Trading in the Southern African Power Pool and possible coupling with the East African Power Pool

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Trading in the SAPP and possible coupling with the EAPP

Outline:
- Eskom at a Glance
- Creating the Trading platform
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- Operations of SAPP
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  - Bilateral Trading
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- SAPP Gen & Tx Projects
- Challenges for the SAPP region
- Overview of East African region
- Comparison of the 2 regions
- Why integrate power regions?
- Coupling of SAPP with EAPP
- Future possibilities (Eastcor / Nile Basin Initiative)

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Eskom at a Glance

Eskom:

- Is State-owned and is central to the South Africa Government’s growth and development strategy
- Generates 95% of SA’s electricity and >50% of the electricity consumed on the African continent
- Has an installed capacity (total nominal capacity) of 42,618MW and is currently busy with a R150billion 5 year investment program
- Connected 3.2million households in last 14 years
- Was awarded Global Power Company of the Year 2001
- Internationally is 6th largest utility in terms of sales and 11th largest utility in terms of generation capacity(*)
- Is an active and proud member of the Southern African Power Pool (SAPP)

(*) DatamonitorResearch Co. UK: 2005 Survey

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Creating the Trading Platform

- 1950’s - Interconnection and regional trade in Southern Africa started with lines connecting the DRC and Zambia
- 1960’s - Interconnection of Zambia and Zimbabwe systems started following the construction of Kariba Dam
- 1975 - South Africa was connected to Mozambique via a DC line from Cahora Bassa to Apollo

Two networks were therefore developed as a result:
- The Southern network, mainly thermal (Namibia, South Africa & Mozambique)
- The Northern network, mainly hydro (DRC, Zambia, Cahora Bassa & Zimbabwe)

The two networks were linked by weak lines 220kV and 132kV via Botswana until 1995 when the 400kV was constructed.

The interconnection of the northern and southern networks created a platform for regional trade and cooperation.
The formation of SAPP

• Factors leading to the formation of the Southern African Power Pool (SAPP)
  – Interconnection of the northern and southern networks
  – Drought in the region in the 1990’s curtailed hydro-generation in Zambia and Zimbabwe
  – Increases of power tariffs due to shortages in generation capacity particularly in Zimbabwe
  – Constraints in power supplies and need for more reliable sources
  – End of the apartheid and successful democratic elections in South Africa in 1994
  – Understanding of synergy of the regional generation mix

• At the SADC summit in SA in 1995, an Inter-Governmental Memorandum of Understanding was signed that lead to the formation of SAPP

Four agreements govern SAPP:
  – Inter-Governmental Memorandum of Understanding - Enabled the establishment of SAPP
  – Inter-Utility Memorandum of Understanding - Establishes SAPPs Management and Operating principles
  – Agreement Between Operating Members – Establishes the specific Rules of Operation and Pricing
  – Operating Guidelines – Provide Standards and Operating Guidelines

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Objectives of SAPP

SAPP was created with the primary aim to provide reliable and economical electricity supply to the consumers of each of the SAPP members, consistent with the reasonable utilisation of natural resources and the effect on the environment.

• Vision of SAPP:
  – Facilitate the development of a competitive electricity market in the Southern African region.
  – Give the end user a choice of electricity supply.
  – Ensure that the southern African region is the region of choice for investment by energy intensive users.
  – Ensure sustainable energy developments through sound economic, environmental and social practices.
SAPP has twelve member countries represented by their respective electric power utilities.

<table>
<thead>
<tr>
<th>No.</th>
<th>Country</th>
<th>Utility Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Angola</td>
<td>ENE</td>
</tr>
<tr>
<td>2</td>
<td>Botswana</td>
<td>BPC</td>
</tr>
<tr>
<td>3</td>
<td>DRC</td>
<td>SNEL</td>
</tr>
<tr>
<td>4</td>
<td>Lesotho</td>
<td>LEC</td>
</tr>
<tr>
<td>5</td>
<td>Malawi</td>
<td>ESCOM</td>
</tr>
<tr>
<td>6</td>
<td>Mozambique</td>
<td>EDM</td>
</tr>
<tr>
<td>7</td>
<td>Namibia</td>
<td>NamPower</td>
</tr>
<tr>
<td>8</td>
<td>South Africa</td>
<td>Eskom</td>
</tr>
<tr>
<td>9</td>
<td>Swaziland</td>
<td>SEB</td>
</tr>
<tr>
<td>10</td>
<td>Tanzania</td>
<td>TANESCO</td>
</tr>
<tr>
<td>11</td>
<td>Zambia</td>
<td>ZESCO</td>
</tr>
<tr>
<td>12</td>
<td>Zimbabwe</td>
<td>ZESA</td>
</tr>
</tbody>
</table>
SAPP Interconnection and Trade Limits

SAPP Area Configuration

--- not yet interconnected

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The Governance Structure of SAPP

- SADC
- Executive Committee
- Management Committee
  - Planning Sub-Committee
  - Operating Sub-Committee
  - Coordination Centre Board
  - Environmental Sub-Committee
  - Markets Sub-Committee
  - Coordination Centre Management
Types of Trading Agreements:

- Bilateral Contracts
- Short Term Energy Market Trading / Day Ahead Market
- Wheeling

**Bilateral Contracts**

- Bilateral agreements are given priority for transmission on SAPP Interconnections
- Bilateral contracts are given priority in order of its maturity
- Each host control area responsible for submitting daily schedules for each of the bilateral agreements administered under its area of control
- Bilateral scheduling is done on a day ahead trading basis
- Wheeling needs to be secured for bilateral contracting
Operations of SAPP

Short Term Energy Market (STEM)
- STEM was formed in 2001 to enable SAPP utilities to trade their excess capacity outside their bilateral agreements.
- STEM is a firm energy market where energy is traded on a daily basis for delivery the following day.
- Three energy contracts on STEM:
  - Monthly / Weekly / Daily Contracts
- Documents that govern the STEM are:
  - Legal Agreement
  - Book of Rules consisting of Trading / Financial Rules
- Participation in the STEM is open to all Operating Members and IPPs.
- Success of STEM has been a motivating factor in creation of a regional SPOT MARKET.

Day Ahead Energy Market (DAM)
- Based on the price setting mechanism used in the Nordic Market – NoordPool
- Bids are connected to geographic areas.
- Interconnection capacities between areas are defined.
- An implicit auction of the transmission capacity is conducted as part of the energy auction (Congestion Management - by Market Splitting)
- The auction price is set to the price where supply equals demand.
- An Unconstrained Market Clearing Price (MCP) is calculated.
- Area prices are calculated based on the available transmission capacity between areas.
- Schedules are awarded based on area prices.

Benefits of DAM
- Creation of a transparent market price:
  - Increased price volatility
  - Price signal for cross border constraints
  - High price area 1 – Low price area 2 = market price due to constraint
- Price basis for structured bi-lateral contracts.
- Price date provides underlying argumentation for generation investments.
- Facilitates new entrants, industrial, private PP, communities.
- Facilitates a platform for Balancing Market, Ancillary Services Market and creates a bench mark for Transmission losses compensation.
### SAPP Generation & Projects

| Source: SAPP Annual Report 2007 |

<table>
<thead>
<tr>
<th>SAPP Generation Projects</th>
<th>Commission Date</th>
<th>Generation Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissioned</td>
<td>2004 - 2006</td>
<td>1,140 MW</td>
</tr>
<tr>
<td>Planned Rehabilitation &amp; Short-term Projects</td>
<td>2007 - 2010</td>
<td>13,517 MW</td>
</tr>
<tr>
<td>Medium to Long-term Projects</td>
<td>2011 onward</td>
<td>32,000 MW</td>
</tr>
</tbody>
</table>

| Source: SAPP Annual Report 2007 |

<table>
<thead>
<tr>
<th>SAPP Generation &amp; Projects</th>
<th>Commission Date</th>
<th>Generation Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed Capacity</td>
<td>53,224 MW</td>
<td></td>
</tr>
<tr>
<td>Available Capacity</td>
<td>45,069 MW</td>
<td></td>
</tr>
<tr>
<td>2006 Peak Demand</td>
<td>41,831 MW</td>
<td></td>
</tr>
</tbody>
</table>

Source: SAPP Annual Report 2007
SAPP Transmission projects can be divided as follows:

- Transmission interconnectors with the aim to interconnect non-operating members of the SAPP:
  - Malawi-Mozambique interconnector,
  - Zambia-Tanzania-Kenya Interconnector
  - Westcor project

- Transmission interconnectors aimed at relieving congestion on the SAPP grid

- New transmission interconnectors aimed to evacuate power from generating stations to the load centres

Enhanced transmission infrastructure will alleviate bottlenecks, increase electricity traded volumes, encourage diversity of dispatch and limit the creation of different pricing areas / zones.
### Challenges for the region

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional network stability</td>
<td>Setting up of additional control centres and the ultimate need for a “super-grid” authority</td>
</tr>
<tr>
<td>Network integration &amp; maintenance standards</td>
<td>Ensuring secure and co-operative operation through a uniform and co-ordinated system</td>
</tr>
<tr>
<td>Limited Capacity</td>
<td>Region is running out of excess generating capacity – focus on rehabilitation projects</td>
</tr>
<tr>
<td>Congestion</td>
<td>Limit congestion by new transmission infrastructure development</td>
</tr>
<tr>
<td>Ageing plant</td>
<td>Aging plant being run to a maximum and maintenance periods being trimmed</td>
</tr>
<tr>
<td>Direct investment attraction</td>
<td>Major investments are required</td>
</tr>
<tr>
<td>Telecommunication network</td>
<td>Need rapid development to ensure reliability and connectivity</td>
</tr>
<tr>
<td>Environmental issues</td>
<td>EIAs for capacity and transmission projects and implementation of environmental guidelines</td>
</tr>
</tbody>
</table>

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According to our desk top study:

The East African Community (EAC), consisting of Kenya, Uganda and Tanzania, is developing a regional energy interconnectivity plan.

Other East African Region Countries include Ethiopia, Sudan, Eritrea, Rwanda, Burundi, Djibouti & Somalia.

The EAPP is not fully functional but some interconnection and cross-border energy trade.

Some EA countries are cooperating in the Nile Basin Initiative (consulting with Nord Pool).

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Energy in EA Countries

- There is significant hydropower capability in Eastern Africa, however, it is subject to periodic drought and dwindling water resources.
- Uganda and Ethiopia have the biggest hydropower potential and would play a major part in any power sharing project.
- The Africa Great Lakes region includes countries surrounding Lake Kivu, Lake Tanganyika and Lake Victoria.
- EA Countries mainly rely on hydropower and climatic changes can negatively affect utilities that are reliant on hydro plants to provide base load requirements.
- Fuelwood and biomass is still greatly used in the region.

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Demand for electricity in the Eastern Africa region is increasing with no apparent source of supply to meet this demand.

The figure illustrates the growing EAC economies and the consequent increase in peak energy demand.

The energy needs of both Southern and Eastern Africa are growing and more generation and transmission capacity is needed if economic growth targets of the region are to be attained.

Comparison of 2 regions

Access to electricity in SAPP and EAC countries

Comparison of Generation Mix

**Generation mix** of utilities in SAPP and EAC in comparison to South Africa

**RSA**
- 232,443 GWh
- (Eskom)

**SAPP**
- 20,244 GWh
- (BPC, EDM, ESCOM, SEB, ZEDC, ZESCO)

**EAC**
- 7,864 GWh
- (KPLC, Tanesco, UMEME)


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Comparison of Electricity Prices

**Average selling price** of typical customers of utilities in SAPP and EAC in comparison to Eskom

## Why Integrate Power Regions?

### Benefits:
- Economies of scale
- Increased system reliability and security of supply
- Generation mix and optimisation of resources
- Improved delivery service to customers
- Increase in volume of electricity trade
- Seasonal and load diversity
- Minimise energy cost differentials
- Increased investor confidence
- Accelerated economic development

### Challenges:
- Transmission interconnections covering large geographical area
- Adherence to operational discipline is vital
- Transmission congestion management is critical
- Efficient metering and telecommunication systems needed
- Trust and transparency needed
Coupling of SAPP and EAPP

- Interconnection of the SAPP with the EAPP is in alignment with various stakeholder priorities:
  - **SAPP** – Long Term Expansion Plan Investigation
  - **SADC** – Regional Indicative Strategic Development Plan (RISDP)
  - **NEPAD** – Short Term Action Plan (STAP)
  - **EAC** – East Africa Power Master Master Plan (EAPMP)
  - **Nile Basin Initiative** – Nile Equatorial Lakes Subsidiary Action Programme (NELSAP)

- Coupling of SAPP and EAPP will exploit the synergy of thermal capacity in southern Africa and hydro capacity in eastern Africa
To Facilitate Coupling

- Accelerate the construction of the Zambia – Tanzania 400kV line (about 700km)
- Strengthening of the lines in Zimbabwe
- Establish the north – south interconnection in Mozambique
- Interconnect Mozambique with Tanzania and Malawi
- Integrate the power systems of Rwanda, Burundi and eastern DRC to EAC grid
- Identification of loads to support infrastructure development
- MOUs (Utility / Governmental)
Future possibility – ‘Eastcor’

- **Eastern Power Corridor** – involves the establishment of Eastcor
  - To exploit the various hydro, gas, and coal/thermal potential in countries participating in SAPP and EAPP
  - A phased approach for interconnection is envisaged:
    - Phase I (SA – Mozambique – Malawi – Tanzania)
    - Phase II (Tanzania – Rwanda – Burundi)
    - Phase III (Tanzania – Kenya – Uganda)
    - Phase IV (Uganda – Eastern DRC – Inga)

- **Benefit to region** – high transmission costs detract from generation business cases and ideally should be separately addressed – hence the need for ‘Eastcor’
Future possibility – ‘NBI’

- **Nile Basin Initiative (NBI)** – achieving sustainable socio-economic development through the equitable utilisation of the common Nile Basin water resource
  - The North and East African countries involved include the DRC, Egypt, Ethiopia, Kenya, Uganda, Sudan, Uganda & Burundi
  - Consulting with Nord Pool on development

- Various projects under the shared vision programme involving:
  - Exploring power trade opportunities
  - Increasing interconnections and power transmission capacity
  - Development of selected hydro projects
  - Assessment of dispatch, control and communication capabilities

- **Benefit to region** - will establish a network providing a corridor for power trade with the Mediterranean Basin
Future – Interconnected Pools in Africa

North African Power Pool

West African Power Pool

Central African Power Pool

Southern African Power Pool
South Africa through Eskom will continue to be a proud and active participant in SAPP, and will strive together with SAPP and the EAPP to facilitate the development of an efficient, reliable and stable interconnected electrical system in the two regions.
Thank-you
References

- SAPP Annual Report 2007
- Datamonitor Research Co. UK: 2005 Survey