kusile-Apollo 400kV line**
  - **Kusile-Lulamisa 400kV line**
  - **Kusile-Zeus 400kV line**
  - **Kendal-Zeus 400kV line**

Developments in Witbank and Middelburg

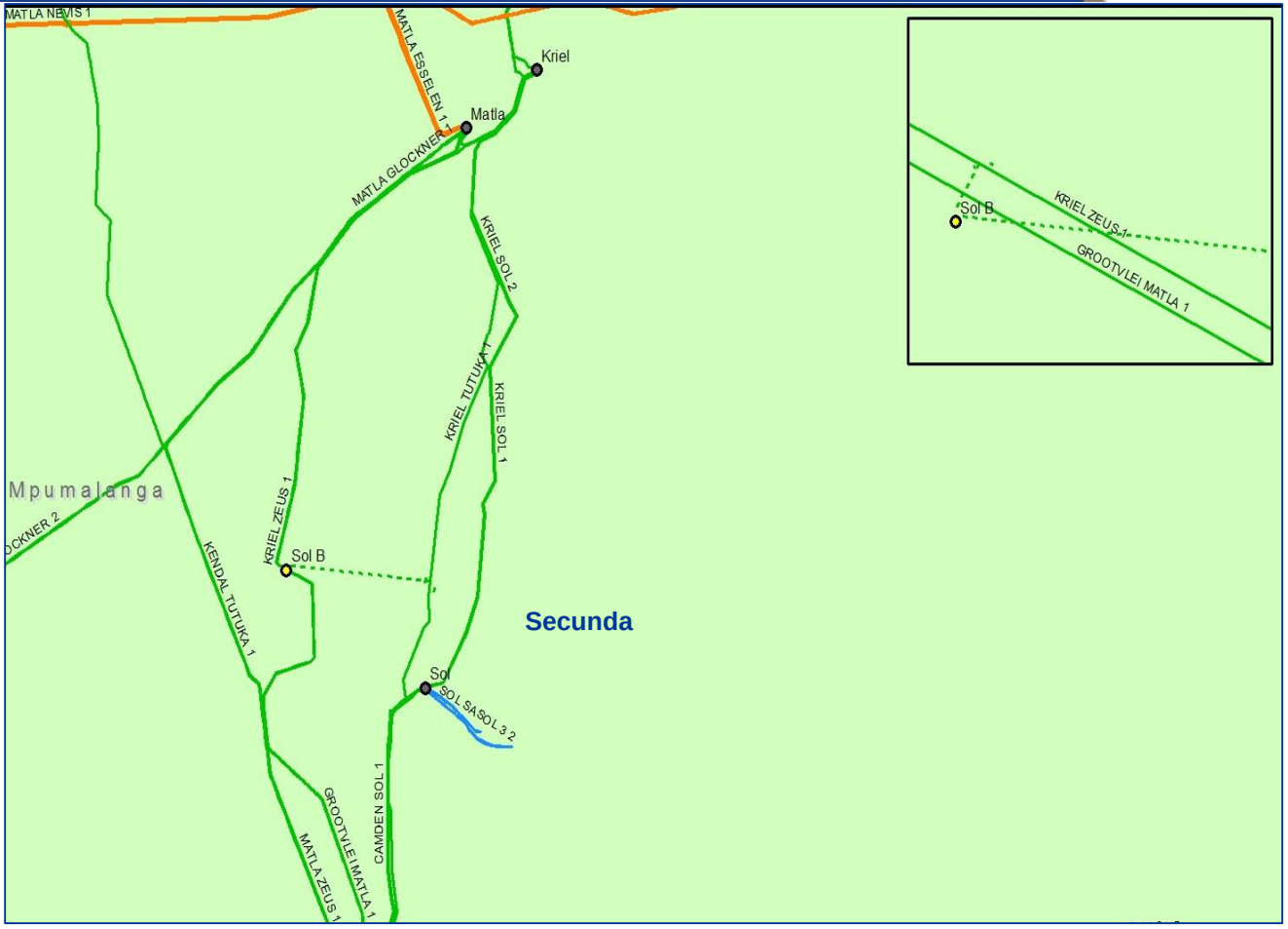
- **Khanyisa IPP**
  - **Kusile-Vulcan 400kV LILO**
- **Emkhiweni Integration**
  - **Arnot-Vulcan 400kV LILO**
  - **Emkhiweni-Silimela 400kV line**





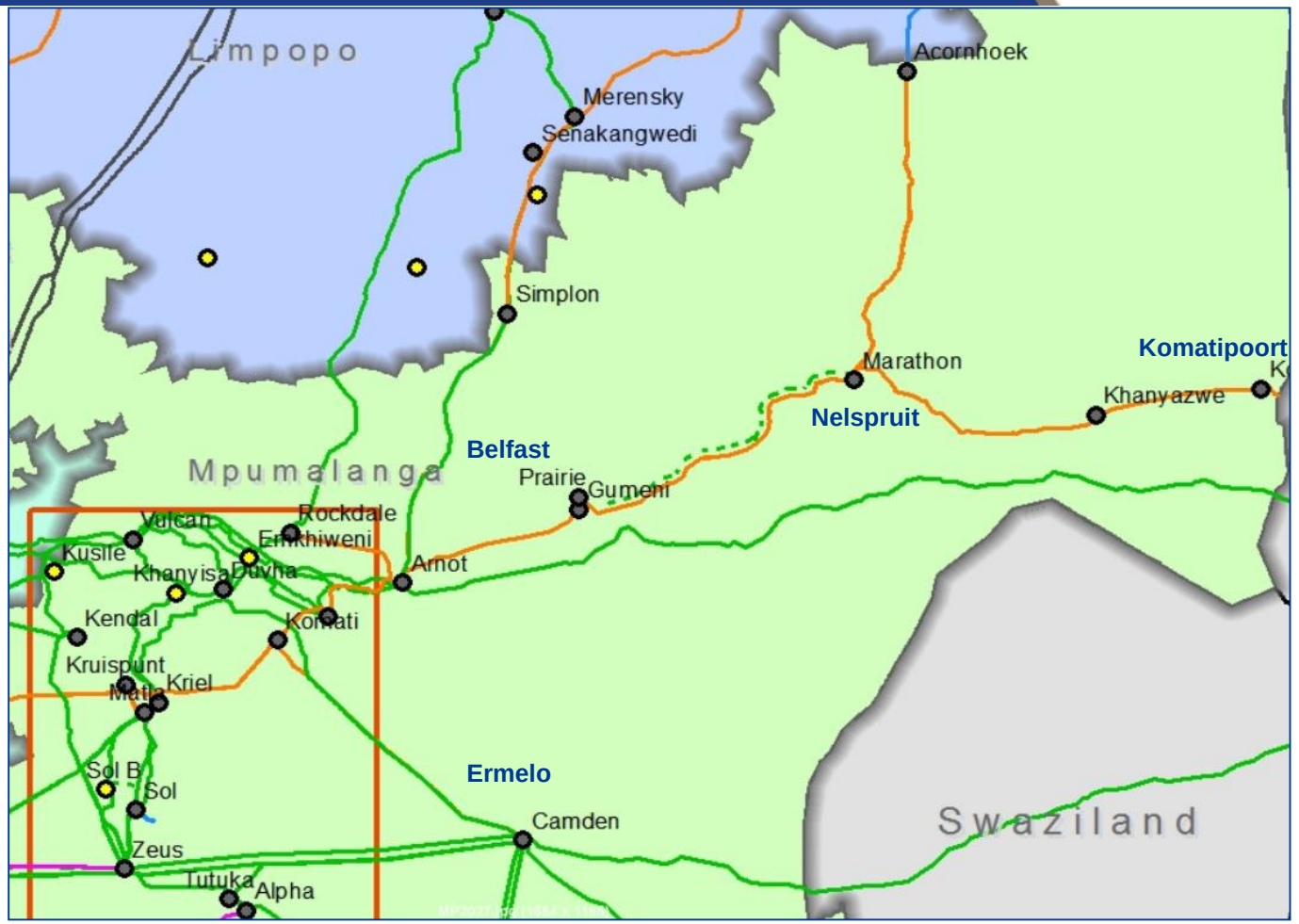
Developments in Highveld South

- **Mulalo (Sol B) Integration**
  - **Kriel-Zeus 400kV LILO**
  - **Kriel-Tutuka 400kV LILO**



Developments in the Lowveld CLN

- **Marathon 400kV Integration**
  - **Marathon 1st 500 MVA 400/132 kV transformer**
  - **Marathon-Gumeni 400 kV line**



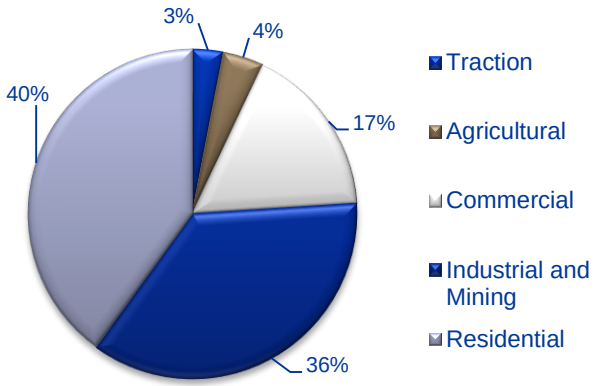
Gauteng Province

Presented by: Thamsanqa Ngcobo (Planning Engineer)

Gauteng Province Profile

Load

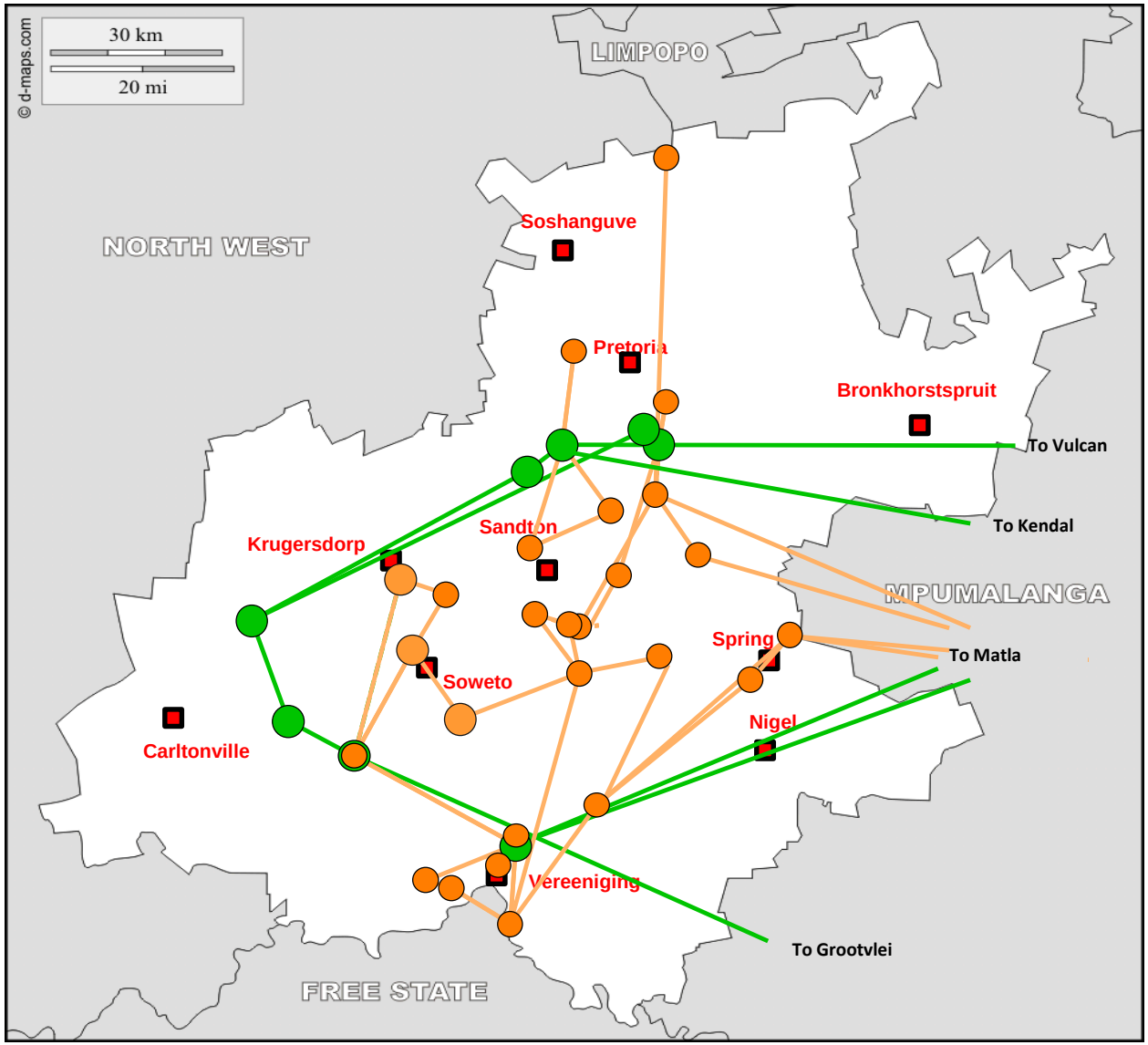
- **Peak load of 9 885 MW : 28th July 2016**



Generation

- Kelvin Power Station (in Johannesburg) and Rooiwal Power Station (in Tshwane) are some of the Independent Power Producers (IPPs) that lie within the defined Gauteng grid area. There is also potential Biomass IPPs in the region.

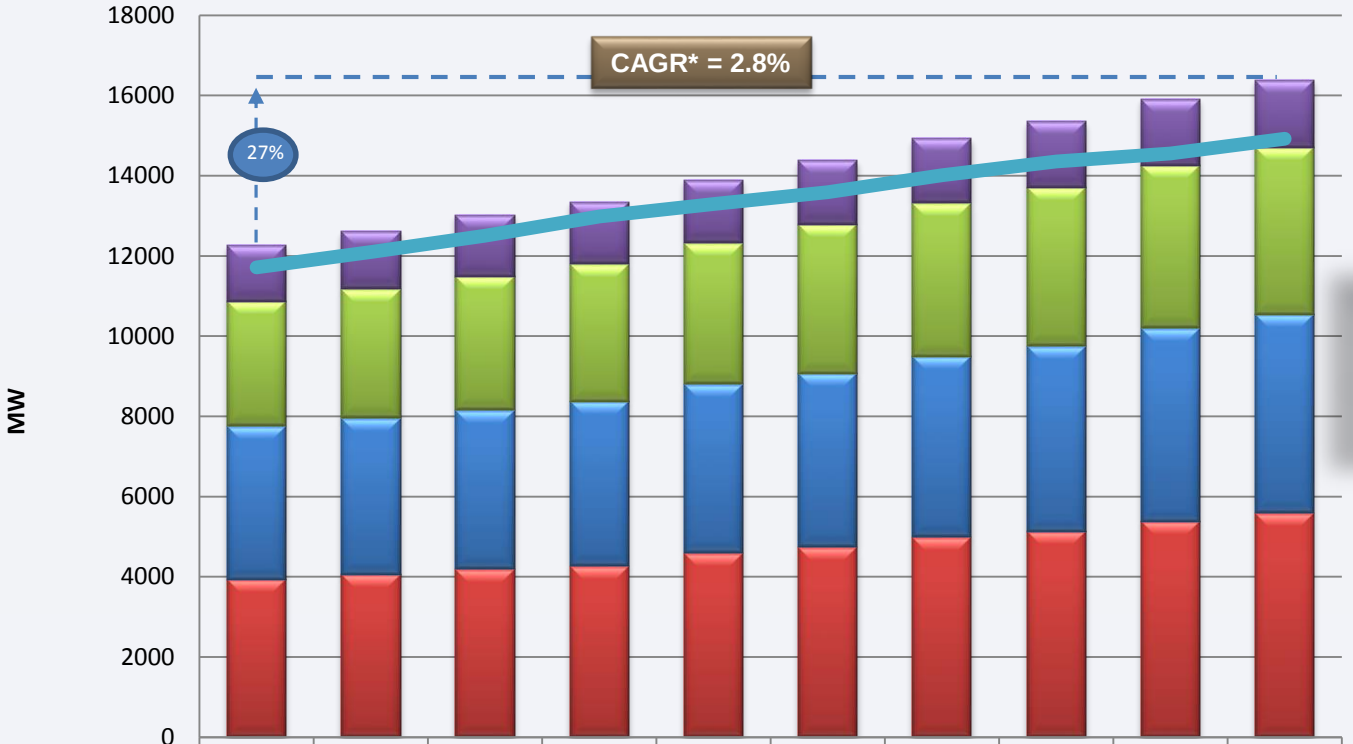
- The primary sources of power are Cahora Bassa, Lethabo, Matla, Kendal, Duvha, Grootvlei and Matimba power stations.



Load Forecast

Gauteng Load Forecast

Gauteng Province Load Forecast



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
VAAL GRID PEAK	1391	1431	1543	1558	1571	1597	1609	1651	1658	1682
WEST RAND GRID PEAK	3110	3217	3326	3424	3515	3722	3829	3948	4061	4173
EAST RAND GRID PEAK	3825	3905	3969	4098	4207	4325	4499	4635	4816	4937
JHB GRID PEAK	3935	4051	4186	4271	4600	4738	4988	5125	5378	5596
GAUTENG TOSP	11716	12095	12505	12982	13290	13592	14012	14351	14557	14925

Natural load growth:
- **residential developments**
- **commercial and light industrial load growth**

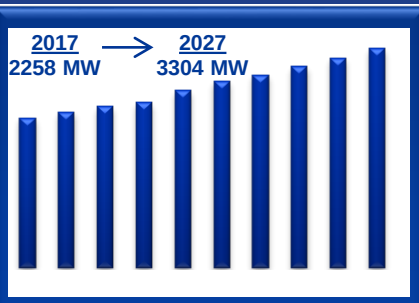
*** Compound Annual Growth Rate**

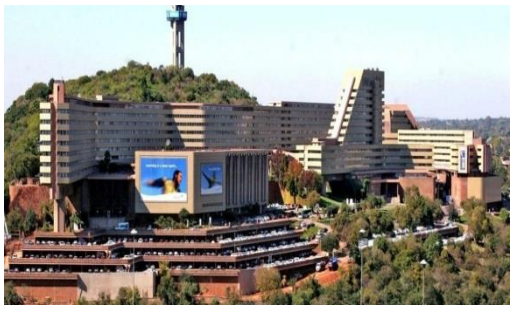
Major Developments

Major developments in Pretoria East

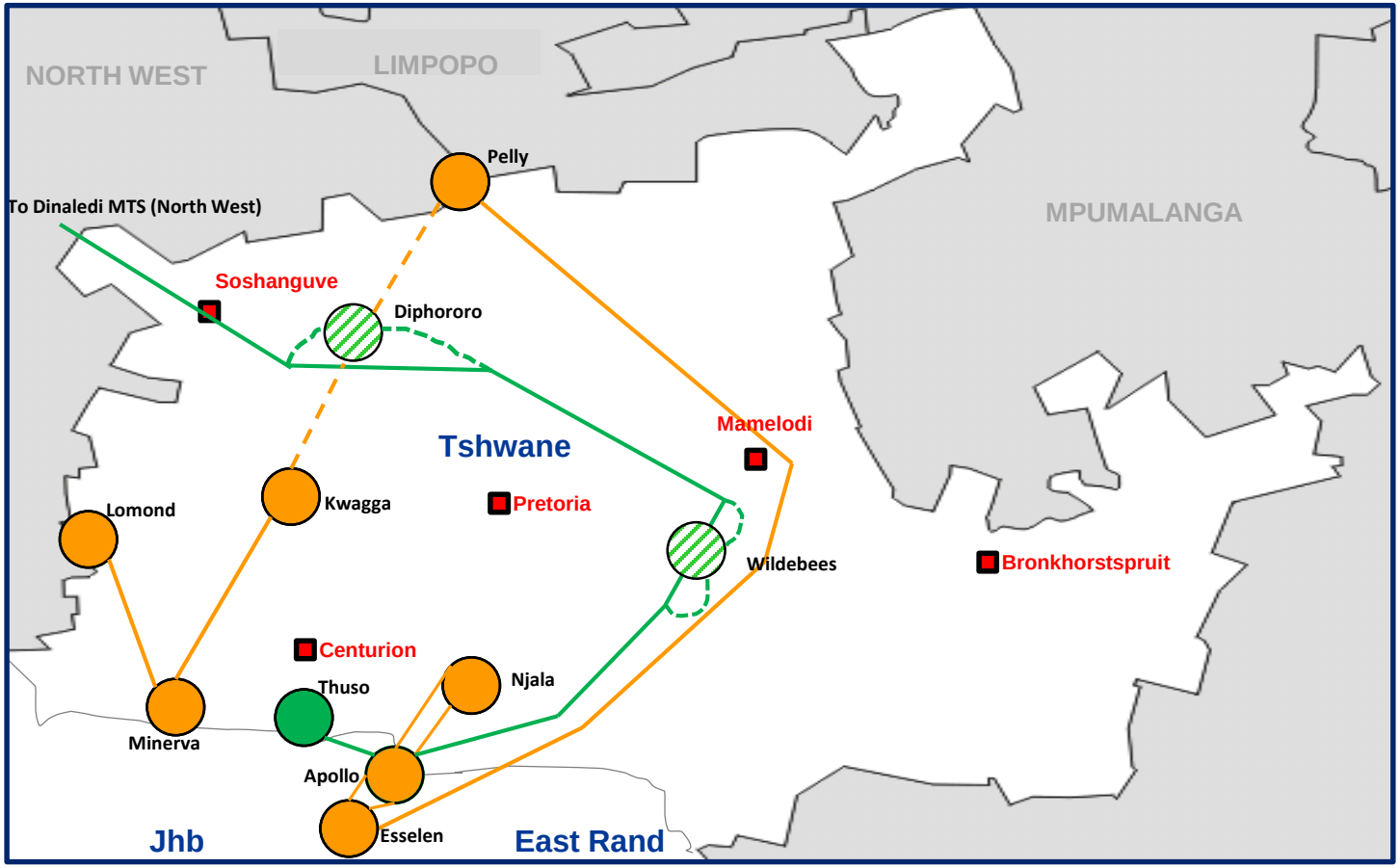
Hazeldean Node Development (East Capital): The Hazeldean Consortium master plan includes a mall, hospitals, educational facilities, residential, retail, hospitality and tourism components.

Developments in the Tshwane CLN

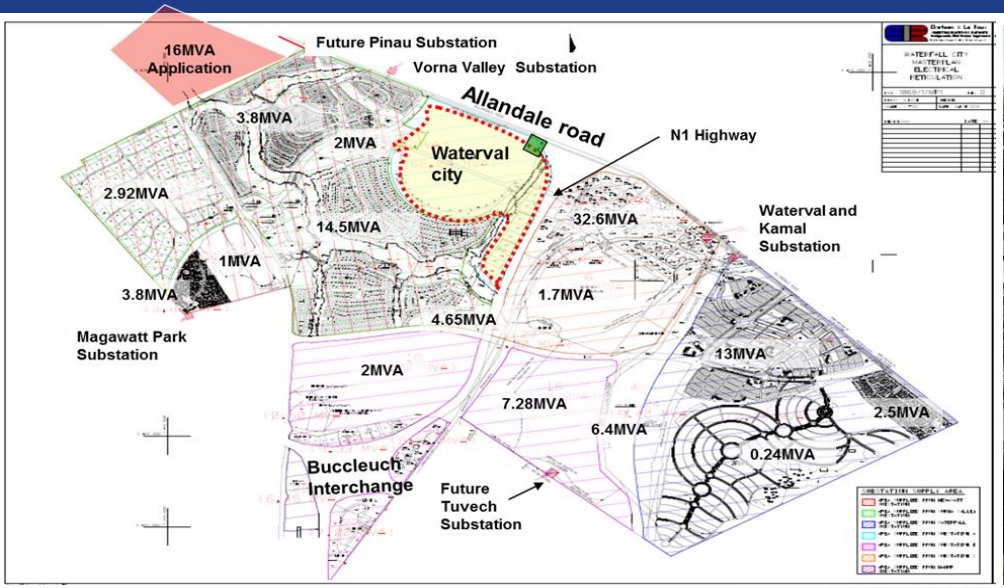


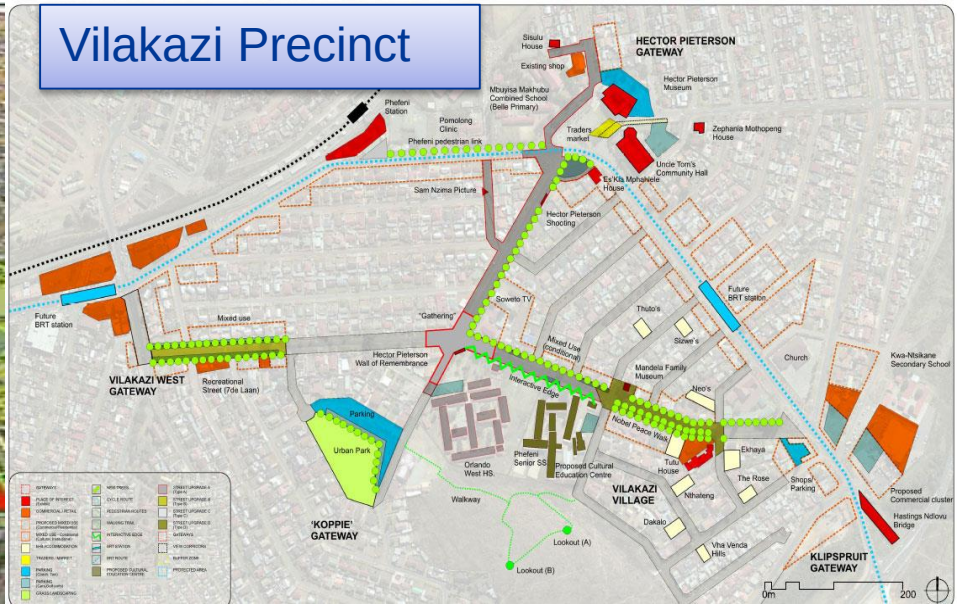


- Tshwane Reinforcement – Wildebees integration
- Tshwane Reinforcement – Diphororo Phase 1
- Tshwane Reinforcement – Diphororo Phase 2



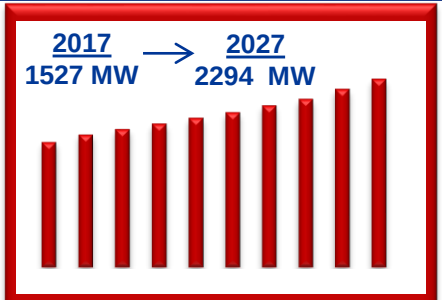
Key Developments in Joburg North/West Rand



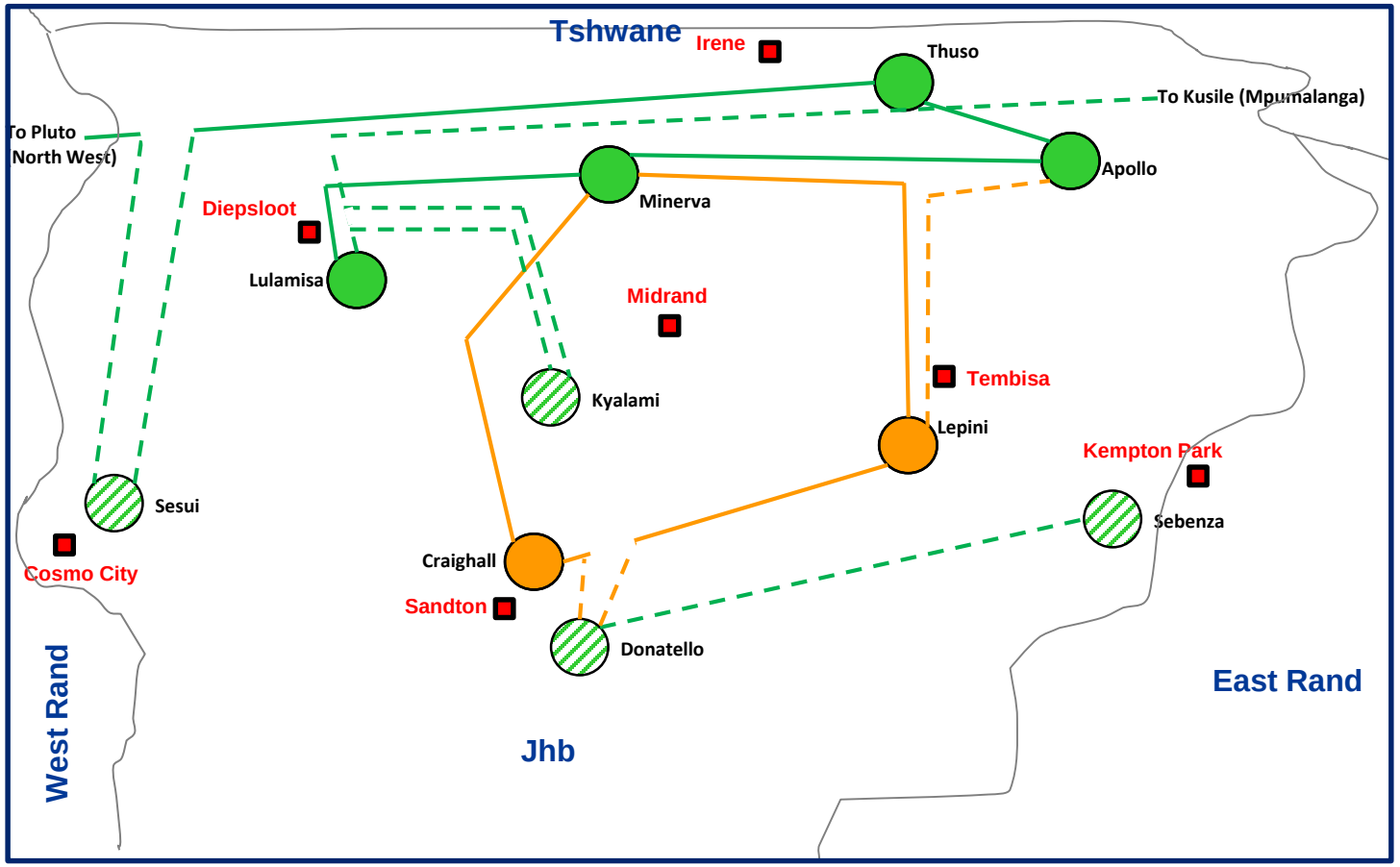


- Lufhereng and Syferfontein Development – Mixed housing developments planned in the Soweto area. (>60 000 housing units envisaged)

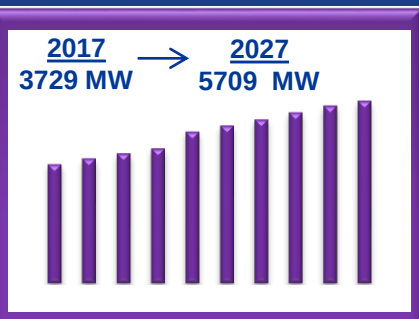
Developments in the JHB North CLN

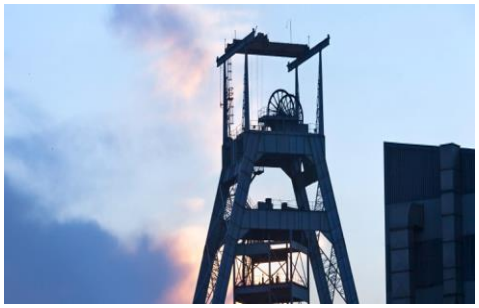


- Kusile-Lulamisa 400kV line
- Apollo-Lepini 2nd 275kV line
- New MTS Sesui 400/88kV
- New MTS Kyalami 400/88kV
- New MTS Donatello 400/88kV

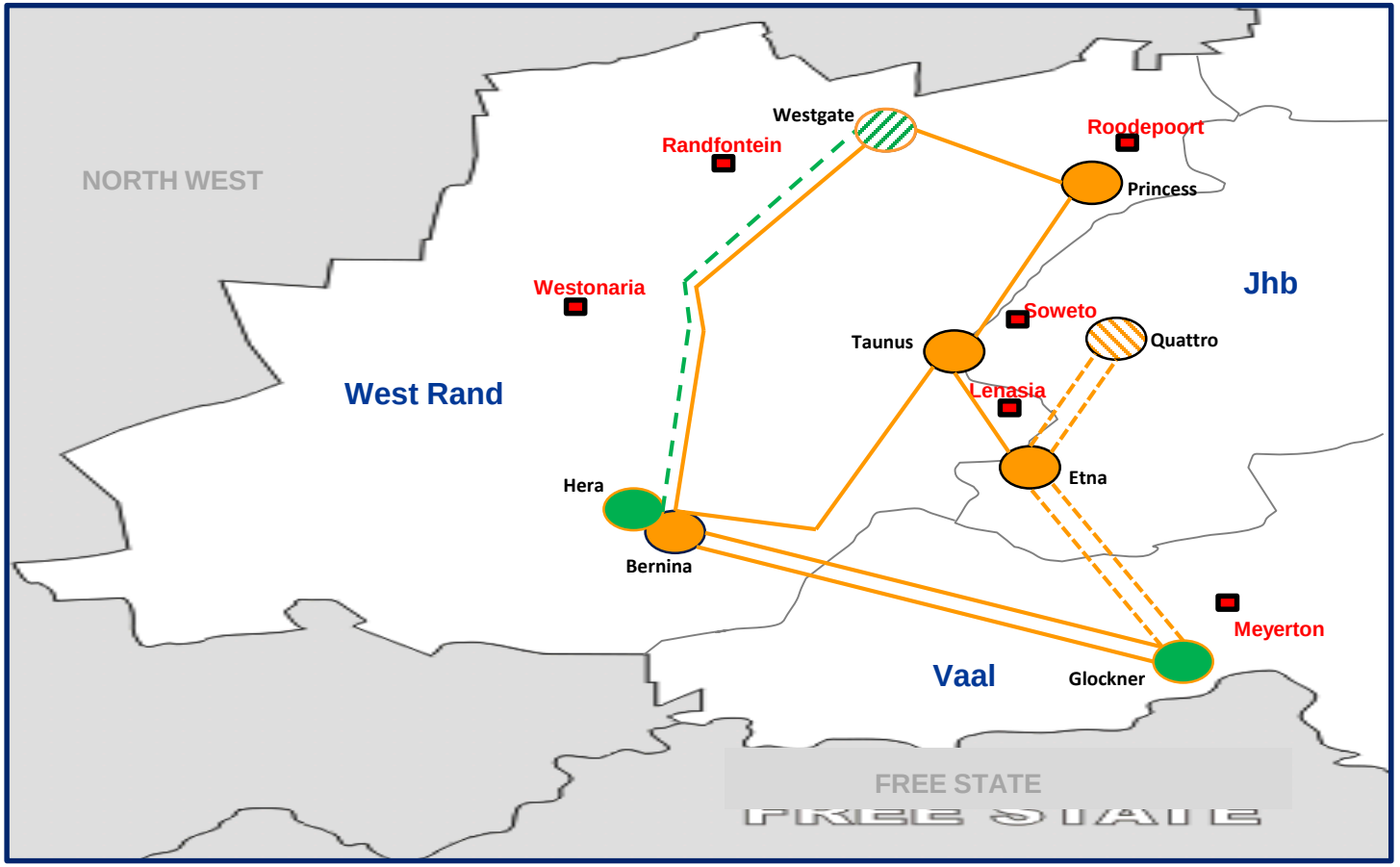


Developments in the West Rand and Vaal CLN

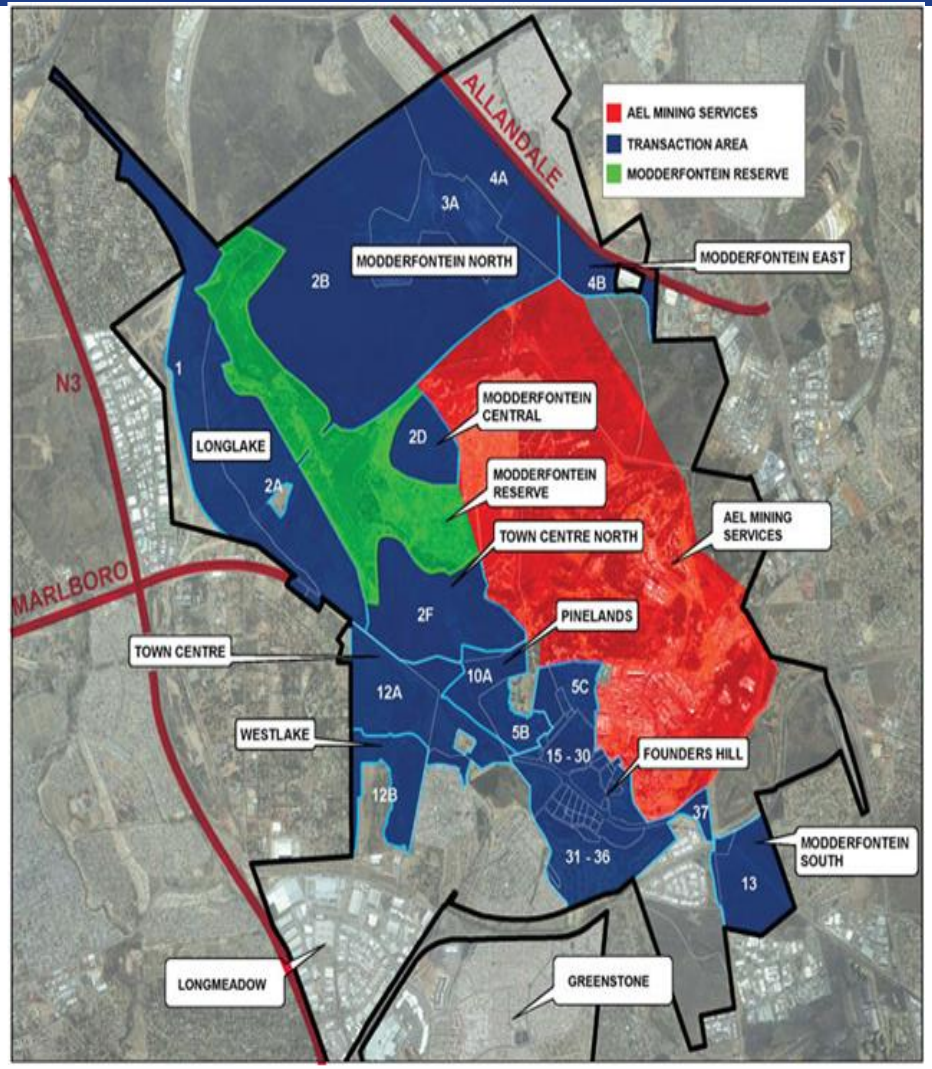


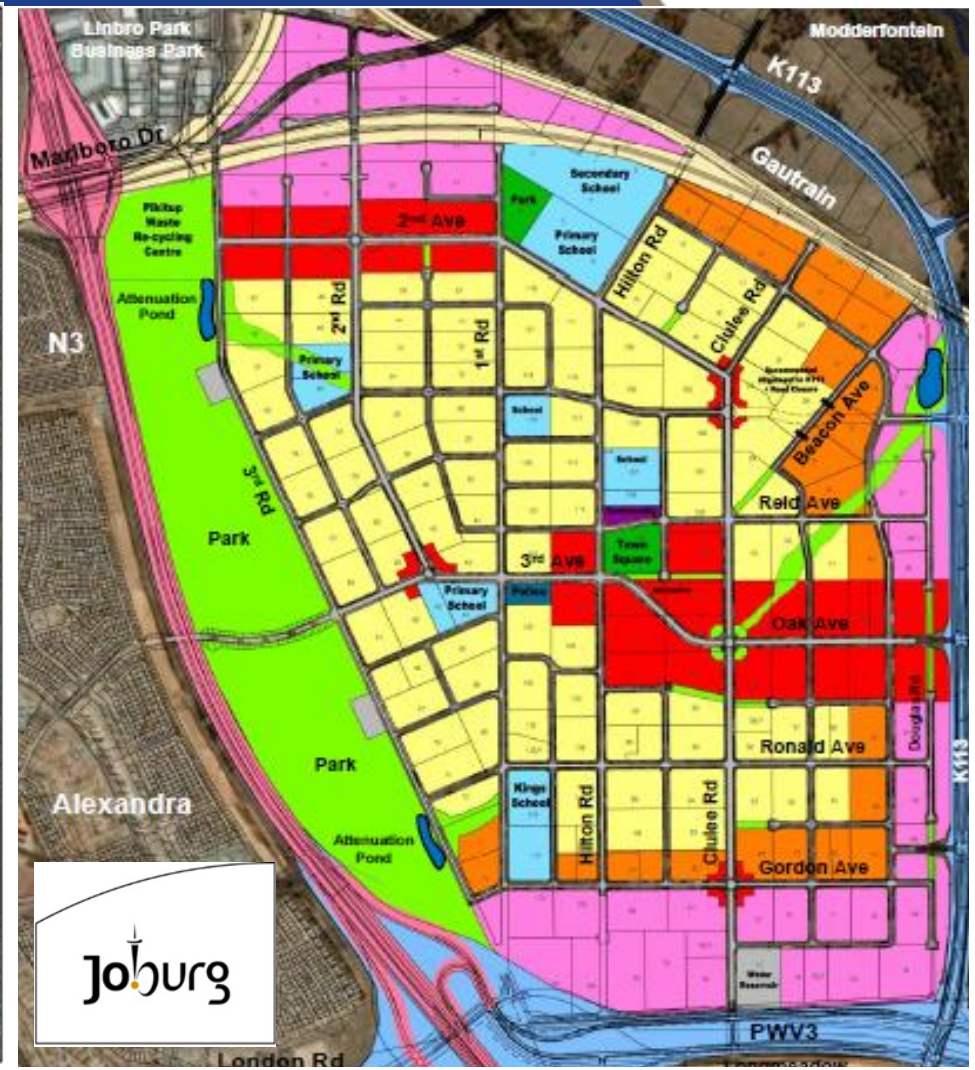


- Vaal Strengthening Phase 2
- Soweto Strengthening
- West rand Strengthening Phase 1



Key Developments in Joburg South/East Rand





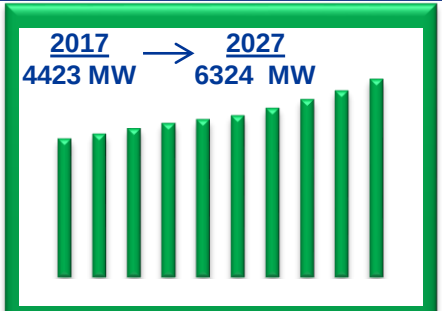
Zendai Modderfontein (Mixed Development)

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

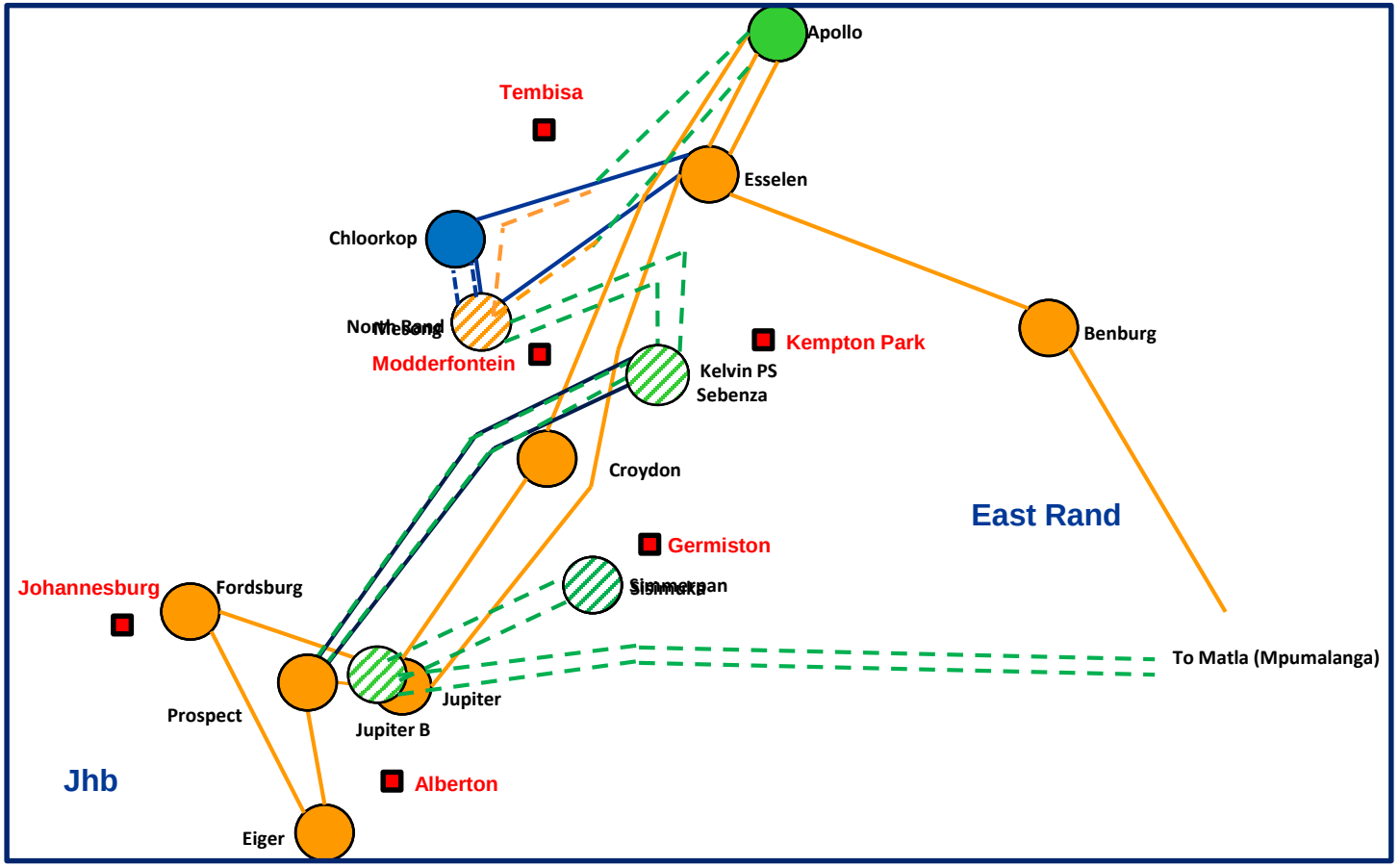
Linbro Park (Mixed Development)

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

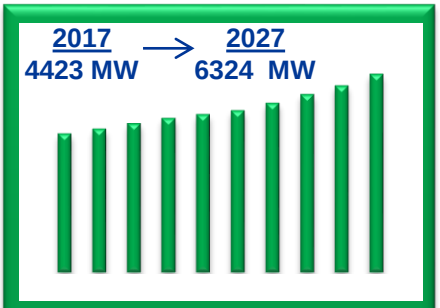
Developments in the JHB East and South CLN



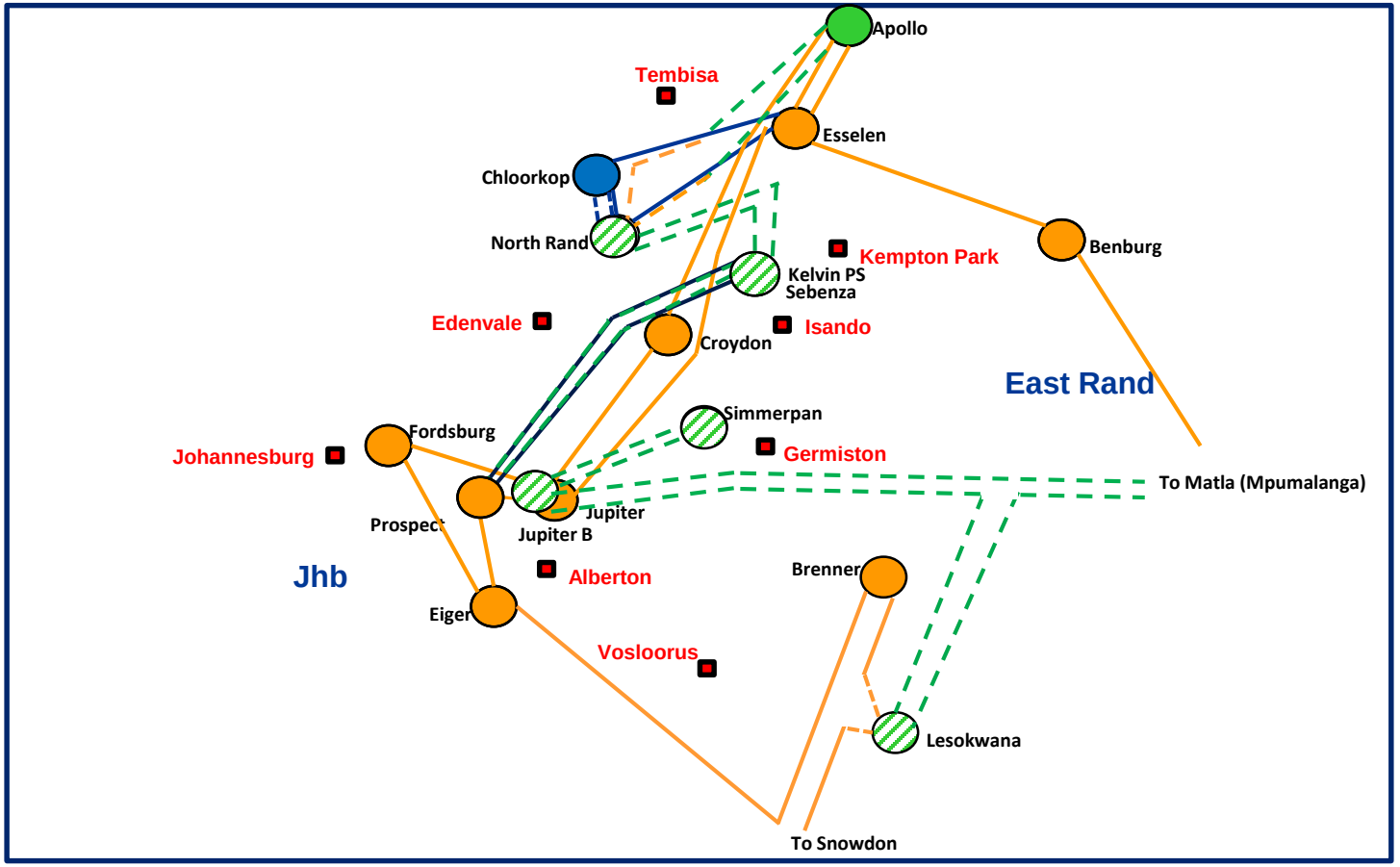
- City Power integration
- Mesong integration
- Sebenza integration
- Jupiter B integration
- Sisimuka integration



Developments in the JHB East and South CLN



- City Power integration
- Mesong integration
- Sebenza integration
- Jupiter B integration
- Sisimuka integration
- Lesokwana Integration



Servitude Constraints – GP Urban Area

KwaZulu-Natal Province

Presented by: Thokozani Bengani (Planning Engineer)

KwaZulu-Natal Province

Generation

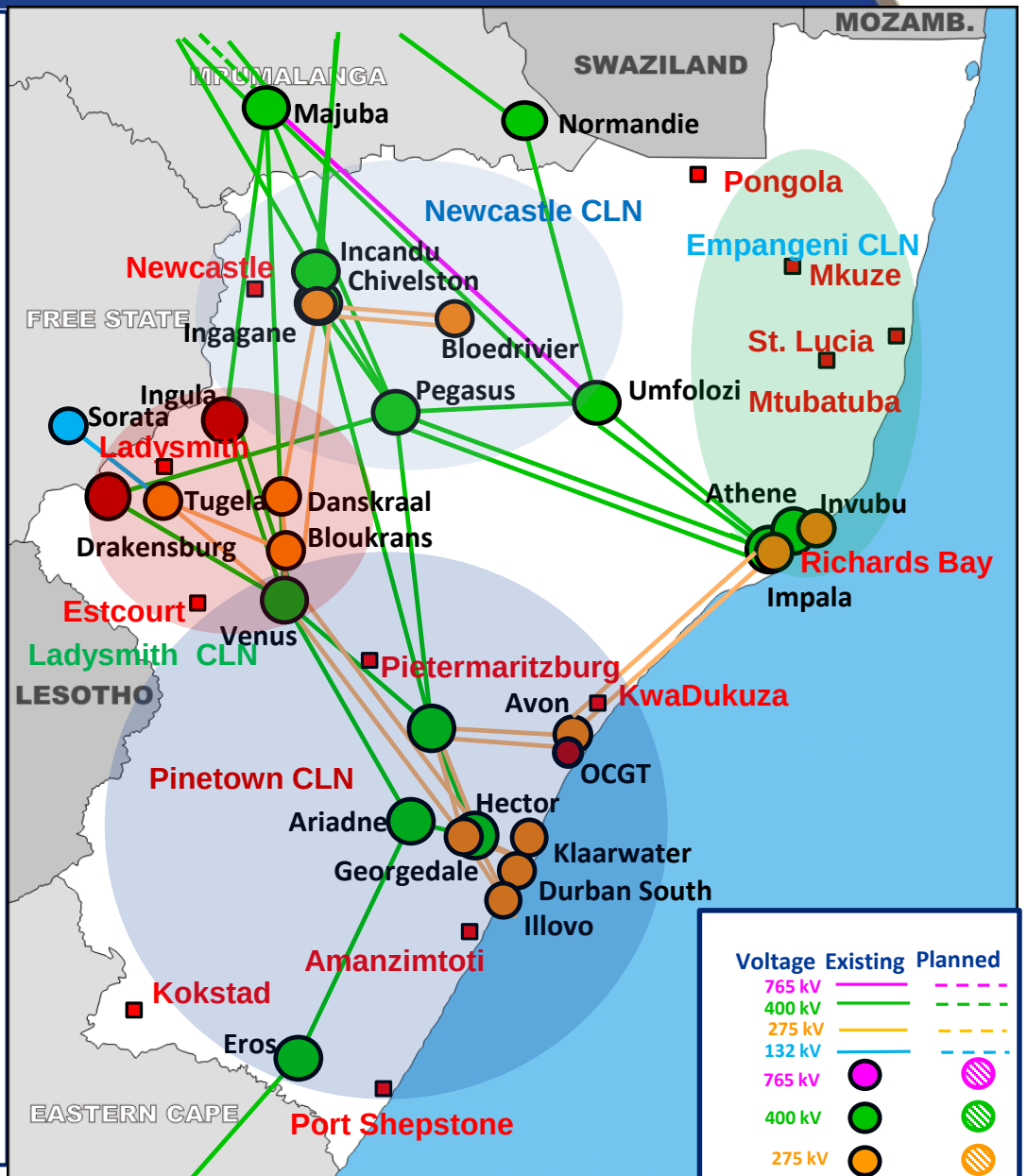
- Power supply into the province is mainly from Mpumalanga Province power pool
- Drakensberg Pumped Storage with 1000 MW installed capacity
- Ingula Pumped Storage with 1330 MW installed capacity
- Avon OCGT with 680 MW installed capacity

Geographical area

- Newcastle, Ladysmith, Drakensberg, Pietermaritzburg, Pinetown, Port Shepstone, Amanzimtoti, Durban, KwaDukuza, Empangeni, Richards Bay, St Lucia, Hluhluwe and Ermelo

Economic Activity

- Redistributors, Commercial, Mining, Industrial, Residential, Agricultural, Traction



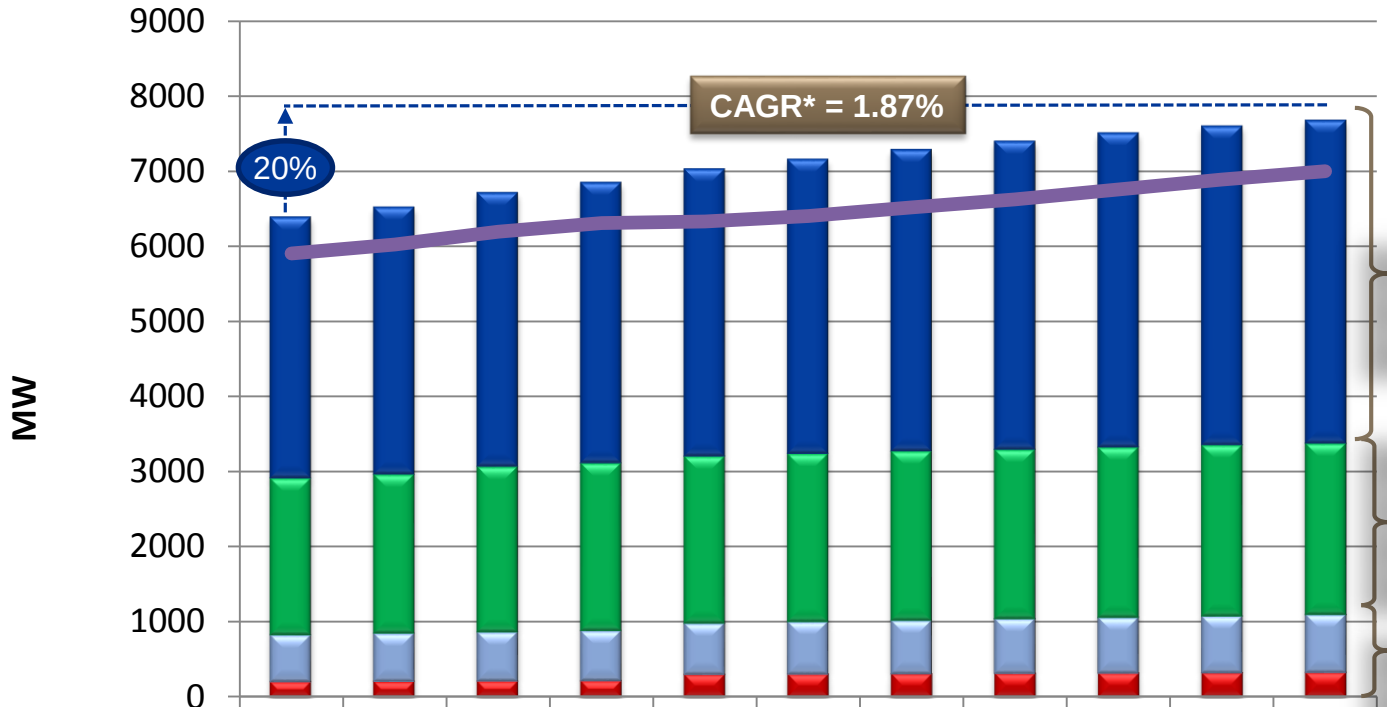
Achievements

Avon, Mersey and Incandu 3rd Transformers

1 x 500 MVA & 2 x 250 MVA transformers were installed in KZN in 2016, adding a total of 1000 MVA of capacity to the system

Load Forecast

KwaZulu-Natal Load Forecast



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Pinetown (GP)	3477	3557	3646	3736	3826	3922	4014	4100	4184	4242	4300
Empangeni (GP)	2088	2123	2206	2234	2225	2237	2253	2259	2270	2282	2283
Newcastle (GP)	627	642	658	673	688	702	717	732	746	760	773
Ladysmith (GP)	207	210	213	217	300	305	309	313	317	322	326
TOSP	5,903	6,025	6,196	6,312	6,332	6,405	6,519	6,626	6,759	6,890	7,002

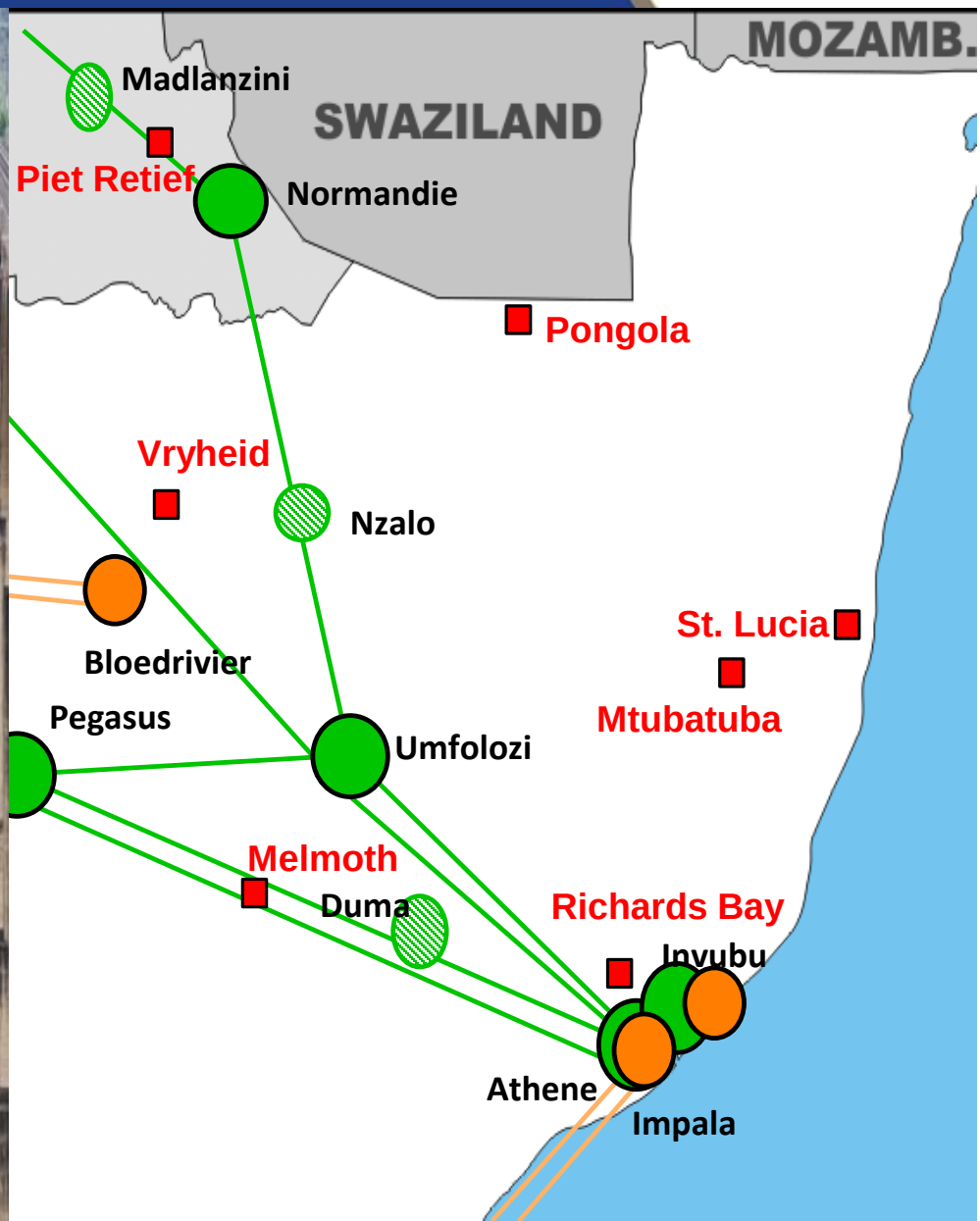
*** Compound Annual Growth Rate**

Network Development Plan

Key Developments in Empangeni, Ulundi, Vryheid and Newcastle

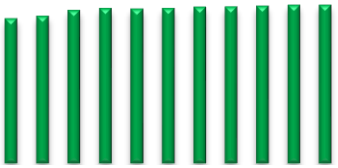
- **Drivers for load growth:**
  - **Coal Mining and Ermelo-Richards Bay Coal line**
  - **Industrial activities**
  - **Public infrastructure delivery**
- **Planned Project:**
  - **Madlanzini substation loop into Camden-Normandie 400 kV line**
  - **Nzalo substation loop into Normandie-Umfolozi 400 kV line**
  - **Duma Substation loop into Pegasus-Athene 400 kV line**

These substations will reinforce the Ermelo-Richards Bay coal link

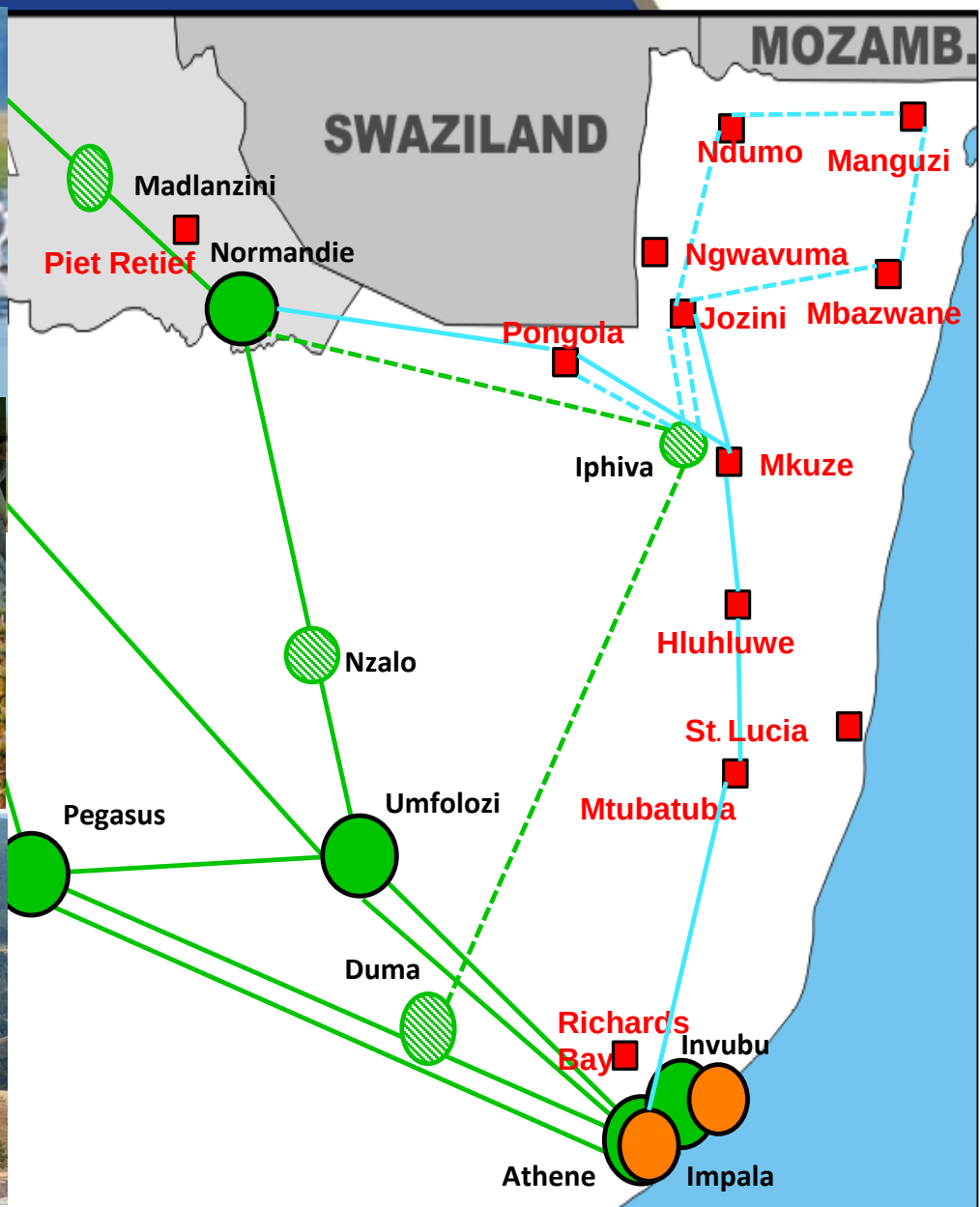


Key Developments in Northern KZN

Empangeni CLN: 2027 2283 MW

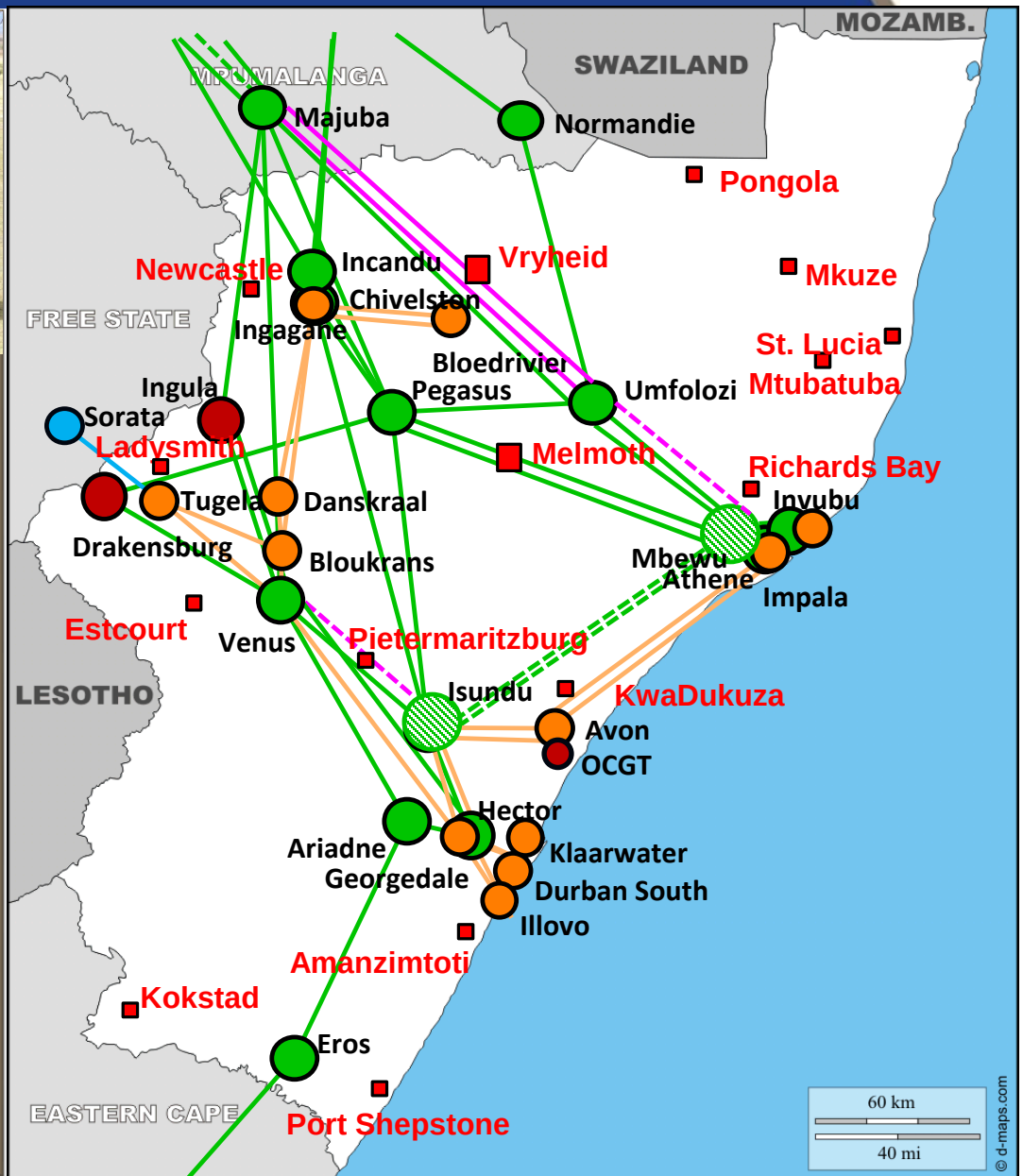


- Growth Drivers :
  - iSimangaliso wetland park eco-tourism
  - Agriculture
  - Public infrastructure delivery
- Planned Project:
  - Northern KZN Strengthening: Phase 1: Normandie-Iphiva 400 kV line and integration of Iphiva Substation near Mkuze
  - Phase 2: Duma-Iphiva 400 kV line



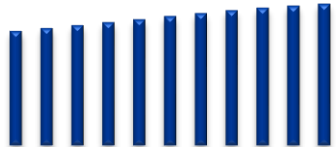
KwaZulu-Natal 765 kV Strengthening

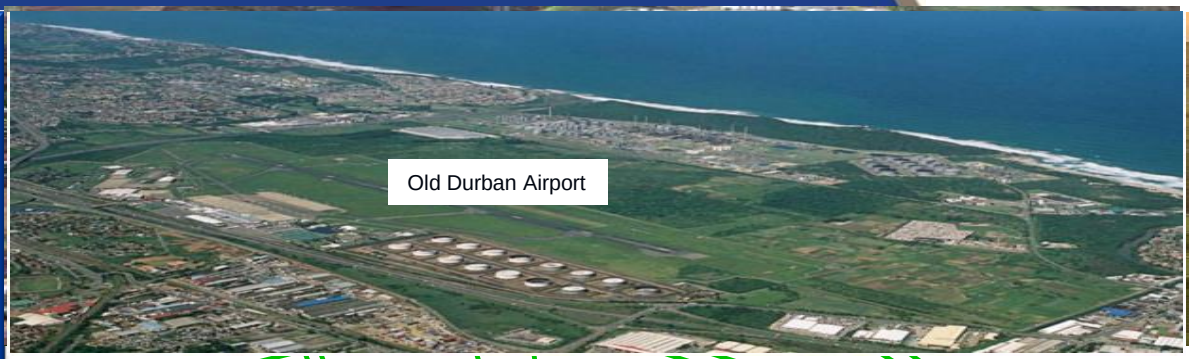
- **Purpose:**
  - To create sufficient capacity to meet the growth in demand
  - Also provide opportunities to switch off critical circuits for maintenance
- **KZN 765 kV Strengthening Planned Projects:**
  - Empangeni Integration
  - Pinetown Integration



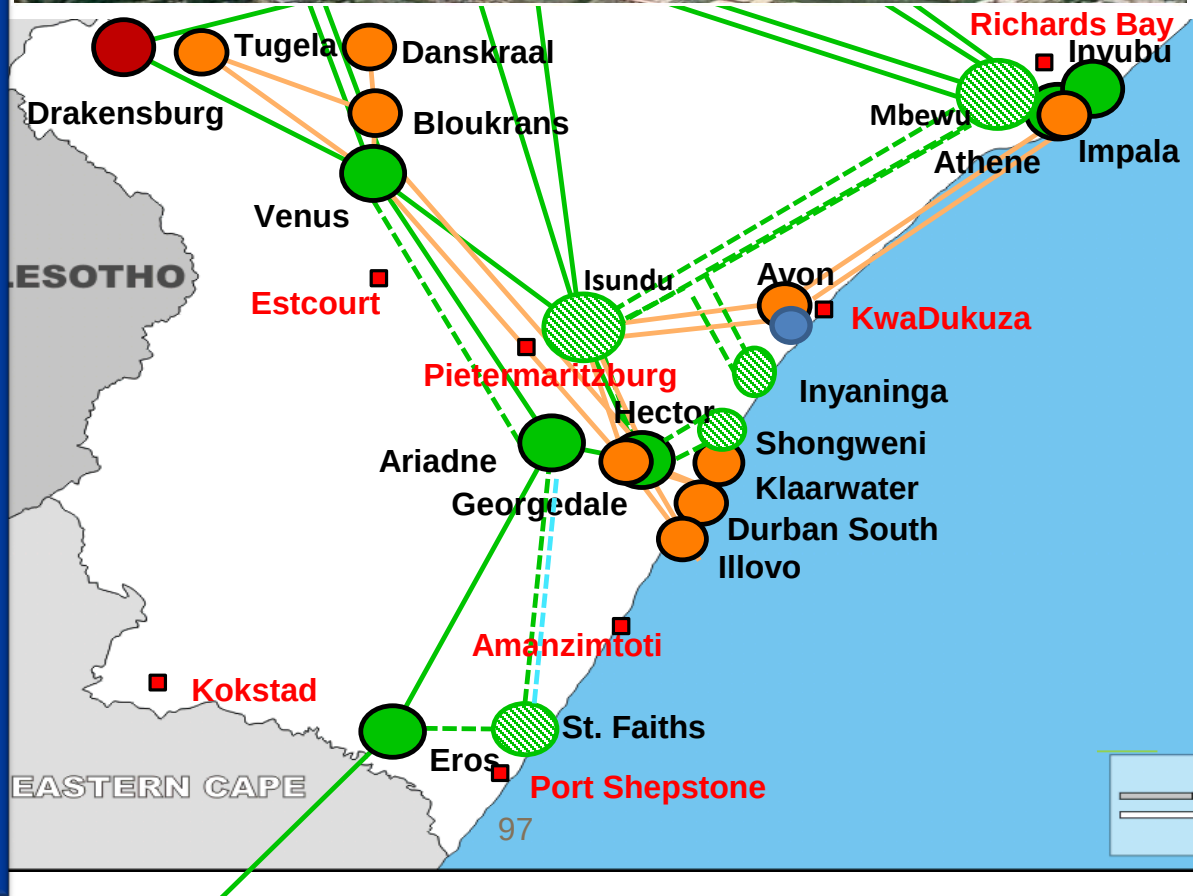
Key Developments in Pinetown CLN

Pinetown CLN: **2027 4300 MW**





- **Drivers for load growth:**
  - **eThekwini Metropolitan:**
    - **Shongweni development**
    - **Cornubia development**
    - **Dube tradeport development**
    - **Old airport dig-out**
  - **South Coast:**
    - **Commercial and tourism**
    - **Public infrastructure delivery**
- **Planned Project:**
  - **Venus- Ariadne 2nd 400 kV line**
  - **eThekwini Strengthening**
    - **Integration of Inyaninga SS**
    - **Integration of Shongweni SS**
  - **South Coast Strengthening:**
    - **Ariadne-Eros 400 kV line and integration of St Faiths SS**



Free State Province

Presented by: Thokozani Bengani (Planning Engineer)

Free State Province Profile

Generation

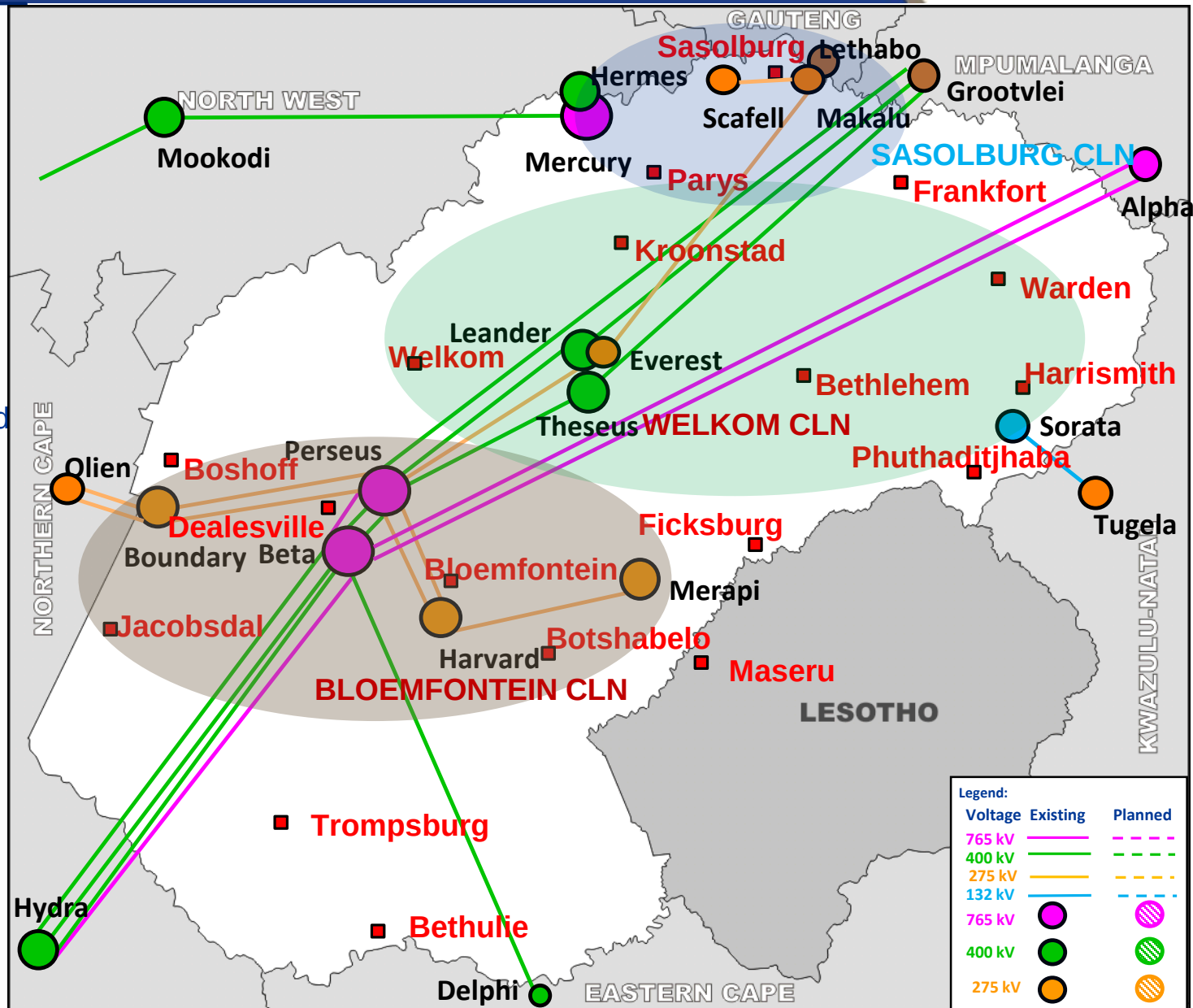
- Power supply into the province is mainly from Mpumalanga Province power pool and Lethabo Power Station 3558 MW
- There is a potential for renewable energy generation
- Solar PV commissioned 124 MW

Geographical area

- Harrismith, Bloemfontein, Botshabelo, Welkom, Sasolburg, Kroonstad, Parys, Phuthaditjhaba and Bethlehem

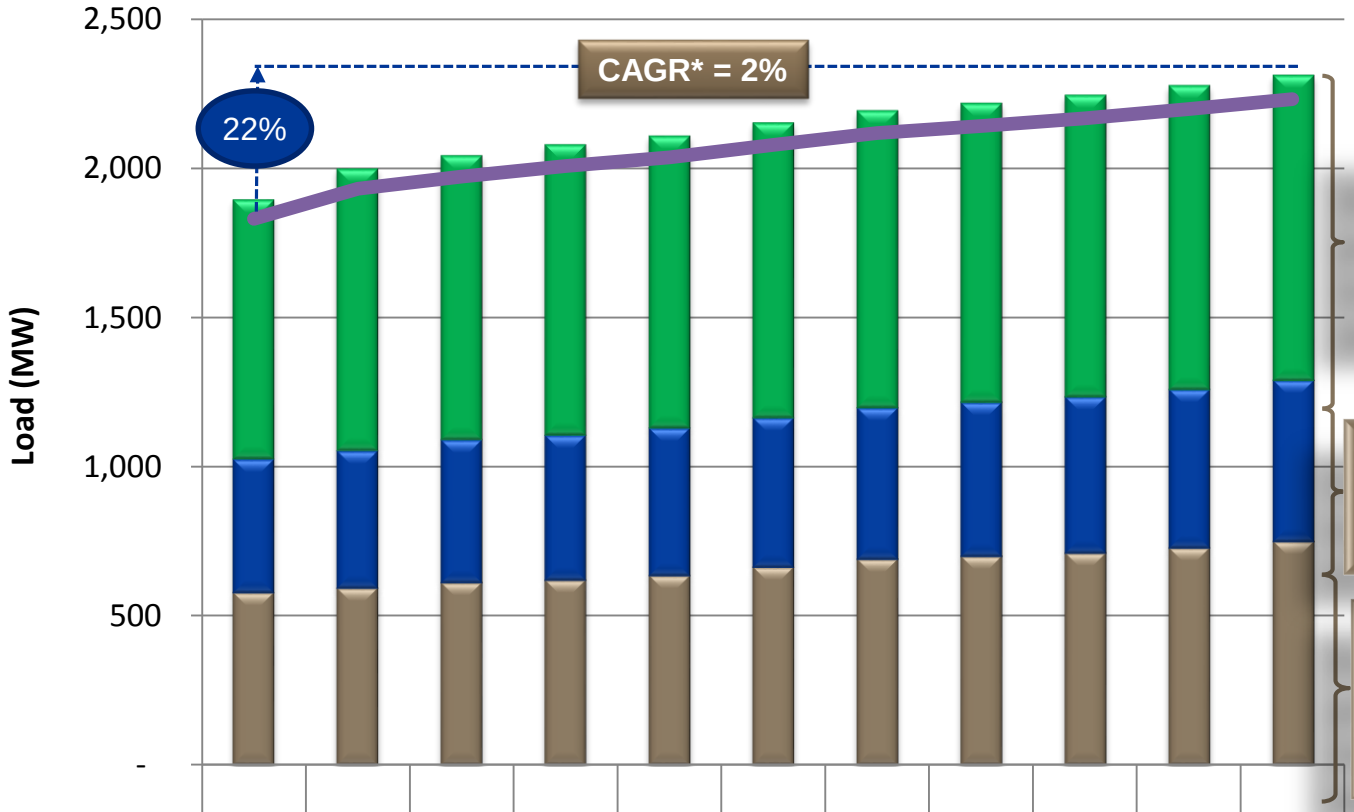
Economic Activity

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



Load Forecast

Free State Load Forecast



	2,017	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	2,026	2,027
Welkom (GP)	869	945	952	973	980	988	996	1,003	1,011	1,019	1,023
Sasolburg (GP)	450	463	481	488	495	503	510	517	524	532	541
Bloemfontein (GP)	578	593	611	619	635	662	689	699	710	727	748
TOSP	1,831	1,931	1,973	2,008	2,037	2,079	2,119	2,143	2,168	2,199	2,232

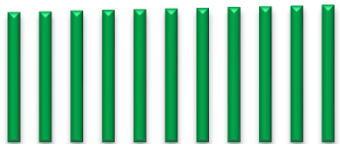
*** Compound Annual Growth Rate**

Network Development Plan

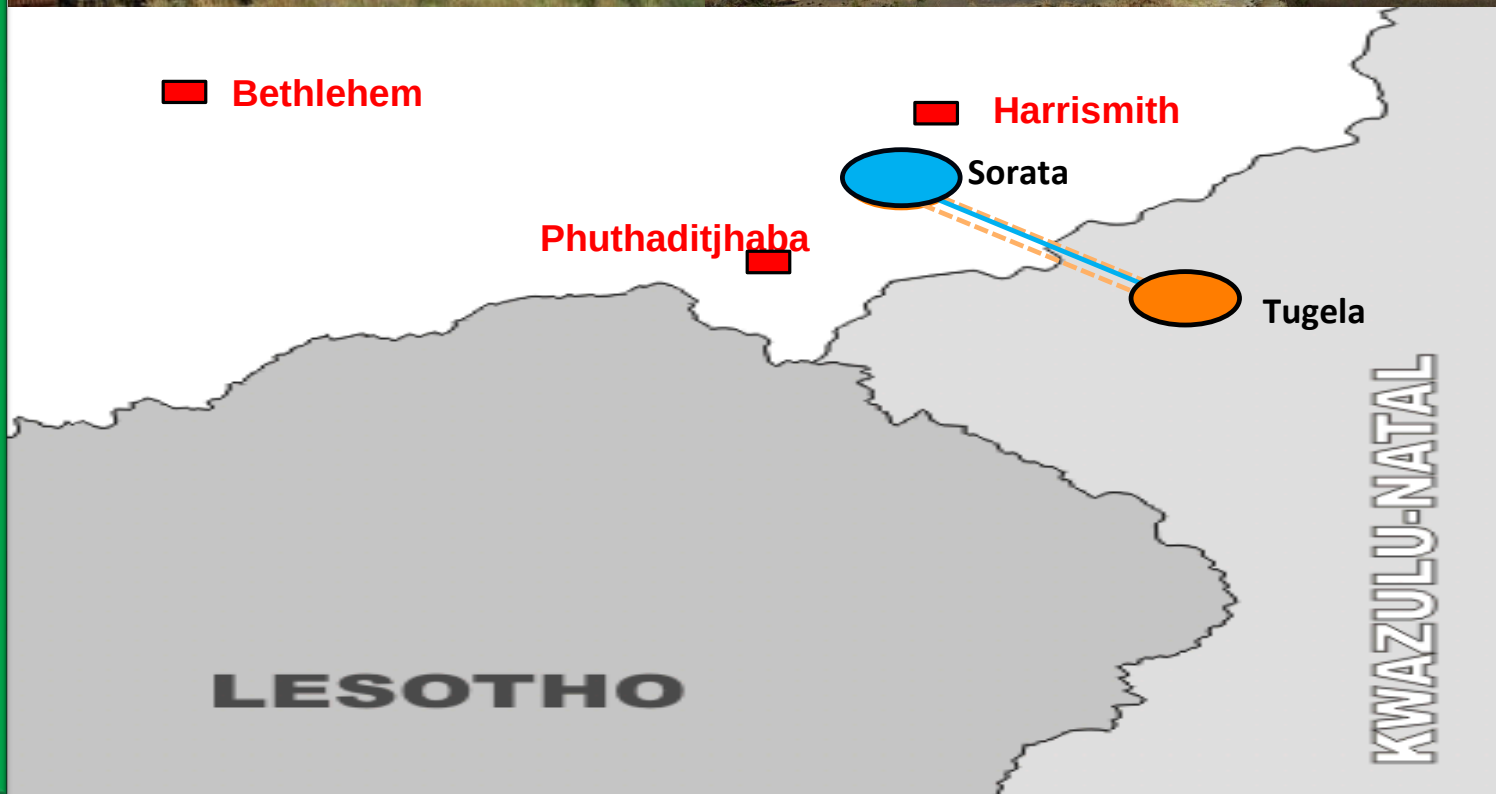
Key Developments in Eastern Free State

Eskom

Welkom CLN: 2027 1023 MW



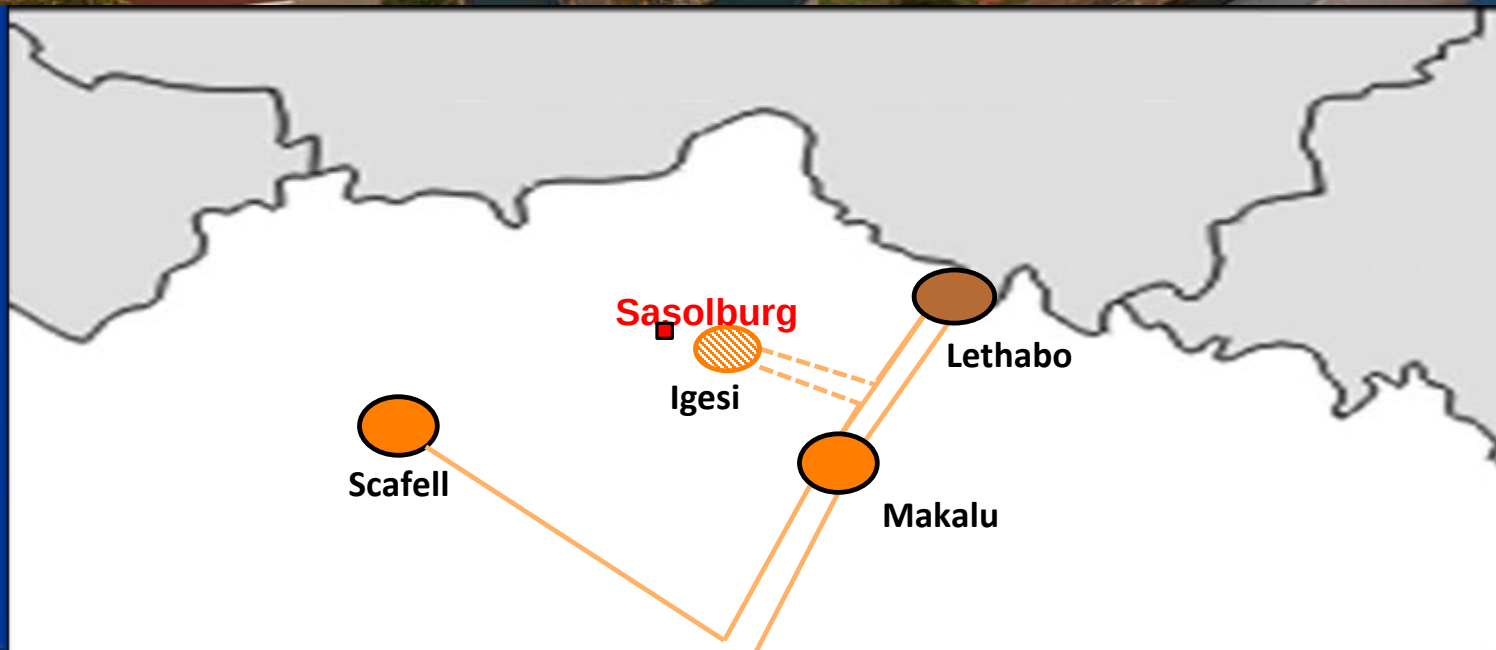
- Drivers for load growth:
  - Strategic Integrated Projects 2 (Harrismith Logistics Hub)
  - Public infrastructure delivery
- Planned Project:
  - Harrismith Strengthening: Extension of Sorata Substation (Phase 1 and 2)



Key Developments in Sasolburg

Sasolburg 2027
CLN: 541 MW

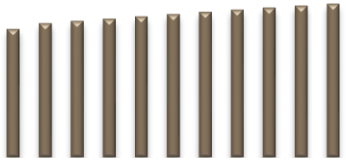
- Drivers for load growth:
  - Mining activities
  - Industrial activities
  - Public infrastructure delivery
- Planned Project:
  - Integration of Igesi Substation



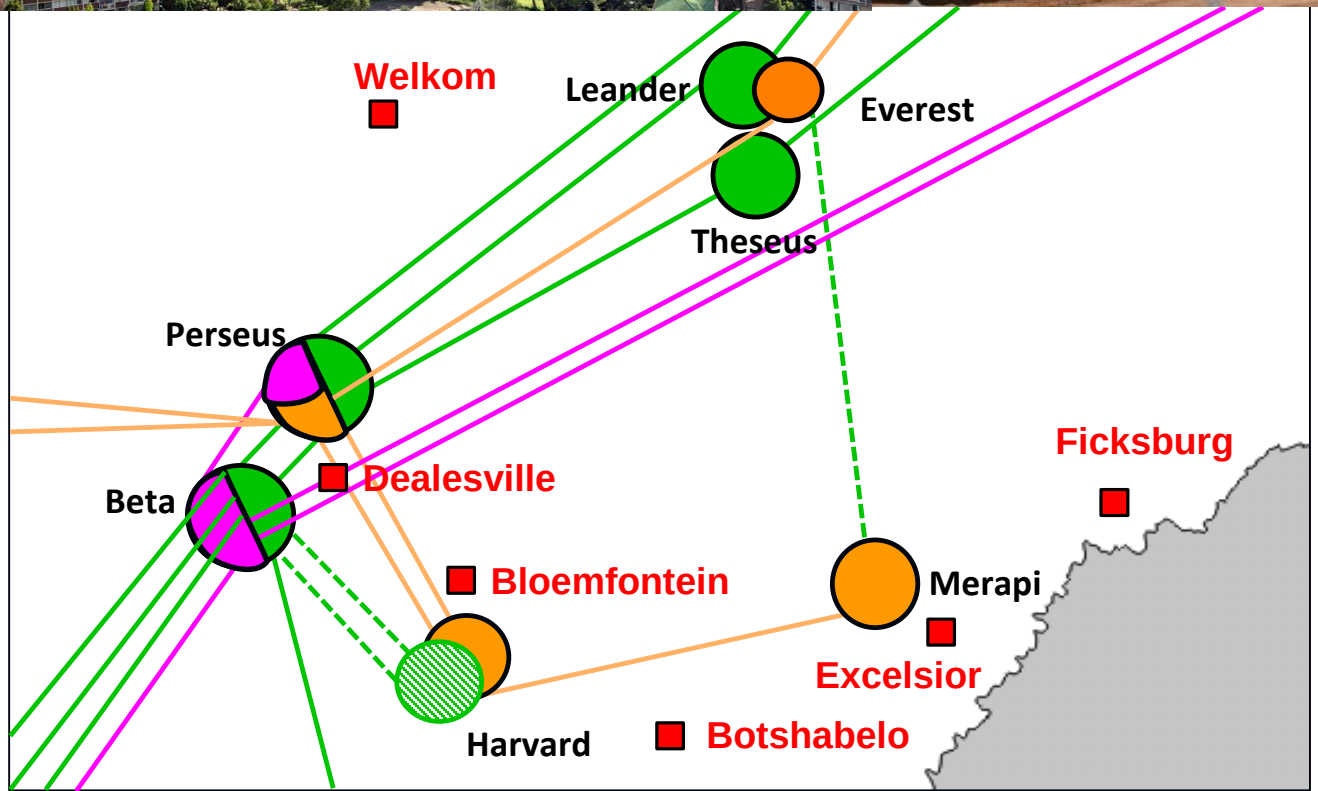
Key Developments in Mangaung and surrounding regions

Eskom

Bloemfontein **2027**
CLN: **748 MW**



- **Drivers growth:**
  - **Public infrastructure delivery**
  - **Solar power generation**
- **Planned Project: Bloemfontein Strengthening:**
  - **Everest-Merapi 400 kV Line**
  - **Harvard 400/132 kV Substation**
  - **2 x Beta-Harvard 400 kV Lines**



Venus – Ariadne – Eros 400 kV Line Route

Northern Cape Province

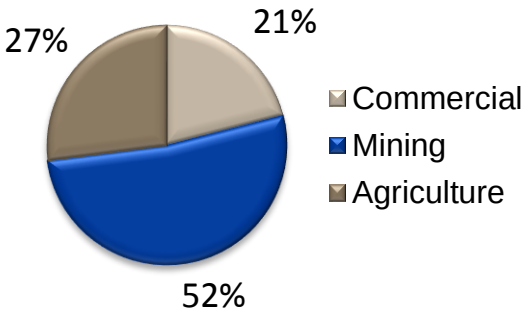
Planning Engineer: Jamila Kombe

Presented by: Ahmed Hansa

Northern Cape Province Profile

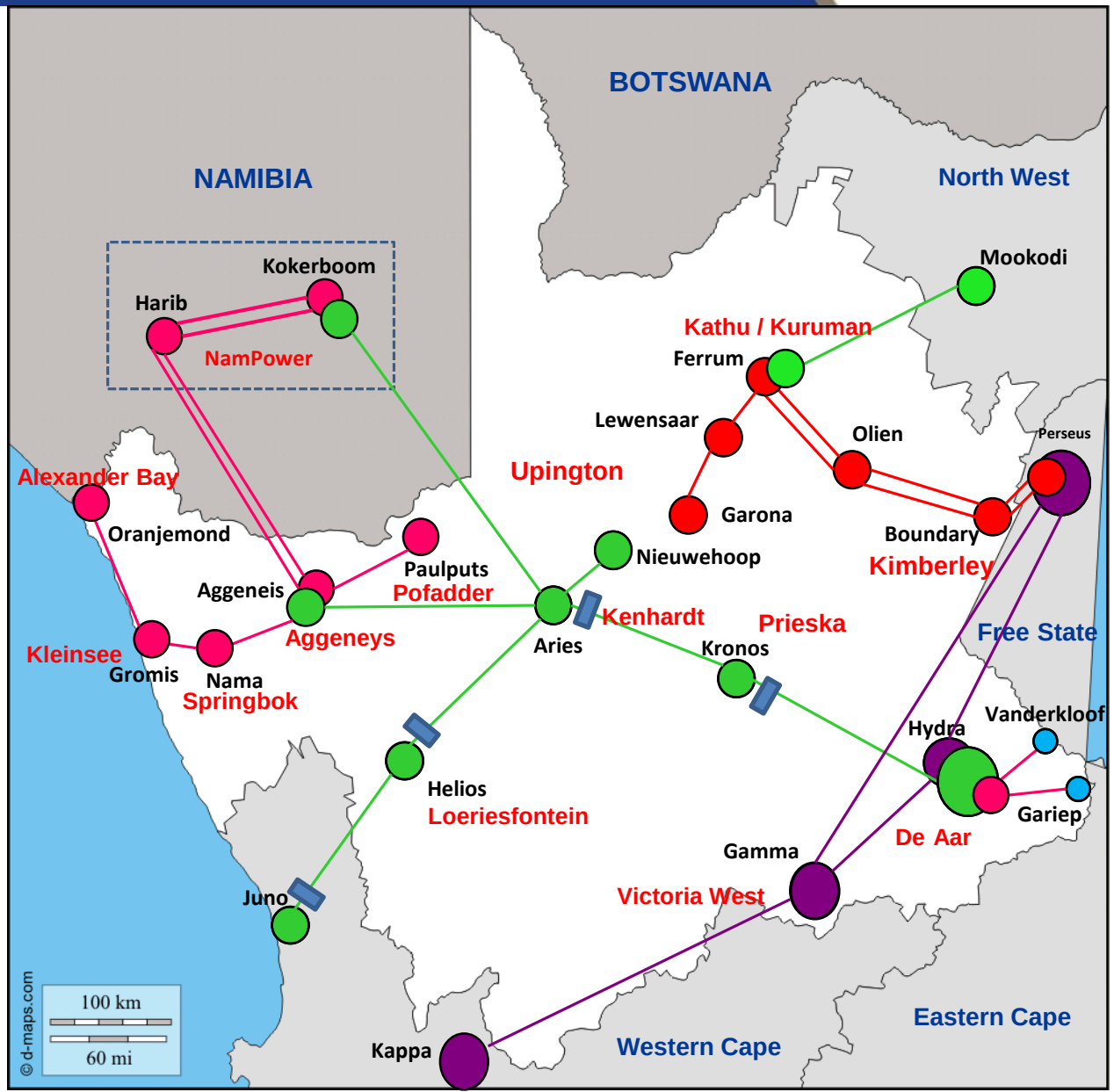
LOAD

- **Peak load of 728 MW: Feb 2016**



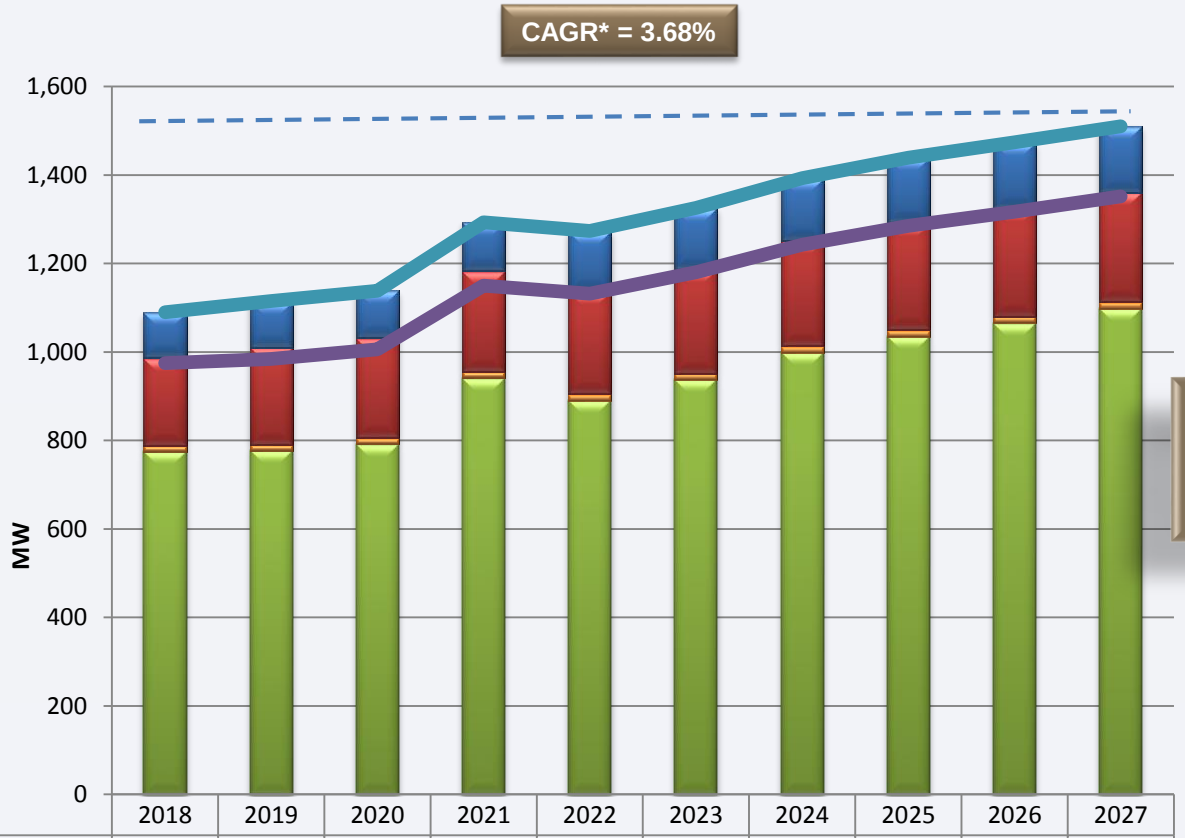
GENERATION

Type		Name	Output
Peaking	Hydro	Van Der Kloof	240 MW
		Gariep	360 MW
Eskom Total			600 MW
REIPPPP Projects		Wind	150 MW
		PV	950 MW
		CSP	200 MW
		Hydro	10 MW
REIPPPP Total			1310 MW



Load Forecast

Load Forecast



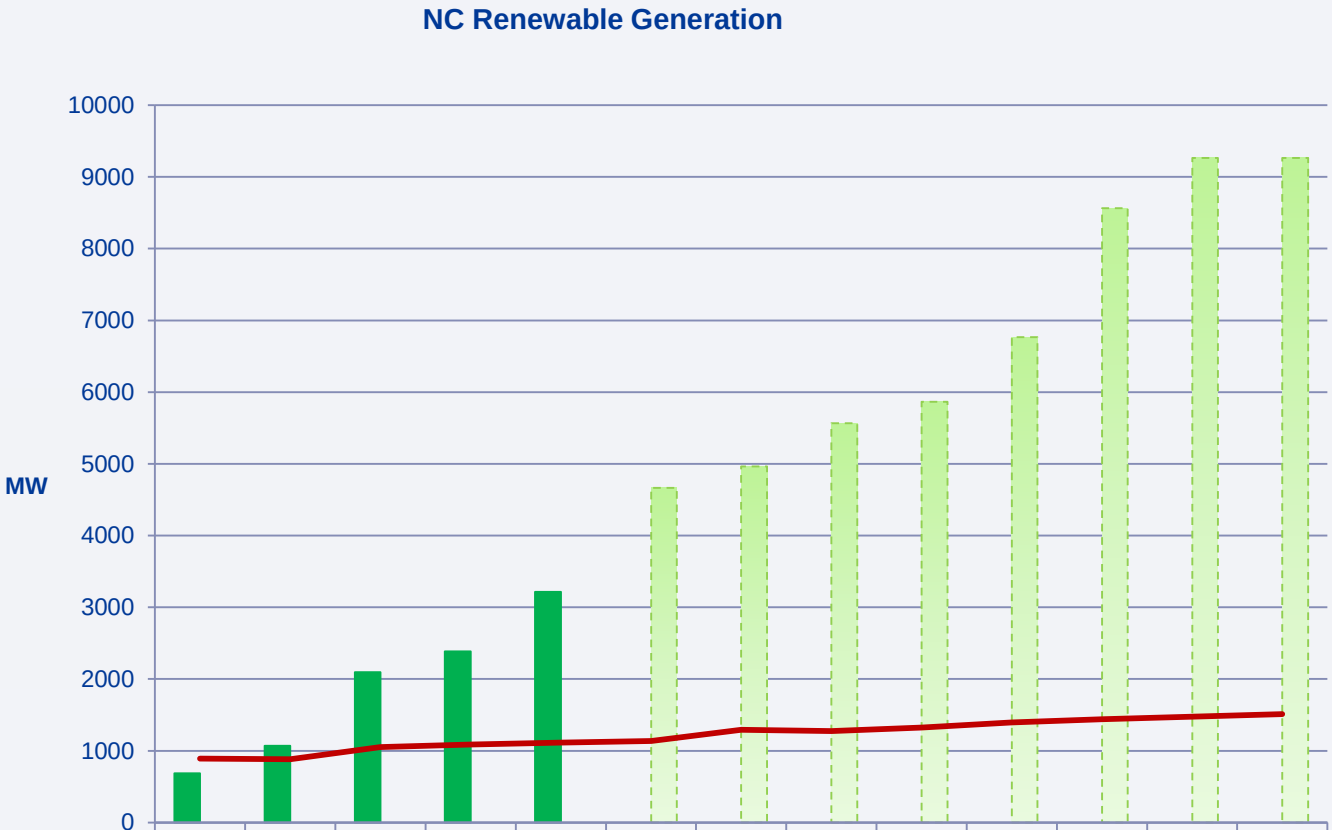
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Namaqualand CLN @ Provincial Peak	103.4	105.2	107.2	109.9	137.3	139.5	141.4	147.9	148.8	149.7
Karoo CLN @ Provincial Peak	197.9	218.8	225.3	228.0	231.5	235.0	238.6	242.1	245.6	248.1
West Coast CLN @ Provincial Peak	13.72	13.80	13.89	13.98	14.07	14.16	14.24	14.33	14.42	14.51
Kimberley CLN @ Provincial Peak	774.7	777.5	791.9	941.5	891.1	937.2	999.0	1035.0	1065.0	1098.2
Northern Cape Province (Area Max)/Province	1089.7	1115.3	1138.3	1293.3	1273.9	1325.9	1393.3	1439.3	1473.7	1510.5
Northern Cape Province (MSD)	974.7	984.5	1005.8	1149.8	1131.7	1180.0	1242.6	1285.3	1317.3	1351.4

Load Drivers
- **Natural load growth**
- **Anticipated mining loads in Kimberley**

*** Compound Annual Growth Rate**

Generation Forecast

Generation Forecast



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
NC RG Cumulative	685	1070	2094	2384	3214								
NC RG Cumulative						4664	4964	5564	5864	6764	8564	9264	9264
NC Load forecast Provincial Peak	891	883	1054	1090	1115	1138	1293	1274	1326	1393	1439	1474	1510

Achievements

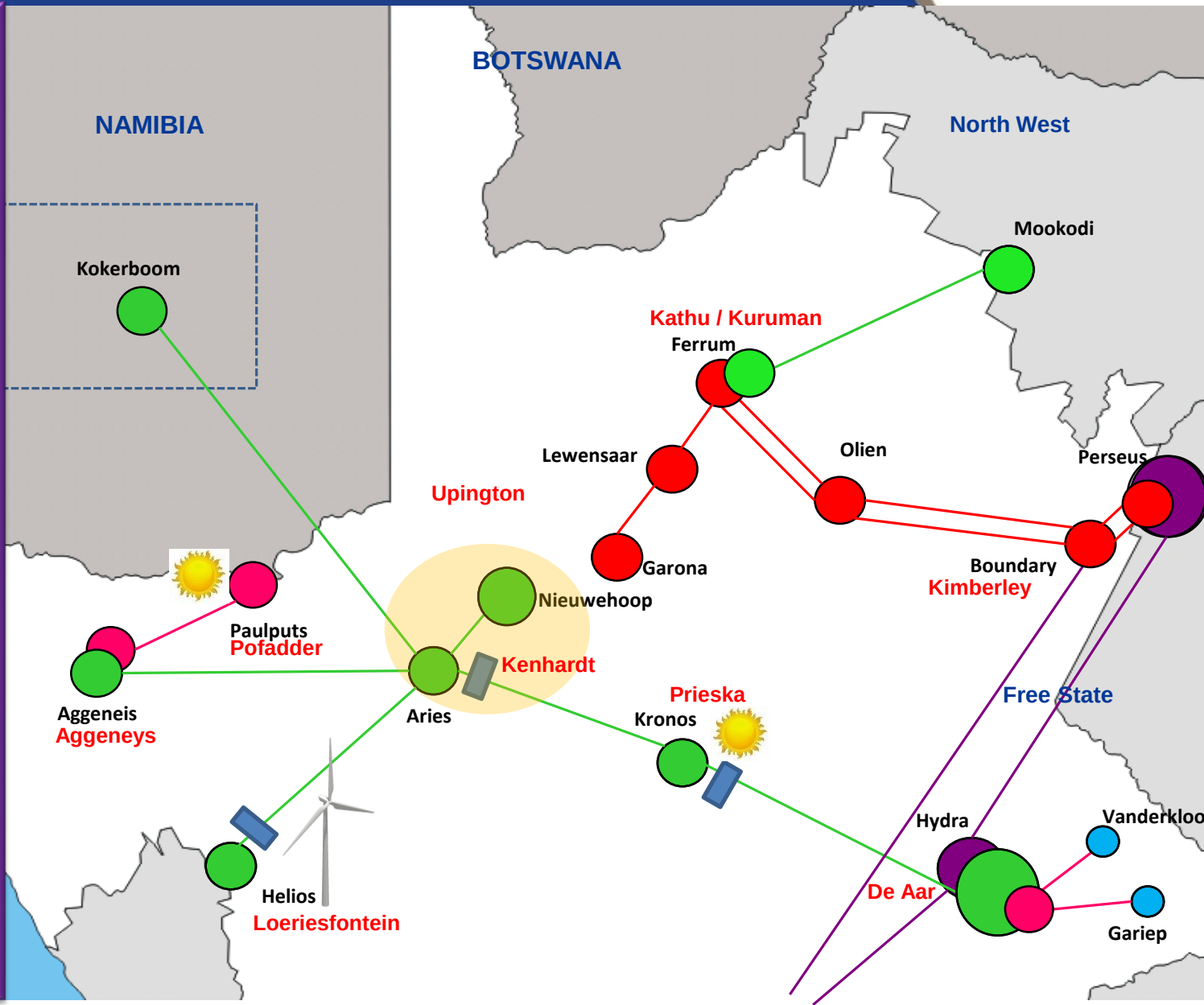
Achievements

Aries - Nieuwehoop 400 kV line

Kronos 400/132 kV transformation for load which also facilitated:
- **Prieska 75 MW PV**
- **Sonnidex 75 MW PV**

Helios 400/132 kV transformation for:
- **Loeriesfontein 140 MW wind farm**
- **Khobab 140 MW wind farm**

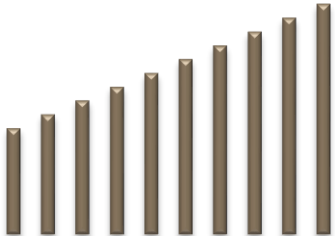
Paulputs transformation for load which also facilitated :
- **Kaxu 100 MW CSP**
- **Xina 100 MW CSP**
- **Konkoonsies 9.7 MW PV**
- **Neusberg Hydro Electric 10 MW**



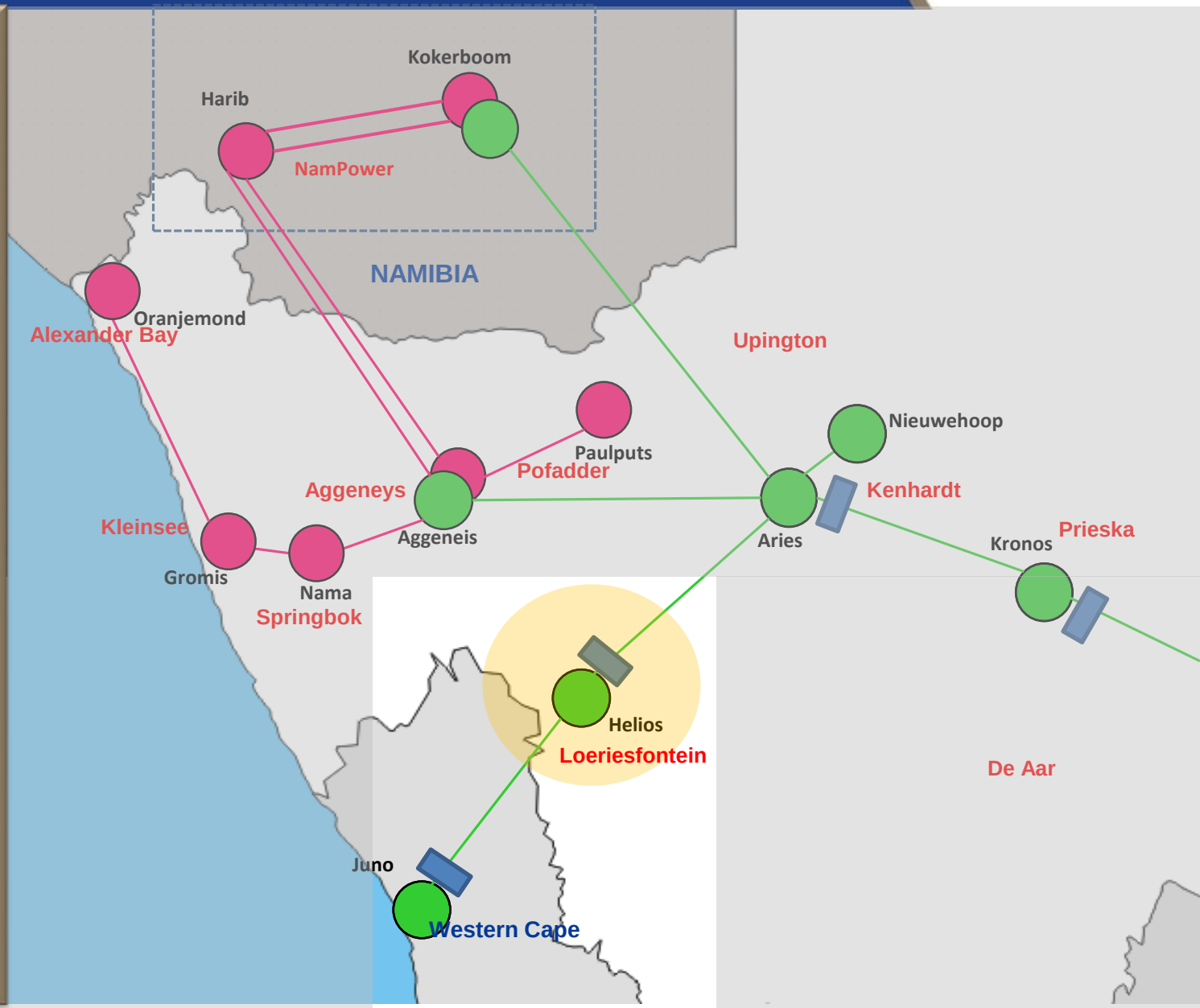
Network Development Plan

Developments in the West Coast CLN

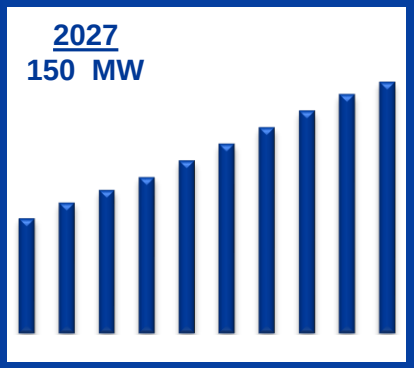
2027
14.5 MW



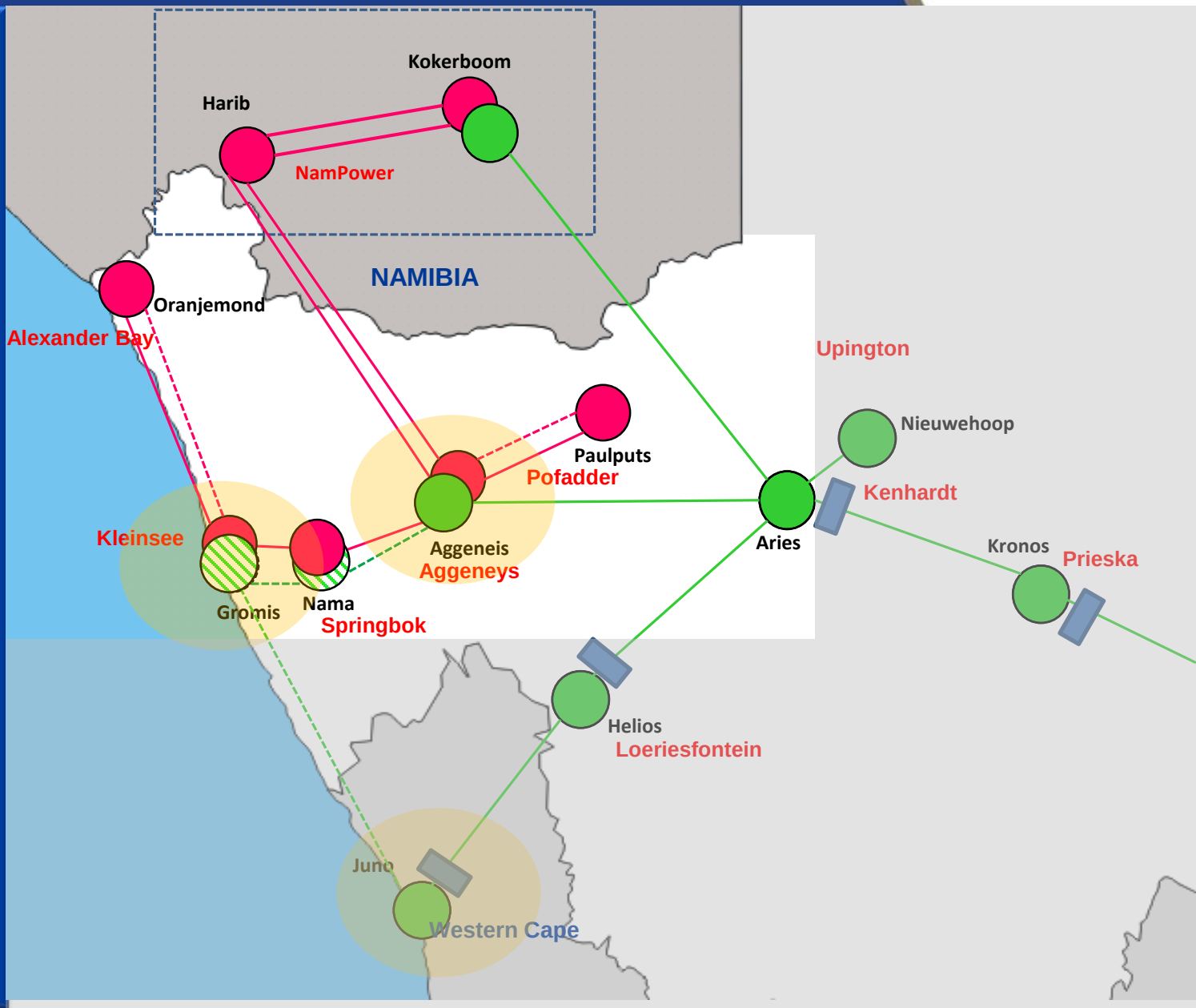
- **Further transformation at Helios for load**



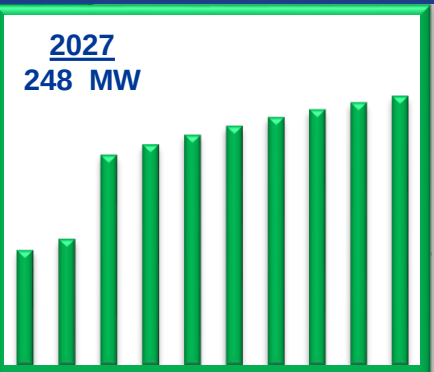
Developments in the Namaqualand CLN



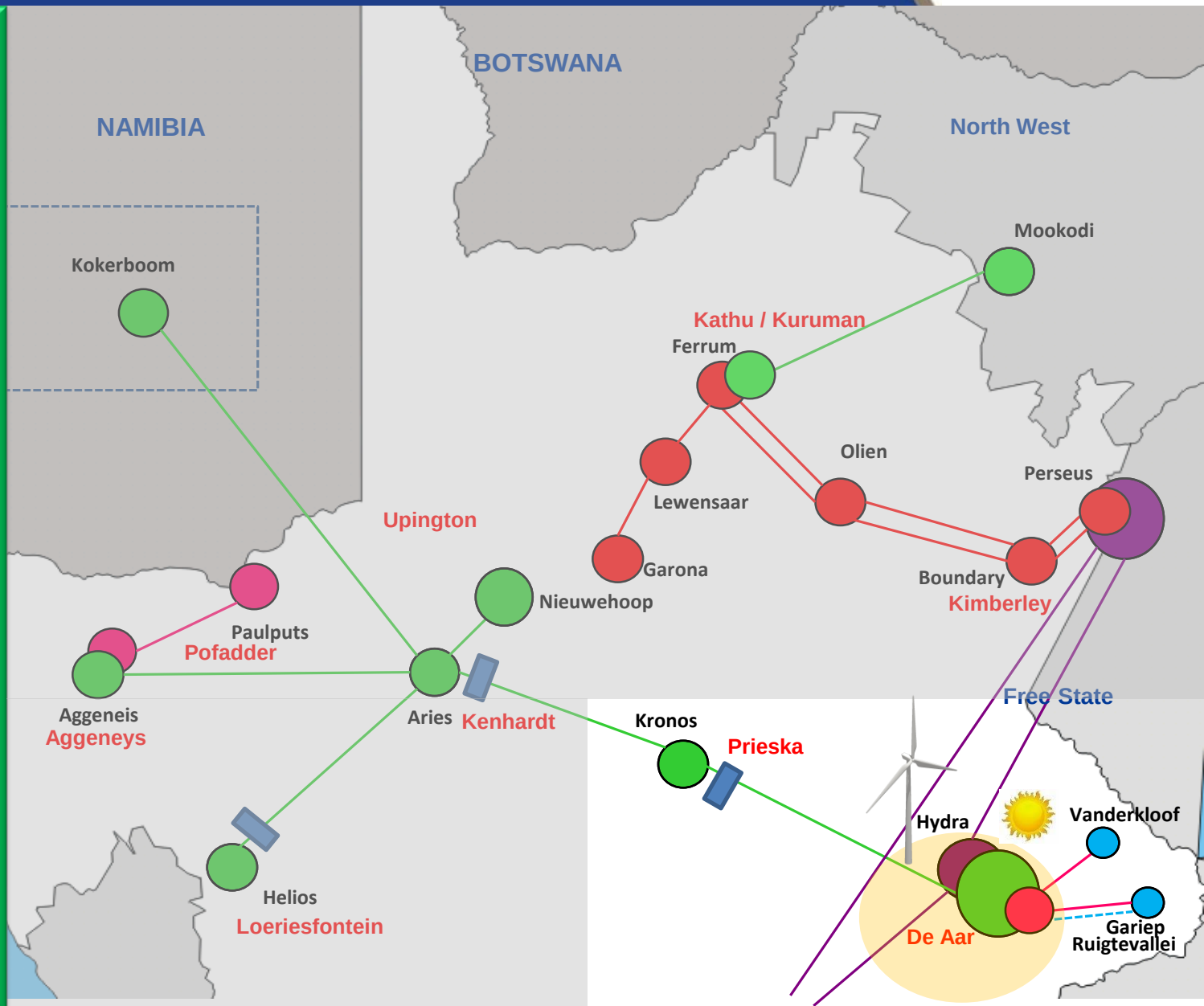
- Juno-Gromis-Oranjemond 400 kV line
- Gromis-Nama-Aggeneis 400 kV line
- Aggeneis-Paulputs 2nd 220 kV line
- Aries FACTS Device



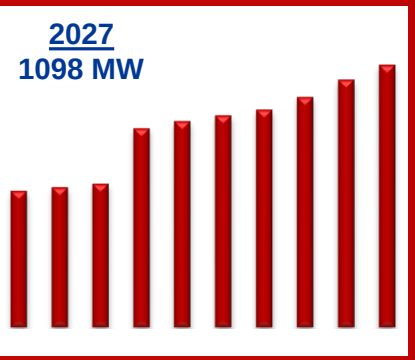
Developments in the Karoo CLN



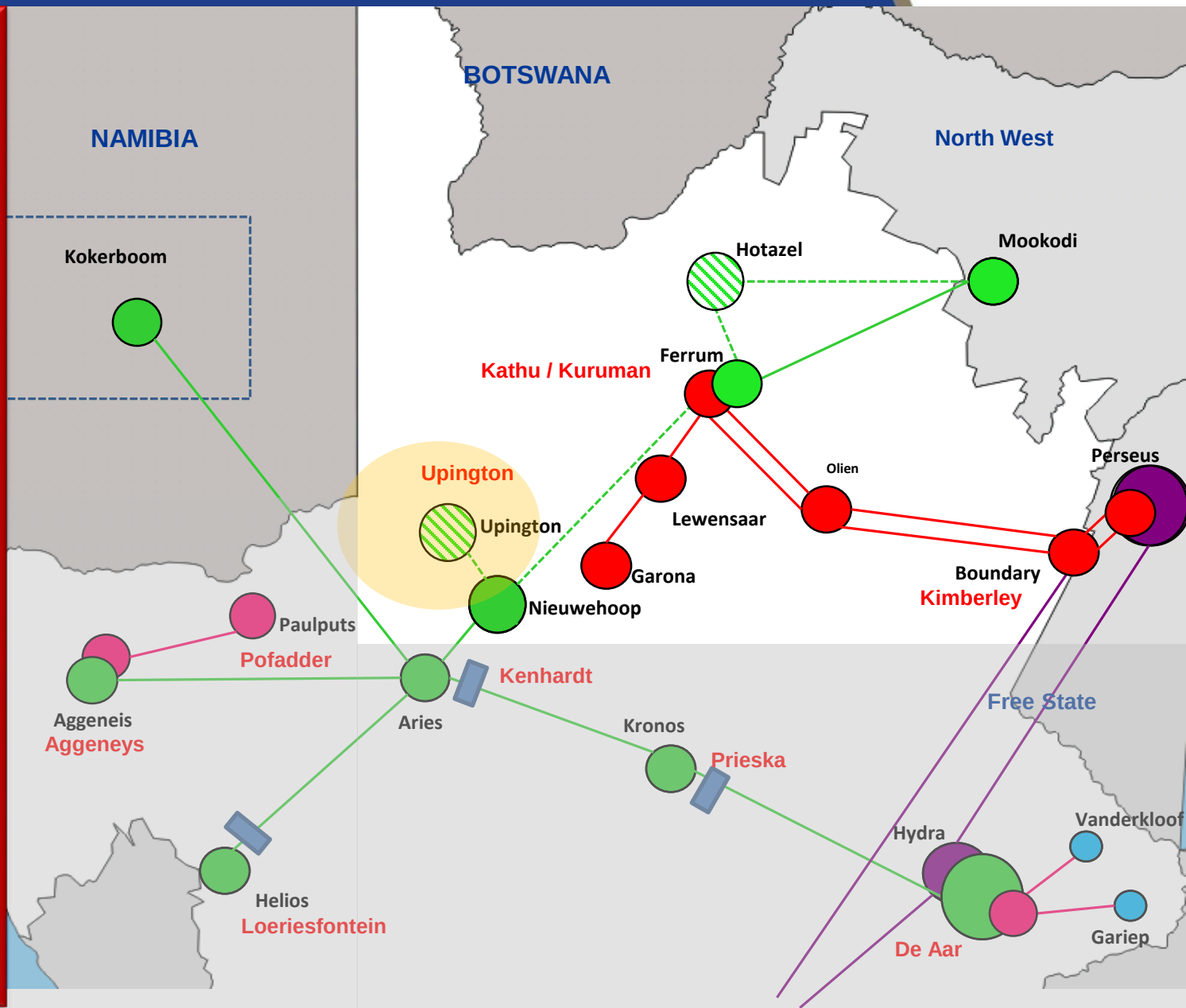
- Hydra transformation
- Ruigtevallei transformer normalisation and transformation
- Gariep Strengthening



Developments in the Kimberley CLN



- **Upington Substation and Upington-Nieuwehoop 400 kV line**
- **Nieuwehoop-Ferrum 400kV line**
- **Ferrum-Mookodi 400 kV line via Hotazel**



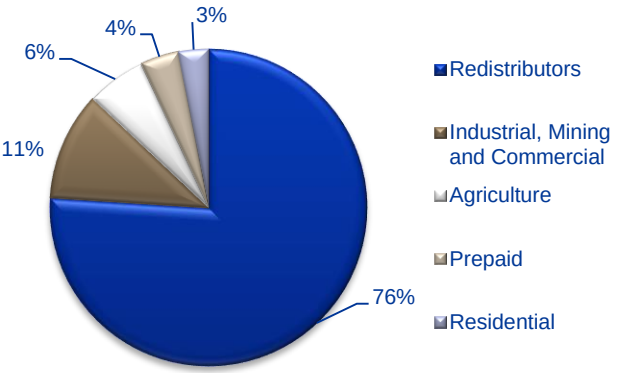
Western Cape Province

Presented by: Ahmed Hansa (Planning Engineer)

Western Cape Province Profile

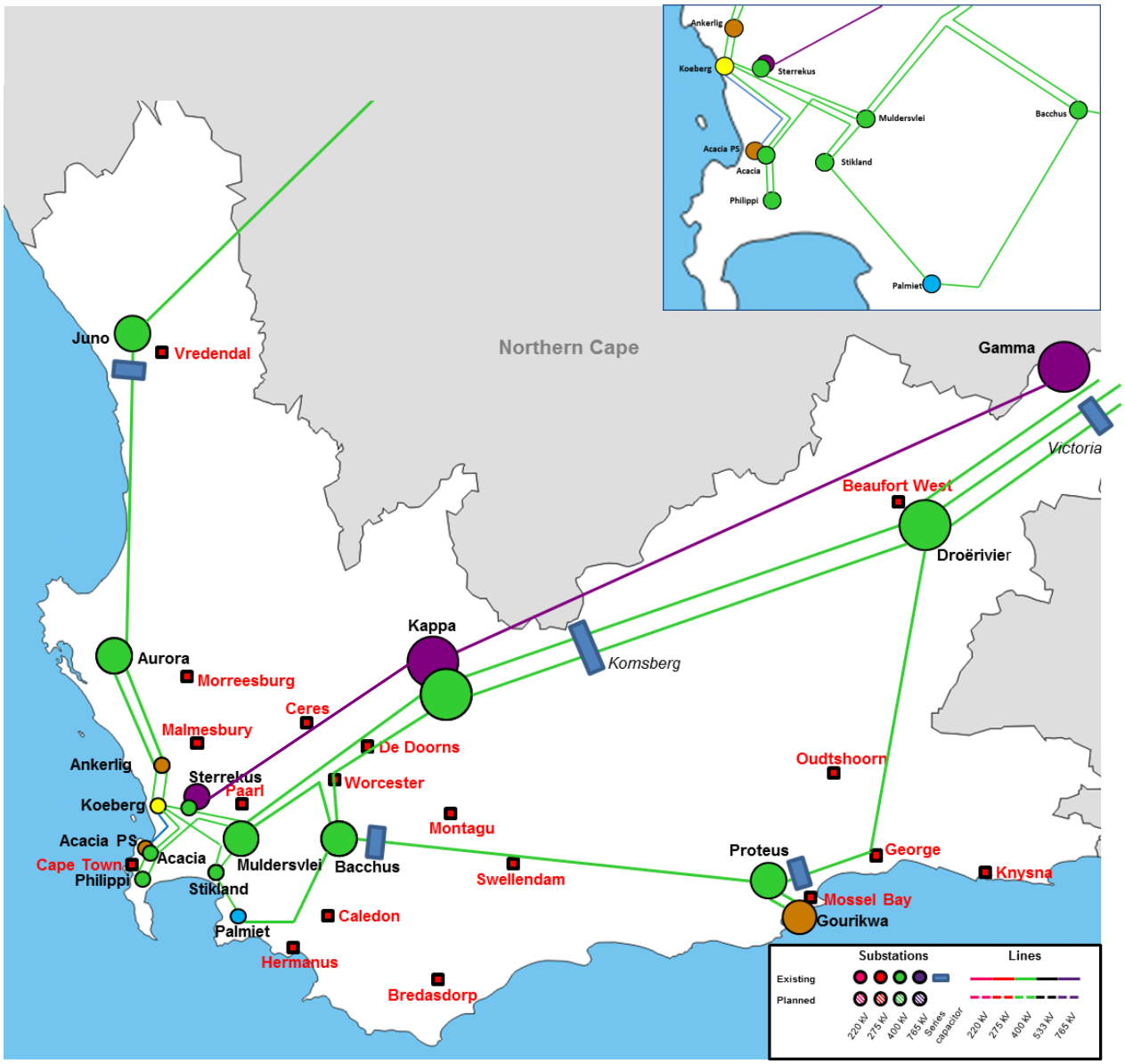
Load

- **Peak load of 3850 MW: 26th July 2016**



Generation

Type		Name	Output
Base Load	Nuclear	Koeberg	1860 MW
Peaking	Gas	Acacia	171 MW
		Ankerlig	1332 MW
		Gourikwa	740 MW
	Pumped Storage	Palmiet	400 MW
Eskom Renewables	Wind	Sere	105 MW
Eskom Total			4608 MW
REIPPPP	PV	IPPs	134 MW
	Wind	IPPs	316 MW
REIPPPP Total			450 MW
City of Cape Town Total			258 MW



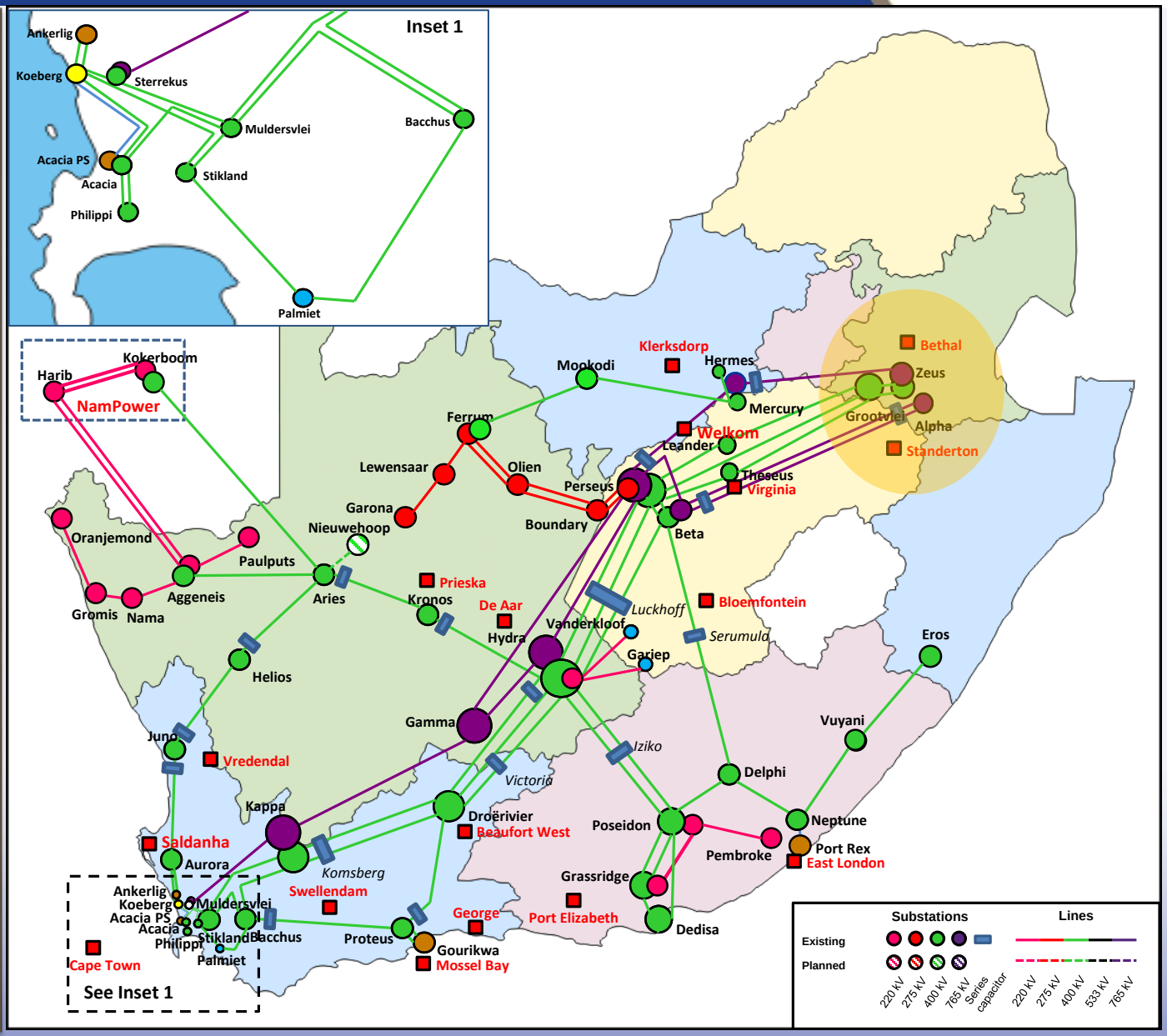
Cape Corridor

- Comprises of 400 kV and 765 kV lines originating from ***Zeus Substation and Alpha Substation*** in Mpumalanga to ***Hydra Substation*** in the Northern Cape.

- It then ***extends into the Western Cape Province***.

Cape Corridor 765 kV Progress

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

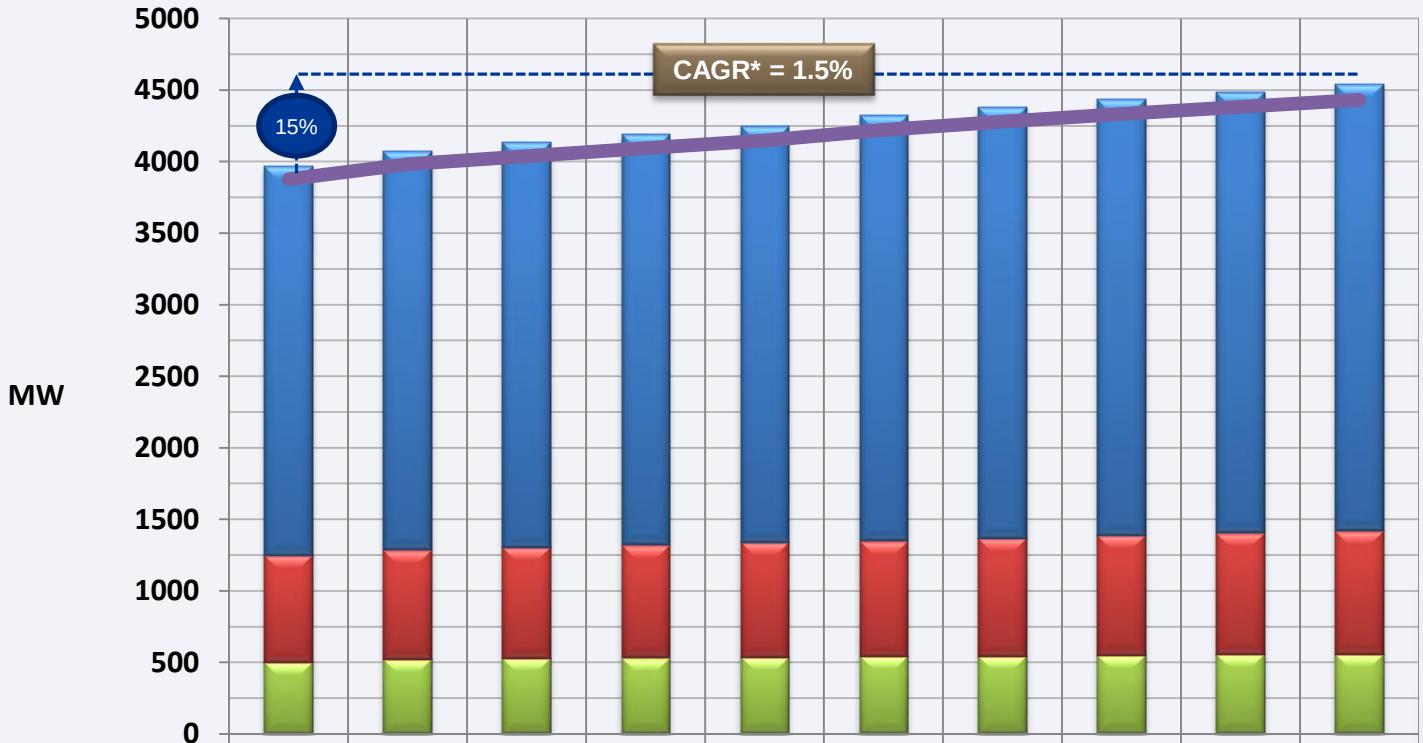


Achievements

Kappa-Sterrekus 765 kV line

Load Forecast

Western Cape Load Forecast



	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Peninsula	2715	2791	2830	2871	2910	2971	3015	3050	3084	3118
Southern Cape	752	763	775	788	800	812	824	836	851	864
West Coast	498	520	529	532	536	539	542	550	553	556
TOSP	3876	3981	4038	4094	4147	4222	4279	4332	4382	4431

Residential, commercial and light industrial load growth

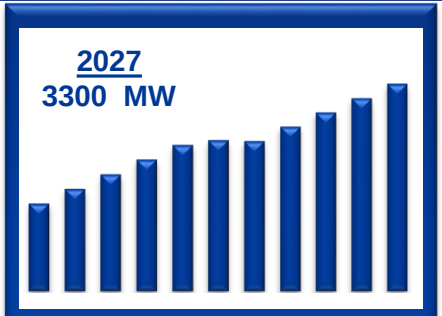
Natural load growth and residential developments

Load growth due to the Saldanha Bay IDZ

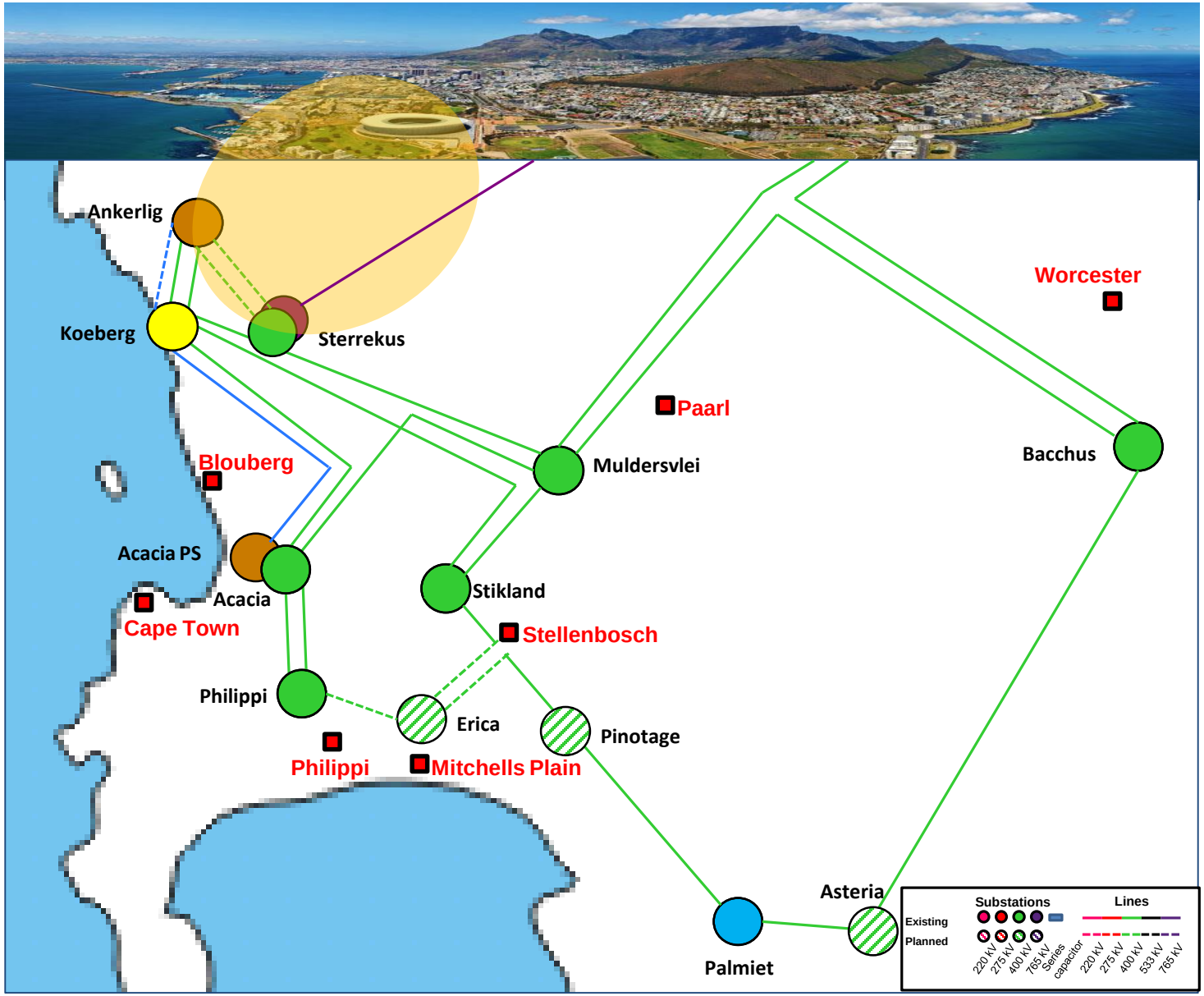
* Compound Annual Growth Rate

Network Development Plan

Developments in the Peninsula CLN

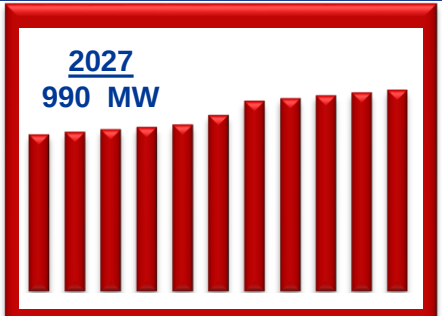


- Ankerlig-Sterrekus 1st and 2nd 400 kV lines
- Relocate Koeberg offsite supply to Ankerlig
- Koeberg -Acacia 2nd 400 kV line
- Erica Substation
- Erica-Philippi 400 kV line
- Pinotage Substation



Pinotage Substation – Under construction

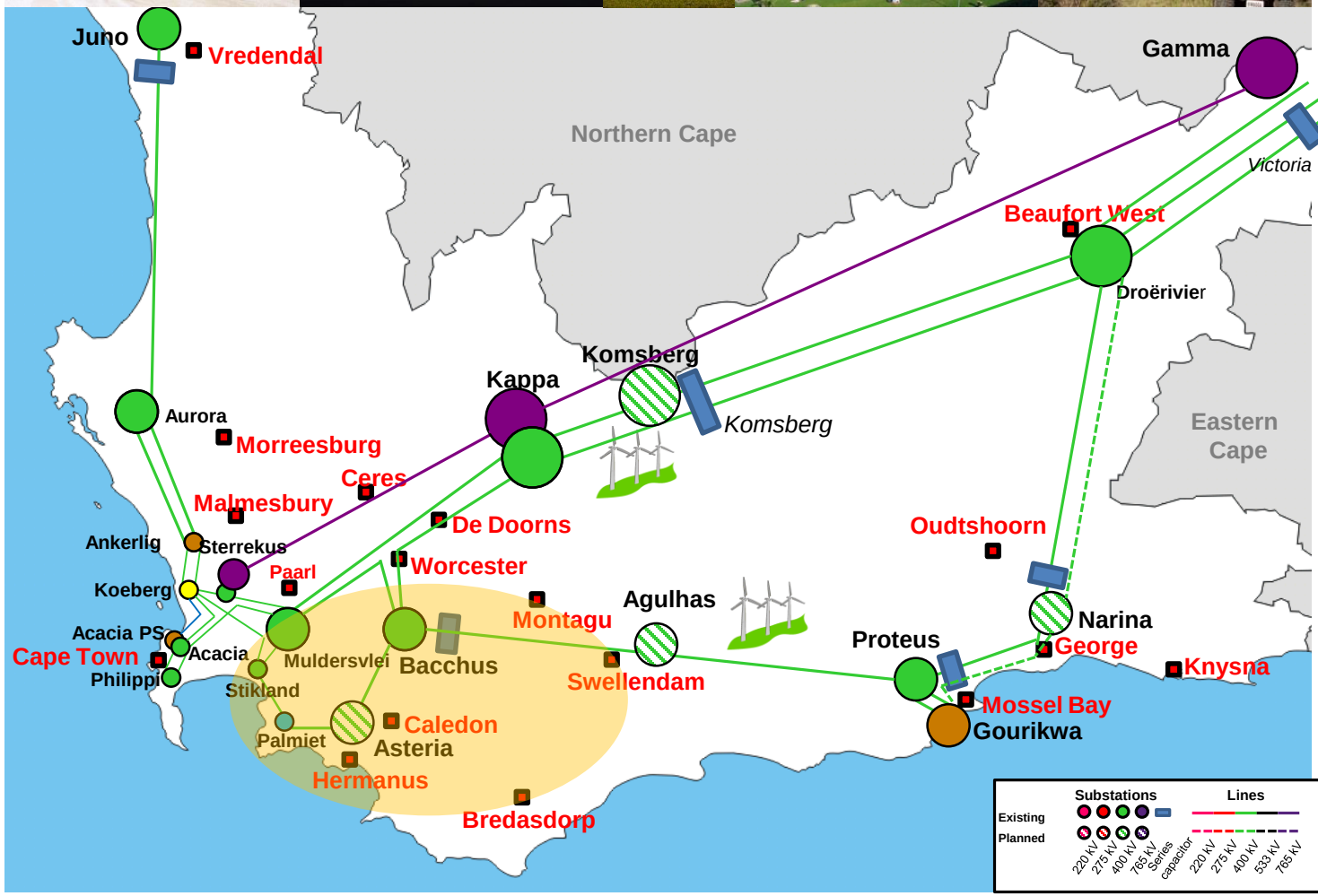
Developments in the Outeniqua CLN



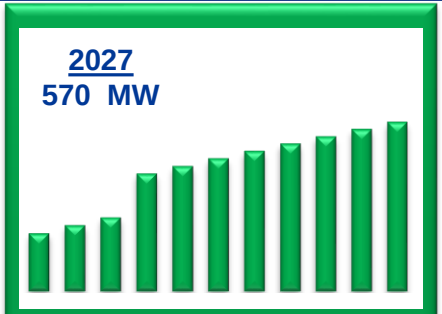
- Asteria Substation
- Agulhas Substation
- Kappa 400/132 kV transformation
- Komsberg 400/132 kV Substation
- Narina Substation
- Gourikwa-Narina-Droërivier 400 kV line
- PCB series cap phase out plan



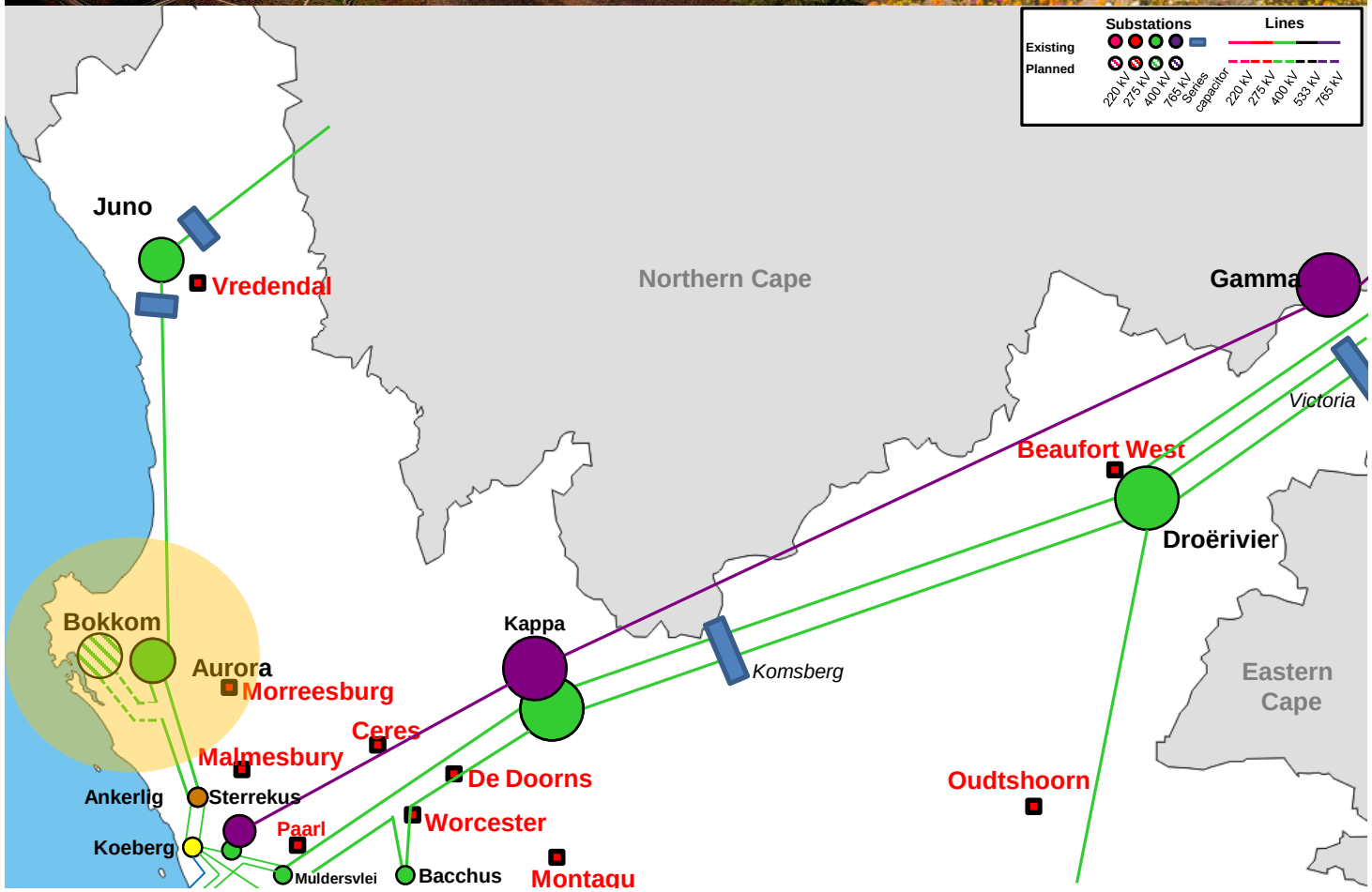




Developments in the West Coast CLN



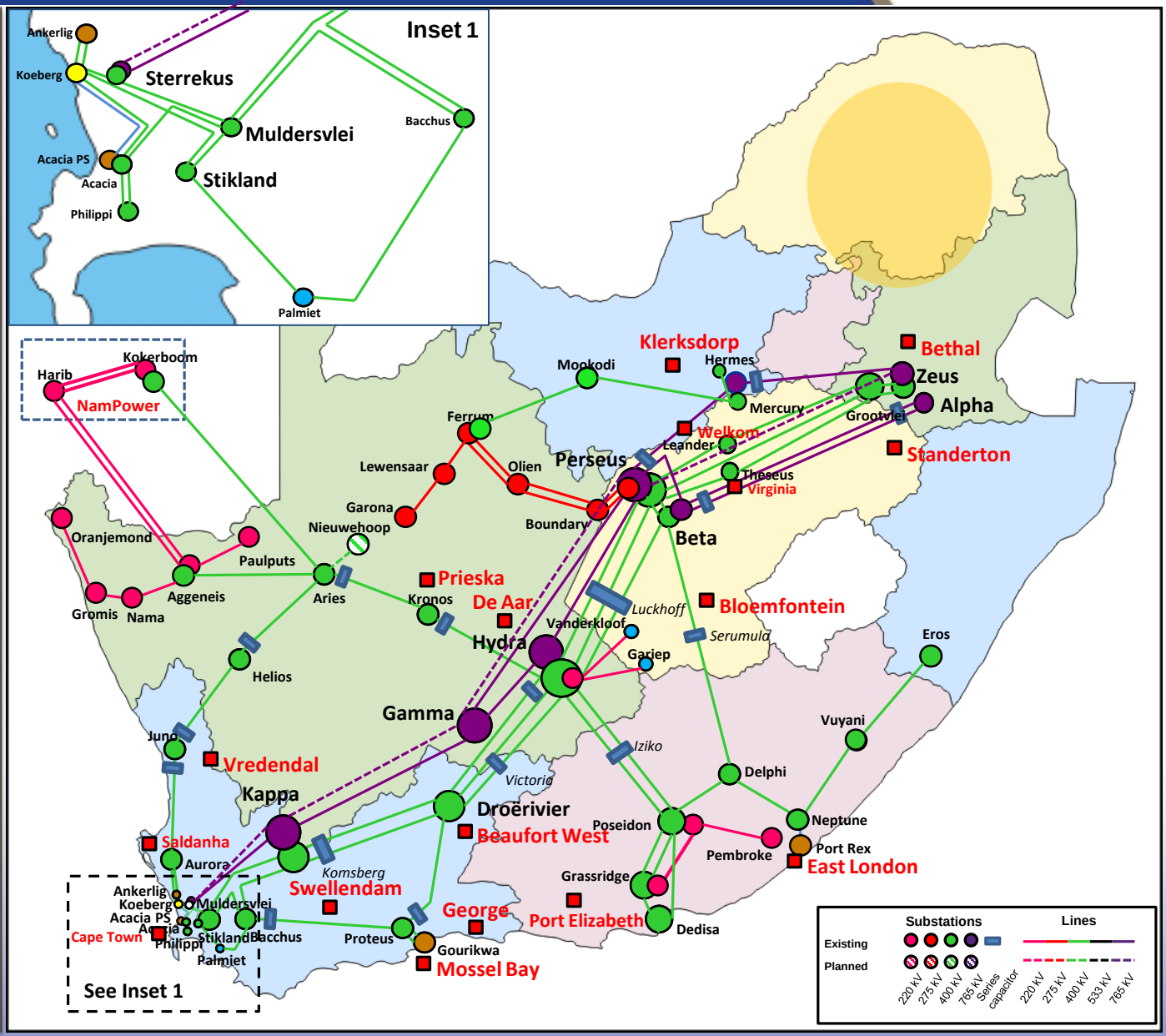
- Aurora transformation upgrade
- Bokkom Substation
- Juno transformation upgrade
- PCB series cap phase out plan



Cape Corridor Phase 4

Construction of a second 765 kV link from Zeus to Sterrekus in order to ensure adequate transfer capacity into the Cape

- Zeus-Perseus 765 kV line
- Perseus-Gamma 2nd 765 kV line
- Gamma-Kappa 2nd 765 kV line
- Kappa-Sterrekus 2nd 765 kV line

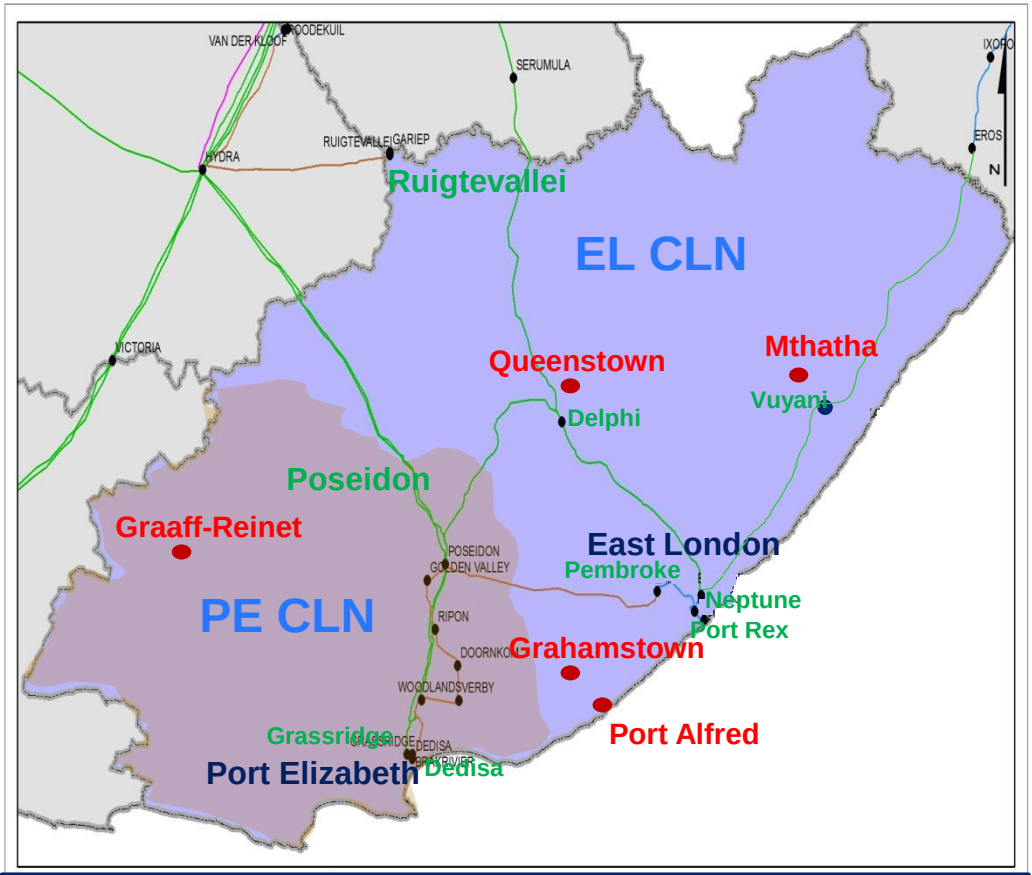


Eastern Cape Province

Planning Engineer: Caswell Ndlhovu

Presented by: Ahmed Hansa

Eastern Cape Province Profile



General

- EC Population ~ 6.7 million
- 3rd most populous province
- ~ 8 % of total South African GDP
- 4th largest contributor to GDP
- Major Industries
  - Automotive, tourism, agriculture, agro-processing, ocean economies

Generation in Eastern Cape

Port Rex	171 MW
Dedisa OCGT	372 MW
RE IPP (Wind & Solar)	~ 1060 MW

Load Served

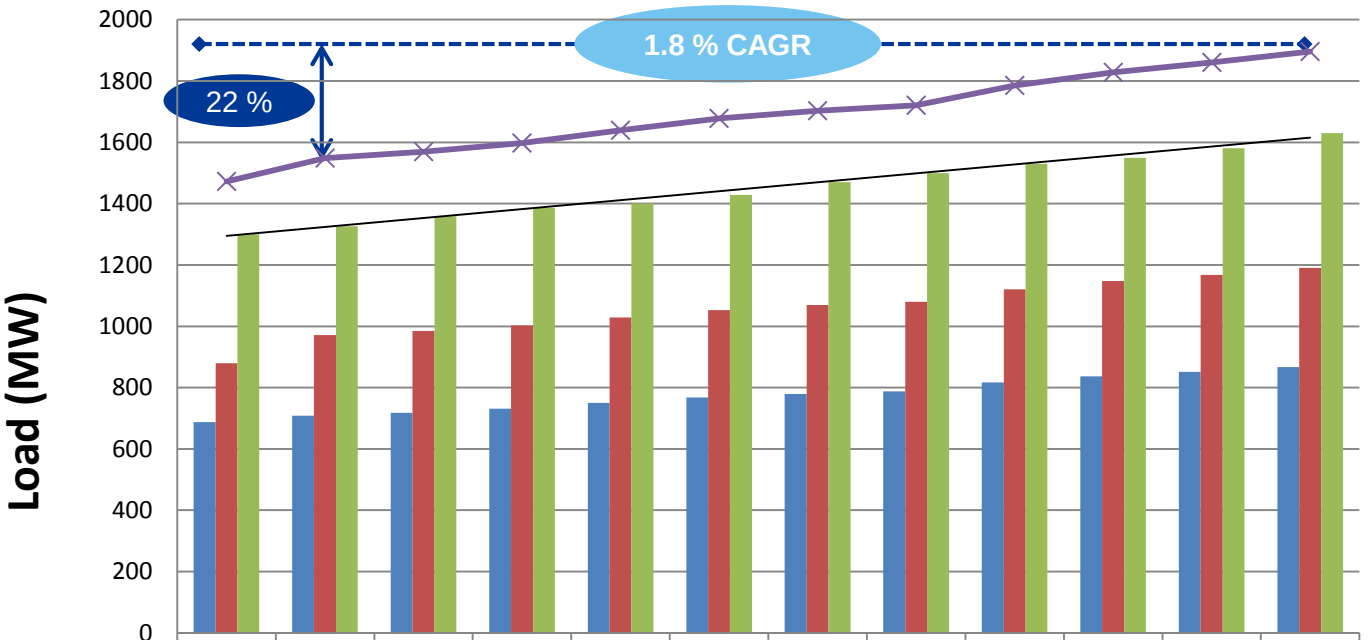
- Peak Load demand (2016) 1472 MW
- Geographic Areas: Nelson Mandela Metro, Buffalo City Metro, Mthatha

nelson mandela bay

BUFFALO CITY
METROPOLITAN MUNICIPALITY

Load Forecast

Eastern Cape Load Forecast



	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
East London Peak (MW)	687	708	718	731	750	768	779	787	817	836	851	867
Port Elizabeth Peak (MW)	879	972	985	1003	1029	1053	1069	1080	1120	1147	1167	1190
Eastern Cape @ TOSP (MW)	1300	1326	1358	1385	1400	1428	1470	1499	1529	1550	1581	1630
Eastern Cape Grid Peak (MW)	1472	1548	1569	1598	1639	1678	1703	1721	1785	1828	1860	1896

Drivers - East London

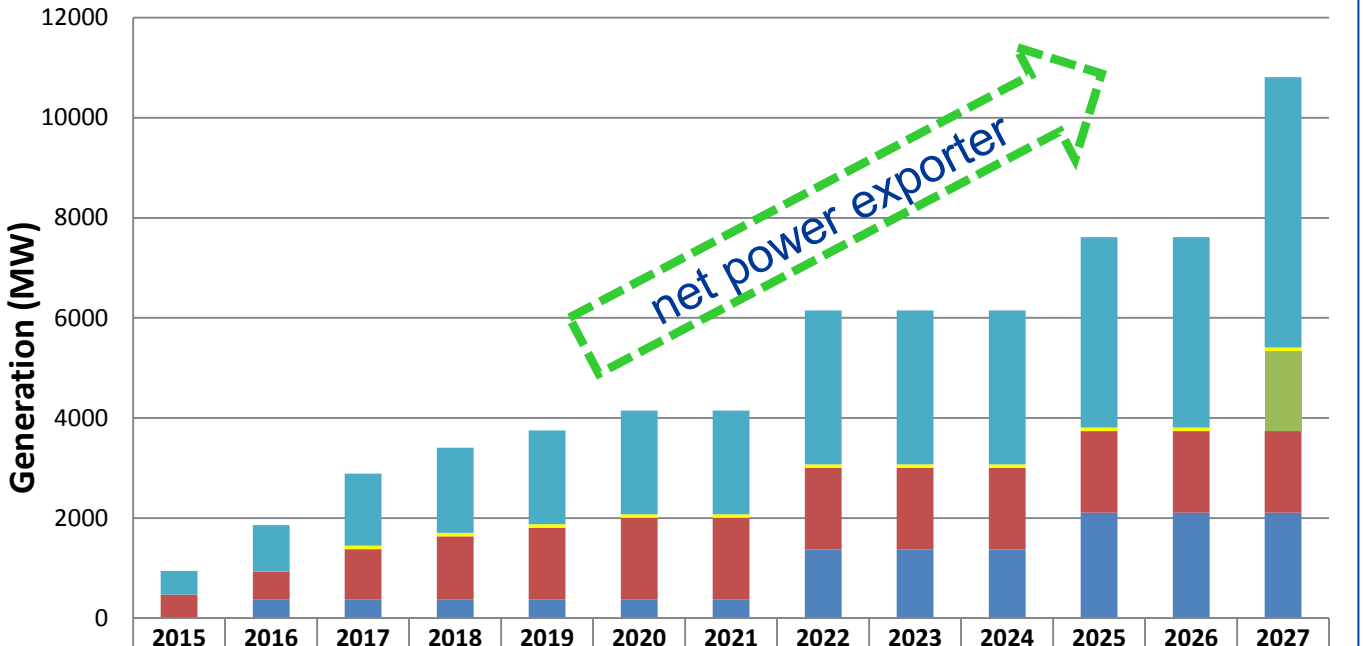
- Electrification
- Construction – Commercial Growth
- Agriculture, Forestry and
- Agro-Processing
- East London IDZ

Drivers – Port Elizabeth

- Coega IDZs – Petro/ Ferrochrome Smelter(s)
- Manufacturing, Auto Industry, Exports

Generation Forecast

Eastern Cape Generation Forecast



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Year Total	470	928	1445	1702	1874	2074	2074	3074	3074	3074	3806	3806	5406
PV	0	0	70	70	70	70	70	70	70	70	70	70	70
Nuclear	0	0	0	0	0	0	0	0	0	0	0	0	1600
Wind	470	556	1003	1260	1432	1632	1632	1632	1632	1632	1632	1632	1632
Gas	0	372	372	372	372	372	372	1372	1372	1372	2104	2104	2104

Renewables (MW)

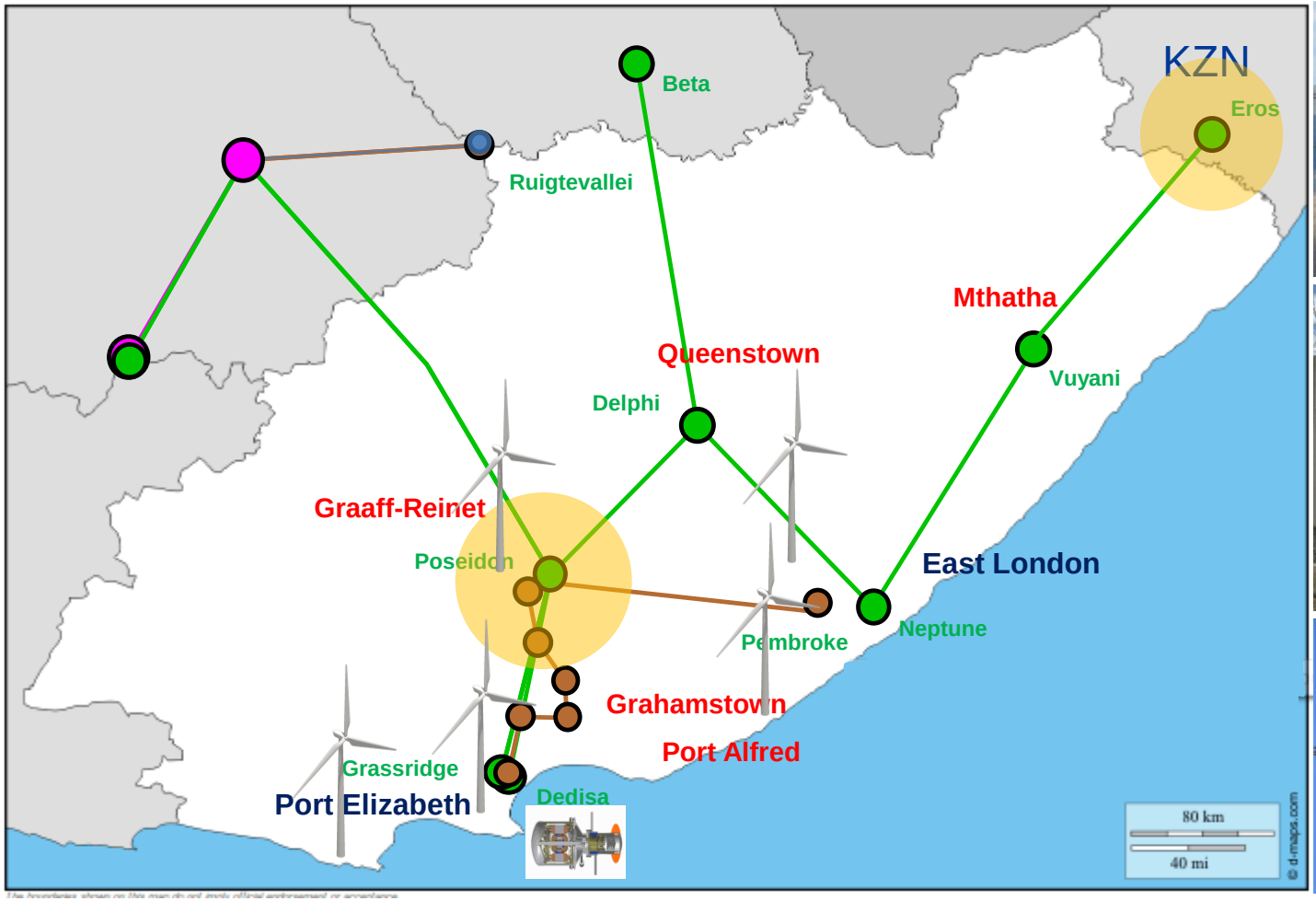
EL	PE	Total
250	1452	1702

Gas generation ~ 2000 MW

Thyspunt Nuclear, depends on government approval and IRP ~ 1600 MW

Achievements

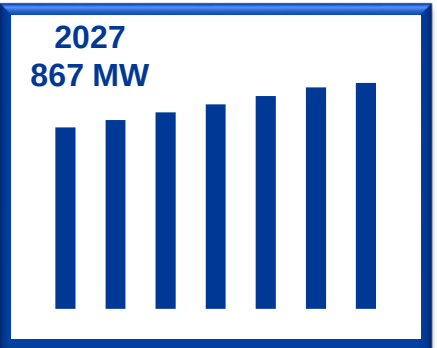
Achievements 2014 - 2017



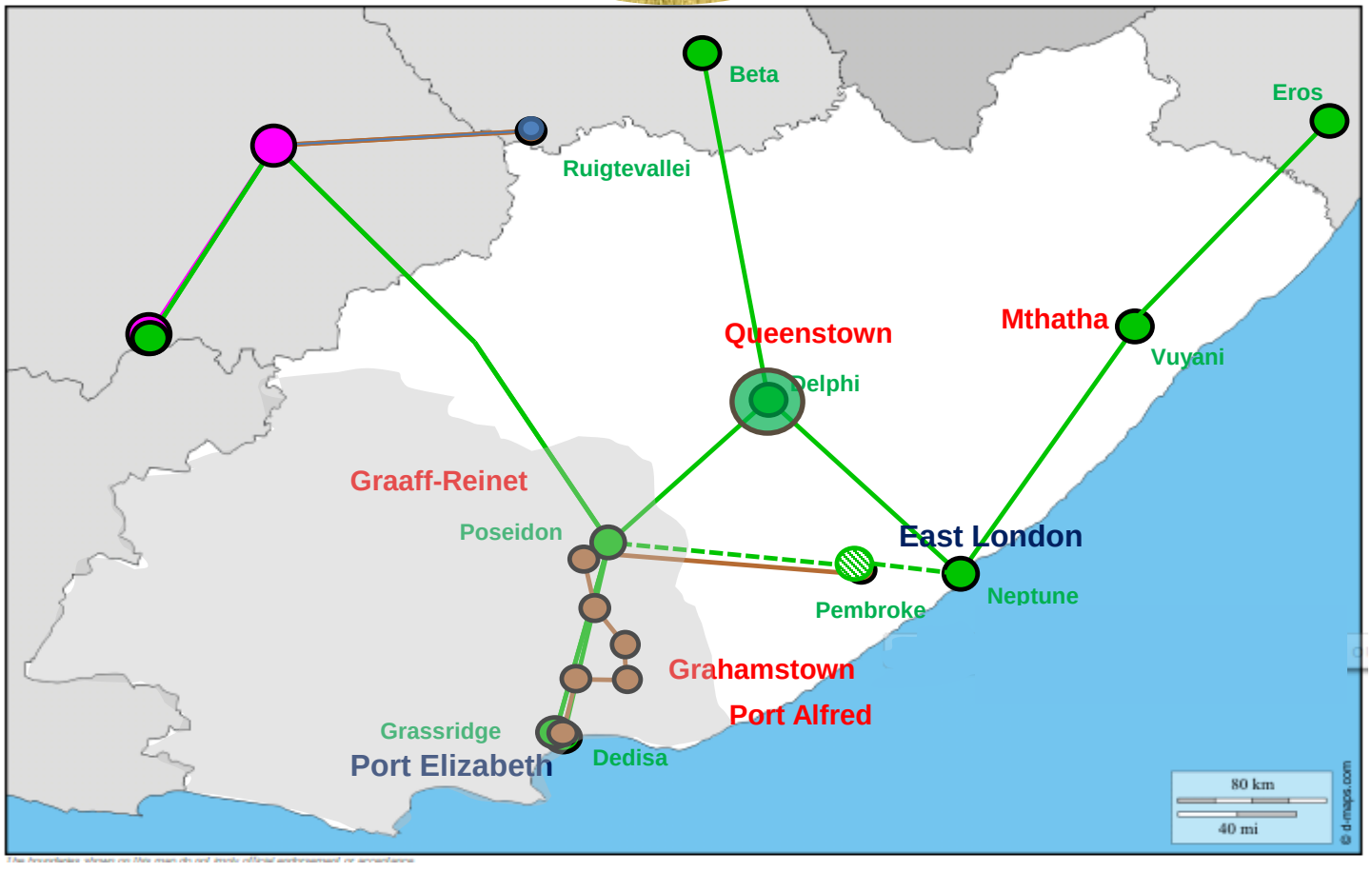
- Eros-Vuyani line, Vuyani substation and Vuyani – Neptune line
- Poseidon 500 MVA 400/132 kV transformer
- ~ 1060 MW RE in the province and DOE OCGT generation at Dedisa

Network Development Plan

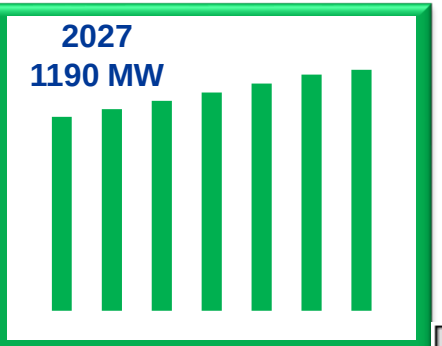
Key projects in the East London area



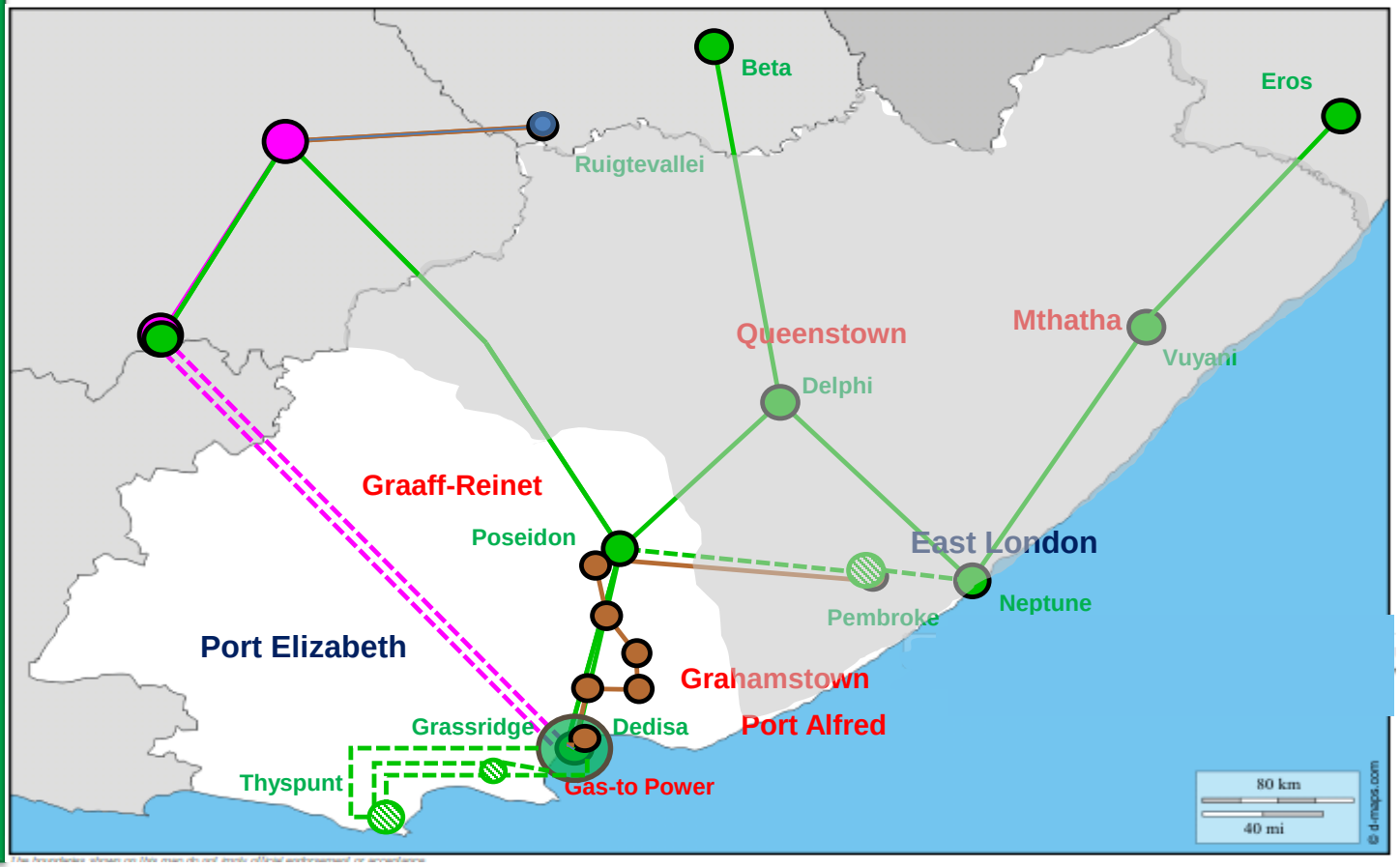
- 400 kV at Pembroke substation:
  - Neptune-Pembroke 400 kV line
  - Poseidon-Pembroke 400 kV line
- 3rd 120 MVA transformer and 100 Mvar 400 kV capacitor bank at Delphi substation



Key projects in the Port Elizabeth area



- 3rd 500MVA transformers and 100 Mvar 400 kV capacitor banks at Dedisa and Grassridge
- Thyspunt nuclear and 1.7 GW gas-to-power generation integration
- Gamma-Grassridge 1st and 2nd 765 kV lines



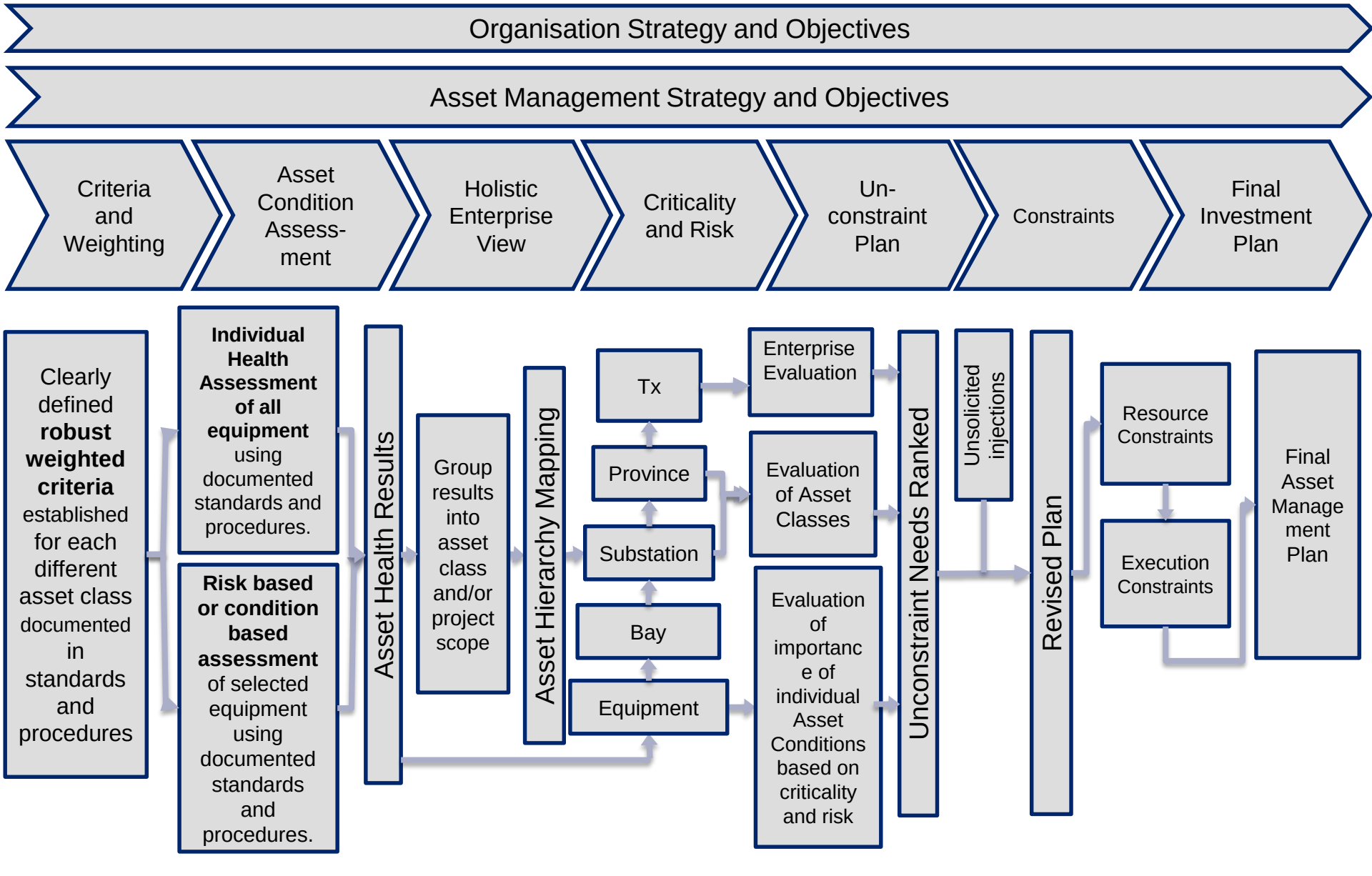
Transmission Refurbishment Plan 2018 - 2027

Presented by: Atha Scott

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.

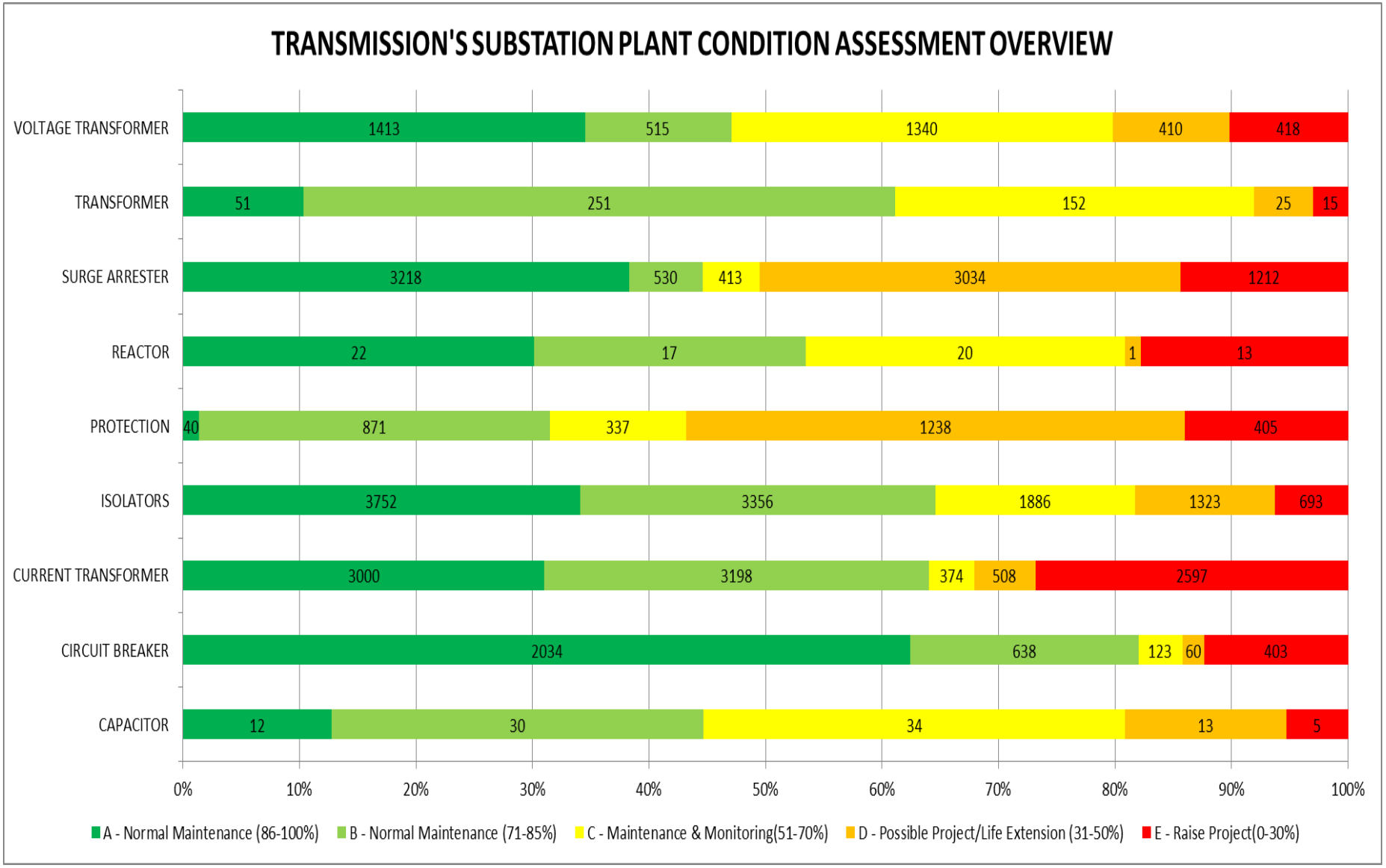
Development of TDP 2018 - 2027 (Asset Refurbishment Framework)



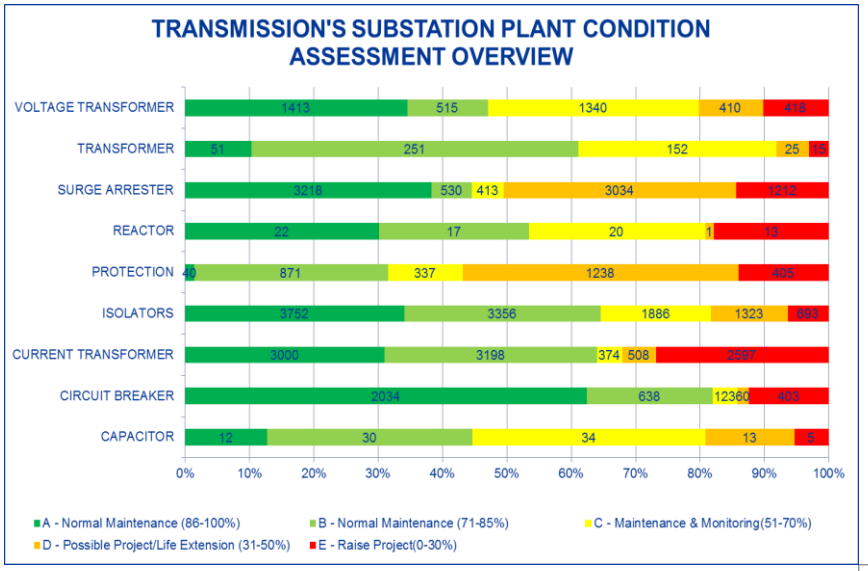
Refurbishment Portfolio Focus Areas

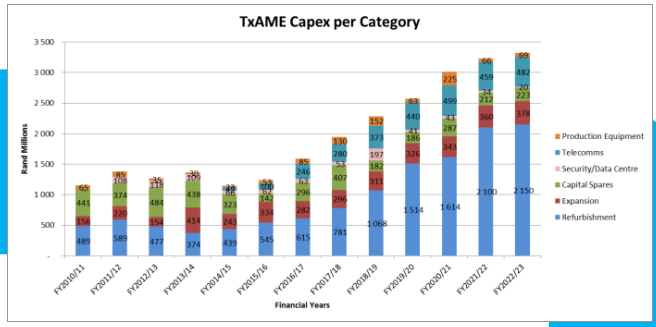
- **Development Mandate:**
  - Capital Spares: Supply restoration
  - Production Equipment: Maintenance support
  - Customer Connections: Secure revenue base
  - N-1 Transformation projects for regulatory compliance
  - Statutory network requirements
  - Refurbishment of network: long term sustainability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

Transmission substations' refurbishment requirements (Needs)



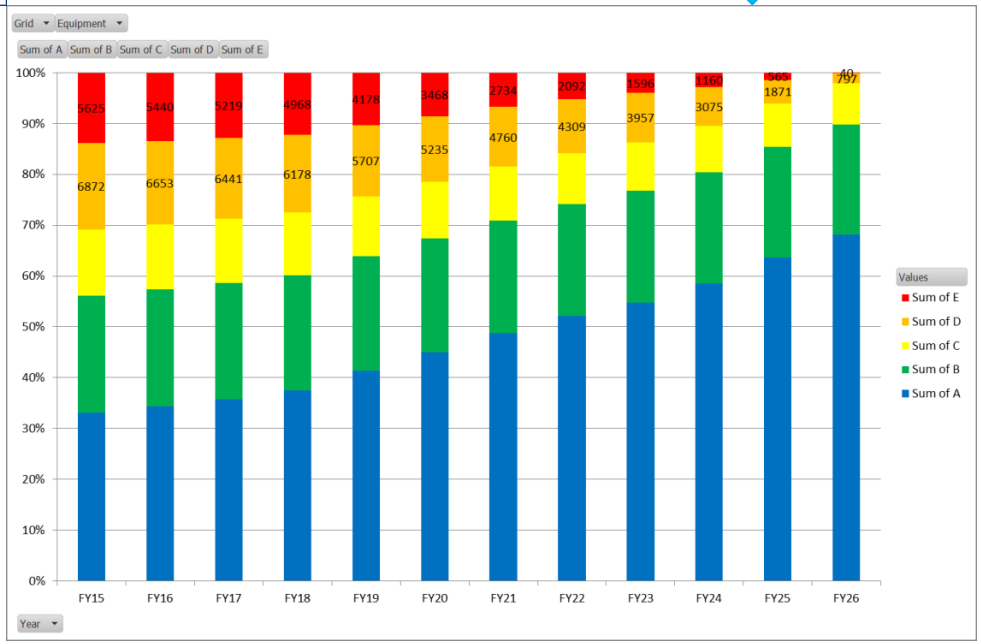
The 10 year asset renewal plan formulation process





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	3	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		1	7	7	6
BREAKERS 11KV REPLACEMENT	PCRA	7.12	9	9	7	5	7	9	9	5	5	7	9					9
Apollo CS: Breakers 11kV Replacement	PCRA	7.12	9	9	7	5	7	9	9	5	5	7	9					9
FORDSBURG SS REFURBISHMENT - ERA	ERA	6.96	8	8	5	6	6	8	9	9	8	1	8					7
Drakensberg Refurbishment Phase 1: Generator Breakers	ERA	6.88	9	9	7	8	7	2	4	8	6	7	8					6
Venus S/S Replacement Of 3X 275Kv Bushings	ERA	6.78	8	8	6	7	8	2	8	8	7	3	8					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	PCRA	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	8	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					8
Zues, Auxili	RA	6.28	6	8	7	6	7	4	4	5	5							7
Acacia SS	RA	6.28	7	8	6	6	7	5	8	6	7							7
Eiger SS Re	RA	6.28	5	9	7	4	8	8	9	4	6	4						5
Replace Un		6.27	9	8	6	5	5	9	9	4	5	6						8
Arnot 275kV	RA	6.27	9	9	8	6	6	4	4	3	4	4						5
Minerva SS	RA	6.26	9	9	9	6	2	8	4	3	8	3						5
Craighall 88	RA	6.26	9	9	9	6	2	8	4	3	8	3						5
Acacia SS	RA	6.25	7	9	7	6	7	5	4	6	7	6						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 previously 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 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:
  - *Ensure the reliability and availability of power capacity to support South Africa's economic growth ambitions*.
  - *Continue capturing efficiencies in operating and capital costs to achieve a sustainable tariff path for the economy*.

Questions?

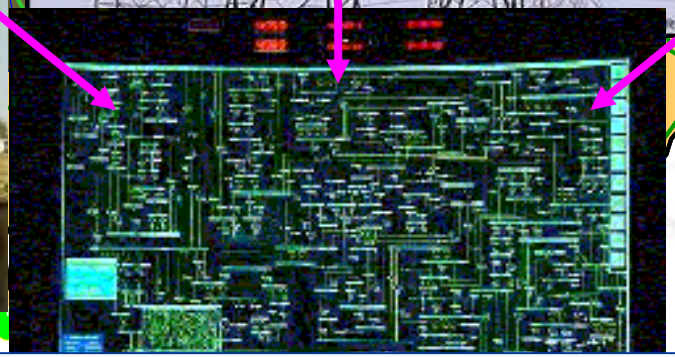
TDP 2018 – 2027
Summary and Capex Analysis

Presented by: Leslie Naidoo

Network Planning: The role of Transmission Planning

Transmission network is required to transport the electricity to Distribution and Large Customers

Existing and new Generation capacity projects as per the IRP



Distribution connections, existing and new loads Customers

Transmission Planning ensures adequate long term network development plans are augmented to ensure the reliability and security of the power system

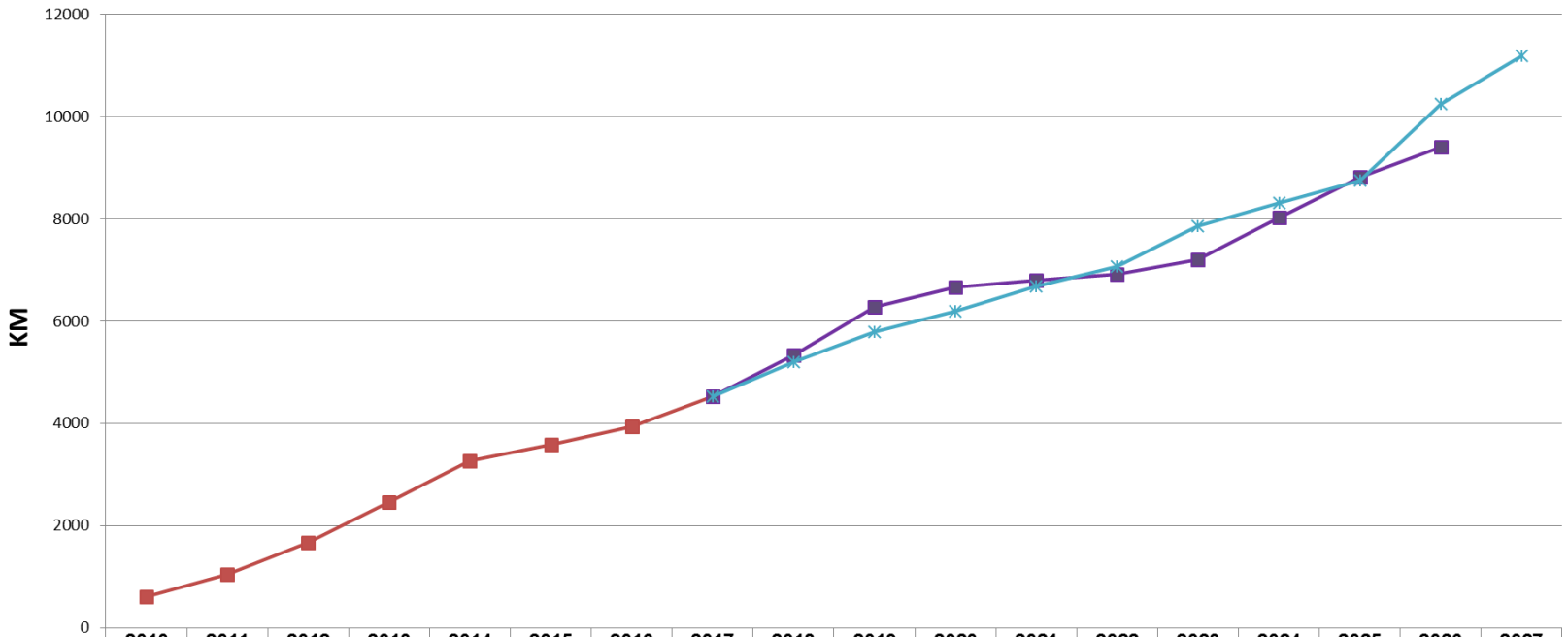
Eskom

Summary of transmission infrastructure requirements over the TDP period

Corporate Plan aligned 2017 TDP Plan

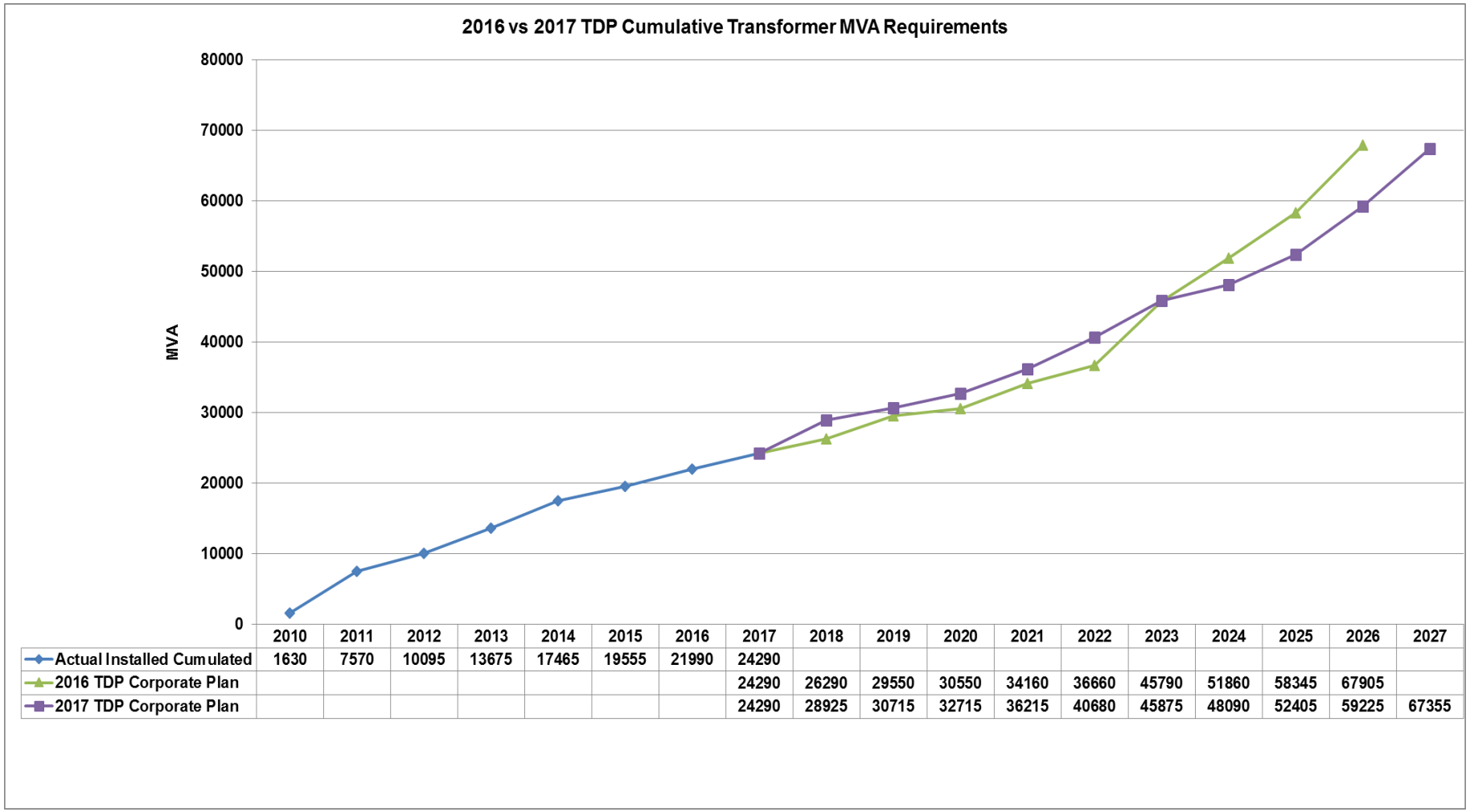
Transmission Assets for National View	New Assets expected in 2018 - 2022	New Assets expected in 2023 - 2027	Total New Assets
Power lines (km)			
765 kV	98	350	448
400 kV	2408	3565	5973
275 kV	33	211	244
Total length (km)	2539	4126	6665
Transformers			
Number of units	44	51	95
Total capacity (MVA)	16390	25045	41435

Planned transmission lines



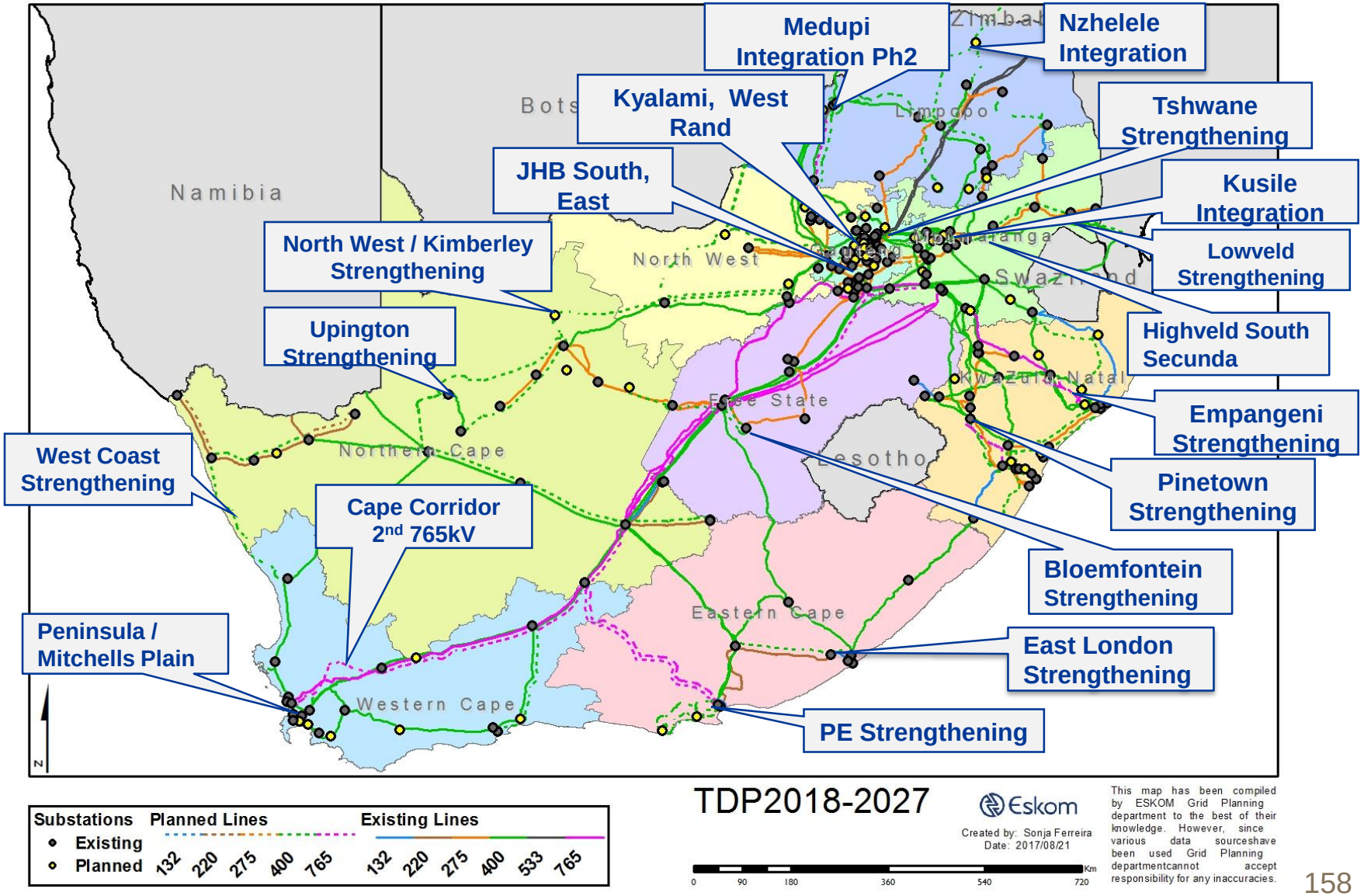
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Actual Built Cummulated	600	1043	1674	2461	3272	3591	3937	4522										
2016 TDP Corporate Plan								4522	5327	6275	6671	6797	6908	7197	8026	8810	9403	
2017 TDP Corporate Plan								4522	5199	5790	6184	6681	7061	7860	8310	8755	10251	11187

Planned transformer capacity



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Actual Installed Cumulated	1630	7570	10095	13675	17465	19555	21990	24290										
2016 TDP Corporate Plan								24290	26290	29550	30550	34160	36660	45790	51860	58345	67905	
2017 TDP Corporate Plan								24290	28925	30715	32715	36215	40680	45875	48090	52405	59225	67355

Major projects planned for in the TDP period



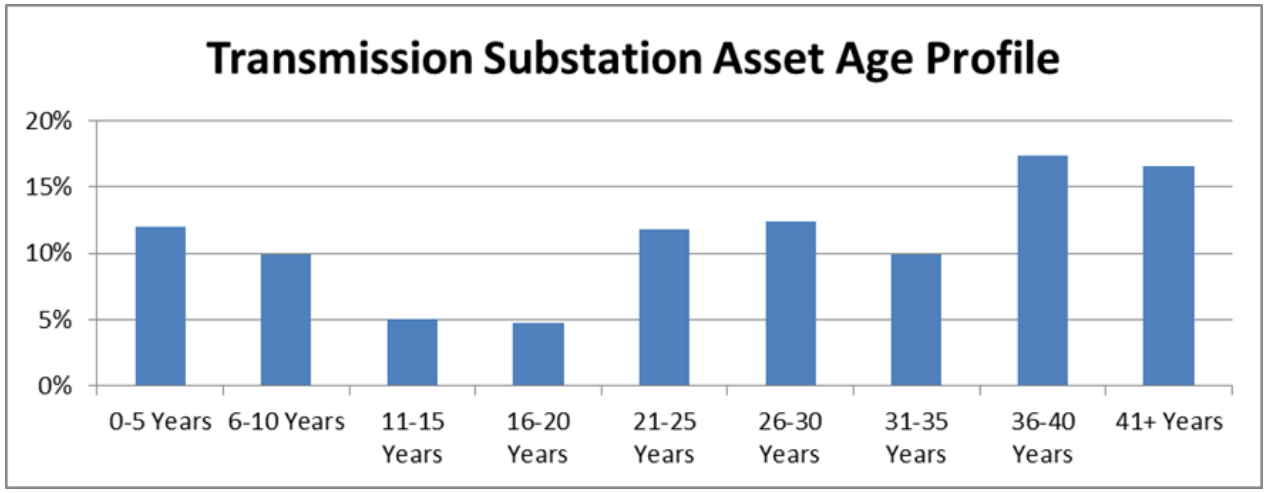
Transmission capital expenditure drivers

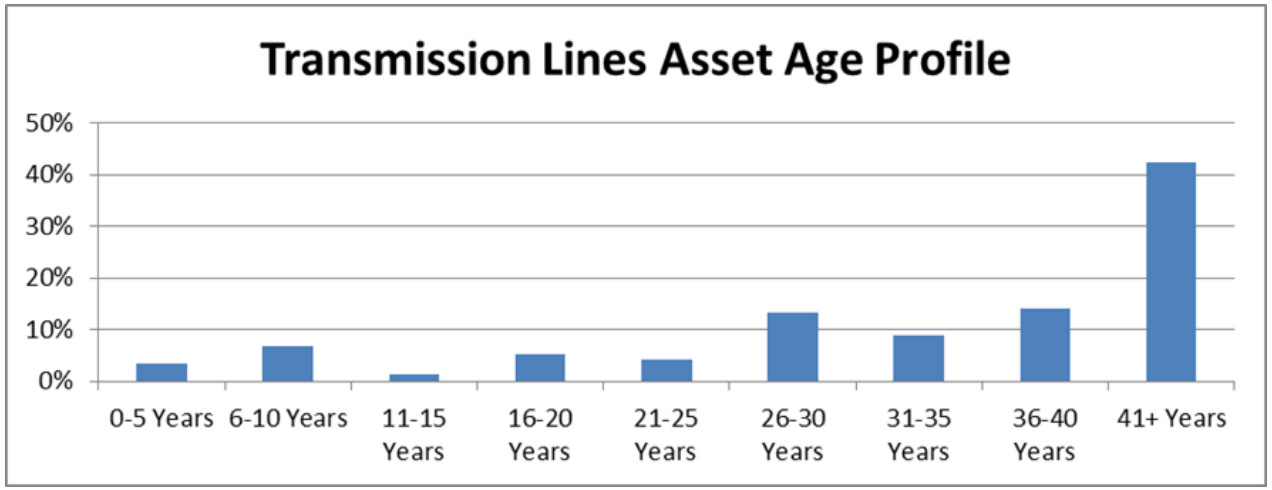
1. **Capacity Expansion and Network Strengthening**:
   - Connection of new and anticipated *customer loads* and *generation*
   - N-1 Reliability Investments
   - Mitigation of Fault-level Exceedances (existing and anticipated)
   - Securing of Servitudes and Environmental Authorisations
   - Compliance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

2. **Refurbishment** (i.e. Extension of Life of Existing Assets):
   - Refurbishment of aging equipment (CTs, VTs, Surge Arresters, H.V. Circuit Breakers and Power Transformers)
   - Targeted Asset Performance Improvements (lines and substation equipment)
   - 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.

Age profile of transmission assets





Transmission 10-year Capex Plan: FY 2018 – 2027

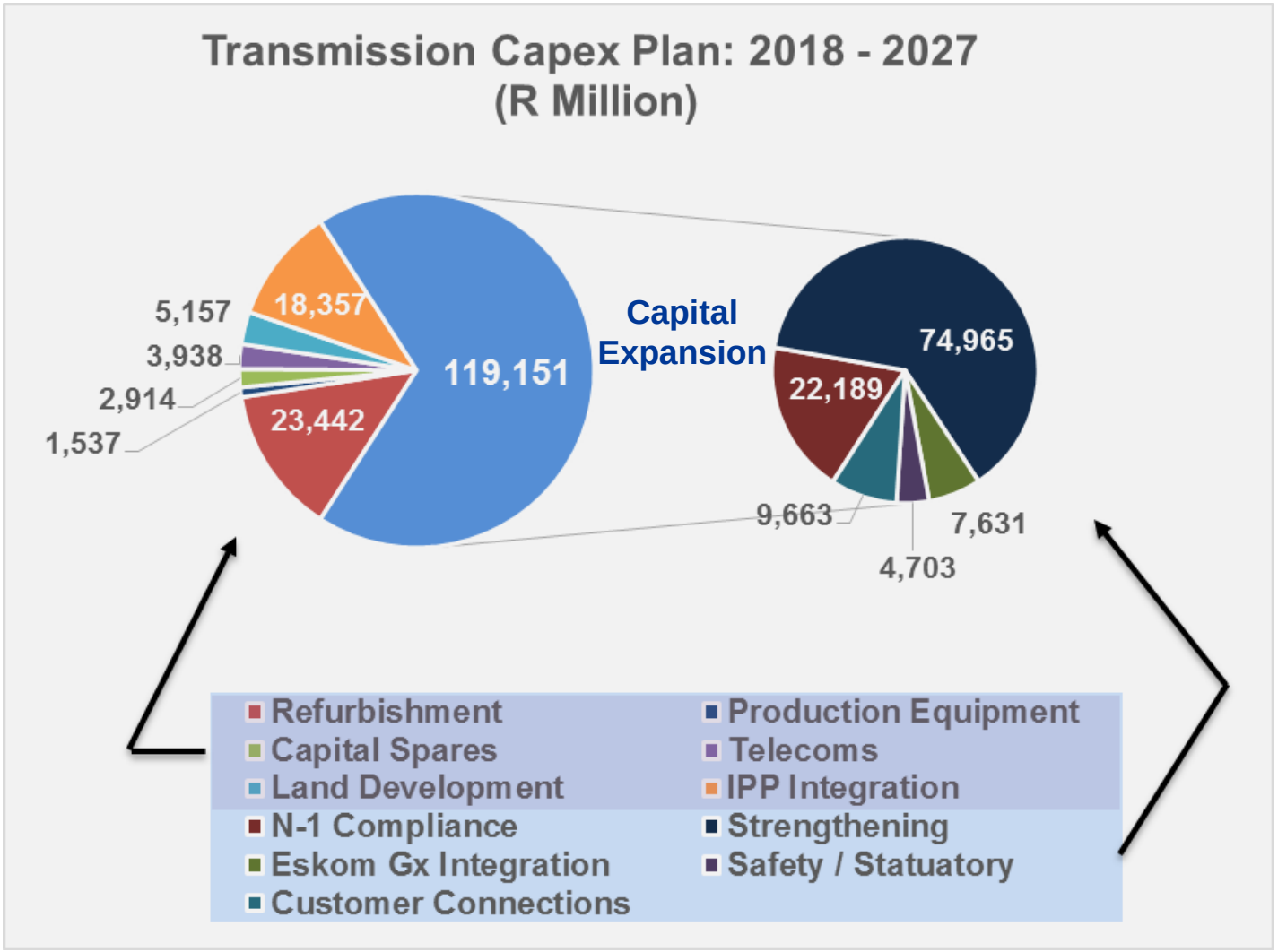
Summary of Transmission Capex Plan (R Million): FY 2018 - FY 2027

	Total: (FY18-27)
Capital Expansion (1)	**119,151**
Capital Expansion for IPPs (2)	18,357
Refurbishment	23,442
Capital Spares	2,914
Telecoms	3,938
Production Equipment	1,537
Land & Rights	5,157
	174,496

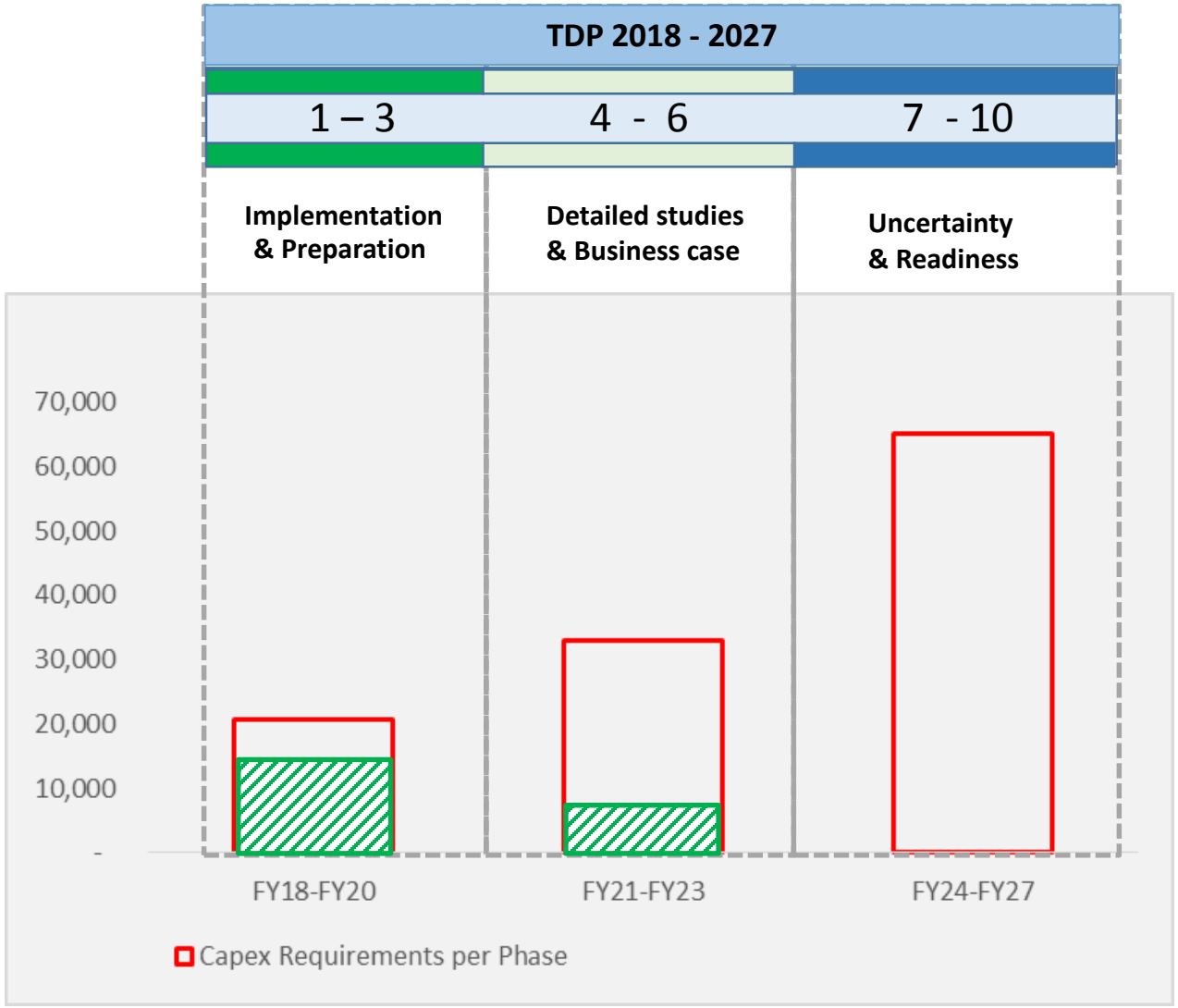
Notes:

1) Capital Expansion: reliability projects (N-1), network strengthening for load growth, integration of generation (Medupi, Kusile, Ingula, IPPs up to Bid Window 3.5)
2) Capital Expansion for IPPs - to integrate IPPs beyond Bid Window 3.5 (Renewables, gas, new coal)

Transmission 10-year Capex Plan: FY 2018 – 2027



Capital Expansion Analysis:



CAPEX Observations

The total Transmission Capital Plan amounts to R174 billion over the TDP period 2018 – 2027 of which:

- R119 billion is required for reliability (N-1) projects, integration of committed generation (Medupi, Kusile, Ingula, IPPs up to Bid Window 4) and connection of new load onto the system.

- R18 billion is required to integrate new IPPs (ie. RE, gas, coal) beyond Bid Window 4 of the DoE's IPP program.

Risk to the TDP 2017

- 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 continues be a challenge to the TDP roll out.

Conclusions

- The demand forecast in the TDP assumptions compares favourably with all the forecasts (IRP and Eskom) and is therefore prudent
- The generation forecast assumptions will be sufficient to allow the 2017 TDP to meet the requirements of the IRP (Draft), and where necessary, sensitivity studies will be done to meet extreme conditions or stress test various scenarios
- We are confident that projects currently in construction will be completed in time
- We will continue engaging with our stakeholders to enable network access in anticipation of the Country's future demand and generation needs
- Investments in the Transmission infrastructure is a crucial enabler for economic growth and development

Questions?

Thank you