



## Portfolio Committee on Environment, Forestry and Fisheries

### Eskom Status of compliance with Environmental laws

17 August 2021

### Content



- Eskom status of compliance with relevant Air Quality Legislation (MES)
- Carbon Footprint and Proportion of Interventions relative to Eskom's grand emission of greenhouse gases

### Eskom MES applications - current status



- Eskom applied for MES postponements in 2014 and DFFE issued decisions in 2015. The postponement decisions were, in terms of law, valid for 5 years
- Eskom is progressively **implementing the emission retrofit projects** committed to in the 2014 MES application.
- Amendments to the MES regulations were published in 2018 which Eskom commented on extensively. These will have a significant impact on electricity supply. Specifically the requirement for existing plant to comply with new plant standards for sulphur dioxide.
- Eskom submitted further applications in 2019 and 2020. The applications addressed the changes in the legislation and the changing financial position of Eskom and the South African economy and considered the transition to a greener energy mix.
- DFFE is presently evaluating the Eskom applications.

### Eskom MES applications - summary of compliance

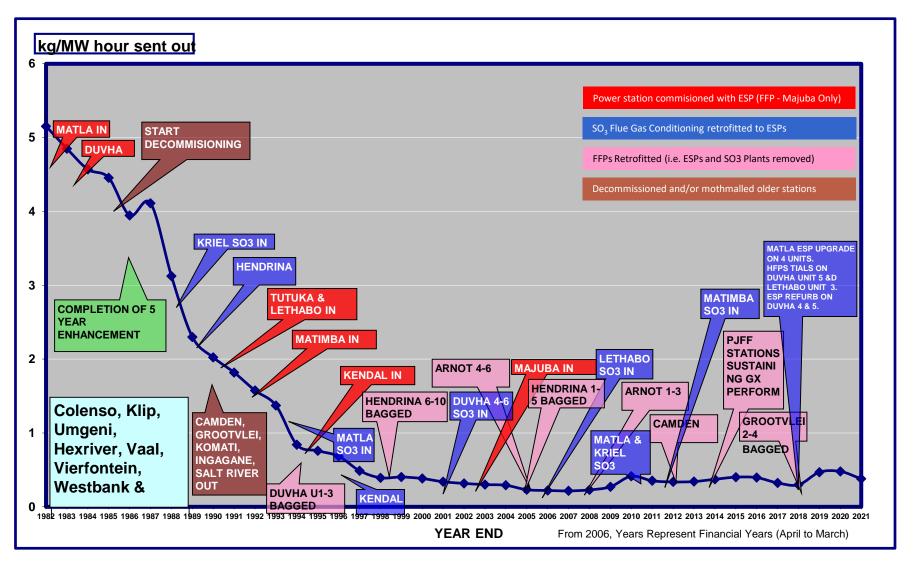


- Eskom supports the Minimum Emission Standards as they are needed to reduce harmful health effects of air pollution and provide certainty for planning.
- Eskom is progressively implementing the emission retrofit projects committed to in the 2014 MES application. Work on many is still ongoing.
- Power Stations generally comply with the conditions of their emission licences issued to give effect to the limits in the MES decisions received in 2015.
- Kendal power station experienced specific emission compliance **challenges** and has recovered from destruction of plant during strike action, is operating in compliance and has made progress with refurbishment of two units.
- The air quality offset programme has encountered delays but will get underway in 2021.

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### Relative Emission Roadmap (coal plant only)





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## The Eskom approach to meeting the MES requirements and present legal issues



#### **Eskom phased approach**

- Due to the excessive financial, outage, and resource requirements of 100% compliance, Eskom adopted a phased and prioritised approach for 57% compliance by 2025.
- Government accepted the 57% compliance phased approach through the approval of the postponement applications in February 2015.
- Decision was for postponement of PM, NOx and SO<sub>2</sub> at multiple stations.
- However legislation has subsequently become more stringent with the promulgation of revised regulations in 2018. (GN 114, 26 October 2018)

#### Revised regulations requirements

- Existing plants which will be decommissioned before 2030 may apply for <u>a once off</u> <u>suspension from new plant standards</u>, they must have a detailed decommissioning schedule.
- If a plant is decommissioned after 2030, it must comply with the new plant standards within 5 years, by 2025 or shut down,
- No postponement of compliance timeframes or a suspension shall be granted for compliance with MES for existing plant standards.
- Alternative limits for a pollutant will be considered if there is: compliance with other pollutant standards at the station; if there is proof of investment in emission reduction on the pollutant at the station and; if there is material compliance with existing ambient standards.

The 2018 regulations are very onerous for Eskom's fleet of coal fired plant which is beyond midlife. Most specifically the requirement to retrofit plant with flue gas desulphurisation

### MES Postponements granted in 2015



	Power station	SO <sub>2</sub>	NOx	PM
New build	Kusile			
coal-fired	Medupi <sup>1</sup>	2025		
	Majuba	2025	2020	
	Kendal	2025		
	Matimba <sup>1</sup>	2025		
	Lethabo	2025	2025	
Coal-fired	Tutuka	2025	2020	2020
Coal-illed	Duvha	2025	2025	
	Matla	2025	2025	2020 (U1-4)
	Kriel	2025	2020	2020
	Arnot	2025	2020	
	Hendrina	2025	2020	
Return-to-	Camden	2025	2020	
service	Grootvlei	2025	2025	2020
coal-fired	Komati	2025	2020	
	Ankerlig			
Liquid fuel- fired gas turbines	Gourikwa			
	Acacia		2025	
	Port Rex		2025	

Postponements were requested based on a per station analysis of historical and predicted plant emission performance as to the ability to meet either the existing or new plant MES limits.

No postponement granted
Postponement granted (and date it lapses as shown).

Note 1: Additional postponement issued to Medupi and Matimba in 2018 to move from a daily to monthly SO<sub>2</sub> limit.

# In preparing the 2019/2020 applications Eskom considered air quality, affordability, and socio economic aspects



1

Full compliance

#### **Description**

- Eskom to fully comply to the Minimum Emissions
  Standard
- This entails all operational plants to comply to the new limits

#### **Implications**

- Cost >R300Bn1
- FGD at 7 power stations
- Low NOx Burners at 8 stations
- FFP at 3.5 stations and ESP at 4 stations

2

Emissions reduction plan

Commitment made by Eskom as part of the 2019 application

- Cost >R67Bn2
- FGD at Medupi
- Low NOx Burners at 4 stations
- ESP and/or FFP at 7 stations

3
Particulate
Matter

- NOx and SOx will reduce as plants retire
- Eskom to focus on reducing particulate matter to below the required limits
- Cost R18 Bn (from 2021 onward)
- FFP at 1 stations and ESP, HFT and flue gas conditioning at 5 stations
- Option 2 was put forward as the preferred option in the Eskom postponement application. This
  option is supported by the just energy transition progressing South Africa toward cleaner
  technologies.
- This plan will also lead to the continual reduction in emissions and water use from 2020 onwards while avoiding the potential negative impacts of full compliance.

## Implications of full compliance with MES to Eskom and RSA

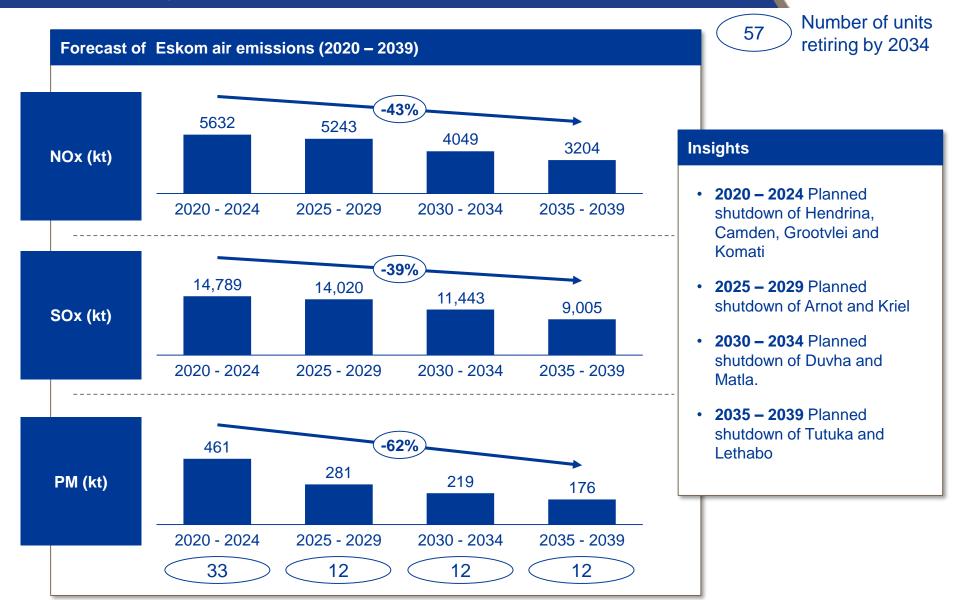


- Increase in electricity tariff 7 10%: CAPEX of more than R300 billion. Annual OPEX costs for operating the FGD will be at least R5 billion. Eskom's ability to fund this is limited.
- Outages: 150 to 190-day outages for all units before April 2025. In some years 14%
  PCLF for existing fleet for the emission retrofits alone. Practically time frames for
  planning before construction are 6-10 years. It will not be possible to deliver
  simultaneous projects without load shedding.
- Increase in auxiliary power consumption: Energy output from the coal fleet will be reduced by almost 2 255 GWh per annum. (equivalent to 257MW used 24/7/365)
- Water use: An additional 67 million cubic metres of water per annum (20% increase), at a time when there is projected to be a deficit in the Vaal River catchment.
- **Sorbent**: 6.5 million tons per annum. This will entail the development of new mines, and potentially the import of sorbent (lime/limestone).
- Increase in CO<sub>2</sub> emissions: Over a million additional tons of CO<sub>2</sub> may be released due to the wet FGD process. Eskom's relative CO<sub>2</sub> emissions (ton/GWh) deteriorates.

The above implications have been raised clearly in the MES application and it is hoped the DFFE considers the broad environmental and socio-economic issues of sustainable development and the National Development Plan in making it's decision on the matter.

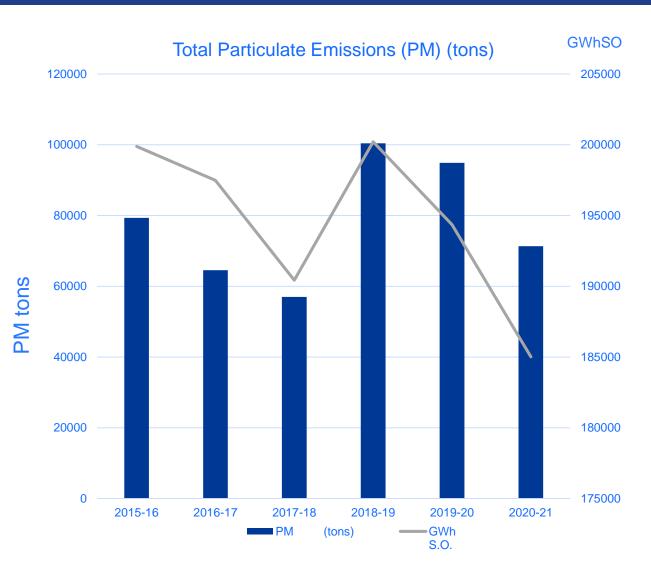
The preferred option for the 2019 application will significantly reduce emissions over the next 20 years through retiring stations and particulate retrofits





## Total Particulate Emissions (PM) tonnages from Eskom: 2015/16 – 2020/21





- Eskom has prioritised PM emission reduction over many years and relative emissions have decreased dramatically since the 1980's.
- Between 2018 and 2020
   Eskom PM emission
   increased predominantly due
   to Kendal units which were
   damaged during a strike,
   kendal contributed some 38
   000 tons in 2018/19 year.
- Kendal's performance improved in 2020-21 and total PM emissions are again decreasing.
- Projects are planned at 6 stations.

#### Gaseous emissions over time







NO<sub>2</sub> is in general compliance to ambient air quality standards in the Highveld and Vaal.

Eskom has implemented a NOx retrofit at Camden. Other projects at Majuba, Matla and Tutuka are planned (subject to funding).

SO<sub>2</sub> ambient air quality levels are high in the Highveld and Vaal.

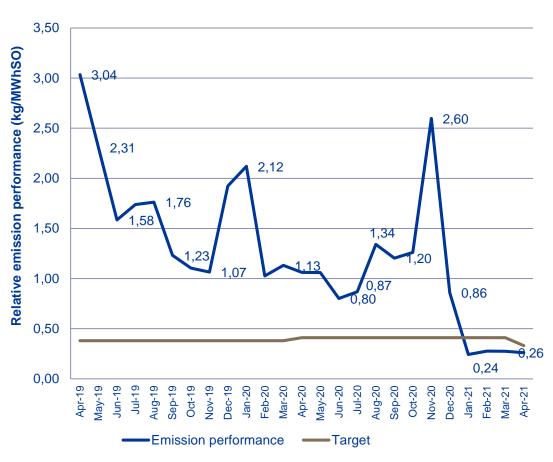
Eskom has implemented SO<sub>2</sub> reduction at Kusile and this will substantially decrease emission from the station.

The progressive closure of coal stations will result in the reduction of PM, NO<sub>2</sub> and SO<sub>2</sub> emissions.

## Kendal emissions compliance status has improved



#### **Kendal Relative PM Emission performance)**



- Kendal power station: significant damage caused during 2018 strike action and a lack of maintenance lead to damage of the plant which resulted in particulate matter noncompliance while operating.
- Unit 5 and 6 were taken off for permanent repairs and will return in May and July 2021. They will operate in compliance thereafter.
- Initial repairs were undertaken at the units 1,2,3 and 5 and with focus it is now possible to operate units within the AEL legal limit.
- Kendal's overall performance has improved significantly during last year and is in operating compliance since December.

## Progress in MES committed projects

AR Alternative Emission Reduction Plan

N Will not meet committed timelines

ED Meet end date but not 1st years

Y On time

C Project is complete



			2014		2019			
Power Station	Project	Resp. Div.	MES Commitment Dates	Comply?	MES Application Dates	Comply?	Current Forecast Dates	Next Steps / Key Issues
Camden	Low Nox Burners	GCD	19/20 - 24/25	Υ	N/A	Υ	18/19 - 21/22	Completed
Duvha U4-6	ESP Upgrade	Gx	18/19-20/21	С	20/21-24/25	С	20/21-24/25	Completed
Duvila 04-0	HFPS	Gx	21/22 - 23-24	Υ	21/22 - 23-24	Υ	21/22 - 23/24	Procurement process in progress - tender evaluation.
Grootvlei	FFP (Unit 2, 3, 4)	GCD	15/16 - 17/18	С	N/A	С	N/A	Complete
	ESP Upgrade	Gx	N/A	N/A	19/20 - 24/25	ED	20/21 - 24/25	Construction on the first two units in progress.
Kendal	CFB -FGD	Gx	N/A	N/A	21/22	N	22/23	Definition stage complete. No funding
	HFPS	GCD	N/A	N/A	19/20 - 24/25	ED	20/21 - 22/23	Construction on the first two units in progress.
V-i al	ESP Upgrade	GCD	19/20 - 24/25	ED	19/20 - 24/25	ED	21/22 - 24/25	Procurement process in progress - tender evaluation.
Kriel	HFPS	GCD	19/20 - 24/25	ED	19/20 - 24/25	ED	21/22 - 24/25	Procurement process in progress - tender evaluation.
	ESP Upgrade	GCD	N/A	N/A	19/20 - 24/25	N	21/22 - 24/25	Procurement process in progress - tender evaluation.
Lethabo	HFPS	GCD	N/A	N/A	19/20 - 24/25	ED	20/21 - 21/22	Equipment installation on the first unit complete.
<u> </u>	SO <sub>3</sub>	GCD	N/A	N/A	19/20 - 24/25	N	21/22 - 24/25	Procurement process in progress - tender evaluation.
Majuba	Low Nox Burners	GCD	19/20 - 24/25	ED	20/21 - 25/26	AR	22/23 - 24/25	Alternative Emission Reduction Plan
Matimba	Multi-Pollutant Pilot	Gx	N/A	N/A	N/A	N/A		Project is in RFI and pre-concept phase. No funding
	ESP Upgrade	GCD	20/21 - 24/25	ED	20/21 - 25/26	ED	21/22 - 22/23	Procurement process in progress - tender adjudication
Matla	HFPS	Gx	20/21 - 24/25	Υ	21/22 - 24/25	Υ	20/21 - 22/23	Procurement process in progress - tender adjudication
	Low Nox Burners	GCD	20/21 - 24/25	N	21/22 - 26/27	AR	22/23 - 26/27	Alternative Emission Reduction Plan
Medupi	FGD Plant	PDD	21/22 - 25/26	N		N	24/25 - 29/30	RFI adjudication in progress.
	DFGC	GCD	N/A	N/A	N/A	Υ	2020/21	Equipment installation on the first unit complete.
Turkelen	FFP (3 units)	GCD	18/19 - 23/24	N	21/22 - 26/27	N	22/23 - 25/26	Tender cancellation. Alternative technologies to be considered
Tutuka	HFPS (3 units)	Gx	18/19 - 23/24	ED	21/22 - 26/27	Υ	20/21 - 21/22	Equipment installation on the first unit complete.
	Low NOx	GCD	19/20 - 24/25	N	20/21 - 25/26	AR	20/21- 25/26	Alternative Emission Reduction Plan
Air Quality Offsets	Phase 1	Gx PM					2020-23	Finalising contracts for Kwaza, Eza and Vaal Kwaza PMO & Insulation, Eza PMO Vaal Clean-up has been approved. Eza insulation is currently in post tender stage (negotiate and to sign a contract. Vaal Parks has bee re-issued, closing date 16 April 2021.
	Phase 2	Gx PM		N		N	2023-28	Request and approval of budget required Phase 2 & phase 3 Approval still to be obtained and approved by Generation

## Progress in MES committed project - challenges



- There has been progress in implementation of several of the planned emission projects (Grootvlei, Duvha and Camden).
- High frequency power supply projects are progressing well at Tutuka, Kendal, Lethabo and Duvha.
- Other projects have been delayed due to various issues including:
  - Procurement/market responsiveness challenges resulting in the need to issue tenders multiple times to the market to get a PFMA valid response.
  - Lengthy Eskom and Government approval processes.
  - Funding and budgeting challenges.
  - Project management delays.
- Work to address all of these is ongoing and receiving focused attention to address.
   Lethabo, Kriel and Matla procurement process are in final stages with the expectation that contracts will be issued in July 2021.

### Clean Coal Technologies Research Portfolio – driven in part by a need to meet the MES





- Continuous Assessment of Developments in Emission Control Technologies
- Techno-Economic Evaluation of the Production of Sulphuric Acid utilising Multi-pollutant **Emission Control Technologies**
- Circulating Fluidised Bed Flue Gas Desulphurisation (CFB FGD) Demonstration Plant at **Kendal Power Station**
- Dual Flue Gas Conditioning Demonstration
- Source Testing Association Membership

#### **Carbon Abatement**

- Carbon Capture, Transportation, Utilisation and Storage:
  - South African Centre for Carbon Capture and Storage (SACCCS)
  - National Carbon Capture Pilot Plant (CCPP) at Kusile Power Station
  - Pilot Carbon Dioxide Storage Project (PCSP)
  - South African Bureau of Standards Technical Committee (SABS TC) 265 participant: Carbon Capture, Storage and Transportation
- **Fuel Substitution** 
  - Torrefied Biomass Co-firing at Arnot Power Station
  - Biomass Action Plan for Electricity Generation in South Africa (BAPEPSA)
  - International Energy Agency's (IEA) Bioenergy task 32: Biomass Combustion and Co-firing Membership



#### **Mandate**

research To and/or develop technology options that assist Eskom implement solutions that have a positive environmental impact and/or improved cost efficiencies.



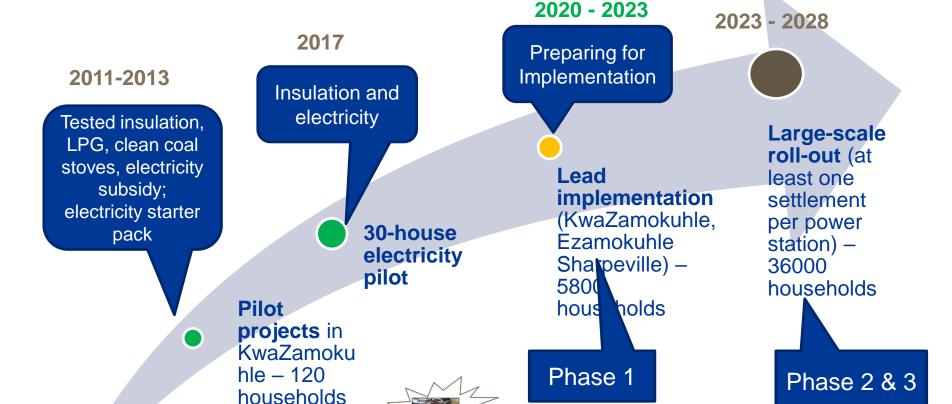
#### **Plant Performance Optimisation**

- Low Fuel Ignitors: Plasma and Mini Oil Gun Technologies
- Materials & Technologies for Performance Improvement of Cooling Systems (MATChING)
- Capture of Evaporated Water with Novel Membranes (CapWa-Pro)
- Planning Committee of The 7th Conference on Industrial Fluidization, South Africa
- IEA Clean Coal Centre (CCC) Membership

### Eskom's air quality offsets journey



**BM** 



feasibility study

Pre-



Stove swap in the Highveld



Waste intervention in the Vaal

### Air quality offset progress

**⊗**Eskom BM

- Phase 1 (lead implementation) commenced in February 2021
  - 7 Contracts in place (MRC, PMV, KwaZa PMO, KwaZa Insulation, Eza PMO, Sharpeville Cleanups)
  - PMV, KwaZa PMO and KwaZa Insulation on the ground in KwaZamokuhle
  - Finalizing contracts for Ezamokuhle and the procurement of stoves and heaters
  - Stakeholders engagement with authorities, municipalities, communities and households ongoing
  - KwaZa Local Project Management Office (PMO) setup and field workers trained
  - Community activations and household registration in KwaZa underway
  - Rollout of interventions KwaZa, Eza and Sharpeville planned for May / July 2021 (the stove contract encountered unexpected delays in April)
- Phase 2 and 3 to commence in 2022 (funding to be confirmed)

















## Matter between Groundwork Trust and Minister of DFFE (high level Eskom input)



- Eskom has shared in this presentation progress with regard to plans which will reduce the Eskom contribution to emissions and minimising the impact on households through the air quality offset programme
- Other matters raised in the court papers relate to enhanced monitoring and reporting of ambient air quality and reporting by industry.
  - Eskom has for at least 30 years monitored and reported on particulate emissions, in the past decade Eskom has, in alignment with legislation implemented continuous emission monitoring for gases.
  - Monthly and annual reports are submitted to the authorities and made available on an Eskom website providing full access to the public.

#### Conclusion



- Practical implementation of the MES, which supports principles of sustainability, is critical for effective air quality management and providing economic and regulatory certainty for industry.
- The requirement for existing plant to comply with new plant standards, most specifically for sulphur dioxide requires further analysis to avoid a capacity shortage immediately and further in 2025.
- Eskom has and continues to implement key projects committed to in the 2014 postponement application. Financial constraints may however impact on any requirements for future retrofits.
- The 2019 postponement application was submitted in 2018 and 2019, additional information was finally submitted in August 2020. Eskom is awaiting a decision from DFFE.

### Content



- Eskom status of compliance with relevant Air Quality Legislation (MES)
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## Eskom's history of engagement with climate change issues



- 1. Voluntary reporting of CO<sub>2</sub> emissions from 1994 and N<sub>2</sub>O shortly thereafter; and mandatory reporting of CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub> emissions since 2017, now with the addition of SF<sub>6</sub>
- 2. Previous engagement with the Intergovernmental Panel on Climate Change processes
- Climate Change Strategy in place since 2005
- 4. Historical contribution of data to numerous DFFE studies and reports, including the national Greenhouse Gas Inventories
- 5. Participation on the South African delegation to various UNFCCC engagements, with a particular focus on Adaptation and Market Mechanisms
- 6. Voluntary participant in the **pilot carbon budgets**
- **7.** Responsive stakeholder in the developing legislative processes; including submissions to the Integrated Resource Planning process (IRP2010 assumed first CO<sub>2</sub> "limit")
- 8. Compliance with current legislation i.t.o. reporting, pollution prevention plans and carbon tax
- **9. Eskom's GHG emissions peaked in 2014** (233.3 MtCO<sub>2</sub>) and have plateaued. 10 years earlier than projected in the peak, plateau, decline scenario for national GHG emissions

### Eskom's most recent Carbon Footprint report



TABLE 1 - ESKOM CARBON FOOTPRINT SUMMARY BY SCOPE AND CATEGORY

	GHG Emissions (†CO2e)	GHG Emissions (%)
Scope 1 - Categories		
Stationary Combustion	212,192,077	99.81%
Mobile Combustion by Eskom Fleet	81,797	0.04%
Fugitive Emissions – SF6	36,212	0.02%
Waste Disposal	3,468	0.00%
Non-Combustion Product Use	9	0.00%
Scope 2 - Categories		
Electricity and Heat Purchased <sup>1</sup>	Excluded	Excluded
Scope 3 - Categories		
Coal Delivery to Site	269,963	0.13%
Official Mileage	12,627	0.01%
Air Travel	3,368	0.00%
Vehicle Rental	1,903	0.00%
Total	212,601,425	100%

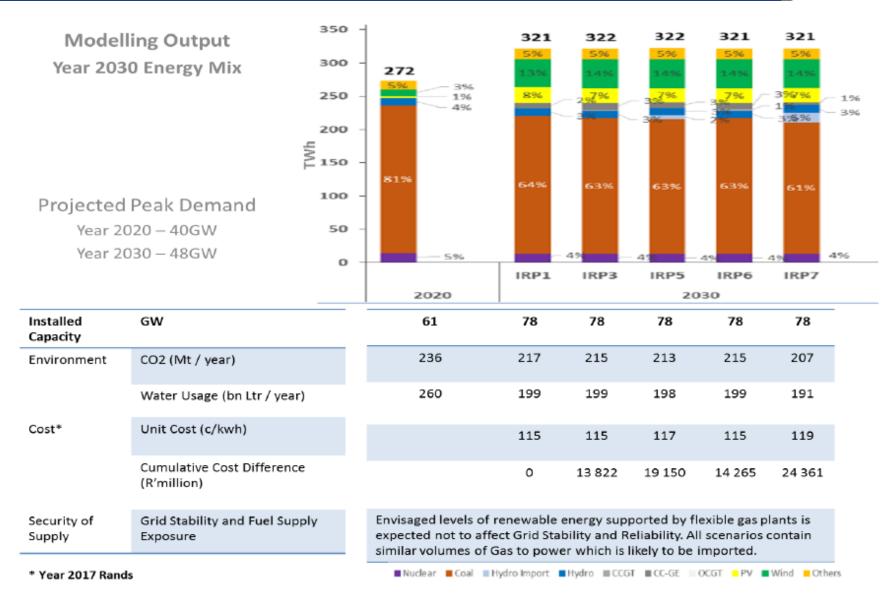
FINAL REPORT
ESKOM CARBON
FOOTPRINT STUDY
2019

A Report for Eskom Holdings SOC Ltd

<sup>&</sup>lt;sup>1</sup> As electricity generation is Eskom's main activity, Scope 2 indirect emissions are in principle accounted for as Scope 1 direct emissions as per the GHG Protocol.

## Diversification of the future electricity supply mix enables a decrease in GHG emissions (2030)





### From 2030, the share of coal reduces in all scenarios



#### Modelling Output Year 2050 Energy Mix

Projected Peak Demand

Year 2020 - 40GW

Year 2030 - 48GW

Year 2050 - 61GW

	450						
	400 -		397	397	399	395	398
	350 -		32	396	27%	28%	2796
	300 -	272	4.2%	28%		2890	2775
	250 -	5-76 376 196 496		1626	16%	1796	1.696
TWh	200 -		20%	896	296	3 <mark>% 1% 3%2%</mark>	- 39 <mark>6 556  </mark> 496 396
	150 -		496	496	390	496	44.96
	100 -	81%	796	3% 37%	42%	1896	20%
	50 -		1796				14% 19%
	0 -	5%					
			IRP1	IRP3	IRP5	IRP6	IRP7
		2020			2050		

Installed Capacity	GW
Environment	CO2 (Mt / year)
	Water Usage (bn Ltr / year)
Cost*	Unit Cost (c/kwh)
	Cumulative Cost Difference (R'million)
Security of Supply	Grid Stability and Fuel Supply Exposure

61	148	126	126	126	126
236	82	160	178	92	90
260	36	54	51	36	38
	135	143	144	148	151
	0	282 315	466 286	515 081	857 073

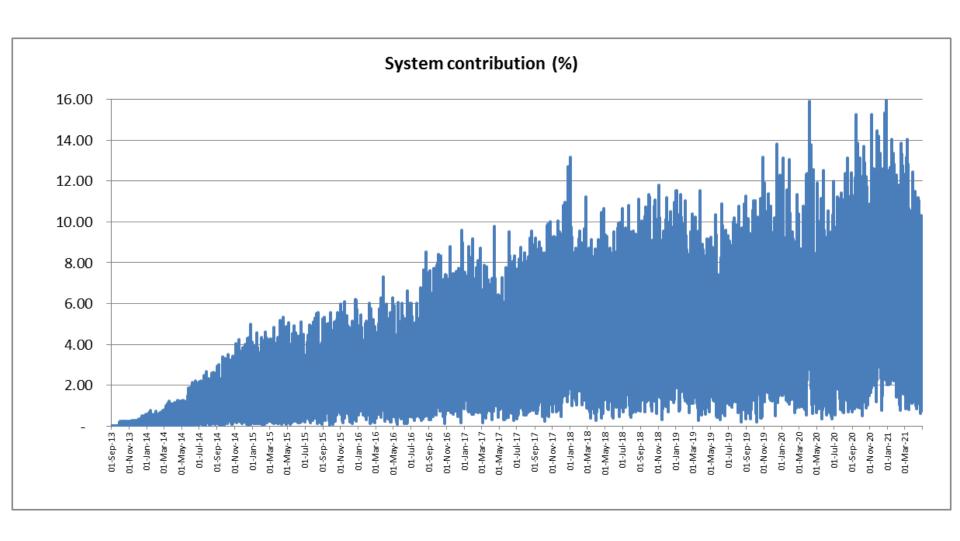
Reliance on coal continues significantly decline to around 30% from between 60% and 80% pre year 2030. Significant reliance on renewables and gas. Depending on source of gas, there is potential price and supply risk. Grid stability at high levels of renewable energy will need to be studied in detail and confirmed before a path is decided.

■ Nuclear ■ Coal ■ Hydro Import ■ Hydro ■ CCGT ■ CC-GE ■ OCGT ■ PV ■ Wind ■ Others

<sup>\*</sup> Year 2017 Rands

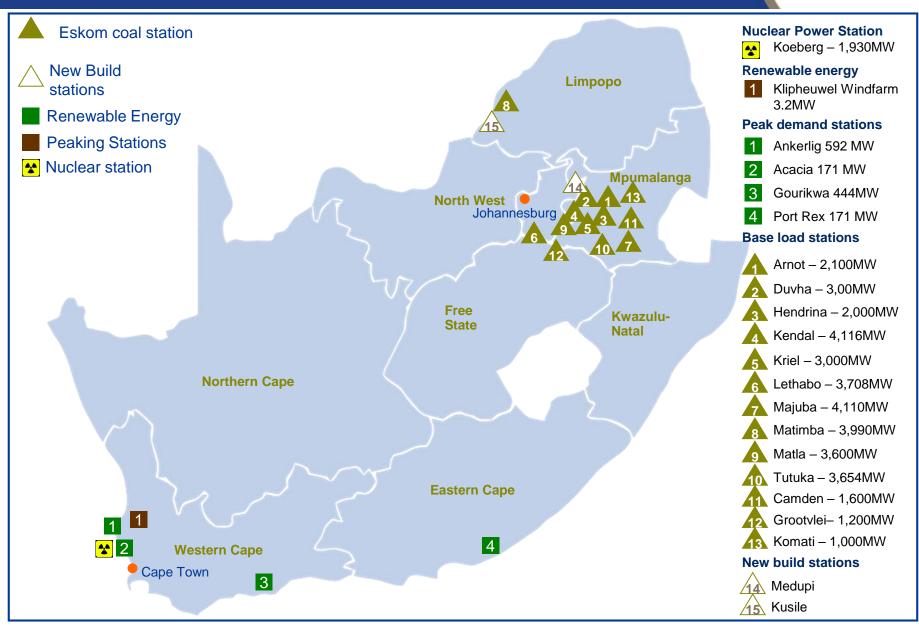
## Renewable electricity generation provides a growing contribution to the electricity system





## Gradual shutting down will have cumulative effects due to the concentration of coal stations





### A Just Energy Transition is required





## Various initiatives are being driven across the business



#### **Initiatives - energy**

- Komati repurposing and repowering execution
- 2. Sere expansion evaluation and project initiation
- 3. Tubatse 1000MW pumped storage opportunity evaluation
- Richard's Bay greenfields gas opportunity evaluation
- Kleinsee / Aberdeen / Kiwano opportunity assessment (300 MW, 200 MW, 750 MW)
- Assess the feasibility of conversion of units at midlife stations
- 7. PV build at existing midlife sites (246 MWp)
- 8. IRP greenfields (2950 PV + 3100 wind)
- Microgrid, smart grids and SSEGs rapid upscaling evaluation and execution
- Grootvlei repurposing and repowering execution
- 11. Hendrina repurposing and repowering execution
- Camden repurposing and repowering execution

#### Initiatives - just, transition and enablers

- Completion of Komati, Grootvlei and Hendrina socioeconomic impact assessments (SEIAs) and mitigation plans
- 14. Initiate the SEIA studies for Camden, Arnot and Kriel
- 15. Establish appropriate green financing structure
- 16. Accelerate establishment of reskilling assessments (internal and external)
- 17. Fully operationalise JET Office
- 18. Develop partnership models for repowering, repurposing and green fields options
- 19. Develop change management plan
- 20. Develop stakeholder and advocacy plan
- 21. Establish policy/regulatory/governance requirements for capacitation projects
- 22. Clean energy technology positions
- 23. Establish Eskom's participation in 30 GW new RE over 10 years for SA
- 24. COP 26 preparation
- 25. Partner with CSIR and other bodies for national reskilling drive
- 26. Initiate socio-economic impact assessments for Tx and Dx projects
- 27. Establish green tariff
- 28. NEDLAC working group

#### In conclusion



- 1. Eskom has a long history in responding to the issues around climate change.
- Analysis shows that the significant reductions needed in electricity-sector GHG emissions is achieved through energy efficiency and diversification of supply.
- 3. Eskom's GHG emissions peaked in 2014 (a full decade earlier than what was expected for the national GHG emissions' peak, plateau and decline trajectory).
- **4. Electricity supply scenarios to 2050** indicate that the electricity system will transform significantly over the coming 3 decades.
- 5. This is a **challenge and an opportunity** that Eskom is excited to embrace.
- 6. We are exploring numerous initiatives to respond to this Just Energy Transition.

### Examples: First Rural Microgrid



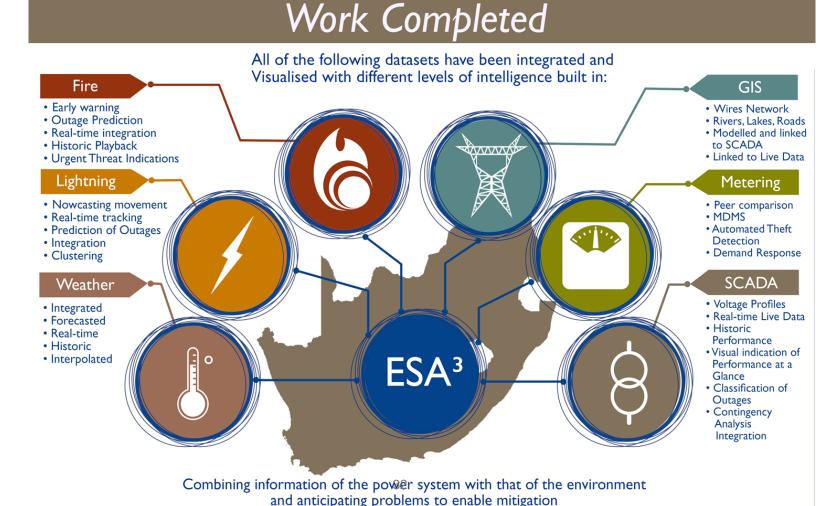


- RT&D has successfully designed, commissioned and implemented a **Smart Rural Microgrid in Ficksburg**, Free State OU.
- The off-grid system is **providing electricity to Wilhelmina farm** and has enabled research into off grid systems to determine the operational requirements, processes and design considerations in order to supplement the current electrification strategy.
- In addition to the social benefits of off-grid systems, there is a need to understand the impact that renewables and distributed technologies have on Eskom's network, and to determine how to effectively manage these impacts.

#### Examples: Grid Situational Awareness – RT&D Lab



 Eskom has many strategically and critically important data sources that exist independent of one another. These data sources have the potential to enhance System Operator's Situational Awareness only if they're integrated and turned into actionable information. The first phase of the project has been handed over to System Operator for implementation.



### Examples: Battery Energy Storage Test Facility



Designed and established large scale battery energy storage test facility in Rosherville, Gauteng.

First and only test facility of its kind in the Southern Hemisphere.





#### **Specification:**

- Capability to test 5 x 200kW 1.2MWh different battery technology units
- All tested under identical load discharge profiles
- Output of the 5 units is then synchronised and fed back into the grid, as if they were a single 1MW battery unit, in order to demonstrate the effectiveness of this form of energy storage.

#### **Objectives:**

- **1. Demonstrate the effectiveness** of battery energy storage at a grid scale.
- Test individual battery technologies under real operating test regimes
- 3. Identify the **best technology** for various **applications**
- **4. Establish** the probable **life cycle** of each of the various technologies under real working conditions
- 5. Establish the **round trip efficiencies** of the various units
- 6. Give Eskom insight into the future installation of commercial battery storage units of the Megawatt scale.





## Conclusion