



# National Society of Black Engineers

*Submission to the ANC SG Cd Fikile Mbalula following the ANC Energy Crisis  
Dialogue Session hosted at the University of Johannesburg  
on 25 January 2023*

*Updated 18 February 2023*

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# Executive Summary - Conclusions

- In the short-term, the possibility of adding another 5GW of RE IPP is completely unrealistic given the current transmission grid limitations. Eskom requires ~3 years to upgrade the existing transmission grid infrastructure and create extra capacity to wheel more power from RE IPPs.
- Poor EAF from the Coal Fleet & poor Capacity Factors from RE (due to lack of adequate battery storage capacity) means that the OCGTs are often run excessively compared to their design role of meeting occasional peak demand incidents in the mornings and evenings. EAF of the Coal Fleet continues to deteriorate unabated.
- The overuse of OCGTs results in R20bn – R25bn of diesel bill per annum and this is unsustainable to the fiscus.
- Constant switching on and off during load shedding is causing collateral damage to the Eskom Distribution Infrastructure.

# Executive Summary - Conclusions

- There's no direct correlation between the age of the power station and the EAF (slide 17). Komati Power Station was 62 years old at the point of decommissioning in 2022 but was one of the best performers at 65% EAF.
- The NECOM Energy Action Plan Roadmap to End Load Shedding is very high level without details and timelines to hold people accountable. It is also out of touch with reality on the ground and is biased towards Renewable Energy as it makes no mention of the energy mix in the medium to long term. For example, the latest update which was published on 19 January 2023 showed that Kusile units 1, 2, 3 & 5 will be online and producing 2880MW in 2023. In contrast, the Eskom Board Media Brief on 22 January 2023 indicated that the same units will at best take minimum 12 months to return to service!

# Executive Summary - Conclusions

- The NECOM Energy Action Plan Roadmap to End Load Shedding is silent on the following critical issues:-
  - ❖ Timelines to fill critical executive vacancies in Eskom, i.e. GCEO, Head of Generation, etc.
  - ❖ Timelines to move Eskom to DMRE as per the ANC 2022 December Elective Conference Resolution.
  - ❖ Timelines & Detailed Action Plan to fix the current Generation Coal Fleet to improve the EAF to 75% and unlock extra 10GW of baseload power to end load shedding.
  - ❖ Department of Forestry, Fisheries & the Environment (DFFE's) ill-conceived environmental legislation on Minimum Emissions Standards (MES) that will put 15GW immediately at risk and 30GW by 2025. This is in the backdrop of RSA not even close to being in the top 10 of the World's Green House Gas (GHG) emitters.
- Load Shedding has cost RSA's economy more than R1.2tn in the last 4 years, with 87.5% of that incurred in the last 3 years. Stage 4-5 load shedding costs the SA economy R2.5bn per day.

# Executive Summary - Recommendations

- Eskom Board to show a sense of urgency in dealing with matters, starting with the recruitment process to find a new suitably qualified GCEO. The new GCEO must be a competent engineer and credible leader with a solid track record in power generation.
- Intensify the coal fleet maintenance effort and improve the quality of workmanship during outages to improve the EAF as a matter of urgency. Allocate enough budget to conduct proper Reliability Centered Maintenance (RCM) rather than wasting billions of rands on burning excessive diesel in OCGTs.
- Invest in utility battery storage capacity to improve the capacity factors of the existing Renewable Energy Fleet.
- Bring back Komati Power Station as a matter of urgency.
- Immediately suspend the DFFE's MES legislation to avoid exacerbating the Energy Crisis.

# Executive Summary - Recommendations

- NECOM Energy Action Plan to be revised to address issues raised in slides 3 & 4.
- Just Energy Transition (JET) must not be just a slogan and be implemented haphazardly without taking the developmental mandate of RSA into consideration. Also, we cannot afford to misuse JET as a vehicle to source expensive overseas capital funding and appease powerful nations with strong balance sheets at the expense of RSA's future generations. Feasibility studies with granular details must be produced and made publicly available to justify the business case for JET.
- RSA must not abandon its Coal natural resource which is still available in abundance and gives SA Inc unique competitive advantage in the world. Instead, DMRE must continue to invest in research to explore Carbon Capture, Utilization & Storage (CCUS) and Emissions Abatement Technologies as part of clean energy transition.

# Executive Summary - Recommendations

- Improve Technical Skills & Staff Morale at Eskom.
- Update the IRP2019 as a matter of urgency.
- Roll-out the Koeberg Program of extending the life of the power station to the Coal Fleet, in tandem with clean coal energy transition.
- There's no doubt that resolving load shedding in 12 – 18 months is within reach. However, ANC's internal factional battles with regards to the future of Eskom and Minister Gwede Mantashe pose a serious risk to efforts to end load shedding and **MUST STOP NOW!**
- We do not believe that the creation of the new Electricity Minister role in the Presidency will resolve the RSA's energy crisis. Instead, it will create more confusion and less accountability with regards to the single point of line responsibility for Eskom. Blame shifting between this role, DPE & DMRE Ministers will get worse.

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# Introduction

The National Society of Black Engineers of South Africa (NSBE SA) :

- Is a non-profit and non-racial organization;
- Was established in 1998 to transform the engineering profession by ensuring full participation of local black engineers in the mainstream economy, wealth creation and distribution for the greater benefit of black communities in South Africa;
- Our membership base of over 2,000 black engineers covers all engineering disciplines, students, young graduates, owners of engineering firms, executives and seasoned engineers across the country;

# Introduction

The National Society of Black Engineers of South Africa (NSBE SA) is:

- Committed to contribute positively to end load shedding and achieve energy security for SA;
- Progressive and open to all sources of energy mix as per our draft IRP 2018 submission and presentation to cabinet;
- Available to assist Eskom to source technical skills to fill critical vacancies.

# Introduction



BLACK BUSINESS COUNCIL



Black Energy  
Professionals  
Association



Energy Forum



DRAFT IRP 2018-2030 ANALYSIS, COMMENTS AND  
RECOMMENDATIONS BY THE BBC; NSBE; SAEF AND BEPA

19 OCTOBER 2018

“THE PEOPLE’S IRP”



## National Society of Black Engineers

### Position Paper on Draft IRP 2018

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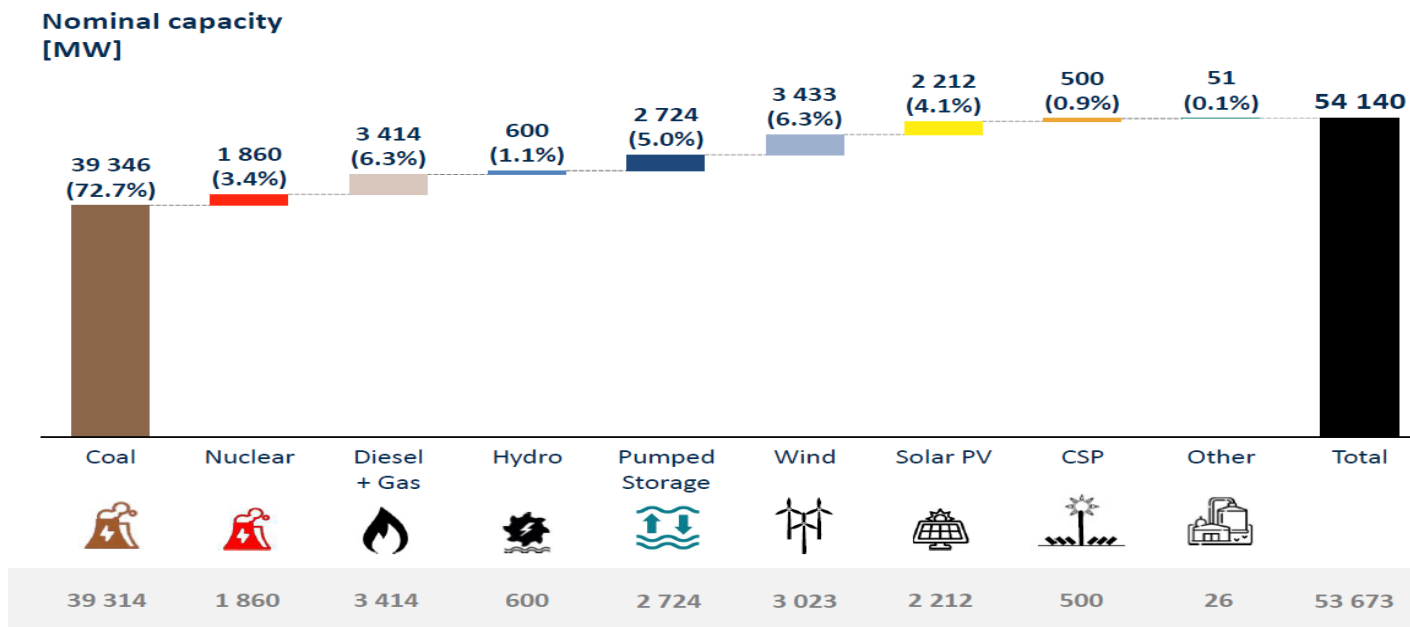
# Energy Availability Factor (EAF)

- Is the percentage of the generation fleet that is working and available to dispatch electricity to the grid.
- Has been declining from a peak of ~93% in 2001 to the current level of ~50%.
- It recovered from ~70% in January 2016 to ~80% in January 2018. Thereafter it started declining rapidly.
- Needs to be stabilized and increased back to a minimum of 75% to end load shedding. In 2022, the demand was predominantly between 24GW – 28GW, with peak at 34GW.

# Energy Availability Factor (EAF)

## Nominal capacity by end of H1 - 2022

Actual nominal installed capacity at 30 Jun 2022 (excluding embedded generation capacity and private capacity)



Notes: RE = Renewable Energy; Total nominal installed capacity = Eskom capacity + IPPs; Embedded generation and municipal-owned capacity excluded  
Sources: Eskom

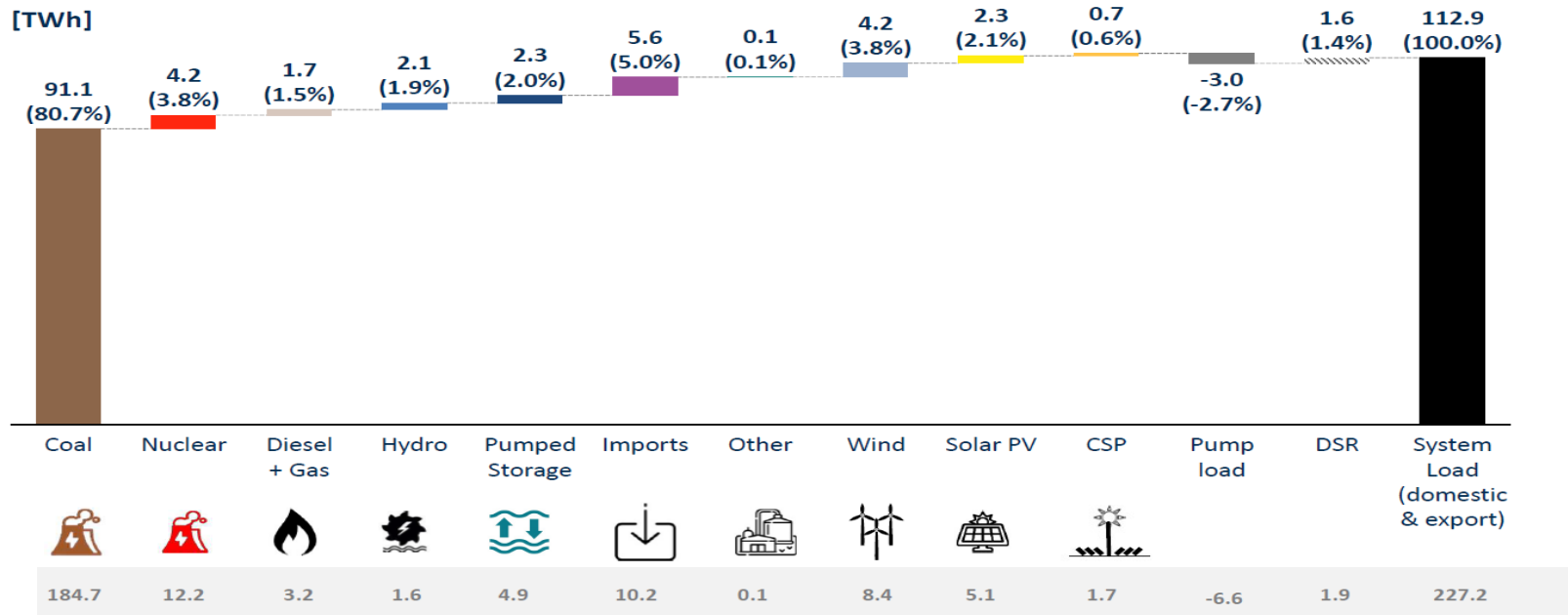


# Energy Availability Factor (EAF)

**In 2022, coal dominated the energy mix at 80.7% of the ~113 TWh of total system load met whilst PV, wind and CSP contributed 6.5%**

Actuals captured in wholesale market for Jan-Jun 2022 (i.e. without self-consumption of embedded plants)

**2022 Electricity  
[TWh]**



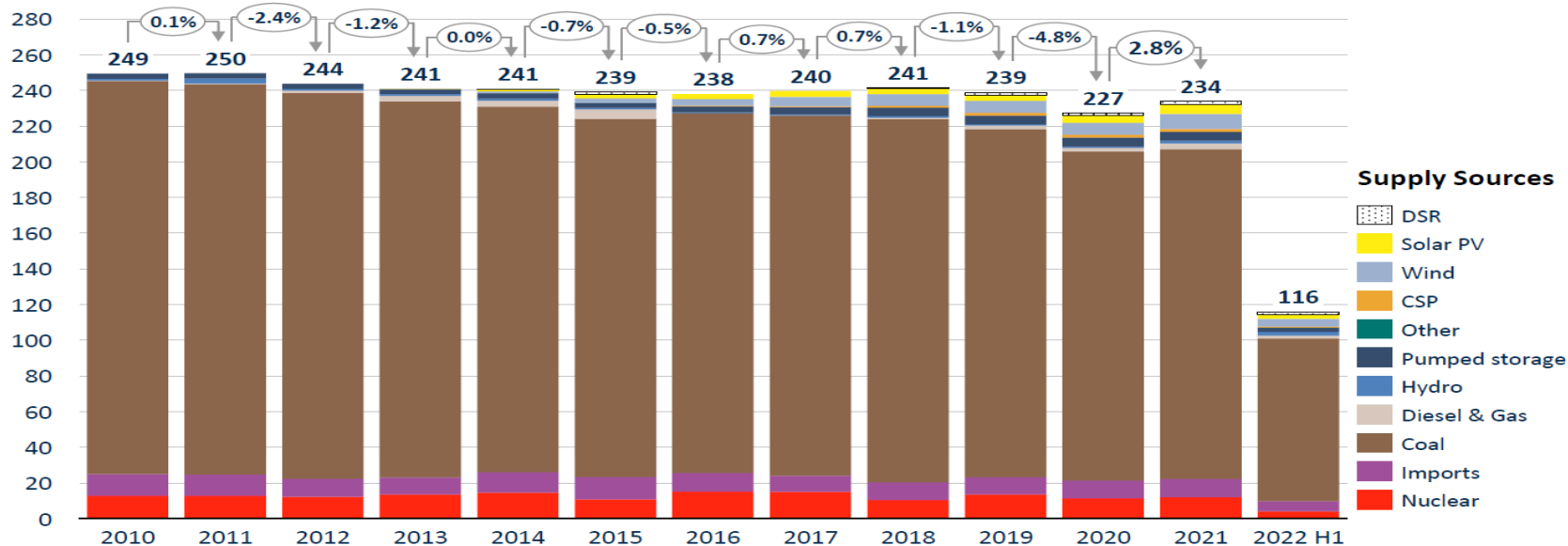
Notes: Wind includes Eskom's Sere wind farm (100 MW). Wind and solar PV energy excludes curtailment and is thus lower than actual wind and solar PV generation. PS = pumped storage  
Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS)  
Sources: Eskom

# Energy Availability Factor (EAF)

## Production in H1-2022 was constrained with diesel & gas running extensively and notable DSR activated

Historical annual electricity production per supply source in TWh

Annual electricity production  
[TWh]

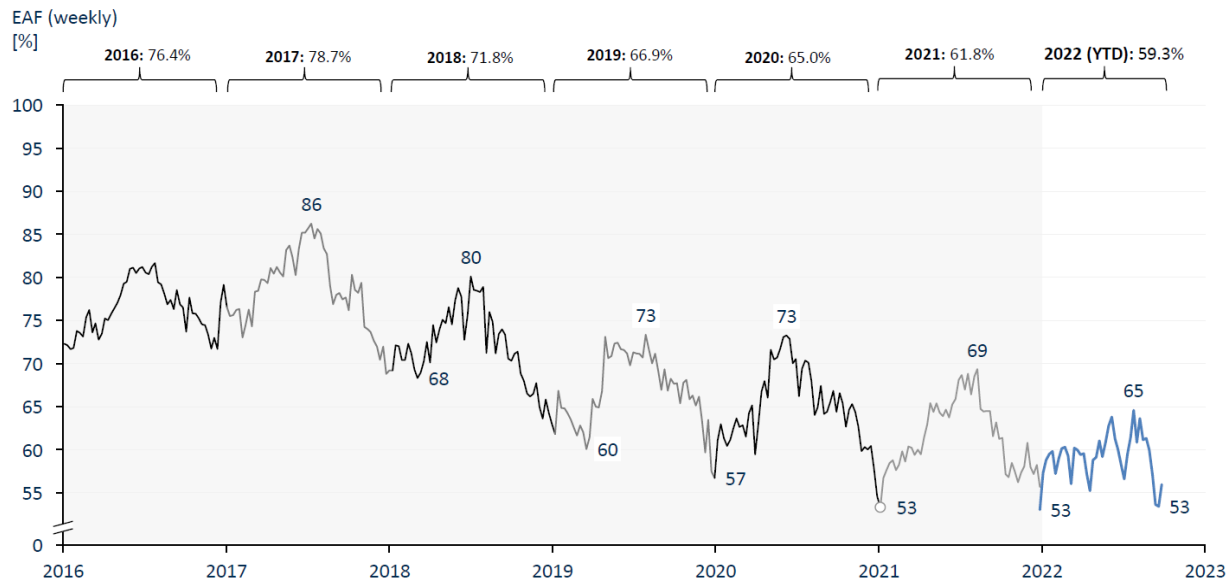


NOTES: Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS). DSR prior to 2020 has been estimated by the CSIR  
Sources: Eskom; CSIR Energy Centre analysis

# Energy Availability Factor (EAF) vs Diesel Usage

**Declining EAF trend continues into 2022 to an average weekly EAF (YTD) of 59.1% but does seem to be 'flattening' out**

The weekly average EAF hit a new low of 53.0% (very similar to previous low)



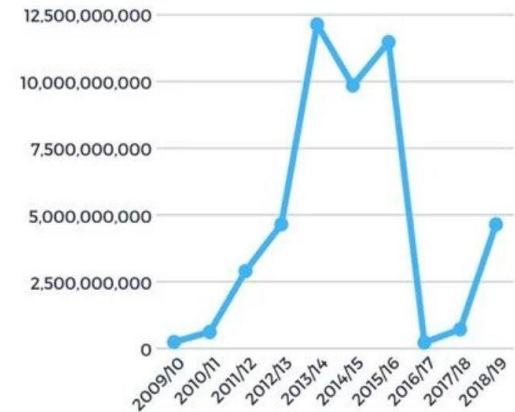
15 Notes: EAF - Energy Availability Factor. Average annual EAF is calculated as an average of the hourly EAF values.  
Sources: Eskom; CSIR Energy Centre analysis



news24

**Eskom**

DIESEL SPEND IN PAST 10 YEARS (BILLION)



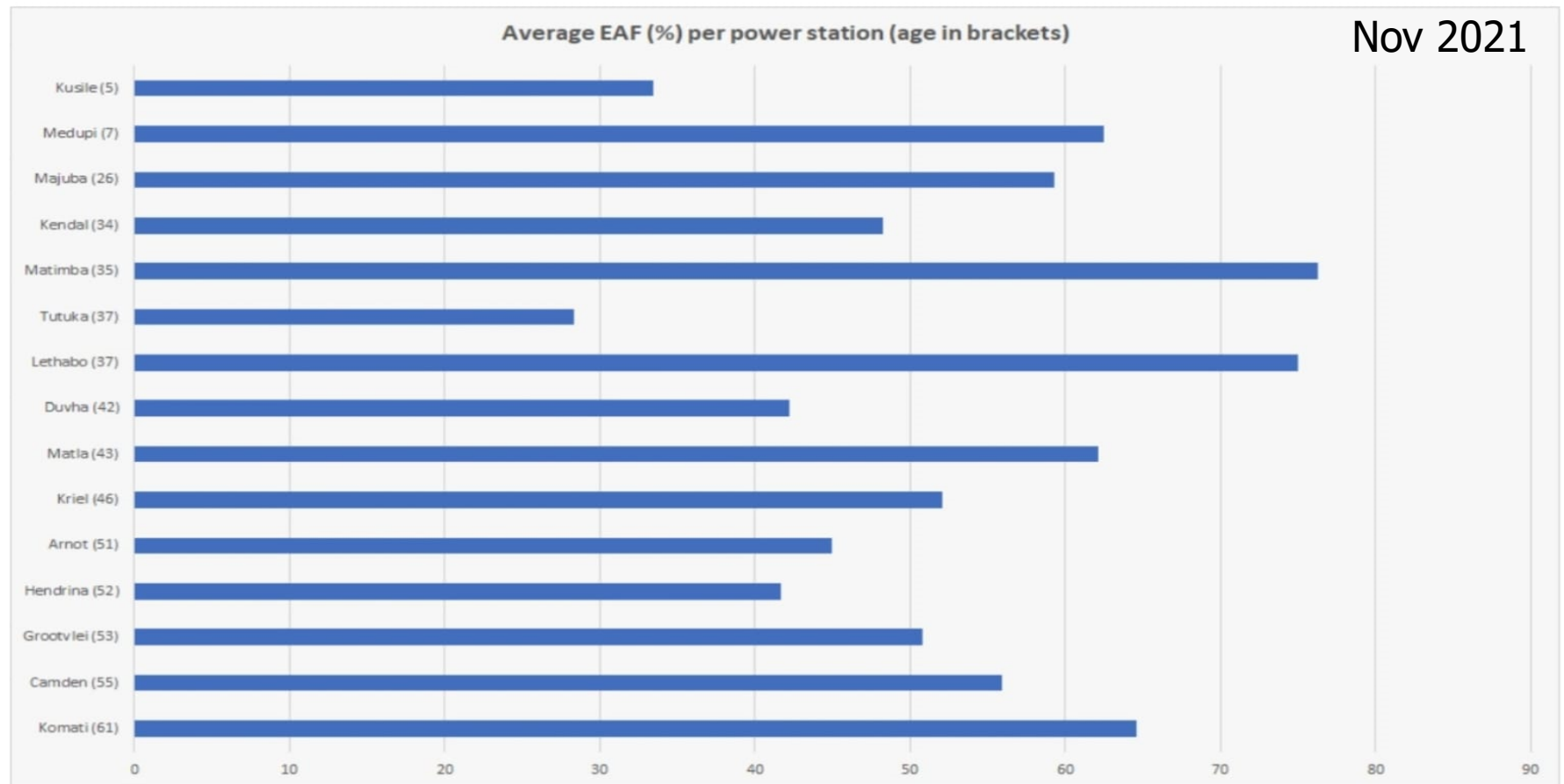
**TOTAL  
R47.4  
BILLION**

2009/10 - R240,829,849  
2010/11 - R615,220,567  
2011/12 - R2,896,931,142  
2012/13 - R4,648,405,839  
2013/14 - R12,137,778,998  
2014/15 - R9,853,534,341  
2015/16 - R11,477,787,806  
2016/17 - R220,279,495  
2017/18 - R715,182,753  
2018/19 - R4,648,911,023

Graphic/Kyle Cowan. Source - Eskom.



# Energy Availability Factor (EAF)



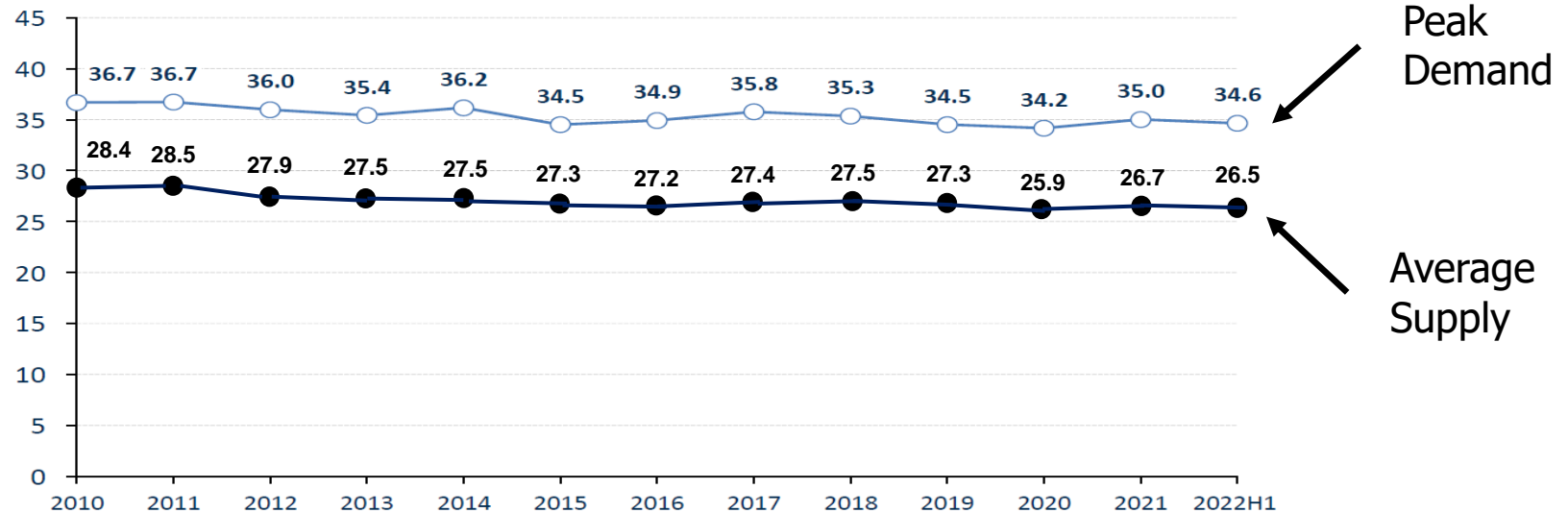
# Peak Demand & Average Demand

## Annual peak demand in H1 2022 decreased slightly in comparison to 2021

Historical annual peak demand in GW; annual peak demand has been declining over the last 10 years

**Current average shortfall : 2 – 4 GW, occasionally 5 – 6 GW**

RSA Peak Demand in GW

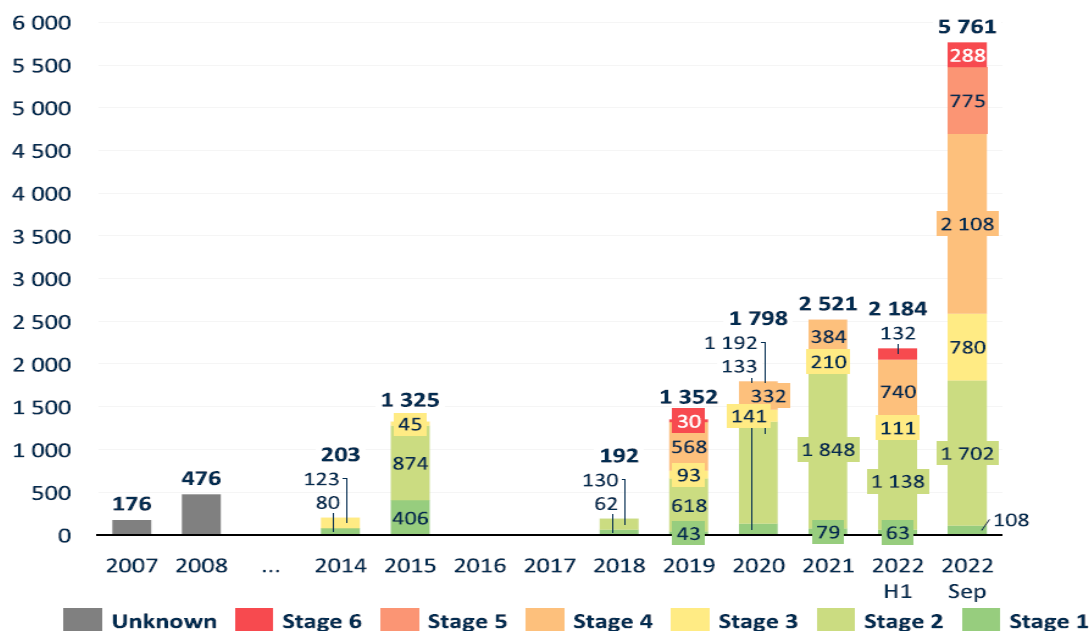


Notes: Peak demand includes Demand Side Response (DSR) = Manual Load Reduction (MLR) + Interruptible Load Supply (ILS) + Interruption of Supply (IOS).  
Sources: Eskom



# Load Shedding

Load shed, upper-limit [GWh]



Year	Duration of outages (hours)	Energy shed (GWh)	DSR (GWh)
2007	-	176	Not available
2008	-	476	Not available
....	....	....	....
2014	121	203	Not available
2015	852	1 325	Not available
....	....	....	....
2018	127	192	392
2019	530	1 352	1 362
2020	859	1 798	1 426
2021	1 169	2 521	1 936
2022-H1	876	2 184	1 598
2022-Sep (Jan-Sep)	1 949	5 761	4 315

**NB : 2022 experienced the worst load shedding in the history of Eskom and was dominated by stage 4 load shedding (4GW shortfall)**

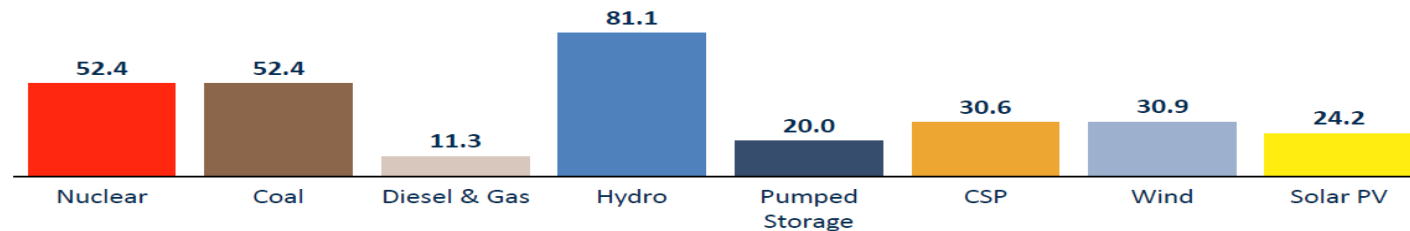
# Coal, Nuclear & Renewable Energy

- Eskom's Nuclear & Coal Fleet produce ~41GW of dispatchable energy (baseload power) which can be quickly ramped up or down by the system operator to stabilize the grid by balancing supply and demand at any given time. 75% EAF will make available extra 10GW of baseload power available to the grid to stop load shedding.
- Eskom's Wind & Solar RE Fleet produce ~3.4GW and ~2.2GW, respectively, of non-dispatchable energy due to external variable factors outside our control, i.e. adverse weather conditions having a negative impact on the sun shining or wind blowing. Hence, this fleet needs to be complemented with expensive energy storage technology (battery & green hydrogen) which are still undergoing constant evolution. Upfront Capital Cost for 5GW of Wind RE is ~R92bn or R9.5bn per annum financed over 20 years.

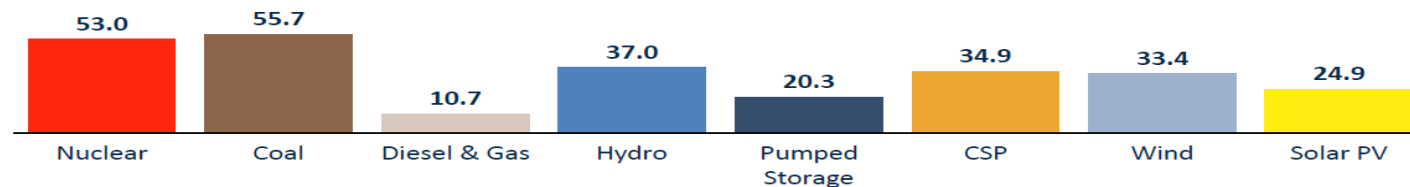
# Coal, Nuclear & Renewable Energy

## Capacity factors per supply source in South Africa in H1-2022 and H1-2021

2022-H1  
Capacity factors [%]



2021-H1  
Capacity factors [%]



**Capacity Factor is a measure of how often a power plant runs over a specific period of time. The above scenarios compare 1<sup>st</sup> Half of 2021 and 1<sup>st</sup> Half of 2022**



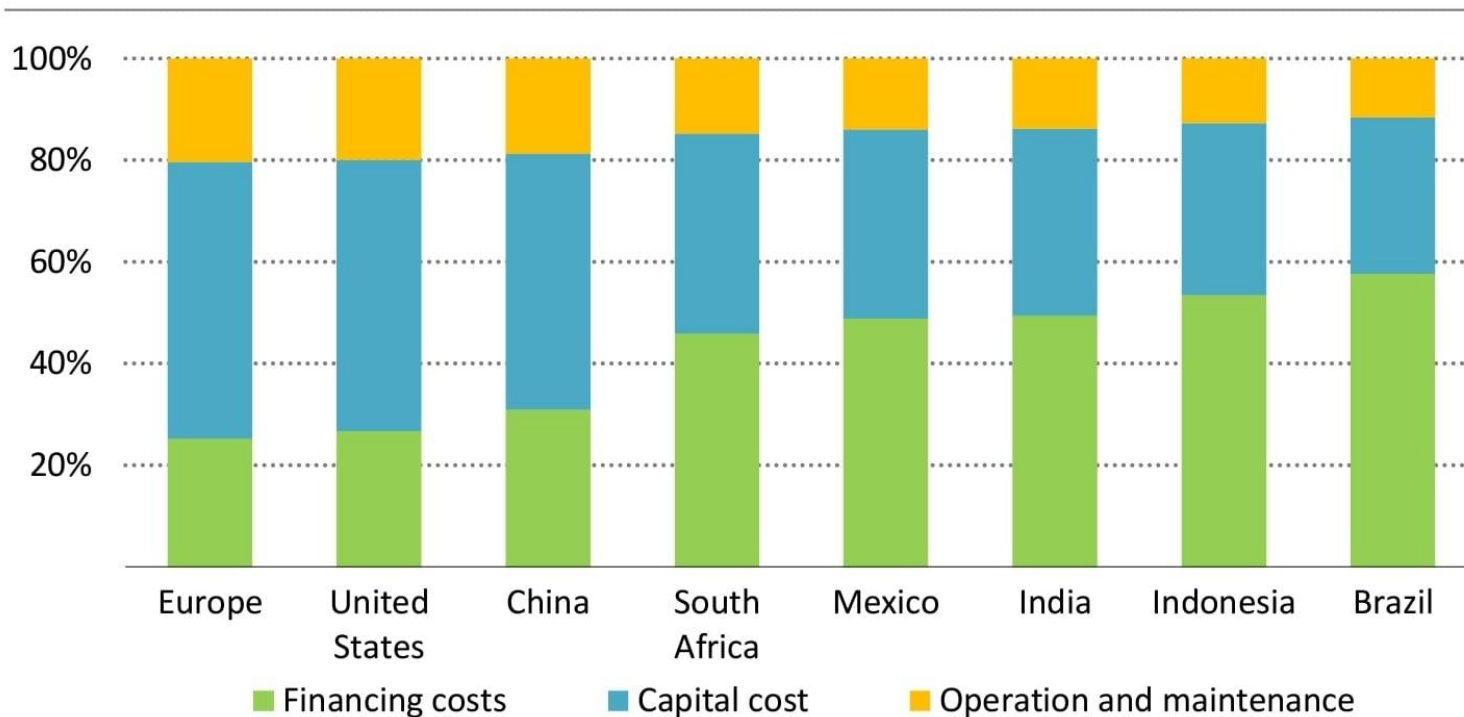
# Renewable Energy



- 580MW Solar Plant in Morocco. It is the world's largest concentrated solar power plant.
- Employed 1,000 people during the construction phase.
- Employed only 60 people during operation and maintenance phase.

# Renewable Energy Financing Cost

**Composition of levelised cost for a utility-scale solar PV plant with final investment decision secured in 2021**



IEA. CC BY 4.0.

# Renewable Energy Financing Cost

Item	Value	Unit	Comments
Battery Storage Capacity	5 000	MW	Capacity Requirement as per the Eskom Load Shedding Report
Capital Cost per MW	18 333 334	ZAR/MW	Latest Cost Estimate from the Wind Projects of BW5
Capital Cost	R91 666 670 000	ZAR	Cost of 5 GW of Wind RE
Annualised Capital Cost Calculation			
Period	20	Years	Payment Period in years
Number of Payments	240	Months	Payment Period in months
Yearly Flat Rate	8,30%	%	Yearly Flat Interest rate in real terms over payment period
Capitalized Cost per annum	R9 545 850 494	ZAR/year	Annual Capital cost over payment period
Capitalized Cost per month	R795 487 541	ZAR/month	Monthly Capital cost over payment period
Ops & Maintenance Yearly Rate	2,00%	%	Annual Ops & Maintenance rate as a percentage of capital cost over lifespan of 20 years
Ops & Maintenance Cost per annum	R1 833 333 400	ZAR/year	Annual Ops & Maintenance cost over payment period
Ops & Maintenance Cost per month	R152 777 783	ZAR/year	Monthly Ops & Maintenance cost over payment period
Capital Cost and O&M cost per annum	R11 379 183 894	ZAR/year	Total Annual Cost over payment period
Capital Cost and O&M cost per month	R948 265 324	ZAR/month	Total Monthly Cost over payment period
Total Paid Over Loan Period	R227 583 677 876	ZAR	Total paid over loan period
Total Interest Paid Over Loan Period	R135 917 007 876	ZAR	Total interest paid over loan period



# Open Cycle Gas Turbine Power Stations (OCGTs)

- There are 4 x OCGTs in RSA, two are owned by Eskom (Ankerlig & Gourikwa) and the other two are privately owned (Avon & Dedisa). Combined they produce ~3.1GW of responsive emergency power to plug a short-term gap between supply and peak demand. Running OCGTs is very expensive.
- Poor EAF from the Coal Fleet & poor Capacity Factor from the RE Fleet result in OCGTs running more frequently than their design role of under 5% in a stable power system. Actual running time is ~15–20%, leading to excessive diesel usage at the cost of R20-25bn per annum for fuel alone.
- Continued state bailouts to run OCGTs excessively is not sustainable.

# Pumped Storage Facilities

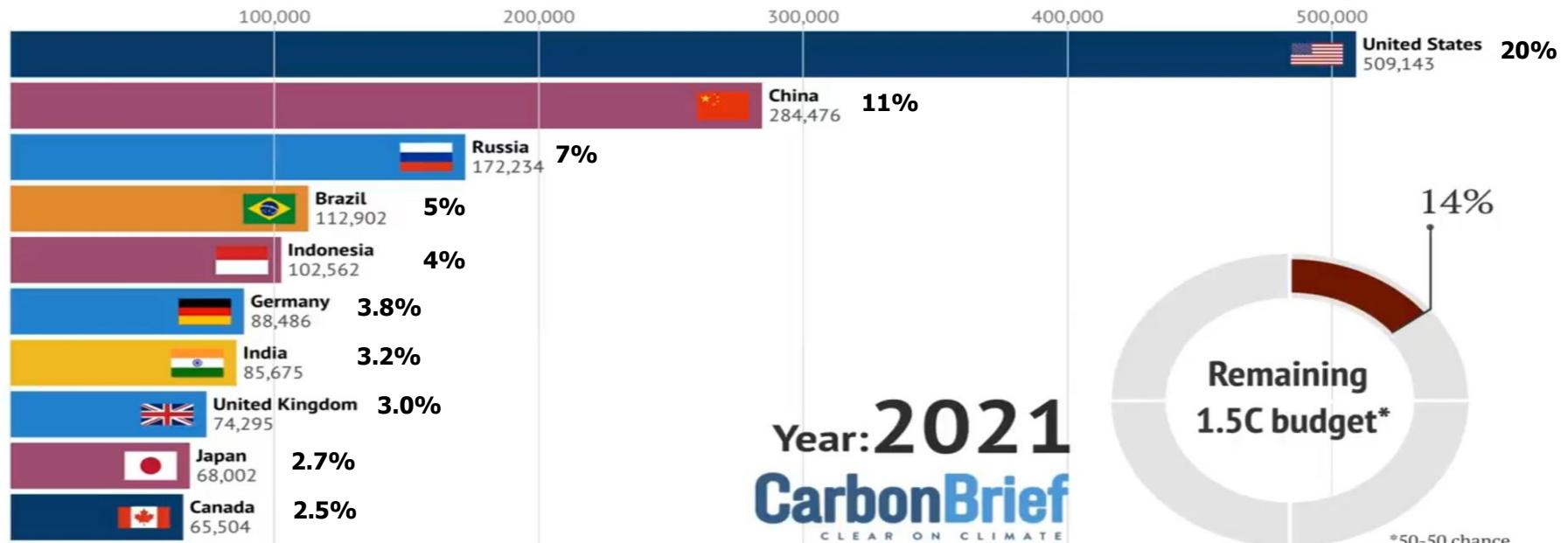
- There are 3 x Pump Storage Facilities in RSA, and they are all owned by Eskom – Drakensberg, Ingula & Palmiet. Combined they produce ~2.7GW of responsive emergency power to plug a short-term gap between supply and peak demand.
- Under normal operating conditions, Pump Storage Facilities are one of Eskom's first line of defense to avoid load shedding before they burn expensive diesel in the OCGTs.
- Pump Storage Facilities are running more frequently than their design role of under 8% in a stable power system. Actual running time is ~20–25% at 75% efficiency due to energy losses associated with pumping cycles.

# Top Ten Green House Gas (GHG) Emitters

## Which countries are historically responsible for climate change?

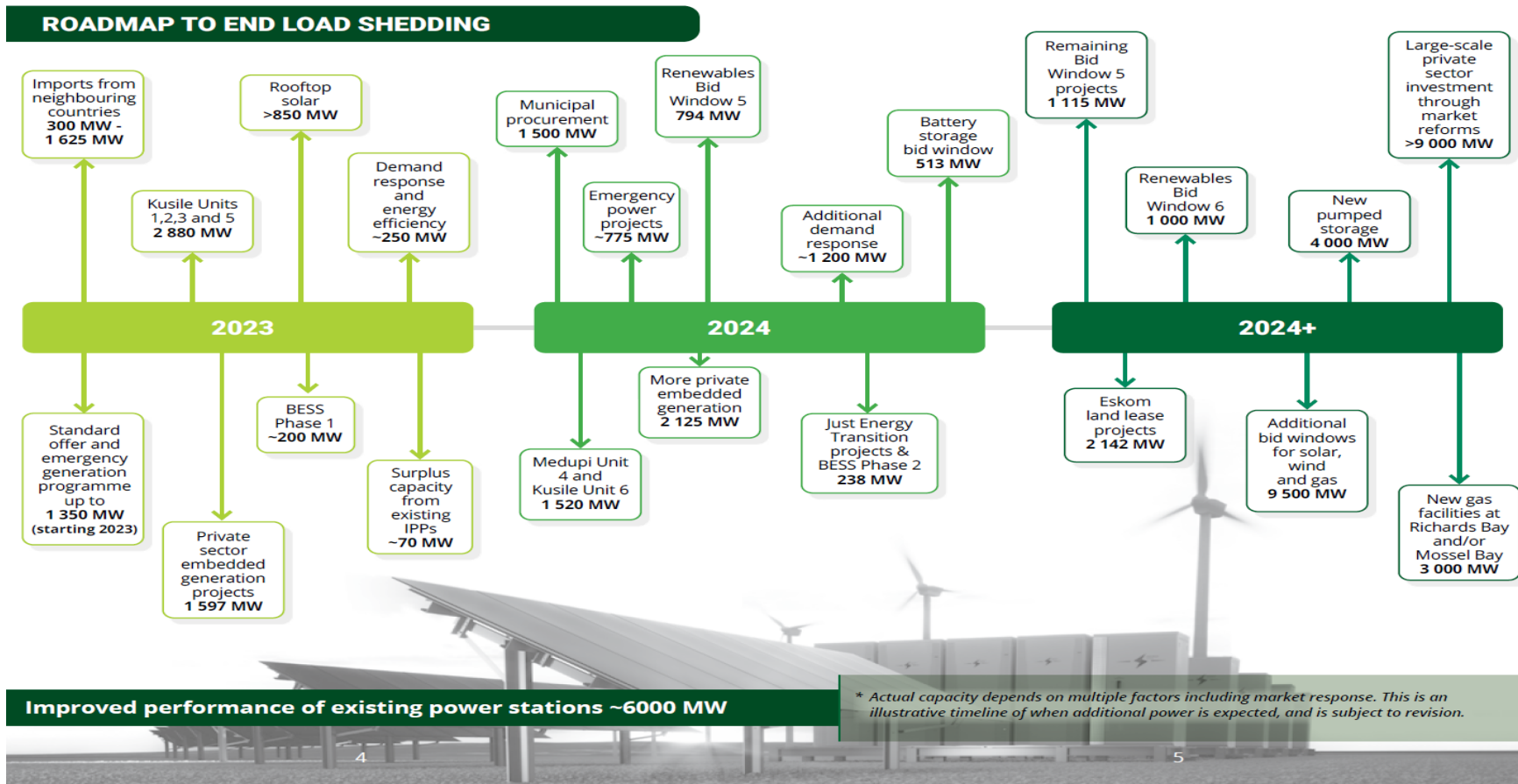
Cumulative CO<sub>2</sub> emissions from fossil fuels, land use and forestry 1850-2021 (million tonnes)

Bar colours represent regions



**NB : South Africa is ranked 16<sup>th</sup> and contributes only 1.2%.**

# NECOM Energy Action Plan



# THANK

# THANK YOU!



# YOU

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