

# 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**

# Overview and purpose of the TDP Public Forum

#### The objective of the presentation is to:

Contextualise the planning timelines relating to the demand forecast and generation patterns

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- 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

## Basis of the TDP 2021



The TDP 2021 was formulated to address the following



Attain Grid Code compliance by resolving both substation and line violations (N-1) to ensure network sustainability



Determine new network infrastructure requirements to sustain and allow for future demand growth



Determine network infrastructure requirements to integrate new generation (Eskom and IPPs)



Consider asset replacement requirements to ensure reliability of supply and network optimisation

# The Different Plans

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#### 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 and 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 break down

## The future of electricity





## Local demand drivers: national overview

SAPP



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# Sustainable capacity demand





# Factors influencing demand uptake



## Forecast methodology





7 step demand forecast process

# Transmission national demand forecast scenarios 2022 – 2031





## Transmission national forecast 2022-2031



# Demand drivers and spatial allocation of demand potential



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# Provincial peak load growth for TDP period

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Renewable energy





Capacity Demand Growth

- 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.

# The way forward





- 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

#### **TDP Process Overview**





## **Grid overview**





Demand

**Generation Capacity Forecast** 





#### Generation Capacity Comparisons (MW)



#### **Spatial Considerations**



- 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

#### Spatial Allocation – Applications Potential CSIR





Source: https://egis.environment.gov.za/redz

#### Spatial Allocation - Applications Eskom & CSIR



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#### Generation Build-up Graph



#### Annual and Total Decommissioning



-14050 MW


#### Cumulative Generation Capacity (MW) 2000 - 2031



#### **Generation Evolution Charts**





Cumulative Generation Percentage 2000 - 2031



#### Spatial Allocation – 2031 With Transmission Network





#### Growth Comparison 2022 vs 2031



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Growth: 138 %

#### 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



#### Generation and Load Balance





Generation increase in the South



# **Northern Cape Province**

TDP 2022 - 2031

Compiled by: Rashaad Tayob



#### Northern Cape Province Profile



#### Northern Cape Province Load Forecast



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\* Compound Annual Growth Rate

#### Northern Cape Province Generation Forecast



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# **Transmission Development Plan**



#### Reliability Plans for the Northern Cape



#### Corridor Strengthening for IRP 2019



#### Substation Strengthening for IRP 2019





# **Western Cape Province**

TDP 2022 - 2031

Compiled by: Ahmed Hansa



#### Western Cape Province Profile





#### Existing Generating Facilities in the Western Cape





City of Cape Town
Total\* 258 MW

23 **Beaufort West** Vredendal Saldanha WESTERN CAPE George Grabouw Agulhas Cape Town lossel Bay

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\*excludes small scale embedded generation (SSEG)

#### Western Cape Load Forecast





\* Compound Annual Growth Rate

#### Developments in the Peninsula CLN



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# Developments in the Outeniqua and West Coast CLNs



#### Developments to enable IRP 2019





# **Eastern Cape Province**

TDP 2022 - 2031

Compiled by: Popi Njapha

## Eastern Cape Province Profile



## **Eastern Cape Province Load Forecast**



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#### Main Load Drivers – Coega Idustrial 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**



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#### Eastern Cape Generation Forecast – IRP 2019

**Eastern Cape Generation Forecast** Generation (MW) Thyspunt Ruigtevallei Poseidon B Poseidon Port Rex Pembroke Iziko Grassridge Dorper Delphi Dedisa Total 

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## Key Projects in the East London CLN



## Key Projects in the Port Elizabeth CLN





# **North-West Province**

TDP 2022 - 2031

Compiled by: Caroleen Naidoo



# North West Province Profile

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## North West Province Load Forecast





#### **Load Drivers**

#### **Rustenburg CLN**

- Natural load growth
- Mining applications
- Load shifts from neighbouring provinces

#### **Carletonville CLN**

- Natural load growth
- Electrification

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- Bulk supply applications
  - Load shifts from neighbouring provinces

# Renewable Energy in North West Province

#### **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**


#### 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.



## 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

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Load □ Peak load of 3357 MW in 2020 **Economic Sectors** Limpopo 2022 Community 3% Services 25% Mining 28% Manufacturing 3% Transport Trade Electricity 5% 16% Contruction 5% 2%

#### Generation

Туре	Name	Output
Coal Base Load	Matimba (excl. unit 4)	3325 MW
	Medupi	2382 MW
Renewables	Witkop PV	30 MW
	Soutpan PV	28 MW
	Villa Nora PV	60 MW
Total Installed	6490 MW	



#### **Economic Sectors**



Mining 37%



### North West Province Load Forecast

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\*Compound Annual Growth Rate

#### Load Drivers

#### 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

# Strengthening associated with Waterberg Generation Pool





#### Strengthening projects for load growth in Limpopo Province

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82



# **Mpumalanga Province**

TDP 2022 - 2031

Compiled by: Kabir Singh



## Mpumalanga province profile



# Mpumalanga generation forecast 2022 - 2031



#### Generation Developments in Mpumalanga





#### Mpumalanga Load Forecast 2022 - 2031



**Drivers** Residential

**Tourism** 

Mining Industrial



\* Compound Annual Growth Rate

#### Strengthening developments in Mpumalanga

Witkop

## Eskom

#### 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



Fosk or \* Phalabo rwa



#### Strengthening developments in Mpumalanga

#### Eskom

# Creating spare capacity Fault level mitigation Emkhiweni integration N-1 Compliance Safety related to burning grounds Creating spare capacity

Wonderkrag

integration

N-1 compliance

Safety compliance





# **Gauteng Province**

TDP 2022 - 2031

Compiled by: Thamsanqa Ngcobo



## **Gauteng Province Profile**

#### Agriculture 0% Mining Mining ■ Manufacturing 15% 27% Electricity Construction 4% 🖬 Trade 14% Transport T 24% 10% Finance **■** Community services

#### Generation

Type / Owner	Name
City Power	Kelvin
City of Tshwane	Rooiwal & PTA West



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#### Gauteng Projects - Complete

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#### 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

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#### Sisimuka 88 kV Busbar

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



## **Gauteng Projects in Execution**

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

 Supports network reliability in the East Rand



#### **Gauteng Load Forecast**



#### Developments in the JHB East & South Area



### **Developments in the Tshwane Area**



### Developments in the JHB North Area

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#### Key Projects

- Kusile-Lulamisa 400kV line
- Apollo-Lepini 2<sup>nd</sup> 275kV line
- New MTS Sesiu 400/88kV
- New MTS Kyalami 400/88kV
- New MTS Donatello 400/88kV

#### Developments in the West Rand & Vaal Area





# **KwaZulu-Natal Province**

TDP 2022 - 2031

Compiled by: Thokozani Bengani



#### **KwaZulu-Natal Province Profile**







#### KwaZulu-Natal Load Forecast





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

#### KwaZulu-Natal Transmission Development Plans



#### KwaZulu-Natal Transmission Development Plans





# **Free State Province**

TDP 2022 - 2031

Compiled by: Thokozani Bengani



#### Free State Province Profile

#### Eskom

Load



**Existing Substations** 

**Existing Lines** 

14004

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#### Generation

Туре		Name	Output
Base	Coal	Lethabo	3558 MW
IPP	Hydro	IPPs	4.4 MW
	PV	IPPs	199 MW
Total Installed Generation			3761 MW

#### Free State Load Forecast





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

#### Free State Transmission Development Plans





# **Questions?**


## Summary of the Transmission Refurbishment Plans FY22 - FY31

Presented by: Atha Scott

Senior Manager: Asset Investment Planning



#### Substation Asset Condition Assessment: Main Asset Classes



National View

#### Overhead Lines Asset Condition Assessment: Main Asset Classes





#### National View

#### Assets replaced and planned for replacement



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

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Grand Total
CAPACITOR	1										1
CIRCUIT BREAKER	38	53	55	53	42	30	41	48	37	40	437
CURRENT TRANSFORMER	111	113	105	195	193	141	231	226	239	195	1,749
DC & STANDBY	52	33	66	29	62	22	18	41	4	5	332
ISOLATORS	64	60	19	35	40	25	31	44	43	57	418
PROTECTION	68	36	27	46	45	39	56	32	39	43	431
REACTOR	12	7	6	20	8	4	4	10	4	5	80
SURGE ARRESTER	104	66	129	198	282	115	122	187	196	134	1,533
TRANSFORMER	17	15	17	15	18	11	15	8	7	5	128
VOLTAGE TRANSFORMER	34	44	49	56	45	40	74	81	132	55	610
Grand Total	501	427	473	647	735	427	592	677	701	539	5,719

Category	Assets Planned for Replacement in Tx FY22 to FY30										
	2022	2023	2024	2025	2026	2027	2028	2029	2030	TOTAL	
CAPACITOR	0	3	5	2		10	1		5	26	
CIRCUIT BREAKER	11	64	71	119	55	129	79	123	97	748	
CURRENT TRANSFORMER	41	265	306	374	242	557	513	416	277	2991	
DC & STANDBY	1		56	5	10	6	14	9	44	145	
ISOLATORS	23	184	253	299	155	488	479	436	476	2793	
PROTECTION	43	56	84	101	97	170	205	146	222	1124	
REACTOR	0			5	3		5	2	3	18	
SURGE ARRESTER	38	132	215	212	165	498	433	417	421	2531	
TRANSFORMER	2	7	5	19	25	4	17	14	5	98	
VOLTAGE TRANSFORMER	12	43	57	129	122	253	275	158	139	1188	
Grand Total	171	754	1052	1265	874	2115	2021	1721	1689	11662	

#### Assets Planned for Replacement in Tx FY22 to FY30



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#### Substation Asset Condition Assessment and Plan



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# Capital projects allocation within the Refurbishment Plan

![](_page_113_Picture_1.jpeg)

![](_page_113_Figure_2.jpeg)

- Substation
- Line
- Production Equipment
- Health & Safety

- Plant Specific
- National Control
- Properties
- Environmental

#### Top Provincial Refurbishment Projects: 2022 - 2031

![](_page_114_Figure_2.jpeg)

![](_page_115_Picture_0.jpeg)

## Transmission Development Plan 2022 – 2031

## **Summary and Capex Analysis**

By: Leslie Naidoo Senior Manager: Transmission Grid Planning

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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

![](_page_116_Picture_1.jpeg)

MVA

![](_page_116_Figure_2.jpeg)

FY2012 FY2013 FY2014 FY2015 FY2016 FY2017 FY2018 FY2019 FY2020 FY2021 Total

# Major Transmission expansion projects completed in the last 10 years

![](_page_117_Figure_2.jpeg)

### DMRE IPP programme overview – end August 2021

![](_page_118_Picture_1.jpeg)

Peakers	REIPP BW1	REIPP BW2	REIPP BW3&3.5	REIPP BW4&4B		REIPP BW5	Small 1-5
2 projects 1200 MW	28 projects 1436 MW	19 projects 1054 MW	18 projects 1656 MW	26 projects 2205 MW	11 projects ~2000 MW	TBA projects ~2600 MW	20 projects MW TBD
All projects connected	All projects connected	All projects connected.	17 projects connected, 1 project in execution phase	19 projects connected, and 7 in execution phase	Projects in evaluation stage by IPPO	Projects in evaluation stage by IPPO	Projects in RFP stage

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.

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

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![](_page_119_Figure_2.jpeg)

#### Recap: Assumptions on the generation pattern

![](_page_120_Figure_2.jpeg)

### **Transmission integration plans for the IRP 2019**

![](_page_121_Figure_1.jpeg)

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### Major projects planned in the TDP period

![](_page_122_Figure_2.jpeg)

## TDP 2021 Project Life Cycle Model (PLCM) summary

![](_page_123_Picture_1.jpeg)

#### Transmission TDP 2021 Project Life Cycle Model (PLCM) Capex summary:

![](_page_123_Figure_3.jpeg)

#### **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

![](_page_124_Picture_1.jpeg)

#### ~ 8406 km of line:

![](_page_124_Figure_3.jpeg)

#### ~ 119 transformers ~ 58 GVA:

![](_page_124_Figure_5.jpeg)

- 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

![](_page_125_Picture_0.jpeg)

![](_page_125_Picture_1.jpeg)

# TDP 2021 Capex Analysis

#### Transmission capital expenditure drivers

![](_page_126_Picture_1.jpeg)

- **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.)

![](_page_127_Picture_1.jpeg)

![](_page_127_Figure_2.jpeg)

![](_page_128_Picture_1.jpeg)

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**

![](_page_129_Picture_1.jpeg)

- 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

![](_page_130_Picture_1.jpeg)

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 "fasttracking" some of the challenges eg. EIAs, servitude acquisitions,
- Programme office has been established to drive the TDP roll-out programme

![](_page_131_Picture_1.jpeg)

- 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.

![](_page_132_Picture_0.jpeg)

## **Questions?**

![](_page_133_Picture_0.jpeg)

## **Questions?**

![](_page_134_Picture_0.jpeg)

![](_page_134_Picture_1.jpeg)

# Thank you