10

Power Generation in Southern Africa: Energy Trading and the Southern African Power Pool

This Chapter reviews power generation and energy trading arrangements that exist in southern Africa. The Chapter also considers the operations and workings of the Southern African Power Pool. The Southern African Power Pool (SAPP) was created in April 1995 through the Southern African Development Community (SADC) treaty that was signed to optimize the use of available energy resources amongst the countries in the region and support one another during emergencies. At the time of creation, the SADC governments agreed to allow their national power utilities to enter into the necessary agreements that regulate the establishment and operation of the SAPP. SAPP membership was therefore restricted to national power utilities of the SADC member states as stipulated in the Inter-Governmental Memorandum of Understanding (IGMOU). In the Revised IGMOU of 23 February 2006, SAPP membership was extended to include other Electricity Supply Enterprises within the SADC region.

10.1 Structure and Governing Documents

There are four legal documents covering the rights and obligations of the SAPP members and participants:

(i.) *Inter-governmental memorandum of understanding* (IGMOU) that grants permission for the utilities to participate in the SAPP and enter into contracts, and guarantees the financial and technical performance of the power utilities. The original document was signed in 1995 by SADC members, excluding the Democratic Republic of Congo (DRC), Madagascar, Mauritius and Seychelles. All the SADC countries, with the exception of Madagascar, Mauritius and Seychelles, signed the Revised IGMOU on 23 February 2006.

(ii.) *Inter-utility memorandum of understanding (IUMOU)* between participants, defining ownership of assets and other rights, e.g. provision for change in status from participating to operating member. The Revised IUMOU was signed by all the SAPP member utilities on 25 April 2007 in Harare, Zimbabwe, with the exception of SNEL of the DRC and TANESCO of Tanzania. TANESCO signed the Revised IUMOU in February 2008 and SNEL in April 2008. The Revised IUMOU has defined a new structure for the management and operations of the SAPP.

(iii.) *Agreement between operating members (ABOM)*, which determines the interaction between the utilities with respect to operating responsibilities under normal and emergency conditions. Operating Members only, i.e., members whose transmission system is interconnected to the SAPP grid signed this document. The document is currently under review and when completed would be signed by all Operating Members.

(iv.) *Operating guidelines (OG)*, which defines the sharing of costs and functional responsibilities for plant operation and maintenance including safety rules.

The basis for the SAPP as defined in the Revised IGMOU is the need for all participants to:

(a) Co-ordinate and co-operate in the planning and operation of their systems to minimize costs while maintaining reliability, autonomy and self-sufficiency to the degree they desire;
(b) Fully recover their costs and share equitably in the resulting benefits, including reductions in required generating capacity, reductions in fuel costs and improved use of hydroelectric energy; and
(c) Co-ordinate and co-operate in the planning, development and operation of a regional electricity market based on the requirements of SADC Member States.

In order to carry out the vision of the SAPP, a Coordination Center was established in Harare, Zimbabwe, in February 2000 to act as a focal point for all the SAPP activities. A Host Country Agreement (HCA) was afterwards signed between the Government of Zimbabwe and SAPP on 13 March 2006 giving the SAPP Coordination Center a Diplomatic Status. Also a Memorandum of Understanding between SAPP and the Regional Electricity Regulators Association (RERA) on liaison and interaction between the two parties was entered into in April 2007.

The structure of the SAPP is shown in Figure 10.1.

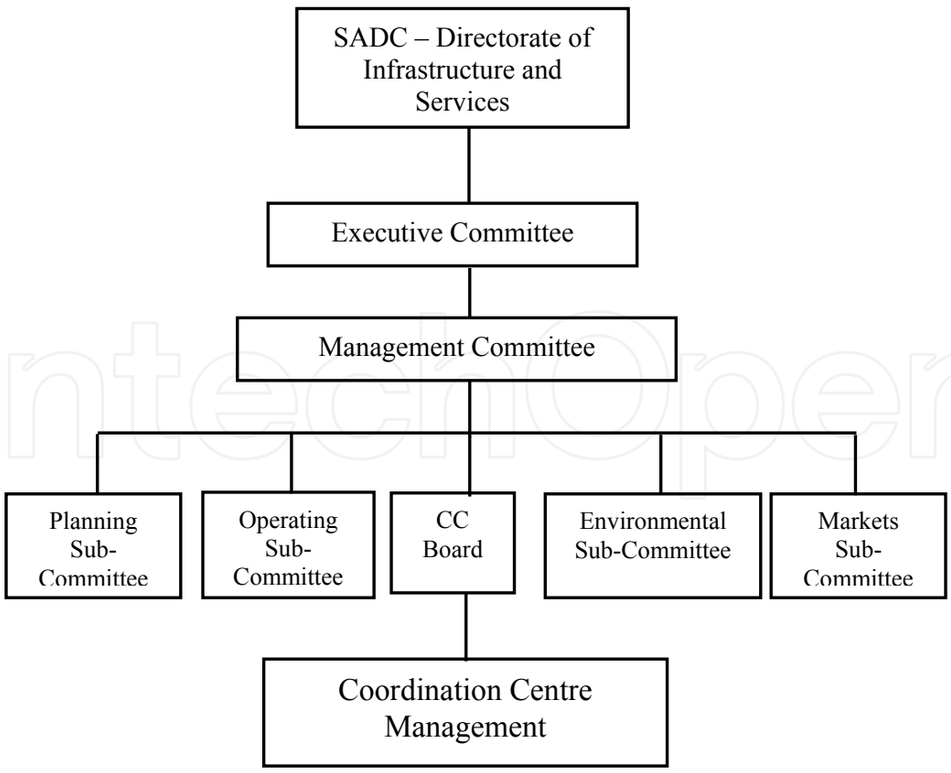


Fig. 10.1 Reporting Structure of the SAPP

The *SADC Government Ministers and Officials* are responsible for policy matters normally under their control within the national administrative and legislative mechanisms regulating the relations between the Government and the national power utility.

The *Chief Executives* of the members and a representative from the SADC Secretariat form the *Executive Committee*. The Executive Committee will refer matters such as requests for membership by non-SADC countries and major policy issues that may arise to the SADC Ad Hoc Committee of Energy Ministers. A country with more than one member utility would need to designate one utility to represent it on the Executive Committee.

The *Management Committee* oversees and decides on the recommendations of the Sub-Committees and the Coordination Center Board.

The *Operating Sub- Committees* consist of representatives from those power utilities already interconnected and exchange power on a major scale (Operating Members), presently 9 countries (Botswana, South Africa, Zambia, Zimbabwe, Democratic Republic of Congo, Lesotho, Mozambique, Namibia and Swaziland). The duties of the sub-committee include the establishment and updating of methods and standards to measure technical performance, operating procedures including operating reserve obligations

The *Planning Sub-Committee* establishes and updates common planning and reliability standards, review integrated generation and transmission plans, evaluate software and other planning tools, determine transfer capability between systems etc.

The *Environmental Sub-Committee* consists of appointed representatives from each Operating Member. The committee develops Environmental Guidelines for SAPP; liaise with Governments to keep abreast of world and regional matters relating to air quality, water quality, land use and other environmental issues. Where Governments have in place related Environmental Organizations, the Committee has to liaise with them to assist one another on specific issues.

The *Markets Sub-Committee* is responsible for the design and continued development of the electricity market in the region and determines criteria to authorize this trade.

All the *Sub-Committees* consist of a maximum of two representatives per Member who are of sufficient seniority in their own organization to make all relevant decisions.

The *Coordination Center* reports to a Co-ordination Center Board consisting of a maximum of two representatives of each National Power Utility (i.e. the signatories of the IUMOU).

10.1.1 SAPP Vision

The vision of the SAPP is to facilitate the development of competitive electricity market where an end user within the SADC region ultimately has possibility of choosing the preferred supplier of electrical energy. To promote the vision and change it into a reality, SAPP is about to change from a cooperative pool to a competitive power market trading both physical and financial contracts. The challenge for SAPP will be to manage all the

difficulties and uncertainties envisaged to emerge during the transition period from administrating a corporative market to the geographical biggest competitive pool in the World. At the same time as the transition is taking place, the SAPP has run out of generation surplus capacity resulting in load shedding in a number of member countries.

10.1.2 SAPP Objectives

The SAPP objectives are:

- To provide a forum for the development of a world class, robust, safe, efficient, reliable and stable interconnected electrical system in the region.
- Harmonise inter-utility relationships.
- Co-ordinate the development of common regional standards on quality of supply; measurement and monitoring of systems performance; enforcement of standards, and facilitate the development of regional expertise through training programs and research.

10.1.3 SAPP Mission, Strategy and Values

Mission

The Mission of SAPP is to provide the least cost, environmentally friendly and affordable energy and increase accessibility to rural communities.

The Strategy

In its operation the SAPP aims at being the most preferred region for investment for value for money by energy intensive users.

The Values

- Respect for others and develop mutual trust
- Honesty, complete fairness and integrity in dealing with issues
- Selfless discharge of duties
- Full accountability to the organization and its stakeholders
- Encourage openness and objectivity.

10.1.4 SAPP Coordination Center

The SAPP Coordination Center was established in Harare, Zimbabwe, at the beginning of the year 2000. The Center represents a focal point of SAPP and a staff to further its vision and technical challenges. In addition to the Manager, a total of seven (7) support staff in fields of Finance, Information Technology, Environment and Secretarial are presently employed at the Coordination Center. The functions of the SAPP Coordination Center are to:

- Implement the SAPP objectives; provide a focal point for SAPP activities; facilitate the implementation of a competitive electricity market in the SADC region;
- Monitor the operations of SAPP transactions between the members;
- Carry out technical studies on the power pool to evaluate the impact of future projects on the operation of the pool;

- Coordinate the training of members of staff to improve the region's knowledge of power pool operations; and
- Provide power pool statistics and maintaining a pool database for planning and development.

A website was developed as a means for SAPP to communicate with the world and inform interested persons of its activities. The Coordination Center also acts as a secretariat for the various SAPP committees and its sub-committees.

The twelve members of SAPP fund the activities of the Coordination Center through an annual subscription fund. The Coordination Center makes a budget and this is presented to the Coordination Center Board for approval. The Coordination Center Board is made up of senior managers of utility representatives and one of their functions is to oversee the activities of the Coordination Center including the approval of the budget. This budget is used to pay for staff salaries and other SAPP operational costs.

Internationally reputable auditors have been appointed to audit the SAPP Coordination Center finances periodically. The audited financial report is then distributed to members and is also published as part of the SAPP

10.1.5 SAPP Membership

The governance and membership of the SAPP was derived from the desire for economic co-operation and integration, equitable sharing of resources and support of one another in times of crisis under the SADC protocol. The environment under which the power pool now operates, and the ongoing development of a competitive market, will significantly change the basis for the operation of the SAPP. The Pool has therefore recently reviewed its governance and membership in order to achieve a competitive market including giving access for an increased number of participants.

Full Name of Utility	*Status*	*Abbreviation*	*Country*
Botswana Power Corporation	OP	BPC	Botswana
Electricidade de Moçambique	OP	EDM	Mozambique
Electricity Supply Commission of Malawi	NP	ESCOM	Malawi
Empresa Nacional de Electricidade	NP	ENE	Angola
Eskom	OP	Eskom	RSA
Lesotho Electricity Corporation	OP	LEC	Lesotho
NamPower	OP	NamPower	Namibia
Societe Nationale d'Electricite	OP	SNEL	DRC
Swaziland Electricity Board	OP	SEB	Swaziland
Tanzania Electricity Supply Company Ltd	NP	TANESCO	Tanzania
ZESCO Limited	OP	ZESCO	Zambia
Zimbabwe Electricity Supply Authority	OP	ZESA	Zimbabwe

OP = Operating member NP = Non-Operating member

Table 10.1 SAPP Membership

SAPP membership is as per the latest revision of the IUMOU open to national power utilities and other Electricity Supply Enterprises (Power Utility, Independent Power

Producer, Independent Transmission Company and/or Service Provider for the electricity market), from SADC member countries. There are currently twelve SAPP members as indicated in Table 10.1, nine operating members and three non-operating members.

10.2 Sapp Achievements

From the time that the SAPP was created in 1995, the following achievements have been made:

10.2.1 Coordination Center

The official opening of the SAPP Co-ordination Center in Harare on the 18th of November 2002 was marked as a great success. The Guest of Honor was the Minister of Petroleum of Angola: The Honorable, José Maria Botelho de Vasconcelos.

10.2.2 Documentation Review and SAPP Restructuring

The signing of the Revised Inter-Governmental Memorandum of Understanding (IGMOU) by the Ministers responsible for energy in the SADC region in Gaborone, Botswana, on 23 February 2006, was the beginning of the restructuring of the SAPP. The Chief Executives of the SAPP Member Utilities then signed the Revised Inter-Utility Memorandum of Understanding (IUMOU) on 25 April 2007 in Harare, Zimbabwe. Therefore, other Electricity Supply Enterprises (Power Utility, Independent Power Producer, Independent Transmission Company and/or Service Provider for the electricity market), from SADC member countries can now join the SAPP.

10.2.3 Cooperation with the Regional Electricity Regulatory Association (RERA)

The resolution of the SAPP-RERA relationship and the signing of the SAPP-RERA Memorandum of Understanding on 25 April 2007 in Harare, Zimbabwe. This is a cooperation agreement that will allow the two institutions to work together and cooperate for the common good of the SADC region.

10.2.4 Transmission wheeling charges and losses

The SAPP adopted a scientific method for the determination of transmission wheeling charges. The new transmission wheeling charges were implemented over a three-year period starting from the 1st of January 2003. In the same year, the SAPP also approved the enforcement of Article 11.3.3 of the Agreement between Operating Members on transmission losses.

10.2.5 Development of a competitive electricity market

- In April 2001, the SAPP started the short-term energy market (STEM) as a precursor to a full competitive market. At the time of this publication, there are eight participants on the STEM from an initial number of two at the start of the market in April 2001.
- The development of the competitive electricity market started in January 2004 when an Agreement between the Government of Norway and SAPP provided SAPP with a grant to the amount of NOK 35 million for this purpose. The SAPP is currently testing the day-

ahead market-trading platform that has been developed by NordPool. The SAPP Executive Committee will determine the date for the market opening. The recommendations of the Management Committee are to wait until governance issues are resolved within the SAPP. It was expected that the opening would take place towards the end of 2007.

- In order to assure a proper development and operation of a competitive electricity market, the SAPP has developed long-term transmission pricing policies and implementation procedures and an ancillary services market. SAPP and Sida signed an agreement in July 2004 covering financial assistance to provide the necessary consultancy services for this and an English company, Power Planning Associates (PPA) was assigned to carry out the task.

10.2.6 Completed transmission projects

The following transmission lines have been commissioned:

- The 400kV Matimba (South Africa) – Insukamini (Zimbabwe) interconnector linking Eskom of South Africa and ZESA of Zimbabwe in 1995.
- BPC Phokoje substation was tapped into the Matimba line to allow Botswana's tapping into the SAPP grid at 400kV in 1998.
- The 330kV Mozambique-Zimbabwe interconnector was commissioned in 1997.
- The restoration of the 533kV DC lines between Cahora Bassa in Mozambique and Apollo substation in South Africa was completed in 1998.
- The 400kV line between Aggeneis in South Africa and Kookerboom in Namibia in 2001.
- The 400kV line between Arnot in South Africa and Maputo in Mozambique in 2001.
- The 400kV line between Camden in South Africa via Edwaleni in Swaziland to Maputo in Mozambique in 2000.
- The 220kV Livingstone (Zambia)-Katima Mulilo (Namibia) interconnector was commissioned in 2006.

10.2.7 Establishment of Westcor

The establishment and launching of the Western Power Corridor (Westcor) in April 2002 to develop the hydropower generation resources in the DRC, Angola and Namibia; and the transmission links from the DRC via Angola, Namibia, Botswana to South Africa, including a telecommunication network has been a great welcome to the region. A Project Office was opened in May 2006 in Gaborone, Botswana.

10.2.8 Environmental Guidelines

The SAPP has completed and approved the following environmental guidelines:

- Environmental Impact assessment (EIA) Guidelines for Transmission Lines
- Environmental Impact assessment (EIA) Guidelines for Thermal Power Plants
- Guidelines on the Management of Oil Spills
- Guidelines for the Safe Control, Processing, Storing, Removing and Handling of Asbestos Containing Material

- Guidelines for Management and Control of Electricity Infrastructure with regard to Animal Interaction.

10.2.9 Other Completed Projects

The other completed projects include the following:

- Completion of the SAPP Pool Plan in 2001. In 2006, the SAPP received a World Bank grant to review the Pool Plan and the Revised Pool Plan was completed in November 2007.
- In 2001, the SAPP received a World Bank grant to conduct a telecommunications study on how best to link the three control areas. The recommendations of the study were to use a VSAT solution in the short-term and fiber in the long-term. The SAPP has now completed the implementation of a VSAT solution and the project has been commissioned.
- Frequency relaxation project was completed in 2003. The SAPP relaxed the operating frequency from 50 +/-0.05 Hz to 50 +/-0.15 Hz. The new frequency bands were implemented from January 2003.

10.3 Energy Trading

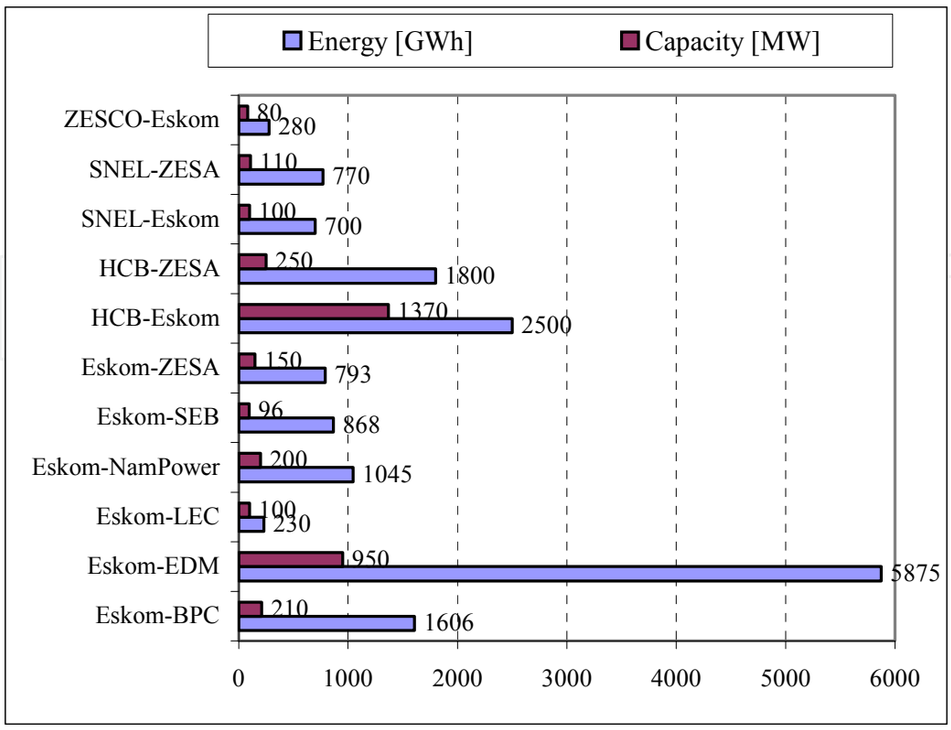
10.3.1 Bilateral Contracts

Based on the current SAPP Inter-Governmental Memorandum of Understanding, the general arrangement for electricity trading in the SAPP is for the national power utilities to engage into long-term and short-term bilateral contracts for the sourcing and consumption of electrical energy. Thus, the intergovernmental agreements and the bilateral contracts between the utilities form the basis and foundation for cross border electricity trading in the SADC region. The routine activities that follow include scheduling, settlements, monitoring of the quality of supply and detailed investigations are conducted into inadvertent energy flows and major power system faults and disturbances [1].

The prices for the bi-lateral energy contracts are negotiated between the buyer and the seller. The pricing structure for bilateral contracts is diverse with some contracts having capacity and energy rates which take cognizance of the time of use, peak or off peak. Other contracts have flat energy rates.

Bilateral agreements provide for the assurance of security of supply but are not flexible to accommodate varying demand profiles and varying prices. To explore further the benefits thereof, the sourcing and scheduling of electrical energy closer to the time of dispatch, the SAPP developed the short-term energy market (STEM) as one option for sourcing and securing supplies closer to real time dispatch. STEM has been designed to specifically mimic a real time dispatch.

Figure 10.2 shows the bilateral agreements in force from 2005.



HCB hydro supply: 1,770MW, Eskom thermal supply: 1,706MW

Fig. 10.2 The 2005 Bilateral Contracts in SAPP

10.3.2 The Short-term Energy Market

The goal of standard market design is to establish an efficient and robustly competitive wholesale electricity marketplace for the benefit of consumers. This could be done through the development of consistent market mechanisms and efficient price signals for the procurement and reliable transmission of electricity combined with the assurance of fair and open access to the transmission system [3]. For the short-term energy market (STEM) design, the following criteria were used [2,3,4]:

i.) Transmission rights
Long and short-term bilateral contracts between participants were given priority over STEM contracts for transmission on the SAPP interconnectors. All the STEM contracts are subject to the transfer constraints as verified by the SAPP Co-ordination Center.

ii.) Security requirements
Participants are required to lodge sufficient security deposit with the Co-ordination Center before trading commences and separate security is required for each energy contract.

iii.) Settlement
Participants have the full obligation to pay for the energy traded and the associated energy costs. The settlement amounts are based on the invoices and are payable into the Co-ordination Center's clearing account. It is the responsibility of the Participants (buyers) to ensure that sufficient funds are paid into the clearing account for the Co-ordination Center to effect payment to the respective Participants (sellers).

iv.) Currency of trade
The choice of currency is either the United States Dollar or the South Africa Rand dependent on the agreement between the buyer and the seller.

v.) Allocation method
The allocation of available quantities based on the available transmission capability is by fair competitive bidding with equal sharing of available quantities to the buyers.

vi.) Firm contracts
Once contracted, the quantities and the prices are firm and fixed. There are currently three energy contracts that have been promoted in the STEM as follows; monthly, weekly and daily contracts. Daily contracts have been most consistent and have been greatly used by participants.

Table 10.2 summarizes the daily trading routine in the STEM. It is important to note that the period for submission of bids and offers close simultaneously.

At 08:30 HRS, a day before trading – The Center publishes the exchange rate between the United States Dollar and the South African Rand.
Any time before 09:00 HRS, a day before trading - Participants submit bids and offers to the Co-ordination Center for future daily contracts.
At 10:00 HRS, a day before trading - The market closes and the Co-ordination Center matches bids and offers for any future trading day;
At 14:00 HRS, a day before trading - The Co-ordination Center publishes the results to all Participants.
At 15:00 HRS, a day before trading – Participants may enter into post-STEM contracts and inform the Coordination Center accordingly.

Table 10.2 Daily Trading Routine in the STEM

For the period from 1 April 2005 to 31 March 2006, corresponding to the SAPP Coordination Center fiscal period, the power supply on the short-term energy market (STEM) was 423-GWh and the corresponding demand was 3,700-GWh. The traded energy was 178-GWh at an average cost of 0.96 USc/kWh. For a similar period from 1 April 2006 to 31 March 2007, supply and demand figures were 377-GWh and 1,118-GWh, respectively. The energy traded was 226-GWh at an average cost of 1.38 KWh/kWh. This period recorded an increase in the cost of energy, but with a much lower power demand [see Figure 10.3].

The total energy sales for the period from 1 April 2005 to 31 March 2006 was *US$2.2 million* and the corresponding sales for the period from 1 April 2006 to 31 March 2007 was *US$3.1 million,* Figure 10.4. Though the same quantity of energy was traded during both periods, it is seen that the cost of energy in the 2006 period had increased due to reduced power supply on the market.

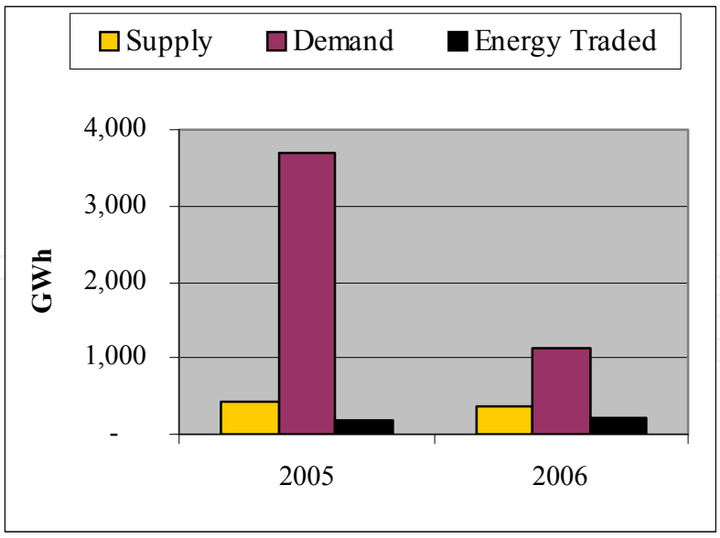


Fig. 10.3 Energy Trading Summary
(1 April to 31 March of the following year)

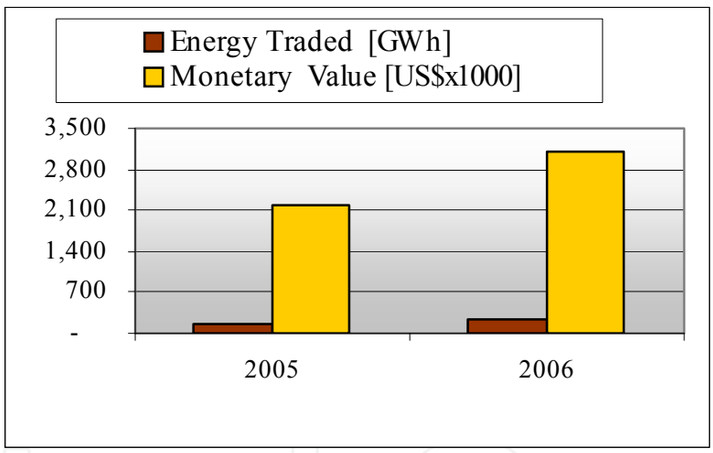


Fig. 10.4 Energy trade versus monetary value
(1 April to 31 March of following year)

The development of the competitive electricity market started in January 2004 when an Agreement between the Government of Norway and SAPP provided SAPP with a grant to the amount of NOK 35 million for this purpose. The competitive market will replace STEM. STEM was developed as a precursor to a full competitive market. The experience derived from STEM operations has formed the basis for the development and implementation of a full competitive electricity market for the SADC region [5,6].

10.4 Regional Challenges

Despite the stated achievements, the SAPP is still faced with the following key challenges that lie ahead as follows:

1) **Electricity sector restructuring and reforms**
   SAPP Members are undergoing a power sector reform process and the restructuring is taking various forms [4]. The restructuring of SAPP members will mean that the members of SAPP would eventually change as more utilities are unbundled by their governments. The number of players in the SAPP is likely to increase as a result and this will have a major impact on SAPP membership and operations. Whilst SAPP members are being restructured, the SAPP is also making a transition from a cooperative pool into a competitive pool.
2) **Electrification**
   Electrification and particularly rural electrification is the cornerstone for economic integration and development. The level of electrification for most SAPP member countries is less than 30% meaning that a lot of people have no access to clean energy. The challenge is to increase access to modern energy services and delivery.
3) **Human resource capacity and impact of HIV/AIDS on the utilities**
   This is a regional problem and it is affecting the operations of member utilities. More and more educated and trained people are dying as a result and replacing them is at great cost to members and the region as a whole.
4) **Diminishing generation surplus capacity**
   The biggest challenge that the SADC region is facing is the diminishing generation surplus capacity. In the last ten to fifteen years, power demand in the SADC region has been increasing at a rate of about 3% per annum. Unfortunately, there have been no corresponding investments in generation and transmission infrastructure to match the increase in the demand and as a result, generation surplus reserve capacity has been diminishing steadily over the past few years [7]. The continued diminishing generation surplus capacity in the SADC region would have a negative impact on the economies of the region and potential investors would be frightened.

The rise in the regional power demand has been caused by the following identified factors:

- Economic expansion in member states requiring more power to supply the new industries,
- Increase in population of most SADC member states coupled with increased electrification programs,
- Non-economic tariffs in most member states that do not support re-investments in power generation, but allow large energy intensive users to come to the SADC region and set up their operations, and
- No significant capital injection into generation and transmission projects from either the private or the public sector.

The total installed capacity in countries included in SAPP is about 55,000MW [see Table 10.3], but the available capacity is only 47,000 MW due to technical limitations. The dependable capacity is further reduced to 43,000 MW as the available hydro capacity varies depending on season and other constraints. The Peak Demand in 2006 was 42,000 MW

resulting in load shedding in rather extensive parts of the region. Bearing in mind that there is a need for continuous reserves of above 4000 MW not included in these figures it goes without saying that the regional deficit situation is becoming a severe challenge for the utilities. From experiences globally such challenges are best met through a strictly formalized regional power cooperation, e.g. through power pools like SAPP.

No.	*Country*	*Utility*	*Installed Capacity [MW]*	*Available Capacity [MW]*
1	Angola	ENE	1,128	943
2	Botswana	BPC	132	90
3	DRC	SNEL	2,442	1,170
4	Lesotho	LEC	72	70
5	Malawi	ESCOM	302	246
6	Mozambique	EDM	233	174
		HCB	2,250	2,075
7	Namibia	NamPower	393	360
8	South Africa	Eskom	43,061	38,764
9	Swaziland	SEB	71	70
10	Tanzania	TANESCO	1,186	780
11	Zambia	ZESCO	1,737	1,200
12	Zimbabwe	ZESA	2,045	1,125
Interconnected SAPP			**52,416**	**45,098**
Total SAPP			**55,052**	**47,067**

Table 10.3 SAPP Installed and Available Capacity

In the period 2004-2006 a total of 1140 MW installed capacity was commissioned consisting of both constructions of new plants and upgrading of existing plants. In 2007 a further capacity of 1450 MW was installed, mainly in South Africa. Existing plans for the period 2007-2010 indicate rehabilitation and short-term generation projects of approximately 13,500 MW if sufficient funding resources are made available.

Even with an optimistic implementation rate for generation projects, the existing growth rate in electrical energy use of 3.6 % p.a. or between 1000 – 1500 MW per year will imply clear risks of further load shedding in parts of the region. Rather extensive Demand Side Management initiatives are consequently required and some have already been initiated, in particular in South Africa, with positive results.

A survey carried out in 2006 by the SAPP Coordination Center [8] reviewed that all the SAPP Member Utilities registered a positive growth in power demand during the period from 2001 to 2005 mainly due to the increase in economic activities in their countries. The Utilities' peak demand occurred almost at the same time and there was basically no load diversity in the interconnected SAPP grid and no benefits of time differences in the region.

From Figure 10.5, it is seen that the non-coincidental peak demand in the SAPP during the winter of 2006 was about 42,000MW against an available capacity of 45,000MW. Accordingly to the SAPP agreements, SAPP Members are required to carry a generation reserve margin of about 10.2%. This means that the maximum peak that the SAPP should reach is 40,400MW (i.e. 45,000MW available capacity less 10.2%). Therefore, the recorded 2006 peak should be set as the maximum peak that the SAPP could achieve with the available capacity. Unfortunately, the load is still increasing and the generation capacity is static indicating that the maximum peak in the coming years will rise beyond the stipulated limit. This is a demonstration of the diminishing generation surplus capacity that the region is now experiencing and should be reversed. Figure 10.5 also shows that in 2007, the SAPP peak demand equalled the available generation capacity and the region had not much reserve capacity to fall back on. Figure 10.6 also confirms what is highlighted in Figure 10.5 that the region runs out of generation surplus capacity in 2007. Figure 10.6 indicates the reserve capacity position in the SAPP if no new generation capacity is built in the next few years. In 1998, the SAPP had generation reserve capacity of over 11,000MW i.e., about 24%. Over the years, the generation reserve has been diminishing steadily due to the reasons given above and is expected to continue reducing unless new investment in generation infrastructure is done.

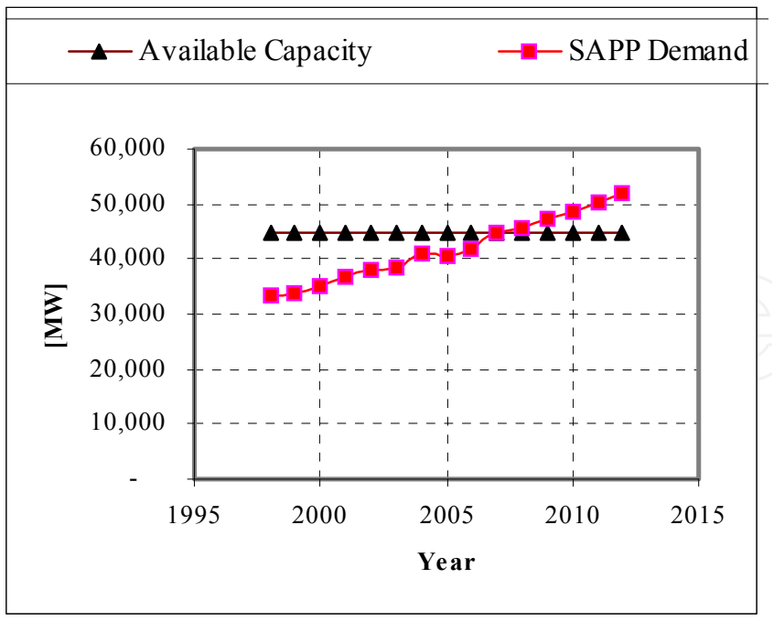


Fig. 10.5 Historic and forecast peak demand growth (1998 – 2012)

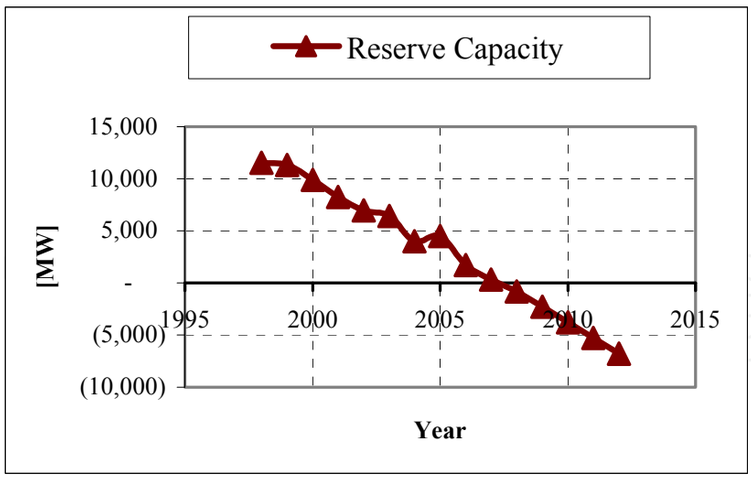


Fig. 10.6 SAPP Reserve Capacity profile: 1998 to 2012

In order to reverse the diminishing generation surplus capacity and to avert an impending energy crisis in the SADC region, the SAPP has put in place the following measures:

a) Implementing Priority Projects

The SAPP has formulated Priority Project Listing, which is expected to act as a project investment guideline to Investors, the Public and the Private Sector. The agreed SAPP Priority projects are as follows:

1) *Rehabilitation and associated infrastructure projects:* These are currently in progress and most of them are under construction. Once completed, they will add 3,200MW of power to the SADC grid. The estimated cost is around US$1.4 billion.
2) *Short-term generation projects:* These projects are expected to be completed in 2010. Feasibility studies and environmental impact assessments on the projects have been completed. Some of the projects have secured funding and for those with no funding available, the SAPP is sourcing funds via different initiatives. Once completed, the short-term generation projects will add about 4,200 MW to the grid at a cost of approximately US$3.8 billion.
3) *Transmission projects:* There aim is to interconnect the three non-operating members of the SAPP (Angola, Malawi and Tanzania) to the SAPP grid. The other and mainly internal transmission projects are aimed at relieving congestion on the SAPP grid and evacuation of power from the generating stations to the load centers. The north-south congestion program that was started is aimed at relieving congestion on the SAPP transmission grid between the north and the south, and also promotes and facilitates trade amongst SAPP member countries.
4) *Medium to long-term generation projects*: These are meant to supply power to the SADC region in the medium to long-term. Notable among them is the Western Power Corridor Project, Westcor, which is expected to move 3,500-4,000MW of power from Inga-3 in the DRC to southern Africa and to pick up 6,500MW of generation at Kwanza River in Angola.

b) Marketing of priority projects

The SAPP and NEPAD are working with the Ministers responsible for energy in the SADC region to market the priority projects and to attract funding for the short and long-term generation and transmission projects. A SADC Regional Electricity Investment Conference (REIC) was held in Namibia in September 2005 aimed at attracting investors into the SADC power sector. A follow-up conference was planned in the following year.

c) Energy Regulation and Tariffs

The Ministers responsible for energy in the SADC region pledged to address regulation, implement cost reflective tariffs and adopt regulatory principles that would enhance those tariffs. Political support from the SADC governments is essential for cost reflective tariffs to be implemented. A tariff study has been initiated by SAPP. The objective of the study is to review the tariff setting principles used by SADC governments and their national power utilities and to compare them with best practices from around the world. The study will also review the issues surrounding tariff settings and electricity pricing including the role of the regulator in those countries with a regulator and the importance of having a regulator in some cases.

In order for the SAPP to complete the projects in progress and those under rehabilitation and to implement the short and long-term projects, an estimated total of US$43 billion would be required, as indicated in Table 10.4.

SAPP Generation Projects	*Capacity [MW]*	*Estimated Cost [US$ Million]*	*Period of Implementation*
In Progress	3,211	1,410	2005 - 2007
Rehabilitation	1,048	523	2007 - 2010
Short-term (New Build)	4,217	3,830	2005 - 2010
Long-term (New Build)	43,542	37,585	2011 - 2020
Total Planned Capacity	52,018	43,348	

Table 10.4 Cost and Timing of the SAPP Projects

In South Africa for example, in order to deliver the required capacity, Eskom plans to spend over R97 billion (about US$14 billion) over a 5-year period in capacity expansion including rehabilitation. The return to service of the three-mothballed power stations Camden, Grootvlei and Komati were completed before the end of July 2007. Major capacity expansion in South Africa will include new coal fired base load stations, new pumped storage technology, open cycle gas turbines (at Atlantis and Mossel Bay), nuclear, and the associated transmission lines. The open cycle gas turbines at Atlantis and Mossel Bay was completed before the end of April 2007.

The SAPP is currently faced with the challenge of a diminishing generation surplus capacity. The continued diminishing generation surplus capacity will have a negative impact on the economies of the SADC region if it is not reversed. In order to reverse the diminishing generation surplus capacity, the SAPP has developed a program of implementing the priority generation and transmission projects so as to avert an energy

crisis. The success to the implementation of this program is key to the development of the region, noting that energy is the cornerstone of development.

10.5 Acknowledgements

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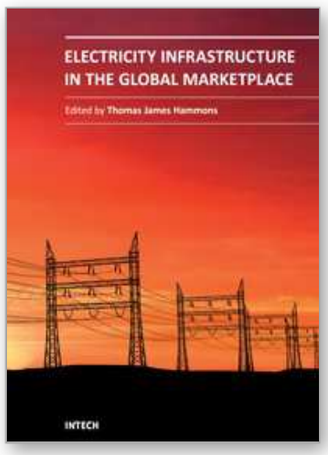

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This book discusses trends in the energy industries of emerging economies in all continents. It provides the forum for dissemination and exchange of scientific and engineering information on the theoretical generic and applied areas of scientific and engineering knowledge relating to electrical power infrastructure in the global marketplace. It is a timely reference to modern deregulated energy infrastructure: challenges of restructuring electricity markets in emerging economies. The topics deal with nuclear and hydropower worldwide; biomass; energy potential of the oceans; geothermal energy; reliability; wind power; integrating renewable and dispersed electricity into the grid; electricity markets in Africa, Asia, China, Europe, India, Russia, and in South America. In addition the merits of GHG programs and markets on the electrical power industry, market mechanisms and supply adequacy in hydro-dominated countries in Latin America, energy issues under deregulated environments (including insurance issues) and the African Union and new partnerships for Africa's development is considered.

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