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Title:

**State of Renewable Energy
Development in South Africa.**

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Introduction

- Energy – enables things to move: Necessary for manufacturing, material processing, agriculture, mining, electricity, etc.
- As early as the 20th Century coal-fired power generation became widespread: with the expansion of the coal mining industry.
- In 1923 Electricity Supply Commission (ESKOM) was established with the continued growth of coal-generated electricity.
- 1970s: The Koeberg Nuclear Power Station was commissioned.
- After the end of apartheid in the early 1990s, South Africa's energy sector faced numerous challenges, including the need for restructuring and modernization.

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- Government introduced policies and initiatives to promote energy diversification, reduce emissions, and address environmental concerns. These efforts included the White Paper on Energy Policy (1998) and the Renewable Energy Independent Power Producer Procurement (REIPPP) program in 2011.
- The 21st century has seen a greater emphasis on renewable energy development, with increased investments in wind and solar power projects through the REIPPP program.
- South Africa continues to grapple with energy access challenges, particularly in rural areas and is working toward expanding electricity infrastructure and addressing inequalities.
- South Africa has committed to reducing its carbon emissions, aligning with global climate goals, leading to a growing focus on transitioning from coal to cleaner energy sources, such as renewable energy and natural gas.

Purpose & Scope of the presentation

- The presentation aims to summarise **the status and trends in renewable energy development** in South Africa and **explore existing opportunities, challenges,** and **key developments** in the sector.

Load Shedding Experiences (EskomSePush App)

Year	No. of Hours	No. of Days
2020	844	35
2021	1153	48
2022	1637	68

Current Status

- Total system demand in 2022 ~ 2021, but still 5.2 TWh (2.2%) less than the pre-lockdown levels in 2019.
- Coal provides 80% of the total system load of the energy mix.
- Renewable energy technologies such as wind, solar PV, and CSP increased their contribution to a 6.2 GW installed capacity, i.e., 7.3% of the total energy mix.
- The Eskom fleet energy availability factor (EAF) continued declining in 2022, with an average EAF of 58.1%, compared to the EAF of 61.7% for 2021 and 65% for 2020 [1].
- 2022 overtook 2021 as the most intensive load-shedding year. Though not yet confirmed, 2023 will have the highest number of load shedding.

South African electricity landscape

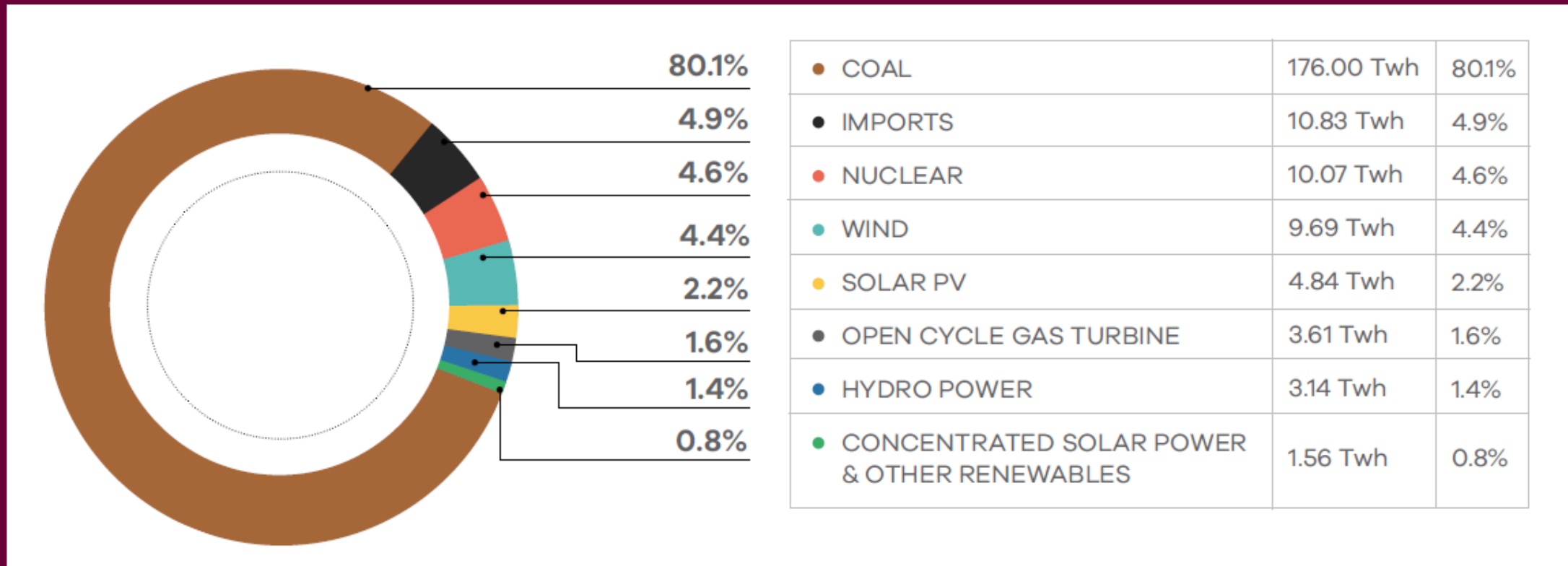


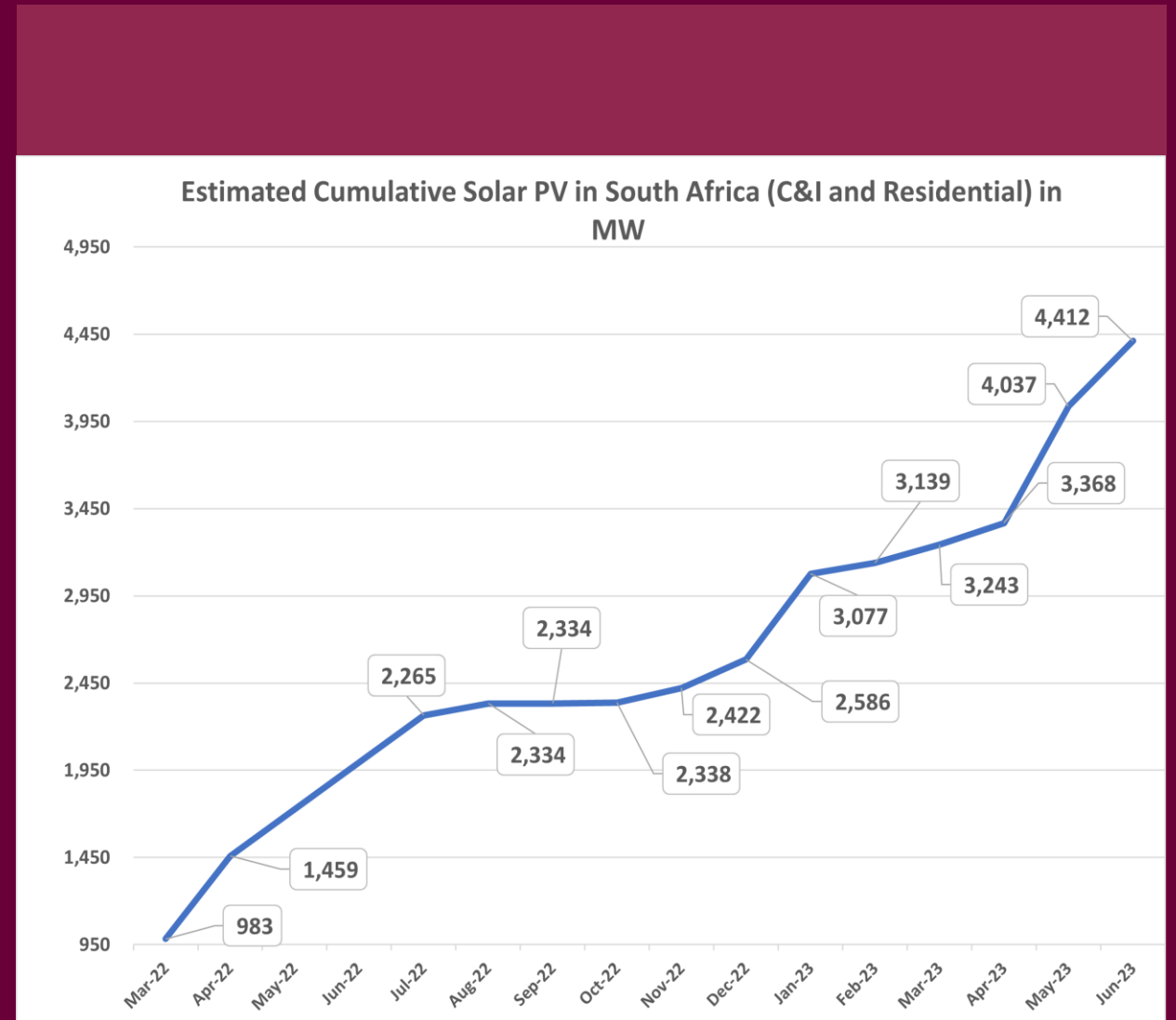
Fig. 1: Electricity contribution by source [7]

Source: ESKOM 2023

ESKOM's Recent status 2023

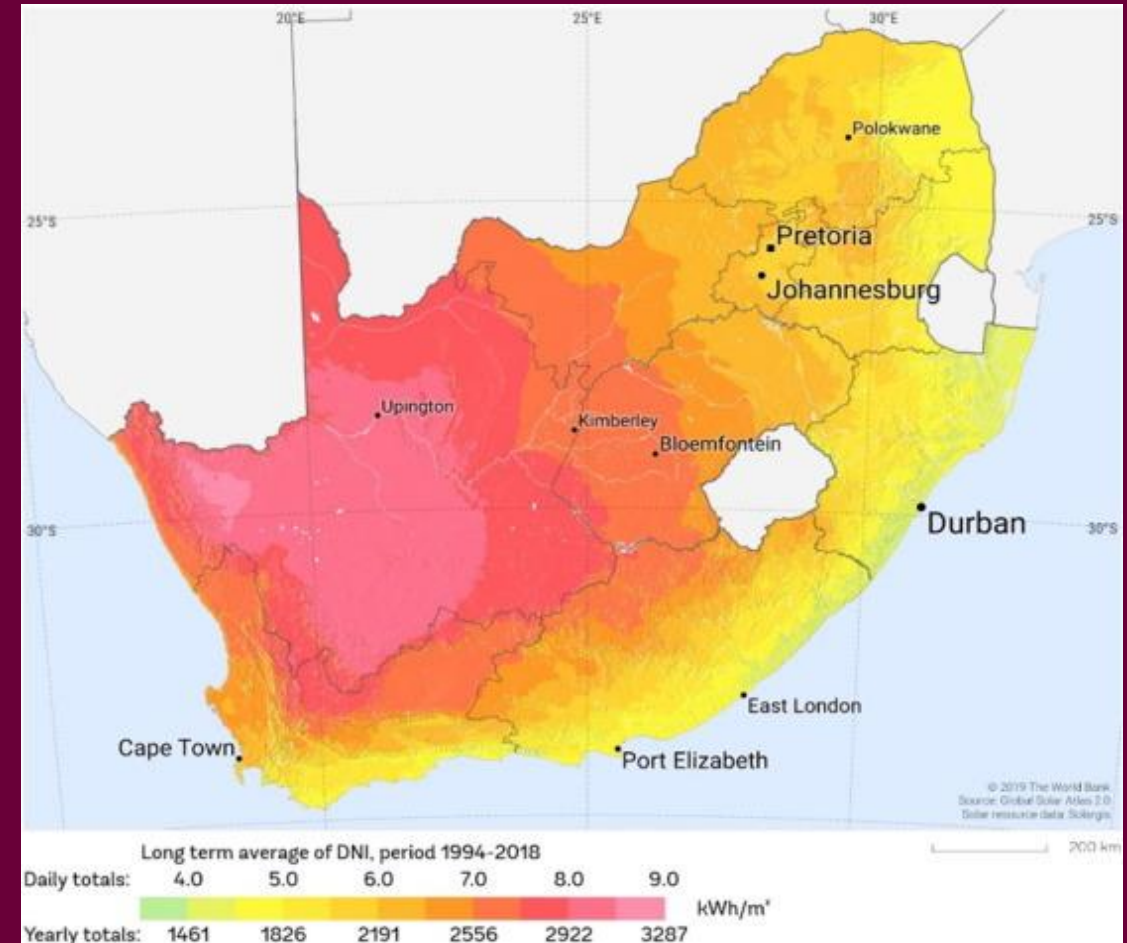
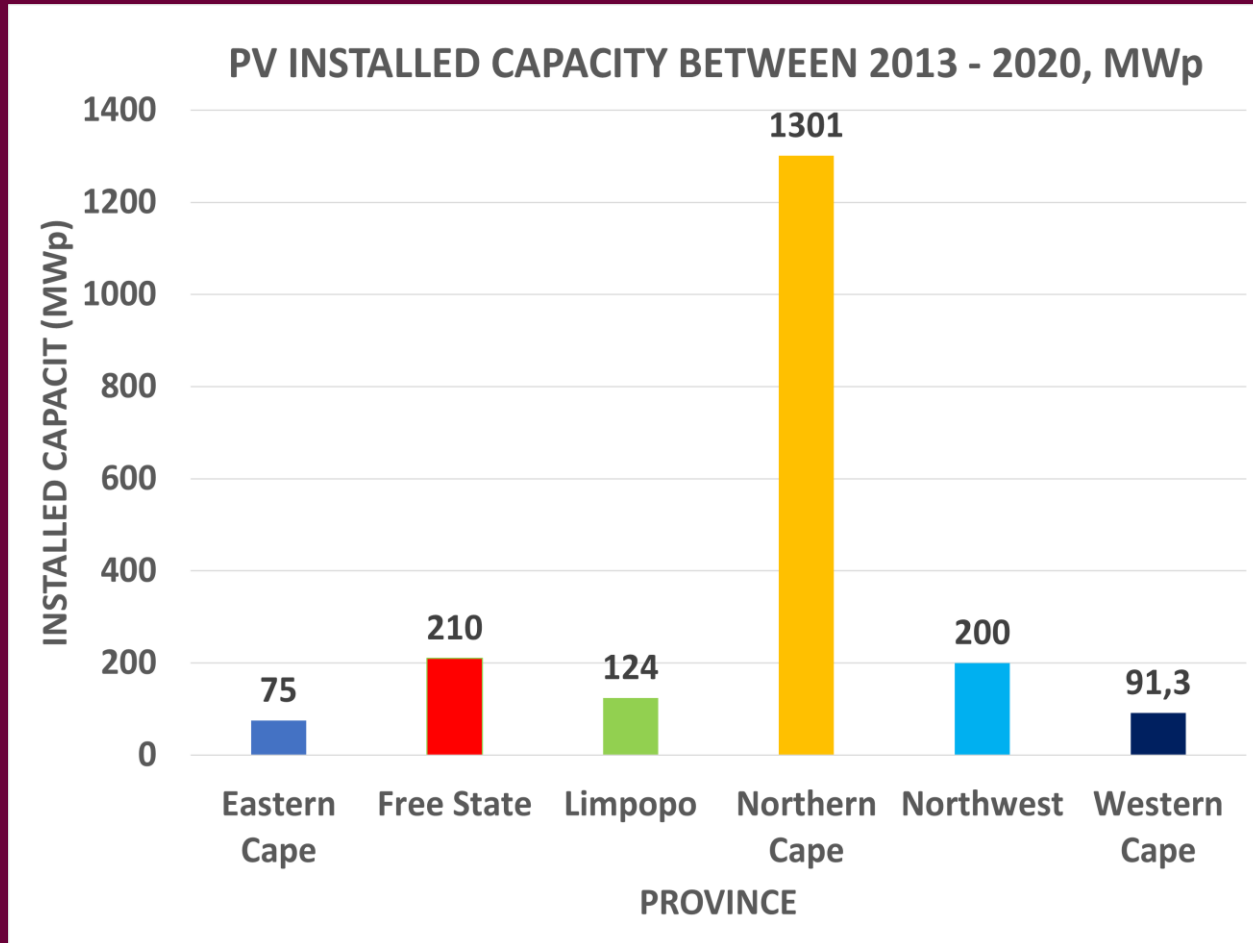
Renewable Independent Power Producer Programme (REIPPP) Current Installed Capacity (MW):

- Concentrated solar: 500 MW
- Utility-scale solar PV: 2,286 MW
- Wind (Eskom plus Independent Power Producers): 3,443 MW
- Total, including other renewables: 6,280 MW
- ❖ Approximately 4,412 MW of rooftop solar PV are installed in the South African C & I and residential sectors.
- ❖ ~ 3,000 MW was added from March 2022 to June 2023 [3]

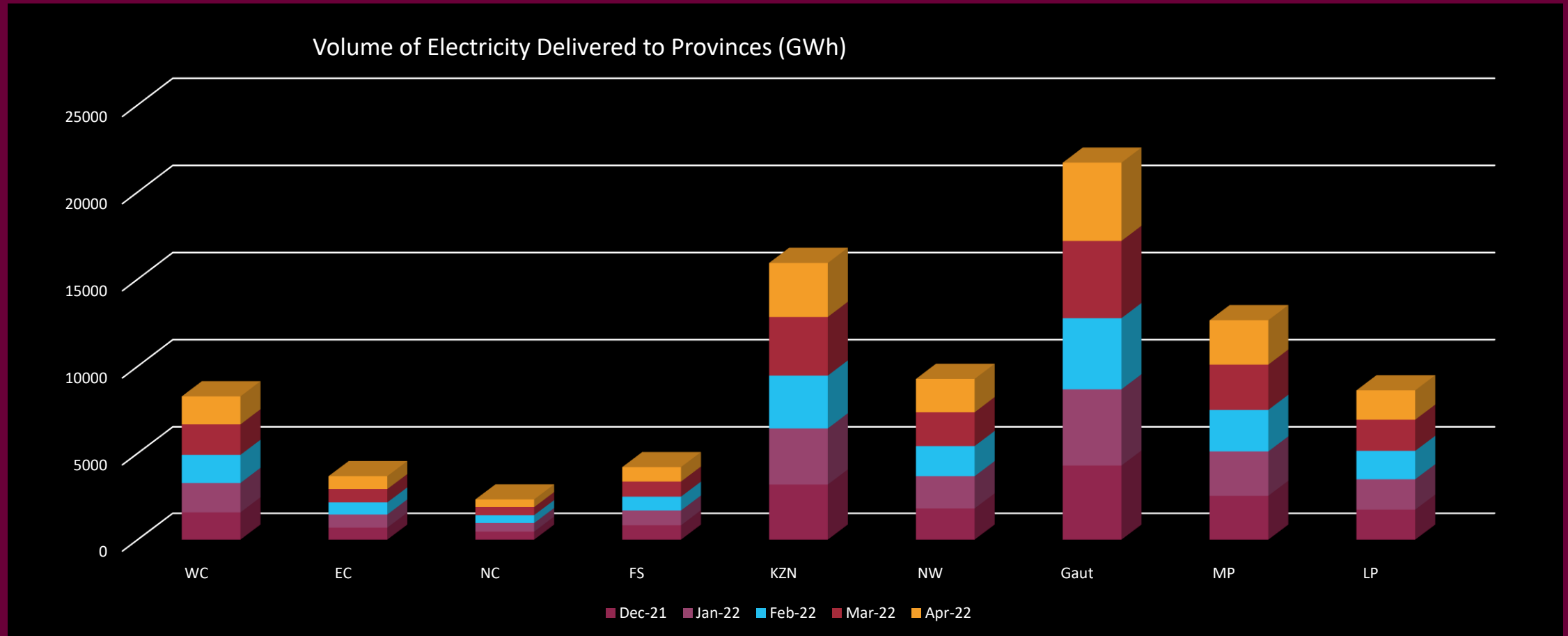


Source: ESKOM

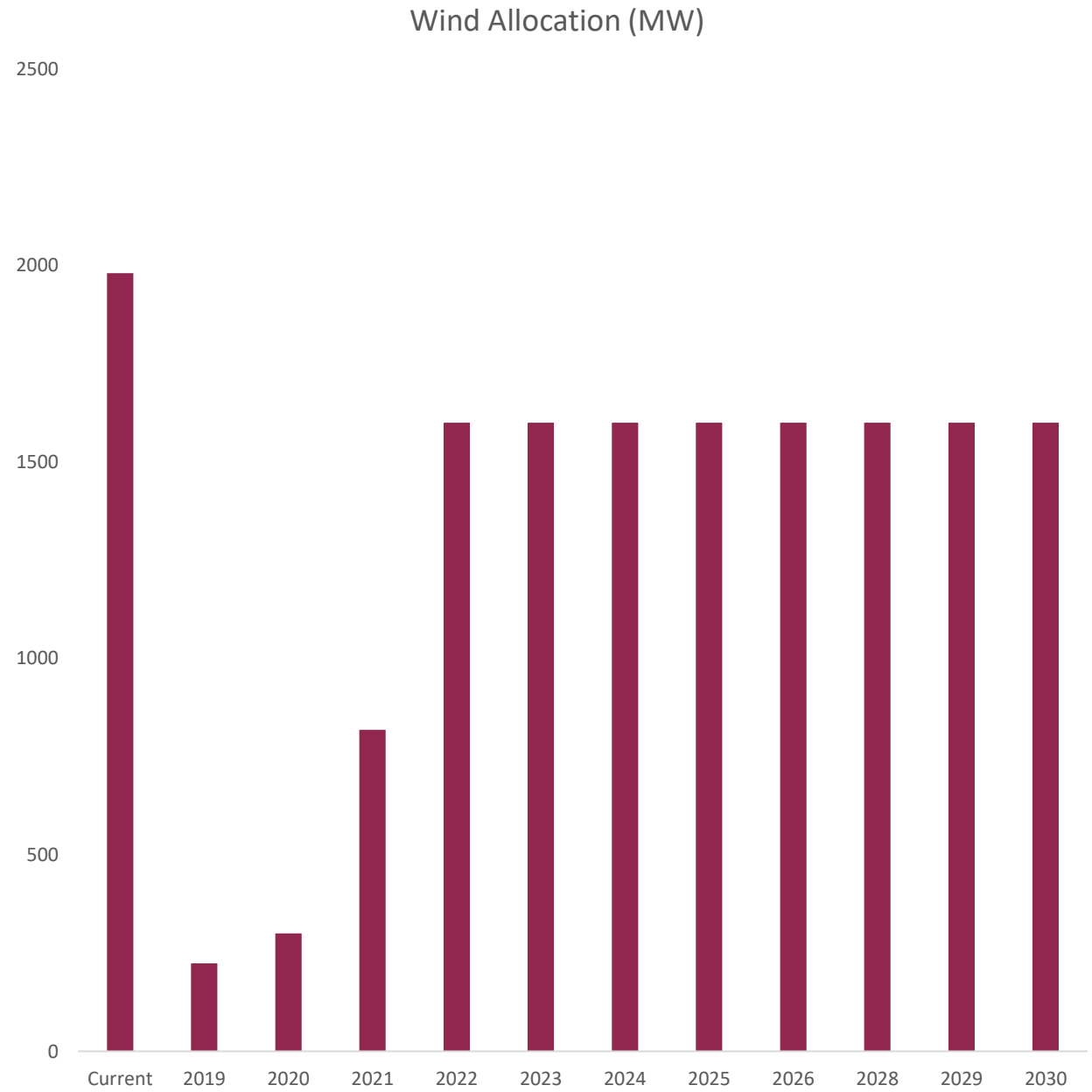
Solar Farms Capacity in SA



Electricity per Province (Dec. 2021 – Apr. 2022)

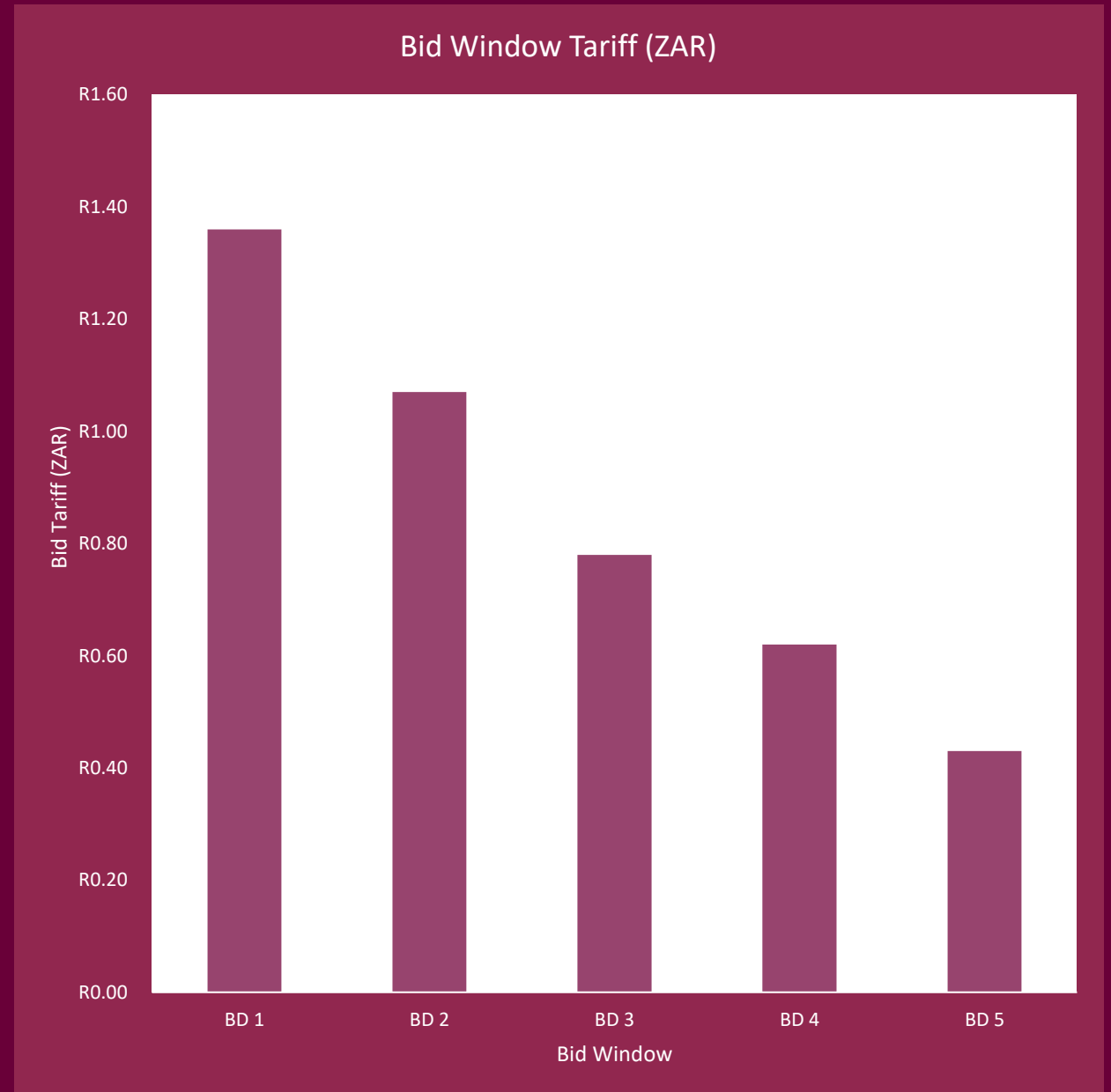


❖ IRP 2019 – Wind Energy Allocation [8]



Wind cost

- IRP proposal to reduce transaction cost [8].



Renewable Energy policies and Initiatives

- Government policies and initiatives promoting renewable energy development.
- The following departments play a role in the development and implementation of policies regarding energy and electricity sectors:
 - ✓ DMRE – drives the energy policies.
 - ✓ National Energy Regulator of South Africa (NERSA)
 - ✓ Department of Trade, Industry and Competition (DTIC)
- Renewable Energy Independent Power Producer Procurement Program (REIPPPP).
- Integrated Resource Plan (IRP) – an electricity infrastructure development plan based on least-cost electricity supply and demand balance

Achievements and milestones

- REIPPPP has successfully procured 6.4 GW
- Cost decline for wind (ZAR 1.51 to ZAR 0.62 per kWh) and for solar, (ZAR 3.65 to ZAR 0.62 per kWh)
- The President announced in June 2021 that “the amended regulations will exempt generation projects up to 100MW in size, from the NERSA licensing requirement, whether or not they are connected to the grid.
- The commercial and industrial (C&I) sector has been leading investments in this sector, with ~70 % of new rooftop solar PV installations nationally in this sector.
- With increasing demand in embedded generation, the South African energy storage market is expected to grow to ZAR14.5 billion by 2035.
- The estimated annual total available market currently stands at ZAR3 billion, reaching an estimated ZAR21 billion by 2035.

Challenges in Renewable Development

The challenges hindering the growth of renewable energy in South Africa.

- Pre-radius defined is a challenge to the developers [4]
- Technical issues: Limited technical skills in designing, installing, operating, managing, and maintaining renewable-based energy services. Lack of reliable and comprehensive technical mapping skills. Local production of renewable equipment is limited.
- Policy-wise: Lack of incentives for private sector involvement and inconsistent policies, absence of feed-in tariff structure, lack of fossil fuel subsidies, weak environmental regulations, low priority given to renewable energy in national planning, and weak implementation framework.
- Financial issues: economies of scale are small, and renewables are still having high initial capital costs and long payback periods. Lack of access to credit and insufficient government financial support. Limited knowledge of market potential. High perceived risks and uncertainties [5].
- Issues related to grid integration, and regulatory hurdles.

Investment and Funding

- In February 2022, a 100MW integrated CSP plant, secured financing of USD 764.63 million and a commitment of USD 151.95 million. The project has received financing from international and South African financial institutions, including ABSA Bank, CDC Group, Development Bank of Southern Africa (DBSA), Deutsche FMO Investec Bank, Nedbank Limited, Sanlam Limited, and the Industrial Development Corporation of South Africa. The project is anticipated to be operational by the end of 2023.

Renewable Energy Development

- The government targets to deploy 11.8 GW of large-scale renewable energy capacity by 2030
- Regulations including REIPPP and the Risk Mitigation IPP program, continue to expand renewables penetration in the country.
- To increase individual adoption of renewable energies, the SA's government amended the Electricity Regulation Act, increasing the threshold for embedded power generation from 1 MW to 100 MW in 2021.
- The installed solar energy capacity for South Africa in 2021 was 2.91 GW, and it is expected to increase

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- Renewable energy contributed less than 1% to South Africa's total primary energy consumption in 2012
- Mid June 2015, the renewable energy capacity grew from 7 to 1860 MW, which was about 13.37% (287 MW) below the planned capacity.
- The solar energy installed capacity in South Africa accounts for more than 50% share of the total renewable energy mix.
- As of 2022, the total installed capacity of concentrated solar energy is around 500 MW, and the photovoltaic power installed capacity is around 2 885 MW.

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- The cost of wind technologies has fallen 70% while the one of solar has fallen 85%.
- The South African government aims to reach net-zero emissions in 2050.
- In March 2022, Amazon launched a 10-megawatt solar plant in Northern Cape Province, South Africa. The plant is expected to generate more than 28,000 MWh of energy annually. The solar plant comprises over 24,000 bifacial solar panels.
- A decline in equipment costs such as solar panels since 2012 led to a decline in solar tariffs by over 88% and onshore wind energy tariffs by 68% – according to the global non-profit organization, Greenpeace.

Future Outlook

- The future prospects of renewable energy in South Africa.
 - ✓ Department of Mineral Resources and Energy (DMRE) – planned to have Bid Window 5 in 2023
 - ✓ IPP projects to a maximum of 75 MW solar and 140 MW
- Targets for renewable energy capacity and emissions reduction.

Some of the SA's Renewable Energy Companies

- EPC Developers/Operators/Owners
 - ✓ EDF Renewables
 - ✓ Acciona Energia SA
 - ✓ Juwi Renewable Energies (Pty) Ltd
 - ✓ Mainstream Renewable Power Ltd
 - ✓ Scatec ASA
 - ✓ Renewable Energy Holdings (Pty) Ltd
 - ✓ Engie SA
 - ✓ Enel SpA
- Equipment Supplier
 - ✓ Hanwha Corporation
 - ✓ Canadian Solar Inc.
 - ✓ Vestas Wind Systems AS
 - ✓ JinkoSolar Holding Co. Ltd , Siemens Energy AG, and Segen Solar (Pty) Ltd

Conclusions and recommendations

Conclusions

- SA's government is doing its best to increase the share of renewable energy in the energy mix and thriving to end loadshedding.
- The country still has vast and untapped potential of renewable energy from its abundant solar resource throughout the entire country and wind in its coastal regions
- The government still has room to put more policies to coerce and incentivise the installation of more renewable energy plant with targets

Recommendations

- Government to put in place policy that enforce mandatory Energy self-sufficient in all it new buildings and of all public institutions and incentivize individuals that do the same

References

1. Banks, D. and Schäffler, J., 2005. The potential contribution of renewable energy in South Africa. Johannesburg, South Africa: Sustainable Energy & Climate Change Project (SECCP).
2. CSIR RELEASES STATISTICS ON POWER GENERATION IN SOUTH AFRICA FOR 2022
3. <https://cleantechnica.com/2023/08/03/south-africa-now-has-over-10-gw-of-wind-solar-generation-capacity/> (By [Remeredzai Joseph Kuhudzai](#))
4. Wlokas, H.L., Boyd, A. and Andolfi, M., 2012. Challenges for local community development in private sector-led renewable energy projects in South Africa: an evolving approach. *Journal of Energy in Southern Africa*, 23(4), pp.46-51.
5. Shukla, A.K., Sudhakar, K. and Baredar, P., 2017. Renewable energy resources in South Asian countries: Challenges, policy and recommendations. *Resource-Efficient Technologies*, 3(3), pp.342-346.
6. Akinbami, O.M., Oke, S.R. and Bodunrin, M.O., 2021. The state of renewable energy development in South Africa: An overview. *Alexandria Engineering Journal*, 60(6), pp.5077-5093.
7. 2023 Large-scale renewable energy market intelligence report by Ulrich Terblanche and Jack Radmore
8. <https://sawea.org.za/wind-map/wind-ipp-table/>

Cont'd

9. Stats SA 2022

10. South Africa - Country Commercial, published 2023 May 06.

Comments & Questions

