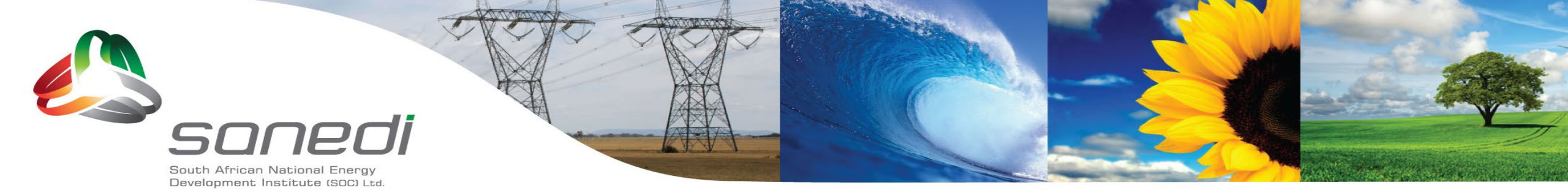

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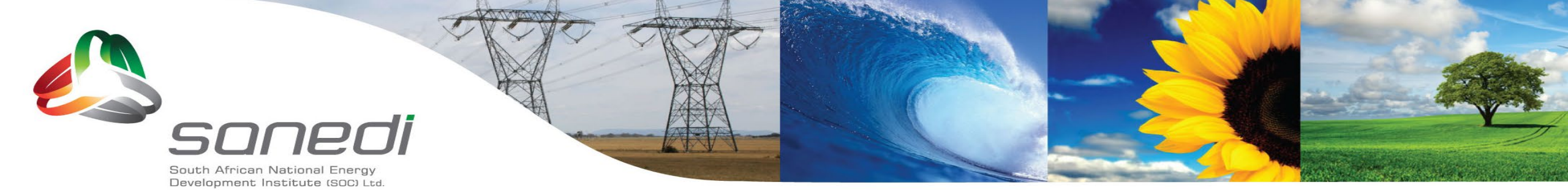
# IRP 2023 Overview

**Dr. Titus Mathe**
Chief Executive Officer
South African National Energy Development Institute

**AMEU/SALGA, VIRTUAL WORKSHOP, Ms Teams, 13 February 2024**

# OUTLINE

- South African Context
- Integrated Resource Plan
  - Recap IRP 2019
  - Draft IRP 2023 Review Methodology
  - Factors considered in the Draft IRP 2023 review
  - Input assumptions
  - Horizon One Summary
  - Horizon Two Summary
- Major issues
- Concluding Remarks



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# South African Context

# Socio-economic, environmental situation & skills

## Socio-economic conditions

- Poverty has reached levels not seen for more than a decade in SA, while inflation is also high
- ***High unemployment (31.9% in Q3 of 2023)*** Unemployment rate is highest among youths aged between 15 and 24, at around ***58%***

## Economic growth

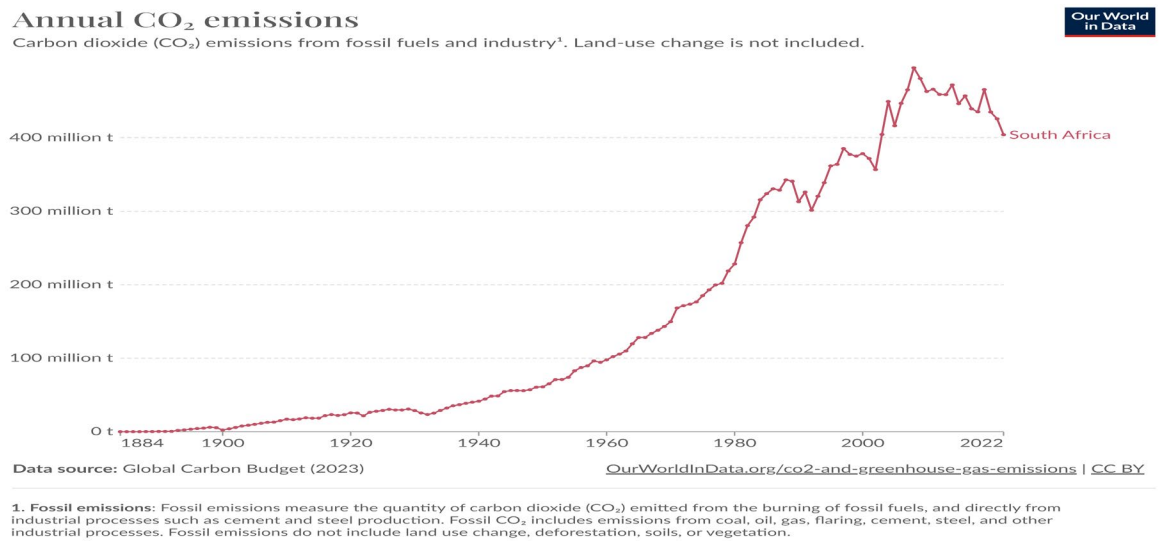
- South African economy continues to recover from the ***effects of COVID-19 pandemic***, albeit more slowly than expected
- According to Treasury, economic growth is projected to average 1.4% from 2024 to 2026. Unreliable electricity & logistics are the main contributors to this slow growth

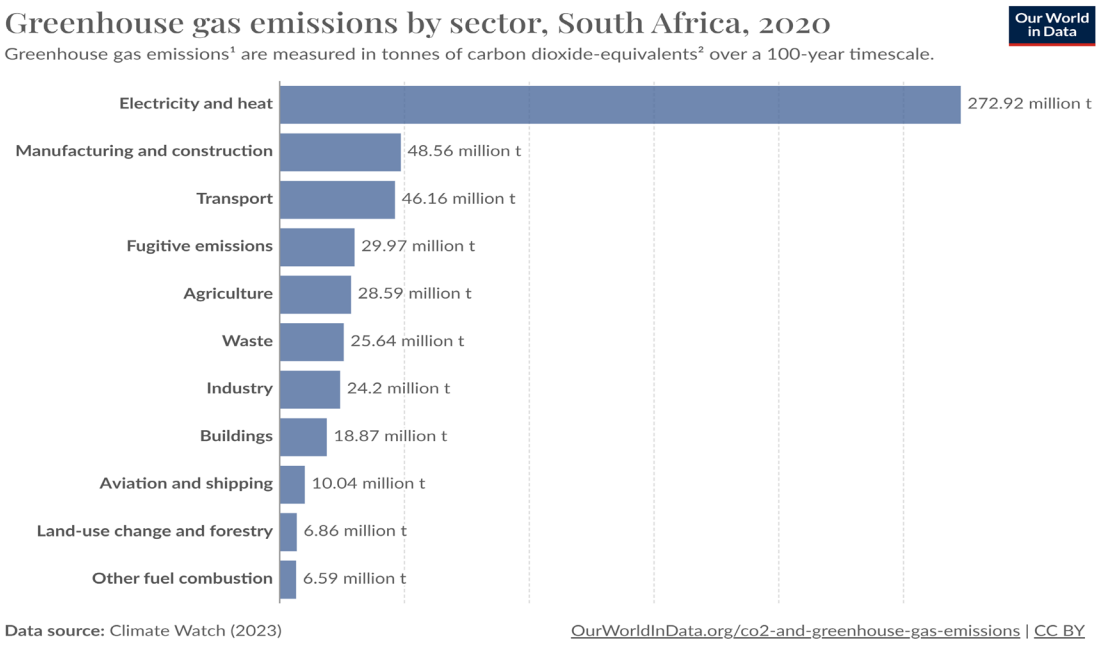
## Environmental issues

- SA contributes ***1.09%*** (as of 2022) to global GHG, which was ***404 million tonnes (2022).*** *As per the Paris Agreement, SA's NDC revised targets range between* ***398 to 510 Mt CO2e for 2025, and 350 to 420 Mt CO2e for 2030***
- ***Electricity sector*** is a major contributor to GHG in SA

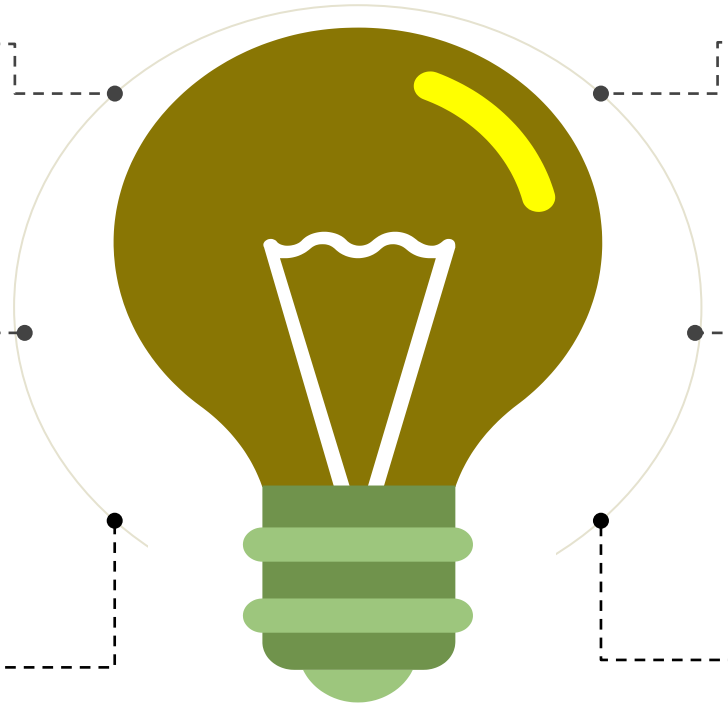
## Shortage of Technical Skills

- Mainly in Municipalities and SOEs, especially at Artisanal level



# We need to immediately attend to Loadshedding!!



1 **Disturbs daily life**

- Cause inconvenience to individuals.
- Essential services are affected.

2 **Businesses and industries**

- Disturbs productivity, jobs.
- Effect on foreign direct investment.
- Financial losses.

3 **Aggravates socioeconomic inequalities**

- Marginalized communities often bear the impact of power outages.
- Low-income communities cannot afford backup power.

4 **SMMEs Impacted**

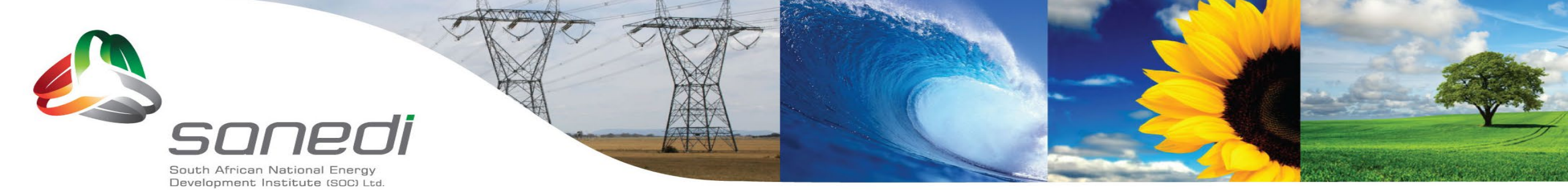
- Lack the resources and backup systems to deal with frequent power outages.

5 **Education Disruptions**

- Hinder online learning.
- Sometimes lead to cancelled classes.
- Poor academic performances

6 **Economic Growth**

- Hinders growth“load shedding cost the country's economy R1 billion per day~ Minister of energy.”



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# Integrated Resource Plan

ENERGY INNOVATION FOR LIFE

# IRP 2019
(Pg 42 of 98)

**Table 5: IRP 2019**

| | Coal | Coal (Decommissioning) | Nuclear | Hydro | Storage | PV | Wind | CSP | Gas & Diesel | Other (Distributed Generation, CoGen, Biomass, Landfill) |
|---|---|---|---|---|---|---|---|---|---|---|
| Current Base | 37 149 | | 1 860 | 2 100 | 2 912 | 1 474 | 1 980 | 300 | 3 830 | 459 |
| 2019 | 2 155 | -2 373 | | | | | 244 | 300 | | Allocation to the extent of the short term capacity and energy gap. |
| 2020 | 1 433 | -557 | | | | 114 | 300 | | | |
| 2021 | 1 433 | -1 403 | | | | 300 | 818 | | | |
| 2022 | 711 | -844 | | | 513 | 400 1000 | 1600 | | | |
| 2023 | 750 | -555 | | | | 1000 | 1600 | | | 500 |
| 2024 | | | 1860 | | | | 1600 | | 1000 | 500 |
| 2025 | | | | | | 1000 | 1600 | | | 500 |
| 2026 | | -1219 | | | | | 1600 | | | 500 |
| 2027 | 750 | -847 | | | | | 1 600 | | 2000 | 500 |
| 2028 | | -475 | | | | 1000 | 1 600 | | | 500 |
| 2029 | | -1604 | | | 1575 | 1000 | 1 600 | | | 500 |
| 2030 | | -1050 | | 2 500 | | 1 000 | 1 600 | | | 500 |
| TOTAL INSTALLED CAPACITY by 2030 (MW) | 33364 | | 1860 | 4600 | 5000 | 8288 | 17742 | 600 | 6180 | |
| % Total Installed Capacity (% of MW) | 43 | | 2.36 | 5.84 | 6.35 | 10.52 | 22.53 | 0.76 | 8.1 | |
| % Annual Energy Contribution (% of MWh) | 58.8 | | 4.5 | 8.4 | 1.2* | 6.3 | 17.8 | 0.6 | 1.3 | |

Installed Capacity
Committed / Already Contracted Capacity
Capacity Decommissioned
New Additional Capacity
Extension of Koeberg Plant Design Life
Includes Distributed Generation Capacity for own use

# IRP 2019

- IRP 2019 is the official policy and roadmap of the SA government. Plans are underway to revise this IRP2019 and should be finalized this year

- IRP2019 target energy mix by 2030 is follows:
  - Coal (43%); Wind (22,5%); Solar PV (10,5%); Solar CSP (0,76%); Gas (8,1%); Hydro (6.2%); Storage (6,35%); Nuclear (2,36%); Other (0,5%)

- Installed capacity targets achieved from Jan 2019 to Dec 2023 are:
  - Coal (37899MW Planned vs 39099MW Installed); Nuclear (1860MW Planned vs 1860MW installed); Hydro (2100MW vs 2100MW installed); Storage (3425MW Planned vs 2912MW installed); Solar PV (4288MW planned vs 2287MW installed); Wind (6542MW planned vs 3443MW installed); Solar CSP (600MW planned vs 500MW installed);Gas/Diesel (4830MW Planned vs 3830MW installed); Other incl DEG, CoGen, Biomass, Landfill (999MW planned vs 5204MW)

- IRP 2019 also assumes that Eskom EAF will be above 70%, currently it is at around 55%

- Draft IRP 2023?

# South Africa's vision of Energy Transition

- Energy transition in South Africa will be implemented in accordance with the domestic policies and plans, which includes dealing with our ***current energy crisis and reducing carbon footprint***, and in support of our foremost task of ***reducing poverty, unemployment, and inequality***;
- Therefore, South Africa will follow a ***differentiated approach and multi-pathways*** to move from a high carbon economy to low carbon economy, and eventually achieving a ***net-zero carbon emissions by 2050***;
- This will be done at a ***pace, scale and cost*** that the country can afford and in a manner that ensures energy security.

# Energy Transition Mapping

## Energy Crisis & High Carbon Economy (Now)

| | |
|---|---|
| Improve EAF from 55% to above 65%); New Capacity (Gas, RE (utility scale & SSEG), Nuclear & Clean Coal) | Grid expansion & Modernization; Micro/Mini Grids; Smart Meters; EE/DSM; EVs; Storage |

## Low Carbon Economy (2040)

| | |
|---|---|
| RE + Storage; Clean Coal (incl CCS & CCU); Nuclear (incl SMRs); Gas (incl Green Hydrogen & Indigenous Gas) | Fully liberalized electricity market, competitive, sustainable, reliable & digitalized power system |

## Net Zero (2050)

Below 160 $CO_2$ eq per annum?

# DRAFT IRP 2023 Review Methodology

- DMRE collaborated with renowned academic institutions (e.g. UCT) and research councils (e.g. CSIR) to leverage diverse expertise in shaping the energy future of the country. Expertise was also drawn from Eskom's Planning Department

- Draft IRP 2023 Review undertaken using the Plexos modelling. Tool has production simulation and capacity expansion capabilities
  - Production simulation module can produce deterministic economic dispatch or be set up to incorporate stochasticity of parameters that consider variability
  - Capacity expansion module incorporates least-cost principles based on linear optimization. This balances supply and demand in the medium to long-term by considering cost and performance characteristics

- Draft IRP 2023 Review considered two-time horizons
  - 2024 to 2030: Addressing prevailing generation capacity constraints and what the system requires to close the electricity supply shortage gap
  - 2031 to 2050: Mainly focusing on the country’s long-term electricity pathways to guide policy choices

# Factors considered in the DRAFT IRP 2023 review

- Eskom Plant Performance
  - Energy Availability Factor
  - Eskom Shutdown Plan
  - Eskom New Build Challenges
  - Lifex (mainly Koeberg)
- Compliance with Minimum Emission Standards
  - If implemented, loss of baseload would be16GW immediately, and up to 30GW by 2025 when current postponement lapses
  - South Africa is targeting to achieve net-zero carbon emissions by 2050
- Timing and Rollout of New Capacity
  - RMIPPP, REIPPP, Eskom Build, Business Initiatives
- Development of the Transmission Grid
  - Mainly informed by Eskom plan

# DRAFT IRP 2023 Input Assumptions

- Electricity Demand Projection
  - Developed by the ERSG of UCT
  - From the mid 2030s, forecast considers National Treasury reforms earmarked for aggressive economic growth
- Eskom Plant EAF
  - Low EAF scenario (49% to 51%)
  - High EAF scenario (66% to 69%), and Gx Recovery Scenario (55% to 69%)
- Eskom Shutdown Plan
  - 50 year life of plant with some power stations shutting down earlier than their design life
- Transmission Availability
  - Considered Eskom Transmission Development Plan (TDP) 2023 to 2032
- Power Generation initiatives by the private sector
  - Pipeline of projects with total generation capacity of 10400MW by 2030

# Horizon One Summary

| Scenario | Description | Comments | Risks & Mitigations |
|---|---|---|---|
| 1 | RMIPPP, REIPPP 5 Wind, business/private projects currently under construction, and low EAF (49% to 51%) | 3776 MW new capacity by 2030 Grid reserved & under construction | Eskom shutdown impact. High usage of peaking stations. Compliance with MES. Tx grid |
| 2 | RMIPPP, REIPPP 5 PV, REIPPP 6 PV, REIPPP 5 Wind, BESS BW1-3, BESS Eskom, business/private projects currently under construction, all other projects with COD, specified location & grid access, and low EAF (49% to 51%) | 11733MW new capacity by 2030 COD + Location | Eskom shutdown impact. High usage of peaking stations. Compliance with MES. Tx grid |
| 3 | RMIPPP, REIPPP 5 PV, REIPPP 6 PV, REIPPP 7 PV, REIPPP 5 Wind, REIPPP 7 Wind, business/private projects currently under construction, all other projects with/without COD, specified location & grid access, and low EAF (49% to 51%) | 19785MW new capacity by 2030 All initiatives | Eskom shutdown impact; Grid access. High usage of peaking stations. Compliance with MES. Tx grid |
| 4 | RMIPPP, REIPPP 5 Wind, business/private projects currently under construction, plus current gas programme, and low EAF (49% to 51%) | 9996MW new capacity by 2030 DMRE Gas + Eskom RB Gas + RMIPPP Gas | Eskom shutdown impact; Access to gas. Price of Gas; Compliance with MES. Tx grid |
| 5 | RMIPPP, REIPP 5 Wind, business/private projects currently under construction, plus Eskom plant improvement, and high EAF (66% to 69%) | 3776 MW new capacity by 2030, and recovery | Eskom shutdown impact, especially by 2030. Compliance with MES. Tx grid |

# Horizon Two Summary

| Pathway | Description | Comments | Risks & Mitigations |
|---|---|---|---|
| 1 | Renewable Energy, plus Gas (mid-merit) programme | *Up to 2035:*<br>• CCGT 7000MW; 4500MW Wind; 4000 MW PV; 2000MW BESS<br>*2036 to 2050:*<br>• 15000MW CCGT; 30000MW Wind; 10000MW BESS | Grid stability; Gas access |
| 2 | Renewable Energy, plus BESS storage, pumped storage, bioenergy | 166000MW by 2050<br>(Wind, Solar, Gas & Storage) | Grid stability |
| 3 | Renewable Energy, plus Nuclear (incl SMRs) | 4000MW Nuclear by 2040; with additional 14500MW Nuclear by 2050; 67000MW Wind; 14000MW BESS | Nuclear (SMRs) technology readiness |
| 4 | Renewable Energy, plus delayed shutdown of coal power plants post 2035 | 4000MW CCGT by 2040; EAF improvement to above 70% | Delayed shutdown without retrofitting abatement technologies will result in increase in carbon emissions, post 2026 |
| 5 | Renewable Energy, plus Clean Coal (incl CCUS, CFB and FBC) | 5000MW of new clean coal by 2040; 60000MW Wind by 2050 | Funding |

# Major Issues

- Timelines for public comments, Assumptions/Data used √

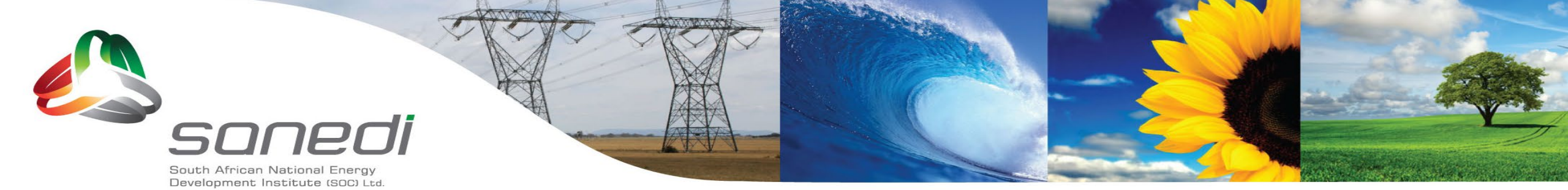
- **Power lines:** The document highlights that more than 14000 km of new transmission lines are required by 2032. Given Eskom's record of only building 4000 km in 9 years, it needs to be explained. That is, how is Eskom going to build 14000 km in 8 years?

- **Life Extension of Coal Power Plants:** While the draft IRP 2023 outlines objectives well, there is a need for more clarity on the practical implementation strategies. Life extension of coal power plants will be challenged by compliance with Minimum Emission Standards. The plan to address this is not mentioned in this document. If MES requirements are enforced as is, the decision will result in the loss of baseload generation capacity of 16GW immediately, and loss of 30GW of baseload generation capacity by 2025

- **Eskom Shutdown Plan:** There is limited information regarding units or power stations to be considered for running beyond 50 years life. It is left up to Eskom to decide based on economic reasons. Eskom is not a supplier of last resort, but rather the State through the DMRE is the supplier of last resort. Ideally, no coal-fired power plant unit should shut down between 2024 and 2030 to provide baseload electricity and ensure energy security

- **Eskom Generation Recovery Plan:** - No details provided in the draft IRP 2023 regarding Eskom Generation Recovery Plan

- **Energy Efficiency and DSM:** – This may require more attention



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# Concluding Remarks

# Concluding Remarks

- Two horizons approach enables a focused view on short, medium and long term perspectives. **Horizon 0ne** is mainly about fixing existing infrastructure, accelerate already committed new build and IPP projects, and maintaining dispatchable capacity for reliability. **Horizon Two** is mainly about adding more dispatchable capacity (i.e. gas and nuclear), continuing with decarbonization initiatives by adding more renewable energy, maintaining grid stability and reliability by introducing cleaner coal technologies and extending life of power plants;

- Climate change and energy security are the two sides of the same coin!! South Africa is doing very well in terms of meeting its NDC targets. However, loadshedding continues to cripple the economy;

- Low carbon technologies (incl Gas & Clean Coal) to play a key role during energy transition. Energy mix of the future will always have coal (albeit reduced), therefore clean coal technologies (incl CCUS) should be pursued;

- In the short to medium term, baseload power will come from coal-fired power plants and nuclear power plants. Therefore emissions abatement technologies, CCUS and energy efficiency initiatives at these power plants should be accelerated. These plants should also be properly maintained and extend their life where it makes technical and economic sense; This does not mean we must not accelerate Gas, RE & Nuclear initiatives

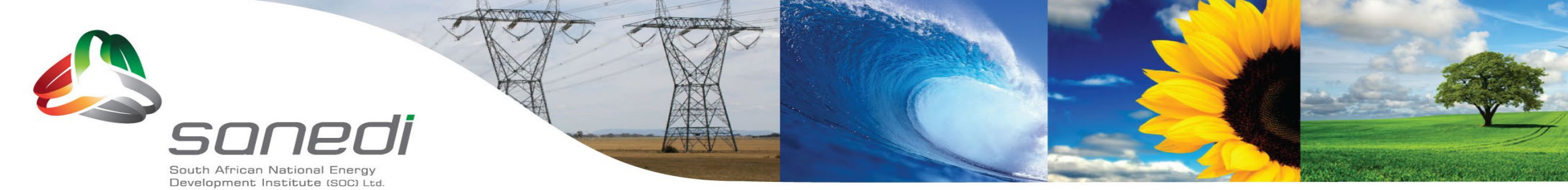
# Concluding Remarks (cont'd)

- Energy transition in South Africa will be implemented in accordance with the domestic policies and plans, which includes dealing with our ***current energy crisis and reducing carbon footprint***, and in support of our foremost task of ***reducing poverty, unemployment, and inequality***;

- Therefore, South Africa will follow a ***differentiated approach and multi-pathways*** to move from a high carbon economy to low carbon economy, and eventually achieving a ***net-zero carbon emissions by 2050***;

- This will be done at a ***pace, scale and cost*** that the country can afford and in a manner that ensures energy security;

- Therefore, coal (including abatement technologies), nuclear (including SMRs), gas (including use of indigenous gas and hydrogen), renewables (including storage), energy efficiency (incl DSM) must be part of the energy mix! We must also not forget about grid access, stability, expansion and modernization.



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