PRESIDENTIAL CLIMATE COMMISSION ("PCC")

ENERGY DIALOGUE: THE ROLE OF NUCLEAR IN SOUTH AFRICA'S ENERGY MIX

"The role of nuclear in a municipal electricity utility's energy mix to address its decarbonisation journey"

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AMEU DISCLAIMER

- To eliminate any doubts or misunderstandings, we want to state upfront that the potential role and integration of nuclear power into the energy mix of municipal electricity utilities will be and is still an ongoing topic for comprehensive discussion and engagement within the AMEU membership (in consultation with its partners and associates).
- What you are about to hear in this presentation today represents our preliminary and evolving perspectives aimed at initiating this critical dialogue, debate and discussion.
- Our goal is to converge in reasonable time on a well-informed, carefully thought of and finalised position regarding the potential role of nuclear power in a municipality's energy strategy.
- That said municipalities have been procuring for many years Eskom's Koeberg P/S nuclear generated electrons through its electricity bulk purchases from Eskom via the national electricity grid
- Therefore, please consider this presentation within that context.

OVERVIEW OF SOUTH AFRICA'S ENERGY LANDSCAPE (1)

1. RELIANCE ON COAL:

South Africa has historically depended heavily on coal as its primary energy source, which accounts for about 80% of electricity generation. This reliance has led to significant greenhouse gas emissions and environmental degradation. The coal-fired power plants, while providing relatively cheap electricity, contribute to air pollution and have raised concerns about sustainability and climate change.

- **Energy Shortages**:

  The country has experienced persistent energy shortages, with load shedding becoming a common occurrence due to aging infrastructure, insufficient maintenance, and growing energy demand. These shortages have impacted economic growth, job creation, and the overall quality of life for South African citizens.

- **Need for Transition to Sustainable Alternatives**:

  Given the pressing need to address climate change and reduce reliance on fossil fuels, there is a critical demand for a to sustainable energy alternatives. This includes increasing the share of renewables like solar and wind energy, as well as incorporating low-carbon sources like nuclear power into the energy mix.

OVERVIEW OF SOUTH AFRICA'S ENERGY LANDSCAPE (2)

2. CHALLENGES IN MEETING DECARBONIZATION TARGETS:

- **Infrastructure Limitations**:

  Municipalities face significant challenges in upgrading and expanding their electricity infrastructure to support the integration of renewable energy and nuclear power. Many existing systems are outdated and not adequately equipped to handle the variability associated with renewable sources.

- **Financial Constraints**:

  Budgetary limitations are a significant obstacle for municipalities. The upfront costs associated with transitioning to renewable energy technologies and nuclear power can be substantial. Funding for such projects often relies on public investment or private partnerships, which can be difficult to secure.

3. THE NEED FOR A STABLE ENERGY MIX:

- **Diversification of Energy Sources**:

  To ensure energy security and resilience, it is essential to diversify the energy portfolio. A balanced energy mix that incorporates both renewable sources and reliable, dispatchable energy like nuclear will help mitigate the risks associated with over-reliance on any single source.

- **Reliability and Stability:**

  A stable energy mix is vital for meeting the fluctuating demands of consumers and businesses. By including nuclear power, municipalities can benefit from its ability to provide baseload power, which can complement the intermittent nature of renewables.

- **Long-Term Energy Planning:**

  Integrated energy planning that considers a mix of energy sources is crucial for sustainable development. Municipalities must adopt strategies that promote long-term energy security while aligning with national decarbonization goals.

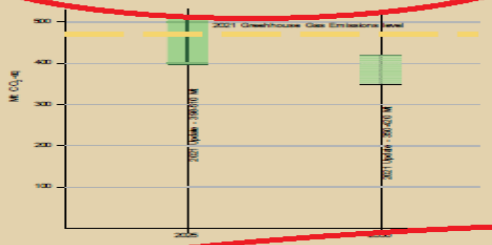
OVERVIEW OF SOUTH AFRICA'S ENERGY LANDSCAPE (3)

JET Investment Plan 2023-2027

Published in 2022, South Africa's **JET IP 2023–2027** sets out the **scale of need and the early-stage investments** required for the country's Just Transition (JT) to a low-carbon and climate-resilient economy in line with its updated Nationally Determined Contribution (NDC) lodged with the United Nations Framework Convention on Climate Change (UNFCCC) in 2021.

To decarbonise the economy to within the target range by 2030

350-420 Mt CO_2 eq



requires initial funding of

~ ZAR 1.5 trillion
over five years 2023-2027
from multiple sources

- Developed countries
- Private sector investors
- Development Finance Institutions
- Government
- Philanthropies
- Multilateral Development Banks

in three priority sectors

- Electricity
- New Energy Vehicles
- Green Hydrogen

and two cross-cutting areas

- Skills development
- Municipalities

through a Just Energy Transition that

- Protects vulnerable workers and communities
- Builds energy security
- Expands energy access
- Promotes industrial development
- Drives innovation
- Develops sustainable livelihoods
- Enables economic diversification
- Spurs inclusive economic growth

GIVEN THE PRESSING NEED TO ADDRESS CLIMATE CHANGE AND REDUCE RELIANCE ON FOSSIL FUELS, THERE IS A CRITICAL NEED FOR A PRUDENT FIT-FOR-PURPOSE COST EFFECTIVE BALANCED JUST ENERGY TRANSITION ("BJET") TO SUSTAINABLE ENERGY ALTERNATIVES THAT REFLECTS A MIGRATION OR TRANSFORMATION OR TRANSITION TO A LOW CARBON ECONOMY. THIS INCLUDES INCREASING THE SHARE OF RENEWABLES LIKE SOLAR AND WIND ENERGY, AS WELL AS INCORPORATING LOW-CARBON SOURCES LIKE *NUCLEAR POWER* INTO THE ENERGY MIX TO REACH NET ZERO BY 2050.

THE DISPATCHABLITY AND FLEXIBLITY ROLES OF NUCLEAR

THE ROLE OF NUCLEAR POWER

- **Low-carbon energy source:** Nuclear energy produces minimal greenhouse gas emissions during operation, making it a crucial player in decarbonization efforts.
- **Reliability and stability in the energy mix:** Nuclear power provides a consistent, reliable energy supply that can support the grid during fluctuations in renewable generation.
- **Complementary to renewable energy:** By integrating nuclear power, municipalities can enhance their energy mix, ensuring that the variability of renewables is balanced with a dependable source of energy.

BASELOAD POWER GENERATION

- **Continuous operation and high-capacity factors:** Nuclear plants typically operate at capacity factors exceeding 90%, allowing them to deliver a constant supply of energy.
- **Ability to provide a stable baseload of energy**: This reliability ensures that energy demand is consistently met, which is crucial for grid stability.
- **Contrast with intermittent renewables**: Renewable energy sources like solar and wind are subject to variability based on weather and time of day, making them less reliable without a stable backup.

FLEXIBILITY AND LOAD FOLLOWING

- **Advanced reactor designs and flexible operation**: Some modern nuclear reactors can adjust their output to better align with demand changes, offering operational flexibility.
- **Ability to adjust output based on demand**: This flexibility allows utilities to optimize their energy generation in response to real-time demand fluctuations.

NUCLEAR POWER'S STRATEGIC VALUE PROPOSITION

LONG OPERATIONAL LIFESPAN

- **Extended availability of nuclear reactors: Nuclear facilities can operate for 40–60 years or more, providing a long-term energy solution.**
- **Supports long-term planning and investment:** The longevity of nuclear power allows municipalities to plan their energy strategies and infrastructure investments over a significant time horizon.
- **Stability in energy supply:** The consistent output from nuclear plants supports a stable energy supply, which is essential for economic growth and public services.

ENVIRONMENTAL BENEFITS

- **Low carbon emissions during operation**: Nuclear power emits negligible greenhouse gases, which is vital for climate change mitigation.
- **Contribution to decarbonization goals**: By reducing reliance on fossil fuels, nuclear energy can help municipalities meet their carbon reduction targets.
- **Environmental stability**: The environmental benefits of nuclear power contribute to a stable ecosystem, supporting biodiversity and public health

GRID STABILITY SERVICES

- **Provision of ancillary services**: Nuclear plants can provide essential grid services such as frequency regulation and voltage support to maintain stability.
- **Frequency regulation and voltage support**: These services are crucial as the grid incorporates more variable renewable energy sources, which can introduce instability.
- **Maintaining grid reliability**: The ability of nuclear power to provide these services enhances overall grid reliability, especially during fluctuations in supply.
- **High Energy Density** : **Efficiency in Fuel Use**: Nuclear energy has a very high energy density compared to fossil fuels and renewables. A small amount of nuclear fuel can produce a large amount of energy, reducing the need for extensive fuel supply chains and infrastructure.

FINANCIAL AND BUSINESS SUSTAINABILITY

- **Stable fuel costs and long-term contracts:** Nuclear energy benefits from predictable fuel pricing due to long-term contracts, which helps stabilize electricity prices. Long term nuclear PPAs e.g. 25 to 50 years and off-balance-sheet nuclear infrastructure projects e.g. BOT, BOOT type projects can also facilitate cost effective procurement of nuclear electricity by municipalities
- **Resistance to price volatility:** Unlike fossil fuels, nuclear energy is less affected by market fluctuations, providing financial predictability for municipalities.
- **Stable investment environment:** The inclusion of nuclear power in the energy mix can potentially attract long-term investments **in derisked nuclear energy projects with select munics/metros as the off-takers** . Nuclear plants often require significant upfront capital but yield stable returns over their operational lifespans, providing financial predictability.
- **Reduction in energy costs**: By diversifying energy sources with nuclear power, municipalities can mitigate the volatility of energy prices associated with fossil fuels and some renewable technologies. This can lead to more stable electricity pricing for consumers and reduced financial risk for utility operators. **Enhanced economic development:** The deployment of nuclear energy (especially through nuclear SMR) can stimulate local economies through job creation in construction, operation, and maintenance of nuclear facilities. This economic growth can generate additional revenue for municipalities, supporting further investments in community services and infrastructure.

******AT THIS STAGE IT IS NOT ENVISAGED THAT MUNICPALITIES WILL BUILD AND OPERATE NUCLEAR POWER PLANTS. WE WILL LEAVE THAT TO COMPETENT AND EXPERIENCED LICENCED NUCLEAR PLANT OWNERS AND EXPERIENCED NUCLEAR PLANT OPERATORS INCLUDING IPPS, NECSA AND ESKOM TO DO SO ON BEHALF OF MUNICS. MUNICPALITIES WILL GIVE FAVOURABLE CONSIDERATION THOUGH TO PURCHASING VIA e.g. COST-EFFECTIVE LONG TERM DERISKED PPAs (+- 25-50 YRS) THE ECONOMIC OUTPUT (ELECTRONS/ELECTRICITY) FROM THESE NUCLEAR ASSETS AT A PACE AND SCALE THAT GOVERNMENT AND THE COUNTRY CAN AFFORD******

NET ZERO NEEDS NUCLEAR
- ACHIEVING NET ZERO GLOBALLY WILL BE VIRTUALLY IMPOSSIBLE WITHOUT NUCLEAR

ACHIEVING 2050 NET ZERO TARGETS NEEDS NUCLEAR

- **Insights from the International Atomic Energy Agency:** The **IAEA** emphasises the importance of nuclear power in achieving global decarbonization targets.
- **The role of nuclear in sustainable energy transitions:** Nuclear energy is recognised as a key player in the transition to a sustainable and low-carbon energy future.
- **Nuclear as part of a diversified energy strategy:** The **IAEA** advocates for a balanced energy mix that includes nuclear to support the growth of renewables while ensuring reliability.

ACHIEVING NET ZERO TARGETS IN 2050 GLOBALLY WILL BE VIRTUALLY IMPOSSIBLE WITHOUT NUCLEAR

- **Nuclear power as a critical component of global decarbonisation**: Nuclear energy is essential for achieving net-zero emissions targets set by various countries and international agreements.
- **Addressing the challenges of high renewable penetration**: As the share of renewables increases, nuclear power can provide the reliability needed to maintain grid stability.
- **Supporting a balanced energy mix**: A diverse energy portfolio that includes nuclear is essential for ensuring energy security while meeting environmental goals

HARNESSING NUCLEAR SMRs FOR DECENTRALISED POWER GENERATION IN SA (1)

1. Flexible Deployment Locations

- **SMRs can also be an off-grid solution. There are currently about 80 different designs of SMRs that are being considered**
- SMRs can be installed in various locations, including rural and underserved areas, allowing for localized energy generation.
- This flexibility reduces the need for extensive transmission infrastructure, enabling energy access in regions where grid expansion is economically unfeasible.

2. Reduced Capital Investment in Grid Expansion:

- South Africa's existing transmission and distribution grids are significantly congested, often referred to as "constipated."
- Deploying SMRs in strategic locations can alleviate pressure on the national grid by providing localized baseload power, minimizing the need for costly grid upgrades and expansions.

3. Enhanced Energy Security:

- By diversifying energy sources and decentralizing power generation, SMRs can enhance energy security, particularly in rural areas that are often vulnerable to power outages and energy shortages.
- Localized generation reduces reliance on long-distance energy transport, increasing resilience against grid failures and disruptions.

4. Support for Economic Development:

The establishment of SMRs in rural areas can stimulate local economies by creating job opportunities in construction, operation, and maintenance. Local energy generation supports industrial development and attracts businesses, contributing to overall economic growth in these regions.

HARNESSING NUCLEAR SMRs FOR DECENTRALISED POWER GENERATION IN SA (2)

5. Environmental Benefits:

- SMRs provide a low-carbon energy source, contributing to South Africa's decarbonization goals while minimizing the environmental impact associated with large-scale fossil fuel generation.
- Their smaller footprint and reduced resource requirements compared to traditional nuclear plants make them an environmentally sustainable option for rural energy needs.

6. Integration with Renewable Energy:

- SMRs can complement intermittent renewable sources (e.g., solar and wind) by providing reliable baseload power, ensuring a stable energy supply throughout the day and night.
- Their deployment can facilitate a more balanced energy mix, maximizing the benefits of both nuclear and renewable resources.

7. SMR rollout by India:

On 1 February 2025, the Indian government announced it is aiming to develop at least 100GW or 100 000 MW of nuclear SMR power by 2047 (in +-22 years).

8. SMRs can power AI driven electricity-hungry companies and data centres:

Microsoft, Google, Meta, and Amazon will use nuclear reactors and partner with local energy companies to ease their respective electricity grid stress. Notwithstanding that they will still pursue wind and solar, they're turning to nuclear power to meet their short-term energy needs and net-zero goals.

IT'S REPORTED THAT ESKOM WILL BE PILOTING NUCLEAR SMRs (100 MW) WITH NECSA

CONCLUSION

YOUTUBE VIDEO LINK (3.34 MINS)

THE INTERNATIONAL ATOMIC ENERGY AGENCY ("IAEA") STATEMENT ON THE VALUE PROPOSITION OF NUCLEAR POWER MADE BY RAFAEL MARIANO GROSSI, SECRETARY GENERAL OF THE IAEA AT COP28 THAT WAS HELD IN DUBAI, UAE IN DECEMBER 2023

(SOUTH AFRICA IS A MEMBER OF THE IAEA)

https://youtu.be/Si0k0eewOTY?si=1pjSs_ji1ojIXkut

"NET ZERO NEEDS NUCLEAR POWER" *(IAEA)*

Thank you

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