

Transmission Development Plan Implementation Forum 2023

15 November 2023



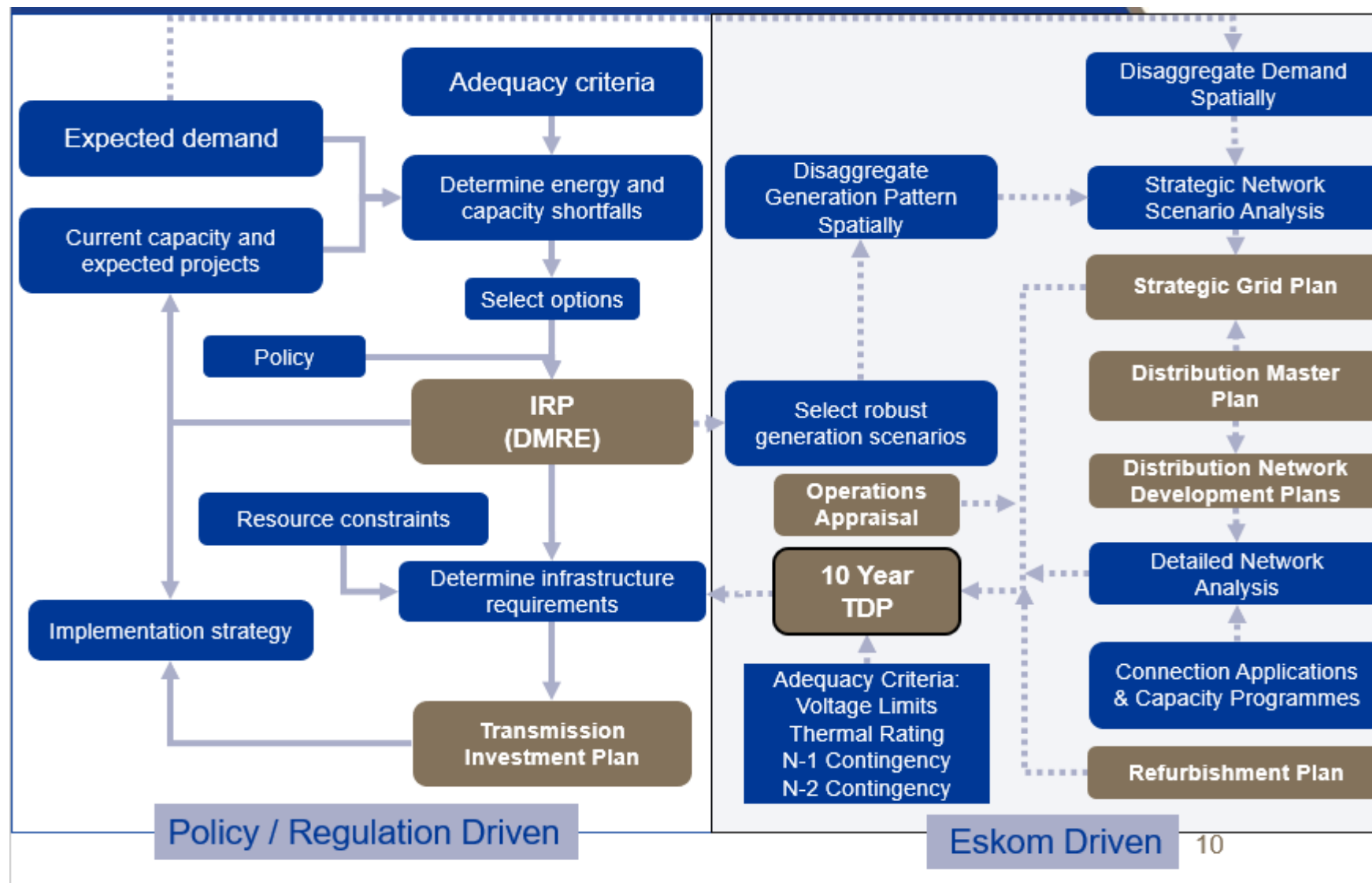
TDP 2022 Overview

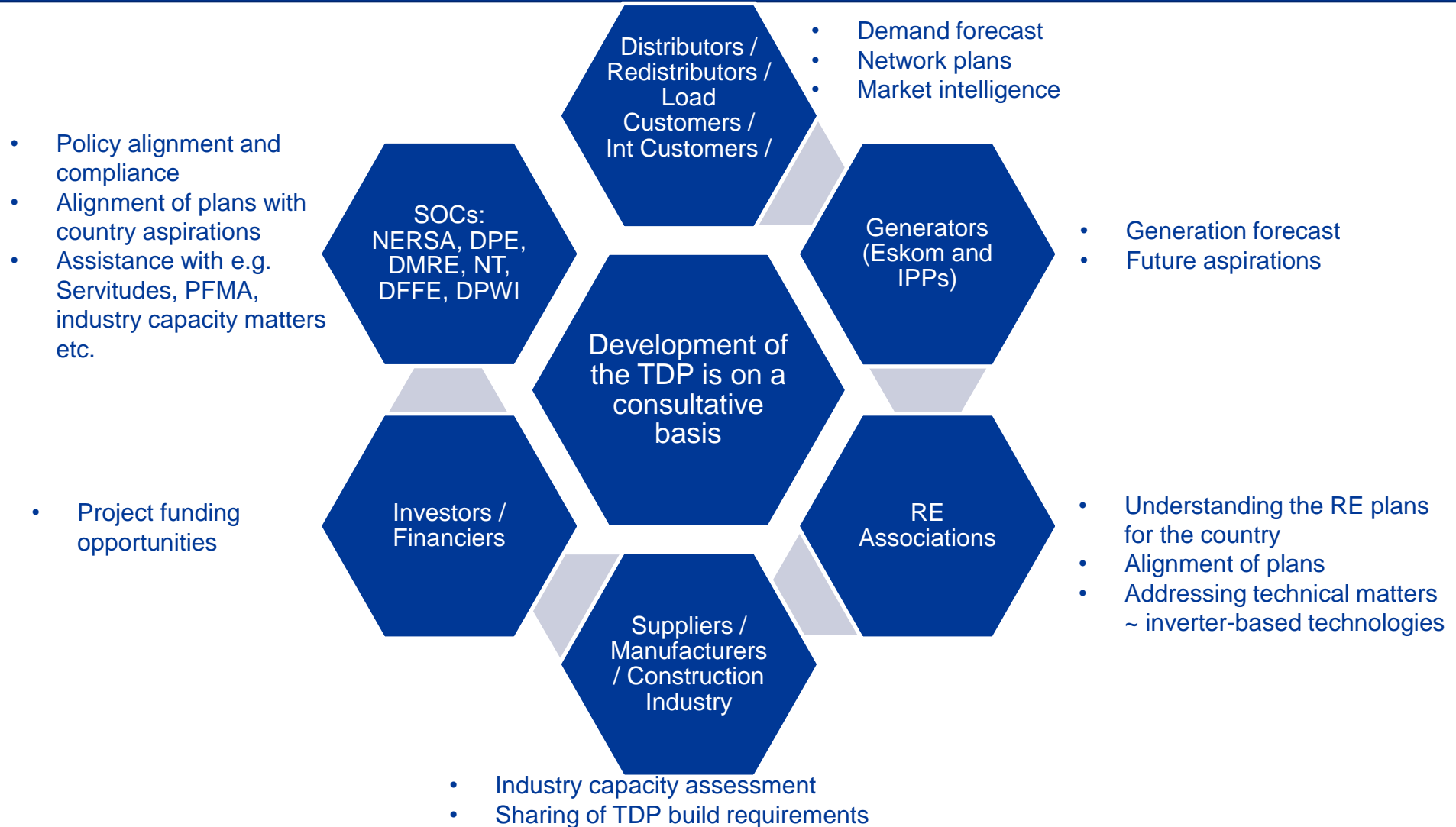
Leslie Naidoo

Senior Manager: Grid Planning

15 November 2023

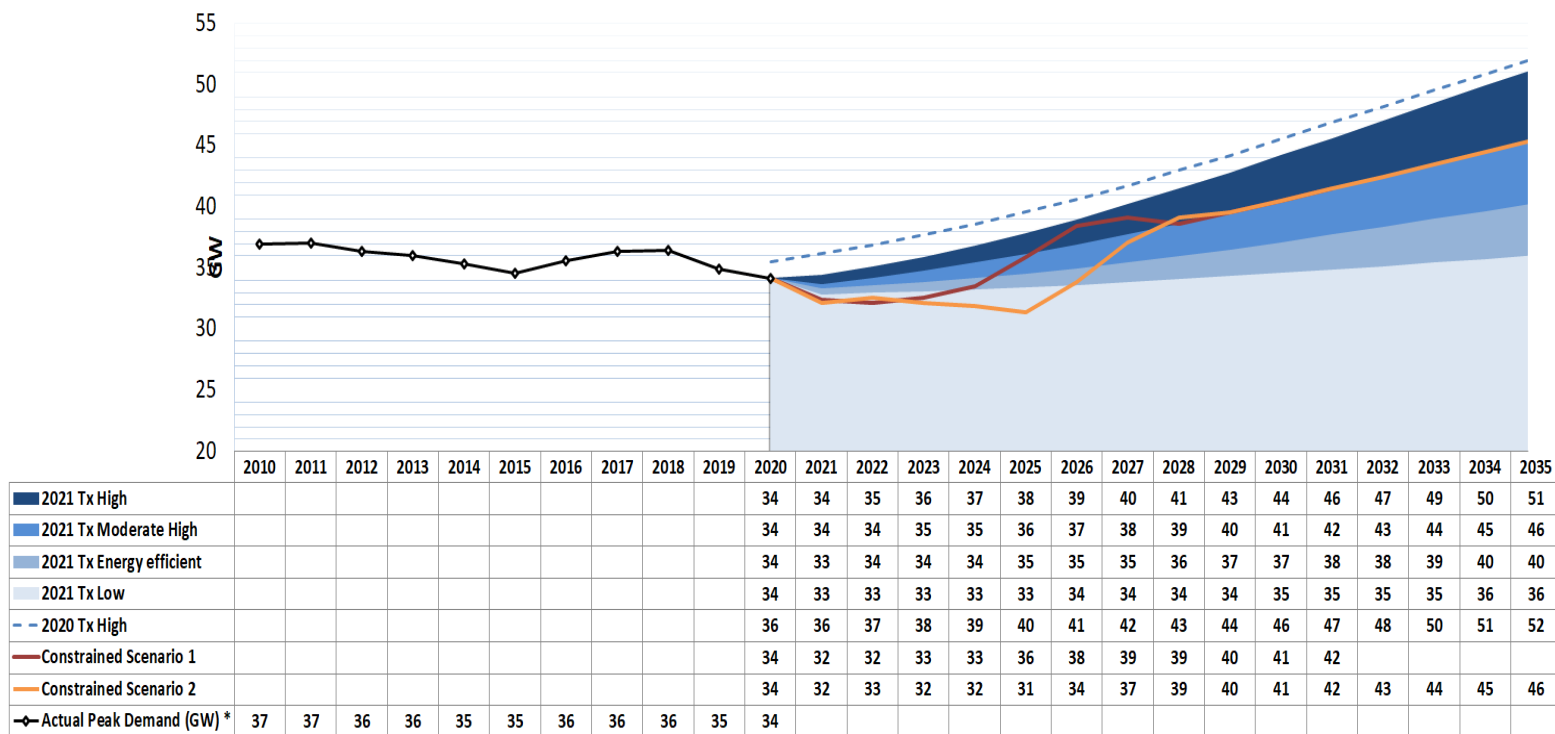






TDP Assumptions - Transmission national demand forecast

2021 National Demand Forecasts (GW) at Time of System Peak shown with the 2020 forecast, and the 2021 constraint scenarios for the TDP period 2021-2035

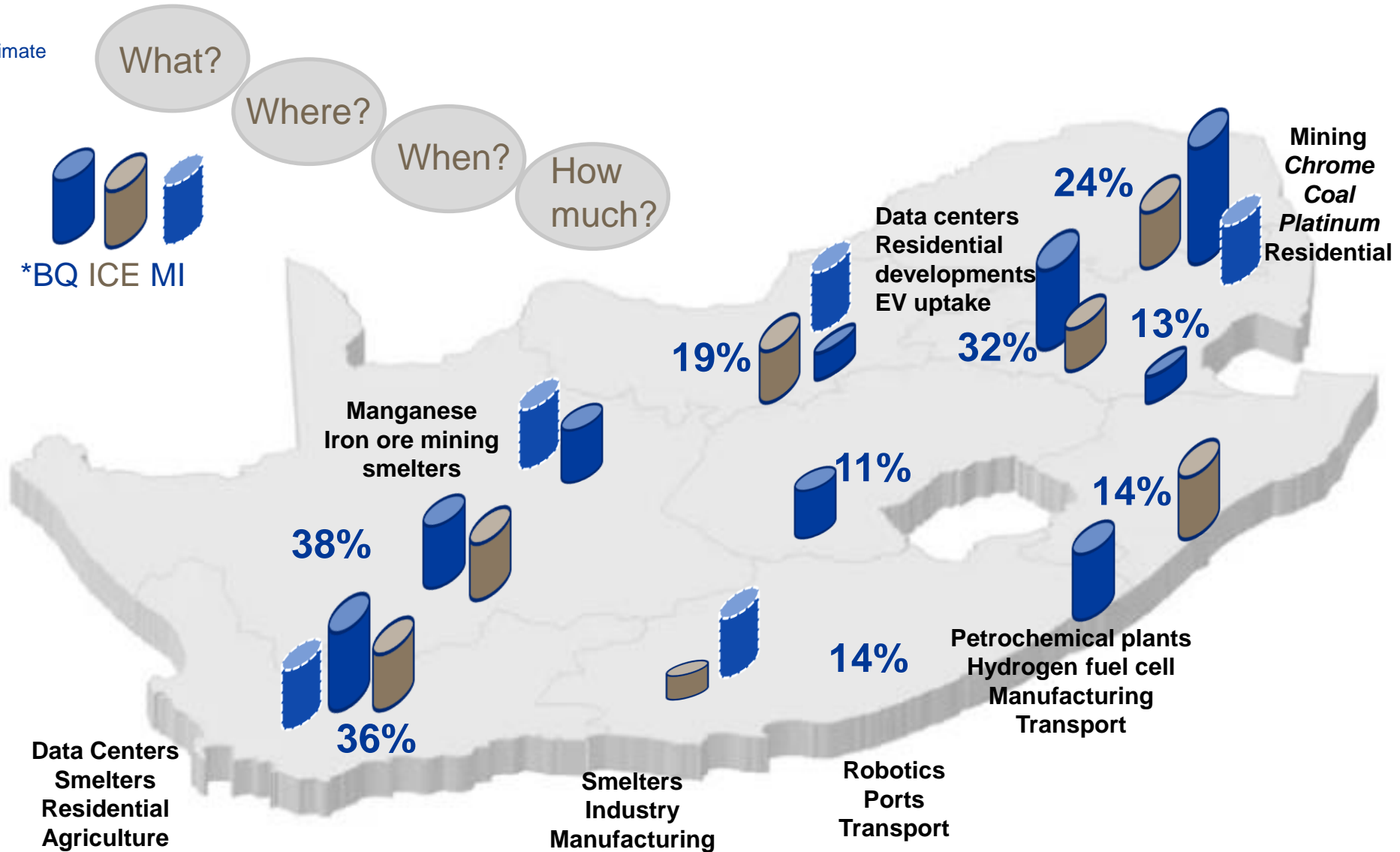


*Instantaneous Peak Demand

- The forecast has been revised down due to lack of gen capacity, Covid-19 effects, and sustained economic downturn.
- The Tx Moderate High Forecast will be used for planning purposes.
- Because of previous higher forecasts projects affected by load will be reprioritised
- **Generation has become the primary driver of infrastructure development henceforth**

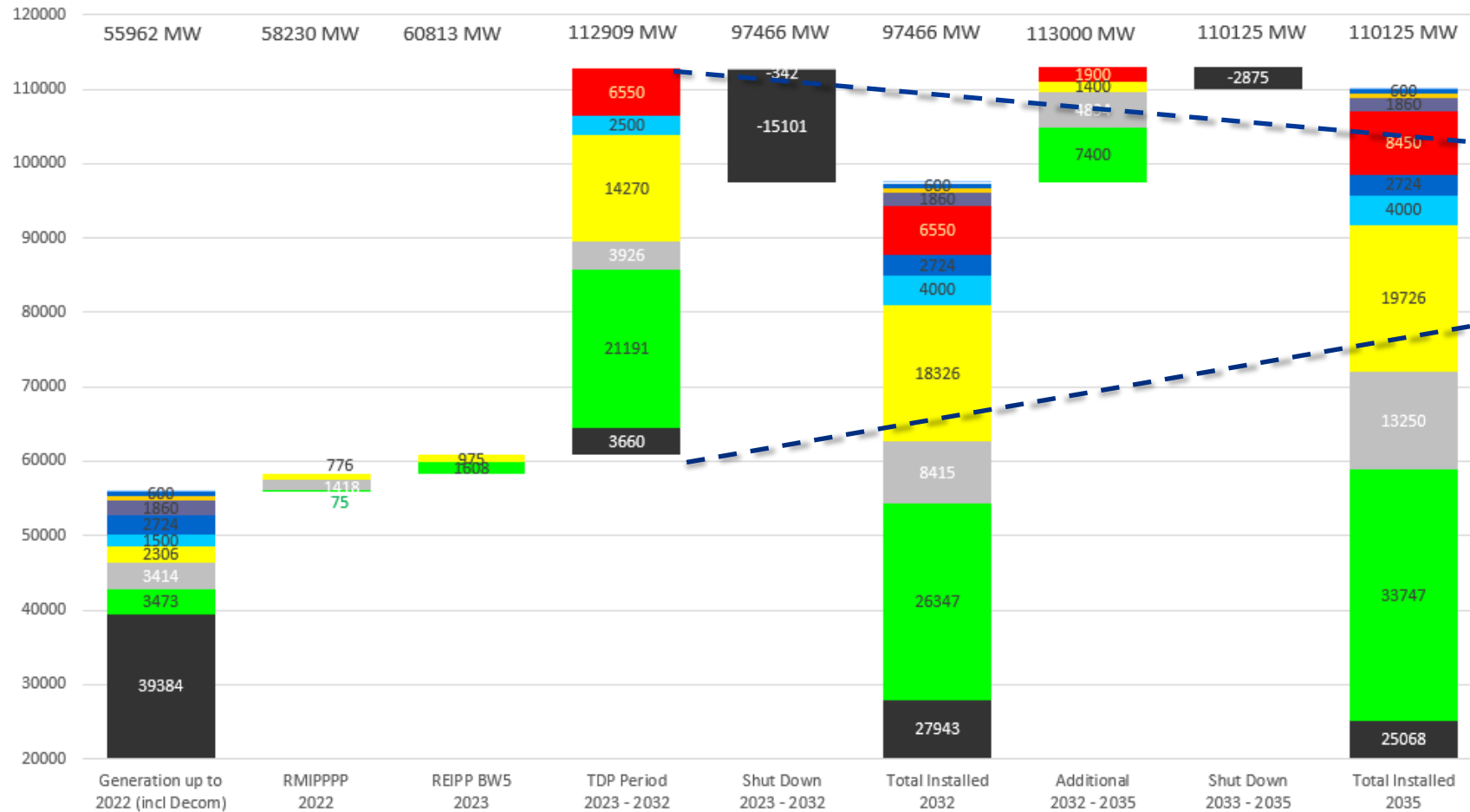
TDP Assumptions - Provincial allocation of demand potential

BQ – Budget Quote
 ICE – Indicative Cost Estimate
 MI – Market Intelligence



TDP Assumptions - Generation build-up graph

Generation Build-up Chart



Generation has become the primary driver for new Tx infrastructure with ~ 53 GW of new capacity by 2032.

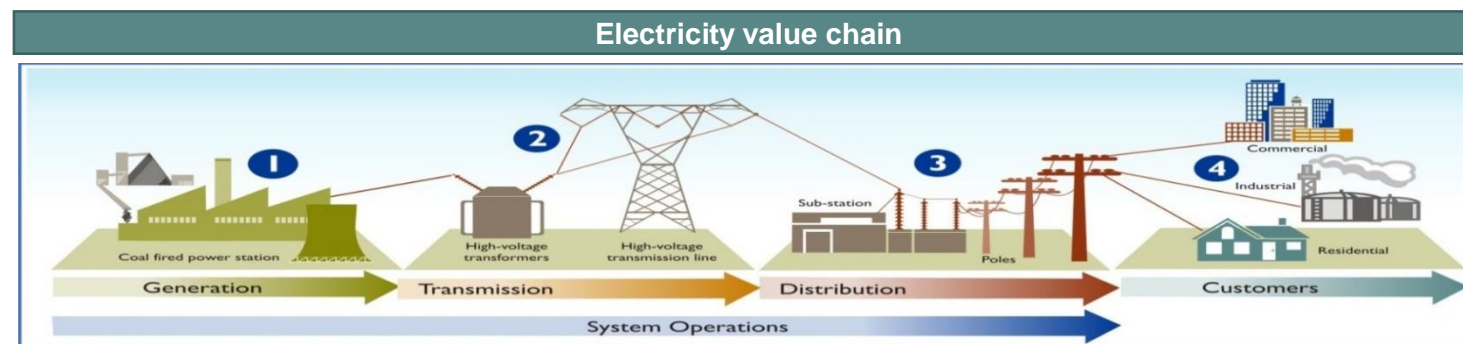
Current situation

- The IRP 2019 that was gazetted in November 2019, proposes ~ 30 **GW** of new generation capacity to be connected to the system by **2030**. When considering the Eskom 2035 Corporate Strategy, applications processed via the DMRE procurement programmes, non-DMRE applications and engagements with RE associations, ~ 53GW of new generation capacity will be required by 2032. Failure to deliver will lead to an increased risk to the security of electricity supply for the country.
- Current network reliability constraints (N-1), as well as meeting the anticipated demand growth also requires significant new network infrastructure.
- This will require an **acceleration of investments** in Transmission infrastructure by development of new corridors and substations, and strengthening at existing substations over the period 2023 – 2032 to address both the new generation capacity, as well as the network strengthening requirements across the country for **security of supply**.
- **The budget for the next 5-year capital requirements has been acquired.**



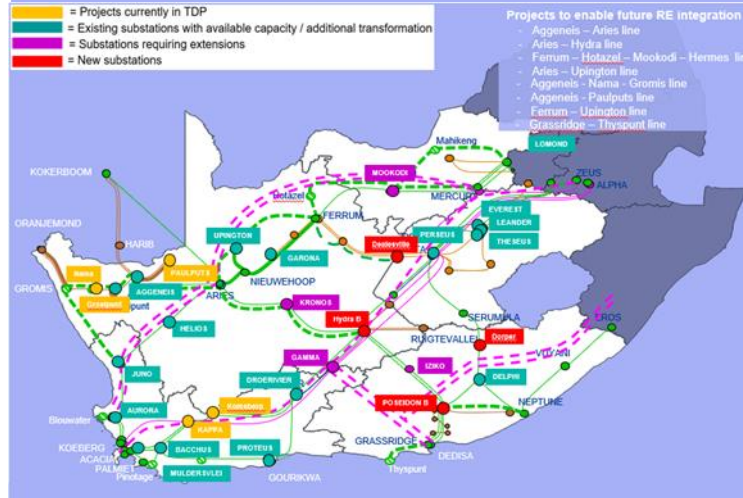
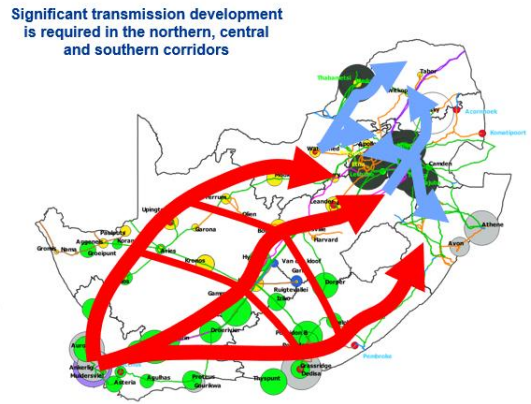
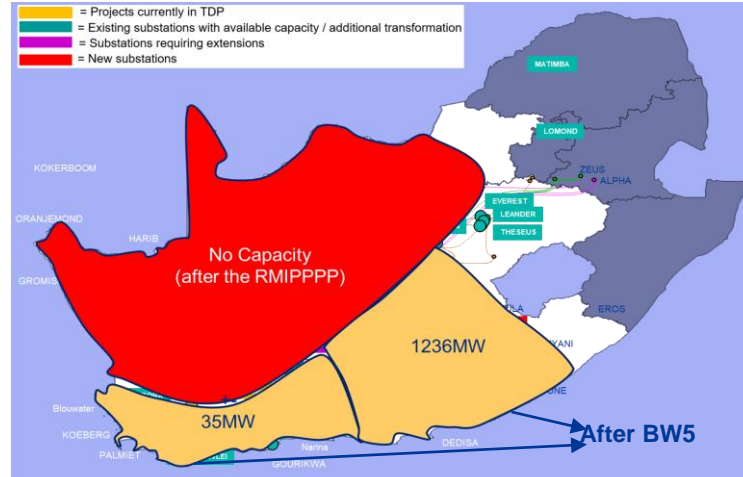
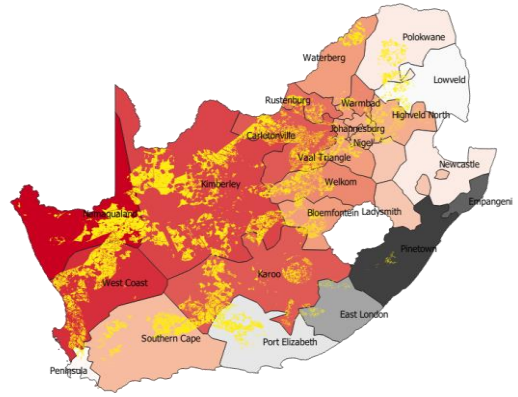
Problem statement

- The grid strengthening required to accommodate this aggressive renewable integration, as well as ensuring the sustainability of the network requires **significant investments**.
- Timelines to implement Transmission Infrastructure take ~ **8 – 10 years** to build due to **servitude challenges**.
- The **resource capacity** in the country across the EPCM value chain is limited.
- The **capital requirements in the later years** of the TDP is substantial and is currently limited by Eskom's balance sheet.



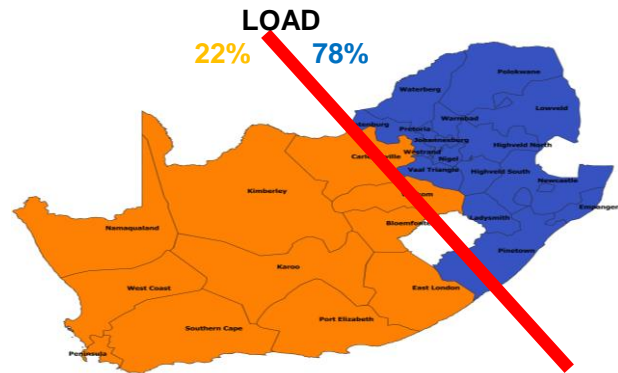
Northern Cape supply area with most efficient solar resource taking into account DFFE and CSIR restriction areas has no connection capacity after BW5 / RMIPPP

Solar sites (yellow) & lowest cost (red)

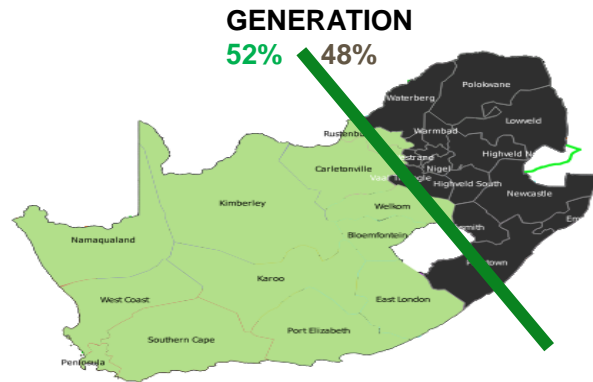


Transmission network infrastructure augmentation in areas with Renewable Energy resources is critical for the country to maximise on the lowest cost energy.

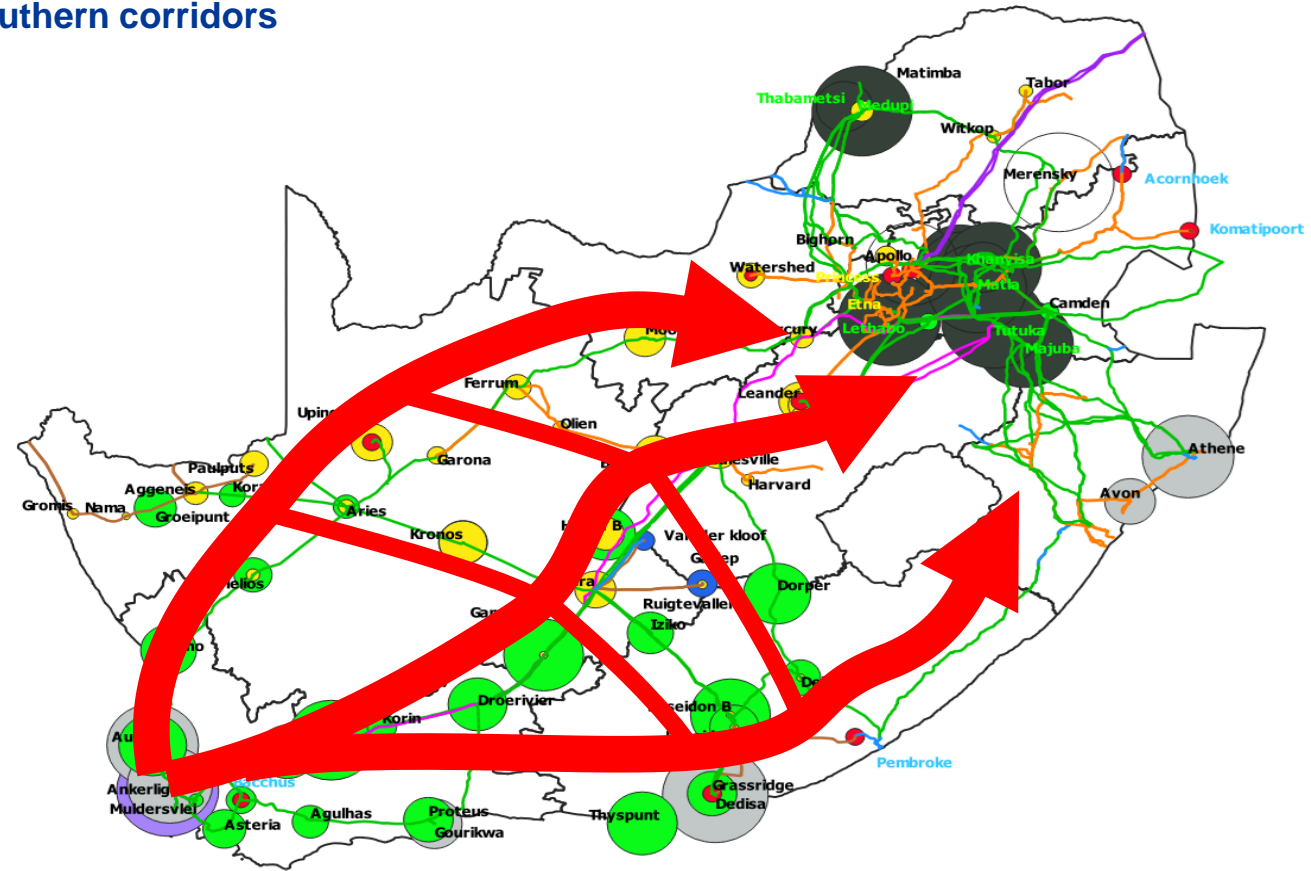
Significant transmission development is required in the northern, central and southern corridors

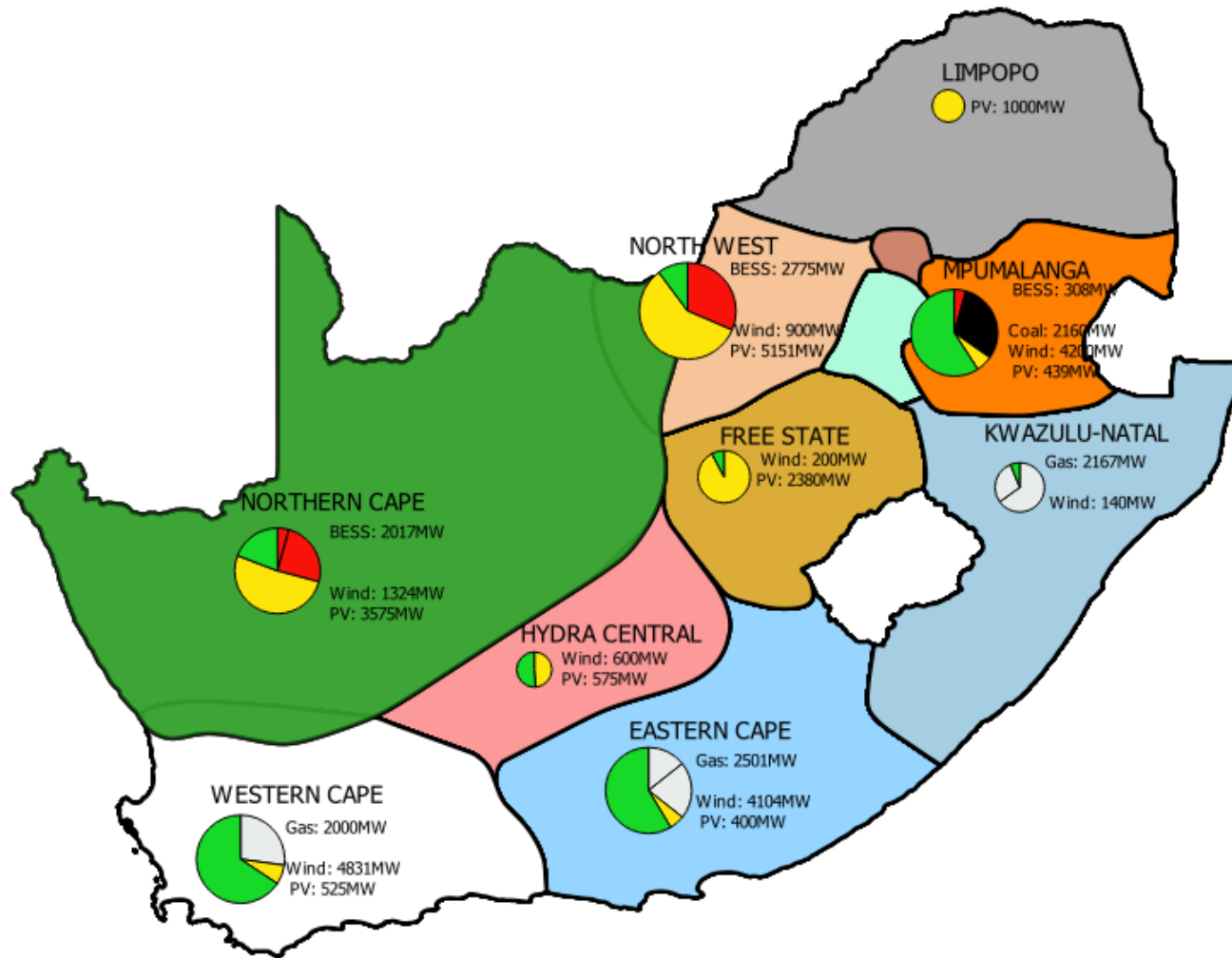


Lower load in the South remains



Generation increase in the South



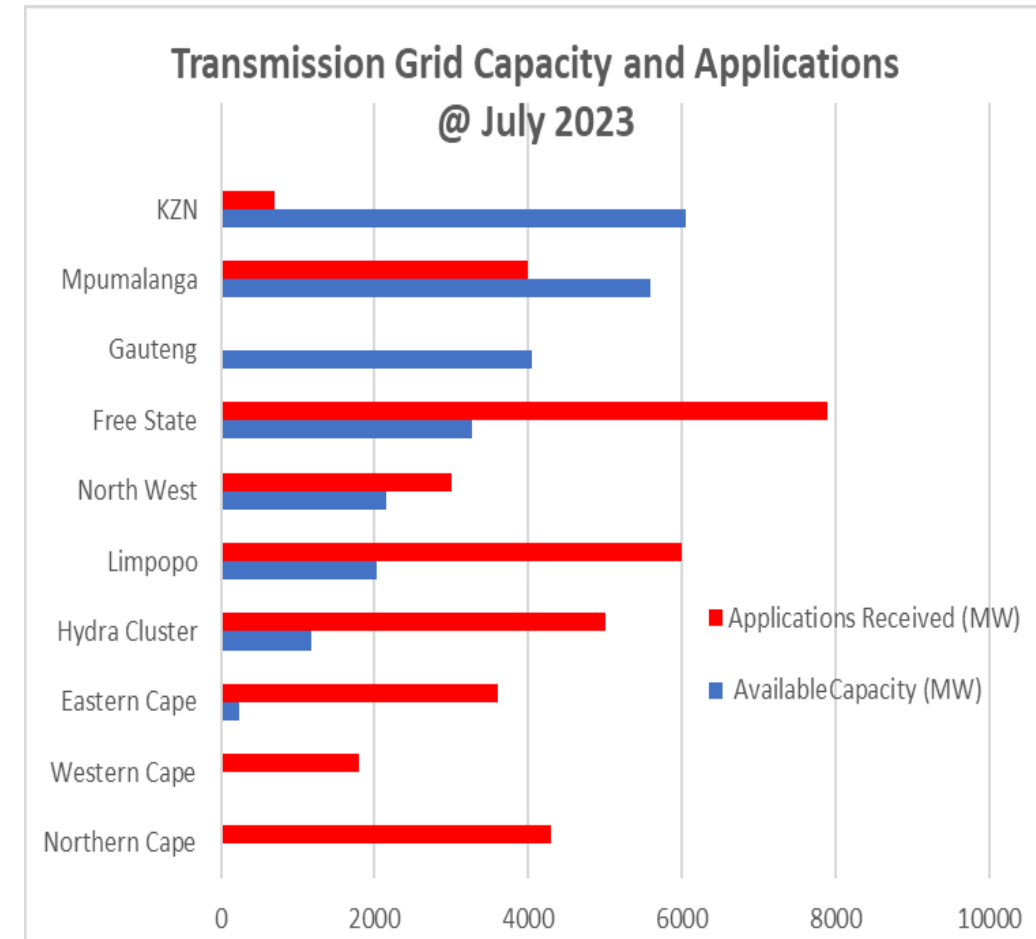
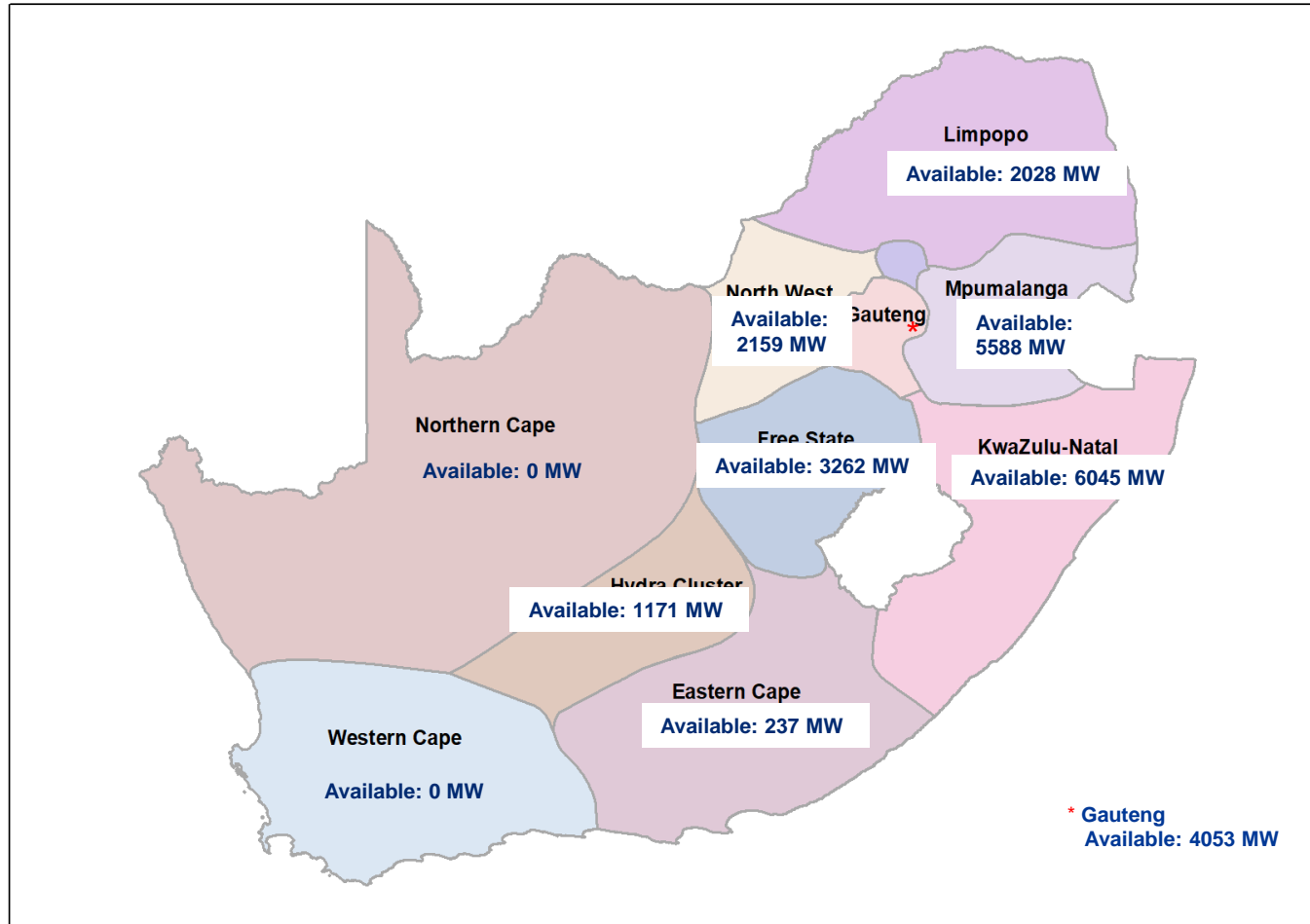


The graphic shows the **projected** generation connections from 2023 to 2032, based on applications processed.

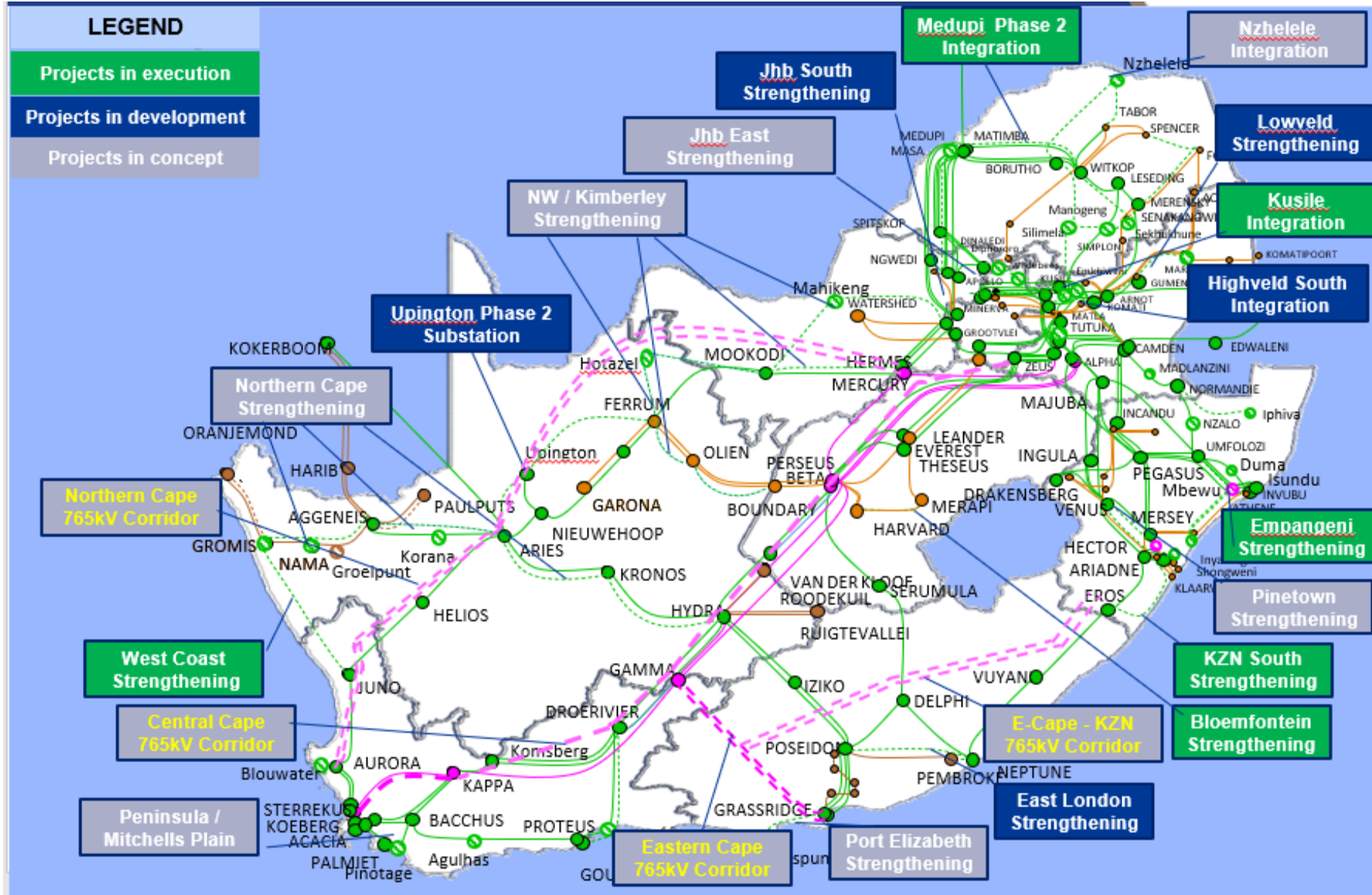
**This graphic excludes plant to be decommissioned.*

TDP Challenges: current generation connection capacity

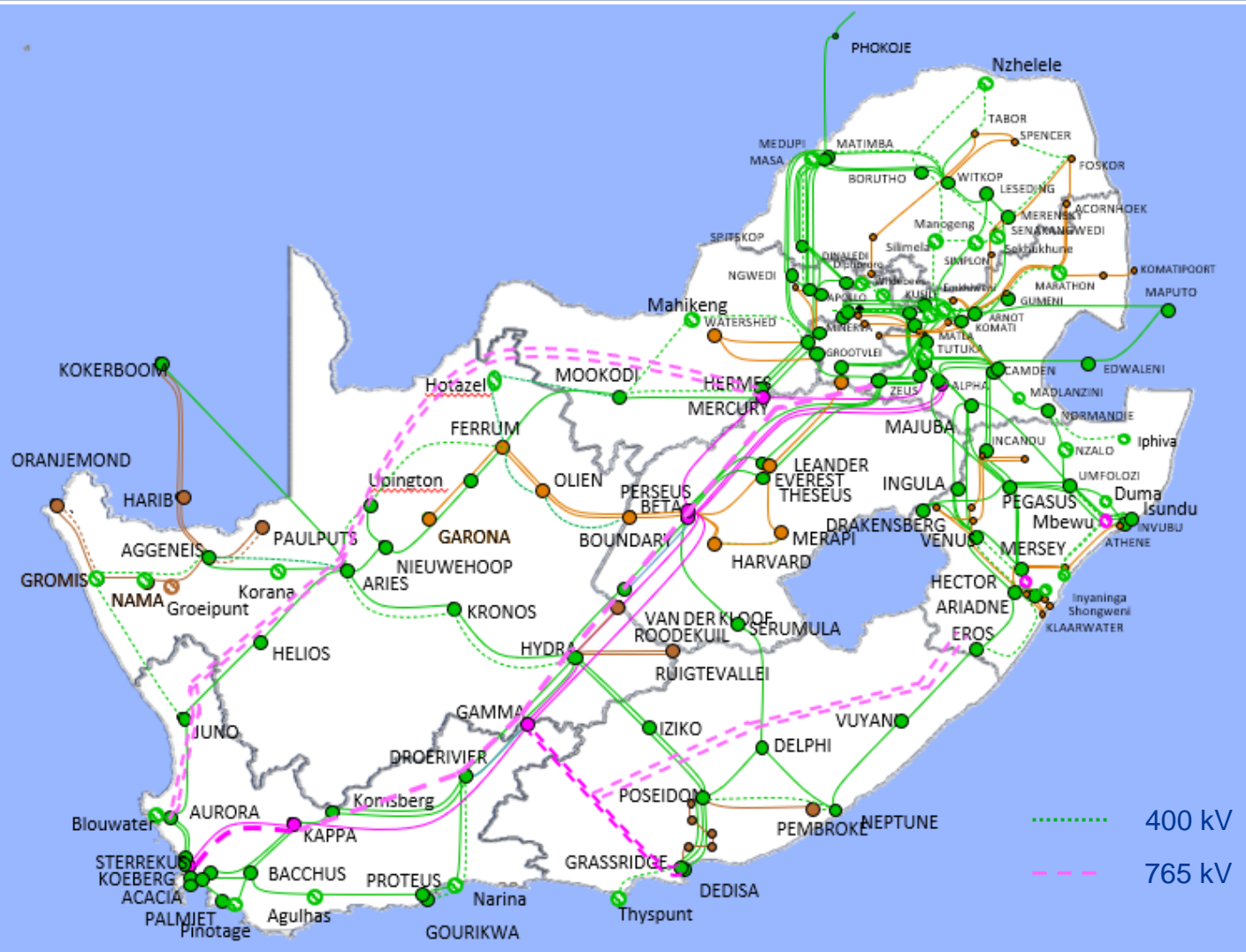
While the Grid is constrained in the Cape Regions, grid connection capacity is available elsewhere as indicated below:



TDP 2022 – Summary of major projects



Summary of major projects & infrastructure requirements

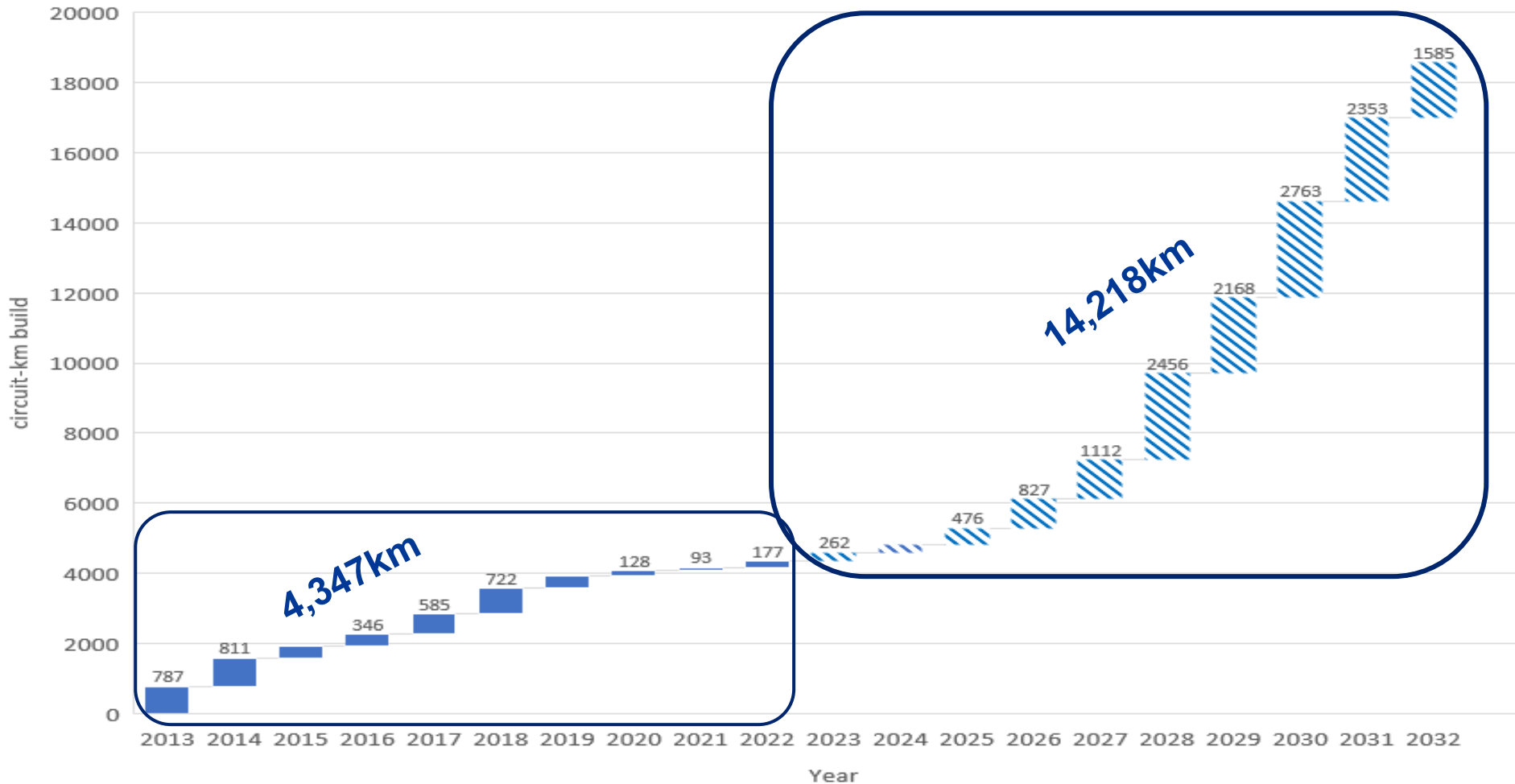


Summary of Transmission Infrastructure Requirements:

Transmission Assets Nationally	Total New Assets: 2023 - 2032
Power lines (km)	
765 kV	6328
400 kV	7698
275 kV	192
Total length (km)	14218
Transformers	
Number of units	170
Total capacity (MVA)	105865
Capacitors	
Number of units	40
Total capacity (MVar)	2700
Reactors	
Number of units	52
Total capacity (MVar)	14713

- Solid lines represent existing lines
- Dotted lines represent proposed new lines

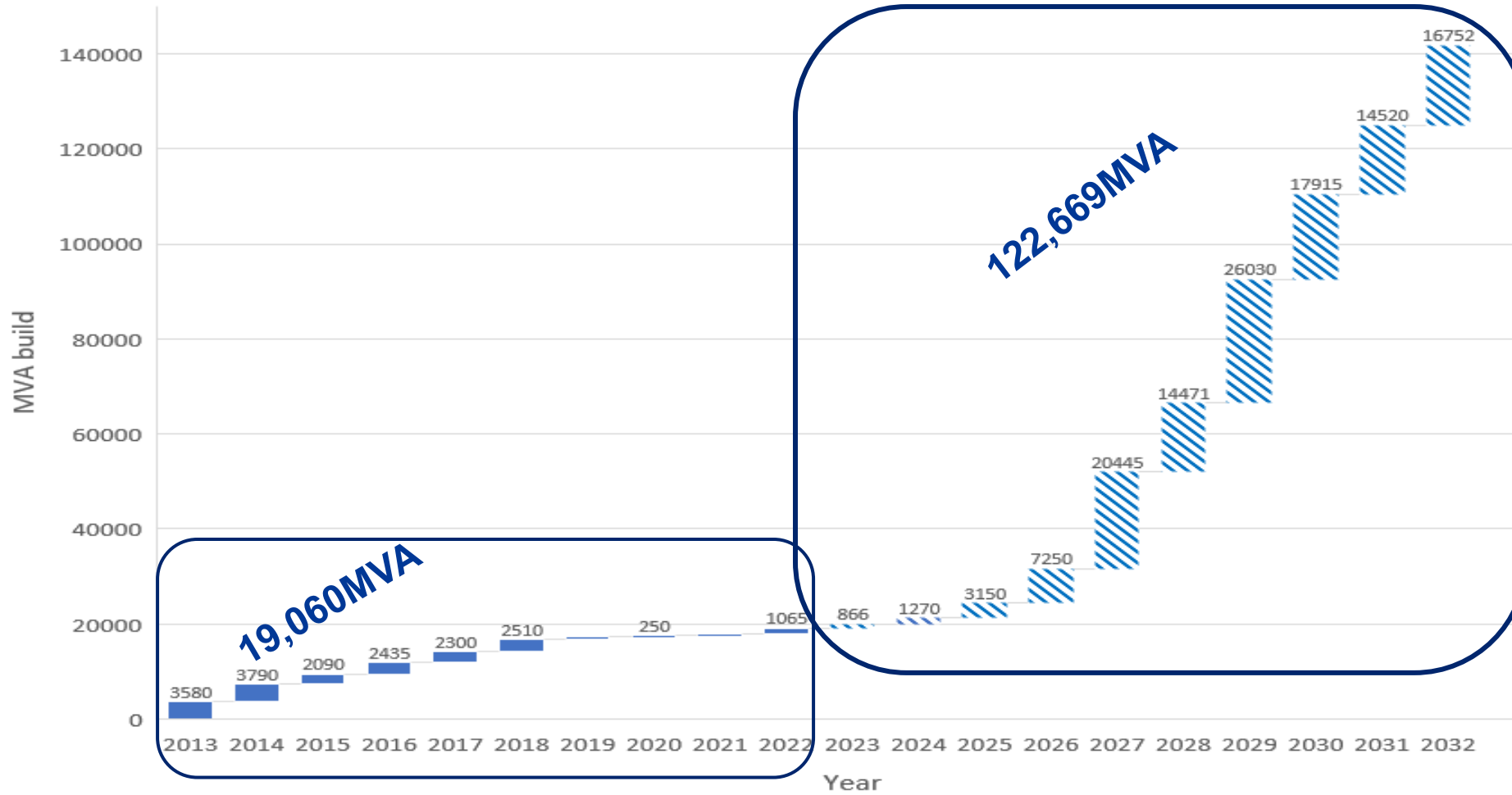
Eskom Transmission circuit-km build per year



~ 325% increase in transmission infrastructure in the next 10 years, compared to last 10-year actuals.

14 218 circuit km is **43%** of current 33 000 circuit km total.

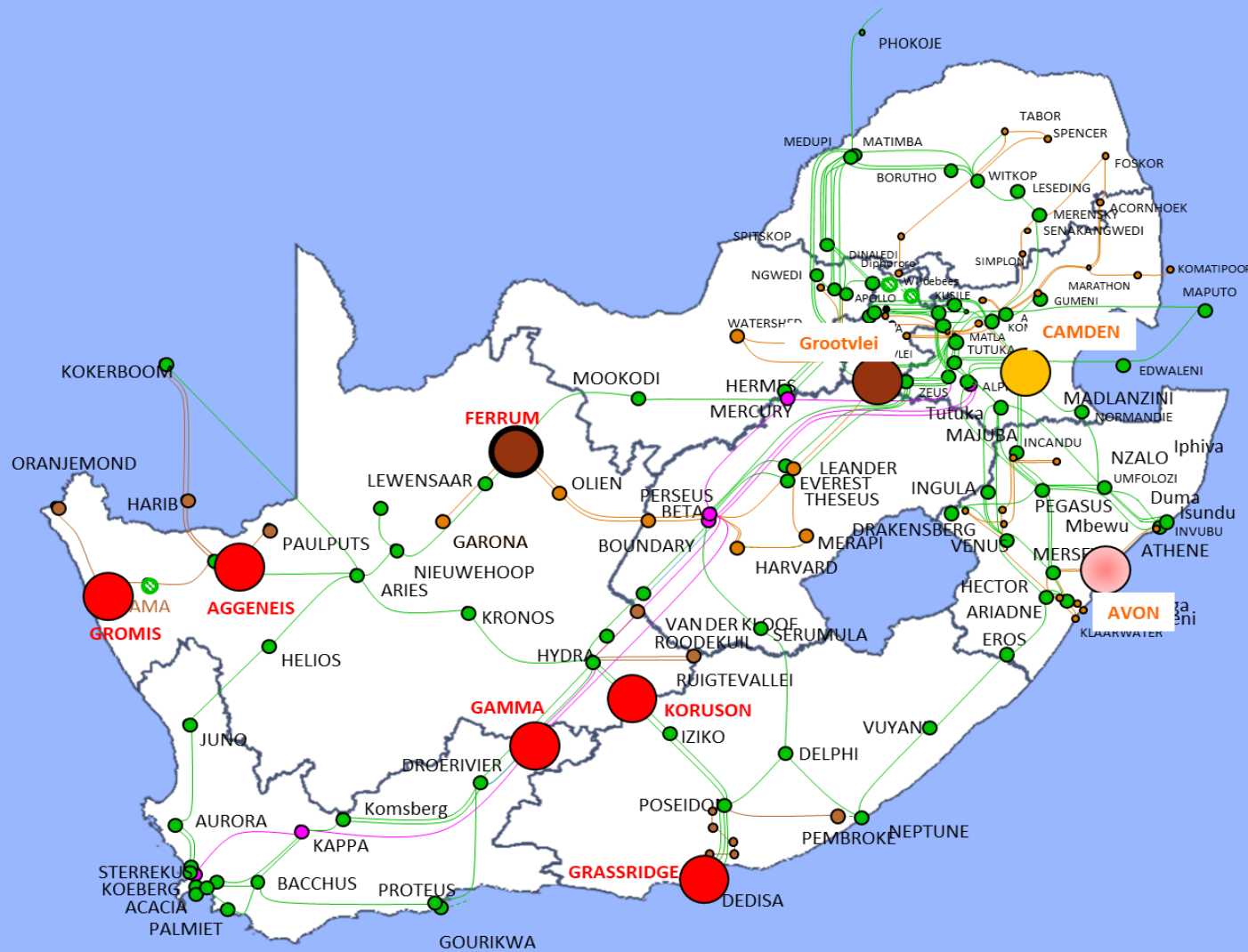
Eskom Transmission MVA build per year



~ 600% increase in transformer capacity (measured in MVA) in the next 10 years, compared to last 10-year actuals.

122 669MVA is 77% of current 160 019MVA total transformer capacity.

New network infrastructure requirements to address system security: Synchronous Condensers



- ❑ Large penetration of non-synchronous generation (solar & wind generation) onto the power system coupled with the decommissioning of large base load synchronous generators will result in grid instability (impacting voltage / frequency stability, reduced inertia and short circuit current).
- ❑ Advanced power system studies, have identified the need to install synchronous condensers at different nodes across the transmission grid as follows:
 - 7 x new synchronous condensers (SCs) at existing substations Aggeneis, Gromis, Gamma, Koruson, Ferrum (2) and Grassridge substations
 - 4 x generators at Camden (2) and Grootvlei (2) need to be repurposed to work as SCs upon decommissioning

- The TDP 2022 has identified the projects required to integrate ~53 GW of new generation capacity, address network reliability and demand growth, and indications are that this is a significant increase in the resource needs across the engineering, procurement and construction value chain in the country. This is both a challenge and an opportunity.
- While generation connection capacity is extremely limited, especially in the broader Cape regions, there is available grid capacity elsewhere on the network for the integration of new generation capacity. Projects have been identified that would assist in expediting the integration of this new capacity.
- Challenges to the TDP delivery are funding for latter years, construction capacity, specific equipment supply, and statutory approvals.
- Other initiatives include curtailment, a concept that will “open-up” the grid sooner than new transmission projects can deliver capacity, and grid stability impacts to ensure the security on the interconnected power system.
- The presentations that follow will address and elaborate on these initiatives, challenges and progress made in implementing the TDP 2022.



Thank you

Progress on strategic initiatives, enablers and challenges

Prince Moyo

General Manager: Asset Management

15 November 2023



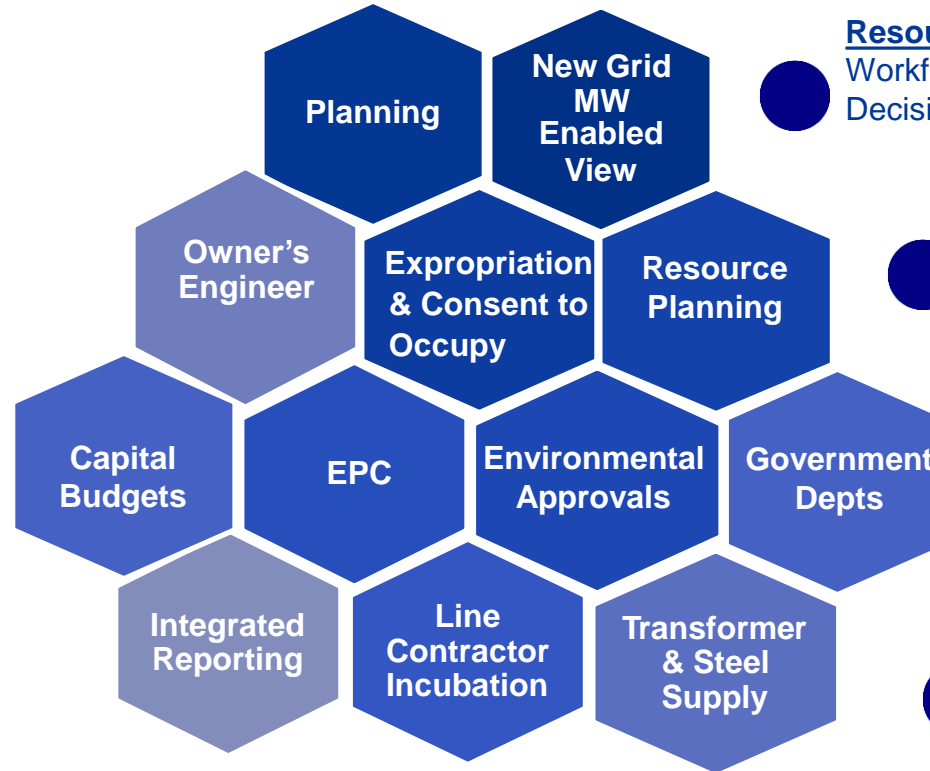
- Transmission is placing a strong focus on the implementation of projects over the next five years and has implemented various strategies for the step-change performance required to deliver the infrastructure programme.
- The TDP Delivery Readiness Index has been developed to monitor initiatives' progress.
- The Capex Delivery Performance Forum, Energy One Stop Shop and Energy NatJoints Workstream 10 have been established to ensure the successful delivery of the TDP. The focus is on:
 - expediting the implementation of TDP through initiatives to increase grid capacity
 - actual progress on identified projects
 - Progress on **47** Priority Projects programs unlocking **37** GW grid connection capacity.

Planning
Planning and release of URSs and Reports

Owner's Engineer (OE) & EPC
Owner's Engineer (OE) tender closed 24 Apr '23; award date Nov '23.
Lines EPC – Issued to the market May '23. Award date Mar '24.
Substation EPC – Issued to the market Aug '23. Award Apr '24.

Capital Budgets
Eskom has allocated a 5-year budget to Transmission.

Integrated Reporting
973 schedules captured in one planning & scheduling tool.
Analytics tool showing milestones and physicals is in production.



Line Contractor Incubation
Line contractor incubation has started. Intake will be annual.

Resource Planning
Workforce plan revised and undergoing approval
Decision - 40% of the TDP to be executed using OE/EPC.

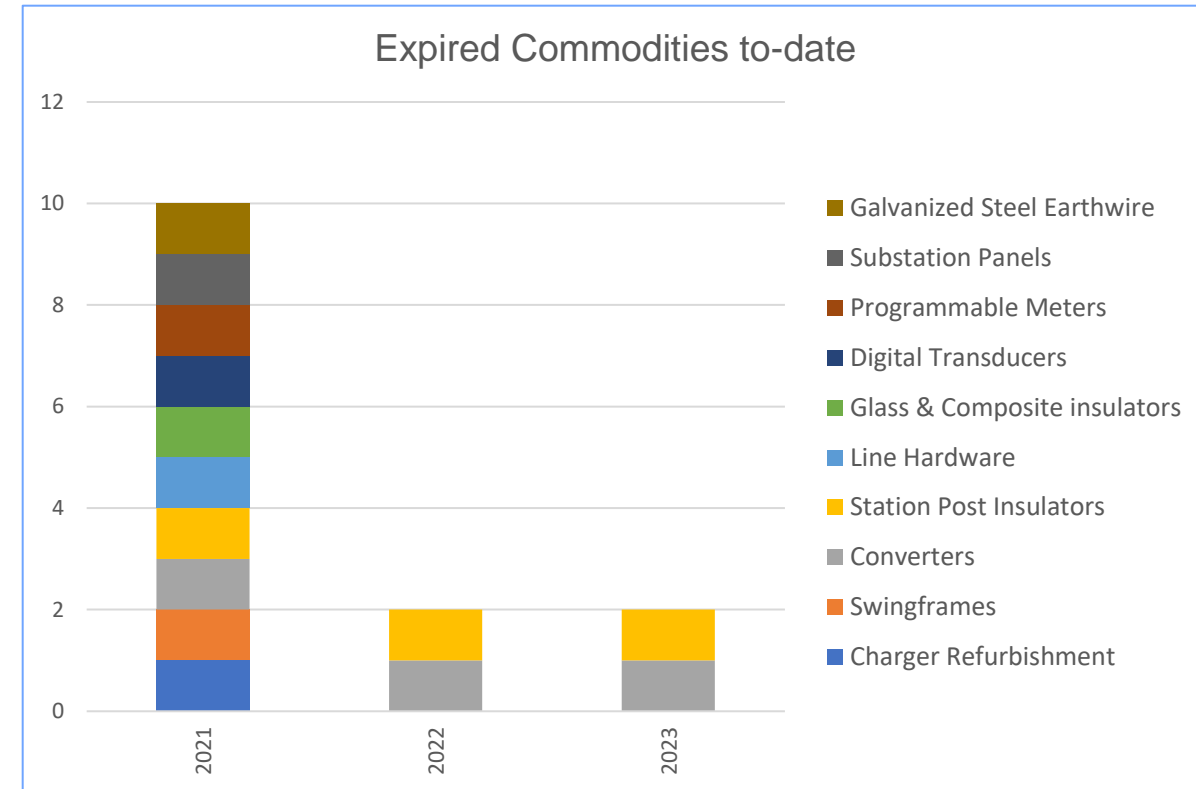
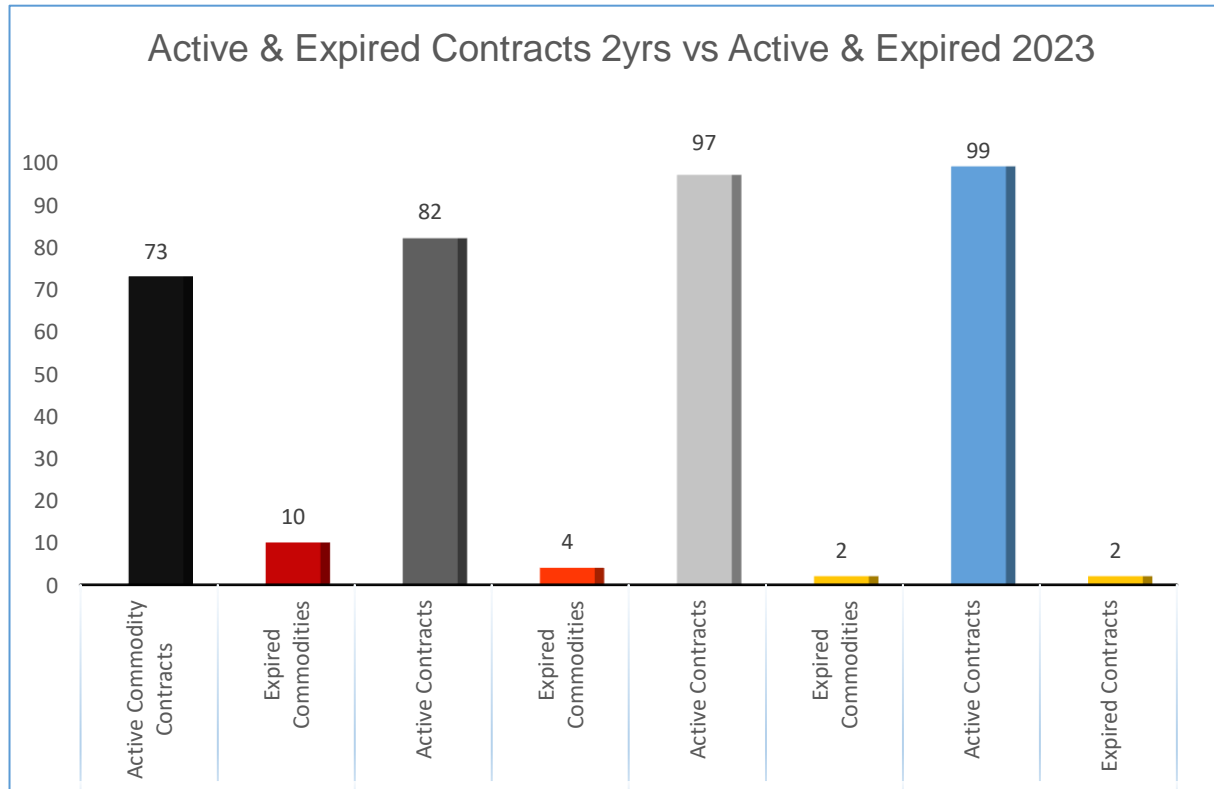
Environmental Approvals
DFFE improved turnaround – from 107 to 57 days
Escalation at NECOM NatJoints where necessary.

Expropriation & Consent to Occupy
DPWI Minister approved 24 expropriations effective Feb '23.
DPWI Minister signed consent to occupy for 27 government properties.
Escalation at NECOM NatJoints possible.

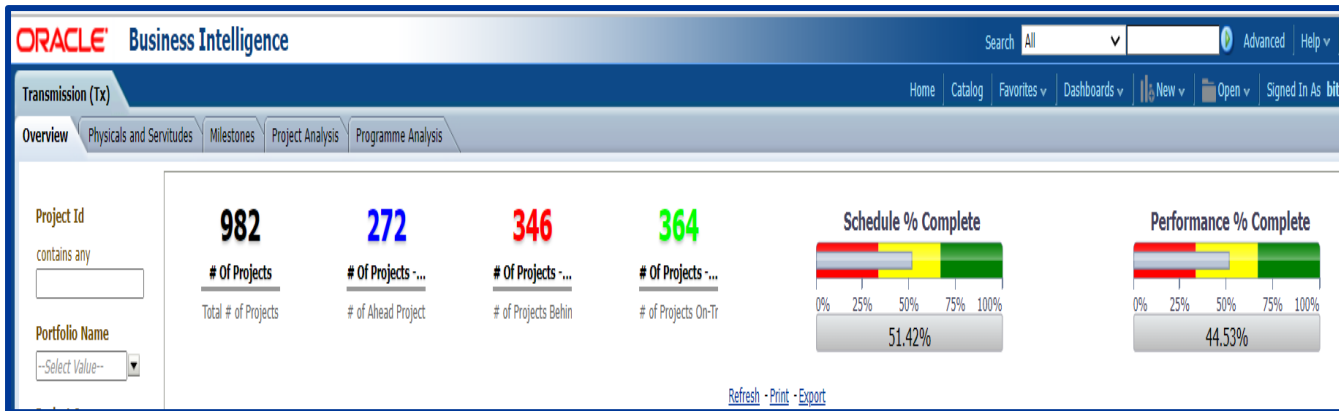
Government Depts
Engagements with Government departments and NatJoints for additional support needed to deliver the program (Energy One Stop Shop).

Transformer & Steel Supply
Accredited 20 factories for Class 3B transformers
101 transformers issued to the market and closed August 2023. Award Feb '24.

- Transmission conducted an assessment to determine the human resource requirements to execute the TDP 2022.
- It was found that the internal human resources capacity was inadequate to execute the large-scale TDP program.
- An OE/EPC impact assessment on human resources for Project Management departments and Engineering was undertaken determine the impact of the workforce plan.
- The study supported a portion of OE/EPC strategy based on TDP physicals (km/MVA).

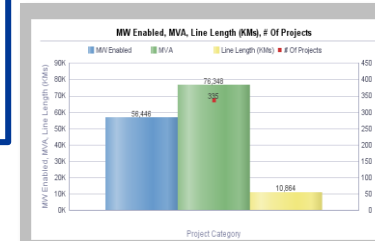


- There has been a steady growth in reducing the number of expired contracts and the placement of contracts, as depicted in the above two graphs.
- Two Commodity Contracts that have expired are:
 - Converters – Negotiations are done, and we are awaiting the response from the supplier.
 - Station Post was re-issued, the new enquiry is to be issued in November 2023.



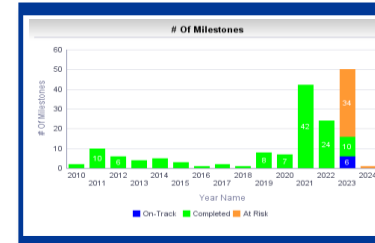
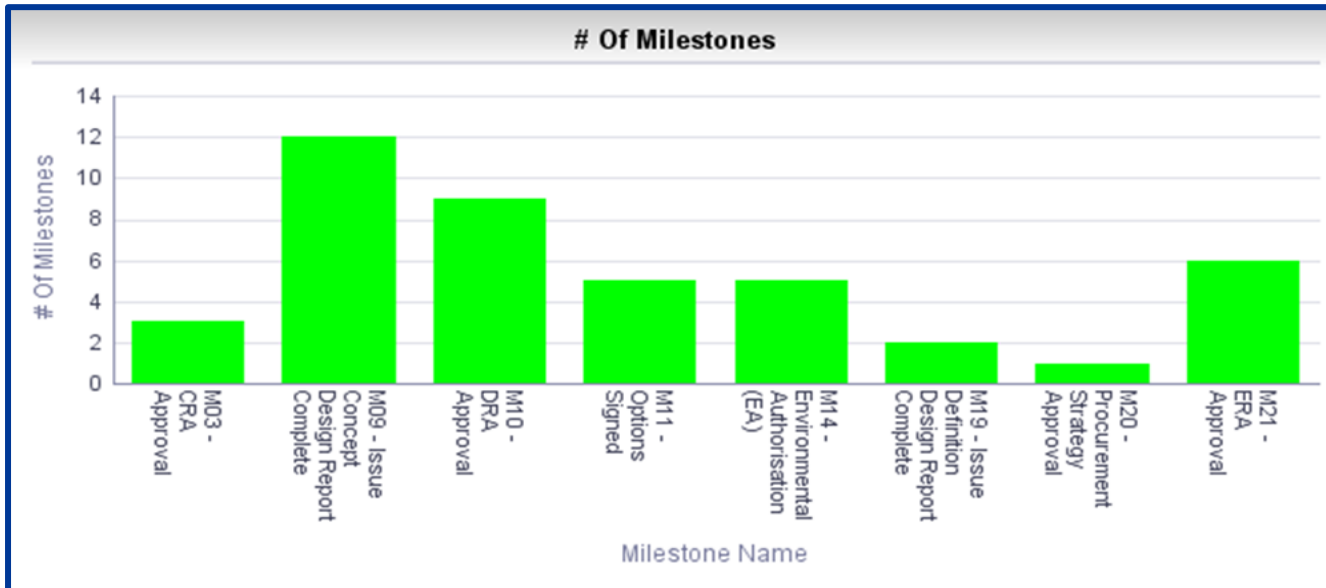
Overview page: Landing page of Oracle BI Dashboard tool

- 983 Transmission projects
- Schedule data sourced from Primavera
- Provides oversight of project progress
- Data search can be specific and provide insights
- Information is in the form of charts and tables



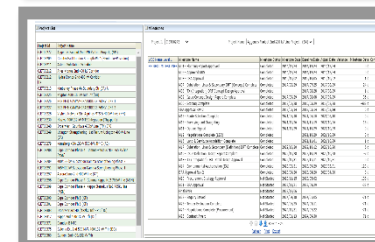
Physicals & Servitudes page:

- Provides **physicals** in terms of Kms of Line, MVA, & Mega Watts enabled
- Provides status update on **Servitudes** in terms of Total Options, number of Negotiated Options, Registered Options, % Negotiated Options



Milestones page:

- Breaks down PLCM in terms of project milestones
- Tracking & monitoring of current milestones and identifies late and at-risk milestones in real time
- Provides reports on programme progress in terms of stage gates achieved



Project Analysis and Programme Analysis page:

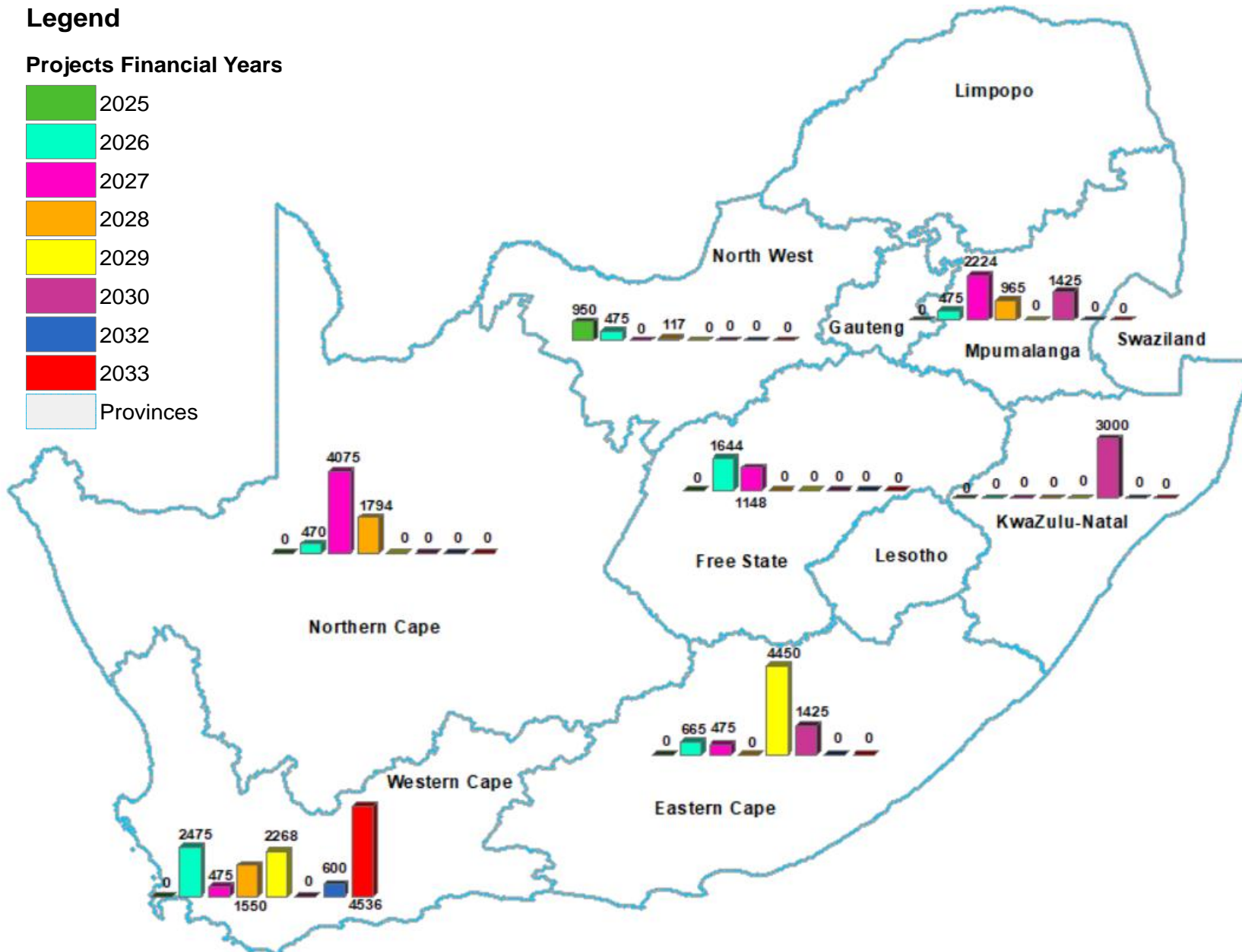
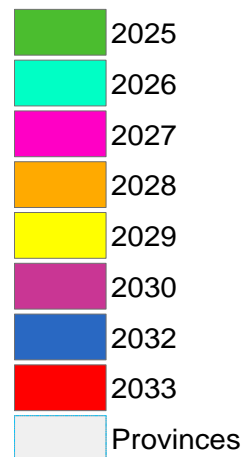
- Provides a breakdown of project milestones and activities
- Shows a drilldown of greater detail of progress made per project against baseline
- Gives timelines as per schedule for every project

- In expediting the delivery of the infrastructure projects, Eskom has prioritised the following programme to speedily unlock the grid:
 - A total of **25 Accelerated Transformer Projects** in existing substations, that will unlock **13 Gigawatts (GW)** in the next 5 years.
 - A total of **22 Expedited Projects** will unlock a further **24 Gigawatts (GW)** of grid connection capability by 2033.
 - These projects are at different stages of implementation in terms of **design, procurement** and **construction**.
- Over and above the **37GW priority projects**, Transmission is developing about **157 expansion projects**.

Transmission Priority Programs (37GW)

Legend

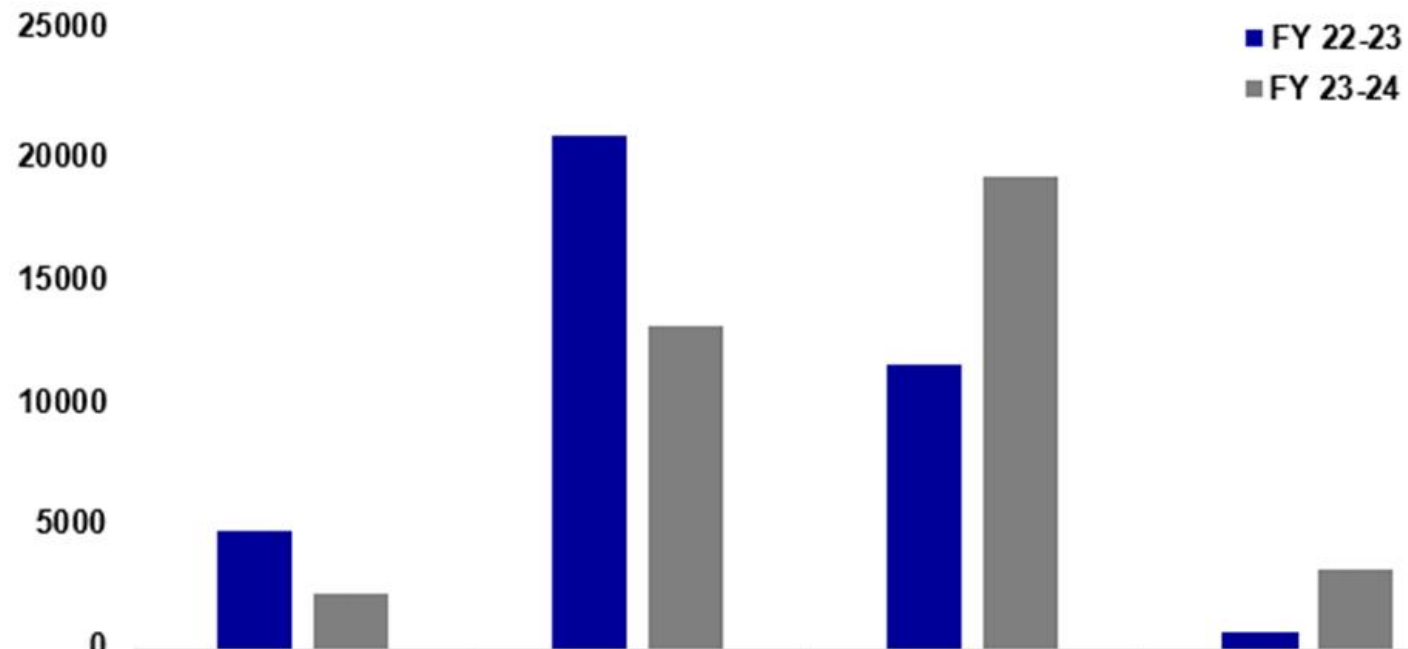
Projects Financial Years



47 Priority Projects
enabling 37GW grid
connection

PROVINCES	Total MW Enabled
Eastern Cape	7015
Free State	2792
KwaZulu Natal	3000
Mpumalanga	5074
North West	1542
Northern Cape	5845
Northern Cape	494
Western Cape	11904
Grand Total	37 GW

Progress Achieved in FY 22-23 and FY 23-24



		Pre CRA	CRA	DRA	ERA
■ FY 22-23	MW Enabled	4758	20716	11513	694
	Number of Projects	3	27	16	1
■ FY 23-24	MW Enabled	2268	13099	19047	3267
	Number of Projects	1	14	25	7

1 Nov 2022 – 30 Oct 2023

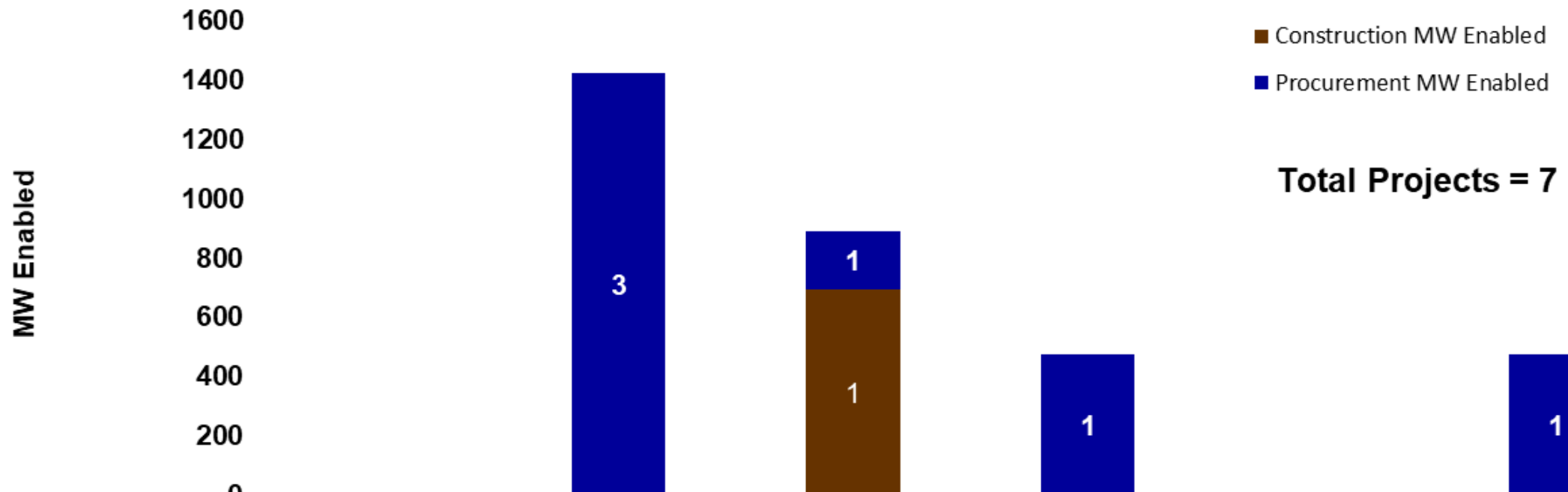
MW Enabled

- CRA (23) - 12 013
- DRA (14) - 2 198
- ERA (6) - 2 573

Environmental Authorisation

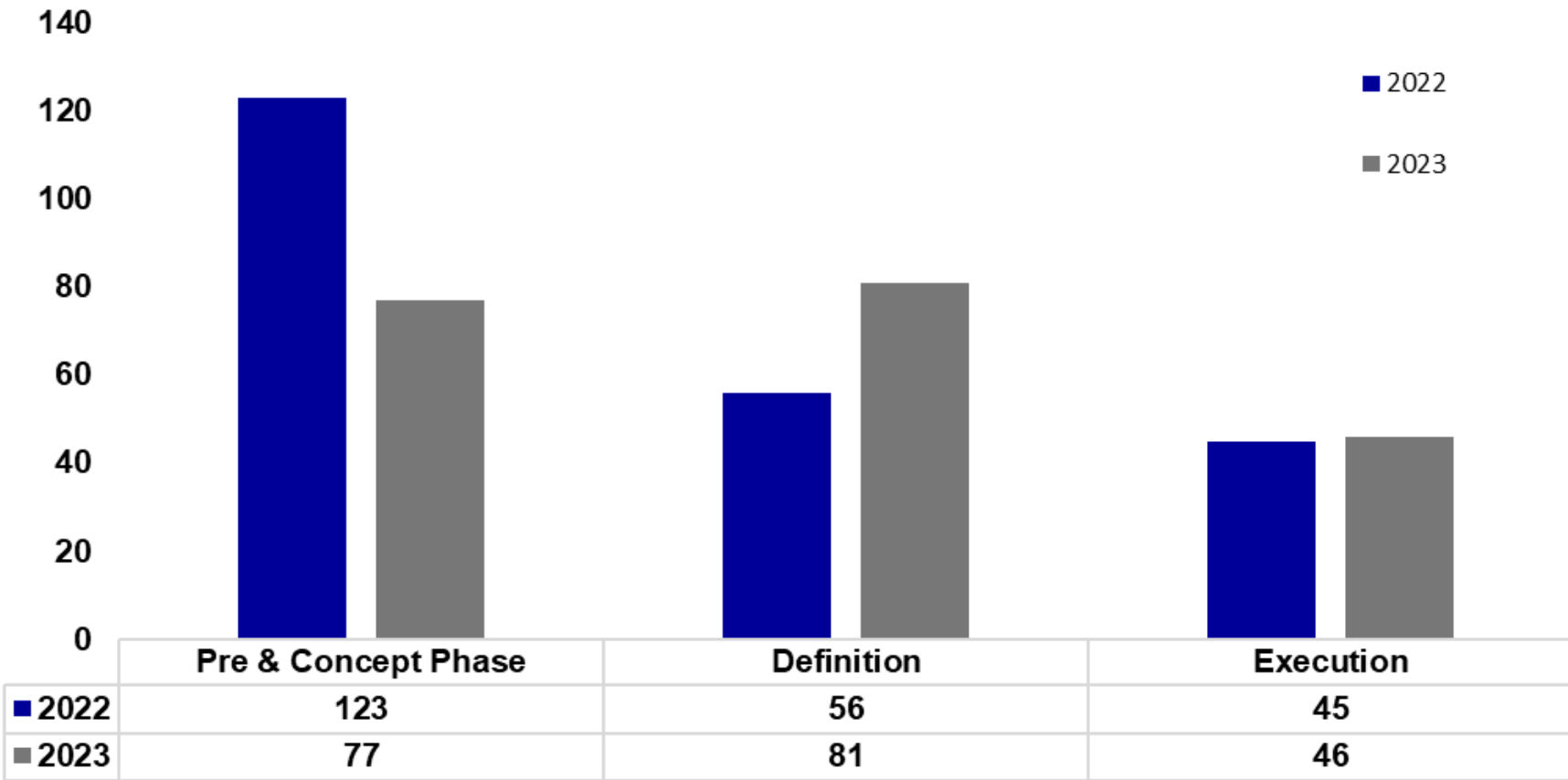
- 8 approved EAs

Priority Program in Procurement and Construction



	Gauteng Portfolio	Western Portfolio	Southern Portfolio	Mpumalanga Portfolio	KZN Portfolio	Northern Portfolio
■ Procurement MW Enabled	0	1425	198	475	0	475
■ Construction MW Enabled	0	0	694	0	0	0

Progress in Expansion Program from 1 November 2022 to 30 October 2023

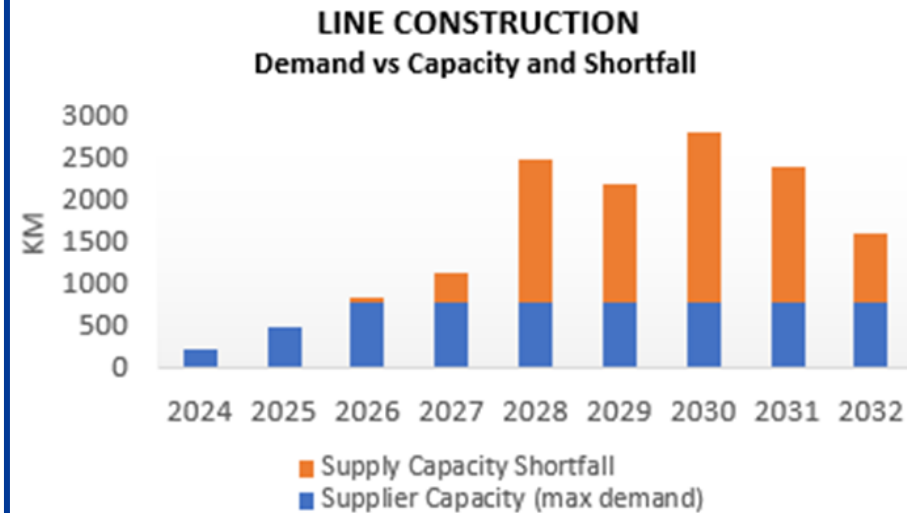


To note: 8 Project in closeout

TDP Delivery Challenges and Progress

Construction Capacity

- The required build out rate averages 1,400km per year and peaks at 2,700km.
- Our industry capacity is 800km per year, at a stretch.



● Incubation of construction contractors has started.

● OE contract at evaluation stage, planned award is November 2023.

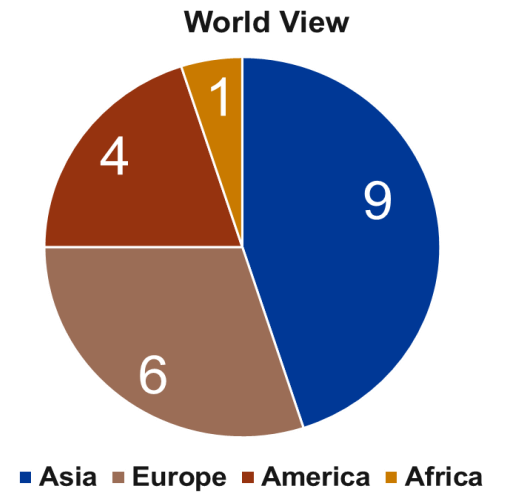
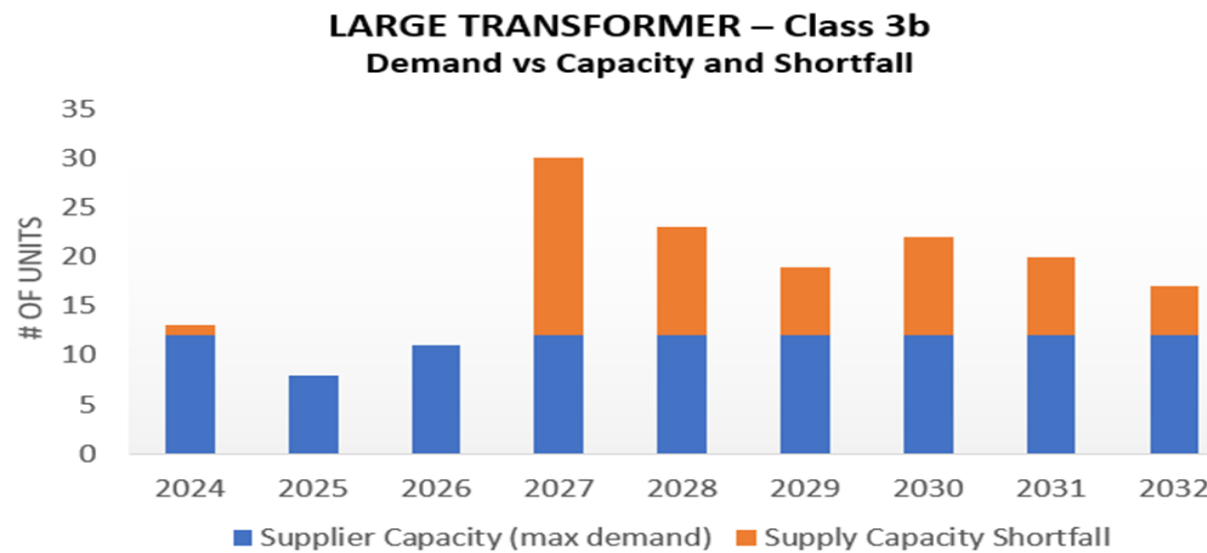
● EPC Lines Engineering contract at evaluation stage, planned award is March 2024.

● EPC Substation contract issued to the market, planned award is April 2024.

Parties like the IDC and LSF are assessing the funding options to assist the incubating contractor program to develop skills, purchase machinery and equipment, as well as working capital fund projects, as they bid for and roll out projects.

TDP Delivery Challenges and Progress Equipment Supply (Transformers)

- Local supply capacity is adequate for Class 1 & 2.
- One single supplier for Class 3b. No local supplier for Class 4.



● Eskom has pre-qualified 20 international factories, up from 8 by the beginning of 2022.

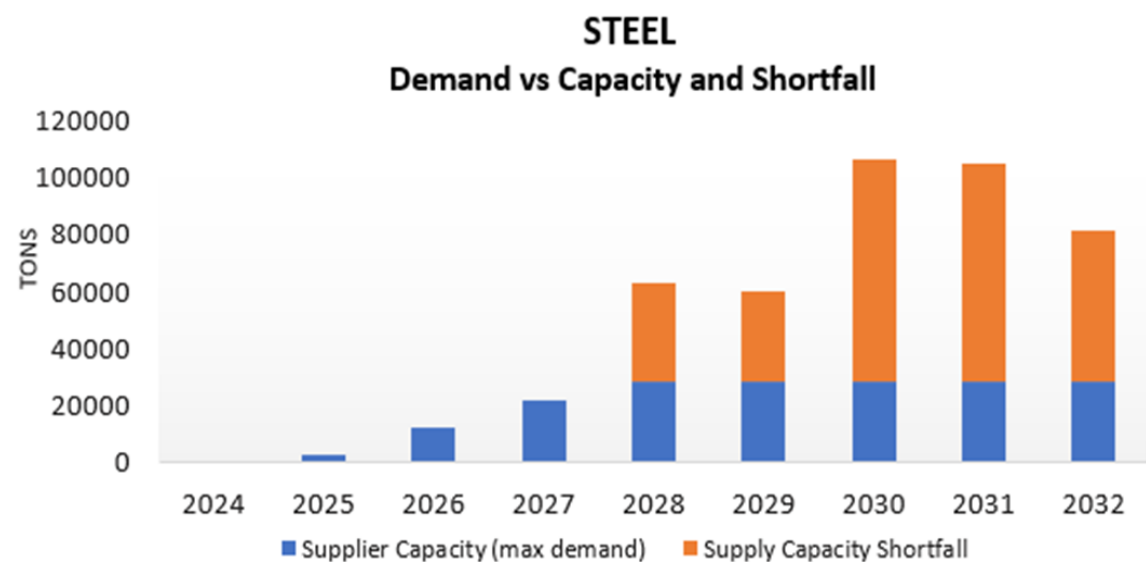
● 101 transformer contract are at evaluations stage to expedite to procurement of Class 3b transformers

● There is a new enabling agreement that has not yet been issued – to cater for all transformer classes.

Project departments are also in the process of preparing the necessary documentation for the projects that are ready for orders to be placed.

TDP Delivery Challenges and Progress Equipment Supply (Steel)

- The country has one supplier of fabricated structural steel.

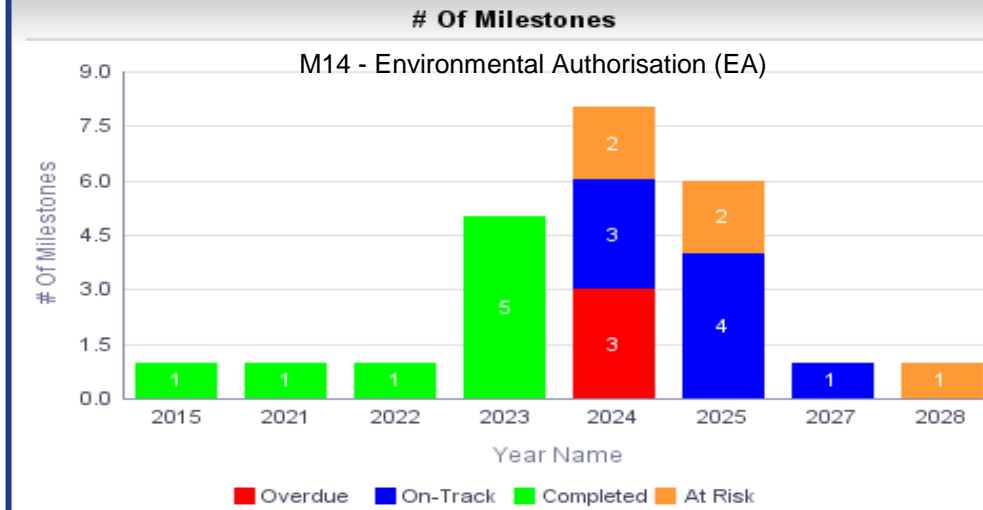
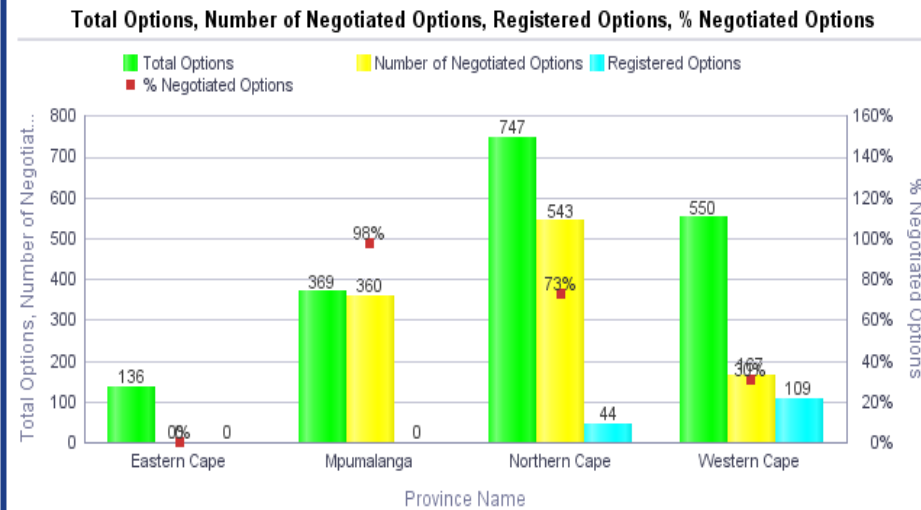


An RFI was issued to the market for structural steel for Transmission powerlines to determine the capability and capacity of the local industry. A final report has been issued and Eskom will be moving to the next stage of prototyping with potential suppliers.

TDP Delivery Challenges and Progress

Statutory Approvals

- Environmental impact assessment (EIA) and servitude acquisition duration.



An example using the x47 priority projects

- Improved turnaround times for EA regulatory approvals from 107 days to 57 days.
- DPWI Minister approved 24 expropriations effective Feb '23.
- Establishment of Energy NatJoints Workstream in May 2023.
- Improved stakeholder relations with the relevant government departments – DFFE, DPWI and DTIC (EOSS).

- Significant progress has been made on key initiatives.
- Transmission is continuing to implement the identified medium to long-term strategies to unlock the grid infrastructure ie Additional Transformers and Expedited Program **(37GW)**.
- TDP Strategic and Operational forums have been established for implementing decisions and improving the speed of infrastructure delivery.
- The TDP delivery challenges, such as construction capacity, equipment supply, and statutory approvals are being addressed to ensure successful delivery of the programme.



Thank you

TDP Execution Progress

Naresh Singh

General Manager: Transmission Projects Delivery

15 November 2023



- There is an urgent need for Transmission to expedite the development of projects given the changes in the generation requirements.
- Transmission is striving to ensure that there is an alignment between the TDP requirements and the project execution on year by year.
- Two things that slow down Transmission project development is the acquisition of land and environmental impact assessments.
- Transmission has a strong focus on the improvement of internal and external processes to achieve the TDP.
- Successful execution of the TDP requires partnership and joint commitment by all key stakeholders.

Project Life Cycle Model (PLCM) Overview – Per phase

CRA

DRA

ERA

FRA

Pre-Project

- Planning Report
- Project Charter
- Select the delivery approach

Concept Phase

- Design alternatives
- Develop concept design
- Develop technical specifications

Definition Phase

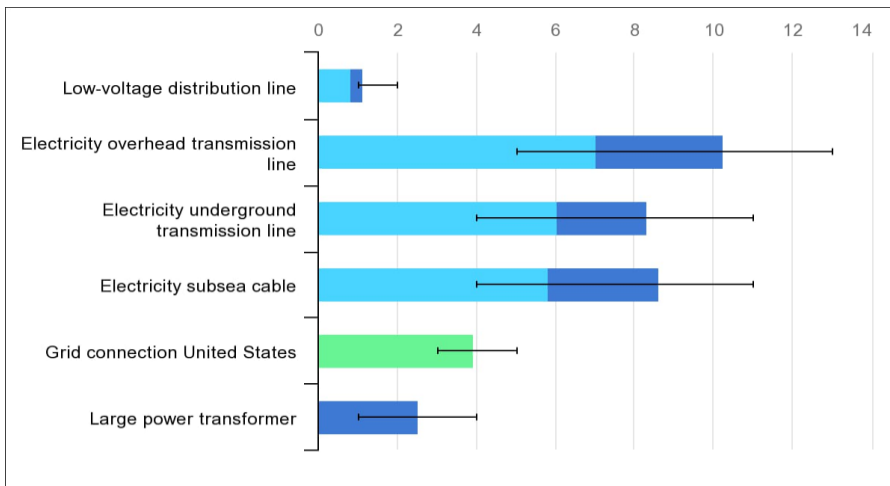
- Detailed Designs
- Obtain all approvals for land; (servitude, environmental, regulator etc.)
- Land and servitudes
- Detailed contracting and procurement strategy
- Develop corporate social investment risk and stability plan
- SHE specifications

Execution Phase

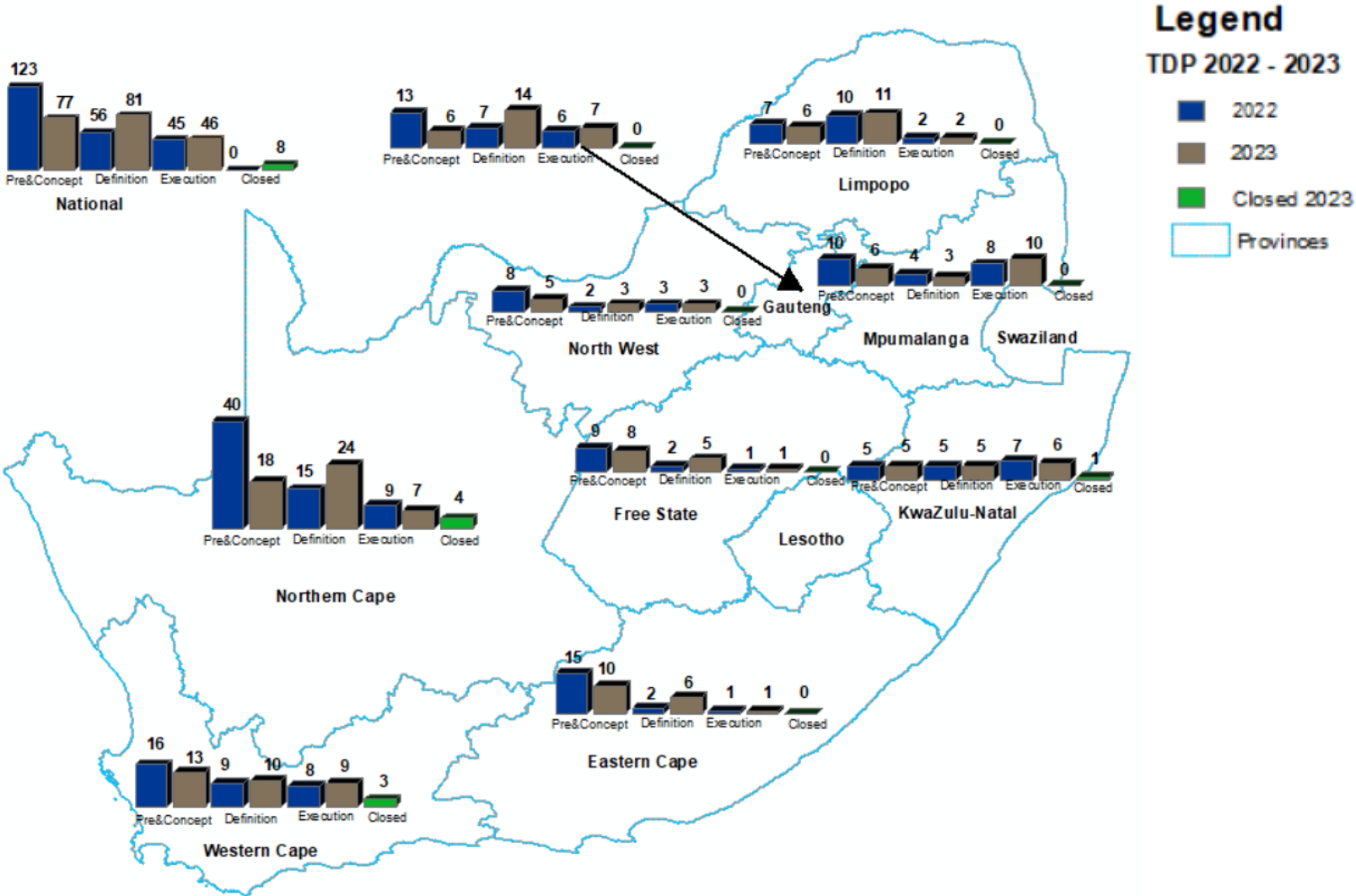
- Appointment of contractors
- Construction management
- Commission and project handover
- SHEQ compliance

Finalisation Phase

- Project close-out
- Transfer obligations
- Evaluate project performance

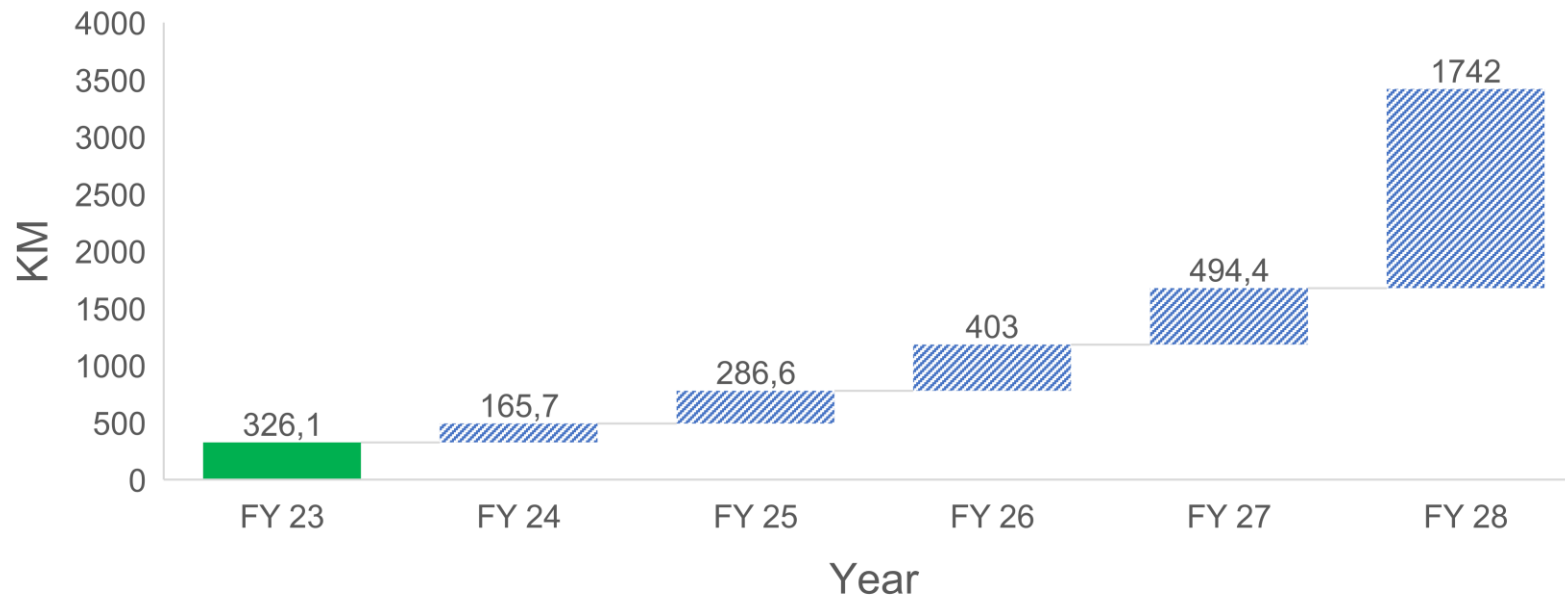


Project Progress Across The Value Chain (2022-2023)



Progress in delivering the TDP (kms)

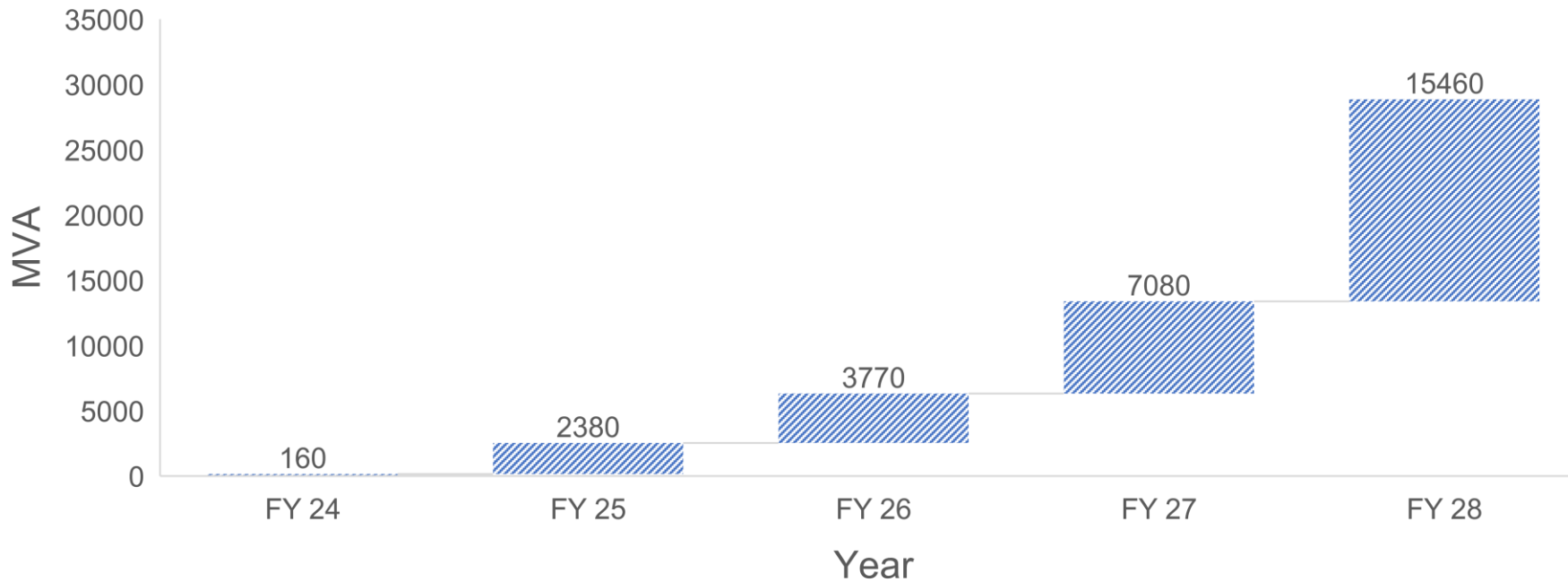
KM PER YEAR



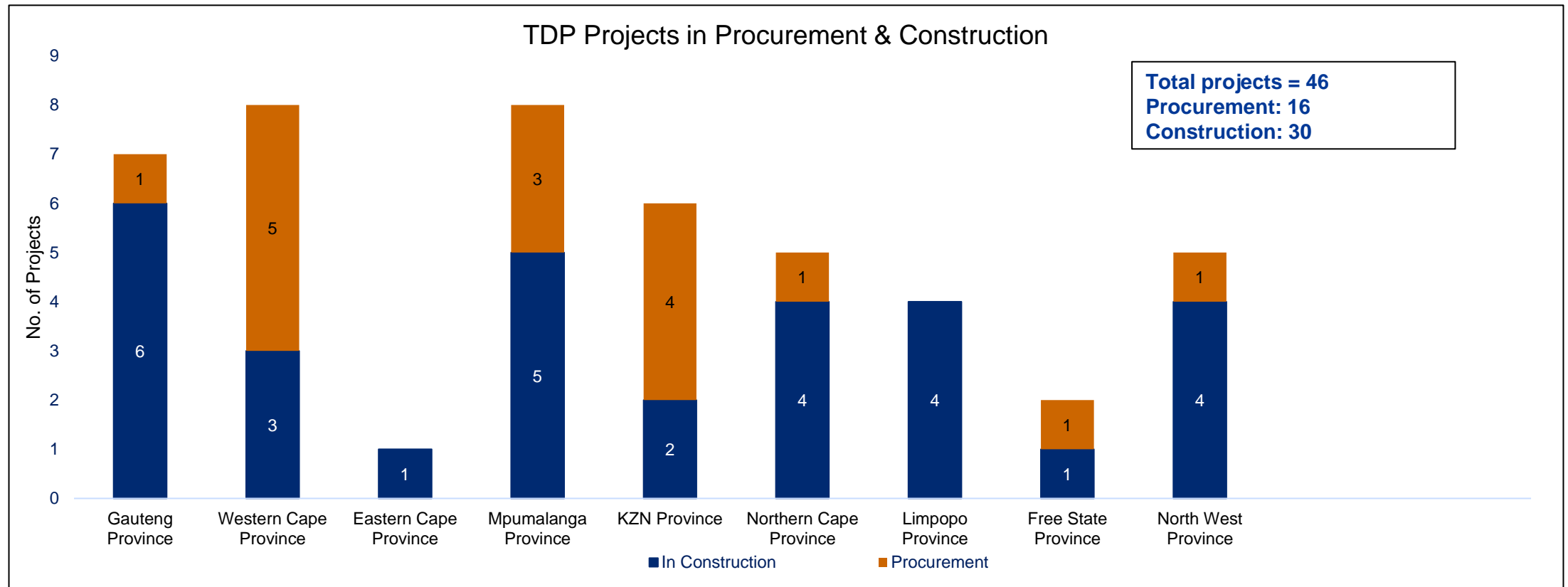
- FY23 Actual of 326.1km
- Projection of 3 418km by FY28, this includes projects both in development and execution phases.
- Expediting programs are in place to facilitate increased delivery.

Progress in delivering the TDP (MVAs)

MVA PER YEAR

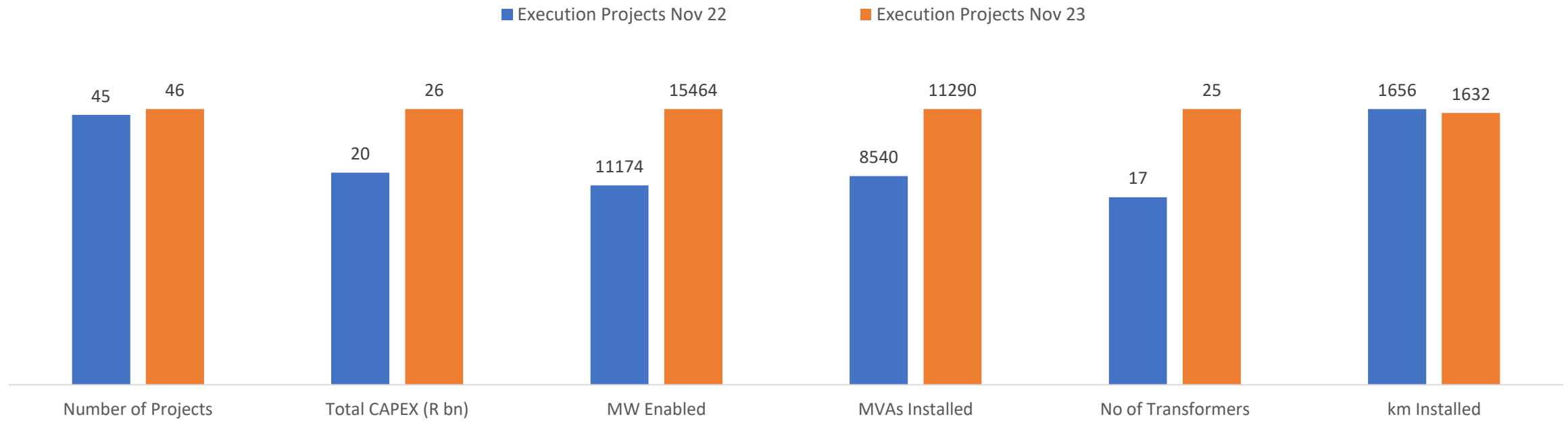


- The number of transformers translates to a forecast of 28 850MVA by FY28, this includes projects both in development and execution phases.
- Total of 64 Power Transformers to be installed (FY24-FY 28).
- The main challenges being the delays in the manufacturing and delivery of transformers.



- Projects in execution, will deliver 1632km, 11 290MVA and over 15 000MW enabled by 2028.
- Multiple re-issue and non-responsive tenders are still a challenge.

Projects in Execution (2022 vs 2023)

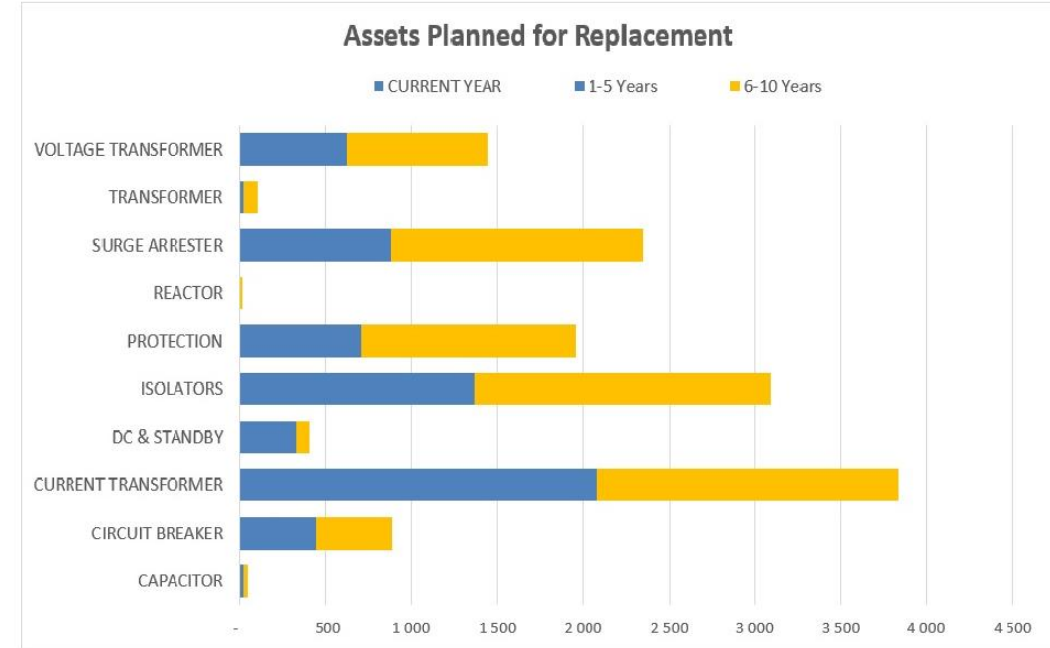


Assets replaced and planned for replacement



Assets Replaced

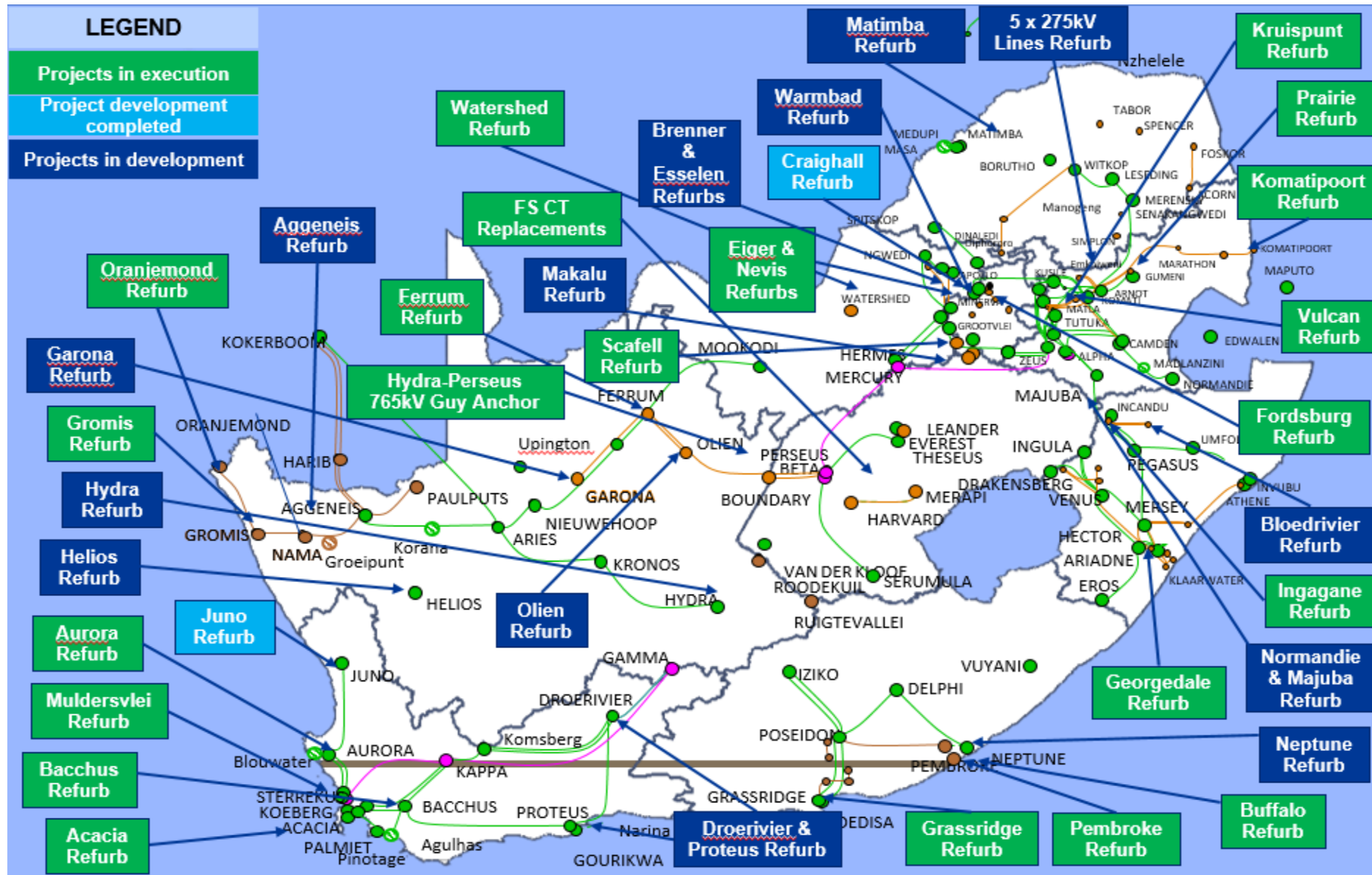
CATEGORY	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Grand Total
CAPACITOR										2	2
CIRCUIT BREAKER	54	55	41	29	40	48	37	40	59	39	442
CURRENT TRANSFORMER	96	194	190	140	228	223	234	202	219	182	1 908
DC & STANDBY	70	29	62	22	19	40	5	5	28	89	369
ISOLATORS	22	35	40	24	31	34	43	57	101	85	472
PROTECTION	20	36	35	31	51	26	37	40	43	28	347
REACTOR	6	18	6	3	1	2	1	2	1		40
SURGE ARRESTER	128	195	276	112	122	187	197	128	165	126	1 636
TRANSFORMER	9	12	13	9	11	7	3	4	4	15	87
VOLTAGE TRANSFORMER	47	54	45	36	77	79	138	59	103	89	727
Grand Total	452	628	708	406	580	646	695	537	723	655	6 030



Assets Planned for Replacement

CATEGORY	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Grand Total
CAPACITOR	2	2	7	3	5	9	6	4	7	5	50
CIRCUIT BREAKER	47	114	111	113	59	97	69	86	85	110	891
CURRENT TRANSFORMER	197	496	423	558	413	401	342	339	287	375	3 831
DC & STANDBY	135	136	6	33	16	22	12	8	32	4	404
ISOLATORS	80	395	224	402	262	324	271	366	349	422	3 095
PROTECTION	35	89	99	225	257	259	275	275	247	198	1 959
REACTOR	-	-	-	-	1	1	6	3	-	3	14
SURGE ARRESTER	64	247	203	199	173	216	224	293	335	393	2 347
TRANSFORMER	-	3	1	6	14	15	19	17	16	12	103
VOLTAGE TRANSFORMER	32	95	83	255	159	142	174	149	157	202	1 448
Grand Total	592	1 577	1 157	1 794	1 359	1 486	1 398	1 540	1 515	1 724	14 142

Major Refurbishment Projects: FY2024 – FY2033



- The planning phase of the TDP is key to indicate the requirements for Transmission infrastructure. Project life cycle model is followed for proper governance and processes for classification, prioritisation and funding amongst others.
- There is an increased effort to expedite project development in order to move them in to execution.
- The current 5-year execution plan indicates a need for Transmission to scale up, different initiatives are in progress to expedite delivery.
- Successful execution of the TDP will require:
 - Safe execution - *Zero Harm*
 - Ethical behavior - *Integrity*
 - Cost prudence and returning transmission capital costs to globally competitive costs
 - Optimisation of the execution strategy for efficient project delivery
 - Continuous review and assessment of supplier performance
 - Review and improvement on tender enquiry requirements to improve contract placement duration



Thank you

Generation Connection Capacity Assessment (GCCA 2025)

Ronald Marais

Senior Manager: Strategic Grid Planning

15 November 2023



This report details the available generation connection capacity of the 2025 transmission network with all the projects that are expected to be commissioned by then. The report details the available generation connection capacity for the entire country, and it was compiled per supply area namely; KwaZulu-Natal, Mpumalanga, Gauteng, Limpopo, North-West, Free State, Northern Cape, Western Cape, Hydra Cluster and Eastern Cape.

The potential introduction of curtailment to enable additional grid connection capacity for wind generation is still work in progress and the results from curtailment are not included in this report. The studies for the greater Cape area have been done and indications are that there is additional capacity that can be provided once governance, system operations readiness and stakeholder engagements have been concluded. Once concluded an addendum with curtailment capacity will be released.

GCCA 2025 Capacity Overview

Available and constrained supply areas

Available Capacity 19940MW (green areas)

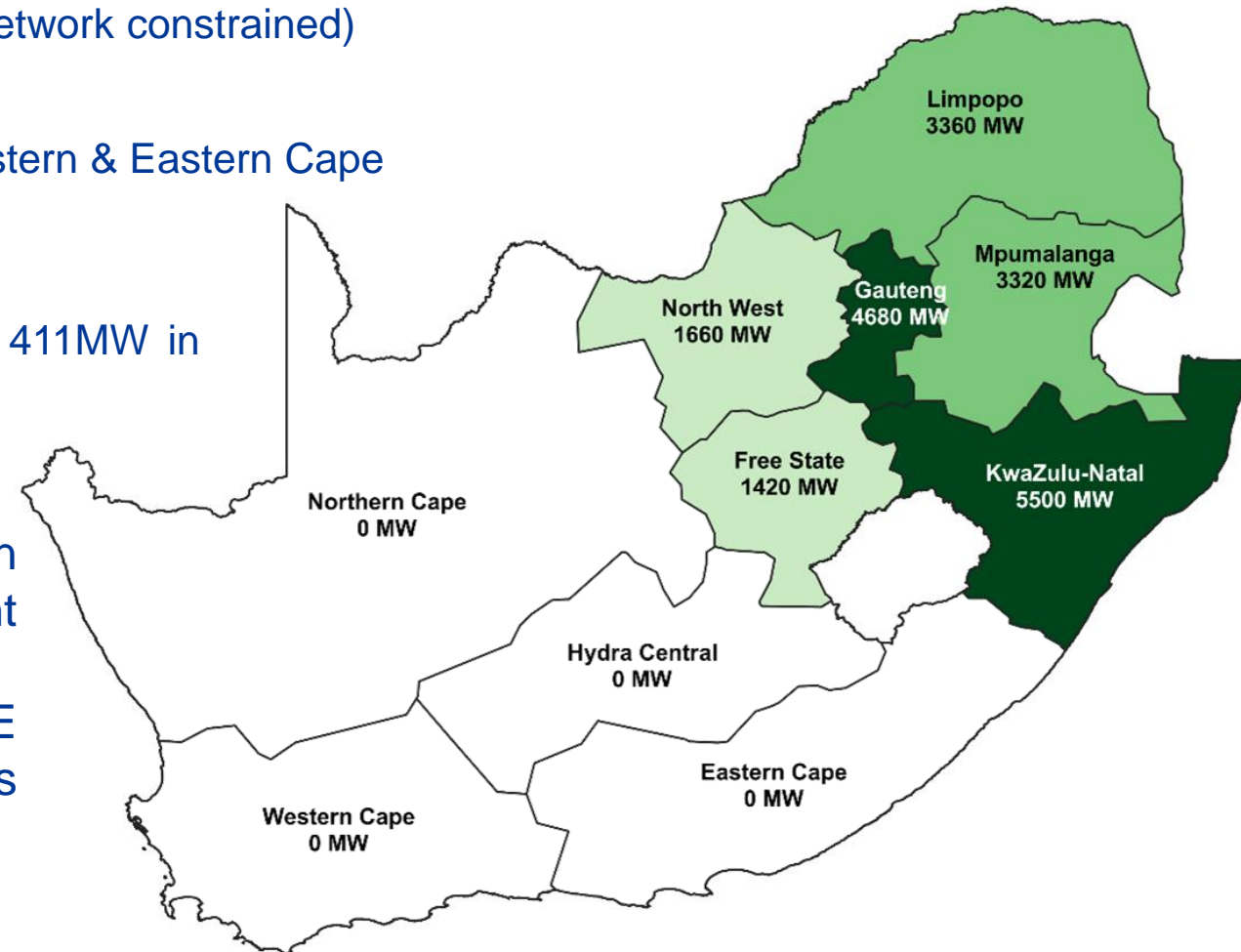
- 10 189MW - KZN & Gauteng (not well suited for utility scale RE)
- 9 760MW - Mpumalanga, Limpopo, North-West & Free State (well suited)
- 0MW - Hydra, Western, Eastern & Northern Cape areas (network constrained)

Opportunity Capacity (wind)

- ~4000MW – Curtailment opportunity if approved in the Western & Eastern Cape

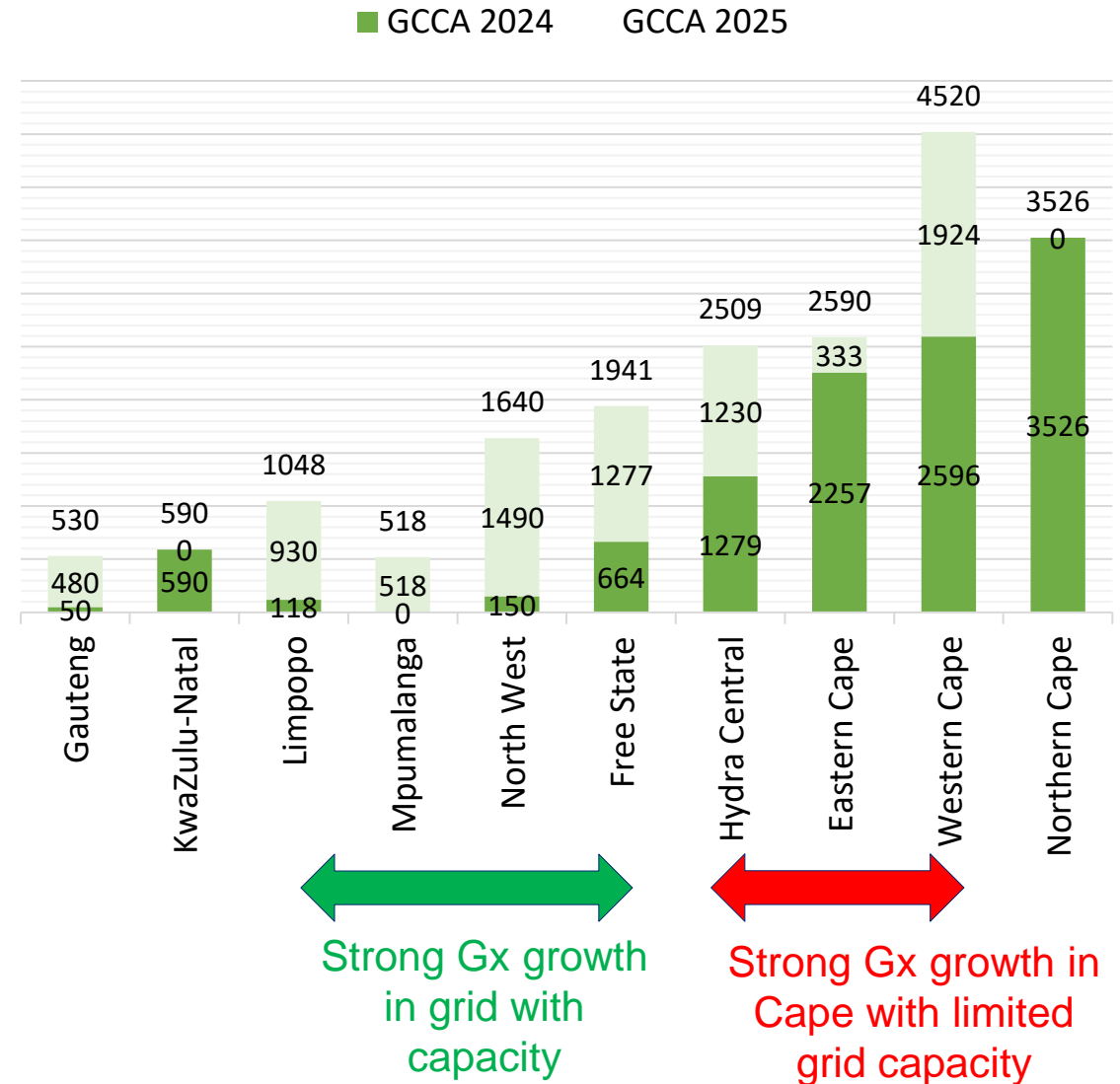
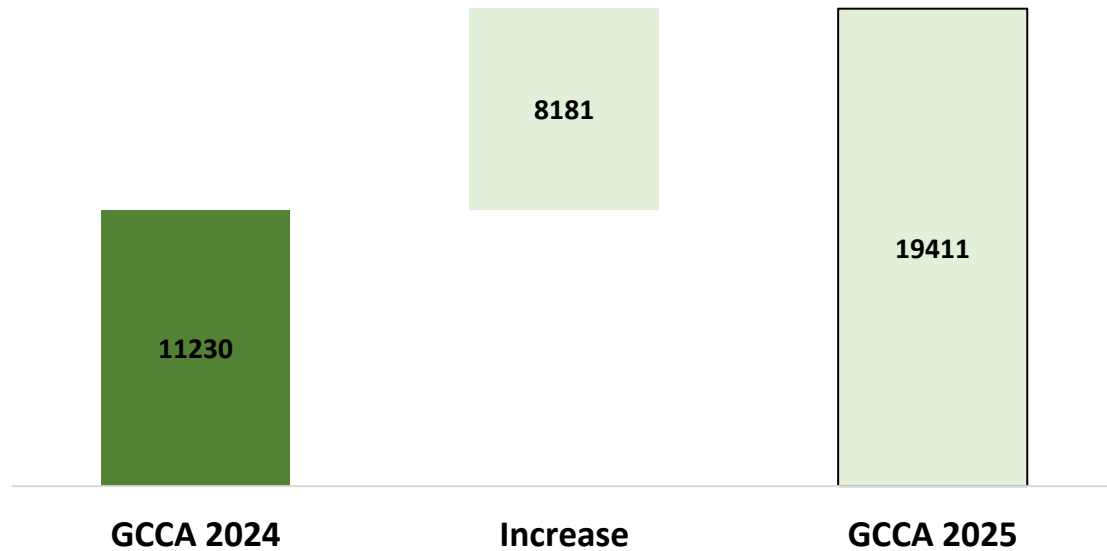
Added Generation Capacity from previous GCCA 2024

- 8 181MW change from 11 230MW in GCCA 2024 to 19 411MW in GCCA 2025
- The planned renewable energy (RE) generation included in the GCCA 2025 exceeded all current plans*
- Grid congestion is largely a result of accelerated RE penetration by 2025, which is ahead of requirements from the plans*

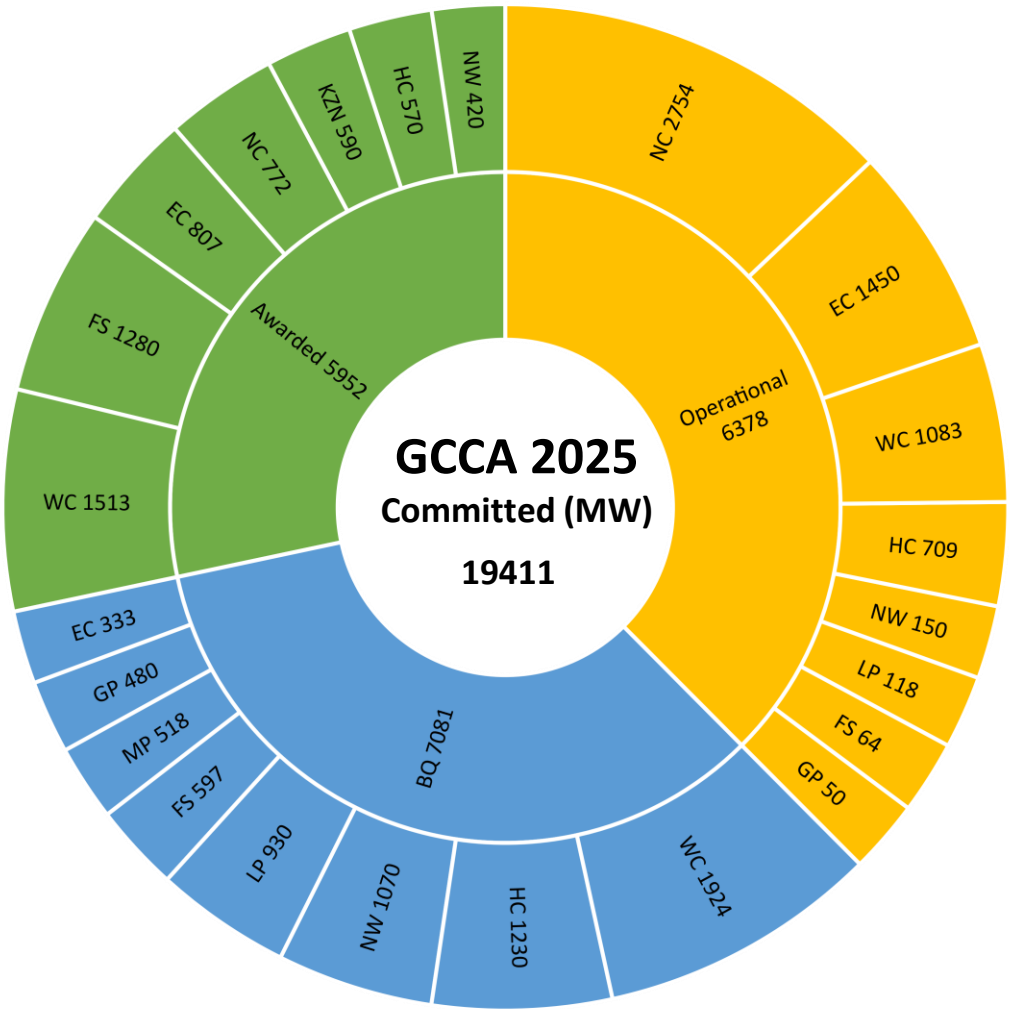
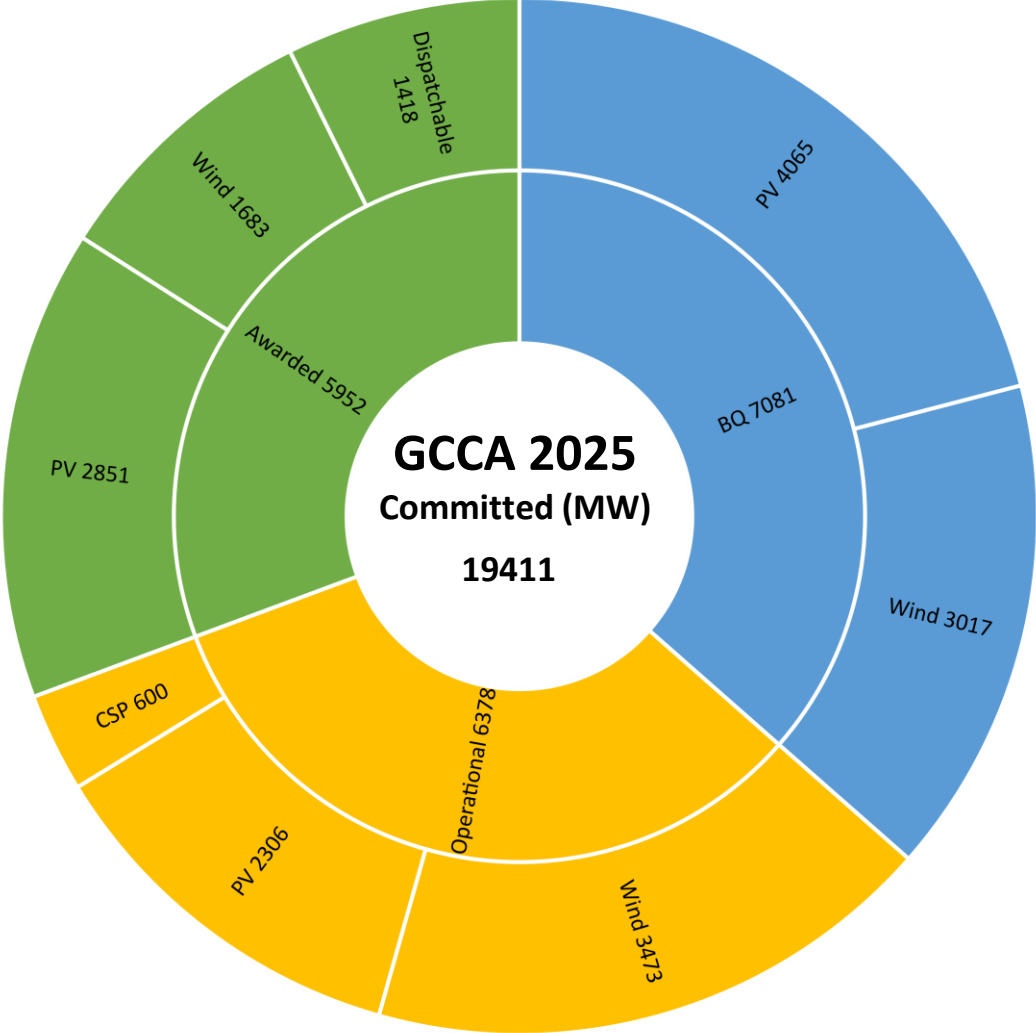


Change in committed generation between GCCA 2024 and GCCA 2025

Change in generation MW between GCCA 2024 to GCCA 2025

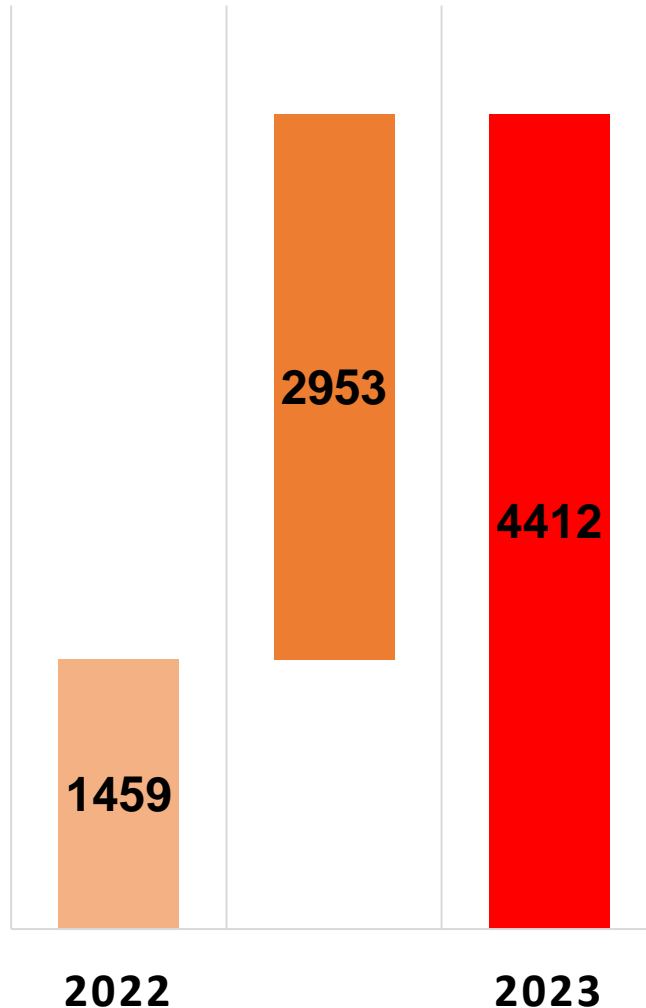


*Data received from GAU 20230711 and an update on 20230821



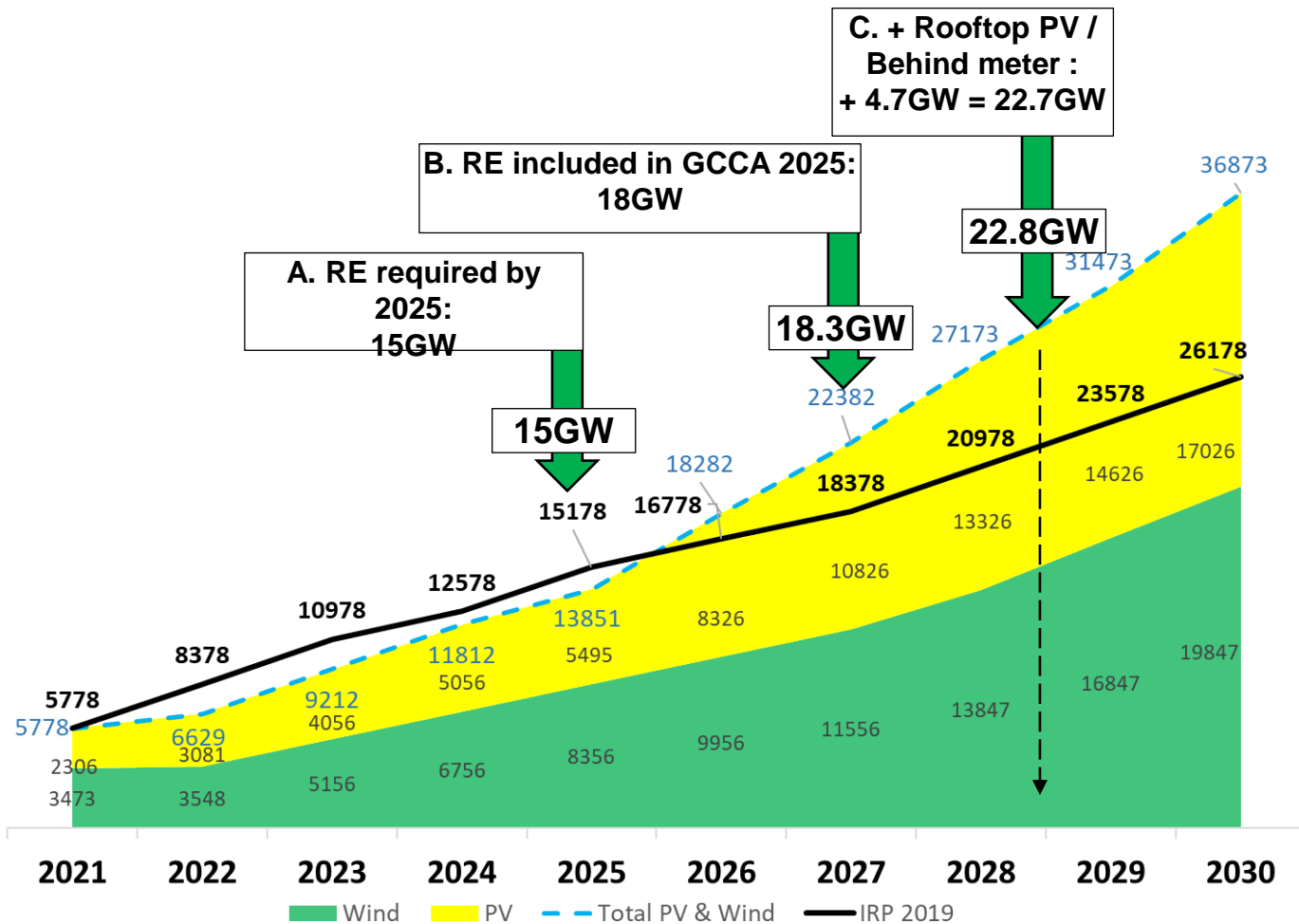
Generation behind the meter (including roof top)

- Behind the meter generation grew **200%** between 2022 July and 2023 July.
- 2022 Load data was used in the GCCA.
- Consideration was given to supply areas near there limits.



Maximum/ Installed behind the meter (MW):	Eastern Cape	Free State	Gauteng	KwaZulu-Natal	Limpopo	Mpumalanga	Northern Cape	North-West	Western Cape	Total
Jul-23	368	280	1,207.8	811	297	451	130	669	527	4740
Jun-23	284	280	1,207.8	566	297	451	130	669	527	4412
May-23	190	205	1,072.1	566	297	451	130	669	458	4037
Apr-23	163	161	918	418	227	327	118	669	369	3368
Mar-23	163	161	918	418	190	318	118	669	290	3243
Feb-23	163	161	918	418	190	306	118	669	198	3139
Jan-23	143	161	918	418	190	299	83	669	198	3077
Dec-22	130	160	848	369	190	299	82	310	198	2586
Nov-22	130	160	848	369	190	299	79	185	162	2422
Oct-22	130	160	848	297	190	299	79	185	150	2338
Sep-22	130	160	848	297	190	299	79	185	146	2334
Aug-22	130	160	848	297	190	299	79	185	146	2334
Jul-22	130	149	791	297	190	299	79	185	146	2265
Apr-22	89	66	468	99	143	261	79	107	146	1459
Mar-22	64	66	270	99	143	129	64	30	118	983

What is the generation gap? (continued)



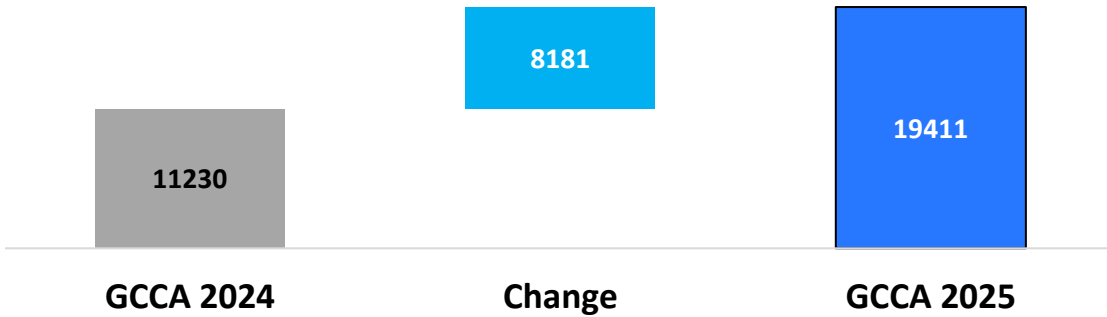
- **Grid congestion is rather a result of greater RE integration, that is faster than what was required by 2025.**

Outcome of GCCA 2025 - Available Capacity

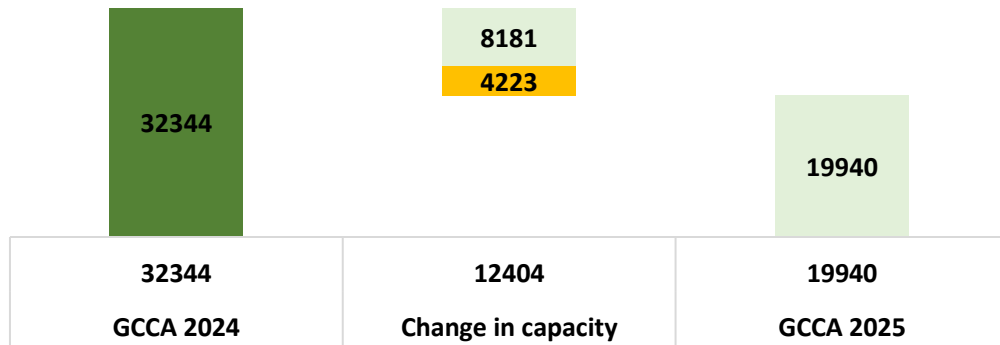
Generation and capacity change between GCCA 2024 and GCC 2025



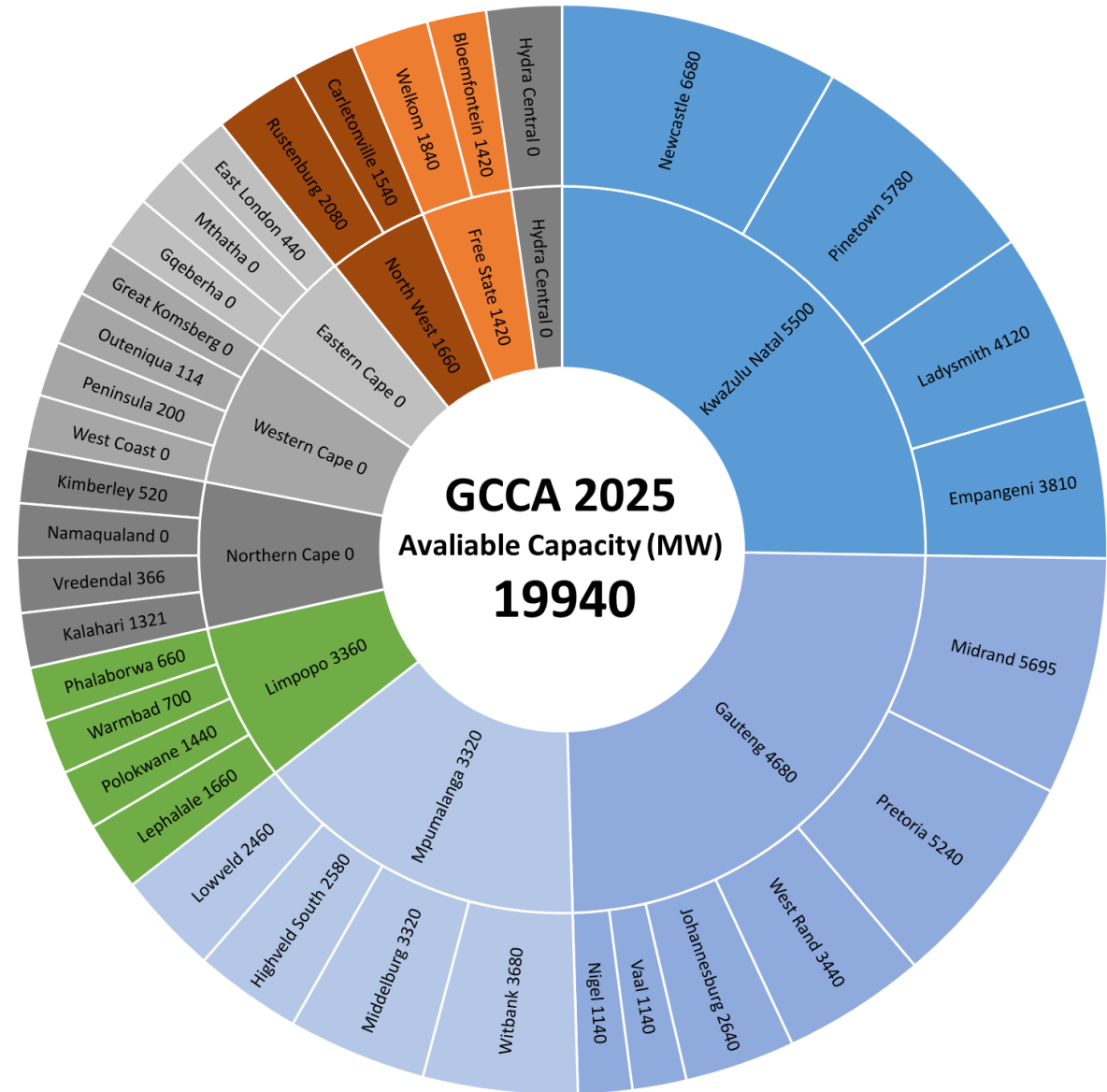
Change in generation MW between GCCA 2024 to GCCA 2025



Change in grid capacity GCCA 2024 to GCCA 2025



■ Generation added ■ Cross flow & capacity changes

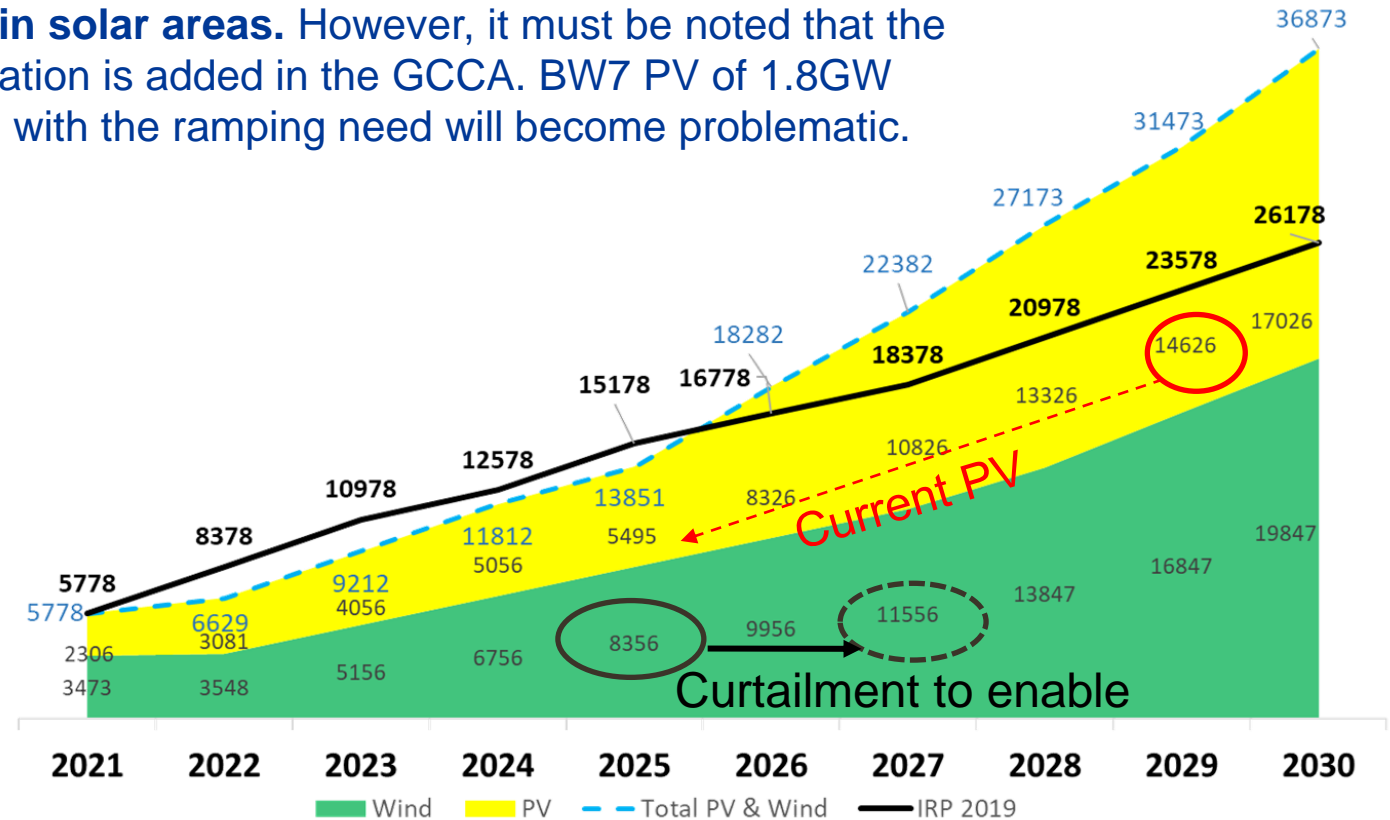
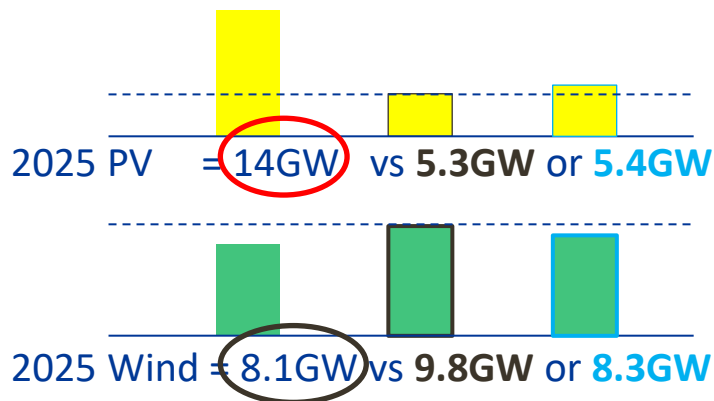


Grid capacity for PV and curtailment to enable Wind

Solar PV – 9.6GW available capacity is dominantly in solar areas. However, it must be noted that the GCCA is already at 2029 PV levels. No flexibility generation is added in the GCCA. BW7 PV of 1.8GW has a market interest >15GW. System flexibility to deal with the ramping need will become problematic.

2025 Committed vs Required

IRP 2019 TDP 2022



Wind – Curtailment is required to enable the required 2027 wind requirements. Governance, system operations readiness and stakeholder engagements are currently underway. Once concluded an addendum with curtailment capacity will be released. The release will be co-ordinated with the gated approach and BW7 wind release in the next 2-3 months.

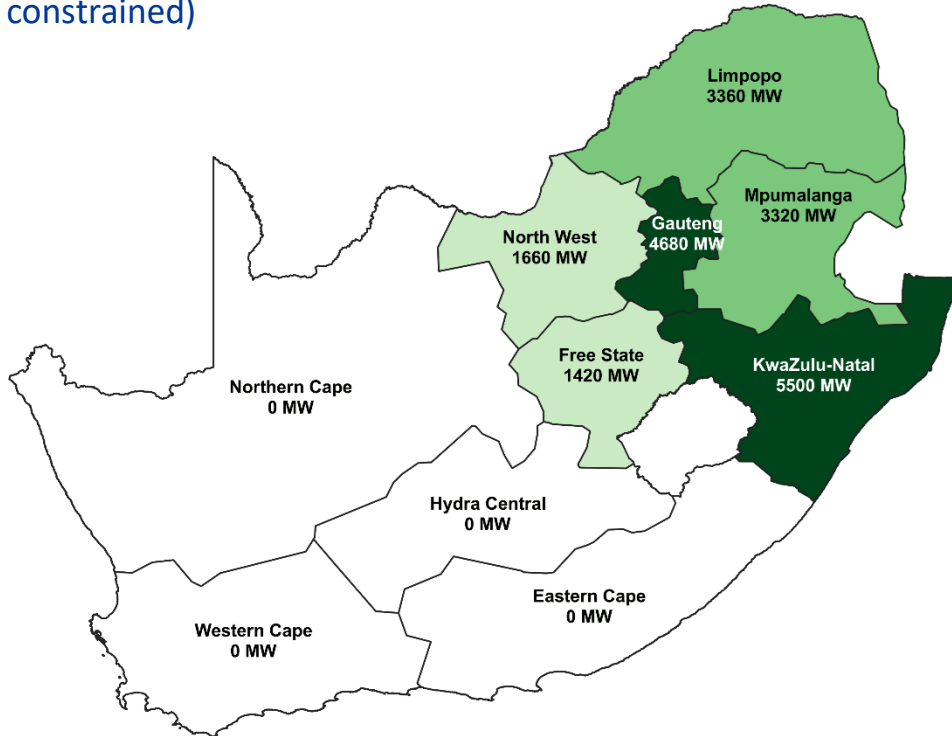
GCCA with curtailment enables generation requirement up to ~2028 requirements. However, remaining grid capacity in the GCCA 2025 will be depleted shortly after 2027. Network strengthening will be the only option beyond this point.

GCCA 2025 Available Capacity

Available and constrained supply areas

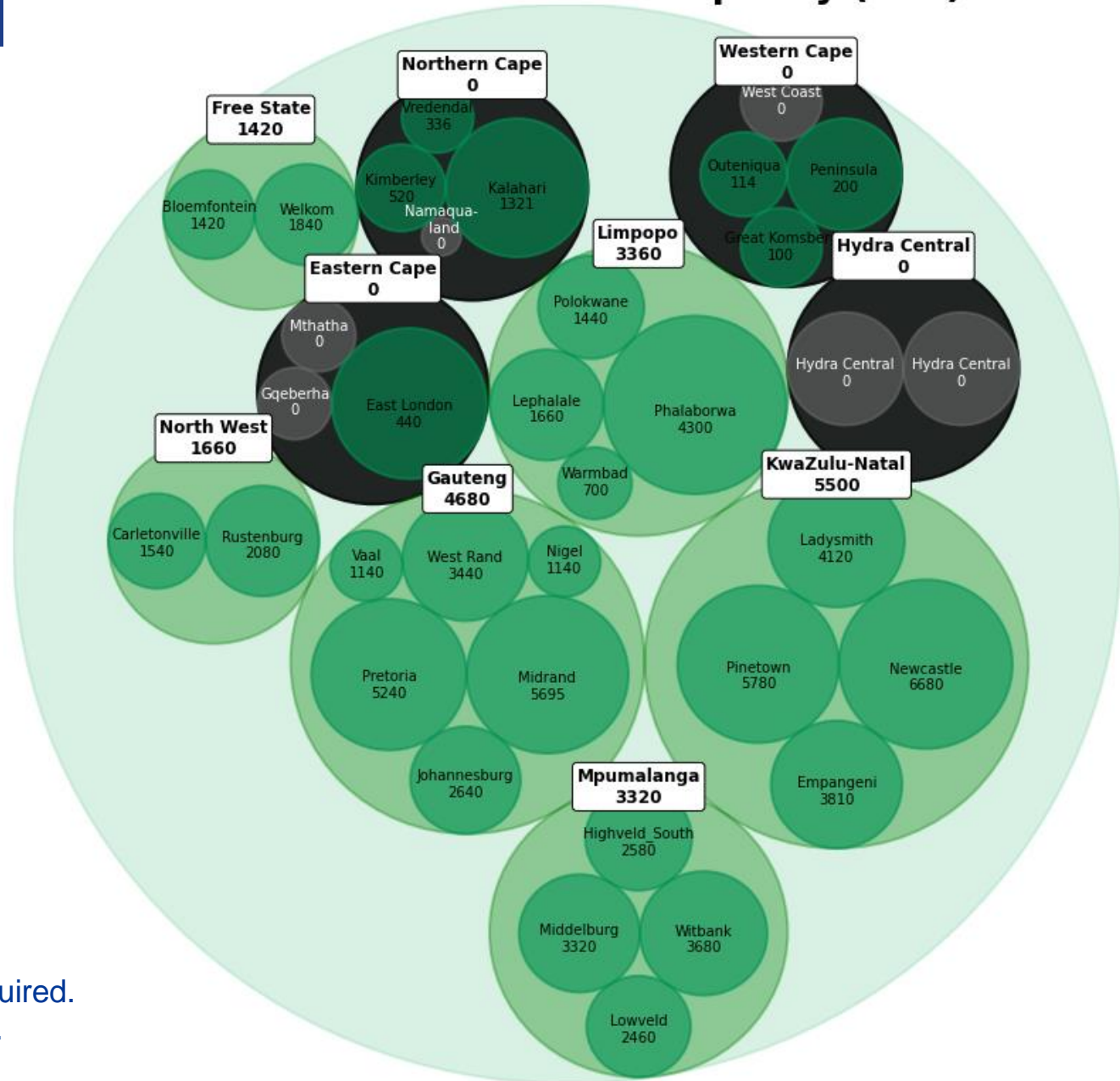
Available Capacity 19940MW (green areas)

- 10 189MW- KZN & Gauteng (not well suited for utility scale RE)
- 9 760MW - Mpumalanga, Limpopo, North-West & Free State (well suited)
- 0MW - Hydra, Western, Eastern & Northern Cape areas (network constrained)



- The gap of 15GW by 2025 is exceeded.
- Grid congestion is a result of greater RE integration than required by 2025 and RE grid integration is ahead of the requirements.
- Grid stability investment will be required.

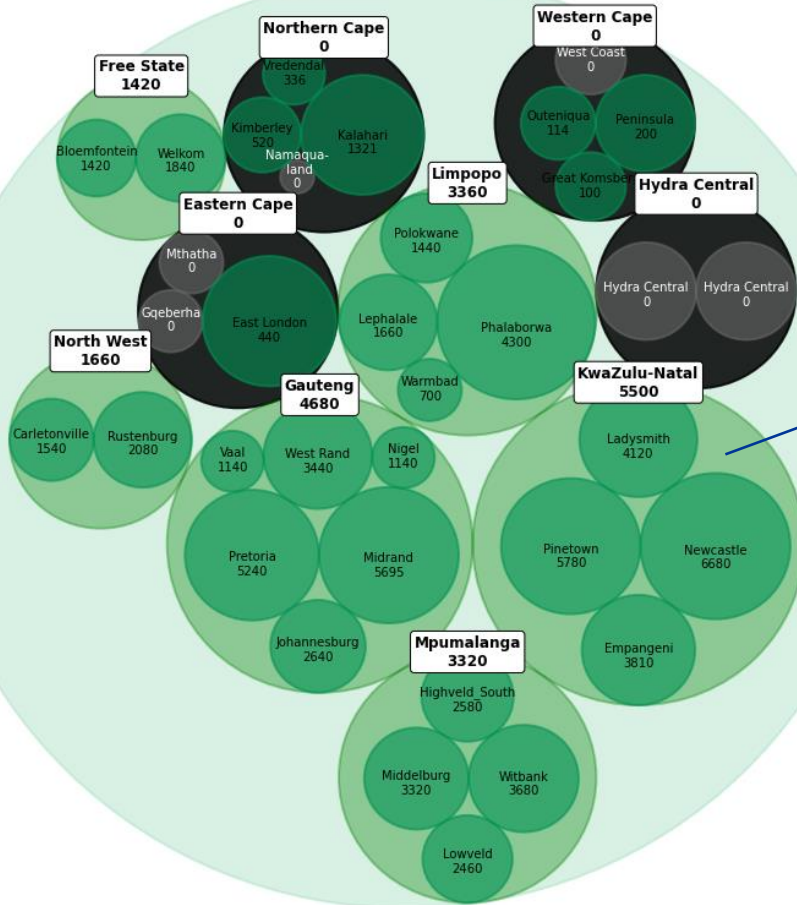
GCCA 2025 Supply Area and Local Area Generation Connection Capacity (MW)



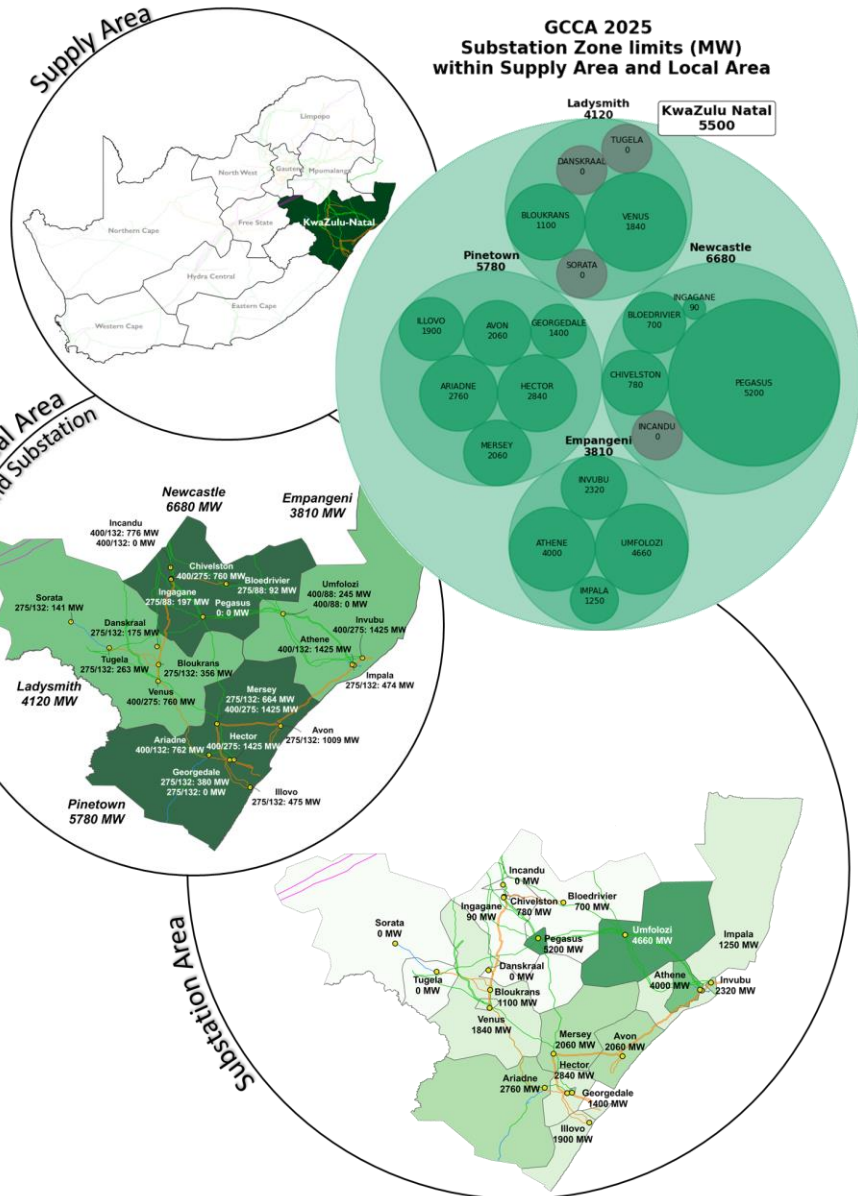
GCCA 2025 Available Capacity

Available and constrained supply areas

GCCA 2025 Supply Area and Local Area Generation Connection Capacity (MW)



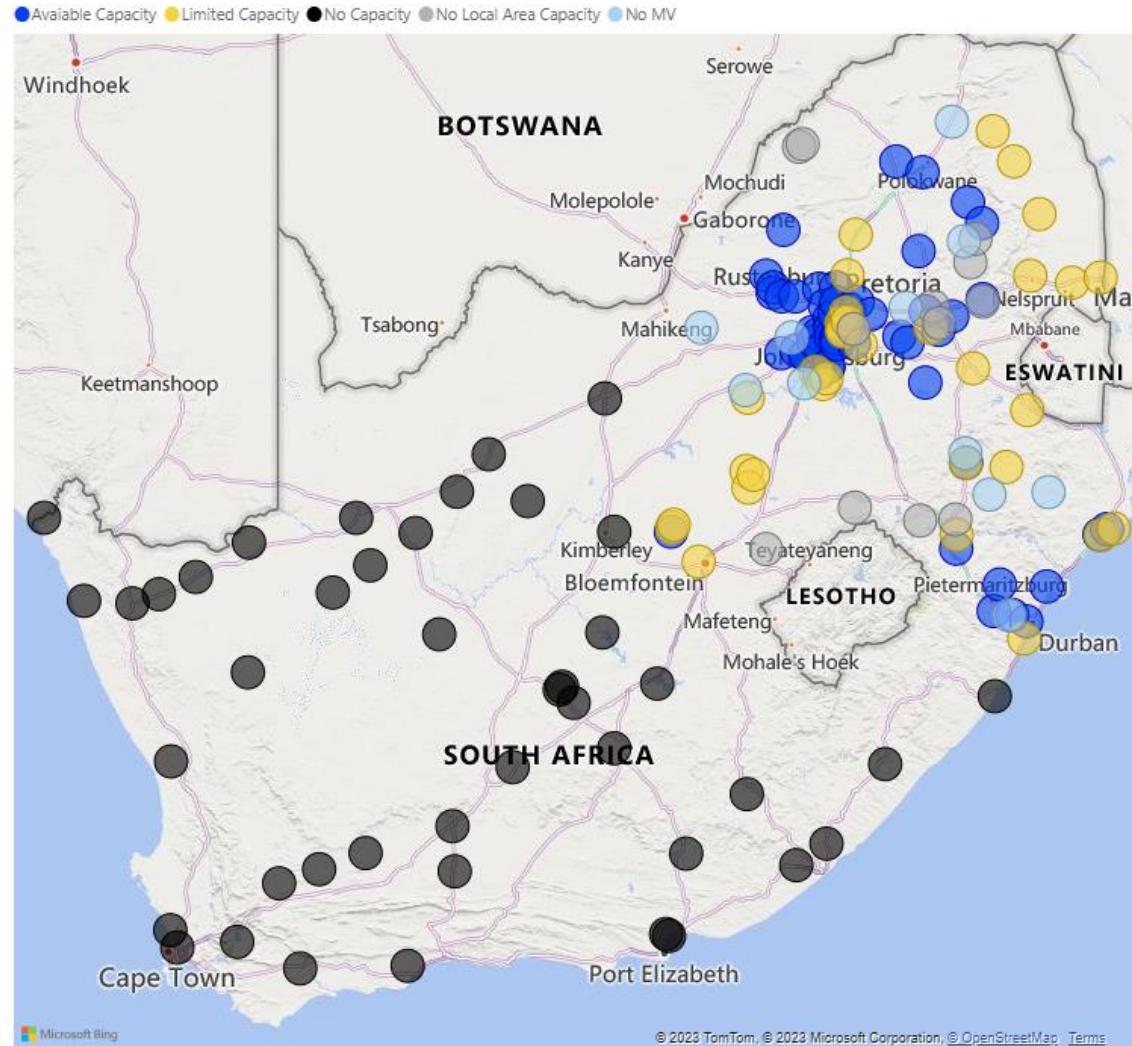
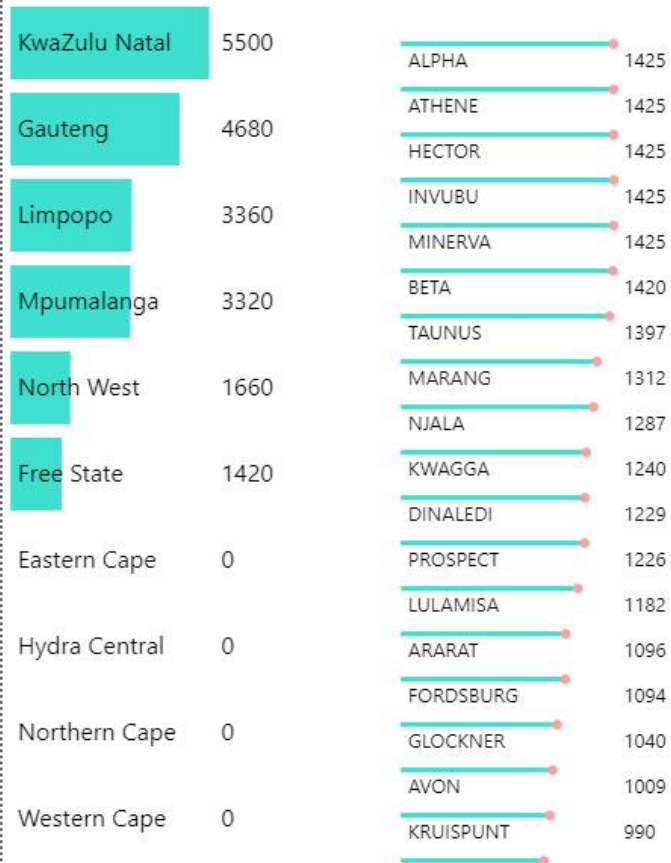
Available grid capacity is provided at Supply Area, Local Area, Substation Area and at Substation levels.



GCCA 2025 Web Tool - Traditional

Connection capacity viewer for supply area, local area, substation area and substation

Generation Connection Capacity Assessment (GCCA) 2025 (MW)



GCCA 2025 Enhanced Web Tool

Connection capacity viewer for supply area, local area, substation area and substation

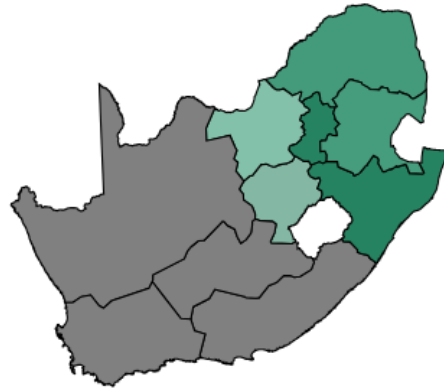
GCCA 2025 (MW)

Connection Capacity

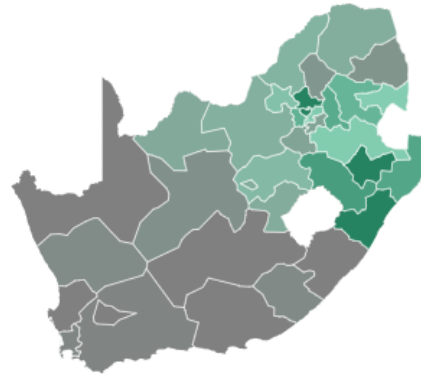
Select

Supply_Area	MW
	0
Eastern Cape	0
Hydra Central	0
Northern Cape	0
Western Cape	0
Free State	1420
North West	1660
Mpumalanga	3320
Limpopo	3360
Gauteng	4680
KwaZulu Natal	5500

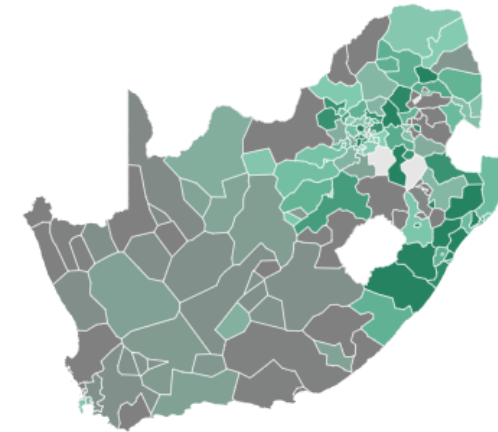
1 - Supply Area



2 - Local Area



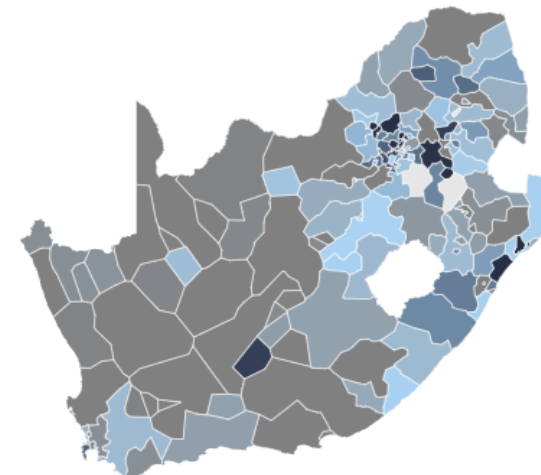
3 - Substation Area



Local_Area	MW
	0
Bloemfontein	1420
Carletonville	1540
East London	0
East London	440
Empangeni	3810
Gqeberha	0
Greater Komsberg	0
Highveld South	2580
Hydra Central	0
Johannesburg	2640
Kalahari	1320
Kimberley	520
Ladysmith	4120
Lephalale	1660
Lowveld	2460
Middelburg	3320

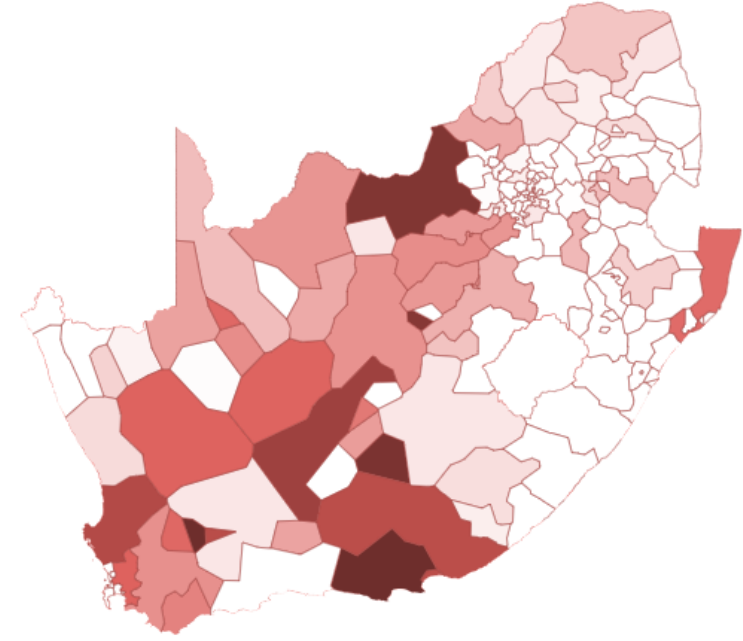
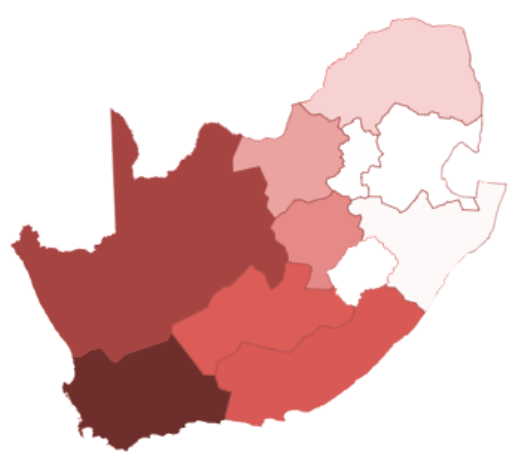
Substation Name	kV/kV	MVA	No. of Trfrs	TOSM Load	Substation	Substation Area	Local Area	Supply Area
				0	0	0	0	0
ACACIA	132/66	120	2	59	173	1094	200	0
ACACIA	400/132	500	3	144	1094	233	200	0
ACORNHOEK	275/132	125	2	170	289	1360	660	3360
AGGENEIS	220/66	40	3	80	116	180	0	0
AGGENEIS	400/220	315	2	120	419	200	0	0
AGULHAS	400/132	500	1	0	95	0	114	0
ALPHA	765/400	2000	3	0	1425	1800	2580	3320
APOLLO	400/275	800	1	-700	60	1940	2640	4680
APOLLO	400/275	1000	2	-700	250	1940	2640	4680
AQUILA	400/132	500	1	0	175	200	0	0
ARARAT	275/88	315	3	497	1096	1300	2080	1660
ARIADNE	400/132	500	2	287	762	2760	5780	5500
ARIES	400/22	45	1	0	33	180	0	0
ARNOT	400/275	400	2	0	760	1920	3320	3320
ARNOT	400/275	800	1	0	760	1920	3320	3320

4 - Substation (Transformer)

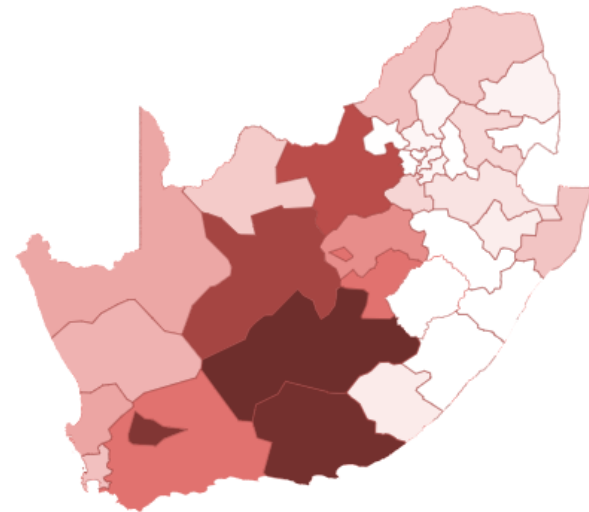


Generation Connection Capacity Assessment (GCCA) 2025 - Generation Committed (MW)

Supply_Area	MW
Eastern Cape	2590
Free State	1941
Gauteng	530
Hydra Central	2509
KwaZulu Natal	590
Limpopo	1048
Mpumalanga	517
North West	1640
Northern Cape	3527
Western Cape	4520
Total	19412



Local_Area	MW
Bloemfontein	1074
Carletonville	1633
East London	153
Empangeni	450
Gqeberha	2437
Greater Komsberg	2280
Highveld South	215
Hydra Central	2509
Johannesburg	60
Kalahari	399
Kimberley	1872
Ladysmith	0
Lephalale	470
Lowveld	0
Middelburg	298
Midrand	0
Total	19412



Substation Name	Wind	PV	CSP	Gx total
ACACIA	0	0	0	0
ACORNHOEK	0	0	0	0
AGGENEIS	0	40	0	40
AGULHAS	380	0	0	380
ALPHA	0	0	0	0
APOLLO	0	0	0	0
AQUILA	0	300	0	300
ARARAT	0	0	0	0
ARIADNE	0	0	0	0
Total	8023	9371	600	19412

- **The grid is constrained largely due to increased renewable penetration ahead of planned renewable energy supply requirements.**
- **There is scope for additional capacity in selected areas with deployment of appropriate technology choices.**

Available Capacity 19 940MW (green areas)

- 10 189MW- KZN & Gauteng (not well suited for utility scale RE)
- 9 760MW - Mpumalanga, Limpopo, North-West & Free State (well suited)
- 0MW - Hydra, Western, Eastern & Northern Cape areas (network constrained)

Opportunity Capacity (wind)

- ~4000MW – Curtailment opportunity if approved in the Western & Eastern Cape.

Challenges requiring attention

- Grid flexibility and stability investments are required (such as BESS, gas gen, synchronous condensers etc.)
- Market signal are essential to guide appropriate investment.

Approval to release the GCCA 2025 and publish the data sets on the Eskom website was received from the Transmission Executive Committee (Texco) on 20 September 2023.

Texco supported that we share the results with key role players:

- Transmission Board
- Distribution Executive Committee
- Regulatory, Policy, and Economic (RPE) Committee
- IPP Office
- Industry

- The publication of the Generation Connection Capacity Assessment of the 2025 transmission network (GCCA-2025) is to inform stakeholders of the potential capacity available on the Eskom transmission network to facilitate connection of generation projects.
- The Generation Connection Capacity Assessment is based on the information currently available and is subject to change. The information contained in this document does not constitute advice; it is a guideline to assist stakeholders.
- Eskom Holdings SOC Limited makes no representations regarding the suitability of the information to be used for any other purpose.
- All information is provided “AS IS” without warranty of any kind and is subject to change without notice. The entire risk arising out of its use remains with the recipient. In no event shall Eskom Holdings SOC Limited be liable for any direct, consequential, incidental, special, punitive, or any other damages whatsoever.
- While the GCCA-2025 will be updated periodically, Eskom Holdings SOC Limited makes no representation or warranty as to the accuracy, reliability, validity, or completeness of the information in this document. Eskom does, however, endeavour to release the GCCA based on the best available information at its disposal at all times to ensure that the stakeholders are kept informed about the developments in the transmission network. Thus, the information contained in this document represents the most up-to-date information that was available at the time it was released.



Thank you

Curtailment Implementation

Comfort Masike

Senior Manager: Technical Operations

15 November 2023



- Bid window 6 was not successful due to network capacity constraints in the Western Cape, Northern Cape and Eastern Cape.
- Curtailment will allow for more renewable energy resources to be connected without violating network requirements.
- Curtailment is currently utilised to manage system frequency. It can also be used to manage grid capacity requirements.
- Eskom had signed an MoU with Elia Grid International (EGI) from Germany to unpack this. EGI compiled a position paper strongly supporting the framework.
- Given the tight system capacity constraints, the implementation of the framework is urgent, to release capacity.

Section 7.8 of the Network Code of the SAGC on Mitigation of network constraints states:

*Obligates **the NTC to resolve network constraints** (“congestion”) and requires regularly review by the NTC. **Economically optimal** plans shall be put in place around each constraint.*

The **least-cost criterion** shall be satisfied.

This requires that if improvements to the **customer is less than the cost** to the service provider, then the service provider should **not invest in the proposed project(s)**. The investment decision shall then be delayed such that optimised economic benefit can be derived.

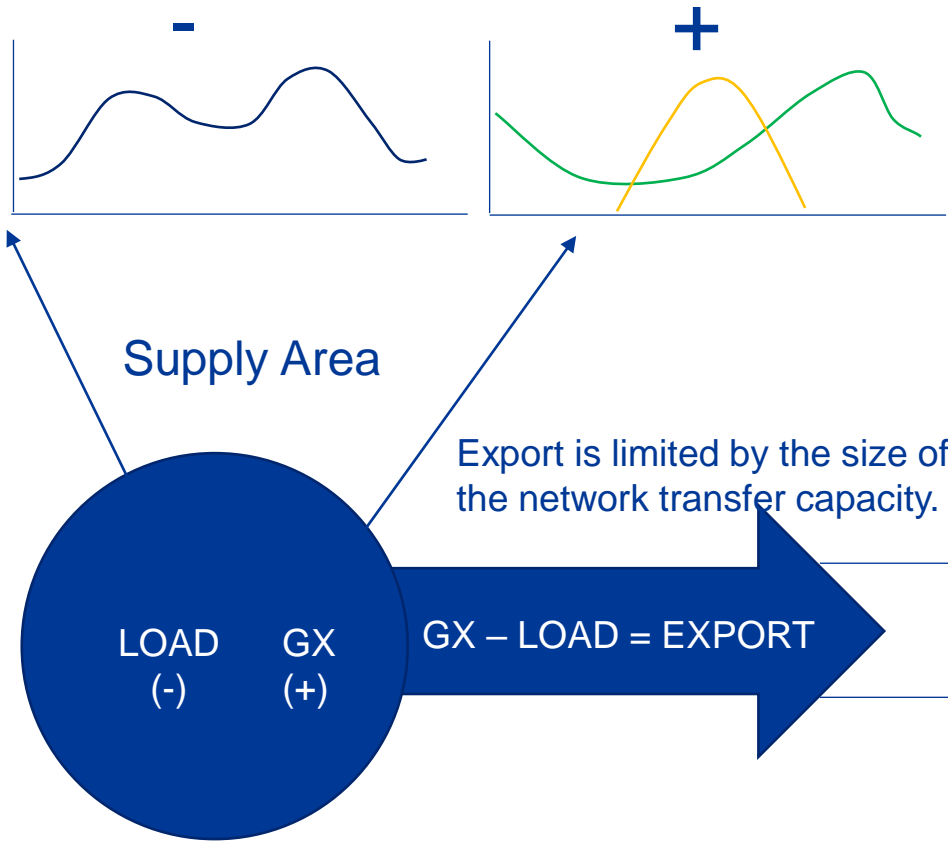
Appendix 1 of the Tariff Code of the SAGC on Details of the NTC tariff structure:

NTC charges are designed to recover 50% of the NTC income per component from generators and the balance from load customers.

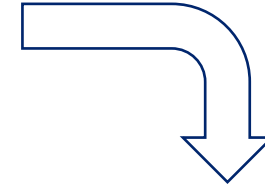
Key takeaways

- Cost always gets recovered from the customer
- Economic optimisation is required (**least-cost criterion**)
- Constrained generation (Curtailment) if costs are lower than grid investment costs then the NTCSA should not invest

There is a need to increase generation connection capacity with curtailment lever



The instantaneous load and generation is the export or import from the supply area. For the export case eg more generation in the supply area than load.



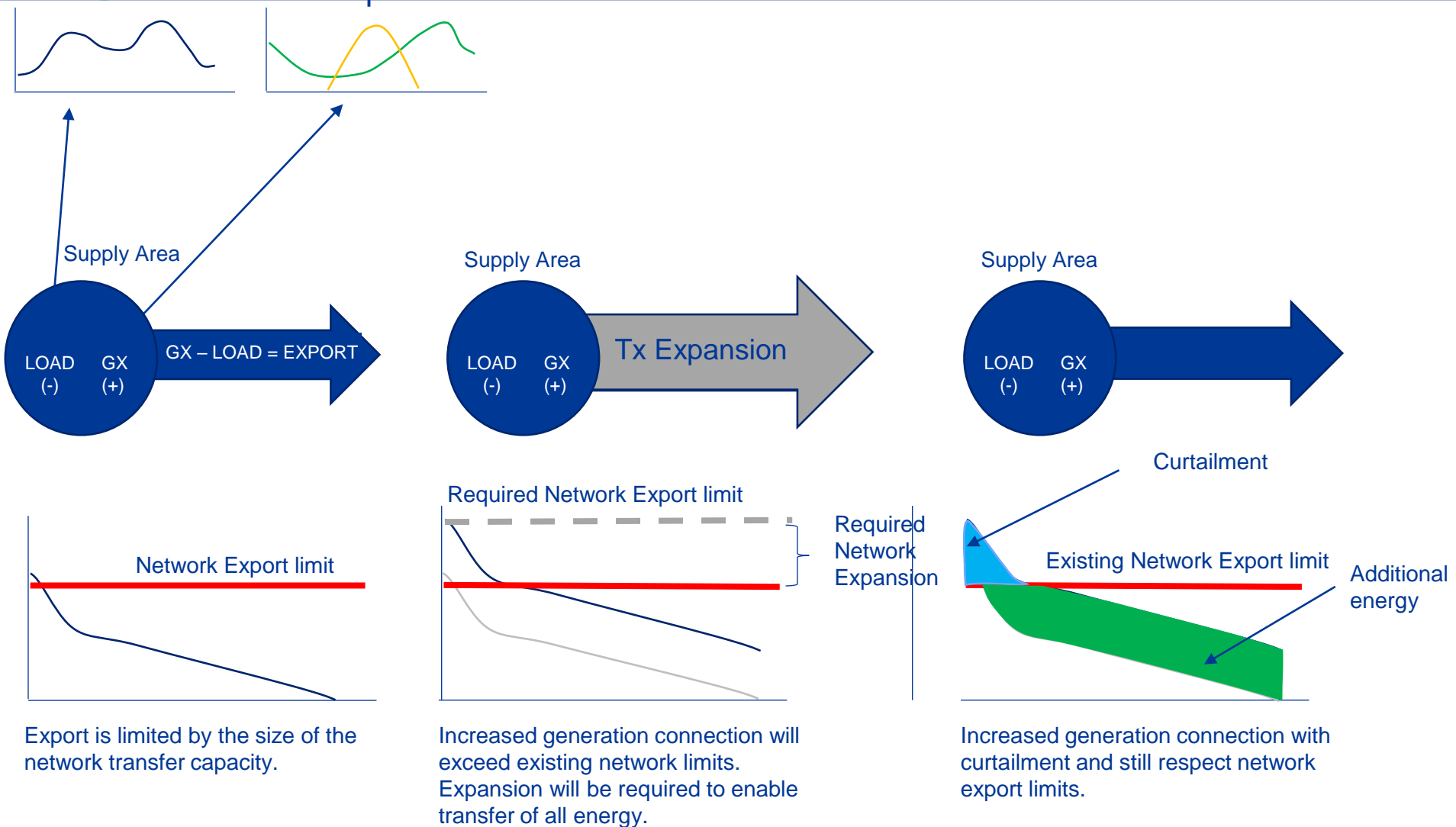
The network transfers this power to other supply areas within the transfer capacity of the network.

Transfer: Network Export limit

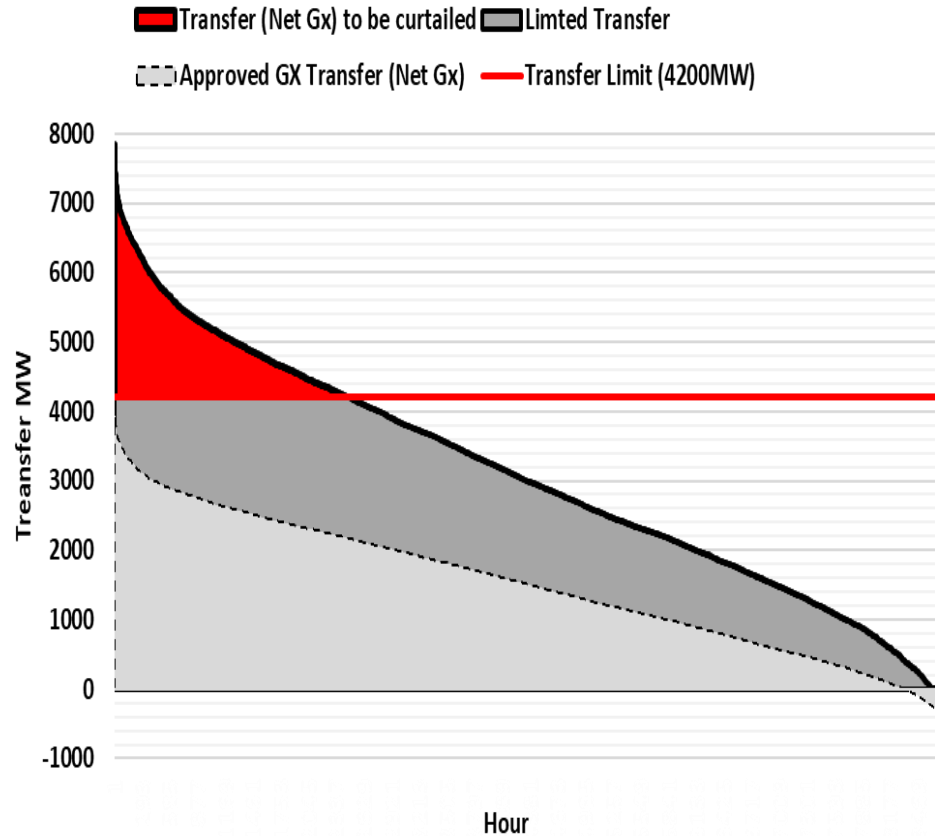
This can be seen as the size of a pipe and transfer cannot exceed the pipe capacity.



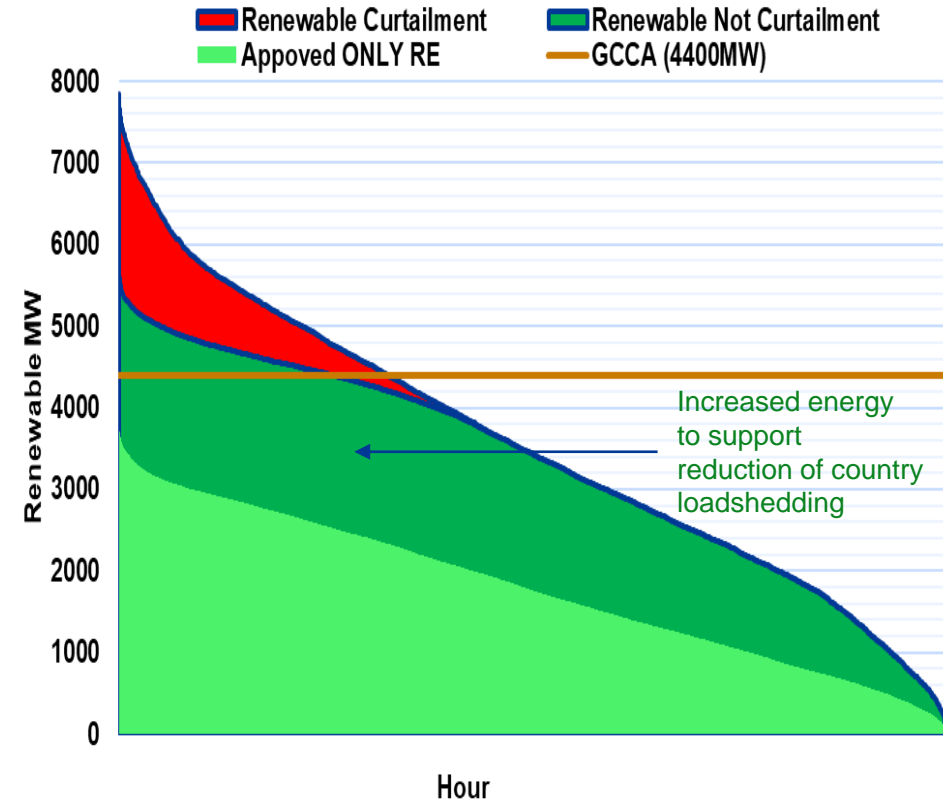
Curtailment is enabling increased generation connection capacity



Transfer Capacity and Curtailment

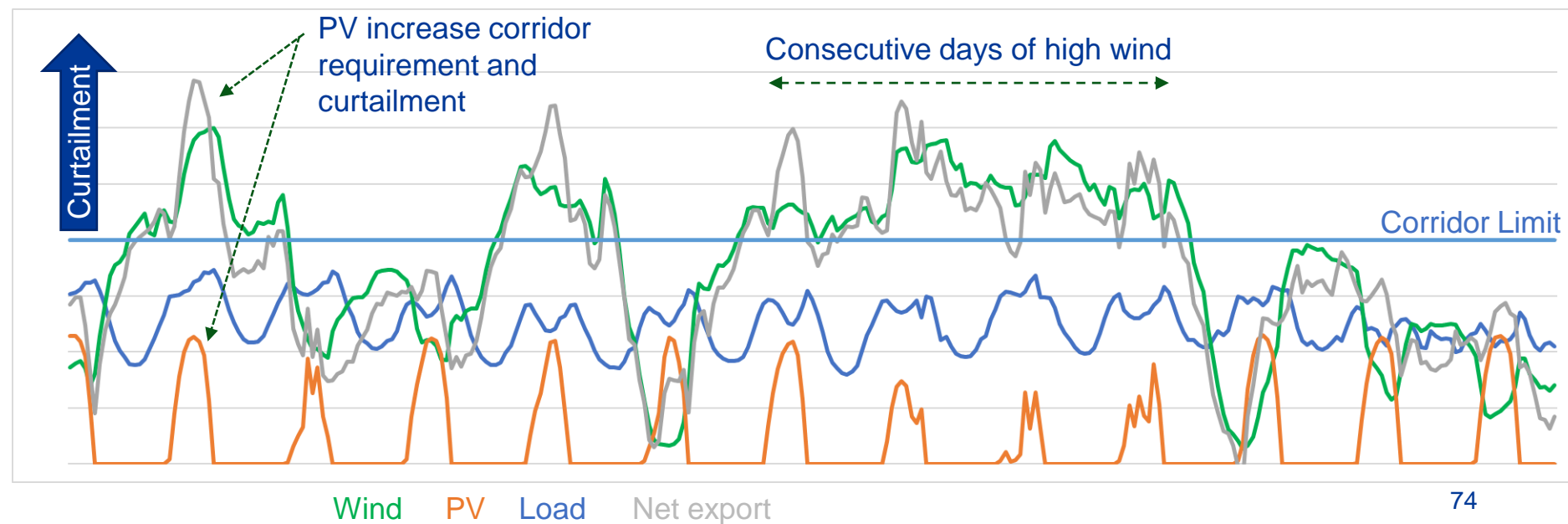


Renewable Capacity and Curtailment Required for Transfer Limit Capacity Management



- Curtailment with wind increases grid utilisation with low curtailment values
- Curtailment is significantly less valuable for solar PV and increases the amount of curtailment required
- Batteries add limited value in high wind area with curtailment (high battery capacity (MW) and long duration (MWh))
- Batteries are more favourable for solar PV

Wind – Curtailment is required to enable 2027 wind requirements.



- Study was done on PLEXOS
- The year 2025 was studied.
- 8,4GW of renewables modelled in the Cape network, made up of 7 054MW wind and 1 340MW solar PV.
- Koeberg runs at maximum output throughout the year.
- Curtailment effected when transfer limit of 4GW is exceeded.
- 650GWh of energy was curtailed (2,14%).
- At R1000/MWh cost estimated at R650 million.

- It is envisaged that the framework will enable ~4GW of additional renewables to be connected in the Cape network. The network requirement for this would be two 765kV lines and one 400kV line, at an estimated cost of R32 billion. If we assume a return period of 25 years and post tax real discount rate of 6.4%, the Annual Project Cost (APC) is R2.6 billion.
- Studies done over a period of year (2025) with 8,4GW of renewables in the Western Cape showed curtailed energy of 650GWh, at a cost of R650 million, which is significantly lower than APC.

- The planning criteria to determine how much renewables can be connected is that overall curtailment levels should not exceed 10%.
- All IPPs can be curtailed.
- An operational guideline will be in place to ensure that curtailment is done only when necessary.
- Curtailment will be done in such a way that the congestion is alleviated with minimal impact.
- A curtailment procedure will ensure fairness among the pool that can be curtailed to impact the constraint.
- A single plant should not be curtailed more than 10% of total energy output per year.

- As Network Service Providers (NSPs) Transmission and Distribution will not compensate for congestion curtailment. Compensation is a contractual matter between buyer and seller.
- Where Eskom is the designated buyer, it is envisaged that deemed energy will be payable under PPAs to optimise total energy costs.
- In existing PPAs congestion curtailment shall first be accounted against allowable grid unavailability period (AGUP) or allowable grid unavailability and curtailment (AGUC) provisions before deemed energy is paid.

- Supported at Transmission Executive Committee - **17 May 2023**
- Supported at Natjoint workstream 3 (Additional Capacity) - **6 June 2023**
- Supported at Natjoint workstream 10 (Transmission) - **13 June 2023**
- Shared with Eskom Transmission Board for noting - **4 July 2023**
- Supported at the Government Framework Support Agreement (GFSA) meeting - **25 July 2023**
- Approved at Regulatory, Policy and Economic (RPE) Committee of Eskom - **7 August 2023**
- Shared at workshop with IPP Office - **17 August 2023**
- Shared with NERSA on **8 and 18 September 2023**

- NERSA's endorsement of the framework.
- Finalisation of studies on capacities to be released.
- Curtailment capacity addendum to GCCA.
- Deep dive sessions with System Operators on SO processes.
- Procurement of an automatic curtailment system and other System Operator tools.
- Finalisation of related procedures and processes.
- Continuous engagements with the industry.



Thank you

Changes in Grid Connection Application Process

Makoanyane Theku

Senior Manager: Customers and Grid Connection

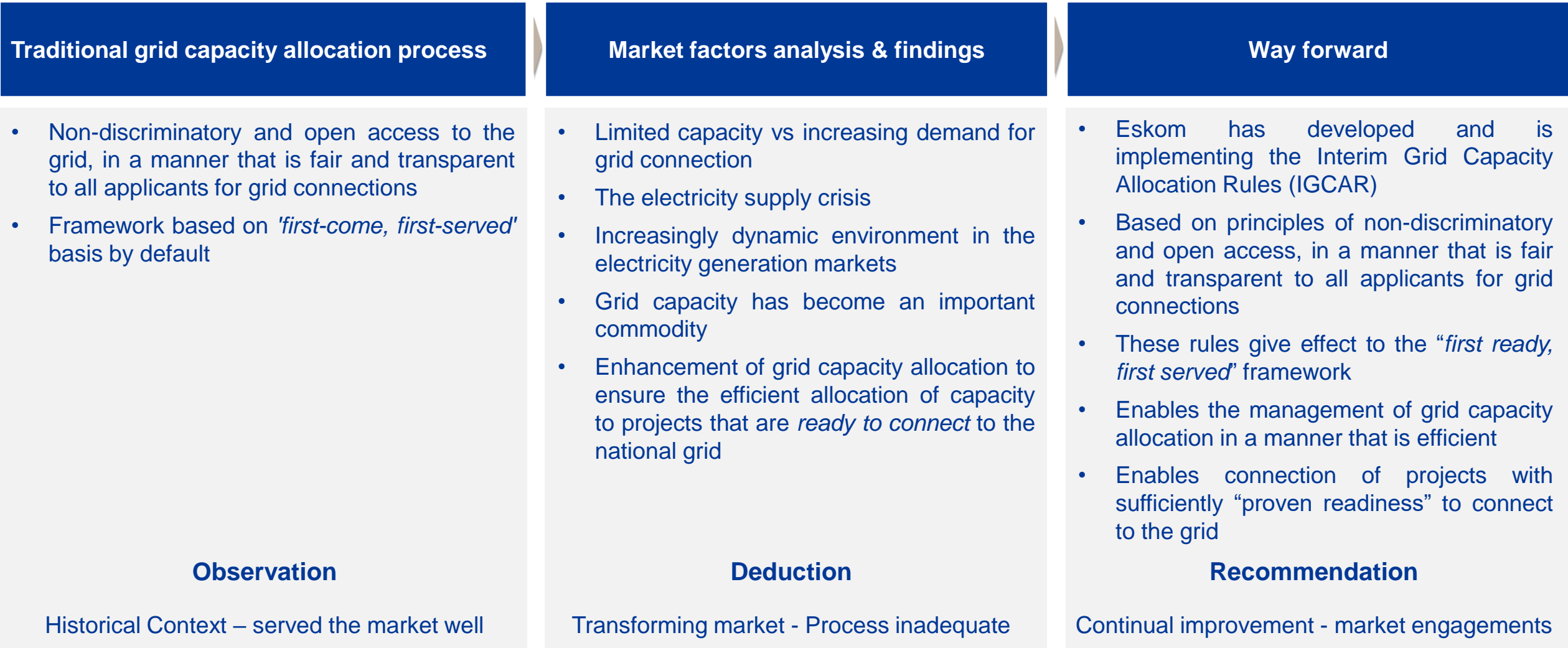
15 November 2023



- IPP connection enablement achievements to-date:
- Grid Connections to-date:
 - REIPP1, REIPP2, REIPP3, REIPP3.5, REIPP4, REIPP4B, REIPP5, REIPP6
 - RMIPP
 - Energy Storage
 - Private Offtaker projects
- Emerging / Current Challenges
 - Limited grid connection capacity
 - Increasing demand for grid connection capacity
 - The electricity supply crisis
 - Outdated processes amid the transforming electricity supply market
- Eskom grid capacity unlocking initiatives covered in the presentation:
 - Interim Grid Capacity Allocation Rules (IGCAR) for capacity allocation based on proven readiness
 - Gated Generation Connection Process (GGCP) for congestion management based on credible information



Interim Grid Capacity Allocation Rules (GCAR) Update

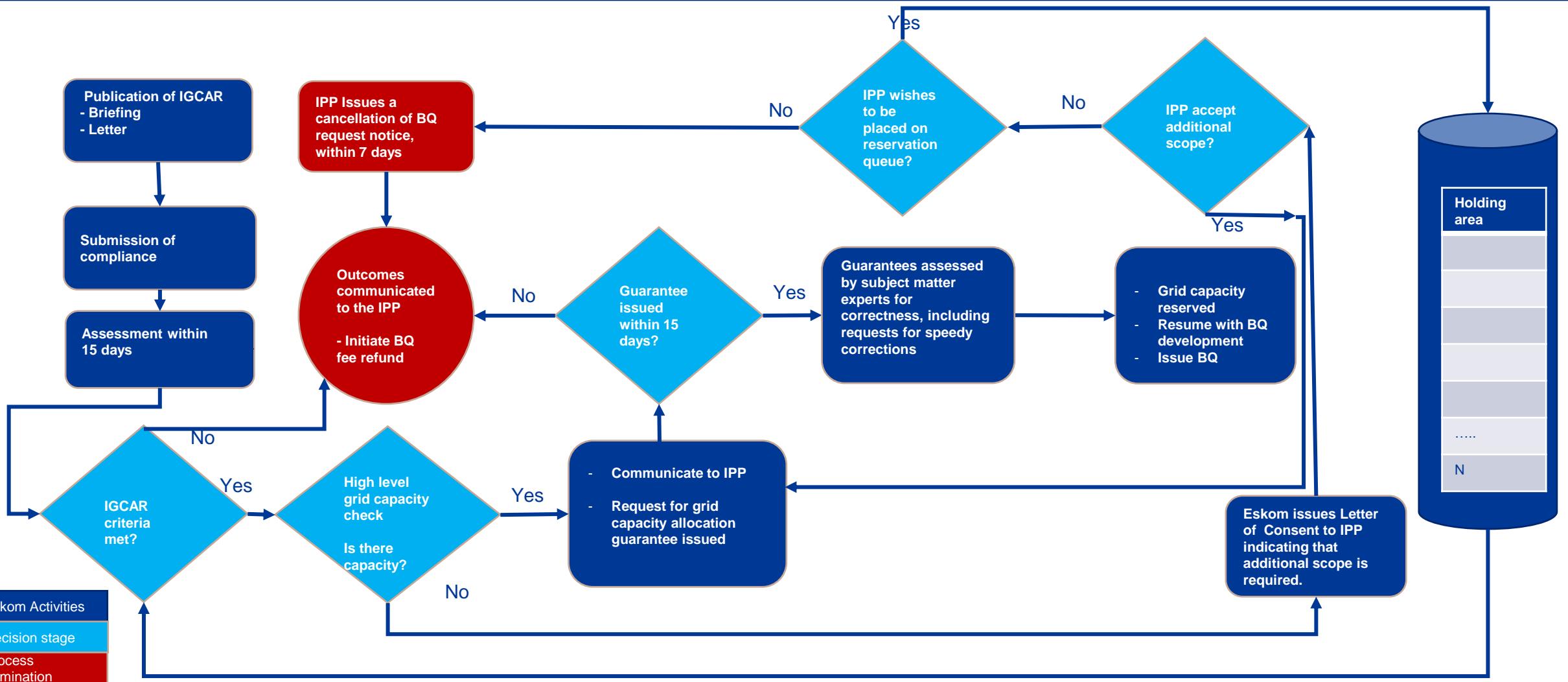


Process adopted for Grid Capacity allocation process reform



Items	Description	State of readiness criteria
Need Assessment	<ul style="list-style-type: none"> Needs assessment conducted by Eskom to manage scarce grid connection capacity in a way that avoids the probability “hogging” of connection capacity and ensures that only “shovel-ready” projects are allocated capacity 	<ul style="list-style-type: none"> Environmental consents – Authorisations (EAs) and Water Use Licences (WUL) in respect of the generation facility
Stakeholder engagement	<ul style="list-style-type: none"> Industry stakeholder engagement on the GCAR - February and March 2023 A successful IPP Conference was held on 28 February 2023 and was attended by over 400 participants These engagements and inputs received from the industry culminated in the development of the GCAR 	<ul style="list-style-type: none"> Approval by SA Civil Aviation Authority in terms of regulations or EIA report indicating no impact on aviation
Implementation	<ul style="list-style-type: none"> GCAR (in the form of Grid Code amendment proposal) were submitted to GCAC for 9 March 2023 GCAC recommended that the codification proposal should be taken directly to NERSA In June 2023 – IGCAR was approved by Eskom for implementation On 31 Aug 2023 – The IGCAR results for the greater Cape were announced Implementation nationwide is in progress 	<ul style="list-style-type: none"> Power Purchase Agreement (PPA) Heads of Terms duly signed with the end-user of the power or a licensed energy trader and confirmation from the off-taker Confirmation of appointment of design consultants accepted by Eskom – For SB
Way forward	<ul style="list-style-type: none"> Eskom continuing to work with industry stakeholders through NECOM to clarify the rules Further, Eskom working with industry stakeholders to facilitate codification of the Rules 	<ul style="list-style-type: none"> Measured data for the primary energy resources, as applicable (1 year for Solar and 2 year for Wind, of which 1 year must be on site data) A Grid Capacity Allocation Guarantee issued by a financial institution approved by Eskom immediately following confirmation that the project meets all other criteria. (R200k/MW)

IGCAR BQ Assessment Process





Gated Generator Connection Process (GGCP) Update

- The grid connections were facilitated through pre-existing grid capacity and investments based on credible information.
- The grid connection capacity is now exhausted in many supply areas with best RE resources.
- We recognise that the need for timeous grid connection capacity is growing; hence we're investigating broad initiatives aimed at unlocking the grid connection capacity, as well as improving the efficiency of the current process.
- Our goal is to ensure the effective and efficient connection of all IPPs, as well as improving the level of certainty for IPP / generators and offtakers towards delivering successful procurement programmes.
- In congruence with this goal, we analysed the generator connection process and identified some deficiencies.
- We therefore launched the process to reform the grid connection process for generators.
 - Call for written comments - Consultation paper: 14 August 2023
 - Virtual Stakeholder Engagement / Market Consultation: 31 August 2023
- All responses to the proposed process reform have been reviewed, and we have incorporated industry stakeholder inputs to the refined proposal named Gated Generator Connection Process (GGCP) for implementation.

- Process review drivers - The current Eskom connection process is no longer effective for generator customer connections due to the following:

Process deficiencies for generation connections in the current environment

- Gradually diminishing connection capacity following the allocation of significant grid connection capacity nationally, no merit assessment from security of supply improvement perspective.
 - Increasing volumes and larger connection projects sizes
 - Credibility of connection applications essential for planning and optimal utilization of limited capacity

- The process was designed for load connections and centralised conventional power stations.
 - No effective reliability connection assessment (adequacy & stability) due to ad hoc nature of connection requests
 - No credible generation forecast information for orderly investments in upstream and shared infrastructure

- CELs issued on one-on-one basis.
 - Scope, timelines and costs uncertainty challenge
 - Big upstream and shared infrastructure upgrades quoted to individual projects – Projects can't absorb the large costs
 - Project dependency problem worsening

- Uncoordinated competition between procurement programmes and between IPPs due to market reforms and transforming generation landscape.
 - Procurement uncertainty and effectiveness – coordination required to objectively demonstrate that security of supply can be attained and sustained

1. Aggregated Connection Assessment

- Moving from a one-on-one assessment of the connection requests to a clustered assessment process, where the studies (aggregated grid adequacy and stability assessment) and cost allocation will be conducted in a batch is proposed.

2. Objective Evidence Assessment

- Mandating objective evidence for projects and procurement programme credibility test as a measure to prioritise shovel-ready generation projects and hold all the IPPs and procurers to the same standard.
- Objective evidence to be used as basis for aggregated congestion management, as well as project development and investment.

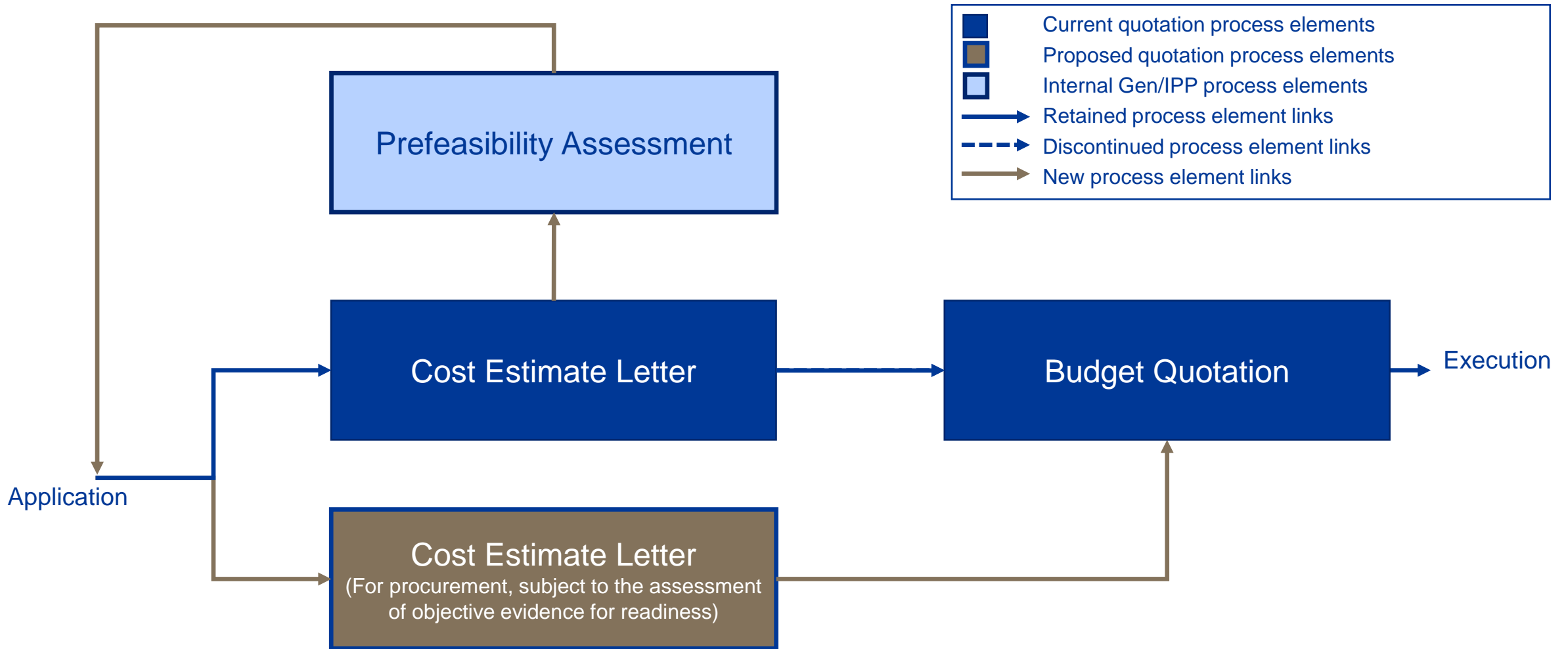
3. CEL-Pro

- Introduction of procurement-compliant cost estimate letters based on the objective evidence assessment against the readiness criteria for procurers and generators.
- CEL for ad hoc generation connection requests (with no objective readiness assessment) will be issued for the generator/IPP developer pre-feasibility assessment.

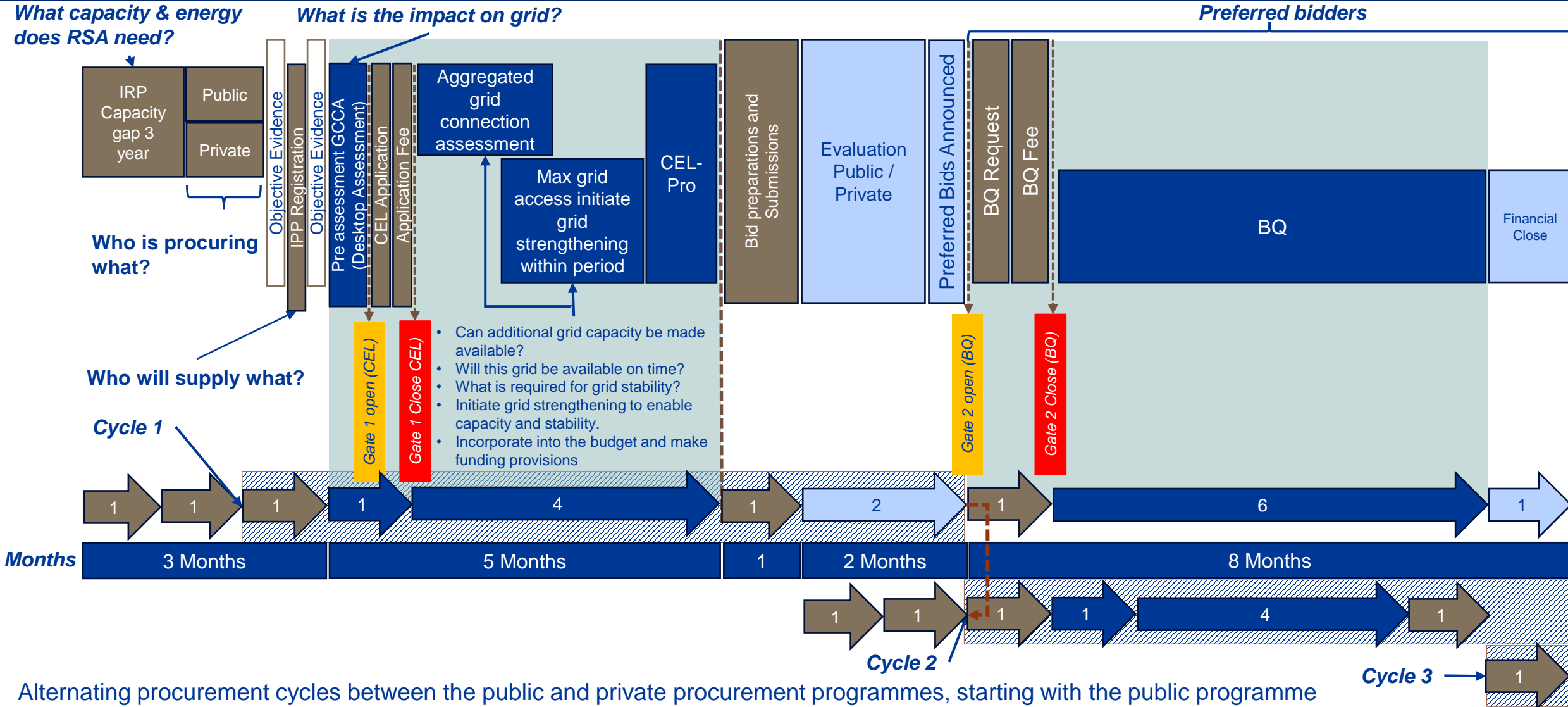
4 Procurement Cycles

- To facilitate orderly processing of connections based on the time-restrictive element of the proposal, the rolling cycles of procurement programmes will be established for all future procurement programmes, alternating between the public and private off-taker procurement programme(s).
- CELs developed shall be specific to Public or Private programmes within a specific cycle.

High level framework for a reformed generator connection process



Implementation plan for a reformed generator connection process



Alternating procurement cycles between the public and private procurement programmes, starting with the public programme

Off-takers/Procurers

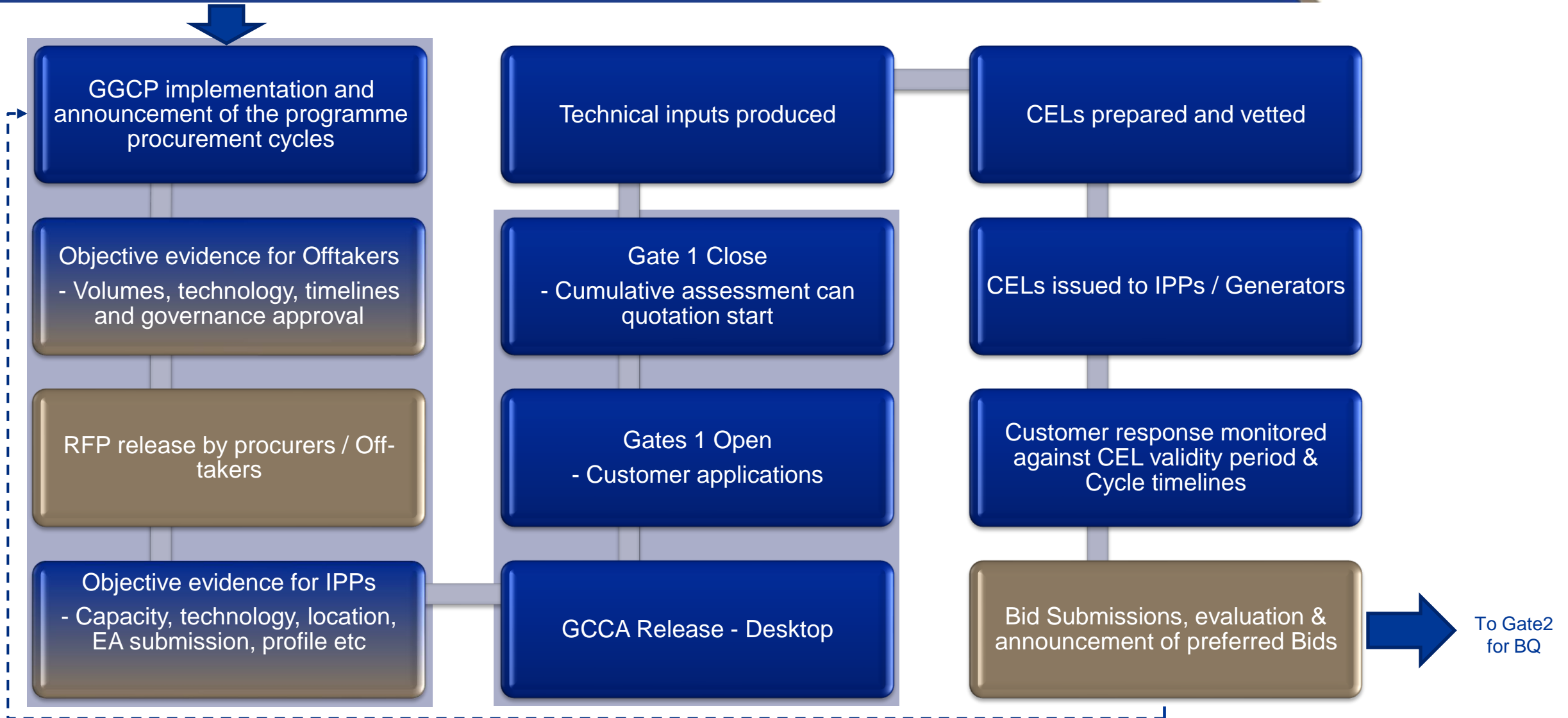
1. Draft procurement programme Request for Proposals (RFP) showing the total energy requirements for the procurement programme, as well as the procurement programme timelines.
2. The list of prospective IPP developers registered for participation in the programme, as well as the load profile (where new load is planned).
3. Additional evidence for private off-takers/procurers programme(s)
 - i. Off-takers' investment governance approval for the procurement programme
 - ii. Off-takers' Board approval for the procurement programme
4. Additional evidence for public off-takers/procurers programme(s)
 - i. The procurement letter from the IPP Office following ministerial determinations

Generators/IPP developers

1. Proof of application for environmental authorisation
2. Measured data for the primary energy resource for a period of one year
3. Proof of land acquisition or land use agreement with the landowner

- Industry stakeholder engagement feedback summary
- Strong opposition to procurement programme specific CEL
 - Process reviewed for alignment – Programme agnostic CEL-pro to be issued for within the private procurement cycle
 - Registration is still a prerequisite
 - Procurers to iterate to final preferred bidders within the required cycle timeframe
- NSP role – ERA/License/SAGC
 - GGCP proposed for enabling an orderly fulfillment of NSP mandate – Grid Connections
- Discrimination concerns
 - No discrimination – IPP/Generators and Offtakers
- Costs of CELs
 - Same application fee – No increase is recommended. *(Note: we're reviewing the process revision for mega connection projects)*

Way forward & High-level Cost Estimate Letters (CEL-pro) process



- **IGCAR**

- Developers have 15 days to issue a guarantee following notification of the guarantee
- Projects meeting IGCAR, but not allocated grid capacity due to unavailability to communicate with senior advisors (GAU) on whether they wish to be refunded or quoted strengthening works
- Scope for CELs that were at the verge of being issued will be revised
- IGCAR assessments for projects outside the Cape have resumed
- Codification of the rules will also resume in conjunction with NECOM
- Rules are not perfect, and we continue to seek industry wisdom in developing a solution that works for the industry

- **GGCP**

- Approved by Eskom for implementation in October 2023
- Development of policies and procedures is in progress
- Implementation date – expected early December 2023, after publication
- Codification of the GGCP being explored, and will be facilitated in consultation with industry and in conjunction with NECOM
- GGCP is not perfect, and we continue to seek industry wisdom in developing a solution that works for the industry



Thank you