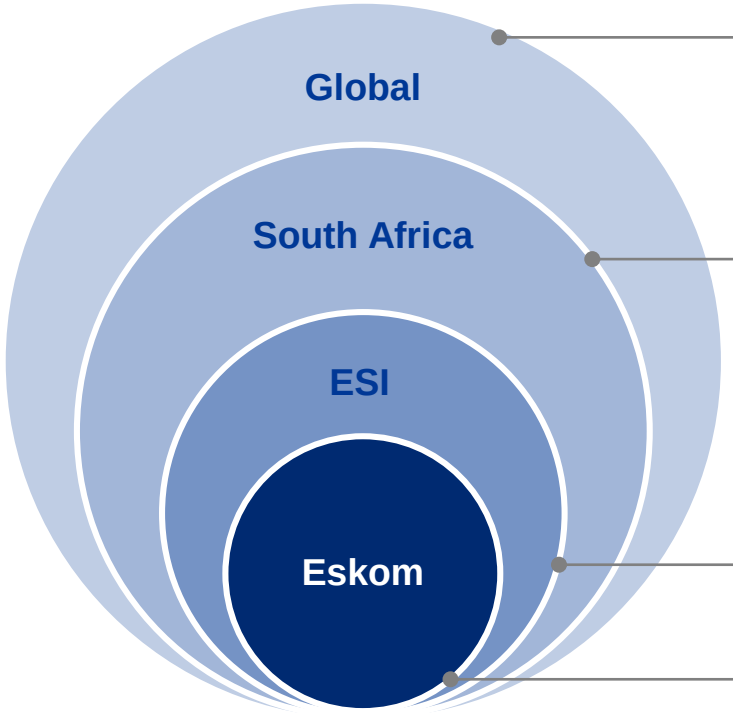
The Pace of Eskom's Coal Fleet Shutdown 2035 Plan

Presidential Climate Commission Event

- Eric Shunmagum
- Senior Manager Generation Business Enablement and Strategy

Several developments in Eskom's direct and indirect environment has required an update in strategic direction



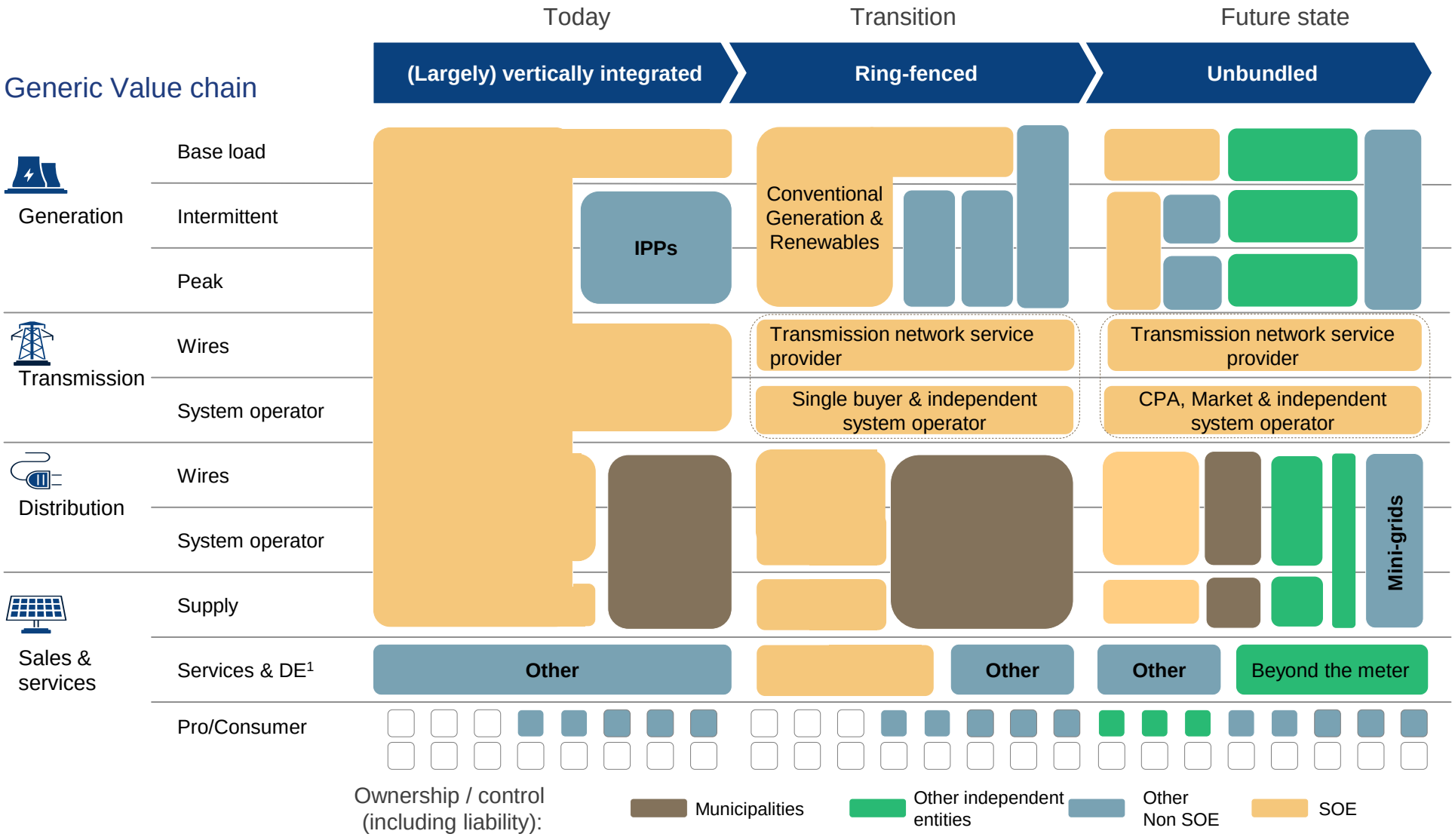
- Global trends show a **shift away from large scale coal assets** towards cleaner, decentralised systems through political and funding mechanisms
- **Coal shortages** over medium term, driving up primary energy costs
- SA is signatory to Paris agreement and pledged net zero by 2050

- **GDP growth has been lower than anticipated, further impacted by COVID pandemic**
- **Carbon Tax Act came into law** in 2019 which significantly changes corporate approaches in terms of energy consumption and procurement
- Costs for **renewable projects** estimated to be up to **88% less in 2021** than BW1 for which the first bids were received in 2011

- A number of **policy** and **regulatory decisions** have been **made** at **varying levels of implementation**; (e.g. NDP, IRP, DPE Roadmap) which further **define Eskom's parameters** and **drive a more competitive energy sector**
- **Licensing threshold** for embedded generation has been completely **lifted** in 2022
- **Municipalities are now permitted to procure directly from IPPs**

- Eskom's is **unbundling** and faces several **financial sustainability risks**, including a severely constrained balance sheet with a debt burden of **R401bn**
- Coal **plant performance** has been **deteriorating** at an alarming rate and are currently not aligned to local and global transitioning ambitions
- Most of fleet **MES non-compliant**, abatement technologies expensive (>R300bn), and will result in **16GW** shut down immediately and **30GW** by 2025

Decisions related to the evolution of the electricity supply industry have a direct influence on the future role of each business



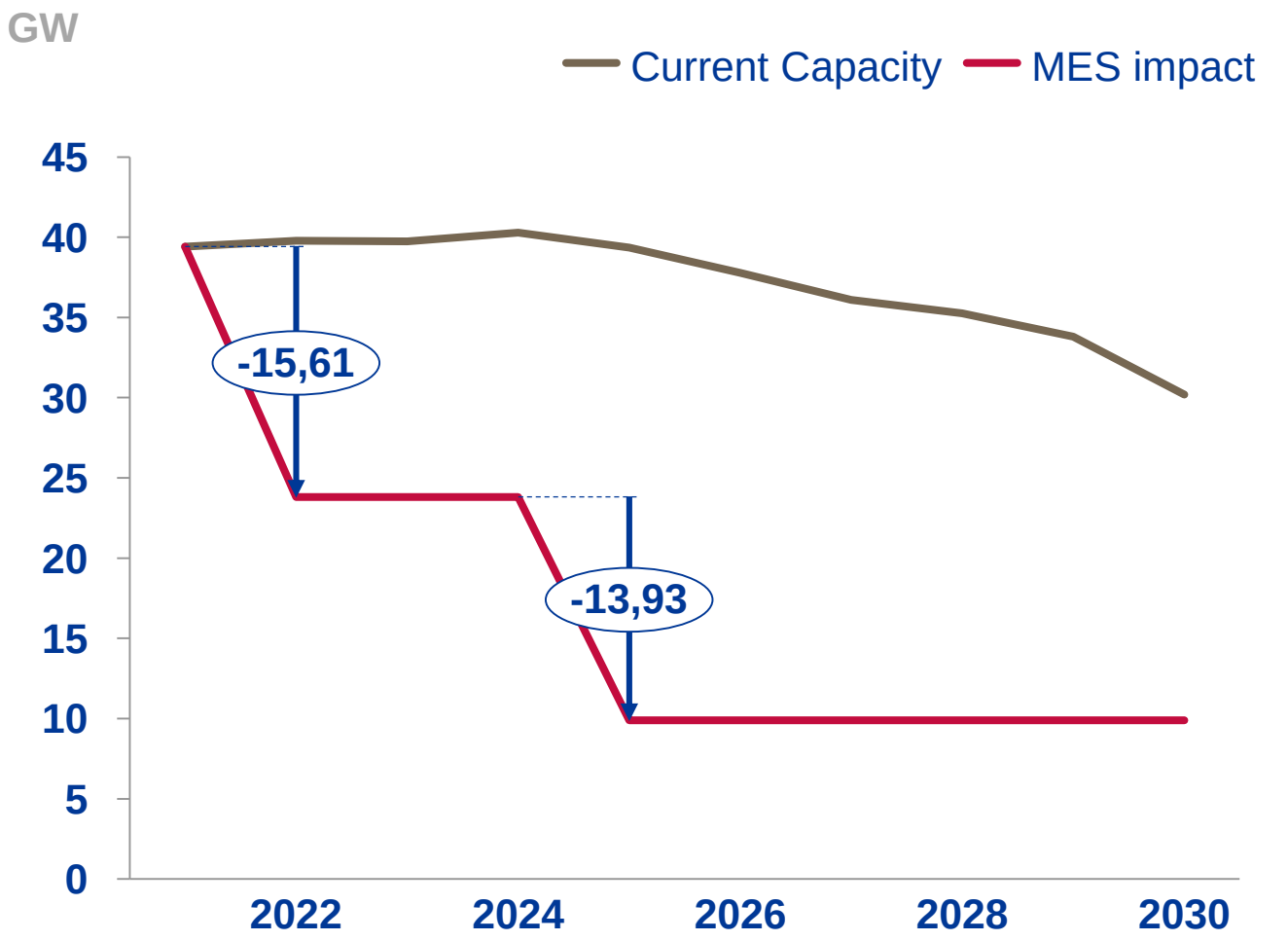
INSIGHTS

- **Generation and distribution businesses will face the greatest threats**
- Consumers **are evolving to prosumers**
- **Renewable modular energy is more accessible, its cheaper** and will continue to decrease in cost whilst **green energy funding increases**
- **More competitors** are entering the electricity supply space
- There is need to move away from business as usual and respond to the changing environment and disruptors

Source: BCG experience

Stricter legislation related to MES compliance places 16GW at risk immediately and a further 30GW at risk by 2025, not considered in IRP2019

Impact of MES decision on coal capacity[1]



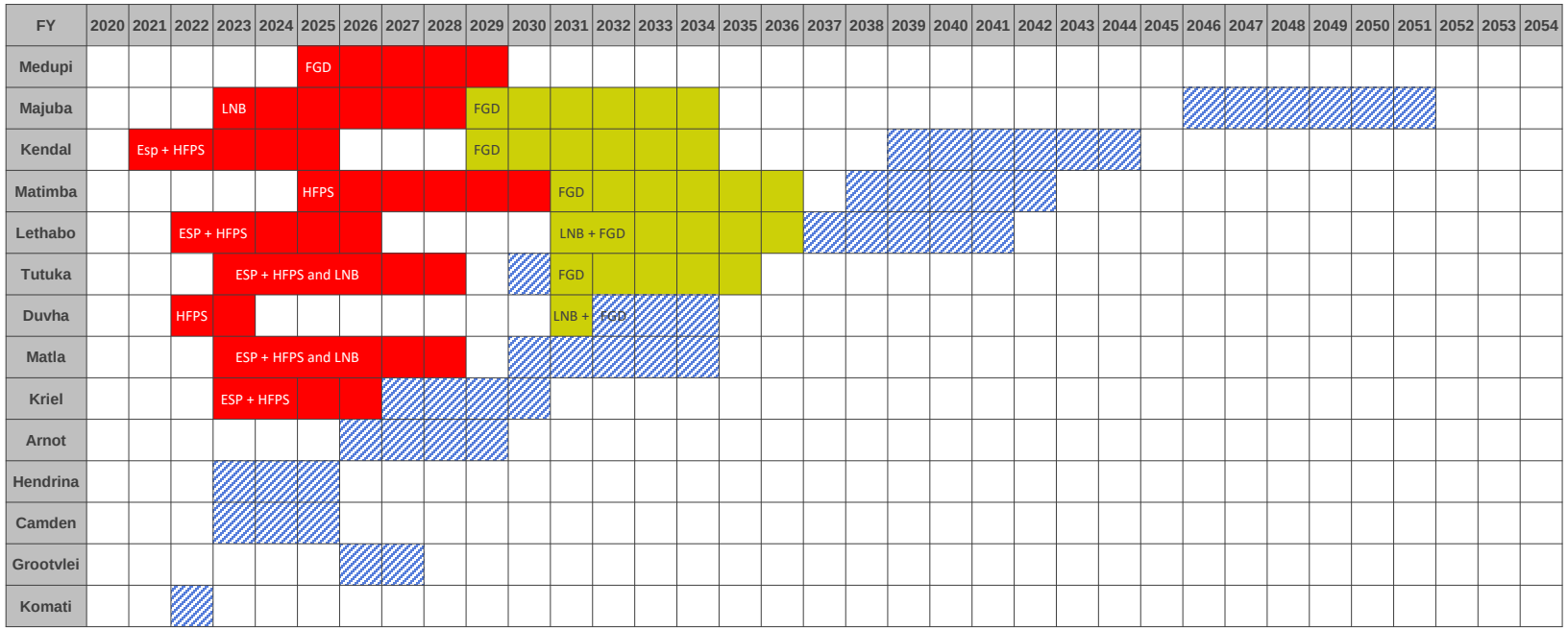
Notes

- Since the development of the IRP 2019, DFFE has issued a decision that puts **15GW capacity at risk immediately** and **30GW by 2025**
- If implemented, this result in **continuous stage 8 load shedding** (immediately), stage 15 (2025) due to reduced coal capacity
- **Eskom has appealed** the decision allowing it to continue to legally operate
- Emission reduction projects are being implemented, but **further legal indulgence is required** to mitigate the impact
- At least **R 300 bn is required** to achieve full compliance and will take **10 years to complete**
- Eskom's proposed shut down (2035) optimises short term capacity constraints, environmental compliance and the need to transition

1. Capacity indicated based on total nominal capacity of Eskom coal stations in commercial operation

Bringing the aging fleet into compliance will require up to 14 years & >R300bn in capital

Necessary refits can only be completed between 2029 and 2036, shortly before or after most plants are decommissioned



- Emission abatement retrofits/upgrades (Phase 1)
- Emission abatement retrofits/upgrades (Phase 2)
- Decommissioning (Eskom expected shutdown dates)

FFP = Fabric filter plant retrofit
FGD = Flue gas desulphurisation retrofit
LNB = Low NOx Burner installation/optimisation retrofit
HFPS = High frequency power supply
ESP = ESP, FGC, DHP Refurbishment/upgrade

Given the time frames, refitting most plants would be imprudent, constituting fruitless & wasteful expenditure

- 8 power stations require refit at a cost of **R30 – R50bn per station (R300bn total)**
- The **'25 deadline is unachievable** as it takes 7 – 10 years to build Flue Gas Desulphurization (FGD) plants
- Several stations **will shut down before** installation is complete (Matla, Duvha, Kriel)
- Others will **shutdown shortly after** the FGD is completed (Matimba, Lethabo, Kendal)
- Majuba and Matimba are in sparsely populated areas **limiting health impact & cost benefit**

The premature shut down of power stations would be catastrophic for Eskom & South Africa

Direct impact on South Africa due to closure of power stations

- **~100 000 job losses** permanent job losses on closure of stations (direct & indirect)
- **18% & 33% negative** impact to **Limpopo & Mpumalanga GDP**[1] respectively
- **R1.7 trillion cost to economy** due to **unserved energy**

Direct impact on Eskom's balance sheet (and govt. guarantees) due to loss of sales[2]

- Further **~R240bn operating shortfall** over 3 years (Eskom no longer a going concern)
- Ballooning of **debt burden to at least R640bn,** & credit rating downgrades
- **Potential default** on existing debt, & **call up of up to R350bn govt. guarantees**

Indirect impact on the economy due to generation shortfall

- The high risk of a **national blackout** and economic catastrophe
- **Loadshedding intensifies** up to **40X** current levels bringing the economy to a standstill
- **Further tariff increases** of up to **~170%** to pay for alternative replacement generation

1. Based on 2019 GDP and October Production Plan energy sent out, assuming 139c tariff across all stations. 2. Assuming 40% drop in sales
Source: Sources: https://cer.org.za/wp-content/uploads/2018/02/Economic-impact-assessment-of-5-CFPSs.pdf. Quarterly and Regional_Fourth_quarter 2020 http://www.statssa.gov.za/?p=14171

Eskom conducted extensive system energy modelling to find an optimal, comprehensive, long-term solution

Objective	Provide an **energy pathway up to 2050**, with a focus on the **next 14 years (to 2035)** given current constraints

This study aimed to answer three key questions:

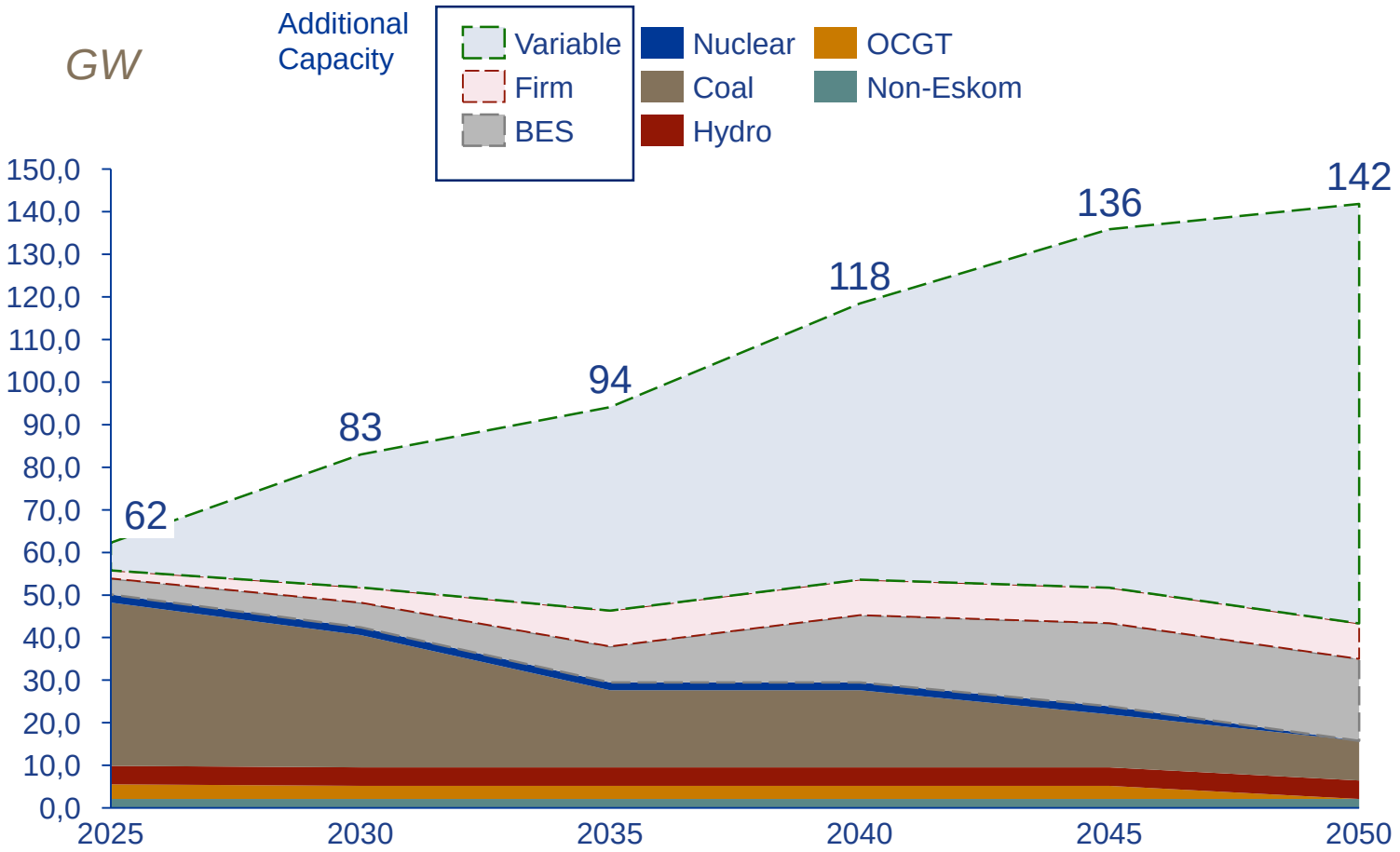
1. What is the **optimal future energy mix and capacity for SA** given practicality and the South African context?
2. What **additional capacity** should SA (incl. Eskom) build & how do we maximise the **socio-economic benefits** of a transition?
3. What are the impacts of an optimized shut down on **water use**, **emissions**, and **transmission & distribution** networks?

The results provided direction in terms of the following key strategic decisions:

- **Viability of the coal shutdown plan**, taking into account system requirements
- **Alternative MES position**, optimising plant shutdown for a JET plan
- **Optimal build of new technologies** i.e., Renewables and Gas
- **5-year increments of energy mix** starting from 2025, 2035, 2040, up to 2050 Energy mix

Eskom's existing generation capacity will be ramping down significantly in the next 10 – 15 years, requiring additional capacity

Existing plant and new capacity required to 2050



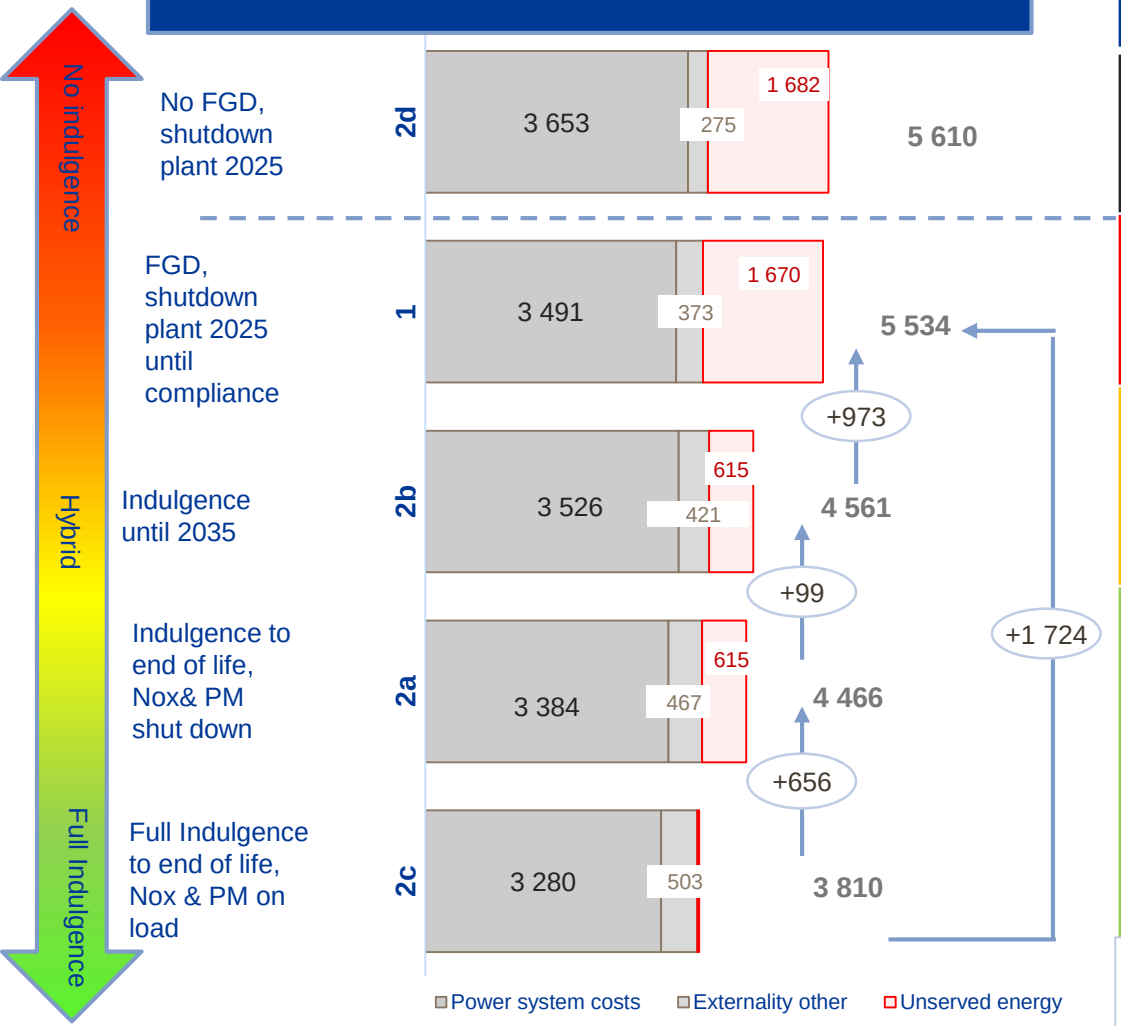
- 90+ power scenarios have been modelled and the optimal pathway identified to ensure a balanced power sector
- Existing fleet generation will ramp down **from ~50GW to ~15GW by 2050**
- Current projections show that **by 2030, new capacity of at least 50-60 GW renewable capacity will need to be added**, even if there is no incremental demand from economic growth.
- The quantum of new capacity required doubles (~120GW) **by 2030 when a 5% increase in demand growth is assumed.**

Current capacity crisis will be worsened by the need to comply to DFFE decision on MES compliance

The selection of the best option included economic and other technical considerations

Blackout High risk Low risk

Gx NPV Cash Outflows R'BN



Source: MES reduction plan

Risks , constraints, executability of the GX & TX Plans

Required New Grid capacity- build rate (Eskom build)	Pace of new GX capacity required (DMRE IPP office)	System adequacy unserved risks	Enviro impact (MES, CO2)
Unlikely, TX just about can connect IRP 2019, implies doubling of build rates	Unrealistic amounts of gas procured & commissioned in short lead times	Inadequate system Potential black out scenario	Least polluting
Removal of units in non-compliance 2025 **Further** pressure on the grid to accelerate further	Acceleration of capacity to fill the gap. Gas in 4 years time is ambitious	Large unserved energy	Better
Additional 16 GW of base load shut down by 2035 implies further ramping up of TX within the constrained window	Accelerates GX build rates required vs option 2a&c, accelerates by 5 years	16 GW in 2035 in one year, more dependencies and challenging	Moderate
Existing grid utilised longer as a buffer and breathing space for TX expansion	Allows breathing space/ room for slippage if New capacity does not deliver		(+/-5 yrs additional Sox) Nox & PM slightly less polluting
			Most polluting for additional +/-5 yrs) on average

The ambitious required expansion plans imply a doubling in build rates for solar and gas vs. IRP 2019, within the context of a constrained TX grid, already 8 years behind schedule. This requires successive record breaking execution performance over 10 years, just to meet IRP 2019 capacity requirements, which is a major risk to the plans

Eskom identified a mix of renewables & limited gas as the optimal power source given LCOE & build time

Technology Preference

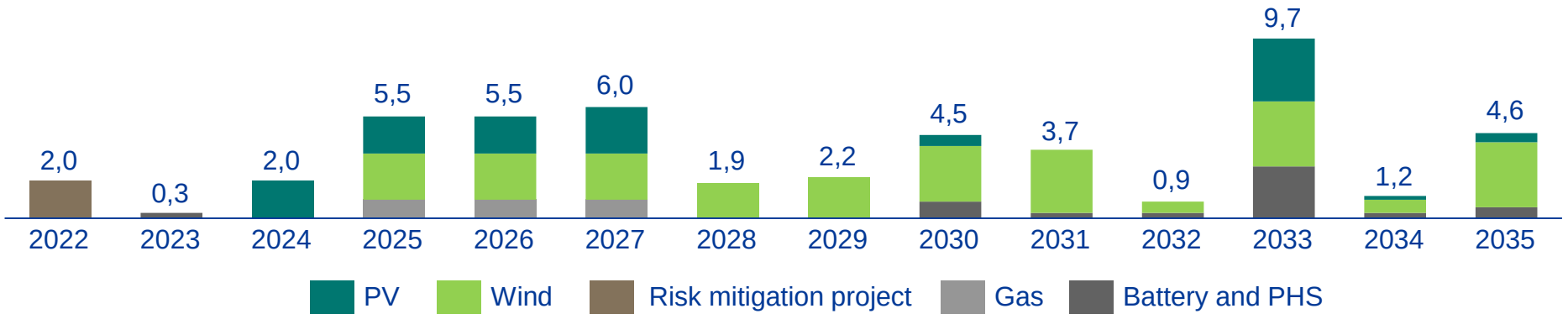
Technology	Capital cost LCOE[1]	Build time	Build	Own	Operate	Comment / Eskom position
PV	**975 $/kW** 4,2 U$ c/kWh	18-24 months	✓	✓	✓	Identified potential sites to retrofit PV capitalising on existing infrastructure & available resources
Wind	**1 450 $/kW** 5,4 U$ c/kWh	24-36 months	✓	✓	✓	Leverage sites for, and get environ. auth. for wind to capitalise on existing infrastructure and available resources
Gas	**1 250 $/kW** 7,3 U$ c/kWh	24-60 months	✓	✓	✓	Use imported gas as a means to supplement baseload in short to medium term
Nuclear	**12 500 $/KW** 19,8 U$ c/kWh	12-15 years	✗	✗	✓	Support Government plans to roll out new nuclear, however, unable to build due to inadequate balance sheet
New coal	**6 225 $/kW** 15,9 U$ c/kWh	10-12 years	✗	✗	✗	Own & operate current coal fleet until shutdown, & repower sites with cleaner options. No new Eskom coal projects

1. Capital cost includes EPC cost, capital cost during constriction, LCOE – levelized cost of energy; Source: Lazard 2020 costs

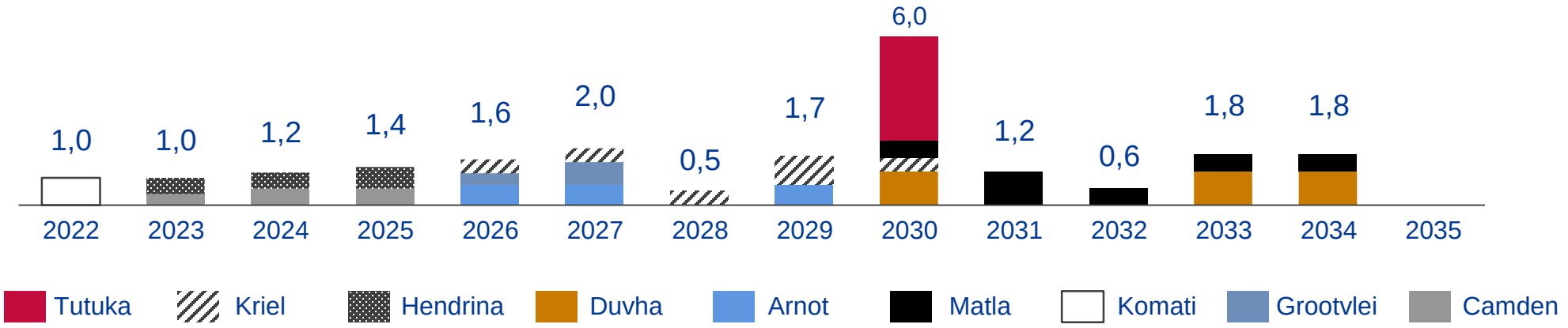
Our models show that 22GW of coal capacity can be decommissioned & replaced by greener energy by 2035

Analysis of additional capacity and shut down of coal plant 2022-2035 (GW)

New clean Generation ~50 GW
53% wind, 26% Solar, 11% battery and PHS, 6% Gas, 4% RMIPPPP



Eskom Coal capacity to be shut down ~22 GW
(Nameplate capacity)



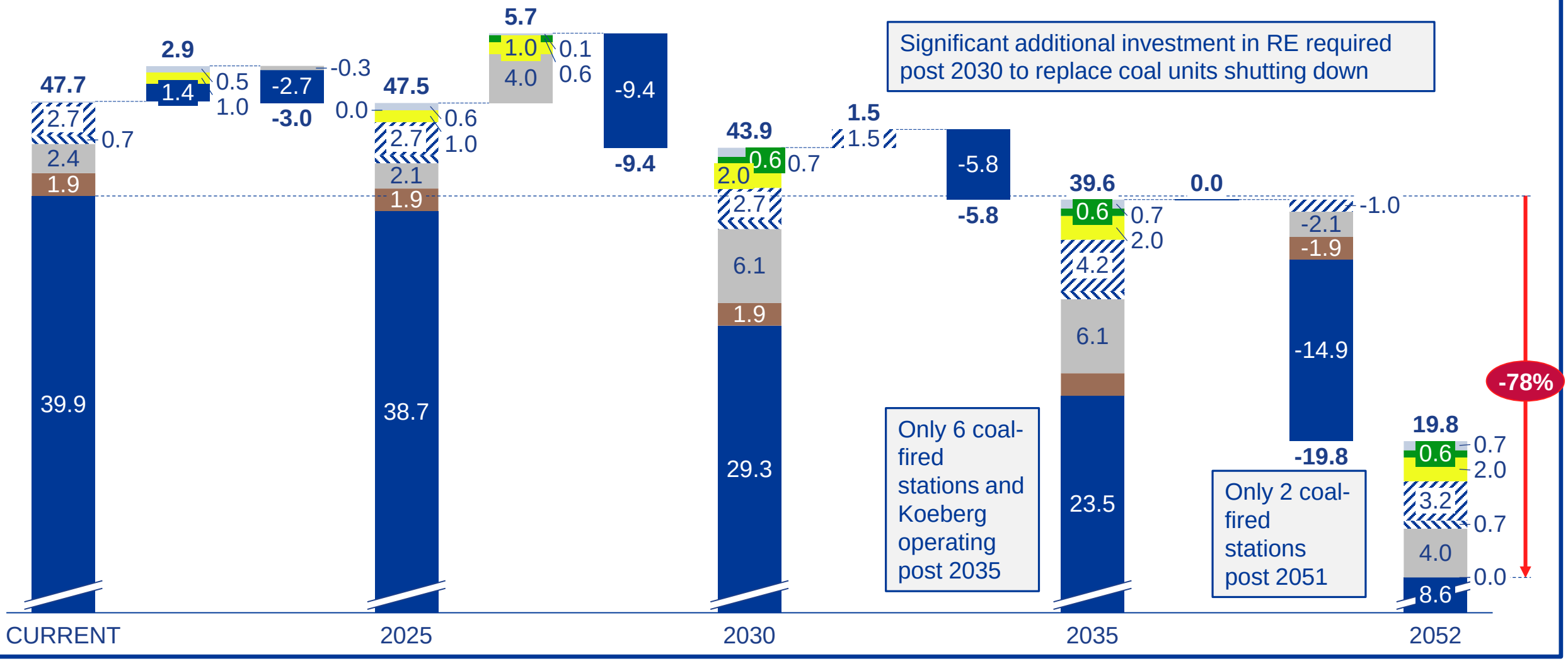
Coal capacity will decrease by 78%; Gas & renewables increase significantly

* based on nominal capacity, base excludes units currently in Reserve Storage and extended inoperability
*Only new capacity in plan included ref. 2022_03_28_JET projects for gazetting_REV 7_FINAL LIST_Priority List

Eskom

Coal | Nuclear | Gas / LF | Hydro | Pump Storage | Solar PV | BESS | Wind

GW New nuclear, aspirational RE build and Dx BESS NOT included. Tubatse assumed to be before 2035 based on current project plan



~R192 bn of funding is required to execute the currently identified JET projects and mitigate social impacts across eleven sites. Timelines are FY23 and beyond

	Projects	Phase [1]	Cost [2]	Capacity
Renewables (Solar)	• Arnot	1	R 0.28 bn	17.2 MW
	• Duvha	1	R 0.38 bn	23.5 MW
	• Lethabo	1	R 1.21 bn	75.0 MW
	• Majuba	1	R 1.05 bn	65.0 MW
	• Matimba	2	R 0.63 bn	35.0 MW
	• Tutuka	1	R 1.06 bn	65.9 MW
	• Camden Repowering	2	R 2.50 bn	185.0 MW
	• Grootvlei Repowering	2	R 2.50 bn	100.0 MW
	• Hendrina Repowering	2	R 2.50 bn	100.0 MW
	• Komati Repowering[4]	1	*R 1.93 bn*	100.0 MW
	• Sere Phase 1A PV	1	R 0.32 bn	19.5 MW
	• Sere Phase 1B PV	2	R 0.84 bn	50.0 MW
	• Sere Phase 2 PV	2	R 9.27 bn	530.0 MW
	• Olyvenhoutsdrift	2	R 9.63 bn	550.0 MW
	• Gamma Sub Station	2	R 0.63 bn	35.0 MW
	• **Subtotal**		**R 34.73 bn**	**1951.1 MW**
Renewables (Wind)	• Aberdeen	1	R 4.48 bn	200.0 MW
	• Klienzee	1	R 6.33 bn	300.0 MW
	• Other Wind	2	R 2.37 bn	100.0 MW
	• Komati Repowering	1	R 1.30 bn	40.0 MW
	• **Subtotal**		**R 14.48 bn**	**640.0 MW**
Grand Total Renewables			**R 49.21 bn**	**2591.1 MW**

	Projects	Phase [1]	Cost [2]	Capacity	Energy
Gas [3]	• OCGT Dual Fuel BOP	1	R 1.88 bn	0 MW	
	• OCGT to CCGT conversion	2	R 20.00 bn	1000.0 MW	
	• East Coast Gas Projects	1	R 70.00 bn	3000.0 MW	
	• **Subtotal**		**R 91.88 bn**	**4000.0 MW**	
Grand Total Renewables and Gas			**R 141.09 bn**	**6591.1 MW**	
Battery Storage	• Camden Repowering	2	R 4.00 bn	150.0 MW	600 MWh
	• Grootvlei Repowering	2	R 4.00 bn	150.0 MW	600 MWh
	• Hendrina Repowering	2	R 4.00 bn	150.0 MW	600 MWh
	• Komati Repowering[4]	1	*R 3.43 bn*	150.0 MW	600 MWh
	• **Subtotal**		**R 15.43 bn**	**600.0 MW**	**2400 MWh**
Pumped Storage	• Tubatse	1	R 35.87 bn	1500.0 MW	21000 MWh
Grand Total Storage			**R 51.30 bn**	**2100.0 MW**	**23400 MWh**
Grand Total JET Projects			**R 192.39 bn**	*** 8691.1MW**	**23400 MWh**

Disclaimer: 1. All costs are estimated; 2. Phases - High Priority (Phase 1); Medium Priority (Phase 2); Low Priority (Phase 3); 3. Gas repowering is currently not viable due to the lack of infrastructure and has been excluded; 4 Costs for the Komati projects estimated jointly at R5352m joined difference assigned equally to individual project figures Source: 2022_03_28_JET projects for gazetting_REV 8_FINAL LIST_Priority List Updated - 2022-10-03;

At least R1.2 trillion will be required in electricity industry investment before 2030

Capacity required	Required to mitigate energy crisis	Estimated cost
Generation capacity	Firm capacity 6GW Variable capacity 50-60 GW Storage capacity 10GW	**~R990bn**

Transmission capacity	• Expansion and strengthening of transmission network:
	  • ~8000km new line
	  • ~101 substations
		~R130bn

Distribution capacity	• Strengthening of the distribution network for embedded generation, ~7500 km of line	**~R56bn**

Approximate capital required for infrastructure roll out is R1.2 trillion by 2030.
Given the magnitude of investment required, private investments and PPP will be crucial

By undergoing a JET we will reduce emissions while avoiding the impact a blunt MES implementation would have

Emissions

JET impact ('35): ~50% reduction in CO_2, 66% reduction in SO_2 emissions; 58% for PM ✓

MES impact: Will immediately restrict harmful emissions ✓

Generation capacity

JET impact ('35): 22GW of coal gen. replaced, & >7GW more from new green energy ✓

MES impact: Immediate loss of 16GW, 30GW loss by 2025 !

Jobs & the economy

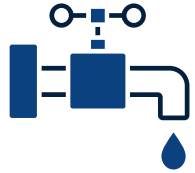
JET impact ('35): >300 000 new net jobs (after coal shutdowns); reduced loadshedding ✓

MES impact: ~100k job losses; stage 15 loadshedding !

Transmission & Distribution

JET impact ('35): ~15 500km of new transmission & distribution lines ✓

MES impact: Added financial pressure precludes investment !



Water scarcity

JET impact ('35): 40bn litre reduction in water consumption from plant refits/shutdowns ✓

MES impact: Requires >16bn more litres of water per year !

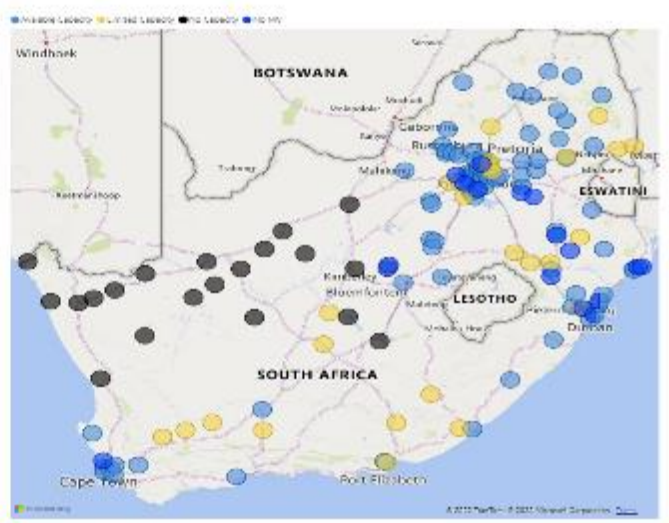
Note: PM = particulate matter; NOx = nitrogen oxide/dioxide/trioxide etc; SO2 = sulphur dioxide
Source: GreenCape analysis (work in progress) WIP, RES4Africa studies; Eskom JET phase II modelling

Land leasing together with the grid optimisation initiatives offer great potential to investors to contribute in resolving the electricity crisis

Releasing additional Eskom land

- Eskom has identified ~30 890 ha of land across the country that can be leased with a potential of ~7020 MW PV capacity
- **Optimising and mitigating impact** of **network expansion & strengthening**
- **Stimulating economic activity** around aging Power Stations that are ramping down

Unlocking capacity on the existing grid to 17 GW



- Unlocking capacity on the existing grid, reduces time associated with EIA and servitude acquisition
- 12 projects, 27 transformers at ~R8,1Bn in the **North inland** region increasing **capacity to 12,3 GW**
- 10 projects, 18 transformers at ~ R5,8Bn in the **South inland** region increasing **capacity to 4,7 GW**

Eskom is implementing a browsable GIS, mapping RE resources, grid access and available land

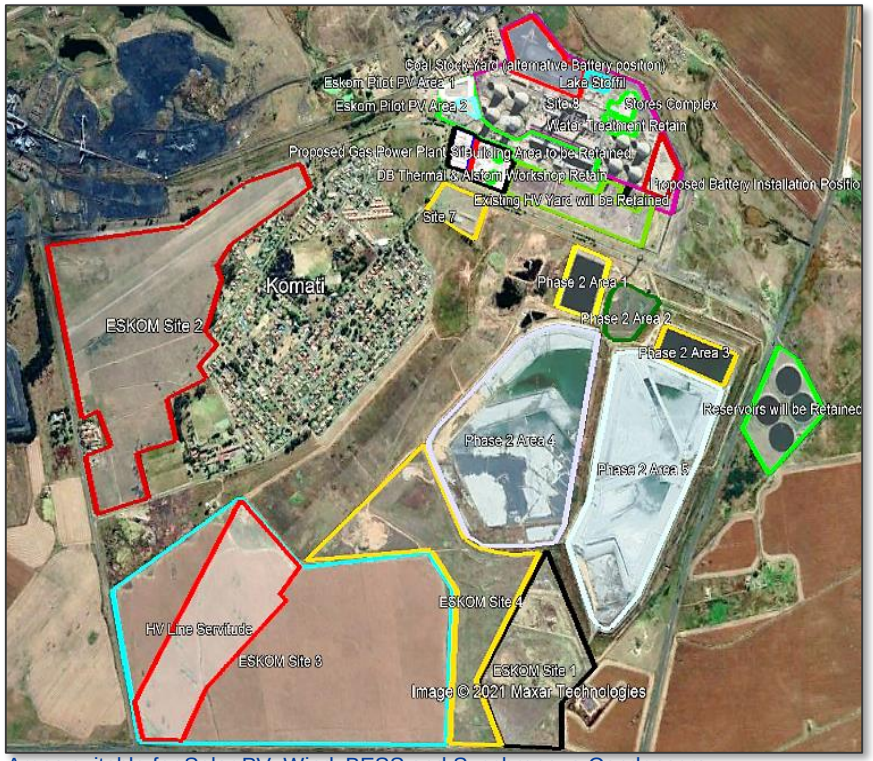
Land leasing together with the grid optimisation initiatives offer great potential to investors

30 890 ha of land across the country that can be leased with a potential of 7020 MW capacity

- Eskom signed lease agreements with four independent power producer investors for the commercial lease and use of land parcels at two of its power stations in Mpumalanga province for the construction of new clean energy generation capacity.
- This is the first batch of lease agreements to be signed with private companies. It is comprised of land parcels around the Majuba and Tutuka power stations.
- The investors will lease a total of 6 184 hectares (ha) of land for a period of 25 - 30 years each and contribute an estimated 2 000MW to the national electricity grid.
- The bidders will now do comprehensive feasibility studies to determine which technologies they will be implementing at each site - wind, solar and battery storage.
- The next phase of land will focus on properties around the Kendal and Kusile power stations in Mpumalanga, as well as the retired Ingagane Power Station in Newcastle, KwaZulu-Natal.
- The land parcels were thoroughly screened for useability, considering accessibility, areas above underground mines, future mining activities, the conservation of environmentally sensitive areas such as wetlands and heritage sites, and the sloping of the land parcels.

Eskom signs land lease agreements with independent clean power generators – October 2022

Komati Power Station | Eskom's flagship project to Repower and Repurpose Komati in a just transition



Areas suitable for Solar PV, Wind, BESS and Synchronous Condensers

Komati R&R Programme Overview

1. Decommissioning

2. Repowering Initiatives:
- Solar PV (~100MWp) + 50MWp Ash Dam
- Battery Storage (600MWh)
- Gas - not viable
- Biomass – not viable
- Wind (up to 70MW)
- Conversion of Generators (x3) to Synchronous Condensers

3. Repurposing Initiatives:
- Microgrid Assembly
- AgriVoltaics (500kWp)

4. RE Training Facility
- Enabling, Empowering, Reskilling, Upskilling
  - Skills required for long term jobs in the renewables value chain.
  - Collaboration with SARECTEC

5. Additional SEIM Initiatives:
- Microgrid Assembly
- Farming (e.g aquaponics)

These projects and initiatives will be replicated at all power station sites

Eskom Komati PS mitigation strategy comprises of five pillars and is driven by repurposing and repowering initiatives

Stabilise

Stabilise the local economy by setting up new economic activities and creating new jobs in the community through

Focus:

- **Repurposing and repowering (R&R) projects focus**
- Economic opportunities in the community

Enable, support and realise

Develop

Focus:

- PS's permanent employees
- ERI employees
- Contractors
- PSA workforce

Reskill, upskill and develop new skills among power station employees and local community workforce

Strengthen

Focus:

- Basic services infrastructure
- Health and education
- Communication
- Sports and leisure facilities

Strengthen the communities by addressing the existing gaps and challenges in the community

Communicate

Communicate plans and engage with stakeholders throughout project life cycle

Grow

Facilitate growth of SMMEs and economy through localisation of supply chains and other business opportunities created by R&R

In response to the upcoming power station shutdown three socio-economic impact assessments across 10 Stations have been conducted

Station name	Capacity[1]	Shutdown Year	Socio-Economic Impact assessments conducted: 1 Urban Econ	2 World Bank	3 NDC
Komati	114MW	2022	■	■	
Hendrina	1 135MW	2025	■	■	
Camden	1 481MW	2025		■	■
Grootvlei	570MW	2027	■	■	
Arnot	2 100MW	2029			■
Kriel	2 850MW	2030			■
Tutuka	3 510MW	2030			■
Matla	3 450MW	2034			■
Duvha	2 875MW	2034			■
Kendal	3 840MW	2044			■

Comments

- Nine coal fired power stations within the generation fleet will be shutdown by 2035
- To understand the impacts of the shut downs three socio economic impact studies have been conducted
- While Kendal is only scheduled to shutdown in 2044 but has been included in the NDC study due to its proximity to other stations within the study
- In addition to these socio economic impact studies a joint study between EPRI and RT&D was conducted to explore technology options that could be explored for repowering the stations

Footnotes: 1 Nominal capacity has been given

Conclusion

- Many of Eskom's **coal-fired power stations come to the end of their operating life** between now and 2035.
- This allows for **opportunity to develop alternative options to generate electricity** that are then aligned to the South African **commitments to reduce its carbon dioxide emissions** through the South African Just Energy Transition.
- The Eskom 2035 plan and **Just Energy Transition programme involves the shutting down of coal and gas plants at the end of life, possible early decommissioning of plants (e.g. Tutuka Power Station) and the introduction of clean technologies such as renewables, gas and nuclear.**
- While shutting down the coal-fired power stations will have a negative socio-economic impact and obvious reduction in emissions, the **introduction of clean technologies will have a positive socio-economic impact**.
- It is in this context that **technical and socio-economic impact assessment are being done** on the shutting down of coal-fired power stations and pursuing repowering and repurposing programmes.

Way forward

We are doing…

1. Implementing 2035 shutdown plan

2. Focussing on repurposing and repowering at sites that are being shut down and next sites to shut down
   - ✓ Komati R&R Programme is prioritised “Proof of Concept”
   - ✓ Lessons learned will inform the rest of R&R Programmes

3. Focussing on clean technologies, new renewable, gas and battery capacity

4. Focusing on the strategies to develop and implement the R&R Programmes, which includes but not limited to:
   - ✓ Traditional approach (excluding socio-economic initiatives, where other stakeholders involvement is required for any strategy adopted), where Eskom raise funding, develop, execute and operate the new plants
   - ✓ Private sector involvement, for example, through Public Private Participation (PPP)


Thank You!