The Southern African Power Pool

www.sapp.co.zw

Regional Cooperation and Cross-Border Trading

Dr. Lawrence Musaba
Coordination Centre Manager

HYDROPOWER AFRICA

Emperor’s Palace, Johannesburg, SOUTH AFRICA

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2. POWER POOLING & ENERGY TRADING
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1. OVERVIEW OF THE SAPP

1.1 Geographic

- **12 SADC Member Countries**
- **230 Million people**
- **Regional Average Electricity growth rate 4.6% p.a.**
Two networks linked by weak lines at **220kV & 132kV** via Botswana

**In 1995** the **400kV** was constructed from Zimbabwe to South Africa via Botswana.
The interconnection of the northern and southern networks created a platform for regional trade and cooperation.

In 1995, the Ministers responsible for energy in the Southern African Development Community (SADC) signed Inter-Government MOU that lead to the creation of a power pool under the name, Southern African Power Pool (SAPP).
1.3 Completed Interconnections (1)

Since **1995**, the following transmission lines have been commissioned by the SAPP:

1. The **400kV** Matimba-Insukamini Interconnector linking Eskom of **South Africa** and ZESA of **Zimbabwe** in **1995**.

2. The **330kV** Interconnector between **Mozambique** and **Zimbabwe** was commissioned in **1997**.

3. BPC Phokoje substation was tapped into the Matimba line to allow for **Botswana’s** tapping into the SAPP grid at **400kV** in **1998**.
4. Restoration of the **533kV DC** lines between Cahora Bassa in **Mozambique** and Apollo substation in **South Africa** was completed in **1998**.

5. **400kV** line between Camden in **South Africa** via Edwaleni in **Swaziland** to Maputo in **Mozambique** in **2000**.

6. **400kV** line between Arnot in **South Africa** and Maputo in **Mozambique** in **2001**.

7. **400kV** line between Aggeneis in **South Africa** and Kookerboom in **Namibia** in **2001**.

8. **220kV** line from **Zambia** to **Namibia** in **2007**.
1.4 Governing Legal Documents

- **Inter-Governmental MOU**
  - Established SAPP.
  - Signed by SADC Member Countries in 1995.
  - Revised document signed on 23 February 2006.

- **Inter-Utility MOU**
  - Established the Management of SAPP.

- **Agreement Between Operating Members**
  - Signed by Operating Members only.

- **Operating Guidelines**
  - Under Review and will be finalized in 2010.
2. **POWER POOLING AND ENERGY TRADING**

2.1 **Power Pooling (1)**

- Linking utilities electricity production facilitates the dispatch of *excess capacity* from one system to another.

- Thus the output from different power plants is *pooled*, scheduled according to *increasing marginal cost*, and dispatched according to *merit order* to meet demand.

- The *benefits* and platform created by power pooling include:

1. **Increased security and reliability of supply**
   - Provision of emergency support
   - Sharing spinning reserve capacity
   - Balancing generation mix (74% coal, 20% hydro, 4% nuclear, 2% gas/diesel)

2. **Improved sector investment environment**
   - Aggregation of individual power markets
   - Improved access to creditworthy
   - Diversification
3. Reduced operating costs
   ✓ Merit order dispatching
   ✓ Balancing non-coincidental peak-loads
   ✓ Optimization of generation resources

4. Reduced & deferred investment costs
   ✓ Advantage of economies of scale
   ✓ Reduced total reserve requirements (SAPP has managed from 20% to 10%)
   ✓ Postponed investments in new peak power capacity
   ✓ Reduced investment in hydro system
## 2.2 Energy Trading (1)

<table>
<thead>
<tr>
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<td></td>
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<td>ZESA</td>
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<td>1,080</td>
<td>965</td>
<td>1,714</td>
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<tr>
<td></td>
<td>TOTAL SAPP</td>
<td></td>
<td>55,927</td>
<td>48,649</td>
<td>7,278</td>
<td>43,444</td>
<td>47,876</td>
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<tr>
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<td>Total Interconnected SAPP</td>
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<td>53,445</td>
<td>46,772</td>
<td>6,673</td>
<td>41,822</td>
<td>46,088</td>
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2.2 Energy Trading (2)

- Energy trading has been facilitated by the fact that some members have **excess** power supply and others are in a **deficit**.

- Balancing **supply** and **demand** is done via **energy trading** arrangements:

**EARLY YEARS**

- Bilateral contracts

**CURRENT AND FUTURE OUTLOOK**

- Bilateral contracts
- Day-Ahead Market (DAM) – From 2009
- Ancillary Services Market – From 2011
- Balancing Mechanism – From 2011

**FROM YEAR 2001**

- Bilateral contracts
- Short-Term Energy Market (STEM) - 2001
- Post STEM (Balancing Market) - 2002
### 2.3 SAPP Bilateral Agreements - 2003

<table>
<thead>
<tr>
<th>Contract</th>
<th>Negotiated Utility Contracts</th>
<th>Energy (GWh)</th>
<th>Capacity (MW)</th>
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<td>ZESCO - ESKOM</td>
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<td>SNEL - ESKOM</td>
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<td>100</td>
<td>770</td>
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<tr>
<td>SNEL - ZESA</td>
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<td>110</td>
<td>793</td>
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<td>Eskom - LEC</td>
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<td>Eskom - EDM</td>
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<td>1,390</td>
<td>2,500</td>
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<td>Eskom - Nampower</td>
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<td>230</td>
<td>1,370</td>
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<td>Eskom - BPC</td>
<td>918</td>
<td>230</td>
<td>1,370</td>
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<tr>
<td>Eskom - SEB</td>
<td>796</td>
<td>230</td>
<td>1,370</td>
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**HCB supply (hydro) – 1770 MW**

**ESKOM supply (thermal) – 1706 MW**
2.3 SAPP Bilateral Agreements - 2005

<table>
<thead>
<tr>
<th>Agreement</th>
<th>Energy (GWh)</th>
<th>Capacity (MW)</th>
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<tbody>
<tr>
<td>ZESCO - ESKOM</td>
<td>280</td>
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<tr>
<td>SNEL - ESKOM</td>
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<td>SNEL - ZESA</td>
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<td>Eskom - ZESA</td>
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<td>793</td>
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<td>HCB - ZESA</td>
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<td>HCB - ESKOM</td>
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<td>Eskom - LEC</td>
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<td>Eskom - EDM</td>
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<td>Eskom - Nampower</td>
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<td>Eskom - BPC</td>
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<td>1,606</td>
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<td>Eskom - SEB</td>
<td>96</td>
<td>868</td>
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HCB supply (hydro) - 1770 MW, ESKOM supply (thermal) - 1706 MW
2008 Bilateral Contracts in SAPP

- HCB-EdM: 270 MW
- Eskom-MOZAL: 950 MW
- EdM-SEC: 40 MW
- EdM-NamPower: 40 MW
- EdM-BPC: 45 MW
- ZESA-NamPower: 40 MW
- SNEL-Eskom: 150 MW
- SNEL-ZESA: 100 MW
- HCB-Eskom: 1370 MW
- HCB-ZESA: 250 MW
- Eskom-LEC: 100 MW
- Eskom-EdM: 120 MW
- Eskom-NamPower: 200 MW
- Eskom-BPC: 210 MW
- Eskom-SEC: 96 MW

Capacity [MW]
STEM TRADING: Supply & Demand

<table>
<thead>
<tr>
<th>Year</th>
<th>Supply</th>
<th>Demand</th>
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<tbody>
<tr>
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<td>2,000</td>
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<td>2002</td>
<td>3,500</td>
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<td>3,500</td>
</tr>
<tr>
<td>2005</td>
<td>4,000</td>
<td>4,000</td>
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</tbody>
</table>
STEM TRADING: Energy Traded & Cost

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy Traded [GWh]</th>
<th>Monetary Value [US$x1000]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>0.41 Usc/kWh</td>
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<tr>
<td>2002</td>
<td>0.39 Usc/kWh</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>0.50 Usc/kWh</td>
<td>0.74 Usc/kWh</td>
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<tr>
<td>2004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td>1.08 Usc/kWh</td>
</tr>
</tbody>
</table>
2.4 STEM TRADING

There has been no energy trading on the short-term energy market (STEM) from June 2007 due to:

- Lack of power supply in the market
- Constrained transmission paths.

Bilateral trading has however continued.
3. THE SAPP COMPETITIVE MARKET

3.1 Goals and Methodology

**GOALS of the SAPP DAM design:**
- Establish an efficient and competitive marketplace
- Ensure that consumers benefit from the market

**METHODOLOGY:**
- Development of consistent market mechanisms.
- Efficient price signals for the procurement and transmission of electricity.
- Assurance of fair and open access to the transmission system.
- Optimization of generation & transmission capacity.
3.2 DAM Features (1)

- **Market for secure, effective and non-discriminatory trade of electricity:**
  - Trading to be concluded daily for delivery next day
  - Forward bidding up to 10 days
  - Participants submit *bids* (purchase) & *(sale)* offers
  - Closed market – only market operator and participant know the details of the bid / offer

- **Provides a neutral reference price**
  - Price discovery
  - Could provide reference for bilateral contracts
3.2 DAM Features (2)

- **Supports an auction-trading model**
  - All sales & demand bids are aggregated at a fixed time
  - The balance price is valid for all trades

- **Tool for managing grid congestion**
  - System price (no grid congestion)
  - Area prices (if transmission capacity is exceeded)
3.3 DAM Design Principles (1)

1. Market type
   - Auction type market
   - Participants bid into market for all 24 hrs of next/future day.

2. Bidding
   - Participants submit purchase & sale bids.
   - Types of bids: Single hour and Block bids.

3. Bid areas
   - Multiple bid areas with configurable transmission capacities between areas.
3.3 DAM Design Principles (2)

4. **Price calculation**
   - At defined time, market closes & Market Clearing Price (MCP) calculated.
   - MCP is price where supply equals demand without taking transmission constraints into consideration.

5. **Congestion Management**
   - Calculated contract flow between bid areas computed & compared with available transmission capacity for spot trade.
   - In case of congestion, market splitting performed, and local area prices calculated.

6. **Auction results**
   - Participants receive area prices with associated volume. Multiple currencies.
### 3.4 DAM Trading Timeline

- **08:30 HRS**
  - Usage of the bilateral contracts registered by participants.
  - Calculation of available transmission capacity performed.
  - Opening of the market for delivery day X.
- **09:30 HRS** Market is closed for delivery day X.
- **10:00 HRS** Price calculation
- **12:00 HRS** Distribution of prices and schedules
- **12:30 HRS** Participants receive price information & schedules.
- **13:00 HRS** Deadline for complaints
- **14:00 HRS** A report about the contracted volume per Balance Responsible Party is sent to System Operators.
- **24.00 HRS** Delivery start for Day-ahead contracts for hour 1
Day Ahead Market (DAM) System

SAPP DAM
Main Trading System

SAPP DAM
Client Server Systems

NORD POOL

enerweb
SAPP DAM
Main Trading System
Used by Market Operator in Harare

SAPP DAM Client Server Systems
Used by all other participants to communicate with the Main Trading System

Vision
Facilitate the development of a competitive electricity market in the Southern African region.
DAM System Communication Methods...

- **Through the Internet**
  - Similar to current method
  - Web address published by Market Operator

- **Electronic Mail**
  - Templates distributed by Market Operator
  - *E-Mail address:*
    damtradingdesk@sapp.co.zw

- **By facsimile (back up solution)**
  - Fax number provided
3.5 Advantages of a Competitive Market

SAPP believes that the creation of a competitive market would:

- Help to **optimise** the use of regional resources
- Assist in determining the correct electricity price in the pool
- Send signals for **investments** and real time utilization of existing assets; transmission, generation and consumption.
- Enable the demand side to respond to the supply side price signals.
- Designing a market is not simply a matter of copy and paste exercise, but **hands on experience** is necessary to know possible solutions of practical problems.
4. CONCLUSION

The three building blocks that form the framework for successful regional power pools are as follows:

**Common Legal and Regulatory Framework**
- Intergovernmental MOU
- Inter-Utility MOU
- Regional Electricity Framework law
- Regional Independent Regulator

**Durable Framework for System Planning & Operation**
- Power pool organisational structure
- Interconnection planning framework
- Systems operations framework

**Equitable Commercial Framework for Energy Trading**
- Commercial rules of practice
- Internal dispute resolution mechanism
- Minimum capabilities of the system operator
THANK YOU