The Eskom Transmission Development Plan (TDP) 2022 - 2031

26 October 2021
Keynote address

By: Segomoco Scheppers
Group Executive: Transmission
### Contents

- Planning assumptions: Demand Forecast
- Planning assumptions: Generation Assumptions
- TDP2021: Provincial Development Plans
- Transmission Refurbishment Plans
- Summary of the TDP2021 Capex requirements
- Risks and conclusions
Setting-the-scene
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 2022 – 2031
- Share information and results relating to the integration of IRP 2019 and address the future network requirements
- Share information on the estimated Transmission Capital Investment Requirements for the period 2022 – 2031
- More importantly, to solicit comments and inputs to improve on the Transmission Plans
The TDP 2021 was formulated to address the following:

1. **Attain Grid Code compliance by resolving both substation and line violations (N-1) to ensure network sustainability.**
2. **Determine new network infrastructure requirements to sustain and allow for future demand growth.**
3. **Determine network infrastructure requirements to integrate new generation (Eskom and IPPs).**
4. **Consider asset replacement requirements to ensure reliability of supply and network optimisation.**
The Different Plans

Integrated Resource Plan (IRP)
- The Department of Mineral Resources and Energy is accountable for the Country’s Electricity Plan, which is the Integrated Resource Plan (IRP)
- The Integrated Resource Plan (IRP) is intended to drive all new generation capacity developments
- 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
- 20-year planning horizon, updated every 2 - 3 years

Transmission Development Plan (TDP)
- The Transmission Development Plan (TDP) represents the transmission network infrastructure investment requirements
- 10-year planning horizon, updated annually
- Indicates financial commitments required in the short to medium term
The TDP 2022 - 2031
Assumptions on the Demand Forecast

Presented by: Jana Breedt
Chief Advisor: Forecasting and Research
The purpose of the Transmission demand forecast is to provide an overview of the national grid electricity demand in South Africa that serves as input to the Eskom Transmission Development Plan.

The presentation outlines the base of the Eskom demand forecast methodology, components used to model the demand forecast and the national forecast scenarios with a provincial breakdown.
The future of electricity

World Energy Outlook 2020

2040

+ 3rd

Oil
Coal
Natural Gas
Bioenergy
Nuclear
Hydro
Other Renewables

Central & South America
India

World Energy Outlook 2020
Local demand drivers: national overview

Infrastructure development

Sustainable cost effective electricity

Cloud computing Data Centers

Revival of local industries

Interconnectivity between locations to meet demand

EVs Renewable Generation

Hydrogen fuel cell technology

Gas to fuel

Emerging markets, investment & policy security

Growth populations & urbanisation

More Technology per capita in home & business

Globalisation vs Localisation

Local Beneficiation Mining Manufacturing

CO2 reduction & decarbonisation

Transportation Heating sources Renewable technology

Alternative fuel sources
Sustainable capacity demand

Peak demand with RE generation

- Total Energy with RE (clear day)

Peak demand without RE generation

- Total Energy with no RE (cloudy day)

Future Customer base

- Grid Connected
- Grid Tied Customers
- Off Grid Solutions

YoY% diff

2020

-6% -1%

2021

+4% +2,5%

TWh GW
Factors influencing demand uptake

Forecasting = Trend x Cycle

- EAF % decrease
- Generation shortage
- Financial downgrade

Eskom Turn around strategy
- Investment Pledges > R500 billion
- Energy efficiency gains
- RE integration

Economic recovery rates:
- WB: +4.5%
- IMF: +5%
- WEC: +5%
2030 > 2.5%

COVID-19 – Economic downturn globally & locally
- Economic lag of 2-5 years
- 2020 GDP contraction -7%

Economic down
- Capital constraints
- Political uncertainty
- Increased planned maintenance
- Low Investors confidence

Turn around strategy
- Investment Pledges > R500 billion
- Energy efficiency gains
- RE integration

Growth Enabled Future

Economic recovery rates:
- WB: +4.5%
- IMF: +5%
- WEC: +5%
2030 > 2.5%
Forecast methodology

Global
- Global events, Global financial impacts, Global economic trends, Import / Export agreements

Country
- Economic growth, Investments plans, Development plans, Policy Frameworks

Utility
- Directives, Governance policies, Regulatory policies, Tariff structures, Energy Trading & Policies

Demand Drivers
- Accelerated Urbanization
- Electric Vehicles
- Transportation fuel sources
- Robotics
- Mineral use in technology (Pt/Mg/Cu)
- Technological innovation
- Big data storage
- Globalization vs Localization

Disruptive factors
- Generation Supply Mix: Renewable & Conventional
- Heating sources
- Shift in economic sector composition
- Technological innovation & Smart energy systems
- Improved Energy Efficiencies
- Energy storage technology
- Climate Change and resource scarcity / choice of resource

Network Implications
- Energy Efficiency
- Technological innovation
- Grid Connectivity
- Energy Intensity

Scenario Development
- Scenario 1
- Scenario 2
- Scenario 3
- Scenario 4

Business Model Strategies
- Strategic Objectives & Goals
- Market Share Directives
- Business Operating Model(s)
- IPP Procurement and long term Planning
- Utility Positioning in Power Sector

7 step demand forecast process
Scenario 2: Tx Moderate High

“Fly with caution, enable, collaborate with off grid solutions”

- Low to medium grid deflection, high grid tied customer base
- Assumes capacity gap to be addressed by turn around plan & IRP Renewable integration plans
- Assumes local and global investment into emerging markets to enable growth and stimulate opportunities
- Assumes steady enablement of localized commodity beneficiation, manufacturing & cloud computing;
- AAG of 2% demand for TDP period, 2.5 GDP
- Quantitatively based on past recovery trends
Transmission national forecast 2022-2031

Customer Applications and Market Intelligence

GW


2021 Tx High
2021 Tx Moderate High
2021 Tx Energy efficient
2021 Tx Low

KSACS Customer NMD (GW) 16 15 14 14 14 14 14 14
Distribution Customer NMD (GW) 24 25 28 28 30 30 30 30
2019 IRP HLI Demand (GW) 38 39 40 41 42 43 43 44 45 45 46 47 47
Actual Peak Demand (GW) ^ 35 35 36 36 36 35 34

Customer Growth Projection at 0,5%
Constrained Scenario 1
Constrained Scenario 2

*Instantaneous Peak Demand
Demand drivers and spatial allocation of demand potential

Additional MW potential TDP period

Total BQ & ICE sources
Provincial peak load growth for TDP period

Transmission high growth:
Total percentage growth per province TDP 2021

Load Intensity
Year 2029
- 1582
- 1918
- 1995
- 3965
- 4695
- 5077
- 5193
- 7314
- 14556

Data centers
Residential developments
EV uptake

Mining
Chrome
Coal
Platinum
Residential

Manganese
Iron ore mining
smelters

Petrochemical plants
Hydrogen fuel cell
Manufacturing
Transport

Data Centers
Smelters
Residential
Agriculture

Smelters
Industry
Manufacturing
Robotics
Ports
Transport

+ 6,7 Billion

+ 1260 MW
+ 1200 MW
+ 3200 MW
+ 513 MW
+ 1100 MW
+ 215 MW
+ 300 MW
+ 514 MW
+ 830 MW

The way forward

Renewable energy

- With cost decreasing and RE adoption increasing, worldwide the share of variable renewables expected to expand to 40-70% by 2050 compared to 10% today.
- Future electricity systems will need to operate flexibly, enabled by adequate capacity and robust grids to enable future demand.
- Electricity demand is growing and an essential catalyst to all economic sectors.
- In South Africa the economy needs electricity to drive development and enable growth.
- A competitive energy market should be enabled and collaboration formed between investors and planners to enable demand waiting to be ignited.
• With cost decreasing and RE adoption increasing, worldwide the share of variable renewables expected to expand to 40-70% by 2050 compared to 10% today.
• Future electricity systems will need to operate flexibly, enabled by adequate capacity and robust grids to enable future demand.
• Electricity demand is growing and an essential catalyst to all economic sectors.
• In South Africa the economy needs electricity to drive development and enable growth.
• A competitive energy market should be enabled and collaboration formed between investors and planners to enable demand waiting to be ignited.
Questions?
The TDP 2022 - 2031

Assumptions on the Generation Forecast

Presented by: Ronald Marais
Senior Manager: Strategic Grid Planning
Grid overview

Demand ~35GW (205TWh)  
Conventional ~48GW + HVDC 1.5GW  
Renewable ~6GW

Demand ~35GW (205TWh)  
7686 MW 22%  
27355 MW 78%

Conventional ~48GW + HVDC 1.5GW  
11814 MW 21%  
44155 MW 79%

Generation
Generation Capacity Forecast

Total Generation Capacity (MW)

- Coal: 1403 MW
- Wind: 1675 MW
- Solar: 1776 MW
- Gas: 4418 MW

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<th>Year</th>
<th>Total TDP 2020</th>
<th>Total TDP 2021</th>
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<tbody>
<tr>
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<td>55910</td>
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<tr>
<td>2038</td>
<td>84121</td>
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</tbody>
</table>
Generation Capacity Comparisons (MW)

**Wind**
- Delta Wind
- Wind TDP 2020
- Wind TDP 2021

**PV**
- Delta PV
- PV TDP 2020
- PV TDP 2021

**Coal**
- Delta Coal
- Coal TDP 2020
- Coal TDP 2021

**Gas**
- Delta Gas
- OCGT TDP 2020
- OCGT TDP 2021
The allocation of Renewables took into consideration the following:
- CSIR view on RE potential adjusted for sensitive areas
- EIA applications in the past few years from DEA
- Grid Planning applications processed thus far
- Proximity to major corridors and network
  - Relocations for earlier years due to network constraints
Spatial Allocation – PV Potential

Source: https://egis.environment.gov.za/redz
Spatial Allocation – Wind Potential

Source: https://egis.environment.gov.za/redz
Spatial Allocation – Wind and PV Potential
Spatial Allocation – EIA Applications

Source: https://egis.environment.gov.za/redz
Source: https://egis.environment.gov.za/redz
Spatial Allocation - Applications Eskom & CSIR

Legend
- Solar 0-5 Survey
- Solar 11-15 Survey
- Solar 6-10 Survey
- Wind 0-5 YRS survey
- Wind 11-15 YRS survey
- Wind 6-10 YRS survey
- Renewables REEA.OR.2019.Q1 (#2)
- Renewables REEA.OR.2015.Q3 (#2)
Provincial Capacity Allocations (MW)
Generation Build-up Graph

Net Added 28050 MW

-342MW Gas
-11125MW Coal

+2269 MW RMIPPPP
+31648 MW
+5600 MW
- 11467 MW

58339 MW
56071 MW
89987 MW
95586 MW
84121 MW

Generation up to 2021 (incl Decom)
RMIPPPP
TDP/IRP
2031 Assumed
Decommissioning
Total

56071 MW
58339 MW
89987 MW
95586 MW
84121 MW

56071 MW
58339 MW
89987 MW
95586 MW
84121 MW
Annual and Total Decommissioning

Buffer  Kriel  Arnot  Hendrina  Duvha  Matla  Camden  Grootvlei  Komati  Acacia  Port Rex

-2583 MW  -2697 MW  -2822 MW  -3072 MW  -5883 MW  -7400 MW  -8575 MW  -9050 MW  -10700 MW  -11750 MW  -14050 MW

2021  2022  2023  2024  2025  2026  2027  2028  2029  2030  2031  Total


-14050 MW  -11750 MW  -10700 MW  -9050 MW  -8575 MW  -7400 MW  -5883 MW  -2583 MW  -2697 MW  -2822 MW  -3072 MW

97X  106X  147X  193X  239X  286X  331X  377X  423X  466X  512X  586X
Cumulative Generation Capacity (MW) 2000 - 2031

- Coal
- OCGT Gas
- Landfill Gas
- Nuclear
- Import Hydro
- Pumped Storage
- Hydro
- Biomass
- Small Hydro
- Wind
- PV
- CSP
- Battery Storage
Spatial Allocation – 2031 With Transmission Network
Spatial Allocation – 2031 Allocations
Questions?
TDP 2021

Provincial Development Plans

Compiled by : Grid Planning Chief Engineers

Presented by : Thamsanqa Ngcobo

October 2021
Provincial total load growth for TDP period

Transmission high growth:
Total percentage growth per province
TDP 2021

- Gauteng: 29%
- Limpopo: 34%
- Western Cape: 33%
- Eastern Cape: 18%
- North West: 25%
- Free State: 13%
- KwaZulu Natal: 20%
- Mpumalanga: 13%
- Manganese
- Iron Ore mining
- Smelters
- Residential developments
- Data Centers
- Residential growth
- Mining
- Chrome
- Coal
- Platinum
- Petrochemical plants
- Hydrogen Fuel Cell
- Manufacturing
- Transport
- Smelters
- Industry
- Robotics
- Ports
- Transport

+ 6.7 Billion
Generation and Load Balance

Lower load in the South remains

Generation increase in the South

Significant transmission development is required in the northern, central and southern corridors.
Northern Cape Province

TDP 2022 - 2031

Compiled by: Rashaad Tayob
Northern Cape Province Load Forecast

Load Drivers
• Natural load growth
• Anticipated mining and smelter load in Kimberley and Namaqualand CLNs

* Compound Annual Growth Rate
## Northern Cape Province Generation Forecast

<table>
<thead>
<tr>
<th>Year</th>
<th>Small Hydro</th>
<th>Battery Storage</th>
<th>CSP</th>
<th>Wind</th>
<th>PV</th>
<th>Cumulative Total</th>
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<td>1965</td>
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<td>4315</td>
<td>4653</td>
<td>9778</td>
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</table>
Transmission Development Plan
Reliability Plans for the Northern Cape

- **Upington – Ferrum 400 kV line**
- **Upington 2nd 400/132 kV transformer**
- **Aggeneis – Paulputs 400 kV line**
- **Aries SVC**
- **Juno – Gromis 400 kV line**
  - Gromis 400/220 kV transformer
Corridor Strengthening for IRP 2019

Support local generation integration

Strengthen 400 kV evacuation corridors

Large scale power transfer to load centres

765 kV
400 kV
275 kV
220 kV
Substation Strengthening for IRP 2019

- Paulputs 400 kV Strengthening
- Korana Substation
- Namaqualand 400 kV Strengthening
- Cape Corridor Phase 5 & 6 (765/400 kV Strengthening)
- Garona 400 kV Strengthening
- Garona 275/132 kV Upgrade
- Boundary 400 kV Strengthening
- Hydra B Substation
- Gamma 400 kV Strengthening
Western Cape Province
TDP 2022 - 2031

Compiled by: Ahmed Hansa
Western Cape Province Profile

Transmission Network
- 400 kV: ~2 800 km
- 765 kV: ~550 km
- 14 Substations
- 48 Transformers
- 16 345 MVA

CLNs
- Outeniqua
- Peninsula
- West Coast

Load
- Peak load of ~3 800 MW

0 1000 2000 3000 4000

Map showing cities like Cape Town, Hermanus, Bredasdorp, Outeniqua, Peninsula, and West Coast regions.
### Existing Generating Facilities in the Western Cape

#### Eskom Power Stations

<table>
<thead>
<tr>
<th>Power Station</th>
<th>Capacity (MW)</th>
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<tbody>
<tr>
<td>Acacia</td>
<td>171</td>
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<tr>
<td>Ankerlig</td>
<td>1,327</td>
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<tr>
<td>Gourikwa</td>
<td>740</td>
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<tr>
<td>Koeberg</td>
<td>1,830</td>
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<tr>
<td>Sere</td>
<td>100</td>
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<tr>
<td>Palmiet</td>
<td>400</td>
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<td><strong>Total</strong></td>
<td><strong>4,568</strong></td>
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#### RE IPPs

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<th>Type</th>
<th>Capacity (MW)</th>
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<td>Wind</td>
<td>348</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>482</strong></td>
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</table>

#### City of Cape Town

<table>
<thead>
<tr>
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<th>Capacity (MW)</th>
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<tbody>
<tr>
<td><strong>Total</strong>*</td>
<td><strong>258</strong></td>
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</table>

*excludes small scale embedded generation (SSEG)
Western Cape Load Forecast

* Compound Annual Growth Rate

<table>
<thead>
<tr>
<th>Year</th>
<th>West Coast</th>
<th>Outeniqua</th>
<th>Peninsula</th>
<th>Provincial Peak</th>
<th>2031 Peak</th>
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<tr>
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<td>847</td>
<td>2741</td>
<td>3757</td>
<td>4991</td>
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<td>728</td>
<td>1093</td>
<td>3630</td>
<td>4991</td>
<td>4991</td>
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</table>

* CAGR = 3.21%
Developments in the Peninsula CLN

- Ankerlig – Sterrekus 1st and 2nd 400 kV lines – **commissioned**
- Relocate Koeberg offsite supply to Ankerlig
- Operate Koeberg – Acacia 2nd line at 400 kV
- Erica Substation
- Pinotage Substation – **commissioned**
Developments in the Outeniqua and West Coast CLNs

Bredasdorp
Montagu
Malmesbury
Morreesburg
Hermanus
Caledon
Worcester
Ceres
Beaufort West
Oudtshoorn
Knysna
Mossel Bay
George
Paarl
Swellendam
De Doorns
North Cape
Eastern Cape

Substations
Existing
Planned

Asteria Substation
Bokkom Substation (Phase 1)
Agulhas Substation
Narina Substation
Developments to enable IRP 2019

Cape Corridor Phase 5 and 6 (new 765 kV corridor)

Aurora – Juno 2nd 400 kV line

Komsberg Substation – commissioned

Kappa ext. 400/132 kV – commissioned

Asteria Substation

Cape Corridor Phase 4 (2nd 765 kV line)

Droërivier B Substation

Koring Substation

Droërivier – Narina – Gourikwa 400 kV line

Agulhas Substation
Eastern Cape Province Profile

2020 Recorded Peak 1545 MW

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Output</th>
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<tr>
<td>Peaking</td>
<td>Gas</td>
<td>Port Rex</td>
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<td></td>
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<td>Dedisa</td>
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<td>RE IPP</td>
<td>Wind &amp; Solar</td>
<td>ALL</td>
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<td>Total Installed Generation</td>
<td>~2031 MW</td>
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Generation

- Agriculture
- Manufacturing
- Electricity
- Construction
- Trade
- Transport
- Finance
- Community services
Eastern Cape Province Load Profile Actuals and Forecast for TDP period 2022 to 2031

Main Load Drivers – Coega Industrial Development Zone
- Load commitment is not as fast as anticipated before
- Potential risk for major developments with potential step loads
- Future Market Developments based on the Market Intelligence:
  - Manganese smelter
  - PV Silicon plant
  - Coega Ridge residential developments with approximately 3800 houses
  - Automotive Assembly plant
  - More industrial developments in the future.
### Eastern Cape Province Load Forecast (2022 – 2031)

#### Load [MW]

<table>
<thead>
<tr>
<th>Year</th>
<th>East London</th>
<th>Port Elizabeth</th>
<th>Provincial Peak</th>
<th>2031 Peak</th>
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<td>2022</td>
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<td>833</td>
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**CAGR = 1.34%**

---

**Eastern Cape Province Load Forecast**

- East London: +13%
- Port Elizabeth: +13%
Eastern Cape Generation Forecast – IRP 2019

Eastern Cape Generation Forecast

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Key Projects in the East London CLN

- Pembroke 400 kV Integration
- Poseidon – Pembroke 400 kV line
- Dorper substation integration
- Poseidon North MTS
Key Projects in the Port Elizabeth CLN

- Dedisa 3rd 500 MVA TRFR
- Grassridge 3rd 500 MVA TRFR
- Hlaziya integration
- Coega Gas Integration
- 2x 765kV Gamma-Grassridge lines
- Poseidon South MTS
- Grahamstown MTS
North-West Province
TDP 2022 - 2031

Compiled by: Caroleen Naidoo
North West Province Profile

Load
- Peak load of 3307 MW in 2020

Economic Sectors
- North-West 2022
  - Community Services: 24%
  - Mining: 34%
  - Agriculture: 3%
  - Electricity: 4%
  - Manufacturing: 5%
  - Trade & Construction: 11%
  - Finance: 11%
  - Transport: 6%
  - Community Services: 24%

Generation
- PV: 157 MW
- REIPP Total: 157 MW
Load Drivers

**Rustenburg CLN**
- Natural load growth
- Mining applications
- Load shifts from neighbouring provinces

**Carletonville CLN**
- Natural load growth
- Electrification
- Bulk supply applications
- Load shifts from neighbouring provinces

*Compound Annual Growth Rate*
Renewable Energy Projections:

- Approximately 1 GW in the 10 year horizon
- Mookodi substation – 275 MW
  - Approved 75 MW Waterloo Solar Park
  - 200 MW PV
- Watershed substation – 525 MW
  - Approved 75 MW Zeerust Solar Park
  - 450 MW PV
- Bighorn substation – 107 MW
  - Existing 7 MW RustMo1 PV
  - 100 MW PV
Completed Projects

Watershed 2\textsuperscript{nd} 250 MVA 275/132 kV transformer commissioned on 2\textsuperscript{nd} September 2021
Available Capacity in North West Province: ~ 4051MW

Round 5 applications were focused on integration at Mookodi Substation.

Approximately 4051MW can be integrated in the remainder of North West Province in round 6.

Mookodi – Ferrum 400 kV line bring power from Northern Cape Province into North West Province. Mookodi Substation is therefore constrained by Mookodi – Mercury 400 kV being the only path to evacuate power from Mookodi Substation.
Developments in the Carletonville CLN

- Mookodi first 500 MVA 400/132 kV transformer
- Mookodi Reactive Compensation
- Kimberly strengthening (new corridor from Northern Cape will transverse via Mookodi)
- Mookodi – Mahikeng 400 kV lines & Mahikeng substation
- Pluto – Mahikeng 400 kV line
Developments in the Rustenburg CLN

- **1x Medupi – Ngwedi**
  - 400 kV line
  - (1x 765 kV design)
  - near Mogwase

- **Rustenburg Reactive Compensation**
  - (Bighorn, Marang and Dinaledi)

- **Bighorn Extension** – near Marikana
Limpopo Province
TDP 2022- 2031

Compiled by: Caroleen Naidoo
Limpopo Province Profile

Load
- Peak load of 3357 MW in 2020

Economic Sectors

Generation

<table>
<thead>
<tr>
<th>Type</th>
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<td>Coal Base Load</td>
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<td>Medupi</td>
<td>2382 MW</td>
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<td>Renewables</td>
<td>Witkop PV</td>
<td>30 MW</td>
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<td></td>
<td>Soutpan PV</td>
<td>28 MW</td>
</tr>
<tr>
<td></td>
<td>Villa Nora PV</td>
<td>60 MW</td>
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</table>

Total Installed Generation: 6490 MW
North West Province Load Forecast

Limpopo Province Load Forecast (2022 – 2031)

Lephalale Load Growth Drivers:
- Electrification
- Commercial and light industrial load growth
- Platinum and Coal Mining

Polokwane Load Growth Drivers:
- Electrification
- Agriculture
- Diamond and Coal Mining

Phalaborwa Load Growth Drivers:
- Electrification
- Agriculture
- Chrome Mining

*Compound Annual Growth Rate
Strengthening associated with Waterberg Generation Pool

Medupi - Ngwedi 1st 765 kV line (To be energised at 400 kV)

Medupi - Witkop 400 kV line

Borutho - Silimela 400 kV line
Strengthening projects for load growth in Limpopo Province

Establishment of 400 kV network to the North:
- Nzhelele integration

Establishment of 400 kV network to the South:
- Sekhukhune Integration
- Manogeng Integration
- Silimela integration

Increase capacity of existing Substations:
- Warmbad
- Acomhoek
- Leseding
- Borutho

Establishment of 400 kV network to the North East:
Limpopo East Corridor
Strengthening (400kV at Foskor and Spencer)
Mpumalanga Province
TDP 2022 - 2031

Compiled by: Kabir Singh
Mpumalanga province profile

Load of ~ 4 GW

- Agriculture: 14%
- Mining: 7%
- Manufacturing: 7%
- Electricity: 9%
- Construction: 3%
- Trade: 3%
- Transport: 2%
- Finance: 2%
- Community services: 9%

Generation capacity of ~26.5 GW

- Nominal Capacity (MW):
  - Komatikraal: 205
  - Grootville: 570
  - Hendrina: 1,313
  - Camdeboo: 728
  - Amat: 1,136
  - Kriel: 1,149
  - Dlubha: 2,850
  - Maria: 2,875
  - Tutuka: 3,450
  - Kendal: 3,516
  - Malebo: 3,840
  - Malelo: 3,843

Existing Substations
- Komatikraal
- Grootville
- Hendrina
- Camdeboo
- Amat
- Kriel
- Dlubha
- Maria
- Tutuka
- Kendal
- Malebo
- Malelo

Existing Lines
Mpumalanga generation forecast
2022 - 2031
Generation Developments in Mpumalanga

- Kusile Integration
  - Kusile-Duvha
  - Kusile-Minerva
  - Kusile-Apollo
  - Kusile-Zeus
  - Kendal-Zeus
  - Kusile-Lulamisa

New 400 kV line
Mpumalanga Load Forecast
2022 - 2031

CAGR* = 0.9%

Key Growth Drivers
Residential
Commercial
Tourism
Mining
Industrial development

* Compound Annual Growth Rate
Strengthening developments in Mpumalanga

• Marathon 400 kV integration
  • N-1 compliance
  • Creating spare capacity
  • Increased cross-border transfer capability

• Madlanzini 400 kV integration
  • Creating spare capacity for freight rail project

Marathon 400 kV Integration
- Gumeni-Marathon line
- 400/132 kV TRFR

Detail in next slide
Strengthening developments in Mpumalanga

- Wonderkrag integration
  - N-1 compliance
  - Safety compliance
  - Creating spare capacity
  - Fault level mitigation

- Emkhiweni integration
  - N-1 Compliance
  - Safety related to burning grounds
  - Creating spare capacity
Gauteng Province Profile

Grid peak demand: ~9 845 MW: 24th July '19

Load

- Agriculture: 27%
- Mining: 3%
- Manufacturing: 15%
- Electricity: 3%
- Construction: 4%
- Trade: 10%
- Transport: 24%
- Finance: 27%
- Community services: 14%

Generation

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<td>City of Tshwane</td>
<td>Rooiwal &amp; PTA West</td>
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</table>

Map of Gauteng Province showing various cities and power stations.
Gauteng Projects - Complete

Lepini Ext. 275 kV
2x150 MVar Capacitors

- supports the Minerva-Lepini – Craighall 275 kV ring which supplies the northern suburbs of JHB (Sandton, Midrand, Tembisa)
Gauteng Projects in Execution

Sisimuka 88 kV Busbar

- 1st phase of converting Simmerpan to a 275/88 kV sub
- supplies growth in Germiston area
Gauteng Projects in Execution

Benburg Ext. 3rd
250 MVA 275/132 kV Transformer

- Supports network reliability in the East Rand
Gauteng Load Forecast

Growth drivers:
- Residential,
- Commercial, &
- Light industrial

Growth Nodes:
- Northern Suburbs
- West Rand
- East Rand
- Tshwane

Gauteng Province
Load Forecast (2022 – 2031)
Developments in the JHB East & South Area

Key Projects

- Mesong Substation
- Jupiter B integration & Matla-Jupiter 400 kV line (operated at 275 kV)
- Sisimuka Substation
- Lesokwana Substation
Developments in the Tshwane Area

Key Projects

- Diphororo Substation
- Wildebees integration
Developments in the JHB North Area

Key Projects

- Kusile-Lulamisa 400kV line
- Apollo-Lepini 2nd 275kV line
- New MTS Sesiu 400/88kV
- New MTS Kyalami 400/88kV
- New MTS Donatello 400/88kV
Developments in the West Rand & Vaal Area

Key Projects

- 2x Etna – Glockner 400 kV lines (operated at 275 kV)
- Quattro Substation
- Her-Westgate 400 kV line
KwaZulu-Natal Province
TDP 2022 - 2031
Compiled by: Thokozani Bengani
KwaZulu-Natal Province Profile

Load

2020 Peak Demand: 5904 MW

- Agriculture: 4%
- Mining: 2%
- Community Services: 25%
- Manufacturing: 17%
- Finance: 16%
- Transport: 13%
- Trade: 16%
- Electricity: 4%
- Construction: 3%

Generation

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<td>Installed Generation</td>
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Existing Substations

- Newcastle
- Gqbelston
- Mpondeni
- Ingula
- Ladysmith
- Danksraal
- KwaZulu-Natal
- Bloukrans
- Ivense
- KwaZulu-Natal
- Estcourt
- Mersey
- Petermaritzburg
- Andover
- Hector
- Durban
- Durban South
- KwaDukuza
- KwaZulu-Natal

Existing Lines
KwaZulu-Natal Load Forecast

Growth drivers in the province: Commercial, Light industrial, Residential, Tourism & Electrification

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<tr>
<th>Year</th>
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**CAGR = 1.98%**
KwaZulu-Natal Transmission Development Plans

**Northern KZN Strengthening: Iphiva 400/132 kV Substation**

Drivers for demand growth are electrification, tourism, and agro processing.

**Empangeni Strengthening: Mbewu 400 kV Switching Station**

Associated 765 kV and 400 kV lines Required to increase power transfers to coastal towns and to facilitate integration of gas power plants in Richards Bay.

**South Coast Strengthening: Ariadne-Eros 2nd 400 kV Line**

Required to create capacity to meet demand growth and to improve the security of supply.

**Ermelo-Richards Bay Freight Rail Strengthening: Duma & Nzalo Substations**

Required to improve security of supply and to increase tonnage capacity.
KwaZulu-Natal Transmission Development Plans

Pinetown Strengthening: Isundu 400 kV Switching Station
Associated 765 kV & 400 kV lines
Required to provide network redundancy and to increase power transfers to the southern parts of KwaZulu-Natal

Inyaninga 400/132 kV Substation
Required to supply the Dube Tradeport as well as commercial and residential developments in eThekwini Metropolitan and KwaDukuza Municipality

Shongweni 400/132 kV Substation
Required to supply commercial and residential developments around Hillcrest, Ntshongweni and Cato Ridge
Free State Province Profile

Load
2020 Peak Demand: 1584 MW

- Agriculture 6%
- Community Services 27%
- Electricity 4%
- Finance 16%
- Manufacturing 11%
- Mining 10%
- Trade 14%
- Transport 10%
- Construction 2%
- Trade 14%

Generation

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Total Installed Generation 3761 MW
Free State Load Forecast

Growth drivers in the province: Commercial, Light industrial, Logistics & Electrification

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*CAGR = 2.7%*
Dealesville 400/132 kV Substation

Required to facilitate the integration of renewable energy sources around Dealesville

Sasolburg Network Reinforcement: Igesi 275/88 kV Substation

Required to enable industrial developments and to reduce high fault currents in the transmission network

Harrismith Strengthening: Sorata 275/132 kV Transformers & Sorata-Tugela 275 kV Line 2

Drivers for demand growth are electrification, commercial developments and logistics
Summary of the Transmission Refurbishment Plans
FY22 - FY31

Presented by: Atha Scott
Senior Manager: Asset Investment Planning
Substation Asset Condition Assessment: Main Asset Classes

Asset Condition Per Category

Very Good (86-100%)  Good (71-85%)  Fair (51-70%)  Poor (31-50%)  Very Poor (0-30%)

- Voltage Transformer
- Transformer
- Surge Arrester
- Reactor
- Protection
- Isolators
- Current Transformer
- Circuit Breaker
- Capacitor

Number of Units

National View
Overhead Lines Asset Condition Assessment: Main Asset Classes

Asset Condition Per Category

- Very Poor (0-30%)
- Poor (31-50%)
- Fair (51-70%)
- Good (71-85%)
- Very Good (86-100%)

National View

10/29/2021
Assets replaced and planned for replacement

### Assets Replaced in Tx (FY2012 - FY2021)

<table>
<thead>
<tr>
<th></th>
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### Assets Planned for Replacement in Tx FY22 to FY30

<table>
<thead>
<tr>
<th>Category</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
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<td>1000</td>
<td>1000</td>
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</tbody>
</table>

Grand Total: 5000
Capital projects allocation within the Refurbishment Plan

Capital Projects Allocation
FY22-31

- Substation: 31%
- Plant Specific: 10%
- Line: 6%
- National Control: 4%
- Production Equipment: 4%
- Properties: 1%
- Health & Safety: 1%
- Environmental: 0.6%

10/29/2021
Transmission Development Plan 2022 – 2031

Summary and Capex Analysis

By: Leslie Naidoo
Senior Manager: Transmission Grid Planning
Investments in the Eskom power system in the past 10 years: 7.9 GW of generation, ~ 4800 km of transmission lines, and ~ 20.5 GVA of transformation capacity.
Major Transmission expansion projects completed in the last 10 years

Lines commissioned: 4 800 km
Substations commissioned: 13
Transformations commissioned: 20 520 MVA
**DMRE IPP programme overview – end August 2021**

<table>
<thead>
<tr>
<th>Category</th>
<th>REIPP BW1</th>
<th>REIPP BW2</th>
<th>REIPP BW3&amp;3.5</th>
<th>REIPP BW4&amp;4B</th>
<th>RMIPPP</th>
<th>REIPP BW5</th>
<th>Small 1-5</th>
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</thead>
<tbody>
<tr>
<td>Peakers</td>
<td>2 projects 1200 MW</td>
<td>28 projects 1436 MW</td>
<td>19 projects 1054 MW</td>
<td>18 projects 1656 MW</td>
<td>26 projects 2205 MW</td>
<td>11 projects ~2000 MW</td>
<td>TBA projects ~2600 MW</td>
</tr>
<tr>
<td></td>
<td>All projects connected</td>
<td>All projects connected</td>
<td>All projects connected.</td>
<td>17 projects connected, 1 project in execution phase</td>
<td>19 projects connected, and 7 in execution phase</td>
<td>Projects in evaluation stage by IPPO</td>
<td>Projects in evaluation stage by IPPO</td>
</tr>
<tr>
<td></td>
<td>All projects connected</td>
<td>All projects connected</td>
<td>All projects connected.</td>
<td>17 projects connected, 1 project in execution phase</td>
<td>19 projects connected, and 7 in execution phase</td>
<td>Projects in evaluation stage by IPPO</td>
<td>Projects in RFP stage</td>
</tr>
</tbody>
</table>

**12151 MW from >130 individual projects (The capacity for individual Smalls REIPP project TBD)**

**85 projects totalling 6420 MW have been commissioned, of which 5423 MW is from RE Sources**

- Eskom has committed Capital to enable the integration of successful bidders (Bid Window 1 – 4B, including Small REIPPs) into the National Grid.
Recap: Assumptions on the demand forecast

National Demand Forecasts (GW) at Time of System Peak shown with the 2021 forecast, and the IRP 2019 forecasts for the TDP period 2022-2031
Recap: Assumptions on the generation pattern

**Generation Allocation**
For the 2031 Network

**Renewables** (REBID Windows 1 to 4)
- Biomass
- Concentrated Solar Power
- Landfill Gas
- Onshore Wind
- Small Hydro
- Solar Photovoltaic
- Solar PV - Single Axis

**CCGT Gas 1**
- Potentially at Dedisa and Ankerlig

**DOE OCGT 1 & 2**
- Kusile

**Central Power Pool**
- Medupi

**North-East Power Pool**
- Matimba

**Battery Storage**
- 2088 MW across the network

**PV Generation**
- 6400 MW across different regions in South Africa

**Wind Generation**
- 14 400 MW potentially across the W Cape, N Cape, and E Cape

**Coal Generation**
- 1500 WW potentially at Waterberg and Mpumalanga

**Gas Generation**
- 3000 MW potentially at Dedisa, Athene, and Saldanha

**Battery Storage**
- 2088 MW across the network

**PV Generation**
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**Coal Generation**
- 1500 WW potentially at Waterberg and Mpumalanga

**Gas Generation**
- 3000 MW potentially at Dedisa, Athene, and Saldanha

**Existing Site**
- Ankerlig
- Koeberg
- Gourikwa

**Confirmed Site**
- Kusile

**Potential Site**
- Medupi
- Matimba

**Existing Site**
- Ankerlig
- Koeberg
- Gourikwa

**Confirmed Site**
- Kusile

**Potential Site**
- Medupi
- Matimba

**Existing Site**
- Ankerlig
- Koeberg
- Gourikwa

**Confirmed Site**
- Kusile

**Potential Site**
- Medupi
- Matimba

**Existing Site**
- Ankerlig
- Koeberg
- Gourikwa

**Confirmed Site**
- Kusile

**Potential Site**
- Medupi
- Matimba
Transmission integration plans for the IRP 2019

- **Projects currently in TDP**
- **Existing substations with available capacity / additional transformation**
- **Substations requiring extensions**
- **New substations**

Projects to enable future RE integration:
- Aggeneis – Aries line
- Aries – Hydra line
- Ferrum – Hotazel – Mookodi – Hermes line
- Aries – Upington line
- Aggeneis – Nama – Gromis line
- Aggeneis – Paulputs line
- Ferrum – Upington line
- Grassridge – Thyspunt line
Major projects planned in the TDP period

LEGEND

Projects in execution
Projects in development
Projects in concept

Upington Phase 2 Substation
Northern Cape Strengthening

NW / Kimberley Strengthening

Jhb South Strengthening
Jhb East Strengthening

Medupi Phase 2 Integration

Kusile Integration
Lowveld Strengthening

Highveld South Strengthening

Empangeni Strengthening
Pinetown Strengthening

KZN South Strengthening

Bloemfontein Strengthening
East London Strengthening

West Coast Strengthening
Peninsula / Mitchells Plain

Projects in execution
Projects in development
Projects in concept

Major projects planned in the TDP period
Transmission TDP 2021 Project Life Cycle Model (PLCM) Capex summary:

- **Expansion (new build)**
- **Refurbishment (life extensions)**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Expansion (new build)</th>
<th>Refurbishment (life extensions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept phase</td>
<td>10.1</td>
<td>6.7</td>
</tr>
<tr>
<td>Definition phase</td>
<td>52.3</td>
<td>4.7</td>
</tr>
<tr>
<td>Execution phase</td>
<td>18.2</td>
<td>4.7</td>
</tr>
<tr>
<td>Total</td>
<td>80.5bn</td>
<td>22.9bn</td>
</tr>
</tbody>
</table>

Challenges / Actions:

- Based on the network requirements, ~ 8400km of power lines and 119 transformers are expected between 2022 – 2031

Key Challenges:

- Capex constraints
- Servitude acquisitions
- Supplier and construction capability

Actions taken:

- Prioritisation of the project portfolio
- Maximise of available capex
- Re-align the plan taking into consideration the key challenges
Summary of Transmission infrastructure requirements over the TDP period 2022 – 2031

~ 8406 km of line:

- 73% increase in line construction
- 124% increase in transformer units

~ 119 transformers ~ 58 GVA:

- 94% increase in transformer units
- 140% increase in transformer units

- Compared to the previous 5 years: 73% increase in line construction
- 94% increase in transformer units

- The following 5 years (FY27 – FY31): 124% increase in line construction
- 140% increase in transformer units
Transmission capital expenditure drivers

1. **Capacity Expansion and Network Strengthening:**
   - Integration of new generation (~30GW) as per the IRP2019 in areas with limited networks
   - Investments in “back-bone” strengthening to dispatch power to the major load centres
   - Connection of committed customer loads (Accepted / issued Budget Quotes)
   - Reliability Investments (N-1) for network sustainability
   - 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):**
   Implementation of the Transmission Sustainability Improvement Plan to address:
   - Maintenance “backlogs” due to outage challenges and increased failure rate of ageing plant
   - Refurbishment of ageing equipment (CTs, VTs, Surge Arresters, H.V. Circuit Breakers and Power Transformers, Protection and Control Systems)
   - Refurbishment of ageing and “obsolete” telecommunications infrastructure
   - Asset Performance Improvements (lines and substation equipment)
   - Security improvements and surveillance and monitoring at our key assets and sites
   - Strategic and operational spares holding (to reduce SML<1 and MI risk)
   - Compliance (Regulatory, OHSAct, NKP Act, Environmental etc.)
Transmission 10 year CAPEX Plan: FY2022 - 2031

Summary of Transmission Capex Plan (R Million) FY 2022 – 2031

<table>
<thead>
<tr>
<th>Transmission Capex Categories (Rmil)</th>
<th>Total FY 22 - FY30</th>
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<tbody>
<tr>
<td>Capacity Expansion</td>
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<tr>
<td>Refurbishment</td>
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<tr>
<td>EIA &amp; Servitudes</td>
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<tr>
<td>Telecommunications</td>
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<tr>
<td>Production Equipment</td>
<td>959</td>
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<tr>
<td>Startric Spares</td>
<td>6 148</td>
</tr>
<tr>
<td></td>
<td><strong>178 442</strong></td>
</tr>
</tbody>
</table>

IRP 2019

N-1

Strengthening

Transmission Capex Summary (Rmil)
The total Transmission Capital Plan amounts to R178 billion over the TDP period 2022 – 2031 of which:

- R144 billion is required for reliability (N-1) projects, integration of committed generation (Medupi, Kusile, IPPs up to Bid Window 4B), integration of the IRP2019 projects, connection of new loads onto the system and to acquire the necessary Servitudes

- R34 billion is required for Refurbishment, production equipment, Telecoms and Strategic Spares
Risks and challenges

- Decision on future MYPD applications may impact Eskom’s revenue stream and hence the execution of the TDP

- Network capacity constraints especially in areas with potential for RE resources requires an acceleration to the TDP implementation plan

- Servitude acquisitions still remains a huge risk and we appeal for support from all concerned (Local and National Authorities, land owners, developer etc.) to come together to resolve this challenge

- Capacity and capability across the engineering, supplier and construction value chain in the Country

- Capex requirements to fund the new network infrastructure and replacement of inadequate assets especially in the later years ie. beyond FY26
Established the TDP Delivery Steering Committee, a subcommittee of the Transmission Board and focusing on the following:

- Resource analysis across the engineering and construction value chain
- Commenced project development to expedite works in Concept / Definition phase in readiness for execution
- Exploring opportunities to “unlock” the capex requirements for the TDP
- Stakeholder engagement to seek the necessary support to assist in “fast-tracking” some of the challenges eg. EIAs, servitude acquisitions,
- Programme office has been established to drive the TDP roll-out programme
The success of the TDP 2021 requires a concerted effort by all role players including our stakeholders in Government, Customers, the various RE associations, as well as the Supplier and Construction industry across the engineering value chain.

In closing I wish to emphasize that our role in Transmission is to provide open and transparent access to the power system.
Questions?
Questions?
Thank you