Compliance to MES: Progress, postponements and technology options.

Portfolio Committee on Environmental Affairs' Workshop on the Minimum Emission Standards.

Date: 06 February 2018

Executive overview

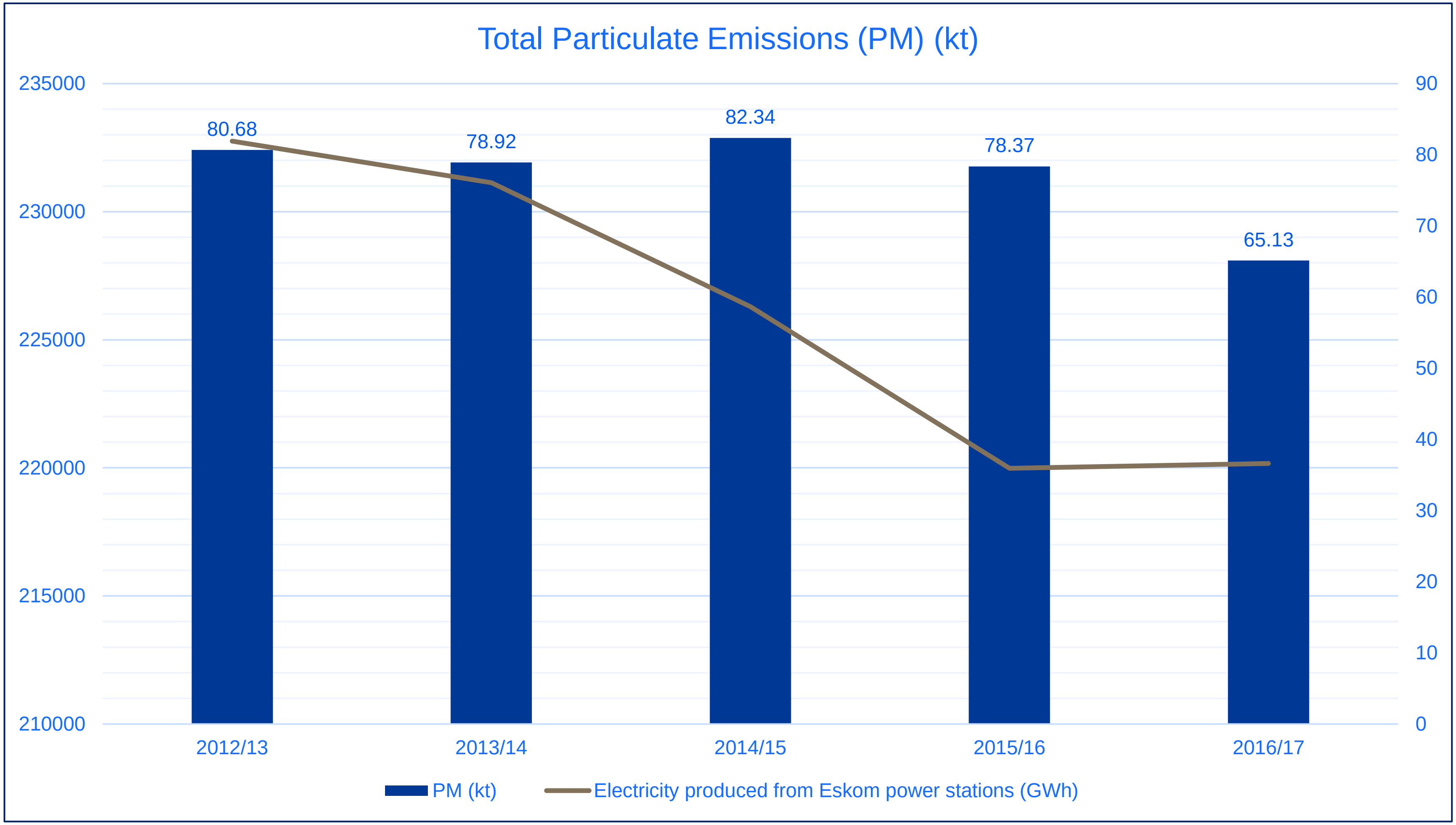
- Eskom supports the Minimum Emission Standards as they are needed to reduce harmful health effects of air pollution and provide certainty for planning.
- Eskom has made progress with its "power plant compliance status" but there are some delays being experienced in project execution
- Eskom has made progress with the Air Quality offset programme
- Eskom's ambient air quality monitoring network shows that there is generally compliance with ambient SO_2 and NOx standards, but non-compliance with PM10 and PM2.5 standards on the Mpumalanga Highveld.
- There continues to be a challenge for existing plants to meet the new plant standards within the required timelines due to high cost, water use and impact on the electricity tariff.
- Eskom has initiated the process of applying for new postponements for the next 5 year period. The detail of what postponements will be requested will be available once Eskom has completed a thorough review. Public meetings for Tutuka power station postponement began in January 2018. For four coal fired power stations, no postponements are expected to be applied for.

Overview

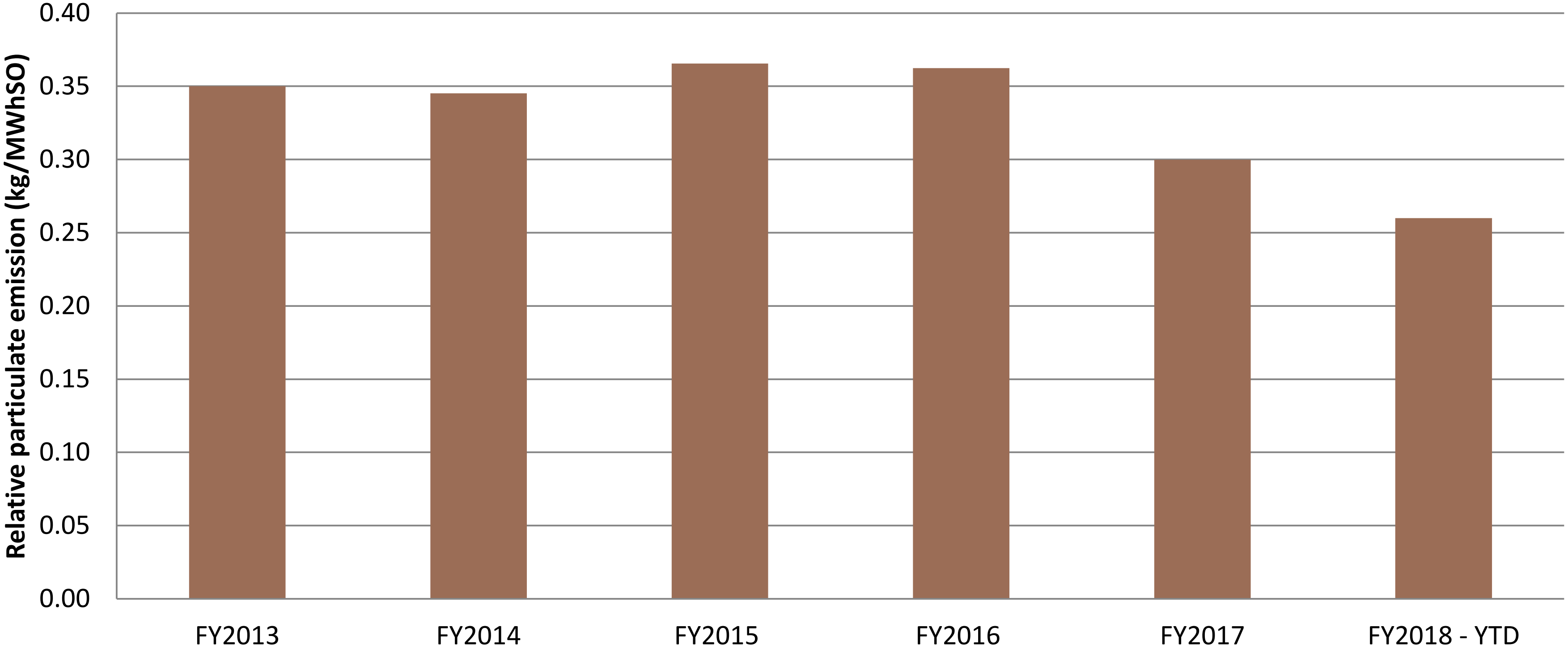
- Emissions and Ambient Air Quality Trends
- Current Status of Eskom's Air Quality Compliance Plan
- Eskom's Air Quality Offsets Project
- Alternative Technologies to Reduce Sulphur dioxide
- Conclusions

Emission and Ambient Air Quality Trends

Yearly (financial year) total tonnages from Eskom: 2012/13 – 2016/7



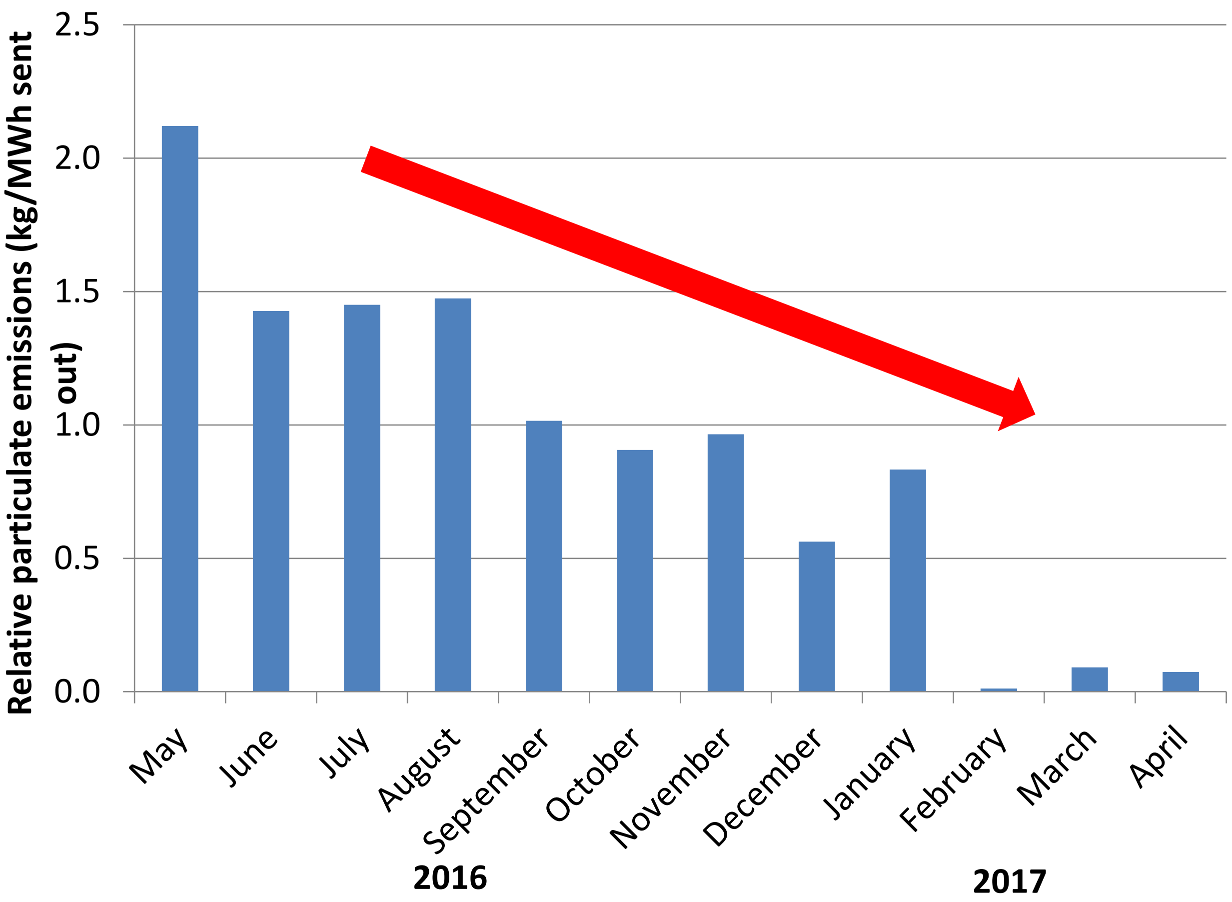
The Eskom roadmap travelled to-date to reduce relative yearly particulate emissions (2012/13 to 2017/18)



High load factors coupled with plant availability challenges at a number of stations led to the sustained high emissions between FY2013 to FY2016. The reduced system demand from FY2017 provided for maintenance opportunity to undertake essential repairs at a number of units. This coupled with the start of the retrofit of Grootvlei units 2 to 4 to FFPs plus the completion of refurbishment of the ESP on 4 of the 6 units at Matla resulted in an improving trend.

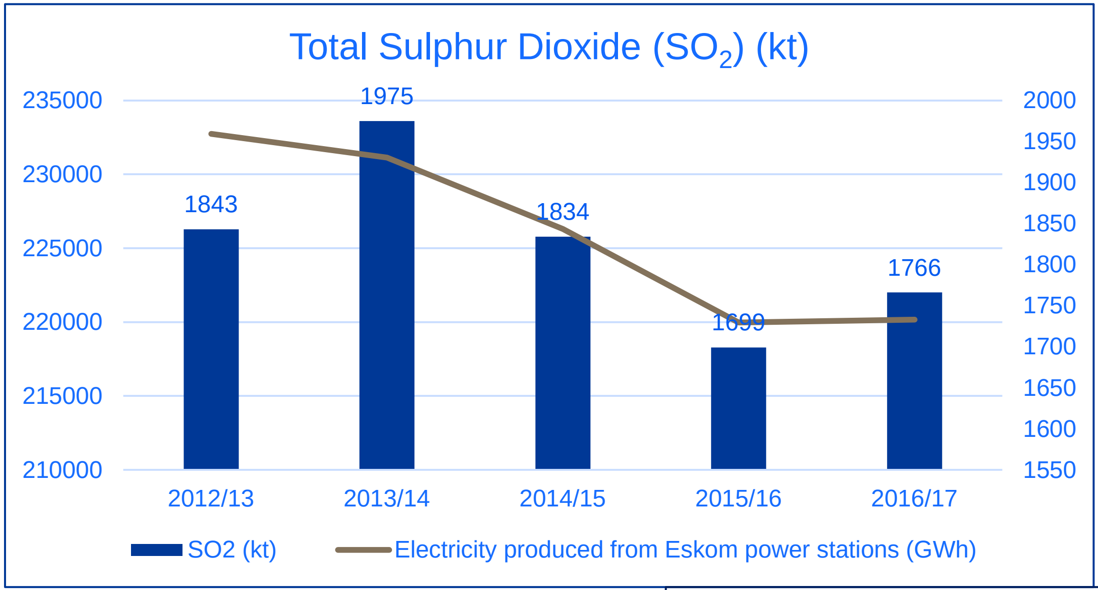
Monthly emission trends (May 2016 to April 2017): Grootvlei fabric filter plant retrofit

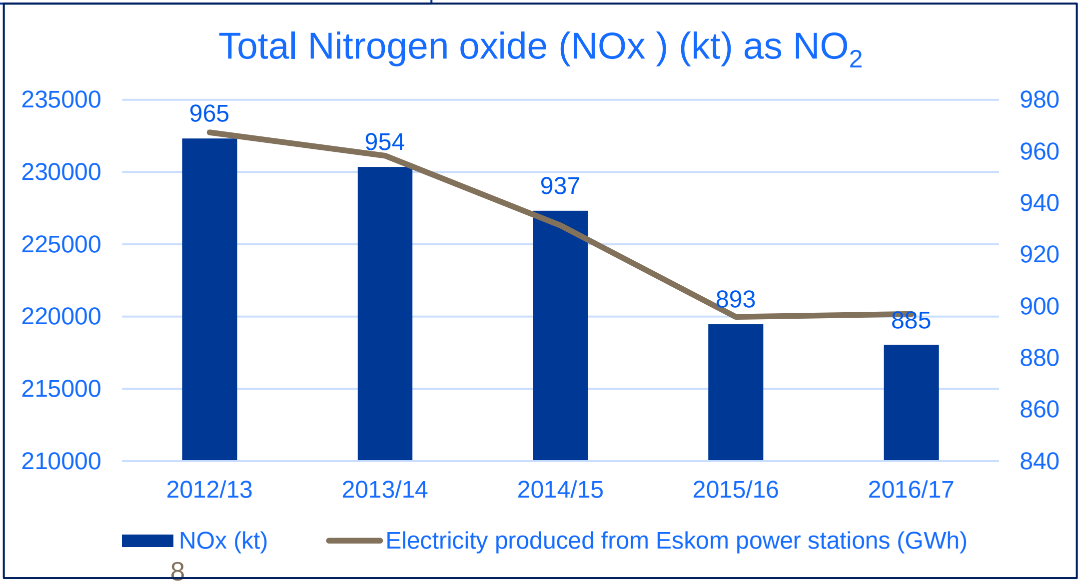
More than 10-fold reduction in relative particulate emissions from Grootvlei Power Station due to fabric filter



Clean stacks after Grootvlei fabric filter plant retrofit

Yearly total gaseous emissions from Eskom: 2012/13 – 2016/17

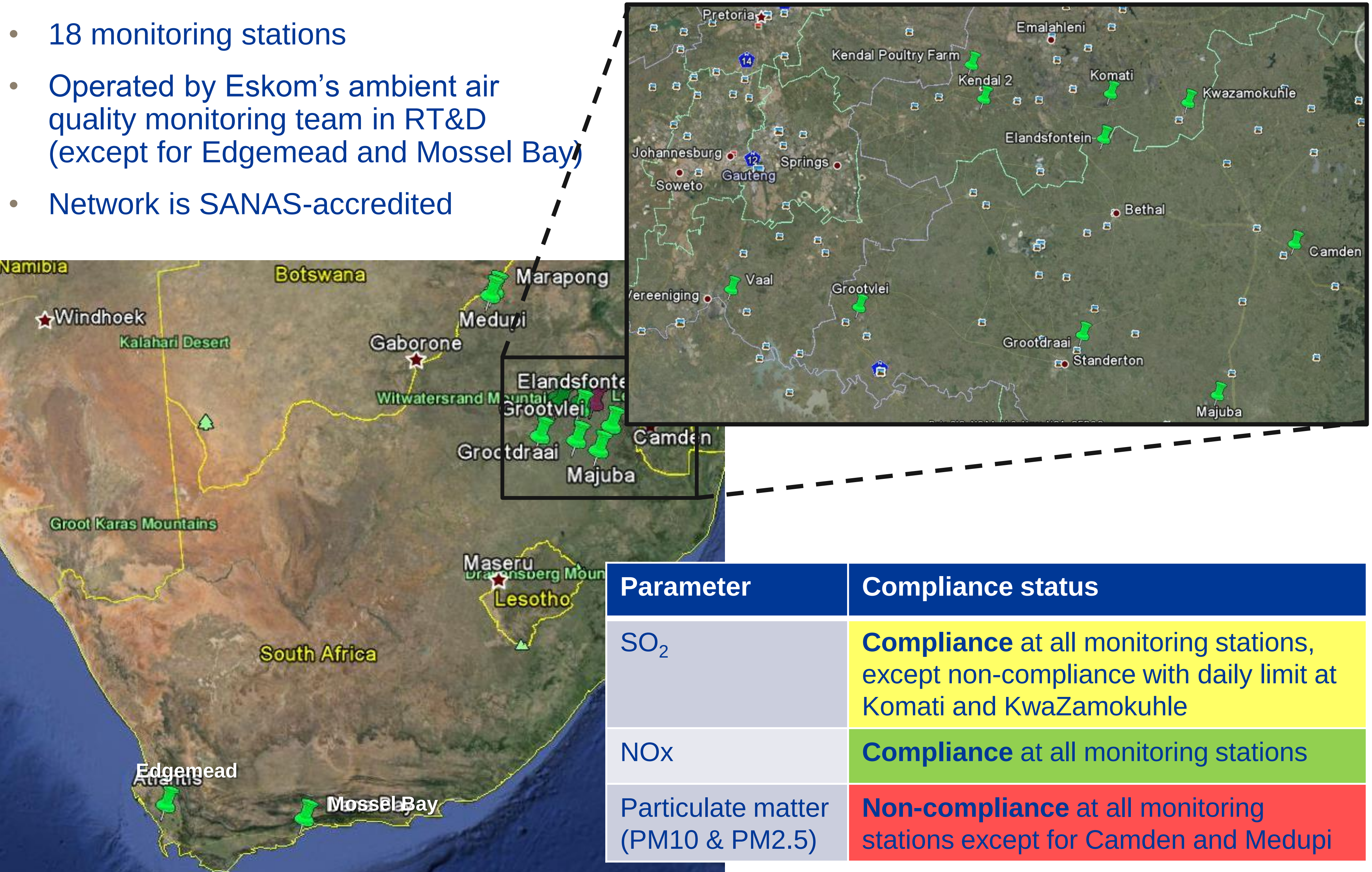




Ambient Air Quality

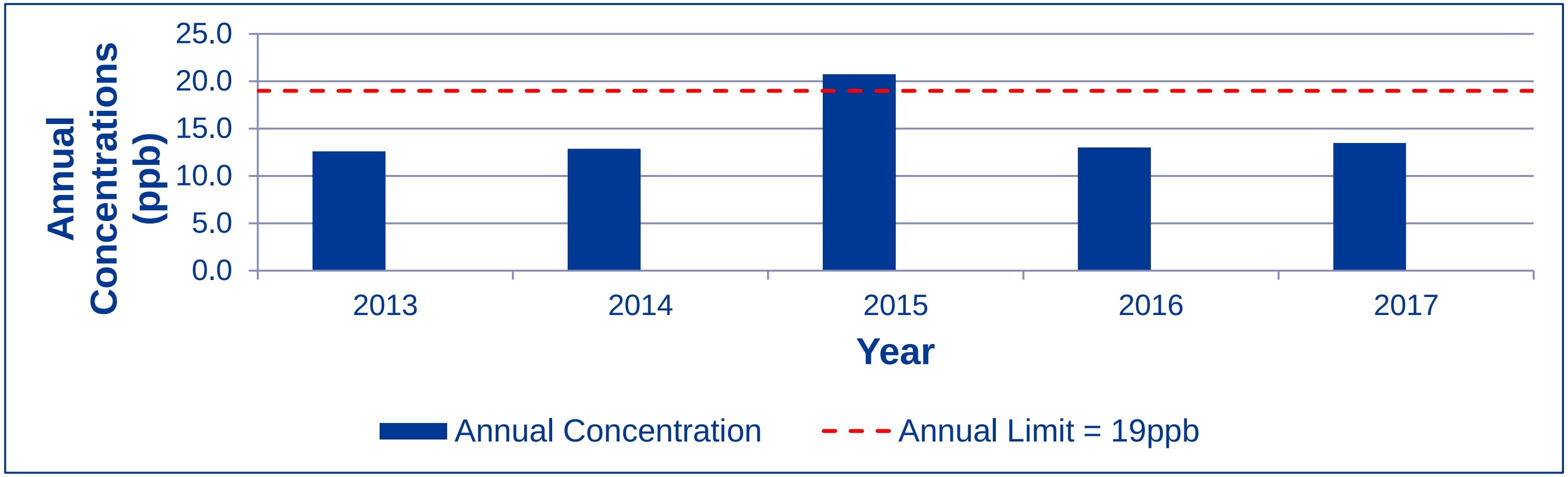
Eskom's ambient air quality monitoring network

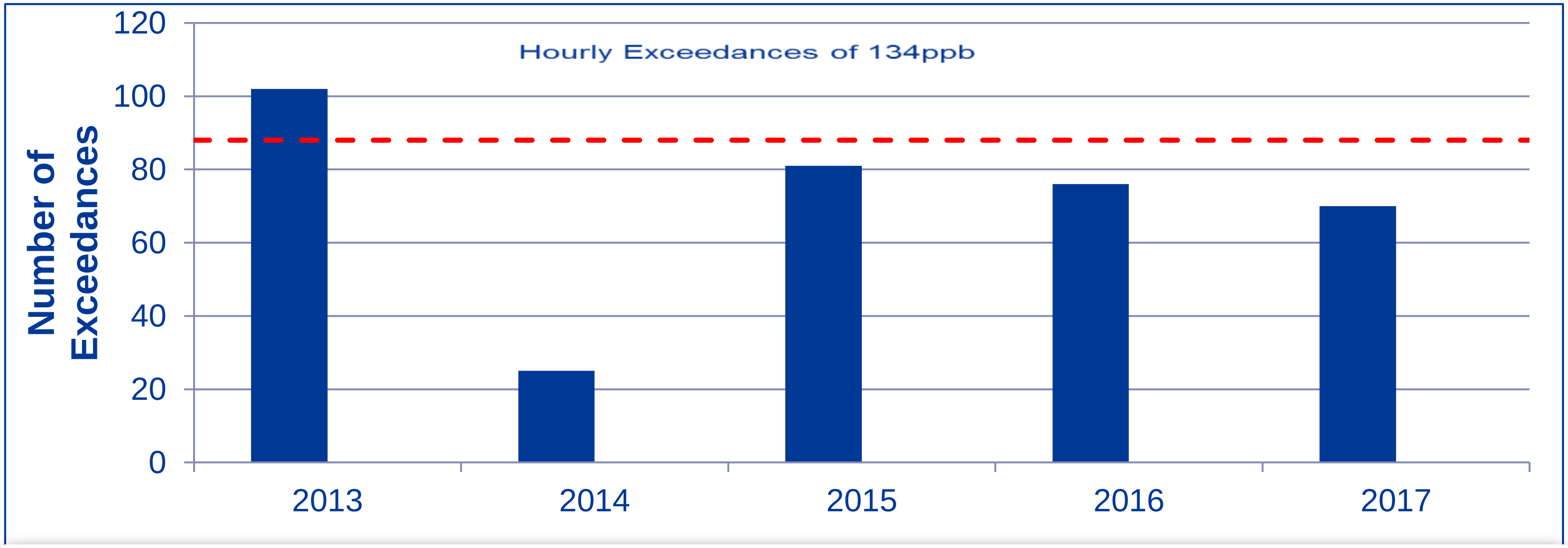
- 18 monitoring stations
- Operated by Eskom's ambient air quality monitoring team in RT&D (except for Edgemead and Mossel Bay)
- Network is SANAS-accredited



Parameter	Compliance status
SO_2	**Compliance** at all monitoring stations, except non-compliance with daily limit at Komati and KwaZamokuhle
NOx	**Compliance** at all monitoring stations
Particulate matter (PM10 & PM2.5)	**Non-compliance** at all monitoring stations except for Camden and Medupi

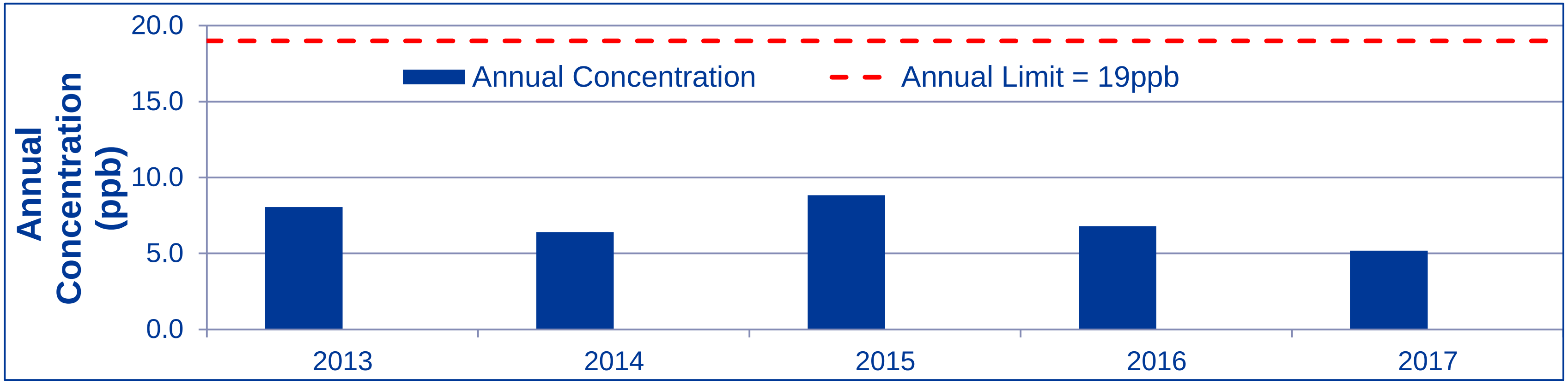
Five year ambient air quality trends of Sulphur dioxide – Kendal Ambient Monitoring Station

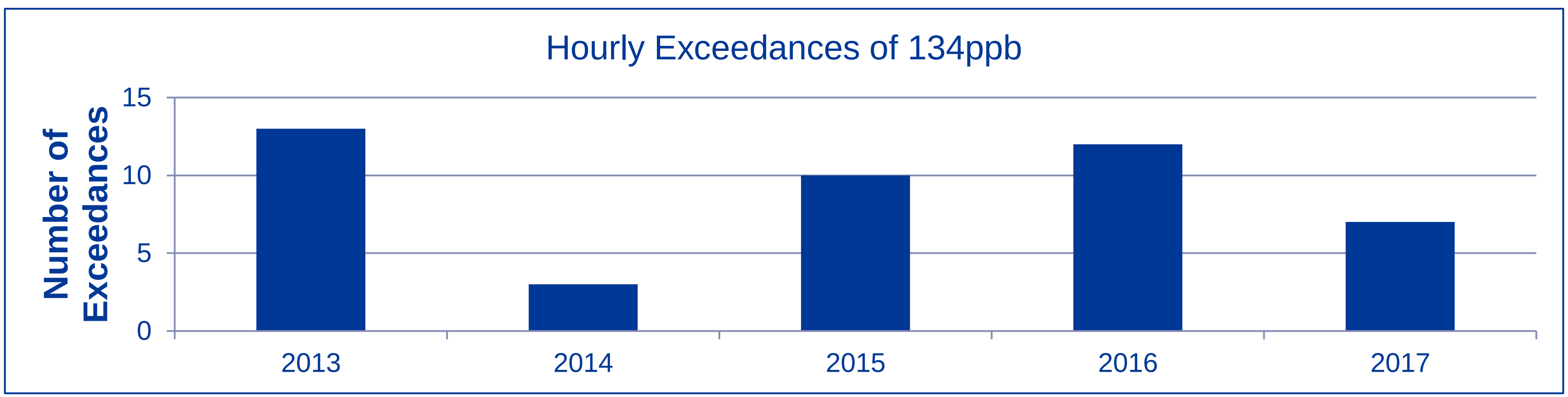




- Ambient SO_2 levels below permissible number of exceedances at Kendal site – 5km downwind of Kendal except in 2013 (point of highest concentration)

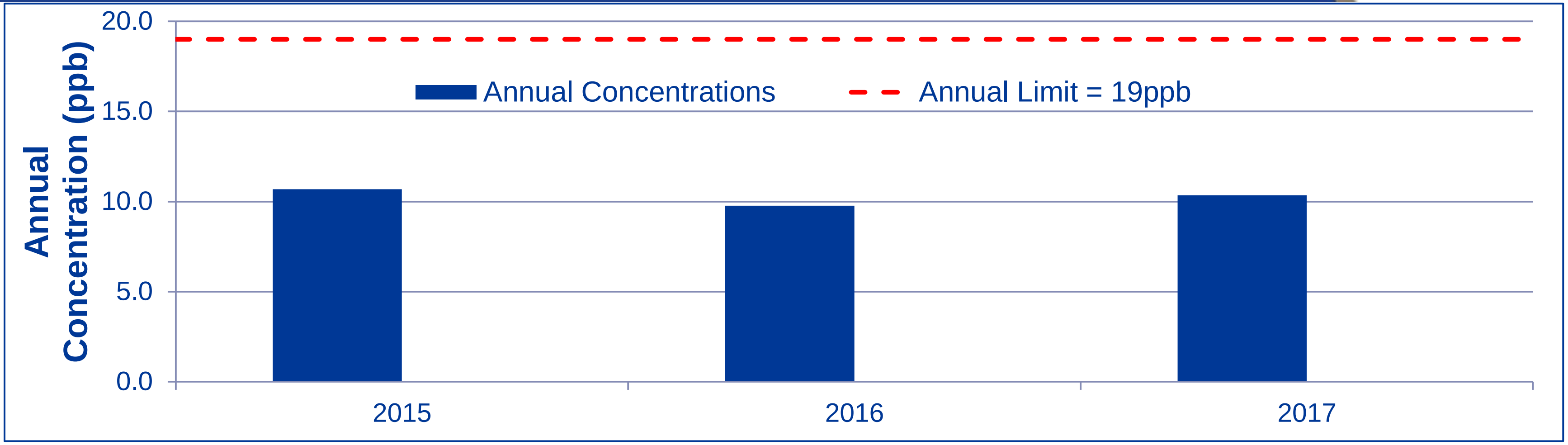
Five year ambient air quality trends of Sulphur dioxide – Marapong Ambient Monitoring Station

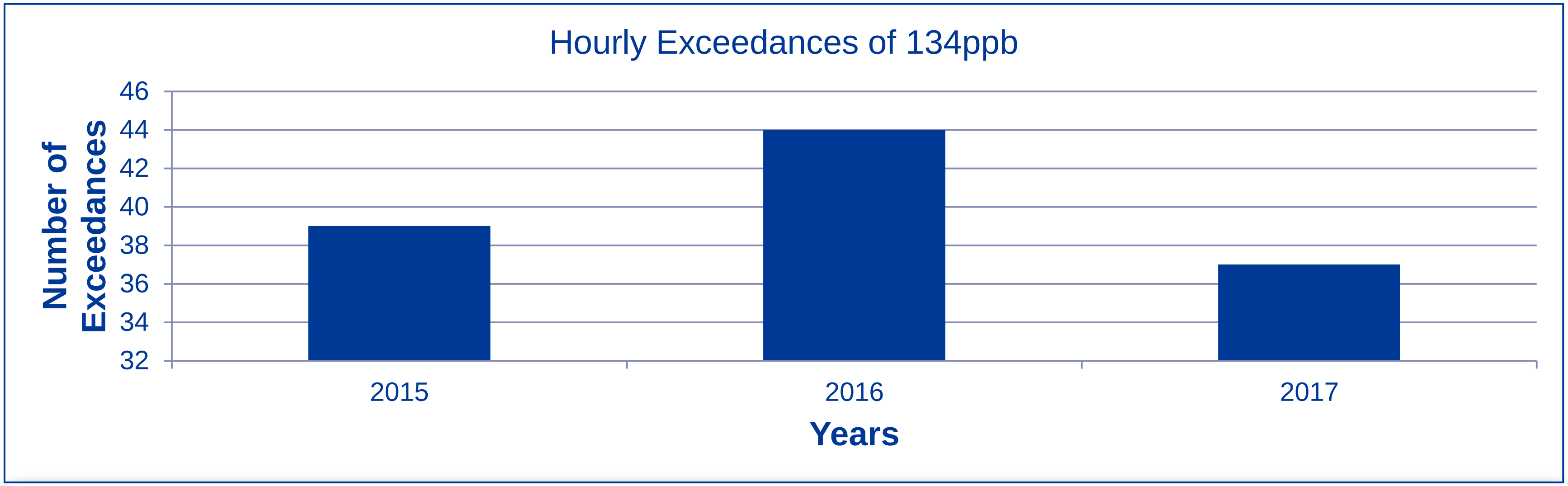




- Ambient SO_2 levels below permissible (88) number of exceedances at Marapong – township upwind of both Matimba and Medupi

Three year ambient air quality trends of Sulphur dioxide – Medupi Ambient Monitoring Station





- Ambient SO_2 levels below permissible (88) number of exceedances at Medupi site – downwind of both Matimba and Medupi

Current Status of Eskom's Air Quality Compliance Plan

Summary of Eskom's Air Quality Improvement plan - roadmap towards compliance

Eskom

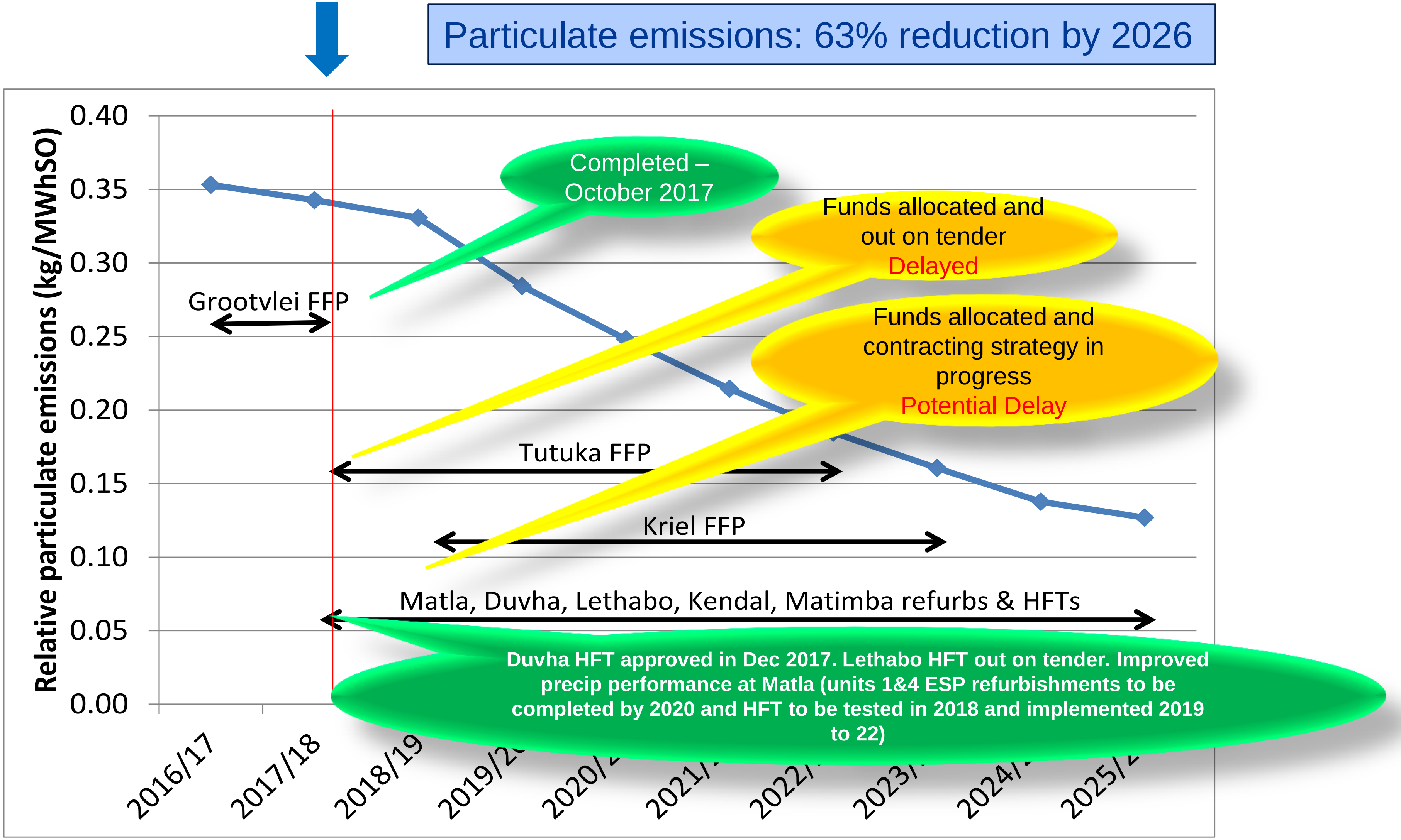
		Years															Decommissioning dates	
	Retrofits	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	**50-year life**	**60-year life**
Medupi	FGD																2064-	2074-
Majuba	LNB																2046-2051	2056-2061
Kendal	**HFT**																2038-2043	2048-2053
Matimba	**HFT**																2037-2041	2047-2051
Lethabo	**HFT**																2035-2040	2045-2050
Tutuka	FFP																2035-2040	2045-2050
	LNB																	
Duvha	**HFT** (U4-6)																2030-2034	2040-2044
Matla	**HFT**															D	2029-2033	2039-2043
	LNB															D		
Kriel	FFP												D	D	D	D	2026-2029	2036-2039
Arnot	None							D	D	D	D	D	D	D	D	D	2021-2029	2031-2035
Hendrina	None						D	D	D	D	D	D	D				2020-2026	2030-2036
Camden	None							D	D	D							2020-2023	
Grootvlei	FFP (U2-4)											D	D	D	D		2025-2028	
Komati	None										D	D	D	D	D		2024-2028	

Completed

- Flue gas desulphurisation (FGD) retrofit
- Low NO_x Burner (LNB) retrofits
- Fabric Filter Plant (FFP) retrofits or high frequency transformer (HFT) installations
- Decommissioning dates: 50 year life and current plan for RTS

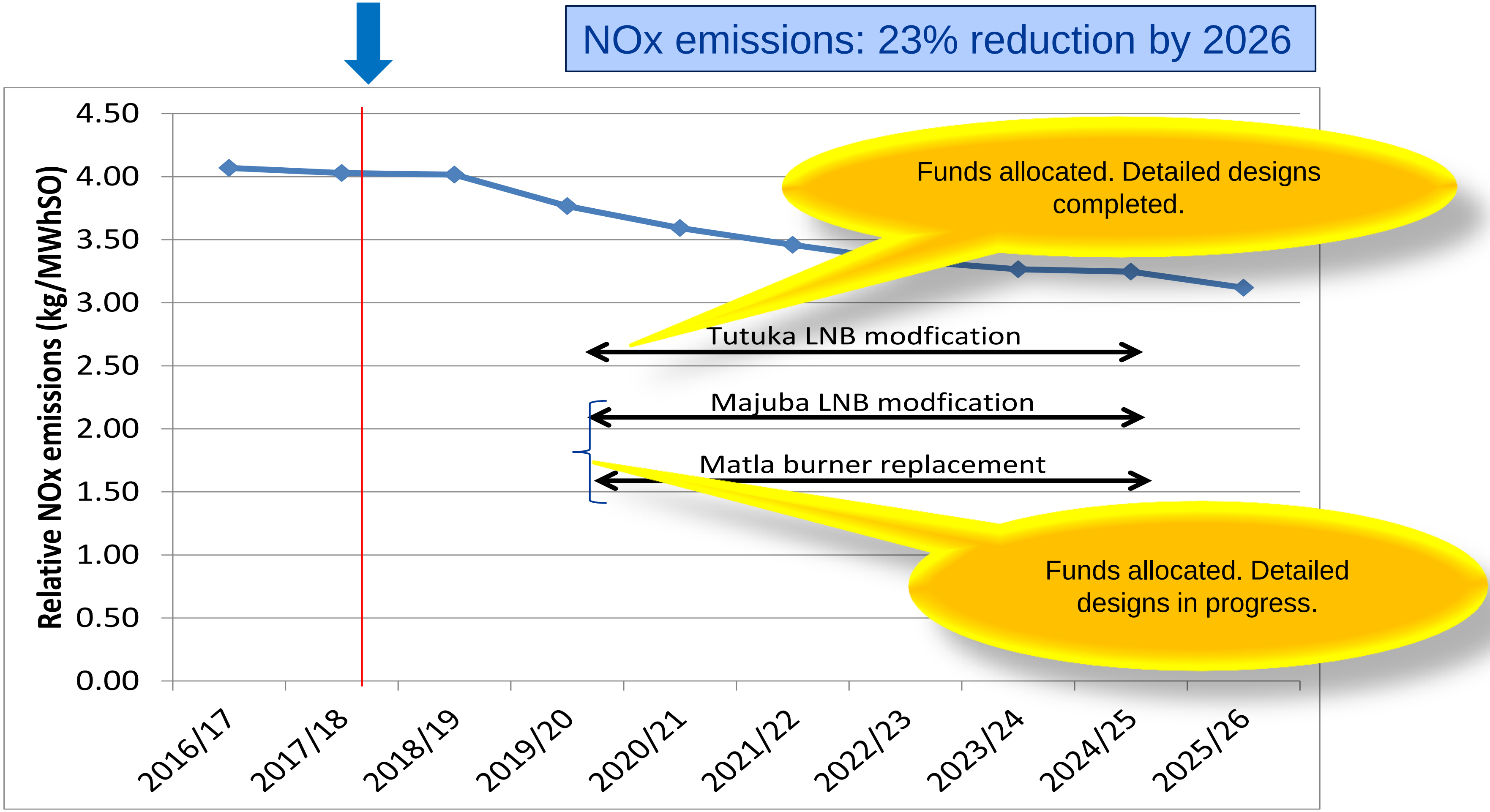
Eskom's emission reductions roadmap towards compliance – Particulate Emissions (PM)

Particulate emissions: 63% reduction by 2026



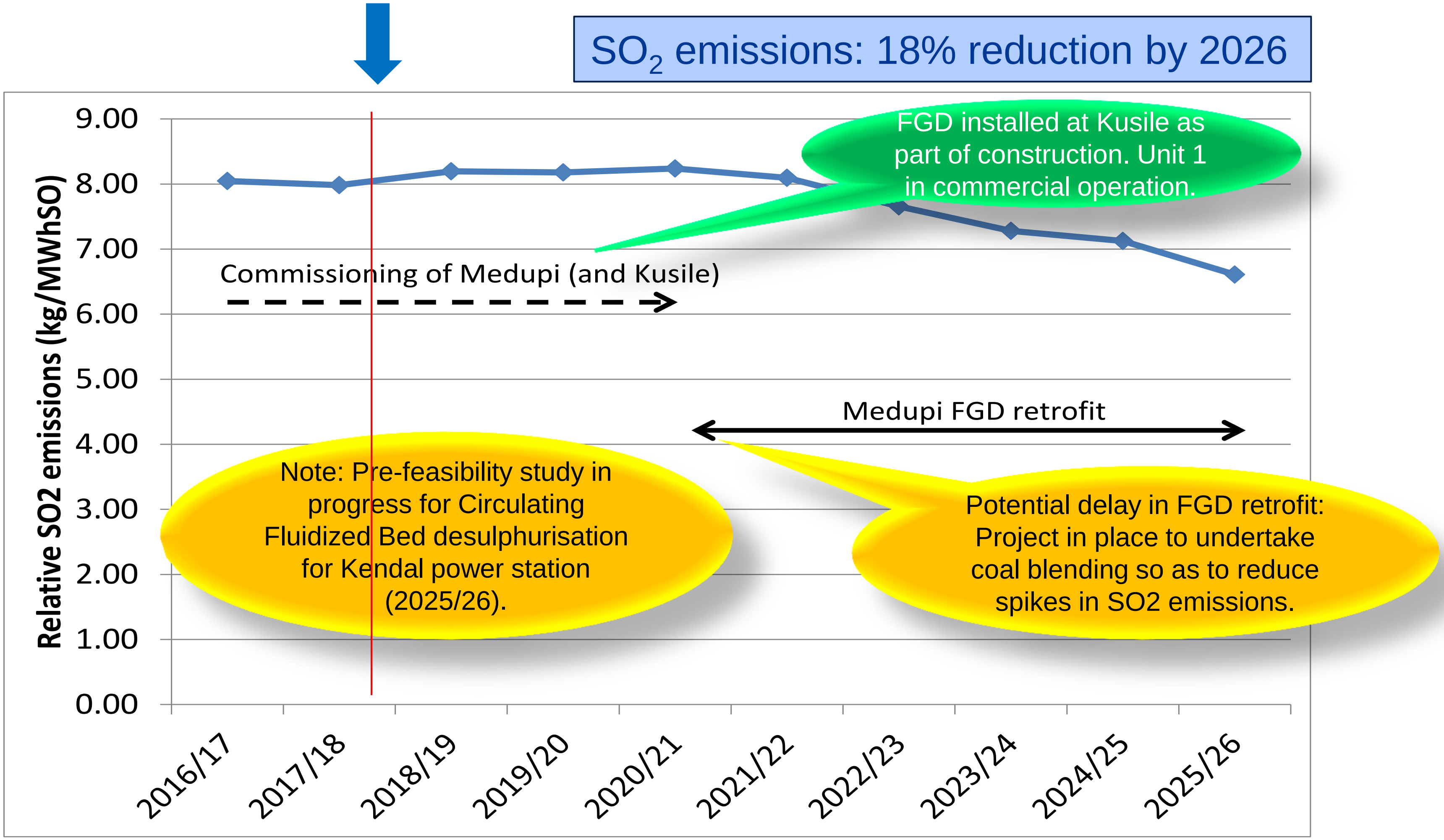
Eskom's emission reductions roadmap towards compliance – Nitrogen Oxides (NOx)

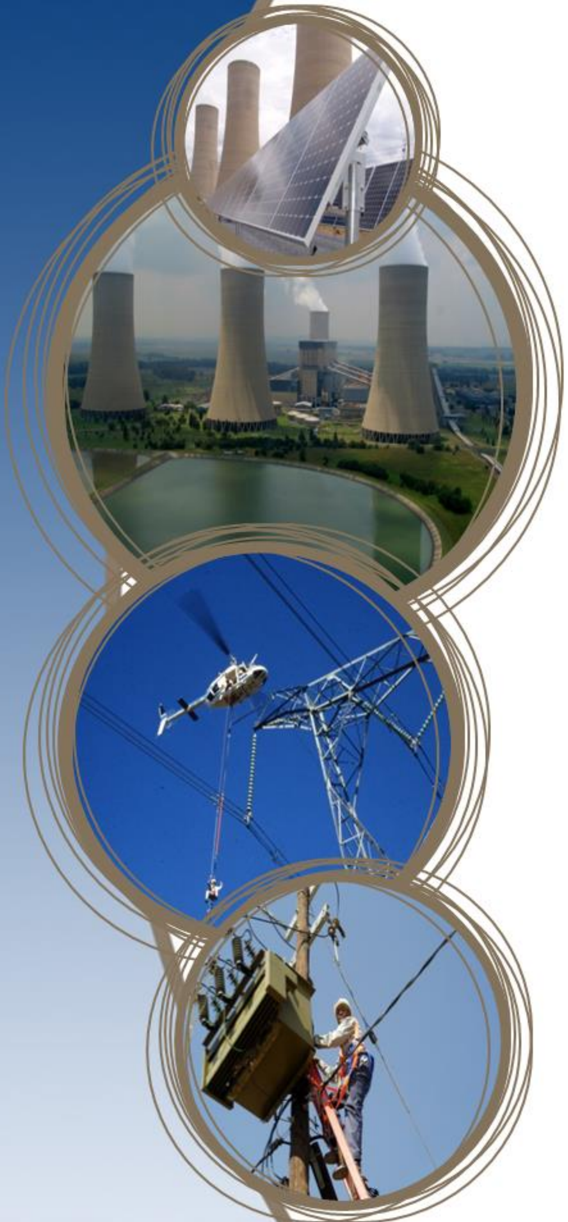
NOx emissions: 23% reduction by 2026



Eskom's emission reductions roadmap towards compliance – Sulphur Dioxide (SO_2)

SO_2 emissions: 18% reduction by 2026





Eskom’s Air Quality Offset Programme

What can be achieved through offsets?

Primary aim

- Improve air quality

Secondary aims

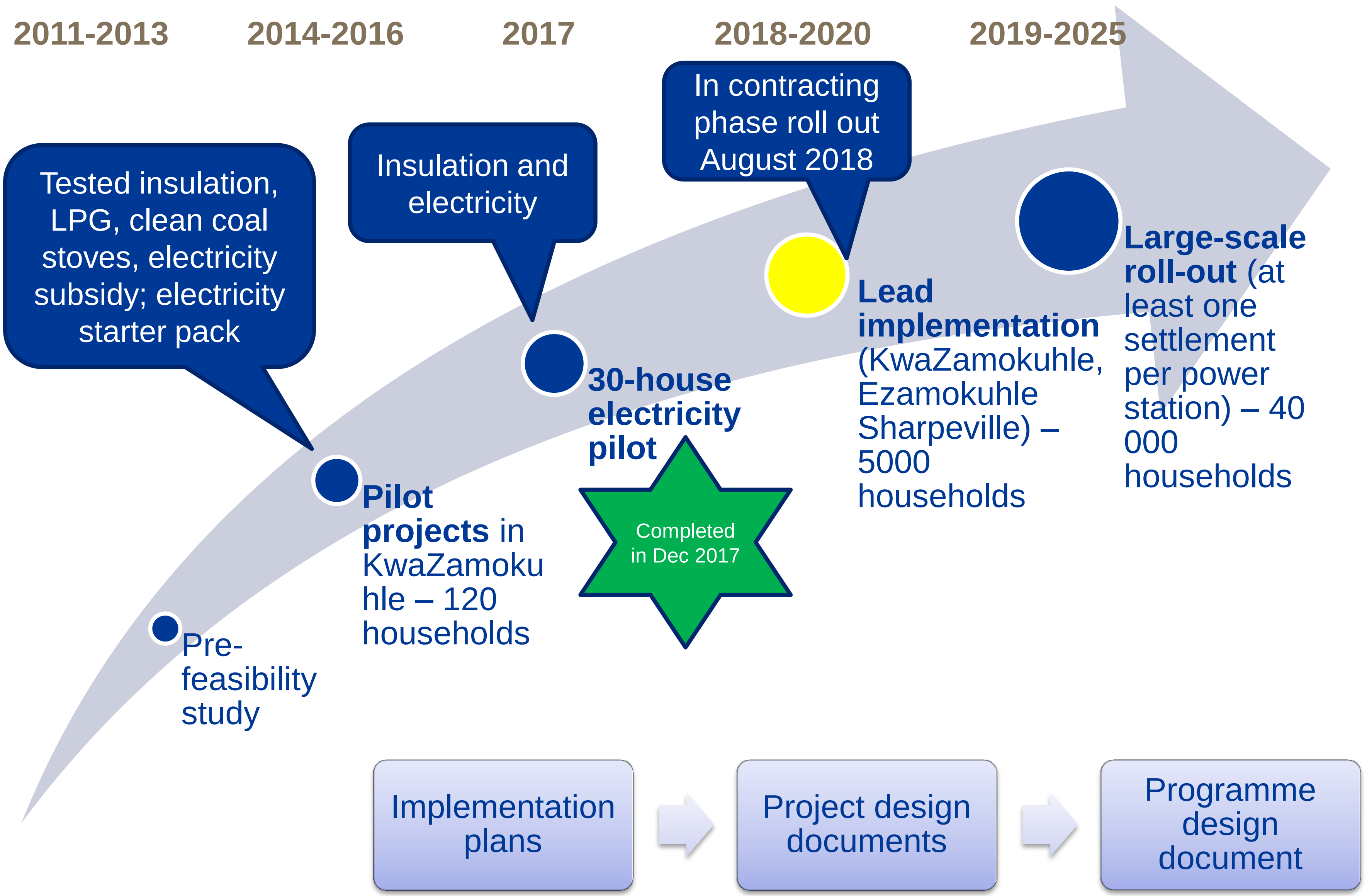
- Local job creation and skills development
- Improve communities' health and quality of life
- Improve relationships with communities
- Reduce energy poverty
- Cost effective channelling of resources
- Reduce CO_2 emissions

What will Eskom be doing for the offsets?

Programme of activities:

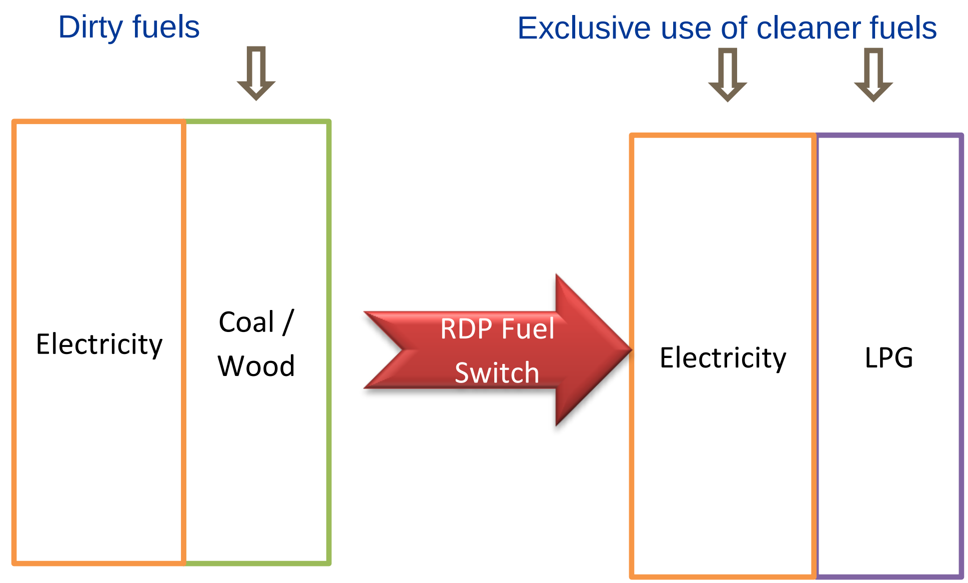
Household emission reduction (Nkangala, Gert Sibande)	Community emission reduction (Vaal)	Education and awareness	Projects to be considered for household application

Eskom's air quality offsets journey



Key findings from the electricity pilot study

- Houses already have electricity but don't use it due to perceived high cost to cook and heat with and cultural preferences.
- It is feasible to switch household from coal to electricity but there is a high risk of reverting back to coal due to cultural norms, electricity cost, electricity supply cuts, ability to heat houses in winter.
- Hybrid of electricity and gas is proposed: Gas/elec plates, electric..



Changes to AQO plans (interventions)

- Intervention for RDP houses (as per **initial** plan)
  - Insulation: Full retrofit (ceilings plus walls)
  - Fuel switching: Switch households to LPG (swop coal stove for LPG stove and heater).




Draft proofing

- Proposed intervention for RDP houses (**current plan**)
  - Insulation: Basic retrofit (ceilings only)
  - Fuel switching: Switch households to electricity plus LPG backup (swop coal stove for hybrid gas electric).

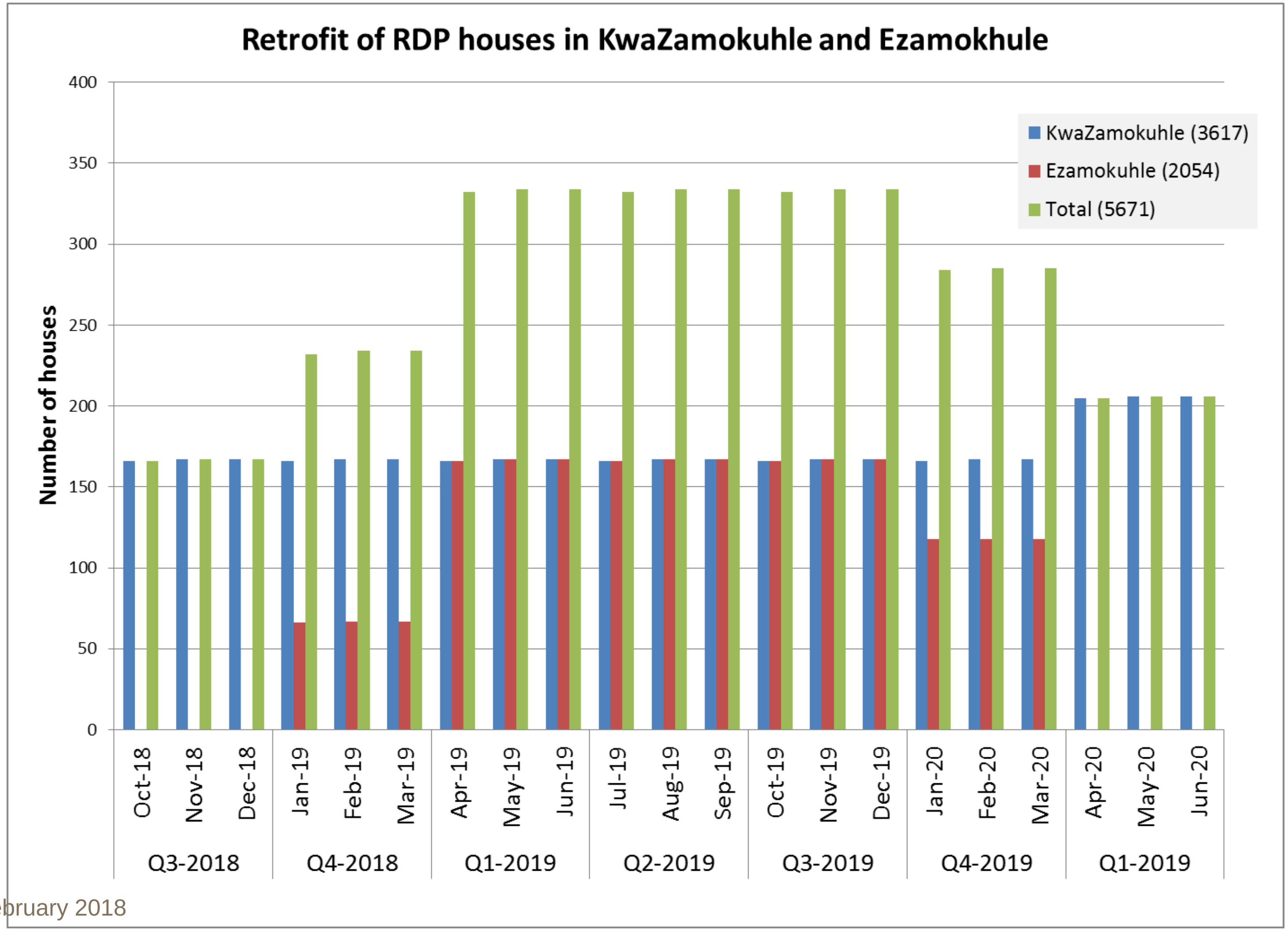



Draft proofing

Rewiring + CoC

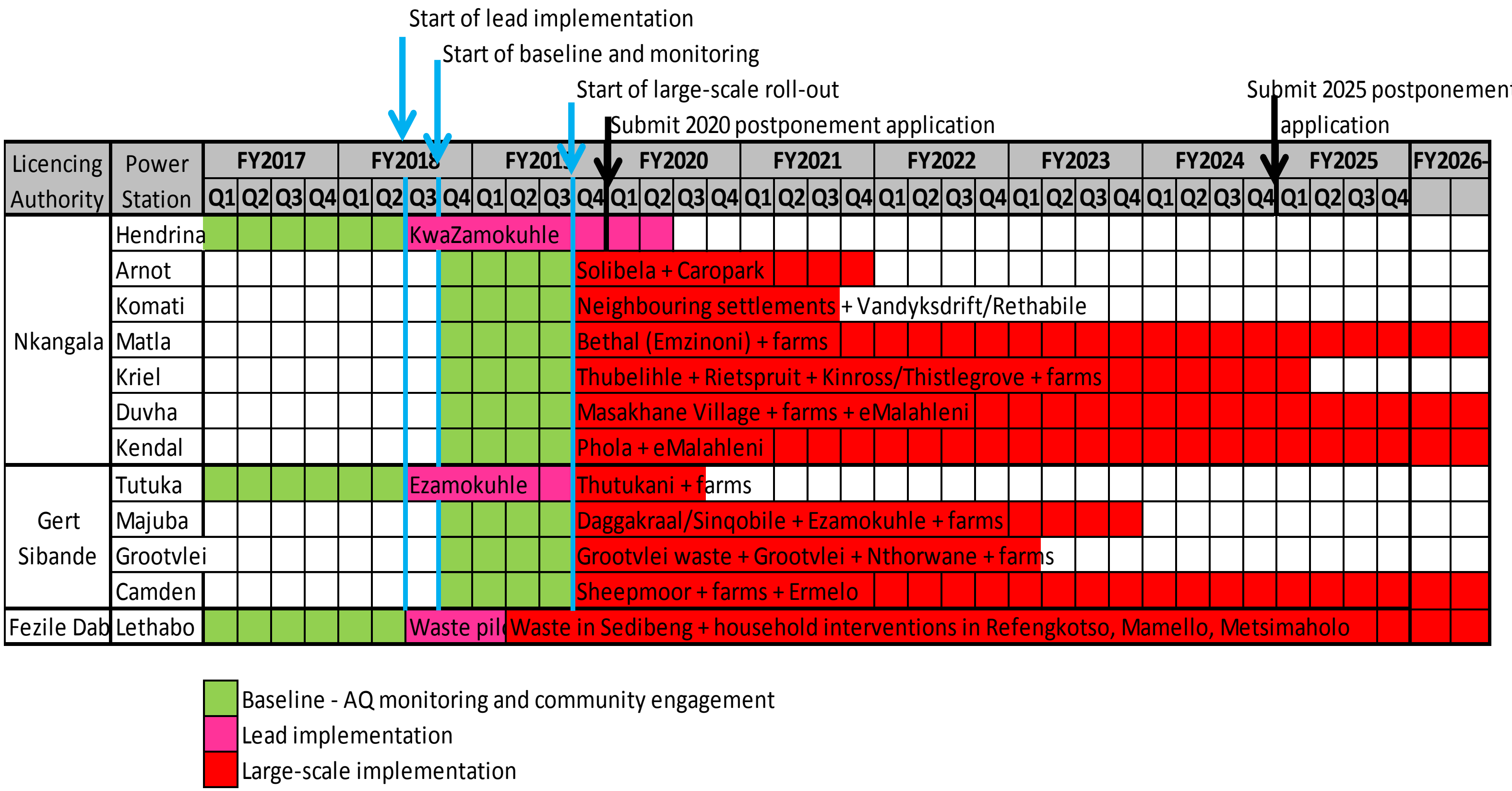
Lead implementation rollout starting in October 2018: Number of houses

Estimated rollout schedule – 166 houses/month ramping up to 334 houses/month



Large scale roll-out

The offset interventions will be rolled out at least one settlement per power station (of which there are 12), commencing with the baseline determination and planning in 2018, and implementation in 2019/20. (overlapping with the lead implementation)



Alternative Technologies to Reduce Sulphur dioxide

Options to Reduce Air Emissions from Eskom's Power Stations

Eskom

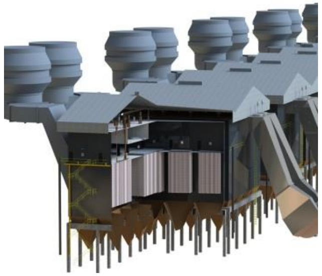
Air Emissions	Technologies (shortlisted options following pre-feasibility studies)

Particulate Matter (PM)	• Fabric Filter Plant (FFP)
	• Electrostatic Precipitator
	  • Sulphur trioxide (SO_3) injection
	  • High Frequency Transformers (HFT)
	  • Ammonia injection

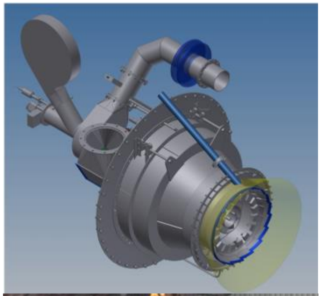
Nitrogen oxide (NOx)	• Low NOx burners

Sulphur dioxide (SO_2)	• Flue Gas Desulphurisation (FGD)
	  • Wet
	  • Semi-Dry
	    • Spay drying absorber
	    • Circulating Fluidized Bed
	    • Duct Injection Systems
	• Coal beneficiation

Kriel FFP Retrofit Concept



Camden LNB



Sulphur dioxide (SO_2) technology options considered: advantages and disadvantages

SO_2 abatement	Advantages	Disadvantages
Wet FGD	• >98% removal efficiency • Can achieve SO_2 emissions to below 500 mg/Nm^3 • Lower sorbent costs (limestone) • Waste – saleable gypsum potential	• Additional water use of 0.21l/kWh • Increased operational cost + 30-40% • Special materials of construction lining to prevent corrosion • 1.2 – 1.5% Increase in power consumption • Large footprint needed for installation
Semi-dry FGD: Spray Drying Absorber	• >90% removal efficiency • Could achieve SO_2 emissions to below 500 mg/Nm^3 • Lower power consumption (0.5% increase) • No waste water produced • The product produced is dry. Can be recycled to improve sorbent utilisation	• Additional water use of 0.14 l/kWh, but lower than wet FGD • Higher sorbent costs (hydrated lime, calcium oxide) • Multiple absorbers required for large plant • Increased operational cost + 35-45%
Semi-dry FGD: Circulating Fluidized Bed	• >95% removal efficiency • Can achieve SO_2 emissions to below 500 mg/Nm^3 • Lime fed can be adjusted to match fuel • Injected water does not need to be high quality • Lower capital costs • Visible (steam) plumes are avoided • No waster water produced	• Additional water use of 0.14 l/kWh, but lower than wet FGD • Higher sorbent costs (hydrated lime, calcium oxide) • Increased operational cost + 35-45% • Higher particulate matter concentrations • 0.5 – 1.0% increase in power consumption • Space needed for its installation
Semi-dry FGD – Duct Injection System	• No additional water use • Lower power consumption (0.5% increase) • Small footprint for installation	• 30-60% removal efficiency • Reduce SO_2 level <3500mg/Nm^3 but not to below 500 mg/Nm^3 • Higher sorbent costs (lime, sodium based) • Increased operational cost + 100%. Costs increase exponentially for higher removal efficiencies • Not demonstrated for large boiler units such as those used in Eskom • 0.5 – 1.0% increase in power consumption
Coal beneficiation	• Low cost	• Sulphur is organically bound – cannot be reduced by washing • Increased water consumption and waste

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Eskom

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Coal beneficiation	• Low cost	• Sulphur is organically bound – cannot be reduced by washing • Increased water consumption and waste

Currently at Kusile & retrofit for Medupi

Option for Kendal: pre-feasibility study

Key Outcomes for Desulphurization

- Each System has it's own complexities, is site dependent and there isn't a one size fits all approach.

- For compliance to the 500 mg/Nm^3 SO_2 limit, the Wet-LFO FGD, Semi-dry SDA or Semi-dry CFB options are being considered.

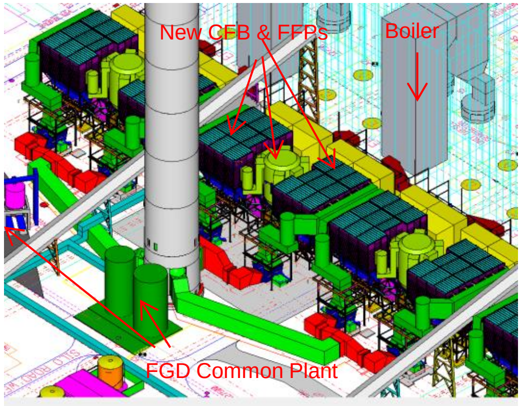
- The wet FGD is being installed at Kusile and being commissioned with the start-up of each unit.

- The Medupi FGD-ready concept and plant layout was based on a wet-FGD system based on the outcomes of a techno-economic life cycle study. Currently detailed designs are in progress.

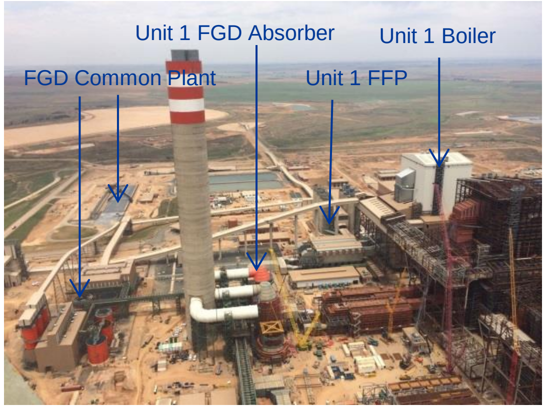
- Due to the complexity associated with a retrofit scenario, the Kendal concept is also investigating the semi-dry options. A CFD pilot plant is being considered to demonstrate applicability in the local context also focusing on skills development and resources utilization potential.
  Tentative Key Milestones:
  FY 2022: Pilot Plant Commission
  FY 2023/24: Test Campaign
  FY 2024/25: CFB Retrofit Concept Design
  FY 2026: CFB Retrofit Bossiness Case and Approval
  FY 2027: CFB Detailed Designs
  FY 2028-30: Procurement and Site Establishment:
  FY 2031-37: Construction & Commissioning (1 unit/year)

- There are emerging multi-pollutant control technologies that could be considered. However, they have not reached commercial maturity at scale and thus need the to be piloted before full-scale considerations can be made.

Kendal CFB Retrofit Concept



Kusile Power Station



Conclusion

Concluding remarks

Power Plant status to compliance

- There has been progress toward meeting the MES for particulates and NOx. There are potential delays for the first units but efforts will be made to ensure the last units are not delayed.
- The offset programme roll out to households will start in October 2018.
- Medupi FGD is delayed, efforts are being made to reduce the delay period and to avoid delays with the later units.

- Postponement applications have been initiated for the next five year period however the detail of these is not yet available it is currently under review and will need to be approved internal to Eskom prior to finalising the application.
- Eskom has evaluated the technology options available to reduce Sulphur dioxide
    - There are emerging multi-pollutant control technologies that could be considered once they commercial maturity at scale,
    - Eskom will pilot technologies which show promise of being better options compared with FGD.

Conclusions continued

- Meeting the MES for Sulphur dioxide presents socio-economic challenges. The current air quality programme will add 3% to the tariff.
- Alternative mechanisms are required to address the challenge faced for existing plants (especially those 25 years and older) to comply with new plant standards specifically with regard to Sulphur dioxide.
  - Given that there are no immediate technical solutions to replace Flue Gas Desulphurisation, and
  - According to Prof Gerrit Cornelius at the November 2017 Parliamentary Colloquium FGD shows negative cost benefit from a socio-economic perspective.