Lack of Investment in Large Scale Generation Plants in the Southern African Power Pool: A Question of Policy, Political Will, Pricing or Planning?

LT Kapolo[1,2]

leandro.kapolo@nampower.com.na
Tel: +264 61 205 2365
Mobile: +264 81 129 3167

J Lalk[1]

jorg.lalk@up.ac.za
jorgl@telkomsa.net
Tel: +27 12 420 4925
Mobile: +27 83 417 7541

[1]Department of Engineering and Technology Management, Graduate School of Technology Management, University of Pretoria, Private Bag X20, Hatfield, Pretoria, 0028, South Africa

[2]NamPower, Namibia

Abstract The Southern African Power Pool was established in 1995 by the Southern African Development Community (SADC). The aim was to optimise the available resources of energy, so that the member states can support one another during technical or natural emergencies, thus contributing to energy security of supply. At the time the SADC states enjoyed combined excess reserve capacity in excess of 20%. This ensured that the region enjoyed some of the lowest electricity prices in the world. Political stability has furthermore led to favourable and steady positive economic growth, driven by increasing customer demand and growth in rural electrification. The downside of this caused an erosion of the reserve margin which by 2007 dropped as low as 5%, a situation that compromises security of supply.

The increase in demand of electricity was not accompanied by an equal growth in power generation capacity. This led to a load shedding situation during 2007 and 2008, and continues in some member states. This paper covers the first part of a research project that aims to discover why, despite predictions that demand would surpass available supply capacity by 2007/8 if no new generation is put in place,theSADC power sector has not put sufficient effort into building the required new capacity.

Introduction

The Southern African Development Community (SADC) is a growing regional economic hub with a population of almost 250 million people. Electrical energy has been playing a key role in ensuring steady regional economic growth with electricity demand growing at a combined annual average rate of between 3 and 4%.

The Southern African Power Pool (SAPP) is a regional utility grouping that was created by SADC member states to harness and create a platform for the regional power utilities to trade electricity amongst themselves whilst also improving security of electricity supply. This purpose has been served and received well amongst member utilities with those with surplus capacity supplying those that are net importers of energy.

The SAPP is made up of twelve memberutilities representing the various SADC states. Of these,nine are electrically interconnected and are referred to as operating members, whereas three are not yet inter-connected to the SAPP network and are referred to as non-operating members. There, however, remains some trading of electricity between some of the operating and non-operating members in the form of cross-border supplies. The interconnectivity discussed in this paper refers to the backbone-to-backbone connectivity that facilitates imports or "wheeling" of energy to a third party.

Member states with their respective power utility companies include ENE – Angola, BPC – Botswana,SNEL – DRC,LEC – Lesotho,ESCOM – Malawi,EDM – Mozambique, NamPower – Namibia,ESKOM – SouthAfrica,SEC – Swaziland,TANESCO – Tanzania,ZESCO – Zambia and ZESA – Zimbabwe. Figure 1 shows the geographic relationship between SAPP member states.

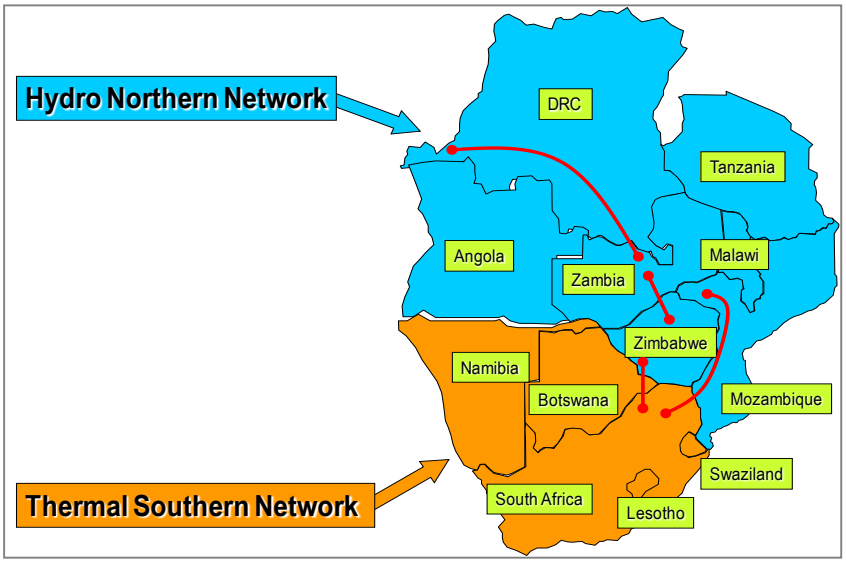


Figure 1 Geographic relationship between SAPP member states (Source: SAPP)

As illustrated by figure 1 the SAPP regional grouping capacity can roughly be divided into two distinct parts, namely, the hydro-potential north and the thermal potential south. This allows southern part of the region to take advantage of cheap hydro energy generated in the north during the rainy season, with the net flow reversed during the dry season when the thermal south would

export energy to its northern neighbours. Figures 2 and 3 show the interconnections of the SAPP; and existing links and individual peak powers respectively, as of 2011.

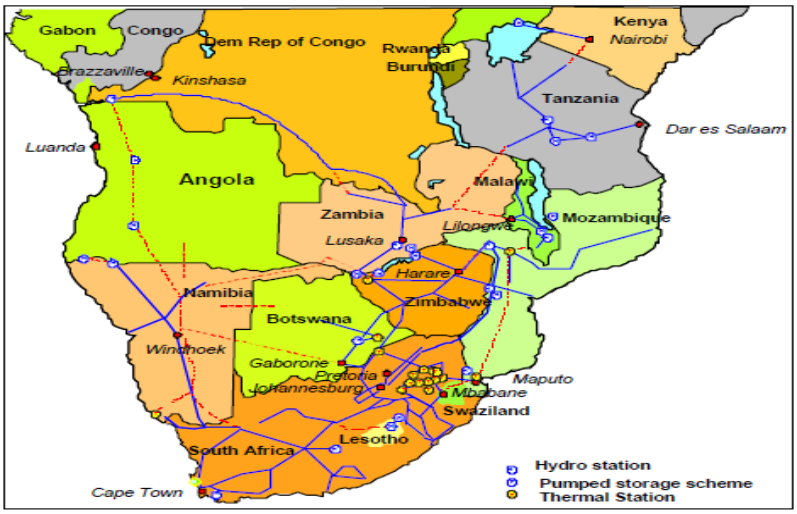


Figure 2 SAPP Interconnection Grid (Source: SAPP)

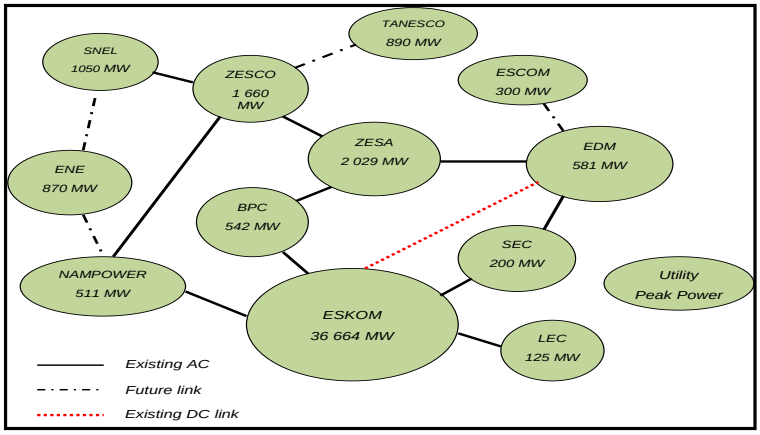


Figure 3 SAPP Main Interconnection links and peaks for 2011 (Source: SAPP CC)

Industrial overview

Southern Africa is rich in natural energy resources. With abundant hydro power potential in the north, vast coal fields in the south and oil reserves off the west coast, there is a definite potential to supply low cost energy in coming years (Alfstad 2005). More recently two vast natural gas fields were discovered off the Mozambique coast which adds substantially to what now can be defined as a energy resource rich region, (Business Day 2011). Over the years since the creation of SAPP, the regional demand for power continued to grow as stable economies take advantage of the relatively low energy cost in the region. Wind and ocean energy could be harnessed in limited quantities (Musaba 2008). The southern region is furthermore one of the sunniest places in the world (maximum irradiance is in the order of 1100 W/m2 according to Ciolkosz,(Ciolkosz2009), making the region a perfect candidate for industrial solar power generation.

In recent years the region has seen the creation of energy/electricity regulators in various countries many of which are operational (Alfstad 2005). This ensures a region that is now widely considered to be having a favourable regulatory environment making it an attractive business environment for the region's utilities and possible Independent Power Producers (IPPs).

Cheap electricity in the region is brought about by the relatively cheap running cost of power stations in the thermal southern region.There is an abundance of coal and the power stations are virtually built on top of coal fields, cutting down on transportation logistics. In the hydro northern region, perennial rivers provide abundant free water as a driver of hydro power stations. Similar to the case of the thermal South's coal power stations most of the North's hydro power stations have been built between the 1960's and 1980's, most of which also have been paid for. Therefore, there have not been many reasons to increase energy prices. What followed is that for the years of abundant cheap electricity prices, no new investment in the generation of power has been observed. While the supply side remained relatively constant, the demand side continued to grow until 2007 when the demand started to outstrip the supply side, causing wide spread load shedding activities in the region. In that year, the interconnected peak demand observed stood at 42 429 MW against the available capacity of 44 689MW,(SAPP Annual Report 2008). This, for the first time, threatened security of supply throughout the region.

In order to manage the SAPP's interconnected power system after the 2007 regional load shedding events, a number of load management programs were launched in all member states. Thisconsisted of managing the demand side as well as the supply side of the regional system. Management of the supply side included, amongst others, the shifting of power station maintenance to off-peak periods, and the installation and commissioning of peaking plants such as diesel and gas generators. These methods are both risky and expensive to run, but have helped in stabilizing the system. Demand side management calls for the participation and cooperation of the wider customer base and involves a number of initiatives. These include educating the public about the need to save power, contracts and agreements with large energy users to reduce their consumption, and voluntary interruptible loads. Where appropriate, in some settlements the use of ripple-control methods to manage peak loads were introduced. A number of utilities also ran energy saving campaigns to educate the people to use other alternative energy sources such as solar geysers for water heating and gas stoves for cooking. NamPower of Namibia and Eskom of South Africa are amongst some of the utilities that have handed out free energy saving compact fluorescent lights (CFLs) to the public in order to cut on the demand of power.

What transpired is that the SADC regionsuddenly found itself moving from an era of excess capacity in the 70's to the 90's to that of regular power shortages (Musaba, et al 2008). This situation can be attributed to:

- Favourable economic growth of the region and expanded growth of rural electrification projects in various member states.
- Insufficient investment in generation projects, many of which have been in the planning stage for decades now.
- Failure to interconnect the non-operating members of SAPP in order to harness the energy locked up in those countries.

Two key events in determining the future roadmap of the SAPP were the Regional Electricity Investment Conference (REIC) held in Windhoek, Namibia during September 2005, and, in July 2009, the SADC Directorate of Infrastructure and Services' Investors Round Table Conference

held in Livingstone, Zambia. Both these events had the aim toattract investors to invest electrical power generating projects in SAPP member states.

Since 2007, a number of small generation projects have been commissioned, the majority of which are gas and diesel units. These units do not serve a long term solution to the region as they are expensive and only service the peaking times. What the region requires is a base load generation project, that can increase reserves provide security of supply. So far, region has only seen a few of such major projects that are in the process, some of which are: the Morupule B in Botswana, the Komati and Medupiin South Africa; and the Inga 1 and 2 in the Democratic Republic of Congo, Itezhi-Tezhi and Kafue Gorge Lower Zambia. These are expected to add a base generation capacity of over 12 000 MW in the next three (3) years. The region however needs an investment in excess of 5000MW new base generation yearly to maintain a healthy 10% reserve and the current demand growth. This requirement does not even taking into account the replacement of the plants that have passed their life cycle and need to be retired.

Because, South Africa produces over three quarters of the energy in the region and contributes less than 20% to the trading (Alfstad,2005), the impact that South Africa has on the development of energy infrastructure is enormous. The South African Integrated Resource Plan (IRP) 2010-2030, for Electricity states the security of supply as an important factor and does not only look at internal resources but those of the bigger region as well.

A recent South African Government Gazette (Government Gazette 2011), proposes the creation of an Independent System and Market Operator (ISMO) bill, that will attempt to eliminate the perception of a monopoly by Eskom, and aims to create aneutral 'referee' situation in the market. Judging by previous attempts to break Eskom's regional monopoly chances of the new ISMO actually realizing so far appears to be slim.

Research Problem and Objectives

The intention of the research this paper is based on is to investigate the reasons why, despite abundant resources for power generation in the region, the regional utilities, the SAPP member states, as well as private investors, find it difficult to invest in power generation projects. In particular, the research examines what affects the regional regulatory policies, political will, energy pricesand regional planninghave on the realisation of investment in power generation within SADC. Furthermore the research aims to reveal why, despite the forecasts of energy planners in the region, their warnings have not been followed by firm actions. Preliminary investigations indicate that most of current generation plants are owned by governments through state-owned utilities. These generation plants (and transmission lines) were built with a lot of reserves in them and most of them have been in operation for over thirty (30) years. At a point not far from now, the majority of these units will reach the end of their life cycle, where they will have to be replaced or refurbished. Even when choosing to refurbish older plants there still would be a need for new plants as the refurbishment of a large power station can take many years to complete. Yet, despite this, many of the SAPP member states still take too long to further invest in base power generation projects, let alone building generating plants with enough surplus capacity.

Trading within SAPP

When the power pool was established during 1995 the main driver was only to make excess generation capacity of the SAPP member states available to other member states, (EAC 2009). At the time the pool was overwhelmingly biased towards South Africa's Eskom that by far held in excess of 80% of all installed capacity.

Utilities within the member states are responsible for more than 95% of all generation and distribution of electricity in their respective countries, but they also supply excess power to neighbouring countries through bilateral cross-border supply agreements. In the last few years, SAPP membership has been extended to include other players who are registered as either Independent Power Producers (IPPs) or Independent Transmission Companies (ITCs). These utilities, IPPs and some ITCsalso trade energy amongst themselves through long- and medium-term bilateral agreements as well as through short-term markets, or spot markets as it is more commonly known. The 2011 demand/supply situation in terms of peak power reached versus installed capacity is shown in Table 1. This highlights that not much has changed since 1995 as the skewed supply position within the power pool remainsbiased with Eskom retaining its dominant position.

Table1 Installed Capacity by December 2011 (source: SAPP Coordination Centre 2012)

No.	Country	Utility	Installed Capacity [MW] As at Dec 2011	Available Capacity [MW] Dec 2011	Installed minus Available [MW]	2011 Peak Demand [MW]
1	Angola	ENE	1,187	990	197	870
2	Botswana	BPC	202	190	12	542
3	DRC	SNEL	2,442	1,170	1,272	1,050
4	Lesotho	LEC	72	72	-	125
5	Malawi	ESCOM	287	287	-	300
6	Mozambique	EDM	233	174	59	581
		HCB	2,075	2,075	-	
7	Namibia	NamPower	393	360	33	511
8	South Africa	Eskom	44,170	41,074	3,096	36,664
9	Swaziland	SEC	70	70	-	200
10	Tanzania	TANESCO	1008	880	128	890
11	Zambia	ZESCO	1,812	1,215	597	1,660
12	Zimbabwe	ZESA	2,045	1,320	725	2,029
TOTAL SAPP			55,996	49,877	6,119	45,422
Total Interconnected SAPP			53,514	47,720	5,794	43,362

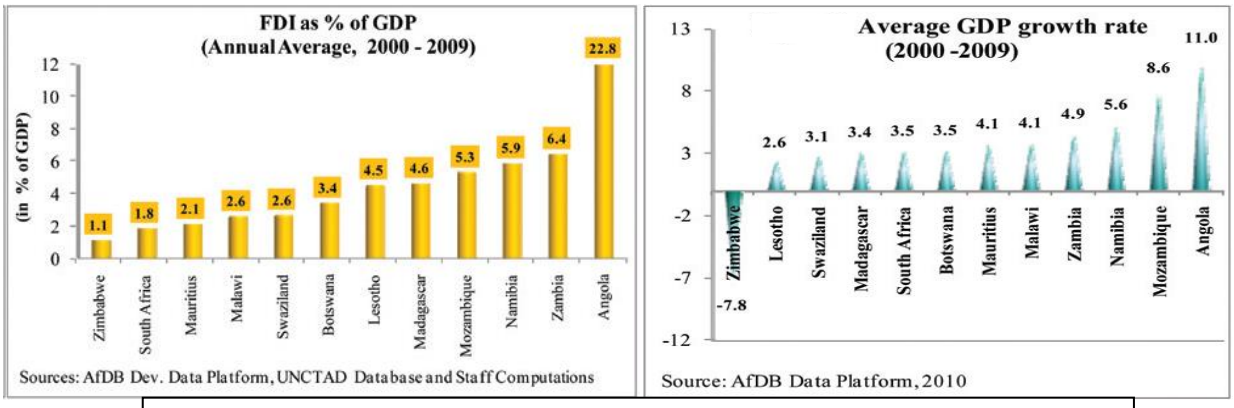
This bias can, to some extent, be explained by the similarly skewed socio-economic profile of SAPP member states. Table 2 illustrates this.

Table 2 SAPP Socio-economic Data for 2007 (source: SAPP Annual Report 2008)

Items	Year	Southern Africa	Africa	Developing Countries	Developed Countries
Area (000 square mile)	2009	6574.0	30307.0	80976.0	54658.0
Population (million)	2009	160.5	963.7	5448.2	1223.0
GDP per capita (current US$)	2009	2674.0	1071.0	2000.0	36487.0
Gender-related development index (GDI)	2005	0.5	0.5	0.7	0.9
Population growth (annual %)	2009	1.8	2.4	1.4	0.3
Urban population growth (annual %)	2006	-10.3	3.5	2.6	0.5
Population of 65 years and above (as % of total)	2006	3.6	3.5	5.6	16.4
Population ages 15-49, female (million)	2009	39.8	24.5	24.5	31.4
Life expectancy at birth, total (years)	2009	51.4	54.2	65.4	76.5
Life expectancy at birth, female (years)	2009	50.2	55.3	67.2	80.2
Death rate, crude (per 1,000 people)	2009	14.3	13.2	8.2	10.4
Mortality rate, infant (per 1,000 live births)	2009	73.0	85.3	57.3	7.4
Mortality rate, under 5 (per 1,000)	2009	117.1	130.2	80.8	8.9
Fertility rate, total (births per woman)	2009	4.0	5.0	3.0	2.0
Improved water sources (% of total population with access)	2006	70.0	62.3	80.0	100.0
Improved sanitation facilities (% of population with access)	2006	46.4	45.8	50.0	100.0
Percentage of adults (aged 15-49) living with HIV/AIDS	2005	14.5	4.7	1.3	0.3
Incidence of tuberculosis (per 100,000 people)	2006	583.0	300.7	275.0	18.0
Immunization, measles (% of children)	2007	84.9	75.4	78.0	93.2
Food consumption, total calories	2005	2,407	2,436	2,675	3,285
Illiteracy rate, adult total (% of population ages 15 and above)	2007	22.0	33.3	26.6	1.2
Illiteracy rate, adult male (% of males ages 15 and above)	2007	13.1	25.6	19.0	0.8
Illiteracy rate, adult female (% of females ages 15 and above)	2007	26.0	40.8	34.2	1.6
Arable land (as % of land area)	2007	5.9	6.0	9.9	11.6
CO2 emissions (metric tons per capita)	2007	3.3	1.0	1.9	12.3

Source: AfDB Development Data Platform

The overwhelming position of South Africa would for many years still remain a stumbling block in a more equitable contribution by other SAPP member states in new generation capacity. The positive aspects however are that when one analyses the growth rates and foreign direct investment (FDI) trends it is also evident, as shown in Figure 4, that some other SAPP member states tend to have much higher GDP and FDI growth than South Africa, which, should this be sustained in the medium term, would lead to an expected larger contribution by other members.



Assumption is made that SAPP members, who are also part of Southern Africa will show similar trends than those of the whole region

Figure 4FDI and GDP growth in Southern Africa (source: AfDB)

When looking at the overall private investment into the region World Bank figures show a similar disturbing trend where almost 80% of all investment for ICT, transport and energy projects is into South Africa, (World Bank 2010).

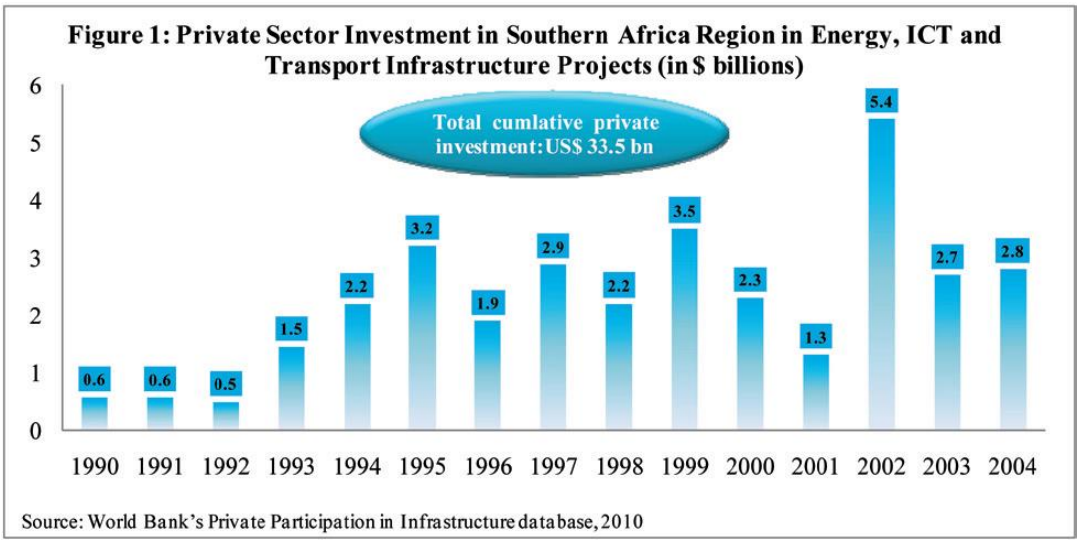


Figure 5 Private Energy, ICT and Transport Investment into Southern Africa

Investment History

Several publications (SAPP Annual Reports, 1999, 2005 and 2008) contain projects that have been on the waiting list since 1999 and were said to be completed in the medium term (three to five year) period. Twelve years later, in 2012, many of these projects are yet to be completed and some have not yet reached any financial closure. The following tables 3A and 3B and 3C illustrate this.

Table 3A: SAPP Generation Projects as projected in 1998/9

Country	Project Name	Capacity [MW]	Type	Expected Year
Angola	Capanda	130	Hydro	2000
Namibia	Kudu	750	Gas	2002
Namibia	Kudu	750	Gas	2005
Zimbabwe	Batoka	800	Hydro	2008
Zambia	Kafue Lower	200	Hydro	2002
Zambia	Itezhi-Tezhi	80	Hydro	2001
Tanzania	Ubungo	34	Gas	2000
Zimbabwe	Hwange Upgrade	454	Coal	2001

Table 3B: SAPP Generation Projects as projected in 2005

Country	Project Name	Capacity [MW]	Type	Expected Year
Angola	Capanda	260	Hydro	2007
DRC	Inga 3	3500	Hydro	2010
Namibia	Kudu	800	Gas	2009
Zimbabwe	Batoka	800	Hydro	2014
Zambia	Kafue Lower	600	Hydro	2009
Zambia	Itezhi-Tezhi	120	Hydro	2007
Tanzania	Ubungo	40	Gas	2005
Zimbabwe	Hwange Upgrade	660	Coal	2008

Table 3C: SAPP Generation Projects as projected in 2007

Country	Project Name	Capacity [MW]	Type	Expected Year
DRC	Inga 3	4300	Hydro	2015
Namibia	Kudu	800	Gas	2015
Zimbabwe	Batoka	800	Hydro	2015
Zambia	Kafue Lower	750	Hydro	2012
Zambia	Itezhi-Tezhi	120	Hydro	
Tanzania	Ubungo	40	Gas	
Zimbabwe	Hwange Upgrade	660	Coal	2012

Future of investment in SAPP

In recent years there has been real and steep growth in international commodity prices as shown here in Figure 6. This comes after decades of rather stagnant and even negative price growth.

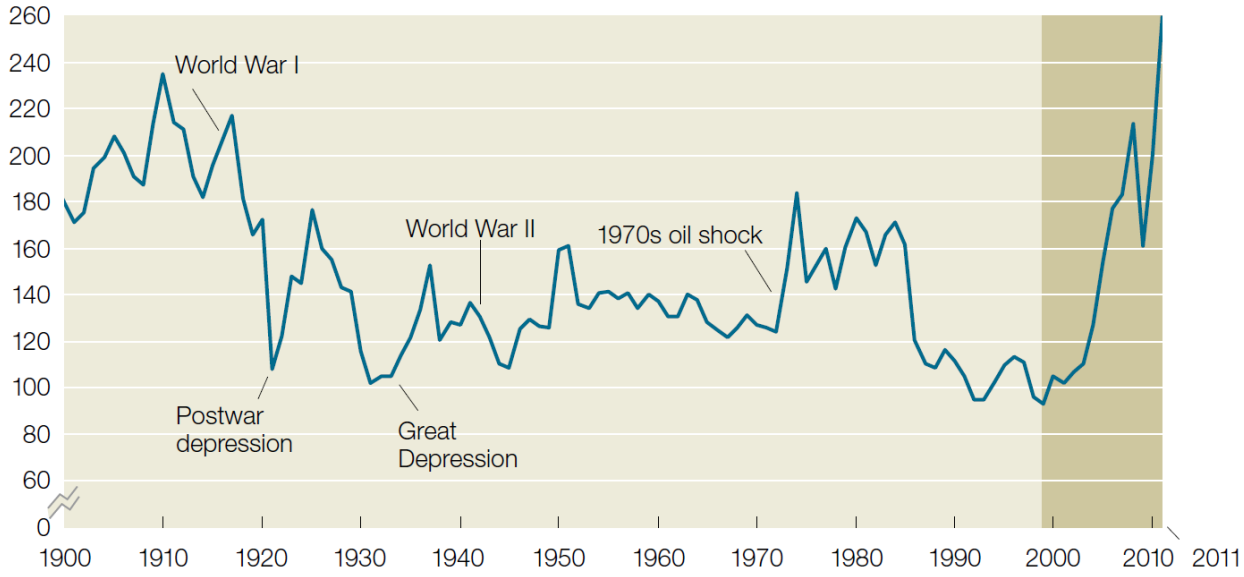


Figure 6McKinsey Global Commodity Price Index (average of 1999-2001 = 100), (Dobbs, Oppenheim & Thompson, 2011)

This should be good news for SAPP member states, almost all of which have economies heavily dependent on commodity exports. This in itself should make it attractive for investors to increase their FDI into member states. It could be expected that much of this investment will also flow towards new power generation capacity projects as most commodity-heavy economies are also large users of electrical power.

Unfortunately, having shown trends in the drivers of SAPP capacity increase, it turns out to be rather disappointing to see that current capital expenditure planning within SAPP (with South Africa being the exception) appears to be aimed mostly at the rehabilitation of older plants. Should this trend continue one could predict that the gap between planned capacity (which will remain constant) and demand will quickly grow to a point where investors will take their investments elsewhere.

Our research has clearly indicated that with a World Bank economic growth estimate of some 5% per annum, (leading to a 3% per annum growth in electricity demand) the SADC region will quickly run out of any reserve margin by 2012. Although there were indications that this will happen much earlier (Rosnes&Vennemo 2008), the 2008/09 world-wide recession delayed this somewhat. But this was only a delay of the inevitable. The general trend is shown by Figure 7 below. What is quite disconcerting is that this is regardless of any effort in Demand Side Management (DSM).

Because of the small size of the economies in the SADC region, the development of large scale projects in those economies need a larger off-taker to be viable. Eskom has a great influence because of its size in helping absorb the excess energy that can be provided by new developers in

the SADC region. Two examples of this are the Mammabula and Kudu Projects in Botswana and Namibia respectively, which are too large to be absorbed by their respective countries.

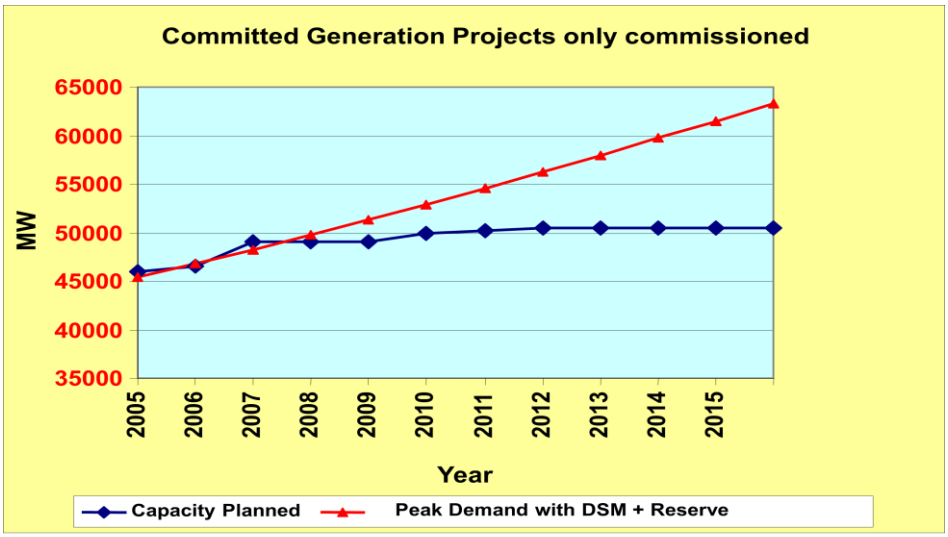


Figure 7 Growing gap between demand and planned capacity (African Development Bank 2009)

As shown in Table 4 the only real growth in new capacity seems to be coming from South Africa. This notion is supported by Figure 7 which shows that even with a major effort in Demand Side Management (DSM) there still remains a major disconnect between growth in demand vs. planned capacity.

Focusing on immediate planned new capacity until about 2016 the picture becomes even bleaker, as is shown by Table4 below.

Table 4 New SAPP Generation Projects (source: SAPP Coordination Centre, 2012)

No	*Country*	COMMITTED GENERATION CAPACITY, MW [2012 -2016]					
		2012	2013	2014	2015	2016	TOTAL
1	Angola	180		80			260
2	Botswana	600					600
3	DRC	430			150	240	820
4	Lesotho		25				25
5	Malawi			64		100	164
6	Mozambique	100		265	300		665
7	Namibia	92	60				152
8	RSA	303	722	6091	2961	2239	12316
9	Swaziland						
10	Tanzania	160					160
11	Zambia	56	360	735	40	244	1435
12	Zimbabwe		30	140	300	600	1070
TOTAL		1921	1197	7375	3751	3423	17662

In order to ensure energy security within the SADC region, the SAPP member states must ensure the refurbishment of 28000 MW of existing generation capacity as well as the construction of 31000 MW of new capacity by 2015, (Rosnes&Vennemo 2008). Seeing this in context with the South African Integrated Resource Plan (DOE 2010) which requires some 43000 MW of new capacity, for South Africa alone, by 2030, it is clear that a further large disconnect exists between the various future visions of pool members. Our research could find no longer-term strategies or plans by any SAPP member state similar to South Africa's Integrated Resource Plan. The stark implication of this is that South Africa's contribution to the SAPP new capacity requirements by 2015 would only constitute about 3000 MW (DOE 2010)leaving a shortfall of some 28000 MW by 2015 for which no obvious contribution by any of the other SAPP states is expected. The revised figure of 12316 MW by 2016, by South Africa, and a total of 17662 MW committed by the Pool still fall short of the required capacity to cater for the units that need to be retired and the regional growing demand for electricity.

At this point, going forward, it would be fair to ask the following questions about the various roles of the SAPP:

- Who is responsible to ensure the security of electricity supply in various countries and in the region?
- Does the region have conducive policies and electricity prices that can attract generation investment in the region? If not, what needs to be done? Out of this are the sub-questions to clarify:
    - Are the policies attracting and protecting investors?
    - Do tariff levels fulfill the requirements of financiers and are there proper project identification and packaging, regulation, market structure and risk apportionment?
- Can we identify the existence of the required regional political will that could persuade governments, utilities and the private sector to invest in the power pool's capacity growth?
- Are the SAPP member state governments supportive of one another?

Our research into large scale power generation plants in the Southern African Power Pool has reached a point where most of the desktop research is complete. Even at this early point the research managed to unearth a number of important pointers that are useful in attempting to answer some ofthe questions above. We expect our field research phase to unearth a number of important areas of concern that, if addressed properly, would contribute to solving the forecasted supply shortfall within the power pool. To lend emphasis to the value of demand forecasting Table 5 illustrate the results of the 1997 SAPP forecast versus the actual yearly demand by 2010.

Table 5: SAPP 1997 Demand Forecast versus SAPP 2010 Actual Demand (SAPP, 1998)

Interconnected		
Year	Total MW Forecast	Total MW Actual
1998	32117	32669
1999	35013	32777
2000	36264	34229
2001	37673	35781
2002	38556	36981
2003	39662	35694
2004	41050	37780
2005	42316	39341
2006	43518	41831
2007	44873	42404
2008	44977	41550
2009	46189	41955
2010	47626	43664

SAPP Energy Resources

The power pool, in its entirety, has enormous potential of power generation both in hydro, thermal (coal) and renewable. In Botswana, despite being a net importer of energy for a long time, the coal reserves at Mmamabula could supply a coal-fired power station having a potential generation capacity of some 4,000 MW (Alfstad 2005).

Alfstad, (Alfstad2005), further confirms that the DRC has enormous hydro resources, with potential generation capacity estimated at 150000 MW. Of this, 39000 MW could be built at the Grand Inga Falls site alone. The Congo River is widely acknowledged as a crucial resource for the development and electrification of Africa in the larger than SAPP sense. As a prelude to this a five nation consortium consisting of the DRC, Angola, Namibia, Botswana and South Africa created a company, Western Power Corridor, (WESTCOR), in 2003. This was an attempt to create a western transmission corridor project that would develop and draw power from Inga 3 and distribute this energy to its southern neighbours. This attempt has failed, putting a potential 3500 MW development on hold.

In Mozambique, the technical hydroelectric potential is estimated at 12500 MW. The majority of this potential is provided by the Zambezi River (Alfstad 2005). Substantial reserves of natural gas have also been discovered and the country is likely to become a major producer of gas. There are three onshore gas fields:Pande, Temane and Buzi-Divinhe with total reserves estimated at 3.1 Tcf (Alfstad 2005). The recent exploration and discoveries in the Rovuma Basin puts the estimate gas reserves at over 30 Tcf.

In Zambia, the national hydro-electric potential is estimated at 6000MW. Unfortunately this is not being leveraged with the Zambian utility (ZESCO) choosing to focus on rehabilitation of existing units rather than capacity expansion (Alfstad 2005).

According to the World Uranium Mining(Mining Journal, Feb 2010), Namibia ranks the 4th largest producer of uranium in the world, producing about 18% of world supplies. This is a source of energy that is being exploited by most of the developing world to produce electricity. With a clear nuclear framework in place, this commodity could be used in the country or in the region to the benefit of the whole region. South Africa is the only African country to operate a nuclear power station, and the South African IRP 2010 indicates that additional nuclear power stations, a total of 9600 MW, must come on stream by 2022.

Southern Namibia, Botswana and Northern Cape are seen as some of the sunniest places on earth, making them the perfect candidates for solar power production. A large scale installation of this kind could be integrated in the energy mix of the whole pool so that it does not surpass the recommended the 10% to 15% renewable allowed for the system. Although the South African government has repeatedly made mention of a planned 5000 MW solar park near Upington in the Northern Cape this project seems to be stalled for the moment with little activity.

South Africa, the largest producer of electricity in the region boasts the largest coal reserves in the region, that are easy to mine and the current stations are virtually built on the coal fields to minimize transportation costs. Kusile (4800MW) and Medupi (4800 MW) power stations are the new additions to the fleet of the coal fired power stations, and they are currently in the construction phase. Ironically, despite their importance both projects seem to be dogged with cost-overruns and schedule slips with the first 600 MW unit at Medupi only to come on line by

late 2013. The environmental concerns against the building of coal fired power stations have also been noticed.

According to the Country Analysis Briefs (Country Analysis Briefs 2010), Angola has become one of the largest crude oil producing countries in Africa, and even briefly became the largest in 2009, surpassing Nigeria as the latter suffered from attacks on oil infrastructure in the Niger Delta. Natural gas production in Angola is tied directly to oil production and is often vented or flared, with limited volumes consumed domestically. Yet, about 97 percent of Angola's electricity generation comes from hydroelectric sources. Developments are underway to capture and market this natural gas for domestic electricity generation and to export most of it in the form of liquefied natural gas (LNG) by 2012. Table 6 below illustrates the potential energy in terms of gas and oil that country possesses.

Table 6: the upcoming Oil exploration Projects in Angola. Source: IEA Medium Term Oil and Gas Markets 2011

ANGOLA: UPCOMING PROJECTS				
Project	Capacity ('000 bbl/d)	Est. Startup	Block	Operator
Tombua-Landana*	75	2011 (peak)	14	Chevron
PAZFLOR	200-220	2011 (Q4)	17	Total
PSVM**	150	2012	31	BP
Kizomba D - Satellites	125-150	2012	15	ExxonMobil
Palas, Ceres, Juno, Astrea, Hebe, Urano, Titania	150	2012+	31	BP
Platino, Chimbo, Cesio	150	2013	18W	BP
Sangos/N'Goma	85	2013	15	ExxonMobil
SE PAJ	150	2013	31	BP
CLOV	160	2013-2014	17	Total
Cabaca Norte-1	40 -200	2014	15	ExxonMobil
Terra Miranda, Cordelia, Porti	150	2014	31	BP
Mafumeira Sul***	95-110	2014-2015+	0	Chevron
Negage	50-75	2014-2015+	14	Chevron
Lucapa	100-130	2014-2015+	14	Chevron
Gindungo, Canela, Gengibre, Mostarda	120-200	2015-2016+	32	Total

According to the Oil and Gas Journal (OGJ), Angola had 10.9 trillion cubic feet (Tcf) of natural gas reserves as of January 1, 2011- a significant increase from the 2007 estimated reserves of 2 Tcf. In 2009, Angola's gross natural gas production was approximately 357 billion cubic feet (Bcf). Of this, 244 Bcf (67 percent) was vented or flared, 81 Bcf (23 percent) was re-injected to aid in oil recovery and only 24 Bcf (7 percent) was marketed for domestic consumption.

According to our analysis, Angola is self-sufficient in terms electricity supply and demand, however,the majority of its population, depend on biomass as a source of energy, with the electrification rate of around 15%. The country remains isolated from the pool and this prevents potential the country holds to be unlocked. This non-interconnectivity also prevents the country from developing its resources for export purpose as there are no transmission lines in place to export this commodity to the greater SAPP.

Discussions

Planning

With no added generation on system, the situation of load shedding was reached in during 2007/8. This state of affairs was expected as planners in the various utilities have forecasted the possible crisis of energy deficit by 2007 as early as 1999 (Musaba and Naidoo 2008), warning governments and relevant institutions that if no investment in power generation was made, the region's total demand of electricity would outstrip the generation by 2007. If the leadership and the responsible entities heeded to this warning and invested in base load plants in good time, this situation could have been avoided.

As indicated in table 5, the 1999 SAPP annual report puts the forecast annual maximum demand at 44 873MWby 2007, as per their projection and comparing this value to the actual value of 42 404MW in 2007, this gives an accuracy of 95%,even with load reduction measures have been implemented in the region, after the 2007/8 blackouts. The message from the planning sector was clear and fairly accurate, yet, their predictions were not followed with concrete actions.

Most of the planning documentation studied tends to focus on grid extensions and on-grid generation growth. Southern Africa has a high number of living in remote rural areas and electrifying such communities require long high voltage lines with low loads at the end. This makes such projects not to be financially viable and thus these communities are left to use the traditional biomass energy resources and remain under developed. Planning needs to include all types of technologies available, to provide energy for both on-grid and off-grid systems.

The call for the IPPs by the governments in the region in an attempt to breakdown the monopoly played by the utilities and increase competition may have led to 'wait and see' approach by the utilities and governments alike, in hoping that the new players would fill the gap. On the contrary, IPPs have not come in big numbers as expected and governments lost time in putting new infrastructures on line.The creation of an Independent System and Market Operator (ISMO) in some countries is seen as an attempt to provide a level playing field for both IPPs and utilities. Challenges however may arise in that an ISMO may have little assets and may need government guarantees in order to sign (power purchase) agreements.

Political influence

In 1995, the Ministers responsible for energy in the Southern African Development Community (SADC) signed an Inter-Government MOU that lead to the creation of a power pool under the name, Southern African Power Pool (SAPP). It is governed by the Inter-Governmental Memorandum of Understanding (IGMOU) at the governments' level, the Inter-utility Memorandum of Understanding (IUMOU) at the utility level and the Agreement between Operating Members (ABOM) that is guiding the interconnected members of the SAPP. In February 2006, the SADC governments signed the Revised IGMOU and the utilities, the Revised IUMOU. This was necessitated by changes that had taken place in the SADC region and also meant to allow other players to participate in the SAPP, including IPPs and ITCs. This was further a demonstration of the region's political will to attract other players to invest in the regional generation and transmission infrastructure.

There seem to be a political will to continue and fostering the integration of the region to harness resources for regional benefit. Electricity is a basic need, and with the low level of rural electrification in the region, the delivery of electricity to the people can be used as a political tool. Therefore, under the current situation of the energy shortage, utilities tend become under a lot of political pressure to deliver. This pressure exerted on utilities makes them to look inwards and to ensure that their internal customers served first. BPC of Botswana had to rent expensive generation plants to cater for more than 40% of their energy requirement that was curtailed due to shortages.

Political influence can have both positive and negative effectson the supply of electricity acrosspolitical borders. Somecases have however shown that the deliverance of electricity supply can continue unaffected by political differencesas discussed under the case study scenarios in the region here below.

Some historicCase Study Scenarios in the Region

(i) The Central African Power Corporation (CAPCO)

On November, 25, 1963, the Government of Southern Rhodesia and the Government of Northern Rhodesia signed an Agreement relating to the Central African Power Corporation at Salisbury (today now known as Harare). The aim was to see that there is an integrated system for the control of the generation of electric power and its transmission in the Territories of the said Governments, which was at that time, the responsibility of the Federal Power Board. CAPCO was to continue to operate and fully develop as a single system under the joint ownership or control of the twogovernments. This agreement was put into operation from 1964 and it carried on until after the independence of both countries, first the Northern Rhodesia when it became Zambia in 1964 and later Southern Rhodesia when it became Zimbabwe in 1980.

CAPCO continued to operate a transmission system from Kariba connecting into both the Zambian and the Zimbabwe networks consisting of 330 kV overhead lines.Before Zimbabwe became independent, the two countries became political rivals for a while during the period whenSouthern Rhodesia (Zimbabwe) was under the rule of Ian Smith.

Amidst all this political rivalry, CAPCO continued to operate over the two nations as if there was peace between them and its operation was never affected by political differences of the two states. CAPCO was eventually decommissioned in 1987 under mutual agreement, seven (7) years after the independence of Zimbabwe.

(ii) Malawi - Mozambique Interconnector

In 2005, the Regional Electricity Investment Conference, (REIC), was held in Windhoek Namibia, where the then Chief Executive Officer of Malawi's ESCOM, Mr.KandiPadambo, called for the international funders to fund the Malawi – Mozambiquetransmission Interconnector. This Project would link Malawi to the rest of SAPP utilities and give Malawi the advantages of trading of electricity in the pool.

By July 2007, The World Bank has approved a $93-million credit for the construction of a power link between Malawi and Mozambique, giving the southern African neighbours access to reliable and affordable energy. Mozambique's share of the credit will be $45-million and involve the

installation of a 135 km, 220 kV power line from the Matambo substation to Phombeya in Malawi. On the Malawi side, about 75 km of 220 kV transmission line will be built and a new 220 kV substation installed at Phombeya (according to article by E Cronje of ee-publishers). This was quoted by the media article in the Nampa-Reuters publication (July, 2007), by Kohler where he quoted Wendy Hughes, a World Bank Senior energy specialist as saying: "The interconnection will allow Malawi to reap the full benefits of membership of the Southern African Power Pool, both to import electricity when necessary, particularly if there's a drought, and also to export any surplus electricity Malawi doesn't use atnight-time".

In 2010, the article in the Engineering News magazine, by Chimwala, reveals that The World Bank, the lead financier of the $93- million Mozambique–Malawi power interconnector project, has initiated negotiations with the Malawi government to kick-start the project, which has stalled because Malawi is unhappy with aspects of the power sharing agreement between the two neighbouring countries.

By 2012, Malawi is still not connected to the rest of the pool. This could be seen as an example of difficulties between governments that could delay or derail a project which could be beneficial to both countries. This situation will require a political solution and willingness by both countries to materialise.

(iii) Other Successful cases

Somesuccesseson cross border trade and investments that can be emulated are the CahoraBassa Power Station in Mozambique that suppliesbulk of electricity to South Africa. This project started to operate while South Africa and Mozambique were not political allies; Mozal Aluminum Smelter plant and its transmission partner MOTRACO also between South Africa and Mozambique. NamPower of Namibia invested in the rehabilitation of Hwange Power Station in Zimbabwe in return of energy supply. These symbiotic relationships are important for the survival of the whole pool.

Similar cases of symbiotic relationship can be found in other industries and can be well protected by treaties.Katse Dam in Lesotho, built with South African government funds, provides water to the Gauteng areas and also benefits Lesotho through royalties, water supply and agricultural schemes.

Regional Electricity Tariff

Electricity in the region remains the cheapest in the world making it difficult for IPPs and new investors to penetrate the industry. Their resources are sourced from international markets and investors need to recover their investments in order to survive. The current tariff in the region is not cost reflective and because of regulated tariffs, cost reflectivity needs to be reached first before any investor would come on boardand be able to compete. It may however be useful to investigate methods of increasing income where the investor can claim funding from carbon credits if their power producing methods are in line with set rules pertaining to clean technologies.Off-grid, hybrid systems maybe an alternative to ensure that the electricity tariff is competitive.

Policy (Regulatory Framework)

Licensed IPPs and ITCs are now operative in some countries and ready to sign power purchase agreements (PPAs) with internal and external off-takers. Energy and Electricity Regulators in the region are established to ensure that the industry has openness and fairness, and that the customers and producers alike are protected. The proposal to create an Independent System and Market Operator (ISMO) in South Africa is seen as a step towards elimination of 'unfair' competition in the industry by preventing the referee from also being a player. This should put prospective IPPs at ease when they want to invest in the market.

During the Round Table Investment Conference in Livingstone in 2006 the then chairman of RERA, pointed out that most SAPP countries have energy policies, but these are in need of review and update to bring them in line with accepted best practices.Most power generation projects aretoo big for national markets and financing mechanisms for cross-borderprojects are not in place. Different country regulatory frameworks remain a challenge in creating a viable regional market that promotes regional trade/investment.

The confinement of utilities and regulators withintheir political borders makes it difficult for the IPPs and ITCs across the borders as regulatory laws of the different countries may not be coherent across such borders. Projects of regional benefit across political boundaries often face conflicting regulatory requirements. Funders often prefer projects that are of multinational interest in the pool.

With the recent discovery of vast coal reserves in Botswana the country seems to make strides in encouraging IPPs who are now negotiating with off-takers outside the borders but this needs to be done within a favourable regulatory framework.

Conclusion

The research this paper is based on is still a work in progress but preliminary findings have given the researchers some interesting pointers:

- Governments are at the forefront of driving the integration and the creation of the pool in order to develop and share the regional resources. They are committed to mobilize the resources for the implementation of the projects; however national concerns regarding security of supply often take priority. Therefore national interest is given higher priority over regional interest.
- The vast majority of all investments in ICT, transport and energy projects earmarked for Southern Africa, is absorbed into South Africa, influencing investments in other SADC member states negatively. This skewness gives South Africa an advantage over other regional nations driven mainly by its economic positioning. Projects that are larger than national energy "gaps" cannot take place without an off-taker who can absorb excess energy.
- Some regulatory challenges due to incompatible country legal and regulatory frameworks lead to low investor confidence and inadequate protection of consumers in the energy sector. There is a need to extent the current regulation to include non conventional energy sources, such as renewable energies. Cost reflective tariffs need to be reached in order to make the market viable for private investment.

- Regional planners need to include innovative ideas that encompass the wide spectrum of energy technologies to reduce the pressure from the conventional energy resources. The off-grid systems have a potential of reducing transmission costs and should feature higher on the agenda. Planning should take into account the plants that have reached their life cycle. The current growth on the supply side remains lower that the demand side growth and the mitigation measures being out in place are not sustainable.
- The region needs to be aware that the pace at which current development of generation plants cannot sustain the demand growth and retirement of old plants.The regional demand will continue to grow and so is the demand for power.
- Gas turbines, rented generators serve the short term need of filling the gap and cannot replace the need for the base load power plants.
- The region needs to invest and exploit its resources in totality for the benefit of the region. There is a need to eliminate the confinement within political borders and take advantage of the cheaper resources anywhere in the region together where these relationships could be governed by much more stronger agreements such as treaties. These initiatives can be of beneficial to all parties involved.
- The governments have the obligation to support and back their utilities both financially, morally and politically, in the effort to invest in the new base power plants wherever this investment may be.
- Governments need to understand that investing in base power plants is not a commercial operation but a developmental obligation.
- The key to attracting investors in power generation lies with:
  - The creation of a conducive environmental in terms legal and regulatory environments, and
  - Implementation of cost reflective tariffs.

The research that this paper is based on will continue over a number of years and should find additional pointers that will lead us to an improved understanding as to why investment in large power projects in the majority of SAPP member states remain low, hopefully leading to suggestions addressing this. If the SADC region wants to truly grow the participating nations' economies it would be crucial to find ways to tap the region's vast energy resources, benefitting all its people.

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Biography

Leandro Kapolo is a Senior Manager in the Transmission Business Unit, NamPower, Namibia, responsible for transmission infrastructure. He is a member of the Engineering Council of Namibia and is registered as in Incorporated Engineer. Prior to his current position he held several portfolios in NamPower, including being Senior Manager of System Operations,

Network Operations and Head of the Protection Section. He represents the utility at various forums in the region including SAPP and acts in various capacities. He was Chairperson of the SAPP Operating Sub-Committee (OSC), a position he held from 2007 to 2009. He formed the Disturbance Investigating Task Team under the OSC, which investigated and coordinated regional disturbances. This task team also ensured that three control areas that were operating in isolation after the 2007/8 energy crisiswere put back in synchronism to ensure that the interconnected system functions normally.

JörgLalk is a professional engineer with four degrees in electrical and electronic engineering, including a PhD from Cranfield University in the United Kingdom. He currently is a senior lecturer at the University of Pretoria's Graduate School for Technology Management where he also is the coordinator of the university's new Energy Institutional Research Theme. Prior to this he held various senior management and systems engineering positions in industry. He has more than 30 years' experience in systems engineering, engineering management, project management and the management of strategic technology programmes in aerospace, automotive, ICT and consulting. He has been one of the founding members of the South African Chapter of INCOSE, served as chapter Vice-president during 2004, Chapter President during 2005 and Membership Board Member for INCOSE Region 3 during 2006. He is a Senior Member of the IEEE and has completed the UNISA Intellectual Law Specialization Programme with distinction during 2010. Outside of his professional activities his interests include DIY and all things equestrian.