Integration of Renewables in SAPP

Presentation by

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Presentation Outline

- **Background to SAPP**
- **SAPP Membership**
- **Renewable Energy Resources in the Region**
- **Enabling Renewable Energy Grid Integration**

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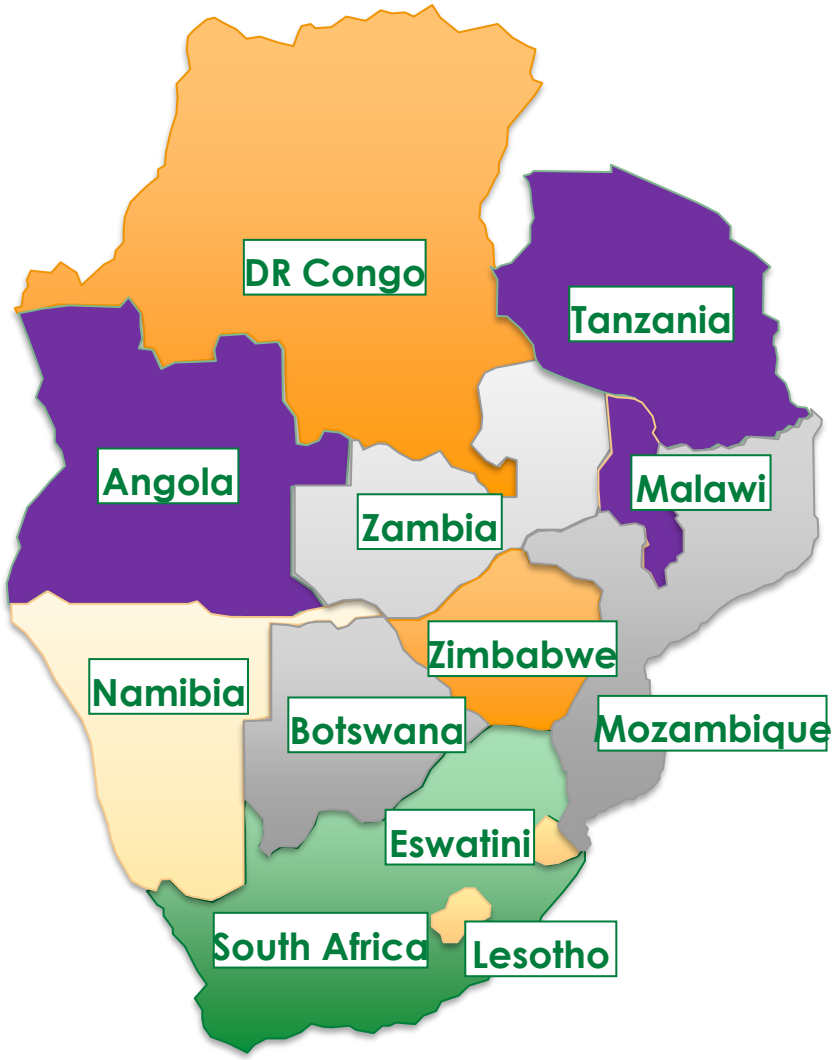
BACKGROUND TO SAPP



Establishment: The Southern African Power Pool (SAPP) was established in 1995 through the signing of an Inter-Government Memorandum of Understanding (IGMOU) by the Ministers responsible for energy in the Southern African Development Community (SADC) with objectives to:

- Coordinate the planning and operation of the electricity business in SADC
- Facilitate cross border electricity trading in SADC
- Promote regional cooperation in power projects development (Generation and Transmission Infrastructure)
- Ensure that the region attracts investment for large energy intensive electricity users

SAPP covers the 12 SADC mainland member states - population of over 350 million people and installed capacity in excess of 70 GW.

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SAPP Membership

SAPP Membership categories are:

- **National Power Utility Member**
- **Operating Member – meant for members whose operations have a significantly high impact on the SAPP Grid**
- **Market Participant – meant for members whose main objective is to trade on the SAPP markets**

✓ **SAPP currently has 18 Members:**

- **12 being National Power Utilities and**
- **6 being Independent Power Producers, Independent Transmission Companies and a Market Participant (4 in Zambia and 2 in Mozambique)**

✓ **SAPP is currently processing a number of new applications from IPPs in various countries.**

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Renewable Energy Resources in the Region

- A key priority for SAPP is to reduce the level of CO2 associated with power generation and to increase the participation of generation from variable renewable energy (VRE) sources

- At the same time SAPP needs to ensure reliable and economical electricity supplies for consumers in the region is maintained

- SAPP is aware that the Region has vast wind and solar energy resources and that the countries are at various stages of exploiting these resources to meet their climate change targets in the Nationally Determined Contributions (NDC)

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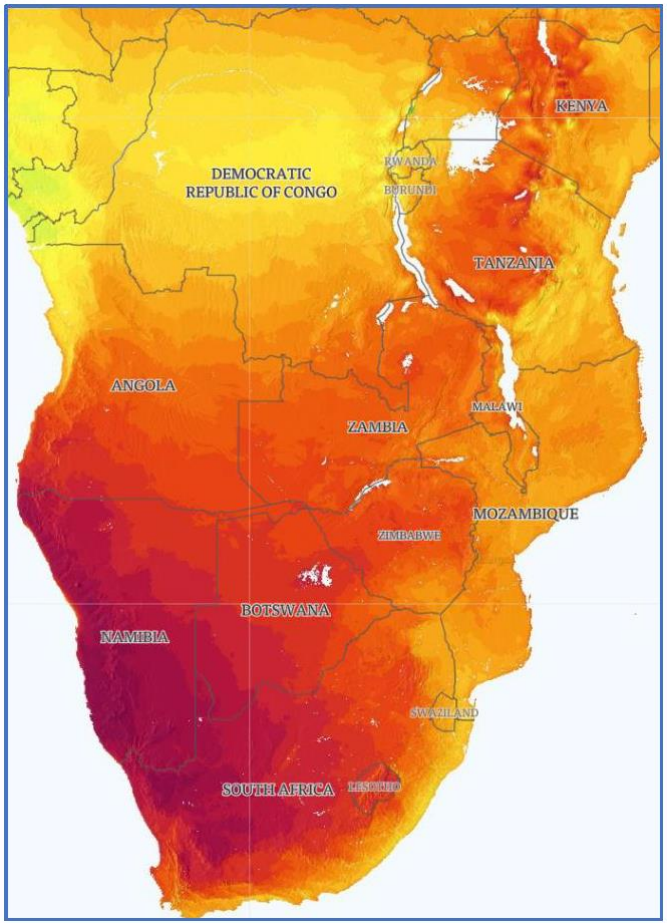
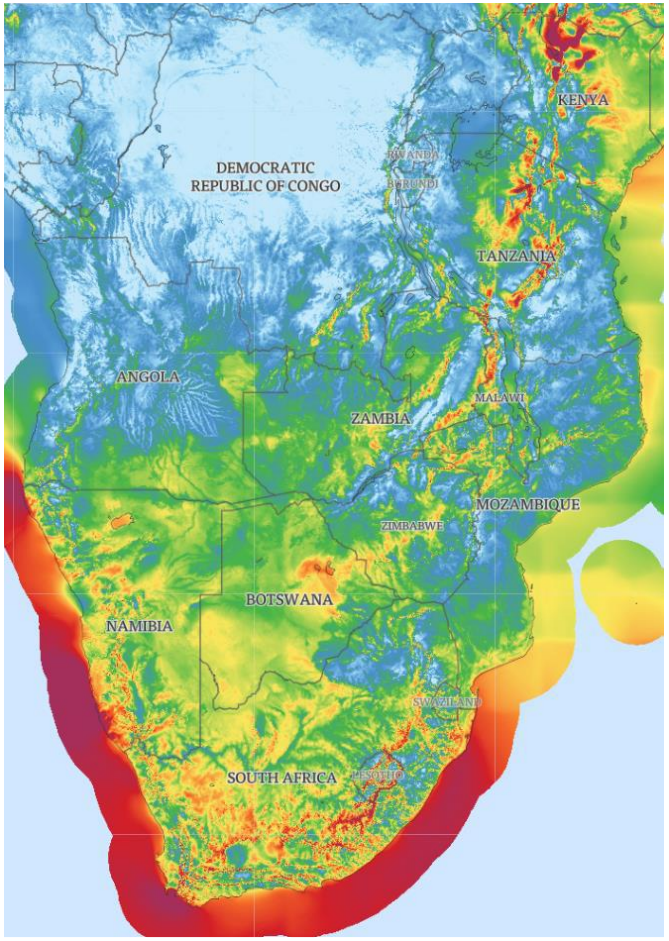
Renewable Energy Resources in the Region



Solar Potential (Average Annual Energy Output) in the SAPP Region (from Global Solar Atlas)



Wind Potential (Average Wind Speed) in the SAPP Region (from Global Wind Atlas)

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Impact of Renewable Energy in SAPP

- The interconnected SAPP grid needs to be able to absorb the intermittent production of VRE in a way that does not jeopardise the system security and management of the overall power market

- Best practice has shown that the bigger a regional market that exists, the more robust will be the regional integration of variable renewable energy (VRE).

- To integrate large amounts of VRE efficiently a regional market along with sufficient grid infrastructure is needed in order to provide efficient transfer of surplus energy to deficit areas throughout the region

- The power system operating procedures should also allow mitigation to the variability of these renewable energy resources

- SAPP enables integration of variable renewable energy resources through

  i. Strong transmission connectivity
  ii. Appropriate power market portfolios and
  iii. Appropriate system operating requirements.

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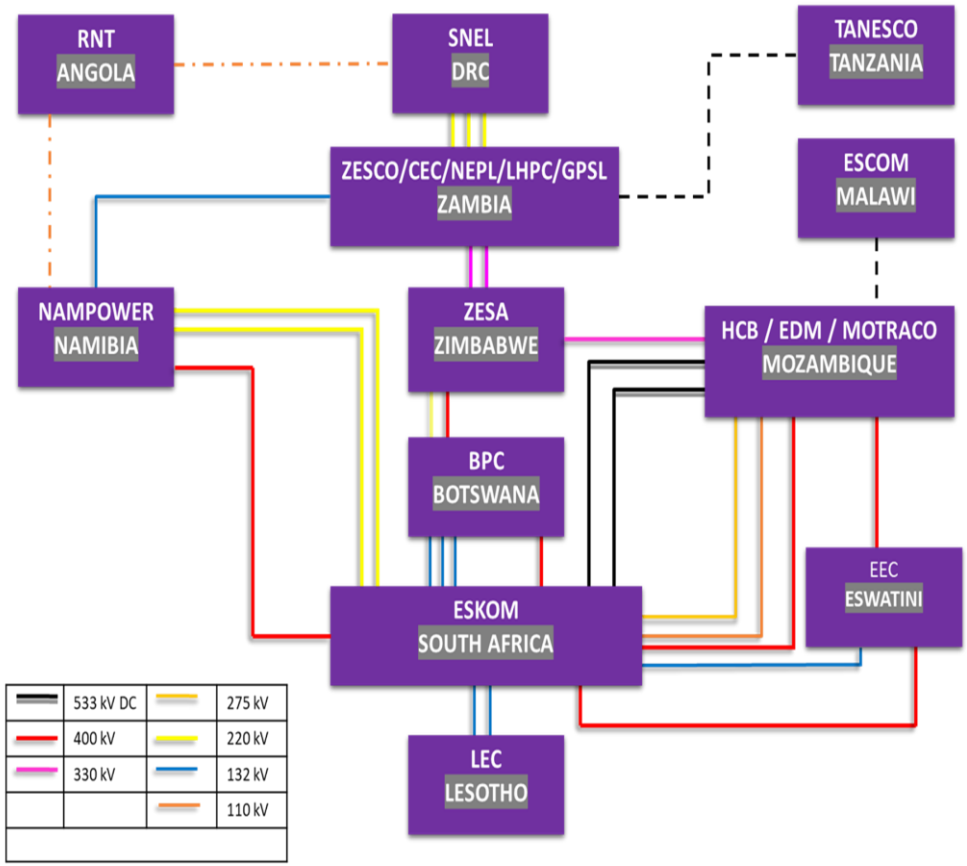
Enablers for Renewable Energy in SAPP - (i) Interconnectivity

- **9 Countries currently interconnected at Transmission level**
- **3 not connected to the SAPP grid**
  - Malawi being connected through the Mozambique – Malawi Interconnector
  - Tanzania being connected through the Zambia – Tanzania Interconnector
  - Angola will be connected to Namibia (Feasibility Studies completed), DRC and Zambia
  - Feasibilities studies for the connection of Mozambique to Tanzania to commence soon



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Enablers for Renewable Energy in SAPP - (ii) Power Markets

PREVIOUSLY

- Bilateral contracts
- Short-Term Energy Market (STEM) – 2001
- Post STEM – 2002
- Day-Ahead Market (DAM) – 2009
- Post Day Ahead Market – 2013

CURRENT

- Bilateral contracts
- Day-Ahead Market (DAM) – 2009
- Forward Physical Markets (Month Ahead & Week Ahead) – 2016
- Intra Day Market (Hour Ahead)– 2016
- Balancing Market- April 2022

FUTURE ADDITIONS

- Ancillary Services Market
- Financial Markets
- Renewable Energy Market

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SAPP Power Markets

The current SAPP market structure offers good market tools to support integration of VRE

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FPM

Forward Physical Contracts

Weekly and monthly
- auction trading -

Forwards
Week – Peak
Week – Standard
Week – Off-Peak

Monthly – Off-Peak
Monthly – Non-Off-Peak

DAM

Physical Contracts
Market equilibrium
one day ahead
- auction trading -

IDM

Physical contracts

Up to hour ahead

Continious Trading

114,25 (50)
114,00 (20)
113,75 (60)
113,50 (45)
113,00 (25)
112,75 (55)
112,50 (40)
112,25 (15)

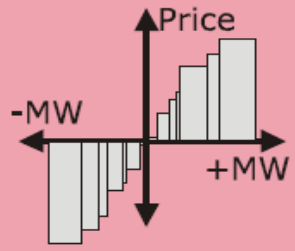
SAPP Settlement and financial management

Settlement of all physical contracts Settlement of wheeling and losses
Market monitoring and reporting

SAPP Market Surveillance

TSOs

Regional Balancing Power Market



Balancing generation and consumption in realtime

System Operation

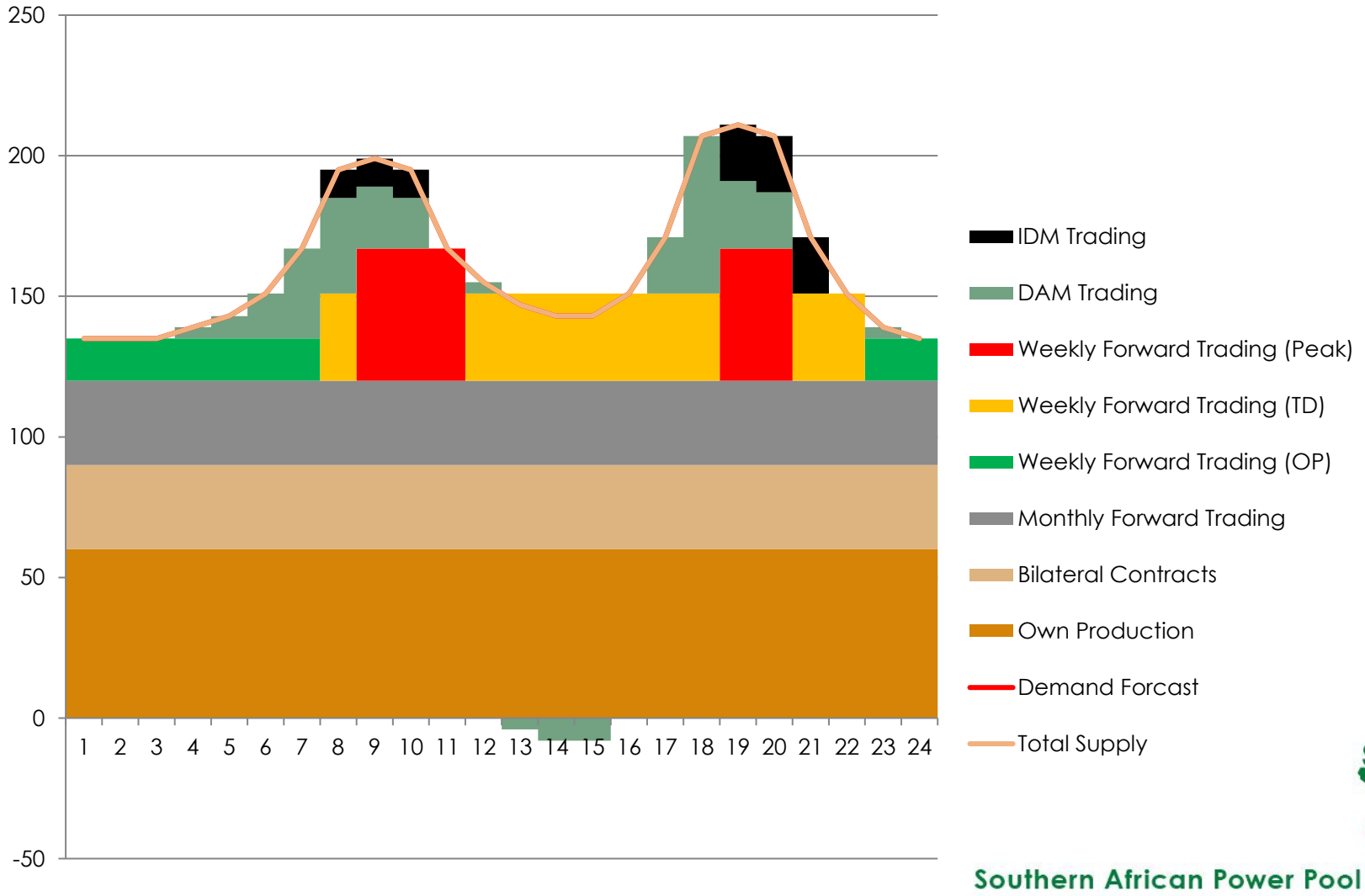
Real-Time Operation

Services during the Real-Time-Operation: Controlling frequency and voltage etc.

SAPP Power Markets (Continued)

- For the integration of RES, the Intra-day Market (IDM) and Balancing Market (BM) are the most important
- VRE production will be part of the portfolio in the DAM (Day-ahead Market), but what goes into this schedule will be based on day-ahead forecast of wind and solar
- Even though the models for this forecast have significantly improved, predicting the weather one day in advance will not be accurate.
- IDM offers the opportunity to allow market participants to trade themselves into balance again taking advantage of new forecasts closer to real-time
- BM offers the opportunity for the system operators to balance the supply and demand close to real-time and smoothen any gaps caused by changes in forecasted renewable energy generation

SAPP Markets Portfolios superimposed on a daily load curve



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Enablers for Renewable Energy in SAPP - Power System Operations

- Each Control Area Operator shall operate sufficient generating capacity under Automatic Generation Control (AGC) to continuously balance its generation and interchange schedules to its load and to provide its contribution to interconnection frequency regulation.

- Every Operating Member in SAPP shall be obliged to maintain their calculated portion of Operating Reserve sufficient to cover a defined percentage of the loss of the sent out capacity of the largest generating unit in service in the Interconnection at that time. This operating reserve shall be sufficient to reduce the Area Control Error (ACE) to zero within a specified time period after a loss of generation.

- 50% of the Operating Reserve shall be Spinning Reserve and the balance Quick Reserve. The Spinning Reserve shall automatically respond to frequency deviations.

- Additional resources shall be made available as soon as practicable to restore the necessary Operating Reserve after the initial reserve has been used as the result of an incident.

- Each Control Area shall provide sufficient regulating reserve.

Conclusion

- The SAPP grid is getting strengthened to increase its ability to support increased renewable energy penetration through planned additional interconnectors.
- The SAPP competitive power market which has continued to grow over the years assists in handling variability of some renewable energy resources.
- SAPP operating and system control requirements assist in mitigating the impacts of variability of certain renewable energy resources.
- Other aspects are being considered to ensure system reliability in increased renewable energy penetration in the SAPP grid.

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Thank you!

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