3.3 Power Generation Development Plan

3.3.1 Energy Balance Details of Power Development Plans (Capacity, Timing, Funds, Construction Cost)

(1) SAPP

The installed capacity and effective power of existing facilities among the 12 counties in the SAPP are 54,700MW and 45,800MW, respectively in 2007. In South Africa, there exist several coal-fired power plants which utilize the abundant coal resources in the country. The installed capacity in South Africa of 43,100MW amounts to 79% of the installed capacity of the SAPP's. On the other hand, Zambia, Mozambique, Zimbabwe, and DRC have high hydropower potentials, with a share of 3%, 4.7%, 3.7% and 4.5%, respectively, of installed capacity in SAPP. The total intalled capacty of the mentioned five countries is about 95% of the SAPP's.

In Southern Africa, thermal plants, hydropower plants, nuclear power plants, gas-turbine plants and pumped storage power plants share 74.3%, 17.4%, 4.0%, 1.6%, and 2.7%, respectively of its power facilities. Among the thermal power plants in SAPP, coal-fired power plants of South Africa are 93%, while the remaining are gas-turbine and diesel power plants. Coal-fired thermal power plants utilizing coal reserve in South Africa supply electrical power to said country where the power demand reaches 83%. On the other hand, large-scaled hydropower stations developed along the Zambezi River from 1960 to 1970 in Zambia, Mozambique, and Zimbabwe, and the Congo River in DRC provide 74% of the hydropower in SAPP. These hydropower stations supply the generated power to neighboring counties and South Africa through long distance transmission lines, including DC line. Figure 3.3.1 shows ratio of installed capacity in each SAPP country and its constituting ratio of power facilities.

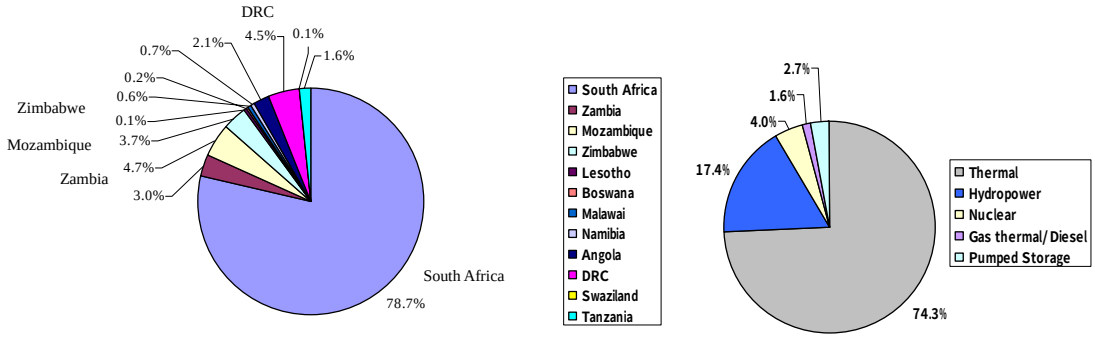


Figure 3.3.1 Ratio of Installed Capacity in SAPP Countries and Constitutional Ratio of Power Facilities

South Africa keeps coal reserve of 53 billion tons, being 6th country in the world. By South Africa, with a coal reserve of 53 billion tons, is ranked as the 6th country in the world rich in coal mines. By utilizing its abundant coal resources, it supplies electric power generated by coal-fired thermal power plants to the country and its neighboring states. Coal-fired power plants will be further developed for supplying base electric power in South Africa. There are also coal reserves along the north bank of the Zambezi River in Zambia and Mozambique. These coal minerals could supply the base power to Zambia and Mozambique once coal-fired thermal power plants are developed. There is also natural gas reserve along the eastern coast of Mozambique. Gas thermal power plants can be developed by utilizing this natural gas reserve.

On the other hand, there remains hydropower potential along the Zambezi River. It is estimated that 14,000MW is technically developed along the Zambezi River and 100,000MW along the Congo River. Among these potential sources, only 6% has been developed. Hence, huge hydropower potential development still remains to be considered. Figure 3.3.2 shows electric power resources of coal-fired, gas and hydropower in the Southern Africa.

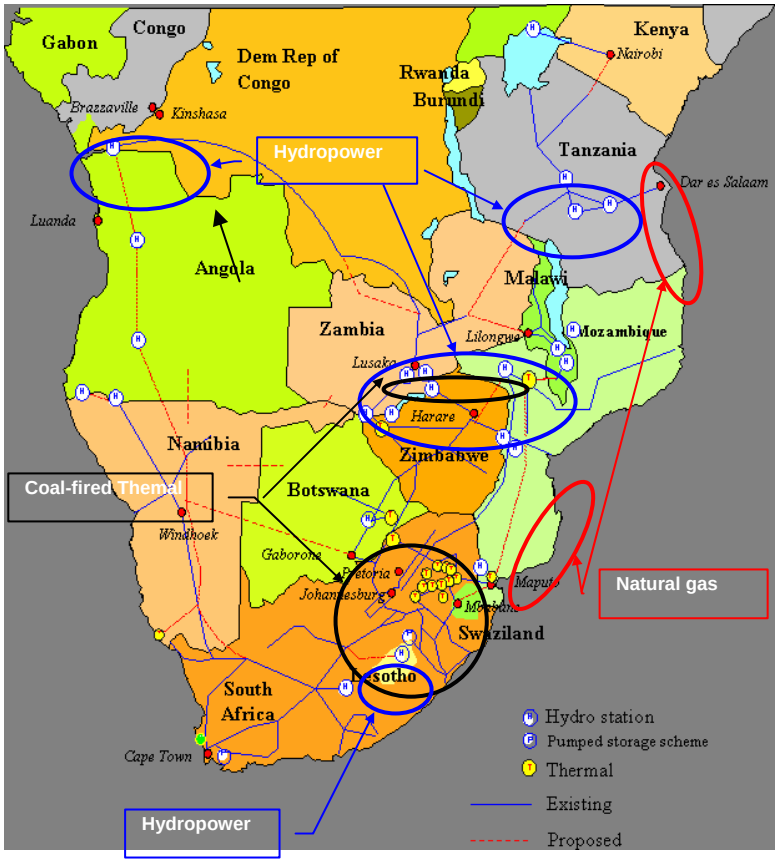


Figure 3.3.2 Potential Power Resources in Southern Africa

1) South Africa

The power demand of South Africa is forecasted by Eskom to be with an average rate of 4% from 2005 to 2025. To supply the electric power for the increasing power demand while keeping the reserve margin of 15%, Eskom plans to rehabilitate and replace the old age coal-fired thermal power plants at Eskom's own expense, as shown in Table 3.3.1.

Table 3.3.1 Power Development Plan in South Africa

	Power Facilities	Installed Capacity (MW)	Commissioning Year
(1)	Thermal Power Plant		
1)	Camden coal-fired (Return-to-service)	780 (390, 390)	2007/08
2)	Grootvlei coal-fired (Return-to-service)	1,170 (585, 585)	2008/09
3)	Komati coal-fired (Return-to-service)	965 (120, 240, 320, 285)	2008/09/10/11
4)	Medupi coal-fired	4,788 (798, 1596, 789, 1596)	2015
5)	Arnot Upgrade coal-fired	225 (75,60,60,30)	2007/08/09/10
6)	Ankerlig gas turbine (Open cycle gas turbine)	1,329 (589, 740)	2007/09
7)	Gourikwa gas turbine (Open cycle gas turbine)	735 (439, 296)	2007/09
8)	Brovo coal-fired	3,212 (803, 1,606,803)	2013/14/15
(2)	Pumped Storage Power		
1)	Ingula	1,332 (3 x 333)	2013

Source： 1) Eskom Annual Report in 2007

2) National Response to South Africa's Electricity Shortage in January 2008 by MoME

South Africa has been shortage of electricity power from December 2007, and has carried out the load shedding of 10% in industrial and public sectors in January 2008. It is said that the power shortage at this time is caused by: 1) the reserve margin of the existing power supply facilities in South Africa has been only 1 to 2%, 2) coal-fired power plants constructed before more than 20 years have been stopped their power generation by the periodical maintenance of generating equipment, 3) some coal-fired power plants can not be operated by shortage of coal because of decreasing storage volume and wet coal due to heavy rainfall during the rainy season in 2007, and 4) the periodical maintenance of old-age power plants and the stop of power generation in coal-fired power plants due to wet coal occurred at the same time.

As a short term of the power development plan in South Africa, two gas turbine power plants of Ankerling and Gourikwa totaling to 1,028MW have been constructed (commencement of their power generation in October 2007, and under implementation

of constructing the extension of 1,036MW till the end of completion in 2009). The refurbishment works of three coal-fired power plants (Camden, Grootvlei, and Komati) have been carried out at present, totaling to 3,800MW till 2011. The construction of two coal-fired thermal power plants (Medupi & Bravo of 8,000MW in total, and the commencement of power generation for first unit in 2013) and a pumped storage power plant of 1,332MW (Ingula in the power commissioning of 2013) has been started. On the other hand, the medium/long term of the power development plan aims that the power supply capacity in 2026 will double that of the existing one, totaling to 80,000MW by implementing nuclear power plants. The power supply facilities of 40,000MW will be added to the existing power system by including nuclear power plants of 20,000MW.

2) Republic of Zambia

The Zambezi River runs the Border of Zambia and Zimbabwe, and has abundant hydropower potential along it. Zambia has technically exploitable hydropower potential of 6,000MW. In addition to three existing hydropower plants of Kafue Gorge (930MW), Kariba North Bank (660MW), Victoria Fall (108MW), there remains the technical feasible hydropower potential of 4,300MW. Three existing hydropower station have been continued for rehabilitation, and will be completed in March 2009.

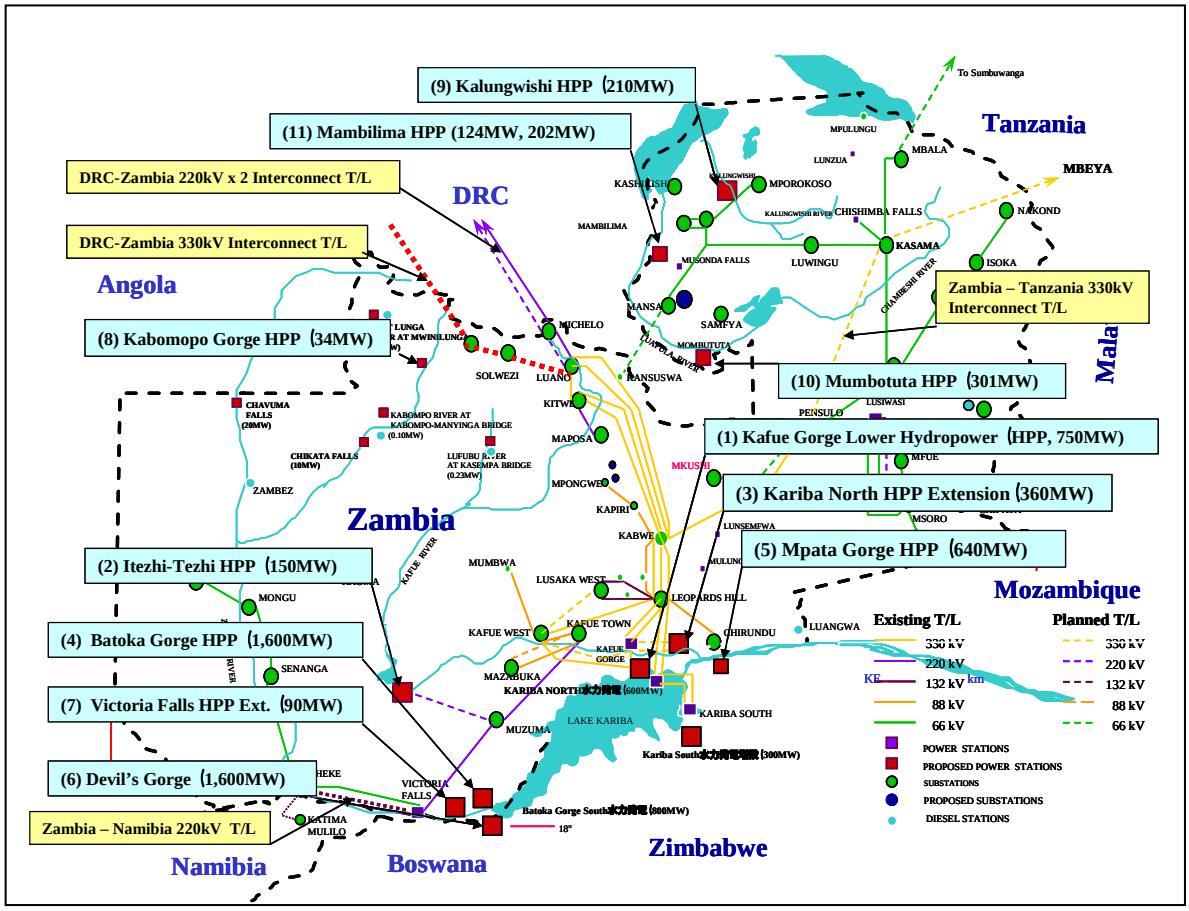
In Zambia having abundant hydropower potential, Kafue George Lower Hydropower (750MW), Itezhi Tezhi HPP (120MW), Kariba North Bank HPP Extension (360MW), Batoka Gorge HPP (1,600MW), Mpata Gorge HPP (640MW), Devils Gorge HPP (1,600MW), Victoria Falls HPP Extenstion (90MW), Kabompo Gorge (34MW), Kalungwishi HPP (218MW), Mumbotuta Falls HPP (301MW), and Mambilima Falls HPP (124MW & 202MW) are considered as hydropower development candidates. ZESCO has countermeasures against the power shortage such as: 1) Short term: Rehabilitation of existing power facilities and transmission lines、2) Medium term: Reinforcement of transmission lines in Zambia and neighboring countries, 3) Long term: Development of Itezi-Tezhi Hydropower Plan (120MW), Kariba North Hydropower Extension (360MW), and Kafue Gerge Lower Hydropower Plan (750MW). Table 3.3.2 shows the power development plan in Zambia and present status, and Figure 3.3.3 presents the location of existing power facilities and development plans.

Table 3.3.2 Power Development Plan and Present Status of Project in Zambia

	Power Facilities	Installed Capacity (MW)	Commissioning Year	Project Cost (US$ Mill.)	Present Status of Projects
Kafue River					
(1)	Kafue Gorge Lower Hydropower Project (HPP)	750	2014-2016	900	F/S of 900MW installed capacity was prepared by HARZA, USA in 1995. Location was shifted, and the capacity was modified to 750MW by ZESCO's review. F/S will be commenced by IFC's finance in April 2008. The Project will be implemented by co-operation with ZESCO and TaTa, India.
(2)	Itezhi-Tezhi HPP	120	2013	150	MOU was concluded between ZESCO and TaTa, India in Nov. 2006, and SPC was established. The construction will be commenced in 2009.
Zambezi River					
(3)	Kariba North Bank HPP Extension	360	2010	360	The Project will be implemented by EPC Contract of SHIOHYDRO in China. Financial arrangement of 85% has been determined, and 15% is remained.
(4)	Batoka Gorge HPP	Zambia (800), Zimbabwe (800)	-	2,200	Hydropower development project by utilizing the rapid of Batoka George between Victoria Falls and Kariba Dam. F/S was prepared in 1993, however, the upgrading F/S is needed.
(5)	Mpata Gorge HPP	Zambia (320), Zimbabwe (320)	-		Located about 180km downstream from Kariba Dam. The Project will be developed by co-operation with Zimbabwe.
(6)	Devils Gorge HPP	Zambia (800), Zimbabwe (800)	-		Located 100km east from Batoka Gorge. Pre-F/S and F/S are needed.
(7)	Victoria Falls Extension	90	-		Extension of the existing Victoria Falls P/S (108MW). The development is highly unlikely because of large environmental impact.
(8)	Kabompo Gorge HPP	34	2012		Pre-F/S was prepared by NORPLAN in Norway in 2002. F/S will be completed in 2008, and the construction will be commenced in 2009.
Kalungwishi River					
(9)	Kalungwishi HPP	218	2013	670 (T/L 170)	Pre-F/S was prepared by HARZA, USA in 2000. OPPPI reviewed the installed capacity.
Kalungwishi River					
(10)	Mumbotuta Falls HPP	301	-		Pre-F/S was prepared by HARZA, USA in 2001.
(11)	Mambilima Falls HPP	124, 202	-	174 & 500	Pre-F/S was prepared by HARZA, USA in 2001.

Source: 1) Water Power & Dam Construction, Yearbook in 2007
2) Hydropower and Transmission Line Development by MOEW, OPPPI in January 2008
3) JICA Zambia Rural Electrification Master Plan Study, Final Report in January 2008
4) JICA Zambia Power Development Master Plan Study, Project Formation Report in March 2008
5) Generation Planning, Least Cost Generation Plan Report by ERB, May 2006

Figure 3.3.3 Location of Existing Power Facilities and Power Development Plan in Zambia



3) Mozambique

The Zambezi River has a catchments area of 1.2 million km^2, and flows in the northern area of Mozambique. There is technically an exploitable hydropower potential of 6,610 MW in Mozambique through the utilization of water resources from the Zambezi River and other river basins. Main hydropower development plans in Mozambique include the Mepanda Nkuwa Hydropower Station of 1,300 MW and the Cahora Bassa North Bank Extension of 1,245 MW in the Zambezi River, and the Lurio Hydropower Station of 120 MW in the Lurio River of northern Mozambique. It is also estimated that small hydropower potential resources of 364MW and 18MW are being developed at present.

There is a coal reserve in Tete Province in northern Mozambique. A coal-fired power plant of 1,500MW is planned to be developed by utilizing coal reserve in Moatize, also located in northern Mozambique. Another on-shore gas reserve exists along its eastern coast. Meanwhile, the combined cycle power plant of 1,000 MW is planned for implementation in Temane, 350 km from Maputo.

The power development plan for Mozambique and the present status of each are shown in Table 3.3.3. Figure 3.3.4 shows the location of main power development plans in Mozambique.

The power generating facility and transmission line of the Cahora Bassa Hydropower Station (CB), constructed by Portugal in 1976, has been rehabilitated after the civil war in Mozambique in 1995. CB recommenced operations in 1997, with its generated power supplied to South Africa through a 1,410 km long, 533 kV HVDC lines, linking Songo S/S in Mozambique and Apollo S/S in South Africa. CB produces an annual electric energy of 14,490 GWh in 2006. The electric energy of 7,870 GWh (54%) that it generated is supplied to Eskom in South Africa, while 3,020GWh (21%) was supplied to ZESA in Zimbabwe. CB also supplies 460 GWh (3%) to the central and northern areas of Mozambique through 220kV transmission line between Songo and Matambo. Furthermore, the power energy of 1,650 GWh (11%) generated by CB is supplied to the southern area of Mozambique including Maputo, through the 533kV HVDC lines to Apollo S/S in South Africa, and 400 kV AC lines from South Africa to Mozambique. The equity of CB was turned-over to the Government of Mozambique by modifying the shares between Portugal, and Mozambique from 85% and 15%, respectively, to 15% and 85%, respectively.. CB supplies a generated power of 250 MW in 2005, and 300 MW in 2006, for domestic use in Mozambique.

Table 3.3.3 Power Development Plan and Present Status of Project in Mozambique

	Power Facilities	Installed Capacity (MW)	Commissioning Year	Project Cost (US$ Mill.)	Present Status of Project
(1)	Thermal Power				
1)	Moatize coal-fired	1,500	2015	2,700	Co-development by Franch Private Company and EdM
2)	Benga coal-fired	450			Submission of Pre-F/S in 2007
3)	Temane combined-cycle	1,000	2011	674	Co-development of EdM and Private Sector
(2)	Hydropower				
1)	Mphanda Nkuwa (MN)[1)]	1,300	2013	1,600（MN）+1,700 to 2,300 (400kV T/L, 1,400km)	Development by EPC JV of EdM, Brazilian Private Company（Camargo Correa）、and Mozambique Private Company（Energia Capital）
2)	Cahora Bassa North Bank Extension[2)]	1,245	2015	730	Pre-F/S and Preliminary Design were completed in 2002. Review of Pre-F/S was carried out in 2007, and waiting Upgraded F/S.
3)	Lúrio	120	2015	344	Submission of Viability Study to MoE
4)	Massingir	25	-	32	Submission of Viability Study to MoE
5)	Majawa	25	-	59	Submission of Viability Study to MoE
6)	Malema	50	-	124	Completion of Fre-F/S
7)	Boroma	200	-	-	
8)	Lupata	600	-	-	

Source： 1) Mpanda Nkuwa Hydropower Project, Mozambique by MoRME in May 2003

2) Technical Due Diligence on Restructuring of Hidroelectrica De Cahora Bassa, Supplementary Report in 2007

3) Information about Power Projects for Financing by Ministry of Energy

The Cahora Bassa Hydropower Station (CB) which was constructed by Portugal in 1976 has been rehabilitated its power generating facility and transmission line after finishing the internal war in Mozambique in 1995. The CB re-commenced its power generation in 1997, and the generated power is sent to South Africa by 533kV HVDC lines of 1,410km long between Songo S/S in Mozambique and Apollo S/S in South Africa. The CB produces the annual electric energy of 14,490GWh in 2006. The electric energy of 7,870GWh (54%) generated by the CB is sent to Eskom in South Africa, and 3,020GWh (21%) to ZESA in Zimbabwe. The CB also supplies 460GWh (3%) to the central and northern areas of Mozambique by 220kV transmission line

between Songo and Matambo. Further, the power energy of 1,650GWh (11%) generated by the CB is returned to the southern area of Mozambique including Maputo through the 533kV HVDC lines to Apollo S/S in South Africa and 400kV AC lines from South Africa to Mozambique. The equity of the CB was transferred to the Government of Mozambique by changing the sharing ratio from Portugal (85%) and Mozambique (15%) to Portugal (15%) and Mozambique (85%). The CB supplies the generated power of 250MW in 2005, and 300MW in 2006 for the domestic use in Mozambique.

The Cahora Bassa North Bank Power Station (CBN) is planned to be developed as an extension project of the existing CB at the north bank. CBN does not cause serious environmental impact, and can be implemented within a short construction period since it utilizes the existing power facility of CB. CBN can supply electric power to South Africa, where power shortage occurs, and for the domestic use in Mozambique. Therefore, CBN is an effective and attractive hydropower facility in Mozambique. The Pre-Feasibility Study (Pre-F/S), for installed capacity of 850 MW was carried out by European Consultants in 2002 simultaneous with the FS of Mepanda Nkuwa. The preliminary design of CBN (Installed capacity of 1,245MW) was also prepared by a Portuguese Consultant in 2002. The review on the Pre-F/S and the preliminary design of CBN was then carried out in March 2007. The review report recommended the optimum installed capacity of 1,245 MW (3 x 415 MW) and the execution of the FS for upgrading.

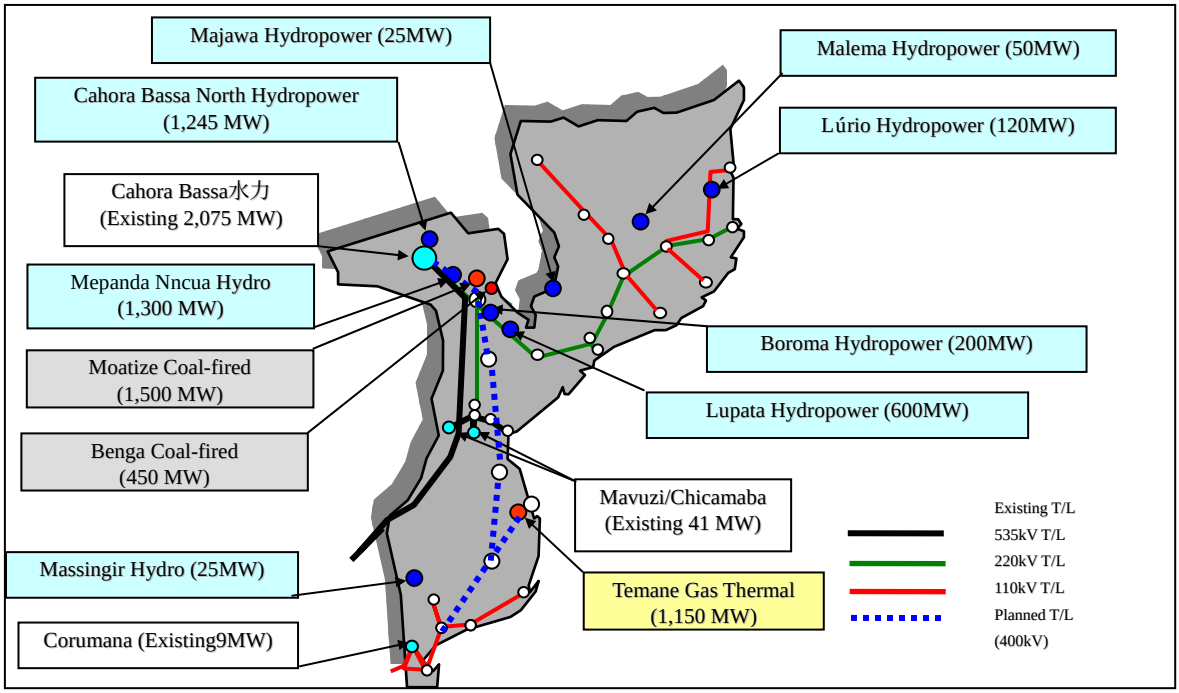


Figure 3.3.4 Power Development Plan in Mozambique

4) Republic of Zimbabwe

Zimbabwe reserves one third of its coal resources in Africa, excluding South Africa. By utilizing these coal reserves, coal-fired thermal power plants amount to 61% of the existing power supply facilities. In addition, the Kariba South Power Station of 750 MW contributes 39% of the installed capacity in Zimbabwe, using the hydropower potential in the Zambezi River.

Coal-fired thermal power plants of Hwanga (660 MW) and Western Power (1,200 MW) totaling 1,860MW are planned to be developed by utilizing the coal in the central region. The Lupani gas thermal power plants (300MW) is also planned for supplying the peak power in the system. In addition, there is an extension plan of 300 MW to supplement the existing Kariba Power Station. The power development plan of Zimbabwe and the present status of each are shown in Table 3.3.4.

Table 3.3.4 Power Development Plan and Present Status of Project in Zimbabwe

	Power Facilities	Installed Capacity (MW)	Commissioning Year	Project Cost (US$ Mill.)	Project Status of Project
(1)	Thermal Power				
1)	Hwanga 7 & 8 coal-fired	660	2008	500[1)]	MOU for coal supply is required.
2)	Lupani gas thermal	300	2009	-	
3)	Western Power	1,200	2008	-	
(2)	Hydropower			-	
1)	Kariba South	300	2007	-	Review of engineering design was completed, and F/S of transmission line was finished.
2)	Batoka Gorge South Hydropower	800	-	-	

Source： 1) Priority List of Power Development Plans in Each Power Pool in December 2006 for the Meeting of Power Sector Investment Organized by AfDB and ICA (Infrastructure Consortium for Africa)

5) DRC

The Congo River with a catchments area of 3.68 million km^2 exists in DRC. Hence, a large hydropower potential can be relized along the Congo River. From the 100,000 MW and 774,000 GWh/year technically exploitable hydropower potential in DRC,, only 1.8% of these have been developed at present.

Inga 1 Hydropower （351 MW commissioned in 1972） and Inga 2 Hydropower（1,424 MW commissioned in 1982）have been rehabilitated through the financial assistance of WB. In addition, Inga 3（3,500 MW） and Grand Inga: 39,000MW (Phase 1: 8,000 MW) are planned to be developed. The power development plan of DRC and present status of each are shown in Table 3.3.5.

Table 3.3.5 Power Development Plan and Present Status of Project in DRC

	Power Facilities	Installed Capacity (MW)	Commissioning Year	Project Cost (US$ Mill.)	Present Status of Project
1)	Inga 1& 2 Hydropower Rehabilitation	600	2007	297	Implementation by World Bank
2)	Inga 3 Hydropower	3,500	2010	4,000	F/S was carried out by Consultants of France and SNEL
3)	Grand Inga Hydropower (Phase 1)	39,000 (8,000)	-	5,000	F/S was carried out by Consultants of France and Germany in 1997.

Source： 1) Water Power & Dam Construction, Yearbook in 2007

2) World Energy Council in 2007

6) Kingdom of Lesotho

The Kingdom of Lesotho consists of mountainous counties surrounded by South Africa. A hydropower of 240MW can be developed in Lesotho in addition to its existing facilities. Its power development plan and present status of each are shown in Table 3.3.6.

Table 3.3.6 Power Development Plan and Present Status of Project in Lesotho

	Power Facilities	Installed Capacity (MW)	Commissioning Year	Project Cost (US$ Mill.)	Present Status of Project
1)	Muela Phase 2 Hydropower	110	2010		Necessity of execution of detailed F/S
2)	Oxbow Hydropower	80	-	156	Completion of F/S in 1989
3)	Jordance Hydropower	36	-	143	Completion of Pre-F/S
4)	Outhing Hydropower	15	-		Completion of Pre-F/S
6)	Musanga Hydropower	230	2010		Completion of Pre-F/S
7)	Monontsa Pumped Storage Power Plant	1,000	-	650	MOU was concluded with Eskom. Pre-F/S will be commenced.

Source： 1) Brief on Monontsa Pumped Storage and Large Hydropower in Lesotho by MoNR, DoE in Feb. 2008

2) JICA Baseline Study on Electric Power Sector in Southern and Eastern Africa in March 2007

7) United Republic of Tanzania

The United Republic of Tanzania has a hydropower potential of 5,000 MW, of which 10% have been developed. Large-scale hydropower development projects exist in two river basins of the country, namely, the Rufii River and the Pangani River. In these river basins, feasibility studies have been carried out for three projects which include Rumakai (222 MW), Ruhudji (358 MW), and Mandera (20 MW) Hydropower Projects. The power development plan of Tanzania and present status of each are shown in Table 3.3.7.

Table 3.3.7 Power Development Plan and Present Status of Project in Tanzania

	Power Facilities	Installed Capacity (MW)	Commissioning Year	Project Cost (US$ Mill.)	Present Status of Project
1)	Stiegiers Gorge Hydropower	2,100		1,068	Completion of design
2)	Mpanga Hydropower	165	2015	42	Completion of Pre-F/S
3)	Ruhudji Hydropower	358	2019	384	Completion of F/S
4)	Rumakali Hydropower	222	-	351	Completion of F/S
5)	Masigira Hydropower	80	-	157	Completion of F/S
6)	Mandera Hydropower	20	-	191	Completion of F/S

Source： 1) Water Power & Dam Construction in April 2005

2) The East Africa Power Master Plan Study, Final Phase II Report

8) Republic of Malawi

In the Republic of Malawi, a theoretical hydropower potential of 700 MW is available. Out of this, 305 MW (44%) have been developed at present. Although Malawi is a member country of SAPP, transmission lines have not been connected with its neighboring countries yet. WB is determined to finance US$ 48.0 million for the 220 kV transmission line of 210 km long between Malawi and Mozambique (75 km long in Malawi and 135 km long in Mozambique). In addition, ESCOM intends to develop Phase 2 of the Kaphichira Hydropower Project for the increased power demand with an annual rate of 5%. The power development plan of Malawi and present status of each are shown in Table 3.3.8.

Table 3.3.8 Power Development Plan and Present Status of Project in Malawi

	Power Facilities	Installed Capacity (MW)	Commissioning Year	Present Status of Project
1)	Kaphichira Phase 2 Hydropower	64	2011	Waiting F/S
2)	Kholombizo Hydropower	240	2018	-
3)	Mpatamanga Hydropower	260	2020	-
4)	Fufu Hydropower	100	2012	-

Source： JICA Baseline Study on Electric Power Sector in Southern and Eastern Africa in March 2007

9) Republic of Namibia

The peak power demand in Namibia is forecasted as 670 MW in 2006 and 746 MW in 2012, considering an annual rate increase of 2.5%. A natural gas reserve exists in the southern area of Namibia, and estimated to have an available 2.2 TCF natural gas reserve. The 800MW Kudu gas thermal power plant which utilizes this gas reserve is planned to be developed to meet the mid-merit peak and peak power requirement of the power system in Namibia. On the other hand, it is seems that there is a hydropower potential of 1,000 MW in its bounding region with northern Angola. The Lower Cunene hydropower project downstream from the existing Ruacana hydropower power station is planned to be developed. The power development plan of Namibia and its present status are shown in Table 3.3.99.

Table 3.3.9 Power Development Plan and Present Status of Project in Namibia

	Power Facilities	Installed Capacity (MW)	Commissioning Year	Project Cost (US$ Mill.)	Present Status of Project
(1)	Thermal Power				
1)	Kudu gas[1) & 2)]	800	2009	1,200[3)]	PPA has been finalized. The implementation will be concluded at the end of 2007. Upgrade to 1,600MW will be carried out till 2014.
(2)	Hydropower				
1)	Epupa Hydropower[1)]	360	2015	-	-
2)	Popa Falls Hydropower [1)]	23	2015	-	-

Source： 1) JICA Baseline Study on Electric Power Sector in Southern and Eastern Africa in March 2007

2) NamPower Annual Report in 2007

3) Priority List of Power Development Plans in Each Power Pool in December 2006 for the Meeting of Power Sector Investment Organized by AfDB and ICA (Infrastructure Consortium for Africa)

10) Republic of Botswana

Mmambula coal-fired thermal power plant in Botswana is planned to be developed by utilizing the coal reserves. The existing Moruplue coal-fired thermal power plant will be extended to 532 MW. The power development plan of Botswana and present status of each are shown in Table 3.3.10.

Table 3.3.10 Power Development Plan in Botswana

	Power facilities	Installed Capacity (MW)	Commissioning Year
1)	Mmamabula coal-fired	3,600	2015
2)	Morupule coal-fired extension	532	2009/2010

Source： JICA Baseline Study on Electric Power Sector in Southern and Eastern Africa in March 2007

11) Republic of Angola

The Republic of Angola has oil and gas reserves in the country, ranking as 2nd in the countries in Sub-Sahara. There is also an economical exploitable hydropower potential of 7,400 MW in Angola, through utilization of its abundant water resources. The power development plan of Angola and present status of each are shown in Table 3.3.11.

Table 3.3.11 Power Development Plan and Present Status of Project in Angola

	Power Facilities	Installed Capacity (MW)	Commissioning Year	Project Cost (US$ Mill.)	Present Status of Project
1)	Cambambe II Hydropower	260	2011	2011	Phase 1（260MW）was completed in 2006. Phase 2 (260MW) is planned to be started in 2007.
2)	M'bridge Hydropower	6.8	-	-	F/S was completed, and detailed design is carried out.
3)	Chiumbe Hydropower	4.1	-	-	F/S was completed, and detailed design is carried out.
4)	Gove Hydropower	60	-	-	F/S was completed, and detailed design is carried out.

Source： 1) JICA Baseline Study on Electric Power Sector in Southern and Eastern Africa in March 2007

2) SAPP Regional Generation and Transmission Expansion Plan Study, Draft Final Report in November 2007

12) Kingdom of Swaziland

A rich coal reserve in the Kingdom of Swaziland exists, occupying 13% of coal in

Africa, excluding South Africa. Three coal-fired thermal power plants namely, Lubombo, Bagasse, and Mpaka are planned to be developed in Swaziland. The Maguga hydropower project of 20 MW will be completed through the cooperation between Swaziland and South Africa in 2007. The power development plan of Swaziland and present status of each are shown in Table 3.3.12.

Table 3.3.12 Power Development Plan and Present Status of Project in Swaziland

	Power Facilities	Installed Capacity (MW)	Commissioning Year	Present Status of Project
(1)	Thermal Power			
1)	Lubombo coal-fired	1,000	2010	Necessity of finalizing F/S
2)	Bagasse coal-fired	1,000	-	-
3)	Mpaka coal-fired	1,000	-	-
(2)	Hydropower			
1)	Maguga	20	2007	-

Source： JICA Baseline Study on Electric Power Sector in Southern and Eastern Africa in March 2007

13) Power Development Plan in SAPP

The power development plan of 12 countries in SAPP is summarized in Table 3.3.13, totaling 84,680MW consisting of coal-fired thermal power plants of 26,250MW (31.0%), hydropower plants of 56,100MW (66.3%), and pumped storage power plant of 2,330 (2.8%). The location of main power development plans is shown in Figure 3.3.5.

Table 3.3.13 Power Development Plans of 12 Countries in SAPP

Country	Utility	Thermal (MW)	Hydropower (MW)	Nuclear (MW)	Pumped Storage (MW)	Total (MW)	Ratio
South Africa	Eskom	13,204	0	0	1,332	14,536	17.6%
Zambia	ZESCO	0	2,240	0	0	2,240	2.7%
Mozambique	EDM	2,950	3,565	0	0	6,515	7.9%
Zimbabwe	ZESA	2,160	1,100	0	0	3,260	3.9%
DRC	SNEL	0	42,500	0	0	42,500	51.3%
Lesotho	LEC	0	471	0	1,000	1,471	1.8%
Tanzania	TANESCO	0	2,945	0	0	2,945	3.6%
Malawi	ESCOM	0	664	0	0	664	0.8%
Namibia	NamPower	800	383	0	0	1,183	1.4%
Botswana	BPC	4,132	0	0	0	4,132	5.0%
Angola	ENE	0	331	0	0	331	0.4%
Swaziland	SEB	3,000	20	0	0	3,020	3.6%
Total		26,246 31.7%	54,219 65.5%	0 0.0%	2,332 2.8%	82,797	

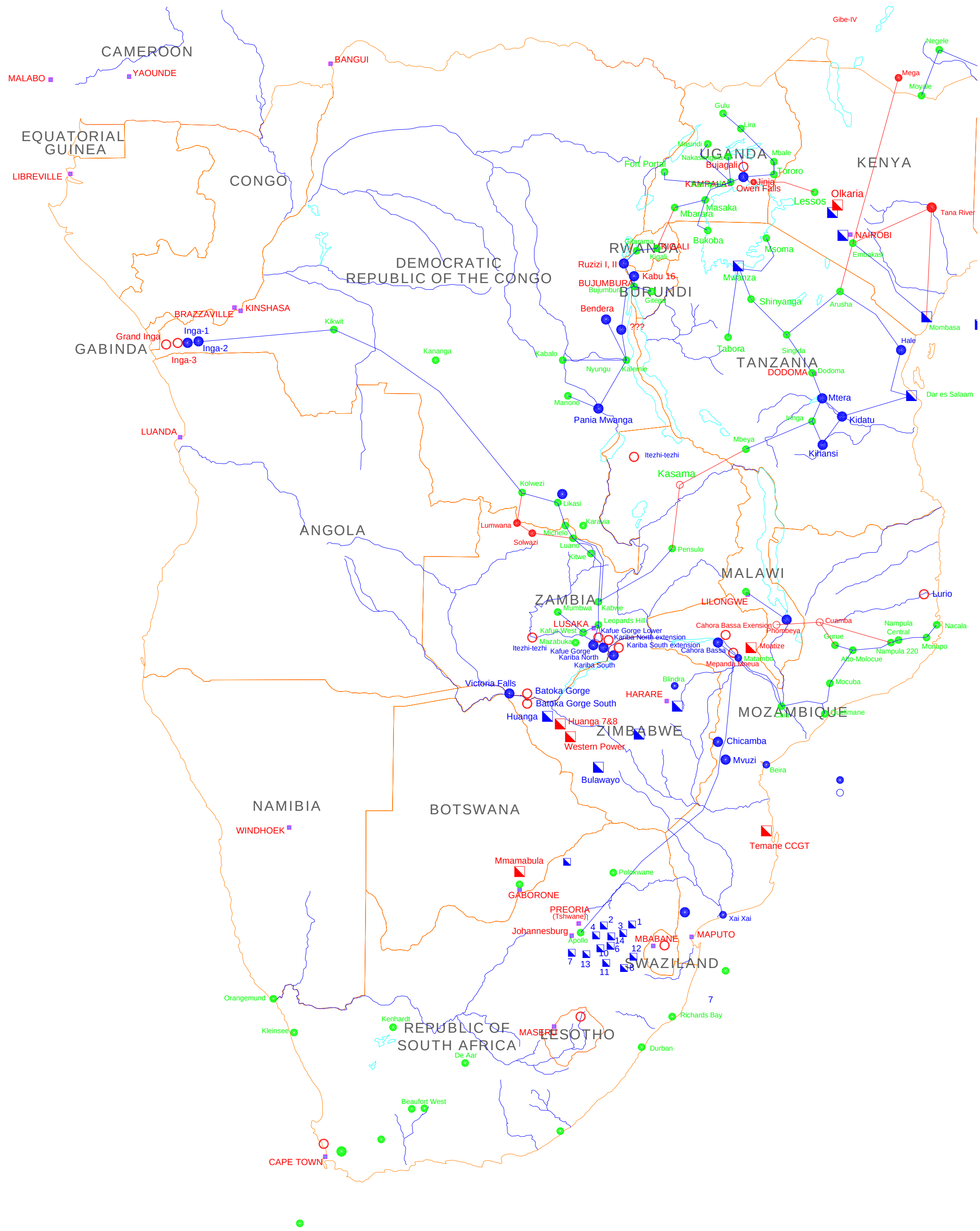


Figure 3.3.5 Power Development Plans of Countries in SAPP

(2) East African Power Pool (EAPP)

1) Overview

Two organizations with overlapping membership exist in Eastern Africa: the East African Community (EAC) consisting of five East African countries, and the Common Market for Eastern and Southern Africa (Comesa) made up of 19 countries of Eastern and Southern Africa. Both have developed and revised their own master plans in the area of electric power.

Section 4.6 presents issues and functions expected from power pools. EAC, EAPP, COMESA, and the Nile Basin Initiative (NBI; Power Trading) in East Africa have each developed or are revising their master plan in which coordination is required. Presently, the master plans to be considered as references for studying the power supply plans in Eastern Africa include the master plan for the three countries updated by the EAC in May 2007, and the one developed by EEPCO in Ethiopia, the country with abundant water resources. There are also reports that in Sudan, China is building a hydropower plant in return for the latter's petroleum resources.

It should be noted that of the River Nile, the largest river in Eastern Africa, 80 percent of the water is from Egypt's Blue Nile, while 20 percent is from Uganda's White Nile. Apart from the River Nile, some water resources that can be used as East Africa's power source are also found in Kenya and Tanzania.

In Kenya, geothermal power plants are in operation as well, i.e., Olkaria 1 and 2 of KenGen's projects, and Olkaria 3 developed by Israeli's IPP Ormat, which can operate at low temperature. There are also plans to increase the capacity. Furthermore, wind-powered generation is being developed through PPP, through the aid of Denmark, a country leading in wind-generated energy (windmills, wind power generators).

In Tanzania, coal resources are available, and natural gas found in Songo Songo is being used as fuel to generate power. In addition, a medium-sized French oil company has discovered natural gas in a location close to the largest city Dar es Salaam. Its utilization for power generation is currently being considered.

East Africa relies heavily on hydropower generation. Historically, Uganda exported excess power to Kenya. However, during the drought a few years ago, when even Kampala, its capital, experienced frequent blackouts during peak times, electricity was imported from Kenya, which also suffering from lack of electricity.

Considering the medium to long-term demands, prioritization of power supply

development for the whole region is necessary, taking into consideration issues such as the progress of Ethiopia's low cost power generation development and the stability of the Blue Nile's hydrology. Meanwhile, as discussed in 3) below, Ethiopia's hydropower seems competitive, hence, a Feasibility Study is under way connecting some of its transmission lines with its neighbors in the north, Sudan and Egypt, and in the south, Kenya and Tanzania.

Developed countries are starting to look at Ethiopia favorably. Therefore, apart from Kenya and Tanzania, cooperating with Eastern Africa with Ethiopia as leverage could be an option.

Regarding the proposed development of a master plan by the EAPP, EU has already granted aid to review the existing study. The AfDB meanwhile will give aid to the development of the master plan.

2) Power generation development projects - EAC

The EAC has recognized the projects listed on Table 3.3.14, three feasibility studies and nine implementation projects, as high priorities. Of these, only two are larger than 500 MW, requiring extensive feasibility studies. Both need to be dealt with carefully, considering previous experience such as Tanzania's Stieglers Gorge which project did not progress for a long time due to environmental issues, and Uganda's Murchison Falls Project, which affects an existing national park.

Moreover, since all implementation projects are small-scale, power interchange from countries other than the three is consequently necessary. As for Rwanda and Burundi, the new members of the EAC, the only potential power resource would likely be methane from Kivu Lake, Rwanda. However, not only is the liquefied methane in this lake water a cause for global warming, it could also be fatal (when carbon dioxide was emitted from a lake in Cameroon, many lives in the neighboring villages were lost). Moreover, although the International Finance Corporation (IFC) of the WB Group, provided aid for a pilot plan, progress was not significant (despite its long-established use as a fuel for a local beer brewery) due to incidence such as the multinational sponsors development delay leading to Rwanda government's buy out.

Table 3.3.14 East Africa Power Master Plan - Generation Capacity Additions and Upgrades in Tanzania, Uganda, & Kenya over the Period 2006-2014

Update by the Standing Committee on the Implementation of the EAPMP during its 3rd Meeting held in Arusha (Tanzania) - May 21-23, 2007

Preparation of feasibility studies (For inclusion into the EAPMP update and potential candidates for EAC Support)	
TANZANIA	Stieglers Gorge Hydro Power Project (2400 MW) in Tanzania
	Muchuchuma Coal Power Plant (400 MW in 2 phases of 200 MW each) in Tanzania
UGANDA	Murchison Falls Hydro Power Project (600 MW) in Uganda
Implementation of Generation Projects Critical for the EAPP	
TANZANIA	Fast track implementation of Gas projects in Tanzania
	・45 MW - Wartsila Gas Project (financing already secured - not candidate for EAC Support)
	・100 MW - Gas Power Plant (Purchase) (financing already secured - not candidate for EAC Support)
	・200 MW - Kinyerezi Gas Power Project (Candidate for EAC Support)
	・Monitor the implementation of the 3 gas projects in Tanzania
	Kiwira IPP Coal Power Plant (Upgrade to 200 MW) in Tanzania (financing already secured - not candidate for EAC Support)
	Ruhudji Hydro Power Plant in Tanzania (358 MW) (IPP - Candidate for EAC Support)
UGANDA	Fast track implementation of Bujagali Hydro project (250 MW) in Uganda (already covered under a WB Operation - not candidate for EAC Support)
	Namanve IPP Medium Speed Diesel Power Plant (50 MW) in Uganda (already covered under another operation - not candidate for EAC Support)
KENYA	Olkaria IV Geothermal Plant (70 MW) in Kenya (Candidate for EAC Support)
	A 3x100 MW Coal Power Plant in Kenya (1st Phase is 100 MW) (Candidate for EAC Support)
	Mombasa Gas Turbine Power Project (80 MW) in Kenya (Not candidate for EAC Support)
	Rabai IPP Medium Speed Diesel Power Plant (80 MW) in Kenya (Not candidate for EAC Support)

3) Power generation development projects - EEPCO

The following shows the power generation projects listed on EEPCO's master plan.

Table 3.3.15 Ethiopia Power Supply Development Projects

	Project	Capacity (MW)	Power Generation (GWh)	Required Funds (€m)	€¢/kWh
1	Gilgel Gibe III	1,870	6,400	1,445	2.86
2	FAN	100	212	130	5.16
3	Hallele=warabessa	422	2,233	470	2.65
4	Tekeze II	450	1,730	450	3.31
5	Gilgel Gibe IV	1,900	7,500	1,900	3.25
6	Genale III	258	1,200	235	2.64
7	Genale IV	258	1,000	296	3.82
8	Geba I&II	366	1,788	384	2.84
9	Karadobi	1,600	8,600	1,548	2.96
10	Boarder	1,200	6,000	1,118	2.63
11	Mendaya	2,000	12,100	1,920	2.23

Source： Unit Energy Cost of generation projects _ Committed & Candidates

Unlike the other East African countries, Ethiopia's water resources are quite abundant as shown in Table 3.3.15. Considering generation cost converted to US dollars (1.50 Euros per dollar as of end of February 2008), the average unit cost of the above projects is 4.7 cents (US), while the average plant load factor (PLF, the utilization of plants) is 53 percent. In the past few years, in addition to the surge in plant costs globally, cement cost in Ethiopia is said to have jumped up a few. Considering the above figures are denoted to have been revised as of last year, the per-unit cost of less than five cents at present seems quite competitive.

Looking at the individual projects, Gilgel Gibe III project is currently short of funds. This project was based on the study and proposal from Italy's Sallini, who was awarded by the Ethiopian government with a contract for the construction of Gilgel Gibe II. However, since the selection process was not in accordance with international financial institution's procedure, it was unable to secure funds from its donors. Currently, electrical and machinery facilities are being considered for tendering, while separately obtaining financing from institutions such as the AfDB, European Investment Bank (EIB) and the WB.

In addition, Sallini is conducting the Feasibility Study of Gilgel Gibe IV at their own expense. However, to avoid a similar incident, i.e. being unable to obtain funding from international financial institutions for a negotiated contract, EEPCO is considering selecting a construction company or (in case of an IPP) contractor based on Sallini's FS report.

3.3.2 Progress of Power Generation Development Projects and Priorities

(1) SAPP

The present status of progress of power development plans and priority in the SAPP are summarized in Table 3.3.16.

Table 3.3.16 Present Status of Progress and Priority for Power Development Plan in SAPP

Power Facilities	Installed Capacity (MW)	Status of Progress	Priority in Each Country
1. South Africa			
Ankerlig Gas Thermal	1,329	Plan of commissioning in 2007/09	1
Gourikwa Gas Thermal	735	Plan of commissioning in 2007/09	1
Brovo Coal-fired	3,212	Plan of commissioning in 2013	2
Ingula Pumped storage	1,332	Plan of commissioning in 2013	2
Medupi Coal-fired	4,788	Plan of commissioning in 2015	3
2. Zambia			
Itezhi-Teshi Hydropower	120	Plan of implementation by ZESCO -Tata in India	1
Kariba North Hydropower Extension	360	Plan of implementation by ZESCO -Tata in India	2
Kafue Gorge Lower Hydropower	750	Plan of implementation by ZESCO-Shinhydro in China	2
Batoka Gorge North Bank Hydropower	800	Finishing Pre-F/S, and necessity of execution of F/S	3
3. Mozambique			
Temane CCGT	1,000	Co-development by EdM and private	1
Moatize Coal-fired	1,500	Co-development by EdM and French company	2
Mepanda Uncua Hydropower	1,300	Co-development by Brazirian company – Local company – EdM	2
Cahora Bassa North Bank Hydropower Extension	1,245	Necessity of execution of Upgrading F/S and design	3
4. Zimbabwe			
Kariba South Hydropower Extension	300	Finished the review on design and F/S of transmission line	1
Batoka Gorge South Hydropower	800	Finished Pre-F/S and necessity of execution for F/S	2
5. DRC			
Inga 3 Hydropower	3,500	Finished F/S	1
Grand Inga Hydropower	39,000	Finished F/S in 1997	2

6. Lesotho			
Muela Phase 2 Hydropower	110	Waiting implementation of detailed F/S	1
Monontsa Pumped Storage	1,000	Concluded MOU with Esko and waiting implementation of Pre-F/S	2
Musanga Hydropower	230	Finished Pre-F/S	3
7. Tanzania			
Mpanga Hydropower	165	Finished Pre-F/S	1
Ruhudji Hydropower	358	Finished F/S	2
Stiegiers Gorge Hydropower	2,100	Finished design	3
8. Malawi			
Kaphichira Phase-2 Hydropower	64	Waiting implementation of F/S	1
Fufu Hydropower	100		2
Kholombizo Hydropower	240		3
Mpatamanga Hydropower	260		3
9. Namibia			
Kudu Gas Thermal	800	Plan of conclusion of PPA at the end of 2007	1
Epupa Hydropower	360		2
Popa Falls Hydropower	23		3
10. Boswana			
Morupule Coal-fired Thermal Extension	532		1
Mmamabula Coal-fired	3,600		2
11. Angola			
Cambambe II Hydropower	260	Plan of commissioning in Phase 2 in 2007	1
M'bridge/Chiumbe/Gove Hydropower	6.8/4.1/60	Finished F/S and implementing detailed design	2
12. Swaziland			
Lubombo Coal-fired	1,000	Plan of finalization for Feasibility Study	1

The effective power exchange can be realized by utilizing coal reserves in the southern area, hydropower potentials in the northern area, and gas reserves in the eastern area of Southern Africa. Priority projects from among the power development plans in SAPP are listed as follows, with due consideration to effective power exchange:

a) The developing progress of planned coal-fired thermal projects of Brovo and Medupi, gas thermal projects of Ankerlig and Gourikwa, and pumped storage project of Inpula is expedited for early input of these projects as countermeasures against power shortage in South Africa.

b) The early implementation of hydropower projects along the Zambezi River (Itezhi-Teshi Hydropower of 120 MW, Kariba North Hydropower Extension of 360 MW, Kafue Goerge Lower Hydropower of 900 MW) are needed to supply electric power to industrial and domestic areas in Zambia.

c) The Temane gas thermal power plant of 1,000 MW and Mepanda Nkuwa hydropower project of 1,300 MW in Mozambique need to be constructed early, through IPP.

d) The early implementation of the upgrading FS on the 1,245MW CBN is vital to the extension of the existing hydropower station. This is realized since CBN can supply electric power with less environmental impacts to Mozambique and South Africa, .

e) The development of Inga 3 (3,500 MW) and Grand Inga (39,000 MW) Hydropower Projects in the Congo River is expedited to supply electric power to South Africa, Zambia, and Zimbabwe.

f) The FS for pumped storage power plant in Lesotho (Monotsa pumped storage plant) needs to be carried out in order to supply the peak power demands in South Africa.

3.4 Transmission Grid Development Plan

3.4.1 Current status of proceeding power transmission network planning and its order of priority

This chapter describes the power transmission network plans of southern African regions with injecting the field information investigated and referring to "SAPP Project Document (Sep. 2007, Cooperation between SAPP and Norway and Sweden)" focusing on the projects prioritized by SAPP.

SAPP is giving priorities to the projects regarding interregional connections shown in the followings in order to establish the competitive electricity market in southern African countries.

1) Projects regarding the power transmission from the regions of power sources to the regions with insufficient power generation by connecting the SAPP member countries that are not connected each other.

a) Mozambique – Malawi interregional connection

b) Zambia- Tanzania- Kenya interregional connection

c) West Corridor in the western region of southern Africa DR Congo – Angola –Namibia – Botswana – South Africa interregional connection

2) Reinforcement of the existing interregional connections with insufficient capacity

a) DR Congo – Zambia interregional connection

This chapter describes the power transmission network plans of southern African regions. This is based on investigated field information and the SAPP Project Document (Sep. 2007, Cooperation between SAPP and Norway and Sweden), focusing on the projects prioritized by SAPP.

SAPP is giving priorities to the projects concerning interregional connections shown in the following, in order to establish a competitive electricity market in the southern African countries.

1) Projects involving connection of power transmission from regions with power sources to regions with insufficient power generation, specifically member countries that have not been linked together, through SAPP.

a) Mozambique – Malawi interregional connection

b) Zambia- Tanzania- Kenya interregional connection
c) West Corridor in the western region of southern Africa DR Congo – Angola –Namibia – Botswana – South Africa interregional connection

2) Reinforcement of the existing interregional connections with insufficient capacity
a) DRC – Zambia interregional connection
b) The transmission line to South Africa through DRC and Zambia

(1) DRC-Zambia interregional connection

From its Inga hydropower station, DRC exports power to Zambia through a 500 kV DC transmission line. Figure 3.4.3 shows the location of this interregional connection.

The existing 220 kV interregional connections is insufficient. Increasing it by twice as much will boost the transmission capacity from 260 MW to 500 MW. Its cost will be around 94 million USD. This project will be connected to the transmission line owned by CEC[21], who will provide the funding to Zambia. Meanwhile, WB is now supporting SENEL of DRC.

Furthermore, a 330 kV transmission line project from DRC to Zambia is on-going. The construction in Zambia section is almost completed with 50 km remaining. A copper mine operated by an Australian company exists in Lumwana around the national border. Hence, the transmission line from Kansashi substation to Lumwana has been constructed first to supply the required power around from 55 MW to 105 MW. On the other hand, the construction of the transmission line in the DRC section has not yet started in spite of the fact that WB have already raised the funding including its FS. Once completed, the power from Inga 1 & II will be transmitted efficiently.

(2) Mozambique – Malawi interregional connection

Presently, there is no power link from Malawi to Mozambique, through SAPP. Once the power sources development is initiated in Malawi, the power transmission connecting to SAPP is expected. Figure 3.4.4 shows the location of the interregional connection. The required voltage is 220 kV and the corresponding cost is 84 million USD. The capacity of 300 MW will be transmitted within a distance of 210 km (75 km in Malawi and 135 km in Mozambique) The detailed design of the first phase will be completed. The determined amount of US$ 48 million will be financed by WB.

[21] CEC: Copper belt Energy Corporation: A private company that has small thermal power plants (gas), 220 kV and 60 kV and power distribution system

(3) Tanzania-Mozambique

A new project involving connection of the domestic power system of Mozambique to Tanzania is proposed. This takes place once Mozambique domestic power system expands to the northern region. Details of the project are still unknown.

(4) Western Corridor Project in the southern Africa

A 400 kV transmission line project intended to connect Inga hydropower plant in DRC to South Africa, through Angola and Namibia, is proposed. The cost including the hydropower development is expected to be around 8 billion USD. The project office was already established in May 2006 but the financing source has not been determined yet. China and India have expressed their interest on the project. According to Eskom, there is a possibility that the project will be eventually proposed considering a higher voltage of 765 kV, based on the master plan currently being carried out by SAPP.

(5) Zambia- Tanzania-Kenya interregional connection

This interregional connection is a transmission line system that will link EAPP with SAPP. This will be executed by connecting Tanzania to SAPP, utilizing the hydropower projects in SAPP and expanding the system to Kenya. The installation of 330kV substation in the northern part of Zambia can also contribute to its rural electrification. Figure 3.4.3 shows the location of the proposed interregional connection.

Required financing is under negotiation. The related FS has been completed by OPPPI of Zambia, except for the environmental assessment for the reinforcement of the transmission lines in Tanzania. Nevertheless, it has not reached the stage for determining the required funding. According to the FS report, the project is divided into two stages. Cost for each stage is shown in Table 3.4.1.

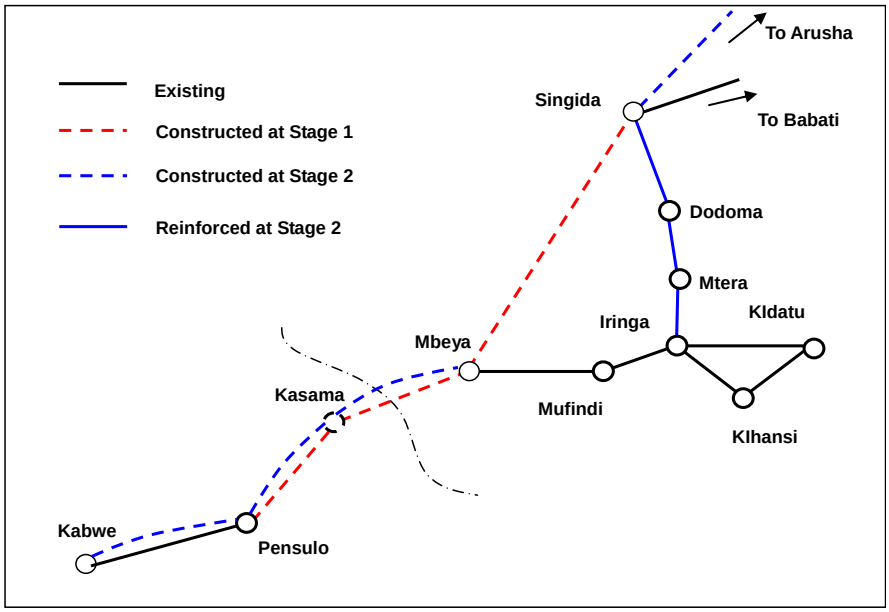
The FS report also presented levels and stages, as shown in Figure 3.4.1.

Table 3.4.1 Zambia-Tanzania Interregional Connection Project

Countries	Stage 1 (2006 in 2004FS) （Million USD）	Stage2 (2012 in 2004FS) (Million USD)
Zambia	150.8	127.4
Tanzania	154.34	156.43
計	255.14	283.83

Source: Zambia-Tanzania-Kenya Interconnection and Reinforcement of the Tanzania Transmission System, Phase 1, Main Report, Feb 2004

The FS report also presented levels and stages, as shown in Figure 3.4.1.



Source: Zambia-Tanzania-Kenya Interconnection and Reinforcement of the Tanzania Transmission System, Phase 1, Main Report, Feb 2004

Figure 3.4.1 Outline of the project of Zambia-Tanzania interregional Connection

The governments of Zambia, Tanzania and Kenya have agreed on the preparatory works and implementation schedule for the project. AfDB and DBSA have granted 0.5 million USD and 0.3 million USD respectively, for the preparatory works based on financial, technical, and legal aspects.

The concerned three governments intend to promote the project by signing the Heads of Agreement in October 2007 in order to establish their invested project enterprise. Draft power purchase agreement is now being studied.

(5) Zambia-Namibia interregional connection

This involves a transmission line connecting Livingstone in Zambia to Katim-Mullio in Namibia and to the central part of Namibia. Figure 3.4.3 shows the location of the interregional connection. The interconnection between Livingstone to Katim-Mullio has already been completed. The interval between Katima-Mullio and the central part of Nambia is currently on-going.

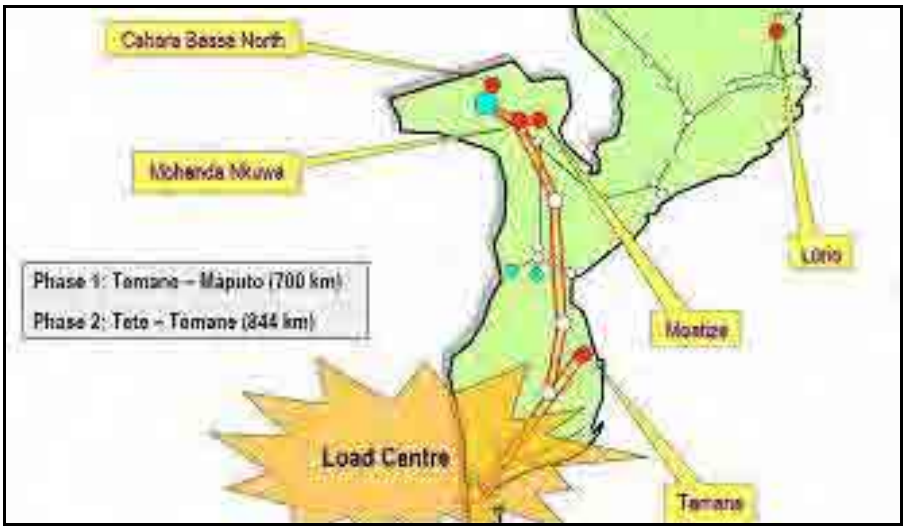
(6) North to south Mozambique Domestic Power Transmission Lines (Back Bone Transmission Line)

This transmission line from Sango substation to Maputo in Mozambique will be vital for the future corridor of power trade within the SAPP region. Its purpose is to transmit the power

from Mphanda Nkuwa hydropower station and Temane thermal power station to Maputo and South Africa. According to the SAPP master plan, there is a possibility that this transmission line will be reinforced in order to serve as a power transmission from Malawi to South Africa. Figure 3.4.4 shows the location of this interconnection.

This transmission line is included in the project of Mphanda Nkuwa hydropower station with remaining issues to be studied such as the capacity needed to be installed for future requirements and how the funding sources will be composed. The least cost study is now being carried out with EdM designated as the counterpart. This is executed through WB and scheduled to be completed by May 2008. Subsequently, the commercial structure study will be implemented with EdM designated as the counterpart, under the same funding.

Figure 3.4.2 shows the plan of the transmission line from around Mpanda Nkuwa to Maputo. This material was extracted from a meeting presentation related to large-scale project in Maputo, dated 8th February, 2008.



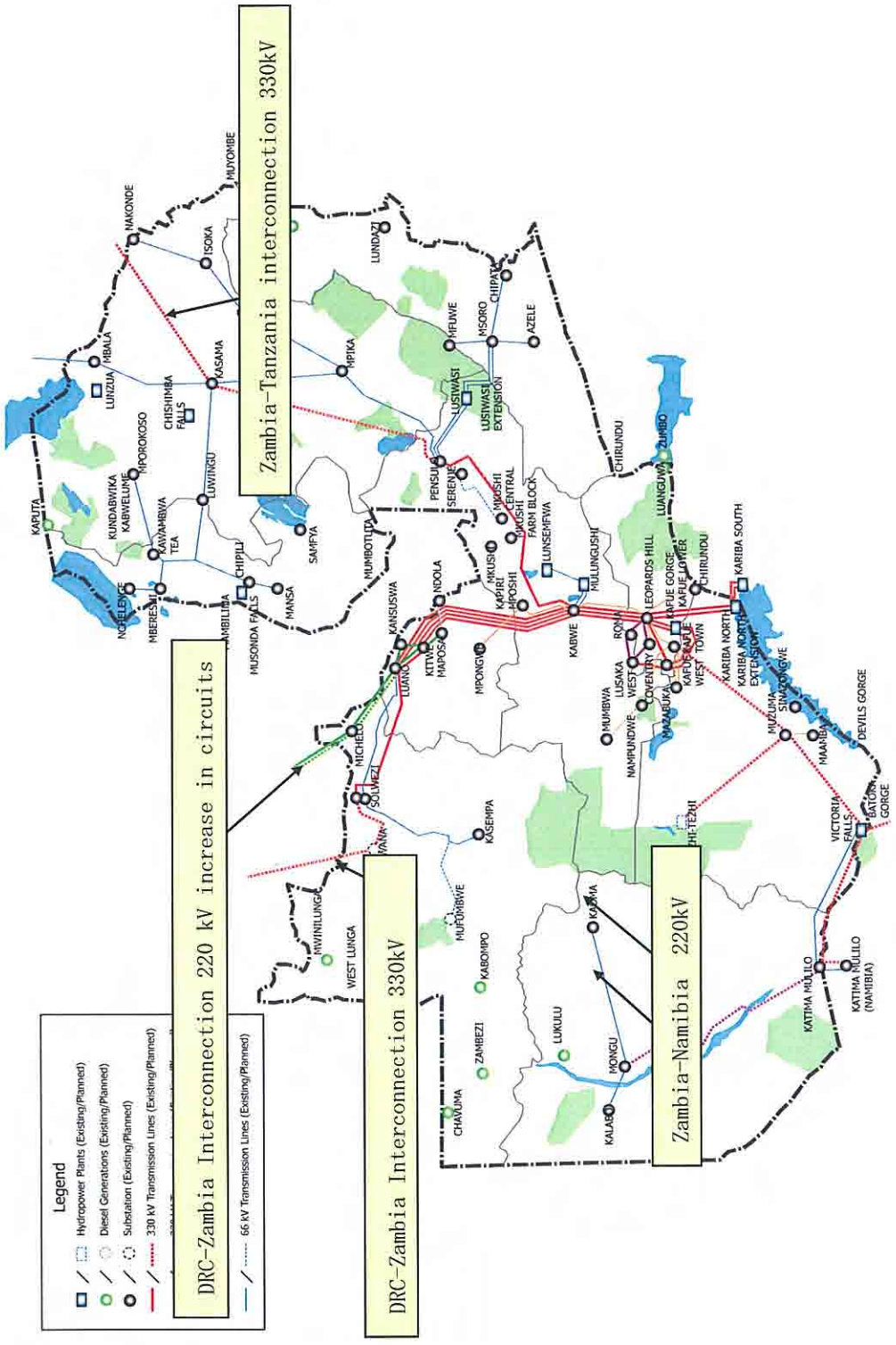
Source: Large Project Finance Workshop in Maputo, Feb 2008, EdM Presentation

Figure 3.4.2The Transmission Line Project of Mphanda Nkuwa Hydropower Station – Temane Thermal Power Station-Mapto

Table 3.4.2 summarizes the main power network plans in the Southern African region.

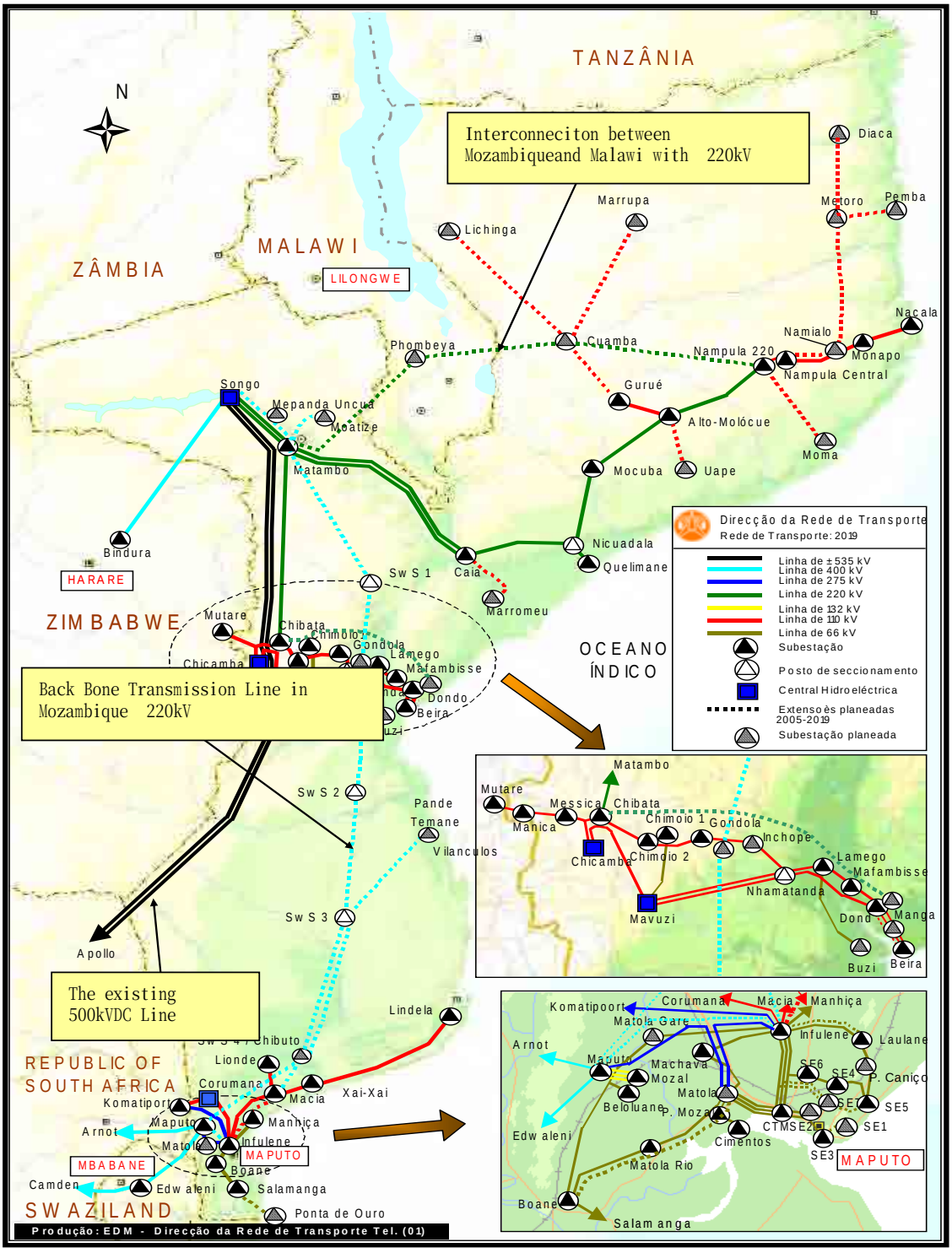
Table 3.4.2 Main Power Network Plans in South African region

Interval	Scale	Capacity	Cost	Progress/Funding	Commissioning
DRC-Zamnia interconnection (220kV 2circuits)	Adding a single circuit of 220kV	500 MW	94million USD		Around 2010
DRC-Zamnia interconnection (330kV 2circuits)	Construction of 330kV T/L			Construction work in Zambua side completed remaining 50 km Construction in DRC has not yet been started	
Mozambique-Malawi interconnection	A single circuit of 220kV with 210km (Malawi 75 km, Mozambique 135km）	300 MW	84million USD	Phase1 is funded by the WB The WB decided to provide the finance of US$48 million in 2007.	Phase1 in 2009
Tanzania-Mozambiq ue interconnection	A single circuit of 220 kV			Not ye decided	Not yet decided
Western Corridor Project	400kV or 765kV	Not yet decided	Around 8 billion including the cost of hydropow er station.	China and India has expressed the interest. 765 kV possibly proposed in the review of SAPP Power Pool Master Plan	Not yet decided
Zambia-Kenya-Tanza nia Interconnection	330kV a single circuit at Stage1 Adding another circuit at Stage2	400 MW		FS is completed in 2004 (Possibly required to be updated) Not ye decided AfDB has provided grant to the preparatory works.	2011 年
Zambia – Namibia Inter-connection	A single circuit with 220kV			Interval from Livingstone in Zambia to Katim-Mullio in Namibia already completed	Under construction
Back-bone transmission line in Mozambique	Double circuits with 440kV (Details are under investigation)			The least cost study by the WB was completed in May After that, commercial structure study is expected implemented. This project may be included in Mphanda Nkuwa hydropower project.	Around 2015



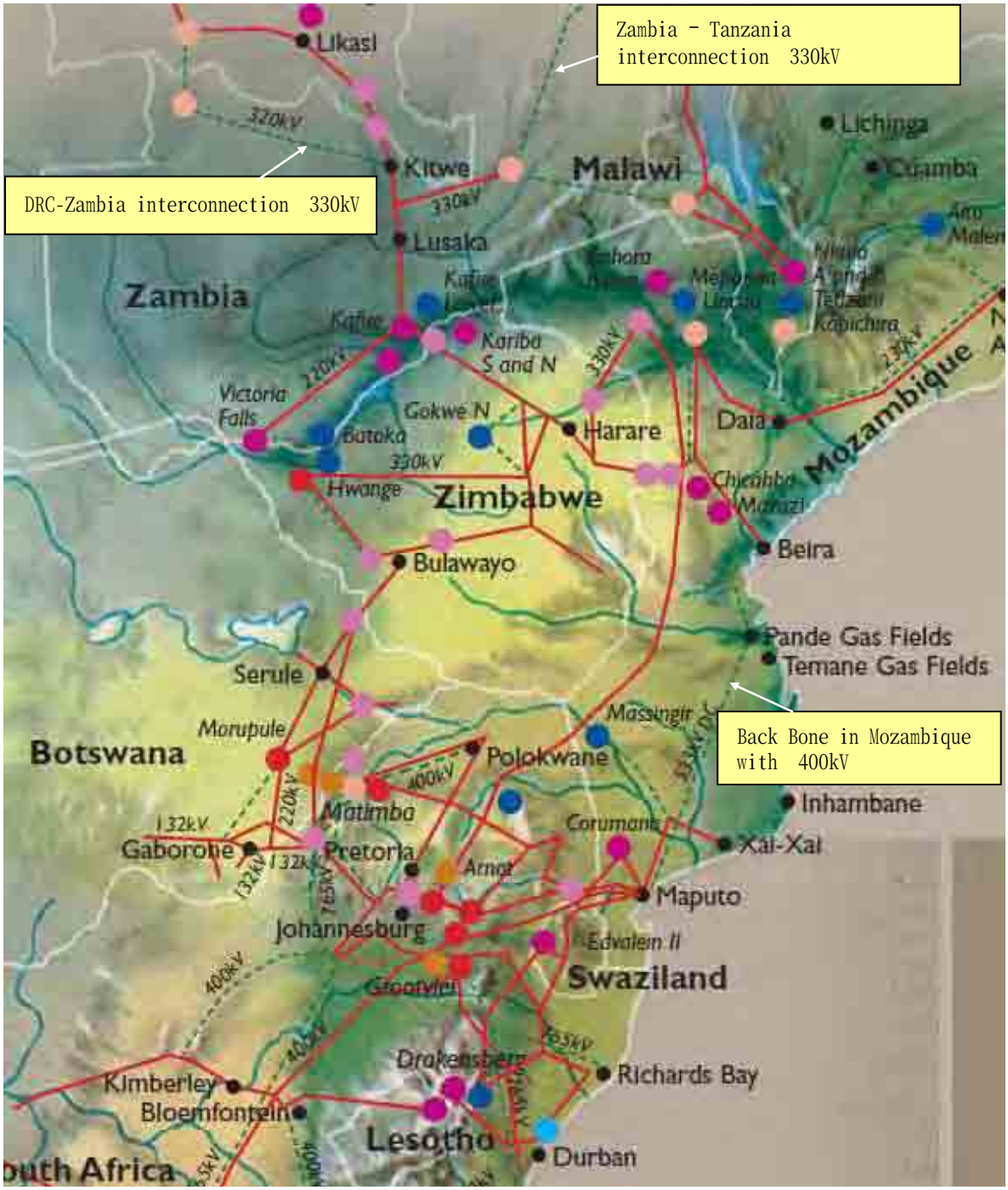
Source: JICA Zambia Office

Figure 3.4.3 Power System in Zambia and Plans of Interregional Correction in Southern African Region



Source: EdM

Figure 3.4.4 Power System in Mozambique and Plans of Interregional Connection in Southern African Region



Source: EdM

Figure 3.4.5 Power System in Mozambique and Plans of Interregional Connection in Southern African Region

3.5 Primary Energy Balance and Fuel Supply

3.5.1 Overview of Primary Energy Import, Domestic Procurement, and Export

(1) SAPP member countries

The data on primary energy import, domestic procurement and export were available for the following nine SAPP member countries: i) Angola, ii) Botswana, iii) Mozambique, iv) Namibia, v) South Africa, vi) Tanzania, vii) DRC, viii) Zambia and ix) Zimbabwe.

1) Angola

Angola produces seven times the energy consumed (9.9 M TOE), in terms of primary energy (as of 2005) of which more than 90 percent is crude oil. Based on the 2005 data, 59.9 M TOE was exported, and the share of crude oil within the domestic primary energy (2.2 M TOE) was 22.4%. Moreover, 63.8 percent of its primary energy is renewable energy. This has decreased somewhat in the past three years, which was offset by imported refined oil.

Table 3.5.1 Angola's Primary Energy Import, Domestic Procurement and Export Trend (1,000 TOE)

		Coal	Crude Oil	Refined Oil	Natural Gas	Nuclear Power	Hydro-Power	Geothermal Solar	Renewable	Electricity	Total	
2003	Domestic Production		43,988		531		107		5,961		50,586	554.7%
	Imports			966							966	10.6%
	Exports		-41,614	-596							-42,210	-462.8%
	International Marine Bunkers										0	0.0%
	Stock Change		-222								-222	-2.4%
	Total	0	2,152	370	531	0	107	0	5,961	0	9,120	100.0%
		0.0%	23.6%	4.1%	5.8%	0.0%	1.2%	0.0%	65.4%	0.0%	100.0%	
2004	Domestic Production		50,481		612		128		6,136		57,358	607.3%
	Imports			992							992	10.5%
	Exports		-47,577	-532							-48,108	-509.3%
	International Marine Bunkers										0	0.0%
	Stock Change		-796								-796	-8.4%
	Total	0	2,108	460	612	0	128	0	6,136	0	9,445	100.0%
		0.0%	22.3%	4.9%	6.5%	0.0%	1.4%	0.0%	65.0%	0.0%	100.0%	
2005	Domestic Production		63,623		612		150		6,315		70,700	714.3%
	Imports			1,119							1,119	11.3%
	Exports		-59,940	-516							-60,456	-610.8%
	International Marine Bunkers			-1							-1	0.0%
	Stock Change		-1,464								-1,464	-14.8%
	Total	0	2,219	602	612	0	150	0	6,315	0	9,898	100.0%
		0.0%	22.4%	6.1%	6.2%	0.0%	1.5%	0.0%	63.8%	0.0%	100.0%	

Source: IEA, 2006 and 2007, Energy Balances of Non-OECD Countries.

2) Botswana

In Botswana, domestically-produced coal accounts for 31.5 percent of its primary energy (2005). The dependence on coal has slightly increased in the last three years, in terms of ratio. Other sources of primary energy include imported refined oil and renewable energy, which are both decreasing and are offset by electricity imports.

Table 3.5.2 Botswana's Primary Energy Import, Domestic Procurement and Export Trend (1,000 TOE)

		Coal	Crude Oil	Refined Oil	Natural Gas	Nuclear Power	Hydro-Power	Geothermal Solar	Renewable	Electricity	Total	
2003	Domestic Production	507						1	521		1,029	55.3%
	Imports	16		709						106	831	44.7%
	Exports										0	0.0%
	International Marine Bunkers										0	0.0%
	Stock Change										0	0.0%
	Total	523	0	709	0	0	0	1	521	106	1,860	100.0%
		28.1%	0.0%	38.1%	0.0%	0.0%	0.0%	0.1%	28.0%	5.7%	100.0%	
2004	Domestic Production	552							456		1,008	55.4%
	Imports	1		671						139	812	44.6%
	Exports										0	0.0%
	International Marine Bunkers										0	0.0%
	Stock Change										0	0.0%
	Total	553	0	671	0	0	0	0	456	139	1,819	100.0%
		30.4%	0.0%	36.9%	0.0%	0.0%	0.0%	0.0%	25.1%	7.6%	100.0%	
2005	Domestic Production	595							456		1,051	55.5%
	Imports	1		692						151	844	44.5%
	Exports										0	0.0%
	International Marine Bunkers										0	0.0%
	Stock Change										0	0.0%
	Total	596	0	692	0	0	0	0	456	151	1,895	100.0%
		31.5%	0.0%	36.5%	0.0%	0.0%	0.0%	0.0%	24.1%	8.0%	100.0%	

Source: IEA, 2006 and 2007, Energy Balances of Non-OECD Countries

3) Mozambique

An analysis of Mozambique's past three years' import, domestic procurement and export trend shows that in general, approximately 85 percent of its primary energy is dependent on renewable energy. Furthermore, it reveals that its electricity exports and imports are slightly increasing. Its domestic hydropower production is usually around 10 percent.

Table 3.5.3 Mozambique's Primary Energy Import, Domestic Procurement and Export Trend (1,000 TOE)

		Coal	Crude Oil	Refined Oil	Natural Gas	Nuclear Power	Hydro-Power	Geothermal Solar	Renewable	Electricity	Total	
2003	Domestic Production	22			2		888		7,070		7,982	96.1%
	Imports			665						466	1,131	13.6%
	Exports	-9								-724	-733	-8.8%
	International Marine Bunkers			-46							-46	-0.6%
	Stock Change			-31							-31	-0.4%
	Total	13	0	589	2	0	888	0	7,070	-258	8,303	100.0%
		0.2%	0.0%	7.1%	0.0%	0.0%	10.7%	0.0%	85.1%	-3.1%	100.0%	
2004	Domestic Production	10			1,124		1,003		8,551		10,689	105.9%
	Imports			658						797	1,455	14.4%
	Exports	-10			-1,122					-895	-2,026	-20.1%
	International Marine Bunkers			-43							-43	-0.4%
	Stock Change			22							22	0.2%
	Total	0	0	636	3	0	1,003	0	8,551	-98	10,096	100.0%
		0.0%	0.0%	6.3%	0.0%	0.0%	9.9%	0.0%	84.7%	-1.0%	100.0%	
2005	Domestic Production	13			1,867		1,141		8,721		11,742	115.0%
	Imports			543						825	1,367	13.4%
	Exports	-13			-1,849					-1,032	-2,894	-28.4%
	International Marine Bunkers			-3							-3	0.0%
	Stock Change			-5							-5	0.0%
	Total	0	0	535	18	0	1,141	0	8,721	-208	10,207	100.0%
		0.0%	0.0%	5.2%	0.2%	0.0%	11.2%	0.0%	85.4%	-2.0%	100.0%	

Source: IEA, 2006 and 2007, Energy Balances of Non-OECD Countries

4) Namibia

Namibia is dependent on refined oil import for its primary energy, which, based on the past three years, accounts for around two thirds. While domestic hydropower production and imported electricity shares are decreasing slightly, the share of renewable energy seemed increasing.

Table 3.5.4 Namibia's Primary Energy Import, Domestic Procurement and Export Trend (1,000 TOE)

		Coal	Crude Oil	Refined Oil	Natural Gas	Nuclear Power	Hydro-Power	Geothermal Solar	Renewable	Electricity	Total	
2003	Domestic Production						130		181		312	24.5%
	Imports	2		841						123	966	76.0%
	Exports									-6	-6	-0.5%
	International Marine Bunkers										0	0.0%
	Stock Change										0	0.0%
	Total	2	0	841	0	0	130	0	181	117	1,271	100.0%
		0.2%	0.0%	66.2%	0.0%	0.0%	10.2%	0.0%	14.2%	9.2%	100.0%	
2004	Domestic Production						138		184		321	24.0%
	Imports	2		890						130	1,022	76.4%
	Exports									-6	-6	-0.4%
	International Marine Bunkers										0	0.0%
	Stock Change										0	0.0%
	Total	2	0	890	0	0	138	0	184	124	1,337	100.0%
		0.1%	0.0%	66.6%	0.0%	0.0%	10.3%	0.0%	13.8%	9.3%	100.0%	
2005	Domestic Production						143		186		328	23.8%
	Imports	2		920						135	1,057	76.6%
	Exports									-7	-7	-0.5%
	International Marine Bunkers										0	0.0%
	Stock Change										0	0.0%
	Total	2	0	920	0	0	143	0	186	128	1,379	100.0%
		0.1%	0.0%	66.7%	0.0%	0.0%	10.4%	0.0%	13.5%	9.3%	100.0%	

Source: IEA, 2006 and 2007, Energy Balances of Non-OECD Countries

5) Republic of South Africa

In the Republic of South Africa, although more than 45 million TOE of its abundant coal is exported (based on the past three years' data), coal still accounts for more than 70 percent of its primary energy. Furthermore, imported and domestically-produced crude oil constitutes 17.4 percent of its primary energy. At the same time, 6.1 M TOE of refined oil was exported in 2005. Moreover, while a part of renewable energy is exported, it also produces about 10 percent of primary energy. Volume of electricity is exported is more than the volumes imported. About 2.9 M TOE of energy is nuclear power (as of 2005).

Table 3.5.5 South Africa's Primary Energy Import, Domestic Procurement and Export Trend (1,000 TOE)

		Coal	Crude Oil	Refined Oil	Natural Gas	Nuclear Power	Hydro-Power	Geothermal Solar	Renewable	Electricity	Total	
2003	Domestic Production	134,773	116		1,079	3,300	151	92	13,407		152,920	125.5%
	Imports	1,174	24,409	794						705	27,082	22.2%
	Exports	-47,867		-5,096					-248	-883	-54,094	-44.4%
	International Marine Bunkers			-2,622							-2,622	-2.2%
	Stock Change	-1,441									-1,441	-1.2%
	Total	86,639	24,525	-6,924	1,079	3,300	151	92	13,160	-178	121,844	100.0%
		71.1%	20.1%	-5.7%	0.9%	2.7%	0.1%	0.1%	10.8%	-0.1%	100.0%	
2004	Domestic Production	137,074	1,621		1,658	3,483	217	92	13,314		157,460	121.8%
	Imports	1,244	18,402	1,724	1,122					844	23,336	18.0%
	Exports	-45,494	-1	-3,786					-246	-1,140	-50,668	-39.2%
	International Marine Bunkers			-2,410							-2,410	-1.9%
	Stock Change	1,573									1,573	1.2%
	Total	94,397	20,022	-4,472	2,780	3,483	217	92	13,068	-295	129,291	100.0%
		73.0%	15.5%	-3.5%	2.2%	2.7%	0.2%	0.1%	10.1%	-0.2%	100.0%	
2005	Domestic Production	138,364	1,500		1,783	2,943	189	92	13,717		158,590	124.3%
	Imports	1,376	20,685	2,176	1,849					953	27,039	21.2%
	Exports	-47,804	-5	-6,106					-254	-1,154	-55,323	-43.3%
	International Marine Bunkers			-2,668							-2,668	-2.1%
	Stock Change										0	0.0%
	Total	91,936	22,180	-6,599	3,632	2,943	189	92	13,464	-201	127,637	100.0%
		72.0%	17.4%	-5.2%	2.8%	2.3%	0.1%	0.1%	10.5%	-0.2%	100.0%	

Source: IEA, 2006 and 2007, Energy Balances of Non-OECD Countries

6) Tanzania

More than 90 percent of Tanzania's primary energy is domestically-produced renewable energy. The rest is primarily imported refined oil.

Table 3.5.6 Tanzania's Primary Energy Import, Domestic Procurement and Export Trend (1,000 TOE)

		Coal	Crude Oil	Refined Oil	Natural Gas	Nuclear Power	Hydro-Power	Geothermal Solar	Renewable	Electricity	Total	
2003	Domestic Production	34					219		15,774		16,027	93.4%
	Imports			1,149						8	1,157	6.7%
	Exports										0	0.0%
	International Marine Bunkers			-22							-22	-0.1%
	Stock Change										0	0.0%
	Total	34	0	1,127	0	0	219	0	15,774	8	17,162	100.0%
		0.2%	0.0%	6.6%	0.0%	0.0%	1.3%	0.0%	91.9%	0.0%	100.0%	
2004	Domestic Production	40			107		203		17,181		17,530	93.5%
	Imports			1,231						10	1,241	6.6%
	Exports										0	0.0%
	International Marine Bunkers			-22							-22	-0.1%
	Stock Change										0	0.0%
	Total	40	0	1,209	107	0	203	0	17,181	10	18,749	100.0%
		0.2%	0.0%	6.4%	0.6%	0.0%	1.1%	0.0%	91.6%	0.1%	100.0%	
2005	Domestic Production	46			114		153		18,786		19,099	93.6%
	Imports			1,315						12	1,327	6.5%
	Exports										0	0.0%
	International Marine Bunkers			-22							-22	-0.1%
	Stock Change										0	0.0%
	Total	46	0	1,293	114	0	153	0	18,786	12	20,404	100.0%
		0.2%	0.0%	6.3%	0.6%	0.0%	0.7%	0.0%	92.1%	0.1%	100.0%	

Source: IEA, 2006 and 2007, Energy Balances of Non-OECD Countries

7) DRC

In DRC, 92.5 percent of primary energy is dependent on renewable energy as of 2005 similar to the situation in 2003 and 2004. On the other hand, 100 percent of domestically-produced crude oil is exported. Apart from this, hydropower contributes to more than three percent of the primary energy, and along with a small-scale production of coal, DRC produces more than the domestic primary energy consumption.

Table 3.5.7 DRC's Primary Energy Import, Domestic Procurement and Export Trend
(1,000 TOE)

		Coal	Crude Oil	Refined Oil	Natural Gas	Nuclear Power	Hydro-Power	Geothermal Solar	Renewable	Electricity	Total	
2003	Domestic Production	63	1,091				553		14,856		16,563	103.1%
	Imports	163		552						1	715	4.5%
	Exports		-1,091	-5						-118	-1,213	-7.6%
	International Marine Bunkers			-2							-2	0.0%
	Stock Change										0	0.0%
	Total	226	0	545	0	0	553	0	14,856	-117	16,063	100.0%
		1.4%	0.0%	3.4%	0.0%	0.0%	3.4%	0.0%	92.5%	-0.7%	100.0%	
2004	Domestic Production	64	1,040				587		15,229		16,921	102.7%
	Imports	173		555						1	718	4.4%
	Exports		-1,040	-5						-125	-1,170	-7.1%
	International Marine Bunkers			-2							-2	0.0%
	Stock Change										0	0.0%
	Total	237	0	548	0	0	587	0	15,229	-125	16,477	100.0%
		1.4%	0.0%	3.3%	0.0%	0.0%	3.6%	0.0%	92.4%	-0.8%	100.0%	
2005	Domestic Production	72	991				636		15,691		17,391	102.5%
	Imports	178		551						1	729	4.3%
	Exports		-991	-5						-155	-1,150	-6.8%
	International Marine Bunkers			-2							-2	0.0%
	Stock Change										0	0.0%
	Total	250	0	544	0	0	636	0	15,691	-154	16,967	100.0%
		1.5%	0.0%	3.2%	0.0%	0.0%	3.7%	0.0%	92.5%	-0.9%	100.0%	

Source: IEA, 2006 and 2007, Energy Balances of Non-OECD Countries

8) Zambia

For the past three years, Zambia has relied approximately 80 percent of its primary energy on renewable energy. Moreover, domestically-produced hydropower accounts for about 10 percent, while crude oil import covers the remainder of primary energy.

Table 3.5.8 Zambia's Primary Energy Import, Domestic Procurement and Export Trend (1,000 TOE)

		Coal	Crude Oil	Refined Oil	Natural Gas	Nuclear Power	Hydro-Power	Geothermal Solar	Renewable	Electricity	Total	
2003	Domestic Production	132					710		5,406		6,247	92.1%
	Imports		518	124							642	9.5%
	Exports	-5		-7						-43	-56	-0.8%
	International Marine Bunkers										0	0.0%
	Stock Change	-41		-12							-52	-0.8%
	Total	86	518	105	0	0	710	0	5,406	-43	6,781	100.0%
		1.3%	7.6%	1.5%	0.0%	0.0%	10.5%	0.0%	79.7%	-0.6%	100.0%	
2004	Domestic Production	137					728		5,495		6,360	91.6%
	Imports		555	119							674	9.7%
	Exports	-6		-8						-20	-35	-0.5%
	International Marine Bunkers										0	0.0%
	Stock Change	-41		-15							-55	-0.8%
	Total	90	555	96	0	0	728	0	5,495	-20	6,943	100.0%
		1.3%	8.0%	1.4%	0.0%	0.0%	10.5%	0.0%	79.1%	-0.3%	100.0%	
2005	Domestic Production	144					764		5,605		6,513	91.4%
	Imports		594	115							708	9.9%
	Exports	-7		-9						-21	-37	-0.5%
	International Marine Bunkers										0	0.0%
	Stock Change	-42		-18							-59	-0.8%
	Total	95	594	88	0	0	764	0	5,605	-21	7,124	100.0%
		1.3%	8.3%	1.2%	0.0%	0.0%	10.7%	0.0%	78.7%	-0.3%	100.0%	

Source: IEA, 2006 and 2007, Energy Balances of Non-OECD Countries

9) Zimbabwe

More than 60 percent of Zimbabwe's primary energy relies on renewable energy. Furthermore, more than two million TOE of coal produced locally covers their primary energy, with more than 100,000 tons exported in the past three years. Although it imports refined oil, its share in the primary energy is decreasing.

Table 3.5.9 Zimbabwe's Primary Energy Import, Domestic Procurement and Export Trend (1,000 TOE)

		Coal	Crude Oil	Refined Oil	Natural Gas	Nuclear Power	Hydro-Power	Geothermal Solar	Renewable	Electricity	Total	
2003	Domestic Production	2,287					461		5,846		8,594	89.8%
	Imports	25		828						274	1,128	11.8%
	Exports	-137									-137	-1.4%
	International Marine Bunkers										0	0.0%
	Stock Change	-17									-17	-0.2%
	Total	2,158	0	828	0	0	461	0	5,846	274	9,568	100.0%
		22.6%	0.0%	8.7%	0.0%	0.0%	4.8%	0.0%	61.1%	2.9%	100.0%	
2004	Domestic Production	2,191					475		5,934		8,600	92.5%
	Imports	25		648						175	849	9.1%
	Exports	-137									-137	-1.5%
	International Marine Bunkers										0	0.0%
	Stock Change	-11									-11	-0.1%
	Total	2,068	0	648	0	0	475	0	5,934	175	9,301	100.0%
		22.2%	0.0%	7.0%	0.0%	0.0%	5.1%	0.0%	63.8%	1.9%	100.0%	
2005	Domestic Production	2,335					502		6,023		8,860	91.1%
	Imports	34		694						259	986	10.1%
	Exports	-119								-3	-122	-1.3%
	International Marine Bunkers										0	0.0%
	Stock Change										0	0.0%
	Total	2,248	0	694	0	0	502	0	6,023	256	9,723	100.0%
		23.1%	0.0%	7.1%	0.0%	0.0%	5.2%	0.0%	61.9%	2.6%	100.0%	

Source: IEA, 2006 and 2007, Energy Balances of Non-OECD Countries

(2) EAPP member countries

Out of the EAPP member countries, only the data on primary energy import, domestic procurement and export were available for i) Kenya, and ii) Ethiopia.

1) Kenya

Kenya's primary energy import, domestic procurement and export were 17.2 million TOE in total, which is a 3.3% year-on-year increase. Out of this, 74.6 percent is renewable energy. The past three years' trend shows that the dependence on renewable energy is declining while that on crude and refined oil is increasing. In addition, the share of domestic production is declining while the share of imports was at the same level of 21.5 percent both in 2003 and 2005.

Table 3.5.10 Kenya's Primary Energy Import, Domestic Procurement and Export Trend (1,000 TOE)

		Coal	Crude Oil	Refined Oil	Natural Gas	Nuclear Power	Hydro-Power	Geothermal Solar	Renewable	Electricity	Total	
2003	Domestic Production						280	677	12,219		13,176	83.6%
	Imports	57	1,546	1,303						15	2,920	18.5%
	Exports			-331							-331	-2.1%
	International Marine Bunkers			-13							-13	-0.1%
	Stock Change										0	0.0%
	Total	57	1,546	960	0	0	280	677	12,219	15	15,754	100.0%
		0.4%	9.8%	6.1%	0.0%	0.0%	1.8%	4.3%	77.6%	0.1%	100.0%	
2004	Domestic Production						247	791	12,539		13,576	81.4%
	Imports	66	2,054	1,452						9	3,581	21.5%
	Exports			-432						-1	-434	-2.6%
	International Marine Bunkers			-37							-37	-0.2%
	Stock Change										0	0.0%
	Total	66	2,054	983	0	0	247	791	12,539	7	16,687	100.0%
		0.4%	12.3%	5.9%	0.0%	0.0%	1.5%	4.7%	75.1%	0.0%	100.0%	
2005	Domestic Production						260	762	12,866		13,888	80.5%
	Imports	66	1,783	1,800						1	3,651	21.2%
	Exports			-249						-2	-251	-1.5%
	International Marine Bunkers			-42							-42	-0.2%
	Stock Change										0	0.0%
	Total	66	1,783	1,509	0	0	260	762	12,866	-1	17,246	100.0%
		0.4%	10.3%	8.7%	0.0%	0.0%	1.5%	4.4%	74.6%	0.0%	100.0%	

Source: IEA, 2006 and 2007, Energy Balances of Non-OECD Countries

2) Ethiopia

Ethiopia's primary energy import, domestic procurement and export were 21.6 million TOE in total, which is a 2.7 percent increase year-on-year. More than 90 percent is dependent on renewable energy, however, the past three years show a declining trend, while the share of refined oil has increased slightly at 8.2 percent in 2005. In addition, the share of domestic production is gradually decreasing while the share of imports is increasing slightly at 7.2 percent in 2005.

Table 3.5.11Ethiopia's Primary Energy Import, Domestic Procurement and Export Trend (1,000 TOE)

		Coal	Crude Oil	Refined Oil	Natural Gas	Nuclear Power	Hydro-Power	Geothermal Solar	Renewable	Electricity	Total	
2003	Domestic Production						196	1	18,706		18,903	92.2%
	Imports			1,328							1,328	6.5%
	Exports										0	0.0%
	International Marine Bunkers										0	0.0%
	Stock Change			278							278	1.4%
	Total	0	0	1,606	0	0	196	1	18,706	0	20,509	100.0%
		0.0%	0.0%	7.8%	0.0%	0.0%	1.0%	0.0%	91.2%	0.0%	100.0%	
2004	Domestic Production						217	1	19,152		19,370	92.0%
	Imports			1,404							1,404	6.7%
	Exports										0	0.0%
	International Marine Bunkers										0	0.0%
	Stock Change			286							286	1.4%
	Total	0	0	1,690	0	0	217	1	19,152	0	21,060	100.0%
		0.0%	0.0%	8.0%	0.0%	0.0%	1.0%	0.0%	90.9%	0.0%	100.0%	
2005	Domestic Production						245	1	19,609		19,855	91.8%
	Imports			1,563							1,563	7.2%
	Exports										0	0.0%
	International Marine Bunkers										0	0.0%
	Stock Change			215							215	1.0%
	Total	0	0	1,778	0	0	245	1	19,609	0	21,633	100.0%
	Share	0.0%	0.0%	8.2%	0.0%	0.0%	1.1%	0.0%	90.6%	0.0%	100.0%	

Source: IEA, 2006 and 2007, Energy Balances of Non-OECD Countries.

3.6 Private Investment and the Environment Surrounding Investment

3.6.1 Current Situation of Private Investment

Among the countries included in this study, Angola and South Africa received a net foreign direct investment (FDI) in excess of one billion US dollars for 12 years until 2006. As for Angola, it has received more than one billion dollars of FDI every year from 1998 to 2004, excluding 2000. South Africa meanwhile has received more than one billion dollars of FDI in 1995, 1997, 1999, 2001 and 2005. However, these two countries have both netted a negative inward FDI in 2005 (Angola) and 2006 (Angola and South Africa).

The other remaining countries, i.e., Tanzania and Uganda from 1995, Mozambique from 1998, Ethiopia from 2000, Botswana and DRC from 2002, and Zambia from 2003, have continued to receive a net FDI of more than 100 million USD.

Table 3.6.1 Inward FDI of Target Countries (net, million USD)

		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
SAPP	ANG	472.4	180.6	411.7	1,114.0	2,471.5	878.6	2,145.5	1,672.1	3,504.7	1,449.2	-1,303.9	-37.7
	BOT	70.4	71.2	100.1	95.3	36.7	57.2	22.1	403.4	418.0	391.1	278.6	486.4
	LES	275.3	287.5	268.1	264.8	163.3	117.8	117.0	84.1	115.7	123.5	91.9	77.8
	MAW	5.6	15.8	14.9	12.1	58.5	26.0	19.3	5.9	3.9	-0.7	3.0	-
	MOZ	45.0	72.5	64.4	212.7	381.7	139.2	255.4	347.6	336.7	244.7	107.9	153.7
	NAM	153.0	128.7	91.0	96.2	1.6	118.9	36.1	51.2	33.3	88.2	166.1	-30.9
	RSA	1,248.4	816.4	3,810.5	550.3	1,503.3	968.8	7,270.3	735.2	783.1	701.4	6,257.3	-183.6
	SWZ	51.8	21.7	-15.3	152.7	100.4	91.4	28.4	88.8	-60.9	70.6	-16.2	36.4
	TAN	119.9	150.1	157.9	172.3	516.7	463.4	467.2	429.8	526.8	469.9	473.4	474.5
	COD	121.8	72.6	79.2	32.8	520.6	165.9	77.2	136.8	323.1	668.4	402.0	474.5
	ZAM	97.0	117.1	207.4	198.0	162.0	121.7	71.7	82.0	172.0	239.0	259.0	575.1
	ZIM	117.7	80.9	135.1	444.3	59.0	23.2	3.8	25.9	3.8	8.7	102.8	-
EAPP	KEN	32.5	12.7	19.7	11.4	13.8	110.9	5.3	27.6	81.7	46.1	21.2	50.7
	UGA	121.2	121.0	175.0	210.0	140.2	160.7	151.5	184.7	202.2	222.2	257.1	391.6
	RWA	2.2	2.2	2.6	7.1	1.7	8.3	4.6	2.6	4.7	7.7	8.0	11.2
	BDI	2.0	0.0	0.0	2.0	0.2	11.7	0.0	0.0	0.0	0.0	0.6	0.0
	ETH	14.1	21.9	288.5	260.7	70.0	134.6	349.4	255.0	465.0	545.1	265.1	545.3

Source: World Bank, 2007.World Development Indicators: 2007. However, data for 2006 and for Namibia are from IMF, January 2008, International Financial Statistics (January 2008).

UNCTAD's Inward FDI Performance Index is a relative index of the net inward FDI level compared against the global FDI received and GDP22. According to this index, the inward FDI of Angola ranked fifth in the world in 2004. Furthermore, Botswana, Mozambique and Ethiopia's ranking seem failing each year. From being among the twentieth placers in 2004,

[22] Inward FDI Performance Index is derived by the formula: (FDIi/FDIw)/(GDPi/GDPw), where "FDIi" is Country i's inward FDI, "FDIw" is the world's total inward FDI, "GDPi" is Country i's GDP, and "GDPw" is the world's total GDP. The scope includes 141 countries.

Zambia is now within the thirtieth to fortieth place, while Tanzania and Uganda's ranks is between the sixtieth and seventieth position.

Table 3.6.2 Target Countries' Inward FDI Performance Index by UNCTAD
(a comparison of 141 countries)

		2004	2005	2006
SAPP	ANG	5	30	139
	BOT	27	46	65
	LES	-	-	-
	MAW	124	116	111
	MOZ	24	54	84
	NAM	42	45	47
	RSA	128	105	120
	SWZ	-	-	-
	TAN	65	65	72
	COD	95	130	131
	ZAM	39	36	49
	ZIM	134	110	107
EAPP	KEN	132	134	135
	UGA	69	70	77
	RWA	133	133	130
	BDI	-	-	-
	ETH	25	38	61

Source: UNCTAD, 2007, World Investment Report: 2007.

3.6.2 Investment Climate of Surveyed Countries

The following chart shows the attractiveness of the investment climate, indexed and ranked accordingly.

Table 3.6.3 Target Countries' Inward FDI Potential Index[23], by UNCTAD
(a comparison of 141 countries)

		2004	2005
SAPP	ANG	81	79
	BOT	67	71
	LES	-	-
	MAW	133	138
	MOZ	96	98
	NAM	85	87
	RSA	74	73
	SWZ	-	-
	TAN	119	121
	COD	140	140
	ZAM	135	132
	ZIM	141	141
EAPP	KEN	123	124
	UGA	113	117
	RWA	124	130
	BDI	-	-
	ETH	128	131

Source: UNCTAD, 2007, World Investment Report: 2007.

Based on this, Botswana and South Africa are about average in terms of attractiveness for investment among the countries surveyed. Angola and Namibia are also rated relatively high according to the list. Mozambique meanwhile ranks within 100th in the world.

Analyzing further, the responses to the nine items included in the WB's Enterprise Survey (in the order of those having more responses to being an inhibiting factor) reveal that responses exceeding 10 percent were, in Botswana - "Financial" and "Crime", and in South Africa - "Skills of Laborers," "Labor Law," "Crime," "Financial," "Tax Rate," "Policy Stability" and "Corruption." Meanwhile, in Angola - "Electricity," "Corruption," and "Financial", and in Namibia - "Crime," "Tax Rate," and "Financial" similarly topped the list with more than 10 percent responding that they were inhibiting factors.

Subsequently, countries which received high response rates from managers, considering "Electricity" as an inhibiting factor in doing business, include (in the order of high response

[23] The Inward FDI Potential Index indicates the Attractiveness of the country's investment climate for foreign investors, using 12 indices on FDI.

rates) Tanzania, Uganda, Kenya, the DRC, Ethiopia, Burundi, Zambia, and Lesotho, with more than one third responding that it was an inhibitor. On the other hand, Botswana, Namibia, Swaziland and South Africa obtained 10 percent or less responses that "Electricity" was an inhibiting factor.

Table 3.6.4 Result of the World Bank's Enterprise Survey[24] (Yr: year surveyed. Unit: %)

	Yr	Corruption	Judiciary	Crime	Electricity	Financial	Labor Law	Laborer Skills	Policy Stability	Tax Rate
ANG	2006	12.5	-	6.2	34.5	11.6	-	1.1	1.6	3.0
BOT	2006	7.9	1.4	10.9	1.7	24.3	1.5	9.4	0.7	7.3
LES	2003	35.1	24.3	45.9	35.1	54.1	17.6	29.7	31.1	41.9
MAW	2005	3.2	1.3	5.1	19.2	27.6	0.6	5.8	5.8	9.6
MOZ	-	-	-	-	-	-	-	-	-	-
NAM	2006	9.3	0.6	20.6	3.1	11.8	4.4	9.4	0.8	17.2
RSA	2003	16.1	8.8	29.0	9.0	22.6	32.8	35.5	17.9	18.6
SWZ	2006	5.2	1.0	18.5	6.8	10.3	0.4	2.3	0.6	15.4
TAN	2006	0.5	-	1.9	72.9	9.3	-	1.4	0.5	3.9
COD	2006	0.5	-	1.8	45.5	14.5	-	1.0	5.3	9.6
ZAM	2002	45.9	38.6	48.8	39.6	84.5	16.9	35.7	56.5	57.5
ZIM	-	-	-	-	-	-	-	-	-	-
KEN	2003	72.5	-	69.6	47.1	72.5	22.5	27.5	49.6	67.8
UGA	2006	2.4	0.1	0.2	63.3	6.7	-	0.4	0.3	11.0
RWA	2006	0.8	-	-	31.8	13.6	-	2.8	0.9	26.9
BDI	2006	2.2	0.2	2.9	40.7	16.0	-	0.1	14.3	3.7
ETH	2002	38.4	4.6	9.4	42.5	50.0	4.5	17.7	38.2	72.2

Source: World Bank, 2007, World Development Indicators: 2007

[24] For each item, managers who are actually doing business in the country choose items that are "major" or "extremely large" inhibitors to doing business (multiple choice).

CHAPTER 4

CURRENT SITUATIONS AND ISSUES OF REGIONAL COOPERATION OF IN THE POWER SECTOR

Chapter 4 Current Situations and Issues of Regional Cooperation in the Power Sector

4.1 Participation of African Countries in Regional Cooperation

Power pools in Europe were initiated and progressed based on the expectation that the liberalization of power markets in its countries (or provinces) that have stable connection and have already achieved development, will promote competition leading to lower tariff rates. The intention for establishing power pools was however different in Africa, where it was envisaged that equitable distribution of unevenly dispersed primary energy resources will provide mutual assistance in alleviating the absolute power deficiencies of its countries. Therefore, the primary purpose and function of power pooling in said region is to solve the power crisis of its neighboring countries, rather than achieve price reduction.

This section analyzes the initiatives of the Southern Africa Power Pool (SAPP) and Eastern Africa Power Pool (EAPP), under the jurisdiction of the Southern African Development Community (SADC) and Eastern Africa Community (EAC), respectively. The analysis shall be based on views on policies and schemes in order to grasp an overview of the current situation on regional cooperation in the power sector in Southern and Eastern Africa. (Technical analyses, such as technical standards and power facilities, will be covered in Sections 4.2 and 4.3. The background, expected functions, issues, and other details of the aforementioned power pools will be elaborated in Section 4.6.)

4.1.1 Initiatives in Southern Africa (SAPP/SADC)

(1) Current situation of regional cooperation via the SAPP

1) Outline of the SAPP

The concept of the SAPP was first posted, before the concern on power deficiency in Southern Africa was intensified, upon realization that the strengthening of the power network in the region is a pressing need. The power pool itself was officially established in August 1995 when the Memorandum of Understanding (MOU) was signed by SADC member states. In December 1995, power utilities and corporations from nine of the SADC member states signed the memorandum. This signing by the

nine power utilities marked the practical establishment of a basic institutional infrastructure for common power market and a power interchange system. The power pool participants as of today comprise of 12 countries out of the 14 SADC members. The two non-members are Mauritius and Madagascar.

The MOU between the utility firms sets forth basic operation and management rules for the SAPP. The secretariat of the organization is located in Harare, Zimbabwe. The following table lists the utilities of the 12 signatory countries.

Table 4.1.1 SAPP member utilities

Country	Power utility
Botswana	Botswana Power Corporation (BPC)
Mozambique	Electricidade de Mocambique (EDM)
Malawi	Electricity Supply Corporation of Malawi (ESCOM)
Angora	Empresa National de Electricidade (ENE)
South African Republic	ESKOM (Eskom)
Lesotho	Lesotho Electricity Corporation (LEC)
Namibia	NAMPOWER (Nam Power)
DRC	Societe Nationale d'Electricite
Swaziland	Swaziland Electricity Board (SEB)
Tanzania	Tanzania Electricity Supply Company Ltd. (TANESCO)
Zambia	ZESCO Limited (ZESCO)
Zimbabwe	Zimbabwe Electricity Supply Authority (ZESA)

Source: SAPP Coordination Center

The Southern Africa power grid connection plan, partially materialized through the foundation of the SAPP, was first envisaged by Eskom of South Africa as a concept for connecting power grids between DRC's Inga hydropower plant and the country. Eskom's concept has developed many regional connection projects in the short-term action plans of the New Partnership for Africa's Development (NEPAD-STAP). In this sense, Eskom and the government of South Africa play a lead role in strategy planning, operation and management of the SAPP.

The basic visions, purposes, and roles agreed by the SAPP signatories are discussed in the following sections. These are referred to as top-level policies when merging the detailed power interchange rules, such as the SAPP Arrangements and Accredited Capacity Obligation[1].

[1] UNECA (2004) Assessment of Power-Pooling - Arrangement in Africa, pp.44

Top-level policies of the SAPP

Vision

(a) Facilitate the development of a competitive electricity market in the SADC region.
(b) Give the end user a choice of electricity supply.
(c) Ensure that the Southern African region is the region of choice for investments by energy intensive users.
(d) Ensure sustainable energy developments through sound economic, environmental and social practices.

Objectives

(a) Provide a forum for the development of a world class, robust, safe, efficient, reliable and stable interconnected electrical system in the southern African region.
(b) Coordinate and reinforce common regional standards of quality of supply (measurement and monitoring of systems performance.)
(c) Harmonize relationships between member utilities.
(d) Facilitate the development of regional expertise through training programmes and research.
(e) Increase power accessibility in rural communities (rural electrification rate).
(f) Implement (SAPP-related) strategies in support of sustainable development priorities.

Roles[2]

(a) Coordinate planning and operation of power systems among the member utilities
(b) Reduce investment and operation costs through coordination
(c) Provide ea forum for discussing solutions to issues in the power sector at the regional level

Source: SAPP Annual Report 2007

2) Current situation of institutional infrastructure for power trading

A Short Term Energy Market (STEM) was developed in April 2001 as an infrastructural scheme which supports power trades between member countries. On this market, power is traded contractually on a monthly, weekly or daily basis.

Meanwhile, due to the lack of interconnection between the participants and other constraints, the power traded in STEM remains limited to the areas under the jurisdiction of Eskom (South Africa), ZESA (Zimbabwe), and ZESCO (Zambia) [3].

[2] Ibid., pp.41

[3] Nagayama (2006), Measurement of appropriate scale of power regulators based on the expected functions of power

Thus, the power traded far peaked at 842 GWh in 2002, as shown in the upper left graph hereunder, which further slipped down to 178 GWh in 2005. (The decrease in 2005 is partly attributed to the limited participation in STEM of Mozambique's HCB and Zambia's ZESCO due to large-scale rehabilitation and maintenance projects.) On the other hand, the traded price per kilowatt fell in 2002, then steadily recovered to 1.24 USc/kWh in 2005, as shown in the lower left graph. Accordingly, the traded value recorded 4.4 million US dollars in 2004, despite the abovementioned declining trend of energy traded. (See the figure in the upper right corner.)

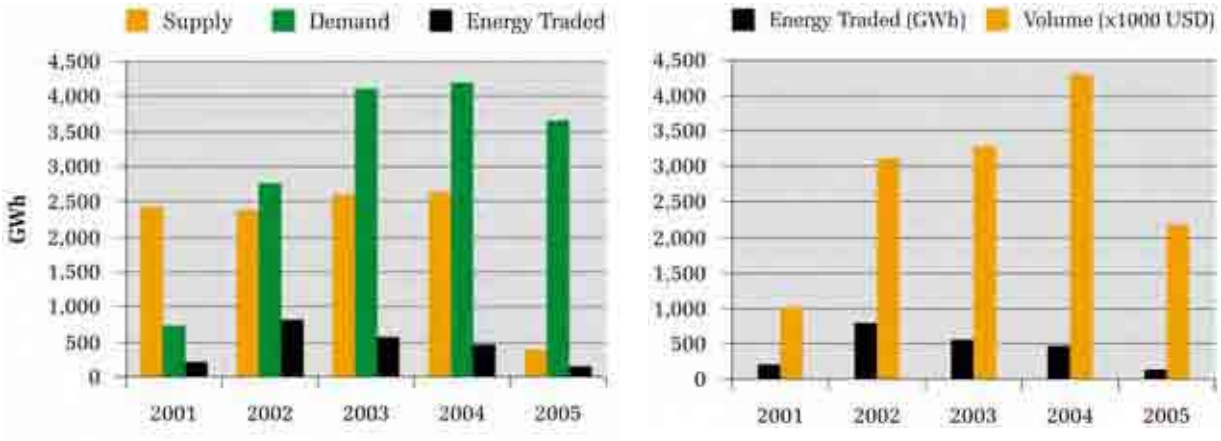


Figure 4.1.1 Energy traded on the STEM within SAPP

(Left: volume of power traded, right: amount of money)

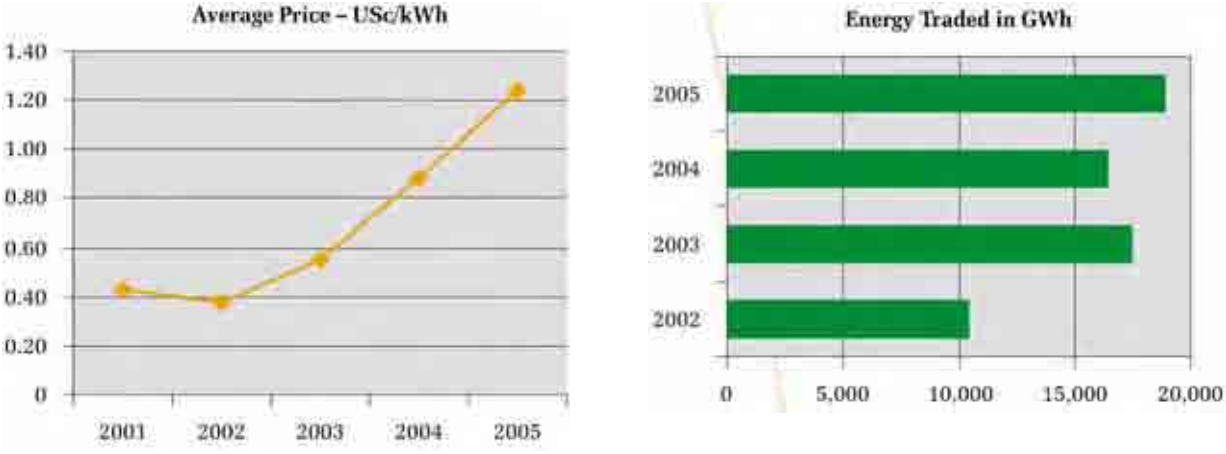


Figure 4.1.2 Average price of energy traded in the STEM (left) and long-term power trading based on bilateral agreements (right)

Source: SAPP Annual Report 2006 (for all four graphs)

regulators in developing countries under the reform of power sectors, a FY2005breport by a JICA visiting researcher

The SAPP member utility firms made long-term bilateral power trading agreements between each other, where Eskom plays a significant role in both the selling and buying energy. (See the following table.) The energy traded based on these bilateral long-term agreements recorded 19 TWh in 2005, and surpassed STEM's prior traded energy (See the lower right graph above.)

Table 4.1.2 Current situation of long-term power trading agreements among the SAPP member utilities

Exporter	Importer	Agreed Power (MW)
Democratic Rep. of Congo (SNEL)	Zimbabwe (ZESA)	100
	South Africa (Eskom)	110
Zambia (ZESCO)	South Africa (Eskom)	300
South Africa (Eskom)	Zimbabwe (ZESA)	150
	Botswana (BPC)	190
	Namibia (Nampower)	400
	Mozambique (EDM)	150
	Swaziland (SEB)	250
	Lesotho (LEC)	85
Mozambique (HCB)	Zimbabwe (ZESA)	500
Zambia (ZESCO)	Botswana (BPC)	0
ZPC (Hwange Power Station)	Zimbabwe (ZESA)	0

Source: UNECA (2004) Assessment of Power-Pooling - Arrangement in Africa, pp.44

3) Current situation of institutional reforms of the SAPP

The energy ministers of the SADC member states signed the Revised SAPP Inter-Governmental MOU during the SADC Council of Ministers Meeting on 23rd of February, 2006. The revised MOU seeks for (i) re-establishment of the SADC secretariat and (ii) implementation and foundation of electricity regulators in the member states; and plans (iii) facilitation of entry of independent power producers (IPPs) into the SAPP and expansion of the SAPP membership[4]. Especially, item (iii) above will finally clarify the legal position of IPPs in the SAPP framework, which will expectedly promote mid and long-term perspectives on power supply in the STEM.

(2) Issues concerning regional cooperation in the policy and scheme aspects

The following were identified as issues concerning regional cooperation (hindrances to regional cooperation) in the policy and scheme aspects, based on the interviews conducted in the countries surveyed. Technical issues meanwhile will be presented and analyzed later in Section 4.2.

[4] SAPP Annual Report 2007, etc.

1) Lack of political stability in each member state[5]

Regarding the means to address the increasing demand for electricity in South Africa, the Department of Minerals and Energy (DME) pointed out that, while they recognize that "the wisest way" is importing from other countries via interconnected transmission lines, they are also aware that "import of power from outside is extremely challenging." DME mentioned, as justification to their comments, the unpredictability of large-scale power projects in countries other than South Africa, exemplified by DRC's Inga development project and other massive power development projects. These were first conceived a few decades ago but just slightly progressed. They also noted the lack of political stability in each country, which has caused the long-term delay in these projects. The lack of continuity, by the authorities and official organizations of individual countries, was mentioned as another hindrance. The interviewee was quoted that "a little bureaucracy, in a positive sense, was needed in order to assure the continuity of projects.[6]"

NERSA, the power regulator in South Africa, shares the same view, saying that the possibility of importing electricity via the SAPP is "not a realistic option", mainly because of high political risks in the other countries in the region[7].

2) Other hindrances[8]

The following points were also raised by other interviewees as hindrances to the regional cooperation.

- High cost for constructing interconnected grid lines (While the necessity for construction is fully understandable, related expense is too costly[9].)
- Low domestic demand in the countries in the region (If the demand in the country is low, no investor will be willing to invest.)
- With South Africa always seem to act as the leading state in the region, the regional usual concept "It depends on South Africa, for better or worse", is not motivating.
- Political corruption, dictatorship, and lack of transparency in project implementation prevail in some countries.

[5] Summary of an interview with Mr. Magbane, Deputy Director of the power and nuclear energy bureau of the DME

[6] They also commented "Although Eskom's argument calling for 'development of power supply in South Africa by power companies in South Africa' is understandable, in consideration of these circumstances, the power crisis faced by the country does not allow that policy to be valid; from the personal point of view, there is an obvious need for facilitating the entry of IPPs."

[7] Interview with Mr. Belinska, Deputy General Manager of Power Infrastructure Operation Department of NERSA. He also mentioned "The country once sought for help from the SAPP, but now they are completely domestic-oriented."

[8] Interview with Mr. Magbane, Deputy Director of the power and nuclear energy bureau of the DME.

[9] Eskom insists, in the interview, that the installation of large-scale transmission line requires an enormous amount of fund, and it is difficult to obtain the understanding from its shareholders.

BOX - Power crisis in South Africa and policies of the Government of South Africa

The power deficiency in South Africa turned serious in December 2007 and has since been described as a "crisis". Planned power interruptions have been carried out since mid-January this year, severely affecting the nation's economy. No traffic light during blackouts has caused sizeable traffic congestion and accidents in Johannesburg and Pretoria, and restaurants that use electric cookers and offices have been forced to close during blackouts. Furthermore, orders for household generators, which people are buying in preparation for winter (June and July) when the demand will reach the peak in the year, are pending for two months. There are some voices questioning the feasibility of hosting FIFA World Cup in 2010.

The impact of the power deficiency spread across the entire Southern African region; on 20th January, Eskom stopped exporting power to neighboring countries. On the following day, 21st, Eskom announced that they projected the power deficiency to last until 2015. The statement endorsed the possibility that chronic power interruptions would delay corporate activities for a long term. The provider is scheduled to cut back power supply by large to mining and manufacturing companies, who are major power consumers.

Power demand in South Africa drastically increased immediately after the democratization in 1994. On the other hand, there have been no significant construction projects of power plants in the meantime, leaving a total power output to stay around 40 million kW since 2001. However, electrification took place in black households after the democratization, which raised the electrification rate in general households from 30 percent in early 1990s to 80 percent. This unexpectedly-rapid increase in power demands is another remote trigger of today's crisis. NERSA has identified the following six factors as the causes of the crisis[10],[11].

- Eskom's optimistic projection of power demand (It estimated at 3% per annum as opposed to 4.7% in actuality)
- Higher load factors
- Lack of maintenance of power-related facilities as a whole
- External factors (e.g., delay of delivery of power-related equipment to Eskom)
- Coal quality (wet coal issue)
- Notable delay in introduction of IPPs into power generation business

The government of South Africa announced the following measures to step out of the crisis on 25th January[12].

- Implement countermeasures against the crisis based on three timeframes: short term (the initial six months), mid term (the first 18 months), and long term (after 18 months from the implementation of the countermeasures)
- Implement three short-term measures: (i) Power Conservation Programme, (ii) specific demand-side behavioral change programmes, and (iii) review of mid- and long-term crisis management plans
- Promote the development of renewable energies, including hydropower, wind, solar, and biomass, as a mid- and long-term action.

In addition, the government is internally studying the expansion of nuclear power: for example, a plan to increase the nuclear ratio to 30-50 percent of the total output[13], and also a new pumped hydropower plant with nuclear energy providing baseload power[14]. In this way, the government will presumably review and modify the power generation portfolio sooner or later.

[10] Interview with Mr. Belinska, Deputy General Manager of Power Infrastructure Operation Department of NERSA.
[11] There was slight implication that the IMF's advice to unbundle and privatize Eskom confused the policies of the Government of South Africa.
[12] Government Information Website of the Government of South Africa, "National Response to South Africa's Electricity Shortage" http://www.info.gov.za/otherdocs/2008/nationalresponse_sa_electricity1.pdf
[13] Interview with Mr. Belinska, Deputy General Manager of Power Infrastructure Operation Department of NERSA.
[14] Interview with Mr. Magbane, Deputy Director of the power and nuclear energy bureau of the DME.

Despite the above measures, it is reported that there have been negative impacts such as decreased production of gold and delays in mega construction projects, due to insufficient power supply since January 2008. In addition, Jacob Maroga, the chief executive officer (CEO) of Eskom, stated on 29th May 2008 that South Africa was going to be in the power crisis for years and demonstrated his recognition that the threat of load-shedding continued for some time.

The economic growth of South Africa in the first quarter of 2008 took a sudden drop to 2.1% to their lowest level in six and a half years. This is mainly because of the power crisis and mining production decline. On the other, the economic growth in the second quarter of 2008 achieved 4.9 %, contributed by the recovery of mining and manufacturing sectors which had poor performance in the first quarter.

4.1.2 Initiatives in Eastern Africa (EAPP/EAC)

(1) Current situation of regional cooperation through EAPP

1) Outline of the EAPP

It has been a long time since regional cooperation on electricity started in Eastern Africa. Kenya and Uganda concluded a bilateral power interchange agreement about 50 years ago. Uganda meanwhile started exporting power to Bukoba, a northern city in Tanzania, in 1993[15].

However, it has not been too long since discussions on establishment of a power pool within the region were initiated, despite the presence of Uganda, which has always been abundant with water-power resources. This is largely due to the status of internal affairs in individual countries.

The EAPP was inaugurated in May 2005, ten years later than the SAPP, when an inter-governmental MOU was signed by nine countries. These were affiliated with either the Common Market for Eastern and Southern Africa (COMESA) or the Nile Basin Initiative (NBI). The secretariat was set up in Addis Abeba in Ethiopia. The table below lists the participating utility firms of the nine member countries.

Table 4.1.3 Utilities of the EAPP member states

Country	Utility
Brundi*	(REGIDESO)
Djibouti	Electricite du Djibouti (EDD)
Eritrea	Eritrea Electric Authority (EEA)
Ethiopia*	Ethiopian Electric Power Corporation (EEPCO)
Kenya*	Kenya Electricity Generating Company Ltd. (KenGen)
	Kenya Power & Lighting Company Ltd. (KPLC)
Rwanda*	Etablissement Public de Production, de Transport et de Distribution d' Electricite, d' Eau et de Gas (Electrogas)
Somalia	Ente Nazionale Energia Elettria (ENEE)
Sudan	National Electricity Corporation (NEC)
Uganda*	Uganda Electricity Board (UEB)

Source: Prepared by the study team based on available documents. (Countries market with * are the subjects of the study)

The SAPP, kicked-off in 1995, has achieved a mature level of organization as a power pool, in terms of power system connection as well as organizational structure. This was realized as rules and regulations were laid out concerning power interchange and as

[15] UNECA (2004) Assessment of Power-Pooling - Arrangement in Africa, pp.59-60

release of monthly and yearly reports were posted on its official website. South Africa, which has the most stable power system in Africa, plays a vital role in the organization. On the other hand, EAPP, established only in May 2005, is still at a stage of drafting its basic operational rules. Furthermore, the Kenya-Uganda link is the only system that is practically interconnected. Thus, the EAPP is still developing from both the scale and organization points of view, as compared with SAPP.

2) East African Power Master Plan (EAPMP)

Considering the above situation together with other factors, the energy ministers of EAC members decided during a meeting to implement an EAPMP at the initial stage of the establishment of EAPP. Its aim is to strengthen the functions of EAPP as a power pool. The final report on the EAPMP Phase-I study was submitted to EAC in November 2003 and subsequently approved in May 2004[16]. On top of that, the Phase-II study has been conducted through funds from the World Bank (WB), to deepen the contents of Phase-I, including specific action plans, e.g., an interconnection plan among Uganda, Kenya, and Tanzania.

To complement for solid implementation of the series of the above action plans, "Standing Committee on the Implementation of the EAPMP" was established in January 2006. Currently, the feasibility of recommended projects in the EAPMP has been examined and, at the same time, it is under consideration how to actually work together with the Nile Basin Initiative of the following[17]. It is also recognized that the updates and further expansion of the current EAPMP are of urgent necessity, in response to Burundi and Rwanda's entry into the EAC membership. It continues to ask for financial support to the implementation of updating the plan[18].

Concerning these studies, EAC has stated "As Phase-II only covers Uganda, Kenya, and Tanzania, a following study should cover Rwanda and Brundi."

3) Coordination with the NBI

NBI, as mentioned earlier, is participated by countries in the basin of the Nile River. Hence, it includes countries other than those specifically covered in this study. However, the initiative is relevant to the power sector in Eastern Africa. This report

[16] The master plan Phase-1 report is released on the EAC's Website (visit http://www.eac.int/programme.htm)
[17] For example, the linkage between the EAPMP and the Nile Equatorial Lakes Subsidiary Action Programme (NELSAP) is being considered. The details of NELSAP can be found at http://nelsap.nilebasin.org/
[18] Source: Interview results from Assistant Commissioner Mr. Bidasala, Ministry of Energy and Mineral Development, the Republic of Uganda.

will not cover a detailed discussion on the NBI[19]. Instead, the East Nile Technical Regional Office (ENTRO), established under the umbrella of the NBI, may be a key player in terms of exploring the direction of regional cooperation in East Africa. This is considering that EAPP is still underdeveloped, and that ENTRO covers Ethiopia under its jurisdiction, and is closely related to the above-mentioned EAPMP.

The establishment of ENTRO was agreed in 2001 under the joint leadership of three NBI participants, namely Egypt, Sudan, and Ethiopia, and was activated in 2002. (The secretariat is located in Addis Abeba, Ethiopia.) Currently, a feasibility study (F/S) concerning hydraulic power generation in these three countries is carried out by expatriate consultants. The Phase-I study is already completed, identifying three candidate sites in Ethiopia and one in Sudan[20].

Eastern African countries, particularly Uganda and Tanzania, are suffering from power deficiency due to droughts, which cause reduction of water level in dams that fetters operational rates of hydropower plants. As a result, Kenya, unable to receive sufficient power supply from Uganda, has no choice but to rely on relatively costly diesel power generation to meet imminent power demands. In resolving such conditions in the medium and long terms, countries within the region now have higher expectations for Ethiopia, the second largest in potential water power after DRC[21]. In this regard, it is high time to more specifically consider (i) re-defining of future roles of ENTRO, (ii) systemized coordination between NBI and EAPP, and also other relevant factors from the standpoint of regional cooperation.

(2) Issues concerning regional cooperation in the policy and scheme aspects

Although there are some EAPP countries, including Ethiopia and Kenya, where power systems are established at a certain standard, the international connection adopted is only between Kenya and Uganda, as previously mentioned. Therefore, EAPP has not yet achieved a level where it can fulfill its role as a power pool (in the context of the Southern and Eastern Africa regions).

The followings were as the identified hindrance issues concerning regional cooperation, in the policy and scheme aspects. These are based on interviews conducted in the countries

[19] The NBI was established in 1999. See its Website http://www.nilebasin.org/, etc. for more detail.
[20] Interview with Ethiopian Electric and Power Corporation (EEPCO)
[21] In the interview with EEPCO, the interviewee stated “Exporting power to other countries was a dream to Ethiopia five or six years ago, and no one would listen to an idea of exporting power (because the domestic market had to be supplied with priority) at that time, but now the situation has completely changed due to the drastic growth of power demand in the surrounding countries.”

surveyed[22]. Technical issues will be presented and analyzed in Section 4.2.

1) Politics and policy aspects
   - Political instability in the countries in the region, e.g., the situation in Somalia and Kenya since the end of last year.
   - The most stringent constraint to further the promotion of regional cooperation comes down to "the difficulty in coordination among related organizations." Of a particular note is the serious lack of coordination between the NEPAD and the AU. (As a countermeasure against this, member states have reached consensus to set up a coordination mechanism. Moreover, an interviewee pointed that the foundation of EU-Africa Partnership on Energy will initiate harmonious and clarification of coordination processes.)
   - The EAPP has just started collaboration with the member utility firms, and thus has not taken any specific actions yet.
2) Financial aspect
   - International financiers are still skeptical in investing. The largest constraint is the lack of financing infrastructure. Furthermore, although the power market is expanding, the growth is not fast enough to attract investors.
   - Absence of motivated investors in geothermal power projects
3) Human resources development/institutional design aspects
   - Lack of a policy institutional framework associated with regional cooperation in the power sector
   - Necessity for institutional strengthening and insufficiency of capacity building of concerned parties (Particularly anticipated are personnel development programs for (i) capability in formulating master plans, (ii) ability on corporate planning, (iii) technical skills on power transmission and distribution, (iv) negotiation skills in power purchase agreement (PPA) discussions, and so forth.)
   - Shortage of manpower for renewable energy power system operations (geothermal, wind)
4) Others
   - Harmonization of regulations on power within the region is also quite important, but was not considered a significant issue by the EAPP (pointed out by the AU Commission.)

[22] Interview with Ethiopian Electricity Agency (EEA), Infrastructure and Energy Bureau of the AU Commission, and Ethiopian Electric Power Company (EEPCO)

BOX - Movements in relation to setting up of power regulators and coordination across the region

As overviewed in Section 3.1, a majority of Sub-Saharan African countries still have very traditional, vertically-integrated power systems, and appear to be relatively slow in privatizing and liberalizing the power sector. Additionally, they are considered as to lack development of laws and arrangements necessary for interchange policy measures with regard to power services23. On the other hand, if the power sector in each country starts to be deregulated, investment in power generation and transmission services will become more active (as already observed in some countries, including Ethiopia), and it will become more difficult for the government to have a centralized management of the sector. Thus, setting up of a regulating body, which oversees across the power sector, and strengthening of its responsibilities will rightfully be next essential milestones.

Based on the above, in spite of the difference in the degree of liberalization of the sector among the countries, the governments are carrying forward the setting up of regulators, as show in the table below. The new regulators are expected to bring about (i) guaranteed establishment of rules with transparency, (ii) reduction of internal subsidies, and (iii) optimization of electricity tariff structures. On the other hand, the lack of accumulated experience, human resources shortage, etc. are identified as issues to be addressed24.

Source: UNECA and UNEP (2007) Making Africa's Power Sector Sustainable - An Analysis of Power Sector Reform in Africa, pp.70

In addition to these movements, "regional power regulators", which oversee the power regulators at the regional level, have been formed. Regional Electricity Regulators Association of Southern Africa (RERA) is the regional power regulator in Southern Africa, and the African Forum for Utility Regulators (AFUR), which is responsible for not only the power sector but also water and other utilities, is the counterpart in Africa. Both organizations were established in 2002. Listed below are the six high-level strategies of the AFUR:

- Information sharing
- Capacity building
- Harmonization of regulatory policies and legislation in the region
- Promotion of the philosophy of autonomous utility regulation and good governance
- Support to African initiatives, such as NEPAD
- Promotion of sound relationships with governments and other stakeholders

With the membership of 25 organizations, including 20 power regulators, the forum is engaged in coordination in conjunction with policies in the power and utility sectors in Africa, including North Africa. In the meantime, there are only three staff members in the AFUR ; clearly, human and material resources are scarce to carry out the above measures.

[23] UNECA and UNEP (2007) Making Africa's Power Sector Sustainable – An Analysis of Power Sector Reform in Africa

[24] Nagayama (2006), Measurement of appropriate scale of power regulators based on the expected functions of power regulators in developing countries under the reform of power sectors, a report by a JICA visiting researcher for FY2005

4.2 Technical Standards and Systems Concerning Power Interchange in the Region

4.2.1 Rules regarding SAPP Power Trade in Southern African Countries

The SAPP was established in 1955, aiming to improve the investment environment and to promote the development of power trade market. Four documents namely, Inter-Governmental MOU, Inter-Utility MOU, Agreement Between Operating Members and Operating Guidelines, govern the SAPP.

The SAPP consist of environment, market, operation and planning committees and Coordination Center as its internal organizations. Coordination Center is in charge of power trade among multi-buyers, supported by NORAD (Norway), Sida (Sweden), the WB, DBSA and USAID. The expected effects of promoting the SAPP program are as follows:

- To reduce the required capacity of power generation by utilizing the regional power trade
- To reduce the amount of fuels used for thermal power plants
- To utilize hydropower resources effectively
- To develop skills and knowledge on power technology by holding seminars, workshops and trainings

SAPP member countries include Botswana, Mozambique, Angola, Malawi, South Africa, Lesotho, Namibia, DRC, Swaziland, Tanzania, Zambia and Zimbabwe. Malawi, Angola and Tanzania have not been connected to SAPP being non-operational members.

Table 4.2.1 shows the SAPP member companies.

The capacities of interconnections among the power companies in the South African region are not enough. Although they intend to have a competitive power market, the main approach in power trade are now based on bilateral contracts for medium or long terms such as from IPP to ESKIM, ZESCO or ESKOM. Besides the bilateral based contracts, short term trade is also carried out as multi-buyer power trade. However, its amount and duration is limited. The implemented power trade of SAPP is as follows.

Table 4.2.1 SAPP Members

Power Companies	Member Countries	○: Operational Members △: Non Operational Members
BPC	**Botswana**	○
EDM	**Mozambique**	○
ESCOM	**Malawi**	△
ENE	**Angola**	△
ESKOM	**South Africa**	○
LEC	**Lesotho**	○
Nam Power	**Namibia**	○
SNEL	**DRC**	○
SEB	**Swaziland**	○
TANESCO	**Tanzania**	△
ZESCO	**Zambia**	○
ZESA	**Zimbabwe**	○

Sources: SAPP Annual Report 2007

The capacities of interconnections among the power companies in the South African region are not enough. Although they intend to have a competitive power market, the main approach in power trade are now based on bilateral contracts for medium or long terms such as from IPP to ESKIM, ZESCO or ESKOM. Besides the bilateral based contracts, short term trade is also carried out as multi-buyer power trade. However, its amount and duration is limited. The implemented power trade of SAPP is as follows.

- Export from Cahora Bassa Hydropower Station (HCB) to South Africa (Eskom)
- Export from South Africa to Botswana (BPC), Lesotho, Mozambique (EdM), Namibia (NamPower) and Swaziland
- Export from Zambia (ZESCO) and DR Congo (SNEL) to South Africa
- Export from South Africa and Cahora Bassa Hydropower Station to Zimbabwe (ZESA)

The bilateral power trade shares a large portion of the power trade in Southern African countries. Table 4.2.2 shows the situation of the bilateral power trade obtained in 2008 by the team..

Table 4.2.2 Situation of the Bilateral Power Trade in SAPP

From	To	Supply Capacity MW	Expiry date	Comments
ESKOM	SEB	96		Expiry date not given
ESKOM	BPC	210	2006	
ESKOM	NamPower	200		Expiry date not given
ESKOM	EdM	120	open ended	
ESKOM	LEC	100		Not given
ESKOM	ZESA	150	2003	Extended on prepayment arrangement
HCB	ZESA	250	2005	
HCB	ESKOM	1,370	open ended	
SNEL	ZESA	100		Extended
SNEL	ESKOM	150		Extended
ZESCO	ESKOM	180		

Source: BILATERAL SUPPLY AGREEMENTS IN SAPP

Apart from the bilateral power trade, Short Term Energy Market (STEP), i.e., Monthly (Designating the amount of energy and price by monthly base), Weekly (Designating by weekly base) and Daily (Designated by hourly base) was initiated. Tenders are issued ahead of time for each power trade for the Coordination Center. The process of tendering is as follows.

i) Participants inform the SAPP Coordination Center about the contractual coverage such as power trading intervals, the amount of energy and prices

ii) Power companies and coordination center confirm the possibility of power trade with reference to the existing bilateral contracts and power transmission constraints. The communication is basically carried out through the Internet or Fax.

iii) Bidding is done in the morning. In the afternoon, selling and buying are matched in consideration with the existing bilateral contracts, the latest information about the transmission line constraints and the wheeling charges.

iv) SAPP members transmit the electricity at determined prices while the buyers pay the wheeling charges. The power company determines the amount of power trade for the next day.

The wheeling charges are categorized by intervals and reviewed every half a year. They are categorized into tariff for maximum power (US$/kW/year) and tariff for energy (US$/kWh)

Table 4.2.3 shows the records of the amount of power trade in SAPP by STEP. The total amount of power import in SAPP is 20,000 GWh, thus, the amount of the power trade is under 1% of the power import and export. It indicates that the large portion of the power trade is done based on bilateral contracts.

SAPP intends to create the Competitive Power Market supported by other organization such as Nord Pool in north Europe, however, its preparation has just started and the multi-buyers and sellers trades is not so significantly progressing. To further this situation, the Nord Pool implemented the testing of the functions of the software for Day-ahead Market Trading Platform (DAMTP) in Johannesburg, from October to November 2006. In February 2007, SAPP Coordination Center in Harare installed DAMTP. The training for the operation staff has also been carried out.

The existing main role taken by SAPP is to boost the technical skills in the southern African Countries through seminars or trainings. Moreover, it intends to improve the environment of power system development in the regions by making master plans for the interregional connections. The SAPP member countries consequently considered the importance of such roles.

Table 4.2.3 Records of Power Trade by STEM in SAPP

Duration	Contracted (GWh)	Demand bidding (GWh)	Supply bidding (GWh)	Averaged Tariff (Usc/kWh)	The amount of selling (million USD)
2005 4/1-2006 3/31	178	3,700	423	0.96	2.2
2006 4/1-2007 3/31	226	1,118	377	1.38	3.1

Source: Short Term Energy Market Book Of Rules

SAPP intends to create the Competitive Power Market supported by the other organization such as Nord Pool in the north Europe, however, the preparation for it has been just started and the progress for the multi-buyers and sellers trades is not so fast. As the progress for this direction, the Nerd Pool implemented the testing of the functions of the software for Day-ahead Market Trading Platform (DAMTP) in Johannesburg from October to November 2006. in February 2007, SAPP Coordination Center in Harare install DAMTP. The training for the operation staff has been carried out.

The existing main roles taken by SAPP is to boost the technical skills in the southern African Countries through the seminars or trainings and to improve the environment of power system development in the regions by making Masterplans for the interregional connections. The SAPP member countries put the importance on the roles of SAPP.

4.3 Outline of Power Facilities in Relation to Regional Cooperation

4.3.1 Power Supply Facilities in SAPP System of Southern Africa

The SAPP consisting of 12 countries was established in the region of SADC in August 1995. Power supply facilities in the 12 countries are shown in Table 4.3.1. The installed capacity and effective power capacity of SAPP are estimated as 54,700MW and 45,800MW in 2007. The peak power demand of SAPP is also recorded as 43,800MW in 2007. This peak demand is equivalent to 95.6% of the effective power supply capacity, while the reserve margin remains only at 4.4%.

Table 4.3.1 Power Supply Facilities and Peak Power Demand of SAPP in 2007

Country	Equity	Installed Capacity (MW)	Effective Power (MW)	Peak Power Demand in 2007 (MW)
Angola	ENE	1,127	943	476
Botswana	BPC	132	120	493
Democratic Republic of Cong	SNEL	2,442	1,170	1,075
Lesotho	LEC	72	70	109
Malawi	ESCOM	302	246	240
Mozambique	EDM	307		343
	HCB	2,250	2,075	
Namibia	NamPower	393	390	449
South Africa	Eskom	43,061	37,258	36,513
Swaziland	SEB	51	50	196
Tanzania	TANESCO	897	680	635
Zambia	ZESCO	1,632	1,630	1,468
Zimbabwe	ZESA	2,045	1,125	1,758
Total		54,711	45,757	43,755
			83.6%	95.6%
			(Effective Power/Installed Capacity)	(Peak Demand/Effective Power)

Source: Overview of SAPP and SAPP Operations in January 2008

1) Decrease in Effective Power Supply Capacity

The effective power capacity of SAPP in 2007 is estimated as 83.5% of the installed capacity. This indicates that the power supply capacity of the existing power supply facilities in SAPP has been largely reduced compared to the installed capacity. This is caused by: 1) the deterioration of existing power supply facilities in each SAPP country since the existing power facilities were constructed from 1960's to 1970's while new power plants have not been built during these period, and 2) the in-sufficient operation and maintenance of power facilities because of civil war in some SAPP countries. The

rehabilitation of power supply facilities has been carried out in 1990's after the civil war, during the progress of democratization in 1990's.

Although coal-fired power plants, which utilize abundant coal reserve in South Africa, accommodate 88% of the installed capacity in the country, these plants have existed for more than 20 years and have deteriorated. Therefore, the rehabilitation of existing coal-fired power plants has been continued, while deteriorated coal-fired power plants have been refurnished. Three coal-fired power plants (Camde coal-fired: 780MW, Groovtvlei coal-fired: 1,170MW, Komati coal-fired: 965MW) will be reconsidered in the integrated power system of South Africa from 2007 to 2011. However, the power shortage in South Africa occurred from end of 2007, and the load shedding has been carried out from end of January, 2008. The rehabilitation and reinforcement of existing coal-fired power plants and inputs of new power facilities are required as countermeasures against the power shortage.

The rehabilitations of three existing hydropower plants in Zambia (Kafue Gorge of 930MW, Kariba North Bank of 660MW, Victoria Fall of108MW) will be finished in March 2009. On the other hand, the power supply capacities of Inga 1 (351MW commissioned in 1972) and Inga 2 (1,424MW commissioned in 1982), constructed in the Congo River, have been reduced to 40% due to lack of sufficient maintenance affected by the civil war. The rehabilitation of Inga 1 & 2 hydropower plants have commenced through grant aid from WB, aiming to increase the supply capacity from 2007. The existing power supply plant (2,075MW) and the transmission line (533kV DC 1,410km) of Cahora Bassa hydropower plant, constructed in 1976 in Mozambique, have been rehabilitated after the 1995 civil war. The Cahora Bassa hydropower plant has restarted its power generation from 1997. Since effective power supply capacities in Malawi, Tanzania and Zimbabwe have significantly decreased, the rehabilitation and reinforcement of existing power plants in these countries are urgently necessary.

2) Shortage of Reserve Margin

In the SAPP region, the peak power demands in Botswana, Lesotho, Swaziland and Zimbabwe are more than their effective power supply capacities in 2007. These countries have imported their electric power from South Africa and neighboring counties. The reserved margin of almost counties in SAPP is less than 10%, while that of South Africa and Malawi is about 2%. Therefore, there could be a possibility of power shortage due to overlapping planned maintenance of existing power plants and power outage in South Africa and Malawi.

It is pointed out that the power shortage in South Africa are due to less reserve capacity, planned maintenance for existing power plants, and power outage at the same time. This power shortage would continue for 7 to 8 years since power plants have not been installed in the integrated power system of South Africa for 20 years. New power plants will be built until 2012. Therefore, early supply from thermal power plants, unclear power plants, and pumped storage power plants are necessary to improve the present condition of power supply in South Africa. Eskom will take countermeasures against power shortage such as: 1) the load shedding of 10%, 2) the effective power use by consumer, 3) the decrease of using electric power by increasing power tariff more than Us ¢ 2/kWh as short term, and 1) the demand side management, 2) the implementation of co-generation, 3) the development of natural gas resources in Mozambique and construction of gas turbine power plants, 4) the power exchange in SAPP and construction of unclear power plants in South Africa as long term.

The economic growth rate of Zambia recently reached 5%, and is forecasted to increase up to 6%. The power demand is further increased with the newly developing copper mine. However, the capacity of existing power supply facilities appears less than the power demand. Although Zambia has an installed capacity of 1,632MW, the reserve margin is smaller than that required in the system. The power supply capacity is also insufficient, being 400 MW less than the power demand in Zambia until December 2008 when the rehabilitation of existing hydropower plants are completed. The power company of ZESCO in Zambia will take countermeasures against the power shortage by: 1) the rehabilitation of existing transmission lines as short term, 2) the reinforcement of interconnecting transmission line between Zambia and neighboring countries as medium term, and 3) the development of new power plants as long term (Kariba Gorge Lower of 750MW, Itezi-Tezh of 120MW, Kariba North extension of 600MW).

In other countries which do not have sufficient reserve margin in the power system, the rehabilitation of existing power facilities and development of new power plants are also required to prevent the power shortage and load shedding. This is accomplished by improving the reserve margin of power supply facilities.

4.3.2 Issues on Formation and Operation of Power Supply Facilities for Power Exchange in SAPP

(1) Effective Utilization of Power Supply Facilities in SAPP

In the SAPP region, there are three large-scaled power supply facilities consisting of: 1) coal-fired power plants utilizing abundant coal reserve in South Africa, 2) hydropower plants developed in the Zambezi River and the Congo River in the northern area of the Southern Africa, and 3) gas thermal power plants using gas reserve along on-shore of eastern coast. Coal-fired power plants located in the southern area firmly supply base power, hydropower plants in the northern area supply mid-merit power and gas thermal power plants along eastern coast supply peak power in SAPP. These power plants can satisfy the power demand in SAPP by combining their capacities. The implementation of main interconnection transmission lines is required in order to utilize power supply facilities omnipresent in the southern, northern and eastern coast area of the Southern Africa and to effectively exchange the electricity power in SAPP by connecting these large-scaled power plants. With the provision of these main interconnection lines, the electric power could be supplied by the power supply facilities in the northern, southern and eastern areas. Figure 4.3.1 shows the power flow by this SAPP concept.

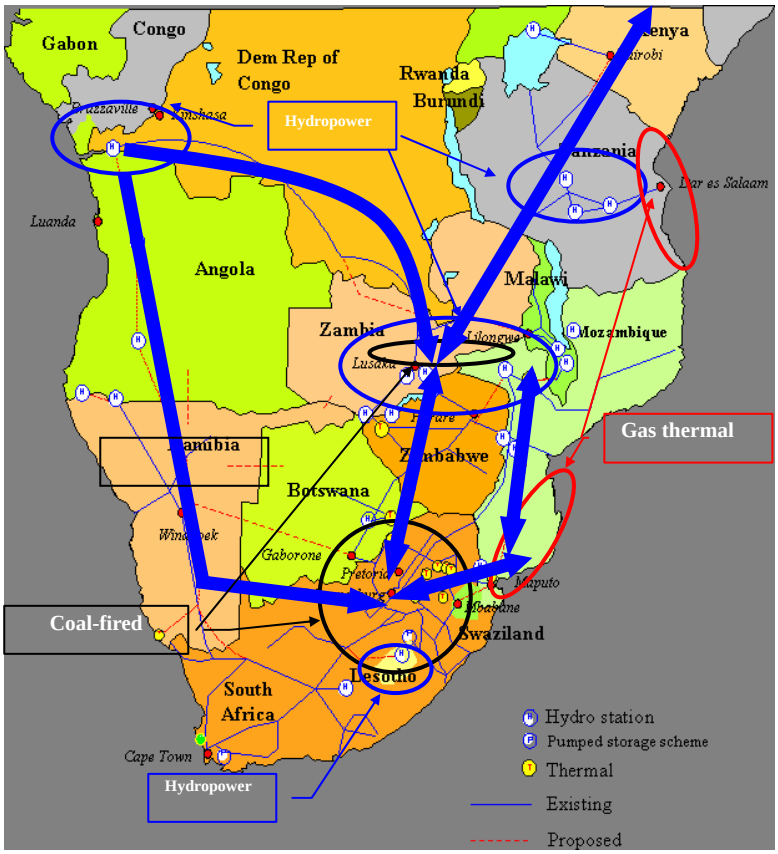


Figure 4.3.1 Power Supply Facilities and Power Flown in SAPP

In order to effectively exchange electric power generated by the power supply facilities in SAPP, installation of new power plants, extension of existing power plants, and development and reinforcement of interconnecting transmission lines in SAPP are conceived as follows:

1) Power Development Plans

a) Early input of two coal-fired power plants, gas thermal plant and pumped storage power plants in South Africa

b) Implementation of three hydropower plants along the Zambezi Rive in Zambia (Itezhi-Teshi, Kariba North Extension, Kafue Gorge Lower)

c) Implementation of gas thermal plant at Temane and Mphanda Nkuwa hydropower plant in Mozambique

d) Extension of the existing Cahora Bassa hydropower plant in Mozambique (Cahora Bassa North Bank)

e) Implementation of large-scaled hydropower plants in DRC (Inga 3 and Grand Inga)

f) Implementation of pumped storage power plant in Lesotho (Monotsa)

2) Interconnection Transmission Lines

a) Early completion of reinforcement of the interconnection transmission line between DRC and Zambia (Extension of 220kV single circuit T/L and new construction of 330kV T/L)

b) Commencement of construction of the interconnection transmission line between Mozambique and Malawi (220kV, 210km long)

c) Implementation of the back bone transmission line in Mozambique (400kV double circuits)

d) Implementation of the interconnection transmission line between Tanzania and Mozambique (220kV single line)

e) Implementation of the interconnection transmission line among Zambia, Tanzania and Kenya (330kV double circuits)

f) Implementation of the interconnection transmission line between Zambia and Namibia

g) Implementation of the western corridor interconnection transmission line in the southern Africa (400kV or 765kV)

(1) Issues on Operation of Power Exchange in SAPP

1) Bottle Neck of Interconnection Transmission Line in SAPP

In the SAPP region, the power exchange has been mainly carried out through interconnected transmission lines between neighboring countries at present. The electric power generated at the existing Inga hydropower plants of 1,775 MW from both Inga 1 and 2 is transmitted to Zambia through 500 kV DC transmission lines. However, the 220kV transmission line connected from the 500 kV DC transmission line to Zambia near the boarder can not effectively transmit electric power due to its deteriorated condition. This 220 kV line becomes a bottle neck for the power exchange between DRC and Zambia. To improve its condition, a new 330kV transmission line is under construction to supplement the 220kV transmission line. Since effective power exchange is urgently required, improving the progress of the rehabilitation and reinforcement of interconnection transmission lines is vital as countermeasures against the power shortage in SAPP.

2) Stability of Interconnected Transmission Lines

When all planned interconnection transmission lines in SAPP are implemented in the future, this power network becomes one of the largest power transmission networks in the world. However, there is a foreseen difficulty in operating the transmission network once the scale transmission line of alternating current increases .

In the power transmission network, the amount of electric power generated in the whole system is regulated so as to equal the system load including losses in the system. However, large variation in frequency is induced in the network system when the regulation of generated power connected in the network system is not properly executed. Furthermore, the generated power can not be regulated well due to the restriction in transmission line capacity in local lines of the network system. As a result, there is a possibility of black out occurring in the whole system. In addition, the power outage in large areas would be induced by the loss of stability in the system, in the case the expansion and construction of transmission line system remain interconnected to the alternate current transmission line system with weak condition. The large-scaled power outages were recently experienced in the network system of Europe and America several times. This is due to the above technical weakness of the transmission line system, even though the large-scaled network system seems economical.

At present, the interconnection transmission lines between Zambia, Zimbabwe and the northern South Africa, and between Mozambique and South Africa, are identified as relatively strong interconnection systems in the SAPP region. The length of the former transmission line is about 1,000 km, while the latter is 1,500 km. There are no larger issues on the stability of the system since the connection is a direct current. No investigation and study on the stability of the whole interconnection system in SAPP have been carried out. It is therefore conceived that each plan for the interconnection system in SAPP remains in the pre-master plan stage.

When the interconnection system is extended in the future, issues on the regulation of frequency in the whole system and the maintenance of stability in the system will be introduced. Therefore, related subjects need to be studied with regards to the operation of the whole system, in the course of realizing each interconnection system. This study consists of: 1) the share of duty of power dispatching facility in each utility in consideration of the whole system, 2) the necessity of the power dispatching center in the SAPP region, and 3) the study on the restricted value of power flow in each interconnection line from viewpoints of the stability in the whole system, in terms of the operational aspect, including the appropriate method of power exchange and system control in the network.

3) Issue on Operation of Coal-fired Power Plants in South Africa

Coal-fired power plants in South Africa occupy 69% of installed capacity in the SAPP region, and are considered large power supply facilities. However, said power plants

have not sufficiently supplied reliable electric power due to the reduction of their capacities as experienced during the power shortage in South Africa from the end of 2007. This reduction is caused by the deterioration of existing power supply facilities and the decreasing stored volume of coal. Because of this, South Africa has reduced 10% of its power export to neighboring countries since January 2008. Six countries import the electric power from South Africa namely, Botswana, Namibia, Zimbabwe, Lesotho, Swaziland, and Zambia. Among these, the imported electric power occupies a large percentage in Botswana, Namibia, Zimbabwe, and Swaziland. Therefore, the power cut of imported power from South Africa would affect the power supply status in these countries. Since the imported power in Namibia largely occupies 48% of the power energy in the country, the 10% power cut of imported power from South Africa could affect the industrial and domestic power supply. Hence, the ,means to ensure a stable and reliable supply of base power in South Africa is to consider maintaining old coal-fired power plants with good operation condition, rehabilitation of these plants and inputting new thermal power plants as the implementation plan.

4） Effects of Drought to Hydropower Plants in Northern Region of SAPP

The effective utilization of hydropower potential along the large-scaled rivers of Zambia, Zimbabwe, Mozambique and DRC generally in the northern region of Southern Africa could be indispensable for the stable power supply in the SAPP region. There is no argument that exploiting hydropower resources would be beneficial as it provides natural and renewable energy. However, the generated energy from hydropower is dependent on climate and hydrological conditions. The reliability of power supply will be reduced by decreasing their power supply capacities during drought season. Therefore, it is necessary to add power supply facilities to sustain the power capacity of hydropower plants which diminishes during the drought season.

5） Gas Thermal Power Plants along Eastern Coast

On-shore natural gas along the eastern coast in Mozambique has been developed as fuel supply for South Africa. This is also utilized for gas thermal plants in Mozambique. Although natural gas will be utilized as natural resources for fuel and thermal power, its price is rising due to recent increasing price of crude oil. It is also conceived that natural gas would be utilized in the future. Therefore, the dependence on natural gas in large percentage should be avoided in order to supply a reliable and stable electric power.

6） Attractive Power Tariff for IPP

Most coal-fired power plants in South Africa utilize abundant coal reserves in the

country. These plants can economically generate electric power due to low price of coal in South Africa and low transportation cost. The average power tariff in South Africa is around US ¢ 2/kWh. On the other hand, new power plants will not be operational until 2013 considering that old coal-fired power plants were constructed in the 1980's. It is planned that 70% of new power plants will be implemented by Eskom, while 30% by IPP. In the case of IPP base projects, the power tariff between the utility and IPP would be set as more than US ¢ 4/kWh in the world. In Southeast Asia, the power tariff between Electricity Generating Authority of Thailand (EGAT) and IPPs is established to be around US ¢ 5.5 to 6.0/kWh. When the new power plant is planned to be implemented through private financing, the power tariff of US ¢ 2/kWh is much cheaper than the expected one proposed by IPP. This low tariff would be less attractive for IPP. Therefore, there is a possibility of raising the present lower power tariff to an attractive rate to enable private sectors to establish a reliable financial condition.

(2) Issues regarding the future power system operation and system stability

When all the proposed SAPP interregional connections were constructed, its system would become one of the largest power systems in the world. Generally, the power system operation tends to become more difficult for larger AC systems. The amount of power generation is always being adjusted to meet the load demand, including power transmission losses. However, if the power generation from the power plants connected to the system is adjusted, the system frequency would change. In case power generation adjustment fails due to the power transmission constraints, a system blackout could occur. If the power system is expanded while the power transmission network remains weak, large power outages with lost system stability will occur. Hence, economizing large power systems could cause two different system characteristics.

The existing intervals with relatively firm interregional connections in SAPP are Zambia-Zimbabwe-South Africa and Mozambique-South Africa. The former has a length of around 1,000 km. The latter meanwhile has 1,500 km but a portion of its transmission lines operates through DC. Thus, stability problems are not so much of a concern. It was found that there were only limited studies carried out to check the system stability of the overall proposed system. This is due to the fact that the existing plans of each interregional connection are still in the pre-feasibility stages.

The expansion of the power network system tends to cause the problems on power frequency adjustment or maintaining stability. Therefore, it is vital that relevant issues are studied concerning the roles of each company's power dispatching center, the requirements of the

central load dispatching center and the power flow constraints in the interregional connections. This is considered from the viewpoints of overall power system stability, including the method of systems operation.

4.4 Export/Import of Power in the Region

4.4.1 Records of power trade in SAPP of Southern African region

Table 4.4.1 shows records of the amount of power generation of power companies and the power import and export (2006) in the southern African region. (Fiscal year of SAPP is determined from April to March)

As seen from said table, the power imports in Botswana (BPC), Mozambique (EDM), Namibia (Nam Power) and Swaziland (SEB) were recorded to be more than their power generation. These power imports are from South Africa (Eskom) and Cahora Bassa hydropower station.

Table 4.4.1 Records of Power Generation and Power Import/Export of Power Companies in Southern African region (2006)

Power Co.	Countries	Power Generation (GWh)	Power Import (GWh)	Power Export (GWh)
ENE	**Botswana**	2,982.0	19.6	0
BPC	**Mozambique**	977.0	2,050.4	0
SNEL	**Malawi**	7,214.0	13.8	1,322
LEC	**Angola**	466.0	39.0	22
ESCOM	**South Africa**	1,177.0	0.0	0
EDM	**Lesotho**	222.0	1,870.0	174
NamPower	**Namibia**	1,606.0	1,948.0	0
ESKOM	**DRC**	221,985.0	8,643.0	5,515
SEB	**Swaziland**	125.8	894.0	0
TANESCO	**Tanzania**	3,674.0	43.0	0
ZESCO	**Zambia**	9,480.0	0.0	505
ZESA	**Zimbabwe**	7,781.0	4,241.0	414

Source: SAPP Annual Report 2007

With regards to power import in the region, the power from Cahora Bassa hydropower station should be included in the table shown above. Cahora Bassa hydropower station is the IPP constructed in 1976, through the support of Portugal, owned by Hydroelectric de Cahora Bassa (HCB, the ratios of capital contributions were changed from 85 % by Portugal, 15% by Mozambique to 15 % by Portugal, 85% by Mozambique in November 2007). Table 4.4.2 shows the amount of power generation from Cahora Bassa hydropower station categorized by the receiving organizations. The amount of power generation from Cahora Bassa

hydropower station reached 14,490 GWh in 2006 and shared over 60% of the amount of the power trade in the Southern African region.

Table 4.4.2 Energy from Cahora Bassa Hydropower Station

Receiving Organization	Sending Energy
South Africa (Eskom)	7,870
Zambia (ZESA)	3,023
Northern Mozambique (EdM)	460
Southern Mozambique (EdM)	1,650
Loss and others	1,487
Total	14,490

Source：Technical Due Diligence of the Restructuring of Hidroeléctrica De Cahora Bassa, Supplementary Report

The following Figure 4.4.1, which was graphically made from the data in Table 4.4.1, shows that Eskom has an overwhelming share of power generation in the South African region. The scale of power demand in South Africa is also large and supplied mainly by its domestic power generation. Therefore, power import to South Africa is relatively small. Moreover, power trade in the region is relatively small compared to the power generation in South Africa alone. However, the power import to the domestic power demand shares a large portion from many countries including Botswana (BPC), Mozambique (EDM), Namibia (Nampower) and Swaziland (SEB).

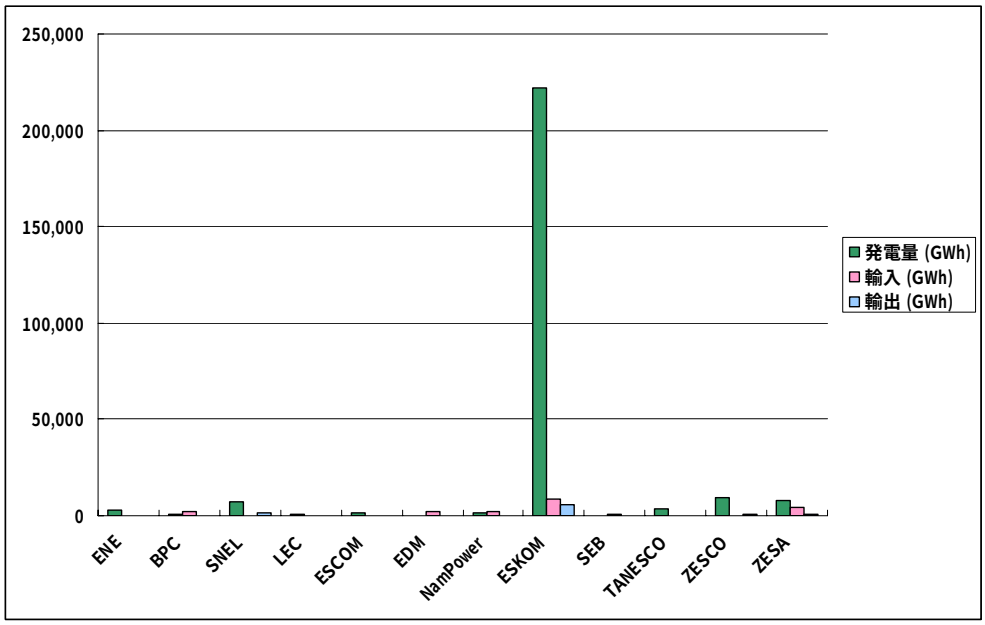
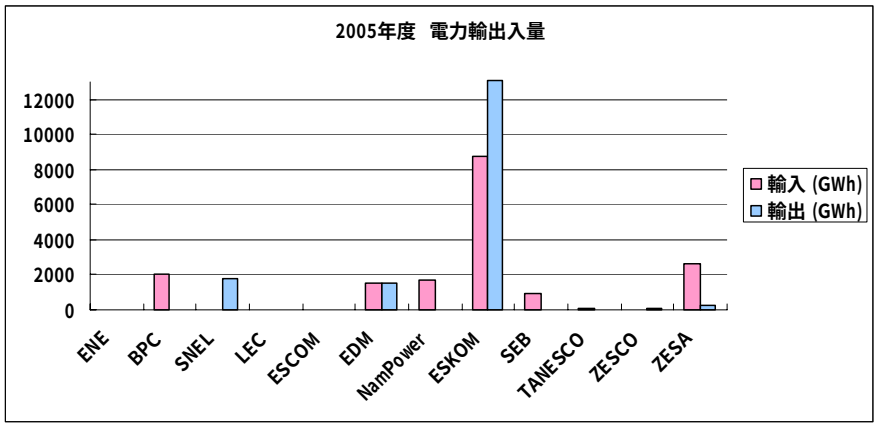


Figure 4.4.1 Power Generation of Power Companies and Power Import and Export (2006)

Figure 4.4.2 shows the records of power import and export of power companies in the Southern African region in 2005. Figure 4.4.3 meanwhile shows the records as of 2006.

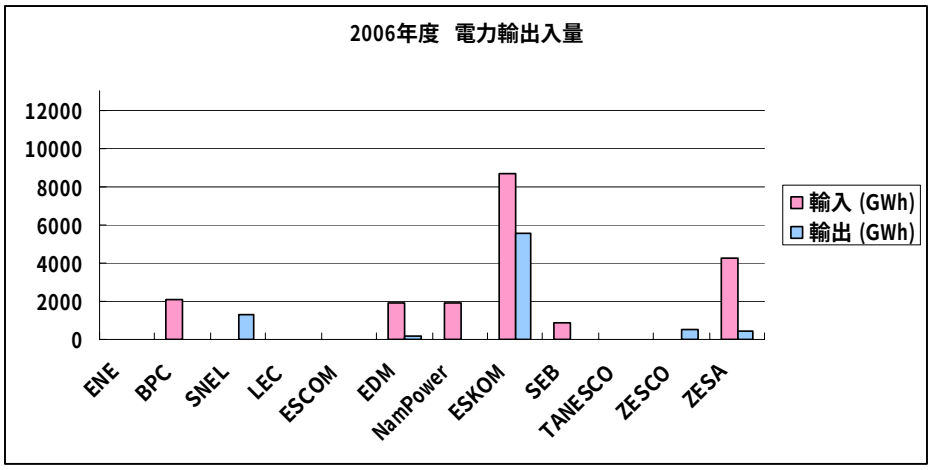
Based on said records, the amount of import was reduced especially for ESKOM of South Africa. This indicates that the power export was not efficiently carried out due to the power shortage in South Africa (Eskom).

Power import seemed to be almost the same in both years, which could be attributed to the good conditions of power supply from Cahora Bassa. Hence, since Cahora Bassa hydropower station is operated as the base of power generation, the shortage of power supply during peak period is estimated.



Source: SAPP Annual Report 2005

Figure 4.4.2 The Record of Power Import and Export of Power Companies in Southern African Region (2005)



Source: SAPP Annual Report 2006

Figure 4.4.3 The Record of Power Import and Export of Power Companies in Southern African Region (2006)

4.4.2 Verification of Power Demand Supply Balancing and Estimation of Possible Amount of Power Trade

Power trade in SAPP system is now limited because of insufficient interregional connections between the power sources and their supplied regions. Especially in recent years, the power shortage is becoming a serious problem due to the lack of power development required to meet the growing demands. Thus, efficient power supply through the motivation of power trade in the Southern African region is considered as one of the effective countermeasures.

A master plan was initiated involving the study on identifying the required interregional

connections by examining the future power demand supply balancing. WB is now reviewing the Power Pool Plan 2001. The outline of the Draft Executive Summary (November 2007) includes the following.

Two scenarios were supposed as the power development program in the region.

i) Base Case: Placing importance on the development of thermal power plants in the southern region such as coal in South Africa

ii) Alternative Case: Development of hydropower plants and transmission line in the northern region

I Study between the above cases were carried out to compare the power demand balancing and the expected power flow in order to estimate the cost of power generation and regional interconnection. The study concluded that case ii) is recommendable. This covers:.

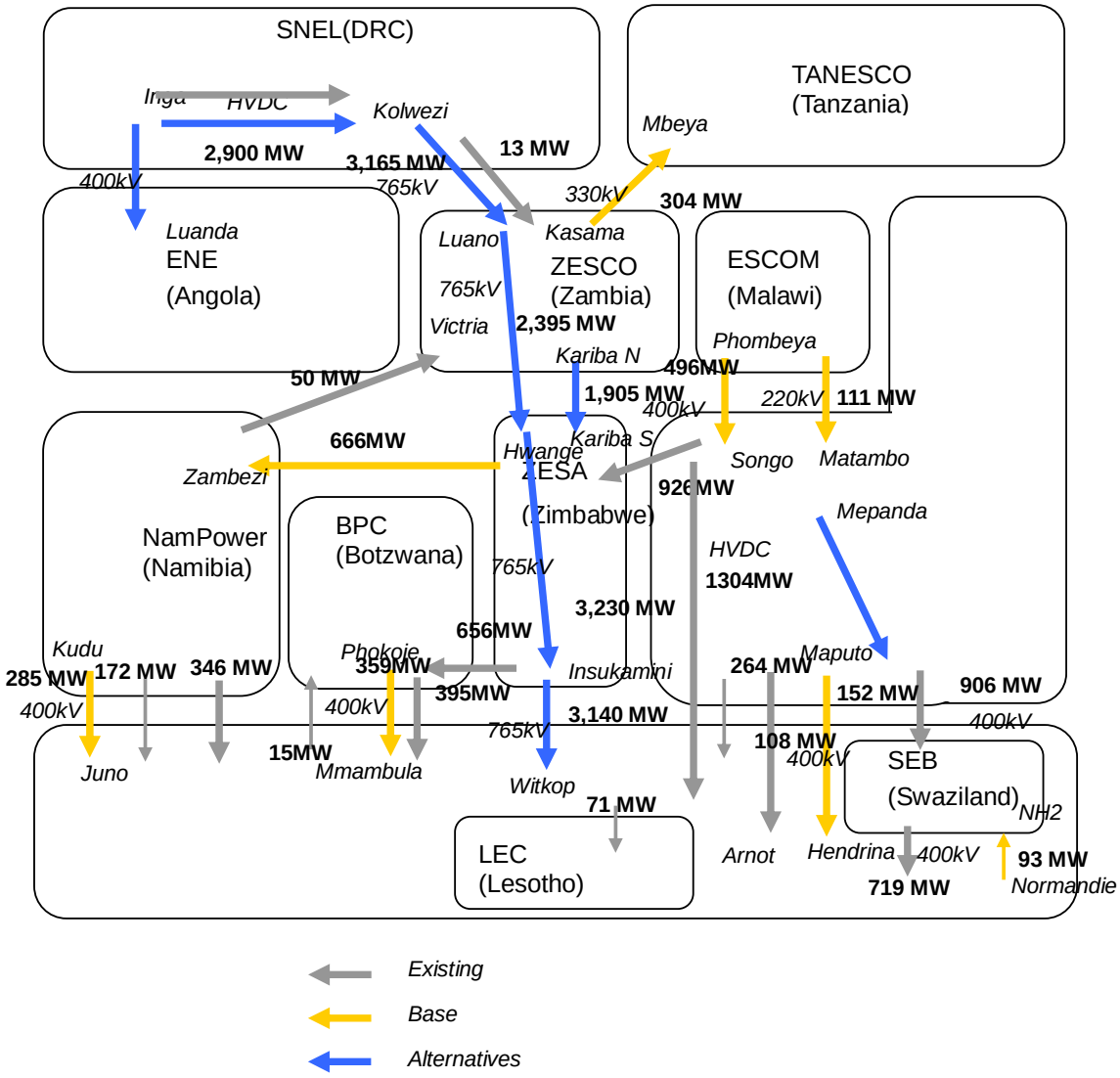
- The construction of the 765kV upper Grid, the reinforcement of the Back Bone Transmission Line in Mozambique and the emphatic development of the hydropower plants and transmission line in the northern region

Prioritized recommendations for both cases include the following:

- Urgent interconnections of Angola (ENE), Malawi (ESCOM), Tanania (TANESCO) to the existing SAPP power network
- Power development coordination in the power companies in the region
- The first step for the implementation of the 765 kV Super Grid interregional connections from DRC to South Africa through Zambia and Zimbabwe

The Draft Executive Summary recommended the carrying out of the construction of the effective power supply system by connecting Angola, Malawi and Tanzania to SAPP, in order to utilize the hydropower in SAPP. This realizes achieving effective power transmission to South Africa from Inga or Zambezi river-based hydropower by implementing the interregional connections. Figure 4.4.4 shows the expected power flow in southern African region in 2025.

However, the abovementioned results are still in the drafting stages. From information obtained from ESKOM, there is still a possibility of introducing other cases or alternatives such as implementing 765 kV interregional connections Western Corridor (Angola-Namibia-South Africa). Hence, the corresponding final report could include amendments to the abovementioned results.



Source： SAPP Regional Generation and Transmission Expansion Plan Study DFR Executive Summary

Figure 4.4.4 Expected Power Flow in Southern African Region in 2025 (At Maximum)

4.5 Technical Cooperation and Exchange Among the Countries in the Region

Sub-committee on "Operation", "Environment" and "Planning" under the Management Committee, exists in SAPP. According to its monthly report in August 2007, the following conferences wee held as intraregional technical cooperation and communication, for purposes of sharing information.

Table 4.4.3 Member Country of SAPP and Power Industry

No.	Conference Name	Date	Place
1	Working Group of personal development of SAPP	2007/9/26-27	**Harare, Zimbabwe**
2	Trader and Operator Forum	2007/9/27-28	Maputo, Mozambique
3	Agreement within Member and Operation Guide Review	2007/10/8-9	Maputo, Mozambique
4	Work Shop of Planning Review of SAPP Pool	2007/10/29-30	Johannesburg, South Africa
5	UPDEA Conference	2007/10	Morocco
6	23rd SAPP Executive Committee	2007/10	Gaborone, Botswana

Source: SAPP's Monthly Report (August, 2007)

4.6 Functions Expected of and Issues Concerning the Power Pools

4.6.1 Background and functions of African power pools

Power pools are expected to bear the following responsibilities, according to the action policies posted by the power pools in Africa.

- Formulation of master plans for the region (power generation and transmission)
- Capacity building for members (in the aspects of technology, legal systems, negotiation in PPP, IPP, and other contracts)
- Mediation on short-term power trading
- Coordination with relevant regional regulators
- Coordination(*) and fund-raising for projects

(*) May include assistance in negotiation on long-term power sales contracts between members in some cases.

4.6.2 Issues concerning power pools

As mentioned earlier, there exist two power pools in the area surveyed in this study.

EAPP, recently established in 2005, is saddled with issues to be taken, such as improvement of the organization and security of its financial resources. Therefore, the following were determined as issues concerning the African power pools, with due consideration to the history and experiences of SAPP in mind:

(1) Background and current status: facilities

The Southern Africa region underwent both short- and long-term power trading based on abundant power surplus in South Africa. However, South Africa's DME remarked in its energy white paper in 1998 that power surplus would dissolve by 2007, unless the country starts discussing the development of new power sources in the succeeding year. At that time, the country initiated utilizing IPPs, excluding its state-run utility, Eskom, from the development. However, no IPP, operating at a marginal cost, was accepted in the country where power tariff rates are very low. As a result, the country's Minister of Public Enterprises in 2004 (Alec Erwin, succeeding Jeff Radebe), assigned 70% of the new power source development to Eskom.

In Southern Africa, SAPP held power investment meetings in Windhoek, Namibia, in

September 2005. In Johannesburg, meetings were held in November, in accordance with the resolution at an SADC Energy Ministries Conference. The meetings called for investments and loans from foreign capital. However, no single power generation project for South Africa's purchase was committed. Moreover there has been no power project involving selling power to South Africa.

With respect to grid projects, the transmission line from DRC connecting to South Africa, the second largest power producer next to South Africa, is expected to reinforce the line between DRC and Zambia as well as within Zimbabwe. The study team in fact directly received a request for assistance in this effort. As for Zimbabwe, such a project will advantageously strengthen the power supply without any new development, once an appropriate structure is put in place, allowing the project to be initiated immediately after the resignation of President Mugabe. (It is said that 300MW out of 500MW can be supplied to South Africa.)

(2) Background and current status: power trading

South Africa, while receiving power supply from Mozambique and the DRC, has been providing its neighbors, such as Botswana, Namibia, and Zimbabwe, with power based on mid-term contracts. These contracts have been revised to drastically reduce the power to be traded in the past few years. Nevertheless, no specific information, including price, has been disclosed even to SAPP. There were recent information that Eskom does not perform its obligations in supplying power in accordance with the revised contracts. It is instead taking advantage of the force-majeure clauses.

It is assumed that power deficiency in South Africa has diminished the short-term power interchange drastically. Moreover SAPP has suspended for a while the electronic distribution of monthly reports.

(3) Issues

International and regional conferences on the power sector are held four to five times a year in the Sub-Saharan region. On these occasions, projects concerning generation and transmission of power and electrification are presented. During these conferences, many raised fund procurement as a problem. Financial institutions as well share the same views, implying their willingness to grant loans, however, no bankable projects exist.

Power interchange inevitably requires an expanded power generation capacity along with the installation or addition of transmission lines. However, prior to that, it is vital to find bankable power purchasers. Now that mine development projects have been progressing,

Ghana, Zambia and other mining countries are reportedly in the process of initiating power generation projects in cooperation with existing mining companies. This form of power development and transmission line construction may be effective while public power corporations are still not bankable.

Moreover, established foreign capitalists acting as counterpart for contracts with private power producers, requires credible financial advisors and legal counsels. Financial assistance to this end will also be needed. (Even Japan has reportedly set up a trust fund in agencies as WB, IFC or AfDB, for employing consultants and advisors. It will be ideal for host countries if they can also employ reliable advisors.)

Other issues according to SAPP include promotion of technical skills in order to establish and operate trading systems (for which North European countries are providing aid), capacity building in the legal system and contract fields, and others.

In addition, as for East Africa, the EAC, EAPP, COMESA and NBI (Power Trading) are discussing formulation or revision of their master plans. Considering that the membership of COMESA and NBI overlaps, and that EAPP is placed under the umbrella of COMESA, coordination is deemed necessary. Incidentally, NBI's Power Trade team in the was scheduled to complete its roles and dissolve in June this year, however, it seems that it would be extended until the end of year on the condition that there is still tasks to perform and available budget. (It was explained that EAC's master plan would have to be revised partly because its number of members had increased from three to five. If said plan is revised, it is likely that it will also help create a master plan for the Eastern Africa as a whole.)

4.6.3 Action policies of the SAPP

This sub-section presents features, particularly action policies, of the SAPP.

(i) Visions

- Contribute to the development of a competitive electricity market in the SADC region.
- Give the end user a choice on electricity supply.
- Ensure that the Southern African region is the region of choice for investments by energy intensive users.
- Ensure sustainable energy developments through sound economic, environmental and social practices.

(ii) Objectives

- To provide a forum for the development of a world class, safe, efficient, reliable and stable interconnected electrical system in the southern African region.
- To create and enforce common regional standards of quality of supply and measurement and monitoring of systems performance.
- To harmonize relationships between member utilities.
- To contribute to the development of regional expertise through training programmes and research.
- To increase power accessibility in rural communities.
- To implement strategies in support of sustainable development priorities.

(iii) Mission

- Aim to provide the least cost, environmentally-friendly and affordable energy and increase accessibility to rural communities.

(iv) Strategy

- To be the most preferred region for investment in terms of value for money by energy intensive users

(v) Values

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

4.6.4 Record of activities of the SAPP

The activities performed by the SAPP are as summarized below.

(i) Foundation of the Coordination Center (November 2002)

(ii) Revision of the inter-governmental MOU and the MOU among utilities, so as to enable private utilities to accede to the SAPP (April 2007)

(iii) Signing of an MOU with the Regional Electricity Regulators Association of Southern Africa (RERA) (April 2007)

(iv) Setting of wheeling charge (January 2003)

(v) Creation of a competitive electricity market

- April 2001: Foundation of the STEM (Short-Term Energy Market). The number of participants has increased from two companies at that time to now include eight.
- July 2004: Aid from Sweden's SIDA was agreed, which enabled the preparation of long-term policies and procedures on wheeling charge, and establishment of a supplementary service market.
- February 2007: With the help of Nord Pool, a trading system for the day ahead market (DAM) was implemented and a test operation began in April.

(vi) Installation of transmission lines beyond its national borders
- 1995: South Africa-Zimbabwe; 400kV
- 1997: Mozambique-Zimbabwe; 330kV
- 1998: Mozambique-South Africa; 533kV
- 2000: South Africa-Swaziland-Mozambique; 400kV
- 2001: South Africa-Namibia, South Africa-Mozambique; 400kV
- 2006: Zambia-Namibia; 220kV

(vii) Preparation of environmental guidelines: Power transmission and thermal power

(viii) Miscellaneous
- 2001: Formulation of a SAPP Pool Plan, which is currently reviewed for revision under the assistance from the WB.

4.6.5 Contents requested by the EAPP

Situated in Ethiopia, EAPP receives aid from the AfDB and the EC, while also requesting USAID, GTZ, Austria ADA and Sweden for assistance. This sub-section summarizes the contents of assistance that EAPP is requesting, based on the request form submitted to the Swedish Embassy in Ethiopia. It also presents details of assistance currently provided by AfDB and EC. The summary below helps understand the roles expected from the power pool. It is also noted that interviewees from the EAPP expressed their requests to the government of Japan during the interviews conducted by the study team.

(i) Details of assistance by the EC
- Construction of databases, review of existing studies, and formulation of future prospects based on the existing studies
- Preparation of strategies and project plans: setting of strategic goals and preparation of roadmaps to achieve the strategic goals, including analyses in the aspects of legal systems, tariffs, and organization of the EAPP
- Drafting of action plans and project plans for three years
- Capacity building

(ii) Details of assistance by the AfDB
- Formulation of a master plan for regional power systems and EAPP Grid Codes
- Education and training: project manager, PPP

(iii) Key contents of assistance being requested
- Establishment of technical subcommittees in the EAPP: three fields—planning, operation, and environment
- Building of a coordination mechanism as the window to power regulators in the region
- Examination on the establishment of a Coordination Center

4.7 Initiatives of Donors (WB, USAID, EU, AfDB) in Regional Cooperation

4.7.1 World Bank

List of WB's ongoing and completed projects in the power sector in Africa are attached following this subsection . Major elements are summarized as follows::

(i) Implemented projects
- Out of the 577 projects implemented in Africa since 2000, which are worth 21 million US dollars in total, 40 projects belong to the power sector, equivalent to 12 percent or 2.7 million US dollars. Of these, there were two regional cooperation projects, namely, the revision of the Southern Africa's Pool Plan (master plan) (May 2007) and the Nile Basin Power Trade (May 2004).

(ii) Pipeline projects
- Of the 28 projects currently under review, 17 projects are in the power sector in Africa. Of these, three involve multiple countries, while two are implemented in Eastern and Southern Africa.
- Felou Hydroelectric Project in the basin of the Senegal river, West Africa
- NELSAP Susumo Falls Hydroelectric Project (with an aim to supply power to Tanzania, Rwanda, and Brundi)
- Eastern and Southern Africa Technical Advisory Services APL Phase 1

(iii) Remarks
- SAPP is supposed to review all power generation projects in the region every five years. Presently, though slightly delayed, it is reviewing its pool plan with funding from the WB.
- Although still at a draft phase, the report encourages shifting from thermal power to hydropower as an alternative case. This is contrary to the past and existing plans, which are considered as base case.
- At the same time, the report points out that the project in South Africa intends to initially proceed with 3,600MW (less than the actual 5,000MW) Mmamabula thermal power plant in Botswana but doubts if such a project will be politically acceptable. It also refers to other issues, such as the necessity for a high backup ratio due to the significant fluctuation in hydropower output over the years.

Table 4.7.1 List of the WB's ongoing (pipeline) projects in the power sector in sub-Saharan Africa (for the informative purpose)

	Project Name	Country
1	Guinea- GEF- Electricity Sector Efficiency Improvement Project	Guinea
2	Kenya KenGen Carbon Finance umbrella	Kenya
3	OMVS Felou Hydroelectric Project	Africa
4	Rw: Urgent Electricity Rehabilitation (GEF)	Rwanda
5	Rw: Lake Kivu Methane-to-Power (Guarantee)	Rwanda
6	DBSA Regional Carbon Finance Operation	Africa
7	CF Kengen, Sondu Miriu, Kipevu	Kenya
8	SN -Energy Sector Recovery DPL (FY07)	Senegal
9	NELSAP: Regional Rusumo Falls Hydroelectric and Multipurpose Project	Africa
10	Zm: Increased Access to Electricity	Zambia
11	Eastern and Southern Africa Technical Advisory Services APL Phase 1	Africa
12	CM-Energy Sector Development SIL (FY08)	Cameroon
13	Uganda: Kakira Bagasse Cogen (Carbon Offset)	Uganda
14	Zm: Increased Access to Electricity & ICT Services - GEF	Zambia
15	Sustainable Energy Management Project	Burkina Faso
16	African Rift Geothermal Development Facility	Africa
17	Kenya KenGen Carbon Finance umbrella	Kenya

Source: The World Bank Proposed Projects

(Website: http://web.worldbank.org/external/default/main?menuPK=258672&pagePK=146740&piPK=512754&theSitePK=258644)

Table 4.7.2 List of the WB's projects in the African power sector since 2000
(for the informative purpose)

No.	Project Name	Country	Approval Date
1	Southern African POWER Market Program: Mozambique-Malawi Transmission Interconnection Project	Africa	17-Jul-07
2	Regional and Domestic POWER Markets Development Project (Southern Africa POWER Market Project: APL-1b)	Africa	29-May-07
3	WAPP APL 1 (1st Phase - COASTAL TRANSMISSION BACKBONE)	Africa	30-Jun-05
4	SVP: Regional POWER Trade (Nile Basin Power Trade)	Africa	5-May-04
5	3A-Southern Afr POWER Mrkt APL 1 (FY04)	Africa	11-Nov-03
6	Burkina Faso ENERGY Access Project	Burkina Faso	26-Jul-07
7	POWER Sector Development Project	Burkina Faso	30-Nov-04
8	ERITREA POWER DISTRIBUTION AND RURAL ELECTRIFICATION PROJECT	Eritrea	6-Jul-04
9	Ethiopia/Nile Basin Initiative: Ethiopia-Sudan Interconnector	Ethiopia	20-Dec-07
10	Electricity Access (Rural) Expansion Project Phase II	Ethiopia	3-Jul-07
11	Accelerated Electricity Access (Rural) Expansion	Ethiopia	22-Jun-06
1	ENERGY ACCESS PROJECT	Ethiopia	19-Sep-02
2	Ghana: ENERGY Development and Access Project	Ghana	26-Jul-07
13	Ghana Rural ENERGY Accesss	Ghana	26-Jul-07
14	Guinea Electricity Sector Efficiency Improvement	Guinea	22-Jun-06
15	DECENTRALIZED RURAL ELECTRIFICATION PROJECT	Guinea	2-Jul-02
16	Decentralized Rural Electrification Project	Guinea	2-Jul-02
17	Energy Sector Recovery Project	Kenya	13-Jul-04
18	POWER/Water Sectors Recovery and Restructuring Project	Madagascar	13-Jul-06
19	Household Energy and Universal Access Project	Mali	4-Nov-03
20	Mozambique: Energy Reform and Access Program	Mozambique	2-Sep-03
21	Energy Reform and Access Project	Mozambique	19-Aug-03
22	Nigeria National Energy Development Project	Nigeria	1-Jul-05
23	SN - Electricity Sector Efficiency Enhancement - Phase 1, APL-1	Senegal	17-May-05
24	SN-Elec Sec Efficiency Enhance GU (FY05)	Senegal	17-May-05
25	SN-GEF Elec Srvc for Rural Areas (FY05)	Senegal	9-Sep-04
26	SN-Elec. Serv. for Rural Areas (FY05)	Senegal	9-Sep-04
27	SL Bumbuna Hydroelectric Environmental and Social Management project	Sierra Leone	16-Jun-05
28	POWER and Water Project	Sierra Leone	1-Jul-04
29	Renewable ENERGY Market Transformation	South Africa	28-Jun-07

No.	Project Name	Country	Approval Date
30	TZ-ENERGY Development & Access Expansion	Tanzania	13-Dec-07
31	TZ-GEF ENERGY Dvpt and Access Expansion	Tanzania	13-Dec-07
32	PPIAF: TANZANIA: Legal Advisors for the Ruhudji Hydro POWER Project	Tanzania	12-Oct-07
33	Songo Songo Gas Development and POWER Generation Project	Tanzania	9-Oct-01
34	UG - Private POWER Generation (Bujagali) Project	Uganda	26-Apr-07
35	Uganda POWER Sector Development Project	Uganda	26-Apr-07
36	Canceled-UG-Bujagali HydroPOWER GU(FY02)	Uganda	18-Dec-01
37	ENERGY for Rural Transformation Project	Uganda	13-Dec-01
38	ENERGY for Rural Transformation Project	Uganda	13-Dec-01
39	POWER Project (04)	Uganda	3-Jul-01

Source: The World Bank Website (Active Project)

4.7.2 USAID

USAID's policies on assistance to Southern and East Africa are quoted at the end of this subsection. In summary, it seems to focus on improvement in the political and security aspects, and enhancement of governance, rather than the development on infrastructure or economy.

On the other hand, according to the report from the European Union (EU) Capacity assessment power pools, the agency has dispatched to the SAPP, personnel who had experience working with the NY Power Pool and have provided aid to WAPP and CAPP. Said personnel however was not yet dispatched to EAPP.

The assistance extended through the USAID to the WAPP consists of advisory support and technical assistance with an end date scheduled in September 2008, which may be postponed by 10 years. It also includes the drafting of a five-year development plan (7 million US dollars). Furthermore, the agency supports human exchange between the WAPP and its member companies, and electricity-related organizations and power pools of the U.S., through the US Energy Association.

In addition, President Bush, during his visit to Tanzania in February in 2008, pledged a grant aid of 698 million US dollars to the country, through the Millennium Challenge Corporation (MCC) (http://www.mcc.gov/documents/factsheet-021708-tanzania.pdf). The total amount covers 373 million US dollars for the transport sector, 66 million for the water sector and 206 million in the energy sector. This is allotted for the following projects:.

(i) Installation of submarine electric transmission cable connecting to Zanzibar (Unguja, the main island of the Zanzibar archipelago). Assistance to improve the situation with the existing cable that is superannuated and no longer sufficient in terms of capacity.
(ii) Construction of a hydropower plant on the Malagarasi River, and extension of a mini-grid system in the Kigoma region, which will replace diesel power generation
(iii) Rehabilitation and extension of the distribution network, in six regions requested by the Government of Tanzania

The U.S. seemingly intends to expand assistance to recipient countries that have been selected according to the progress of governance and democratization. MCC is the executing unit to implement such assistance. Through systematic processes MCC designates a developing country as its recipient of significant amount of funds[25].

[25] It is undisputable that, in interconnecting the infrastructure over a wide area in Africa, where many states do not constitute a minimum

Table 4.7.3 USAID's initiatives in Southern Africa (for the informative purpose)

USAID/Southern Africa

USAID's Strategy in Southern Africa

The United States has four main interests in Southern Africa: increasing trade and strengthening economic ties with the region, mitigating the region's HIV/AIDS crisis and recurrent food insecurity, and strengthening democracy to reduce the risk of conflict in the region.

EXPANDING TRADE IN SOUTHERN AFRICA

Southern African countries recognize that increased trade and open markets are the drivers of economic growth and poverty reduction. However, because of policies and regulations that constrain trade and increase costs, the region is not competitive in world markets. In addition, the private sector needs help to produce goods and services that meet the standards of global markets. USAID established the Southern Africa Global Competitiveness Hub (the "Trade Hub") in Gaborone, Botswana, in June 2002. The Hub builds regional capacity for negotiation and implementation of trade agreements. An Africa Growth and Opportunity Act (AGOA) advisor at the Trade Hub facilitates U.S.-Southern Africa business links and advises on national AGOA export strategies. In the priority sectors of agribusiness, textiles and apparel, and tourism, the Trade Hub identifies bottlenecks to market growth and promotes international business links. The Trade Hub supports regional efforts to reduce high transaction costs, which hinder the cross-border movement of goods and services. Finally, the Trade Hub strengthens the capacity of the private sector to analyze policy and regulatory constraints to trade.

DIVERSIFYING RURAL LIVELIHOODS

The persistence of chronic hunger, malnutrition, and threat of famine in Southern Africa is unacceptable and its cost is enormous, particularly in a region reeling from the effects of HIV/AIDS. People in rural areas depend directly on agriculture and agriculture-related activities for their food and income. USAID's regional program focuses on production support services, market support services, and famine and disaster early warning and mitigation. USAID is helping small-scale fruit and vegetable farmers to supply the formal markets. For livestock and seafood, USAID supports the adoption of sanitary and quality control systems in processing plants, as well

economic unit, the scheme (common systems for laws and customs duties) first needs to be developed and also the economic infrastructure interconnected. For Japan, it is not very clear whether the necessity for providing assistance to Africa can obtain consensus at large, because the Japanese nation and corporations are not very familiar with the region in general. Therefore, the U.S.'s approach of selecting countries, establishing strategic relationships with them and supporting them is a good example for Japan. Formerly, the project leader of the Inga 3 hydroelectric power plant of the DRC requested to the Government of Japan for extending an assistance of five to ten million US dollars, which had remained unfunded as of the end of its FS, with respect to the development of the power plant and the installation of transmission line to South Africa and Botswana. Considering that it was a multi-country project and that Japan did not have particular technical advantage, it was difficult to find the significance of Japan funding the project as one of donors, except the significance from the standpoint of pure international cooperation. Accordingly, it might be worth considering, in the aspect of wide-area infrastructure assistance, that Japan strategically provides assistance to those African countries that will be friends of Japan and will in turn help us in terms of, for example, food and resources now that Japan will presumably further sink in the international arena in the economic dimension.

as market development. USAID also seeks to diversify the agricultural production of resource poor farmers in order to increase their resilience to economic and climatic crises.

IMPROVING MANAGEMENT OF SHARED RIVER BASINS

Water scarcity in Southern Africa is a growing concern. Population growth and growing demands for domestic, farm, and industrial consumption are increasing stress on finite water resources. Seventy percent of the region's watersheds are shared between two or more countries. USAID is focused on improving the management of shared river basins, starting with the Okavango River Basin. USAID is strengthening the Okavango River Basin Commission to help it manage the river and its resources in a fair and sustainable manner.

INCREASING ELECTORAL COMPETITION

Southern African leaders have long endorsed democratic norms, practices, and procedures. However, the lack of citizen participation in political processes impedes competition within the political system. Governance is suffering from inadequate checks and balances. USAID promotes free, fair, and open elections in Southern Africa. USAID supports the efforts of regional partners to increase the accountability and transparency of electoral processes, improve compliance with regional election standards, and reduce election related conflict and human rights abuses.

SUPPORT FOR PRESIDENTIAL INITIATIVES

USAID/Southern Africa provides regional support for several U.S. Presidential and Agency initiatives, specifically the African Global Competitiveness Initiative, the Initiative to End Hunger in Africa, the Anti-Corruption Initiative, and the Conflict Initiative

Source: USAID (Website: http://www.usaid.gov/locations/sub-saharan_africa/countries/rcsa/index.html)

Table 4.7.4 USAID's initiatives in Eastern Africa (for the informative purpose)

East Africa

USAID's Strategy in East Africa

USAID's regional program in East Africa covers 24 countries which range from extremely fragile to relatively developed. Persistent development challenges in the region include poverty, conflict and disease. These factors are amplified by weak national leadership and pervasive corruption, which further inhibit democratic development, stifle economic progress, contribute to decaying infrastructure and deteriorating public services, and threaten regional stability. Some of the most serious problems are regional in nature. Cross-border conflicts in the Horn of Africa provide opportunities for illicit trade and weapons flows, opportunities for extremists and other destabilizing forces that adversely affect the livelihoods of vulnerable populations. Persistent food insecurity and periodic recurrence of food emergencies negatively affect millions of people in vulnerable groups. Insufficient and deteriorating transportation and communication infrastructure, as well as major policy and bureaucratic obstacles, constrain intra-regional trade and aggravate internal and cross-border conflicts along porous borders.

As a result, political stability and economic development throughout the region continue to be fragile. In addition, the presence of an estimated 30 million HIV/AIDS infected people in sub-Saharan Africa amplifies the inadequacies of already overburdened public health systems that are unable to cope with severe health problems such as malaria and other infectious diseases, and high rates of maternal and child mortality. For the foreseeable future, the HIV/AIDS pandemic will continue to have a major and devastating impact on development -- across sectors -- throughout this region of Africa.

USAID/East Africa actively promotes U.S. national interests in the region by supporting, complementing, and enhancing USAID programs, while managing a unique and innovative program of regional activities. Economic growth, increased foreign investment, and the promotion of international and intra-regional trade are essential components of the U.S. Government's effort to reduce the likelihood that the region will serve as a breeding ground for international terrorist activities. Strengthening regional African organizations and institutions with training and new systems to mitigate conflict enhances the strength of national governments and promotes the application of African solutions to pressing economic and social problems. A reduction in the transmission of HIV/AIDS and other infectious diseases will improve health and diminish the risk of future economic disruption and political disintegration throughout the region.

Source: USAID (Website: http://www.usaid.gov/locations/sub-saharan_africa/countries/redso/index.html)

4.7.3 EU

EU's assistance to Southern and Eastern Africa was already explained in detail in Section 2.3.2 “Cooperation with Europe”. Moreover, the union has decided to provide assistance to the African Forum for Utility Regulators (AFUR), which is a group of four power pools in Sub-Saharan Africa and the power and water regulators in Africa as a whole. (It is noted that no such detailed information is found on the websites of EU and its concerned agency, European Investment Bank.)

4.7.4 AfDB

The African Development Bank (AfDB) formulated in November 2002 a comprehensive roadmap called “The Strategic Plan of the African Development Bank Group” for the 2003-2007 period, aiming at determining directions of strategic missions as a regional development bank. In this plan, the Bank is giving priority in allocating its resources i) to agriculture and sustainable rural development, with greater emphasis being given to water supply in vulnerable rural and peri-urban areas, and ii) to human capital formation through primary education and basic health services, and iii) to the development of essential infrastructure. The last mission is targeting sub-sectors such as water and sanitation, transport, telecommunications & IT, and energy. Especially the Plan points out as a deep-rooted problem in this sector that only about 5 percent of the rural population in Sub-Saharan Africa have access to modern electricity, then concluding that “power supply is insufficient and unreliable in most member countries”.

In the Plan, the detailed strategies for energy sector by region (such as by Southern Africa and/or East Africa) are not clearly described

CHAPTER 5

PROPOSAL ON FRAMEWORK OF REGIONAL COOPERATION IN THE POWER SECTOR

Chapter 5 Proposal on Framework of Regional Cooperation in the Power Sector

5.1 Review of Cooperation by JICA

5.1.1 Outline of Report of the Study and Course of Cooperative Action

Japan has so far assisted extensively on the development of agriculture, humanitarian aid and rehabilitation across African countries as well as Southern/Eastern Africa through the TICAD Process. Through the principle of "poverty reduction through economic growth", Japan has contributed to the enhancement of self-effort (ownership) so that it can take root in African countries by assisting in the provision of social and economic infrastructures.

The Japanese government, through JICA and JBIC, has played a main role in extending assistance to the power sector in Southern/Eastern African countries. The assistance that had been afforded is summarized in Figure 5.1.1, which includes Grant Aid, Master Plan/Feasibility Study, technical assistance, and loan-financed projects provided by country. Overall, projects in Kenya, Uganda, Tanzania and Malawi account for most of the assistance to Africa. Hydropower generation, distribution/transmission line improvement, and rural electrification have been implemented for the subject countries. Among these, hydropower generation projects are implemented under loan-financed scheme, while projects for improvement of distribution/transmission lines are implemented under grant aid scheme.

Japanese assistance to the power sector of Southern/Eastern Africa has so far been concentrated towards the eastern area of Africa where Kenya, Uganda, Tanzania and Malawi are situated. In order to encourage development that puts focus on the efficiency of development over the subject area, it is deemed necessary that mutual cooperation within the area for the power resources are ensured. The development of social infrastructure in each country is a prerequisite to attain this goal. As a course of future assistance, it is proposed that more intensive support be provided to the less-developed countries and improve the necessary socio-economic infrastructures for the power sector. In the end, this scenario will lead to the assistance aiming for the power pool inside the region to materialize.

Middel/Western African region
- Improvement of administrative organization of power sector for Ghana, Nigeria and Sierra Leonean

Capeverde
- Power supply and transmission improvement project in Santiago islands(2007)

Ghana
- Project for Rural Electrification (V)
- Master plan study for power supply system
- Development of human resources for PV dissemination

Sierra Leone
- Urgent improvement of power supply system in Freetown

Nigeria
- Basic Design study for rural electrification in the states of Cross River and Akwa Ibom

Rwanda

【Studyon Technical Cooperation】

1)Project for strengthening the capacity of Tumba College of Technology (2007)

【Government Loans】

2) The second Mukunga hydroelectric power station project(1989)

Malawi

【Grant Aid Assistance】

1)Rural electrification program 4(2002～2004)
2)Solar photovoltaic power generation project(2004)
3)Rural electrification program 5(2007)

【Study on Technical Cooperation】

4) Ngana coal field development project(1977)
5)Study for the construction of transmission line between Nkula.B and Lilongwe.B(1988～1989)
6)Rural electrification Master Plan(2001～2002)

【Technical Assistance】

7)Assistance by experts/rural electrification advisor(1999～2001、2002～2004)
8)Assistance by SV for reinforcement of solar photovoltaic power generation system (2005)
9)Rural electrification promotion project(2006～2009)

Zambia

【Study on Technical Cooperation】

1)Briquette production project(1985～1986)
2)Study for development of the rural electrification master plan(2006～2007)

【Technical Assistance】

3)Rural electrification project(2007)

Namibia

【Study on Technical Cooperation】

1)Study on national power sector development(1996～1998)

Zimbabwe

【Study on Technical Cooperation】

1) Study on the promotion of photovoltaic rural electrification (1996～1998)

Botswana

【Study on Technical Cooperation】

1)Master plan study on photovoltaic rural electrification (2000～2002)

【Government Loans】

2)Coal thermal power plant project in Monopool (1986)

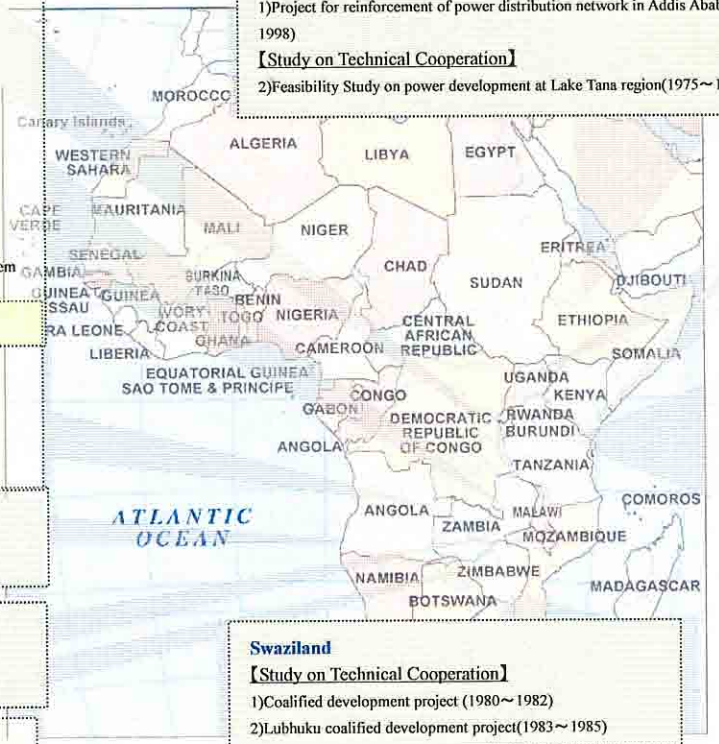
Ethiopia

【Grant Aid Assistance】

1)Project for reinforcement of power distribution network in Addis Ababe (1997～1998)

【Study on Technical Cooperation】

2)Feasibility Study on power development at Lake Tana region(1975～1976)



Swaziland

【Study on Technical Cooperation】

1)Coalified development project (1980～1982)
2)Lubhuku coalified development project(1983～1985)

Kenya

【Study on Technical Cooperation】

1)Study for development of geothermal power plant in Lift valley(1972～1982)
2)Preliminary study for hydroelectric project in Sondu river(1983～1985)
3)Water resources development project(1989～1992)
4)Development of hydroelectric power in Magwagwa(1989～1991)
5)Development of hydroelectric power plant in Grand falls(1993～1997)

【Government Loans】

6) Sondu－Miriu hydroelectric project(1989～2004)
7)Diesel power projects in Monbasa(1995)
8)Sondu-Miriu/Sangoro hydroelectric project(2007)

Uganda

【Grant Aid Assistance】

1)Improvement of distribution network in Kampala(1991～1992)
2Improvement of distribution network in city area(1993～1994)
3)Basic study for rural electrification (1998)
4)Rural electrification project (the 2nd stage)(2007)

【Government Loans】

5)Transmission line network rehabilitation project in Bujyagali(2007)

Tanzania

【Grant Aid Assistance】

1)Dar es Salaam electric power distribution network project(1984～1992)
2) Dar es Salaam electric power distribution network project(1986)
3)Kilimanjaro electrification project(1995)
4)Project for reinforcement of power distribution network in Dar es Salaam (1996～1997)
5) Project for reinforcement of power distribution network in Dar es Salaam(Second Phase)(1997～1998)
6)Project for reinforcement of transmission and distribution facilities in Oyster Bay substation(2007)

【Study on Technical Cooperation】

7) Dar es Salaam electric power distribution network project(1984)
8)Study on smoll-scale hydroelectric power development project in Kilimanjyaro region(1987～1988)
9)Study on Kihansi hydroelectric power development project(1980～1990)
10)Study on Dar es Salaam power supply system expansion(1992～1993)
11)Study on the power sector for major towns(2001～2002)
12)Study on transmission and distribution network in Kilimanjaro region(1978-1979)

【Technical Assistance】

13)Technical assistance for ensuring stable power supply(2008)

【Government Loans】

14) Kilimanjaro transmission and distribution network project(1981)

Figure 5.1.1 Cooperation on Power Sector by Japan

5.2 Review of Advanced Cases of Regional Cooperation in Other Regions

A power pool means a wholesale market for electricity. Power companies originally used to manage the whole process from generation and transmission to distribution of power and selling power to end-users. Thus, there was no system in which the power companies purchase power from others and sell it to consumers. Although buying and selling of goods and products usually takes place via wholesale and retail markets, electricity was an exception, having no wholesale market.

As power deregulation spread and evolved in Europe, the wholesale market of electricity emerged. If purchasing power from another power company is cheaper than generating power by itself, it is more advantageous to buy power at a wholesale market than making massive investment to build power stations. Thus, the power market or power pool developed and matured in Europe. For example, two major power pools have been established in Europe, one in North Europe and the other in Germany. In the U.S., such markets have developed similarly in accordance with the liberalization of the power industry.

This section reviews cases in the EU, U.S. and Indochina as examples where power pools have advanced and developed in regions outside Africa. An overview of the development of the West African Power Pool (WAPP) currently in progress is also provided.

This section reviews cases in the EU, U.S. and Indochina as advanced examples in regions where power pools developed outside Africa. An overview of the development of the West African Power Pool (WAPP) currently in progress is also provided.

5.2.1 Examination of EU's Regional Cooperation Projects and Challenges

(1) History of Wholesale Power Market in Europe: U.K.' Failure[1]

After the end of World War II in the U.K., the state-run Central Electricity Board (CEGB) dominated power generation and transmission, and local distribution agencies monopolized the distribution and retailing of power for a long time. The Thatcher administration that was launched in 1979 promoted privatization and power was also deregulated as the wholesale power market was introduced.

The first development was the establishment of the Electricity Act of 1983. This guaranteed the removal of barriers that hinder the entry of power companies into the power generation market and allowed free access to transmission lines by the IPPs by law. However, the purchase prices from IPPs were low because of the low rate of return adopted by the CEGB, which did little to attract IPPs and the entry barriers were not completely removed to allow free access to transmission lines.

The second development was the establishment of the Electricity Act of 1989, which enabled the reorganization and privatization of the power industry and a new power supply system was established. The core changes were the unbundling[2] of vertical integration of power generation, transmission and distribution, and the introduction of wholesale power trading systems (power pools). The scale of liberalization expanded gradually from 1990 and the retail market was fully opened up in May 1999. Because all the wholesale power was required to be traded through a power pool in principle, it was called a “forced pool arrangement”.

The Department of Trade and Industry (DTI) pointed out the following problems of the forced pool arrangement: (i) price setting limits competition; (ii) absence of participation from the demand side; (iii) technical complexities in bidding and price setting; (iv) a gap between cost and price; and (v) the obligation to participate in the forced pool. Regarding the price setting in (i), in particular, the power pool was expected to play the role of a wholesale power market, which is uniform throughout the UK, and set competitive prices through the market. However, in reality, a power company and the customers (power distribution companies and commercial-scale utility customers) were allowed to conclude a bilateral agreement[3] between

[1] Matsui, 2005, "Energy, Global Warming Issues and Knowledge”, Waseda University PhD Dissertation, and other materials

[2] The CEGB that used to dominated power generation and transmission facilities was disintegrated on 31st March, 1990, and the Nuclear Power (which later became the British Energy) that possesses nuclear power, the National Power and the Power Gen owned power generation facilities and the National Grid owned by 12 local power distribution companies possessed power transmission facilities.

[3] A bilateral contract is completed when both parties agree on the request of what amount of power, for how much and how long they want and the intermediary management company approves it. The advantage is that price risks can be hedged as the volume and price

the two parties and the two parties concluded a contract for difference (CfD[4]) to avoid the price volatility risk in the pool market. Against this backdrop, although retail prices were on the decline trend, the wholesale prices (pool draw-out prices) stayed high as shown in the table below. This was contrary to expectations, while the U.K. was taking the pool system for the ten years from 1990 to 2000.

It began reviewing the forced pool arrangement in 1997 and consequently, the system was abolished in March 2001. A new electricity trading arrangement (NETA), whose cores are bilateral trading and private exchange, was introduced.

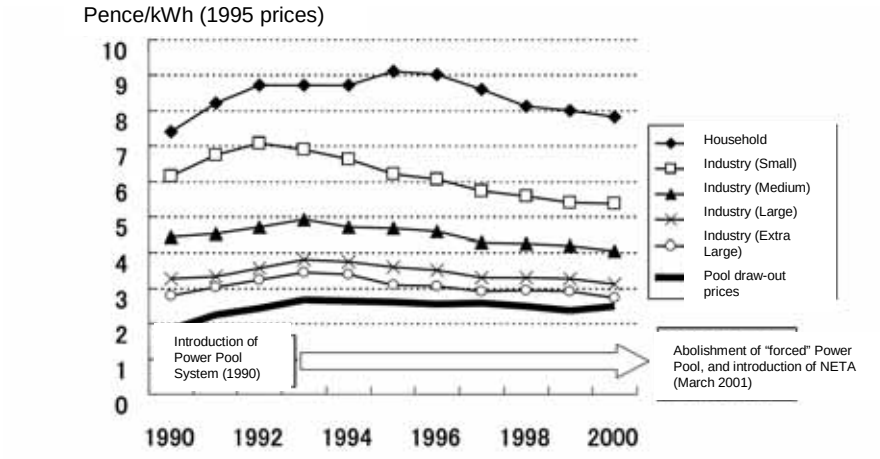


Figure 5.2.1 Trend of Wholesale Power Price and Real Retail Price in the U.K.

Source: Kansai Electric Power Co., Inc., Deregulation of Overseas Power Industry (2002).

(2) Overview and Characteristics of North Europe's Nord Pool[5]

The liberalization of power markets in the Scandinavian countries (Norway, Sweden, Finland and Denmark) began in 1991 when Norway established the Energy Law, reorganized the power industry, and liberalized the market. Sweden likewise liberalized its domestic power market based on a new electricity law in January 1996 and then concurrently, integrated its power market with the Norwegian market. Thus, the Norway market (so-called Nord Pool) was opened. Finland, Western Denmark and Eastern Denmark joined the Nord Pool in June 1998, July 1997, and October 2000, respectively, creating an international power market that covers four North European

are fixed for several years. (Source: Yokoyama, 2007, "Power Systems and Efficient Energy Use (Part 1/2)", Mitsubishi Electric Corp. website.

[4] A CFD is a contract under which a power generation company and a power purchaser agree on a strike price in advance so that both parties can hedge the risk even when the pool price changes.

[5] Ogasawara and Toichi, 2001, "Overseas Situations related to Deregulation of Power and Future Development in Japan"

countries[6].

The Nord Pool is the first multilateral common power market in the world[7]. Although there are zones that divide the area into regions of power trading, the division is in accordance with the areas each power transmission company covers. (Only Norway is divided into two zones.) The role of the Nord Pool is congestion control between zones and price setting. Power transmission companies are responsible for congestion control within their zone. In that sense, the Nord Pool has a role very similar to that of the California Wholesale Power Market. With regard to price setting, the Nord Pool is a voluntary pool and it can conclude a bilateral agreement. (Spot trade through the Nord Pool accounts for some 20 percent.) However, the price set by the Nord Pool in a bilateral contract is often referred to, and thus it serves as a local index price.

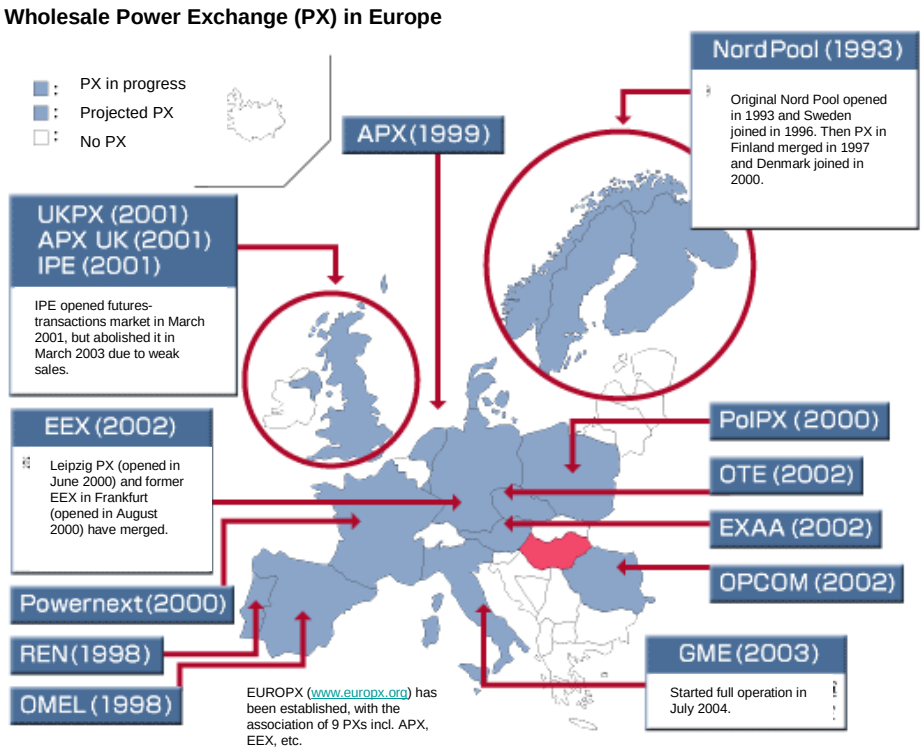


Figure 5.2.2 Wholesale Power Exchange (PX) in Europe

Source: Yokoyama, Power System and Efficient Energy Use in Power Liberalization Era (Part 1/2) (2007) and Mitsubishi Electric Corp. website http://www.mitsubishielectric.co.jp/shoene/kouza/vol04/index.html

[6]Scandinavian countries have a long history of regional power interchange due to different power sources. Norway has hydraulic power generation and Denmark has thermal power generation. In addition to the difference in the power source portfolio among countries, hydraulic power generation accounts for about 50 percent of the total output in the entire region. Due to the seasonal variation of hydraulic power, international interchange was highly needed. (Source: Ogasawara and Toichi, 2001, "Overseas Situations related to Deregulation of Power and Future Development in Japan", Operations Research.)

[7]It was established in 1993. Norwegian Statnett Sf owns 50 percent and Swedish Svenska Kraftnat owns the rest. The Nord Pool has over 60 employees in Oslo, Stockholm and Odense. EL-EX in Helsinki represents Finland.

(3) Lessons Learned from European Examples

In U.K.'s case, the introduction of the "forced power pool arrangements" led to rigid wholesale power prices. As explained above, in the Nord Pool case, trade expanded steadily and it is highly praised in Europe. Although its system seems simple, no security is needed to keep the supply reliability at this point due to stable supply with abundant hydropower.

The power pool in Africa is a market established for mutual assistance to supplement the power shortage in African countries. Its primary objective is not to lower prices as described earlier. However, the "simple system" of the Nord Pool can be considered in designing the system in the future. The following chart shows the flow of trading of the hybrid power market adopted by the Nord Pool.

Trading Flow at the Hybrid-type Power Market

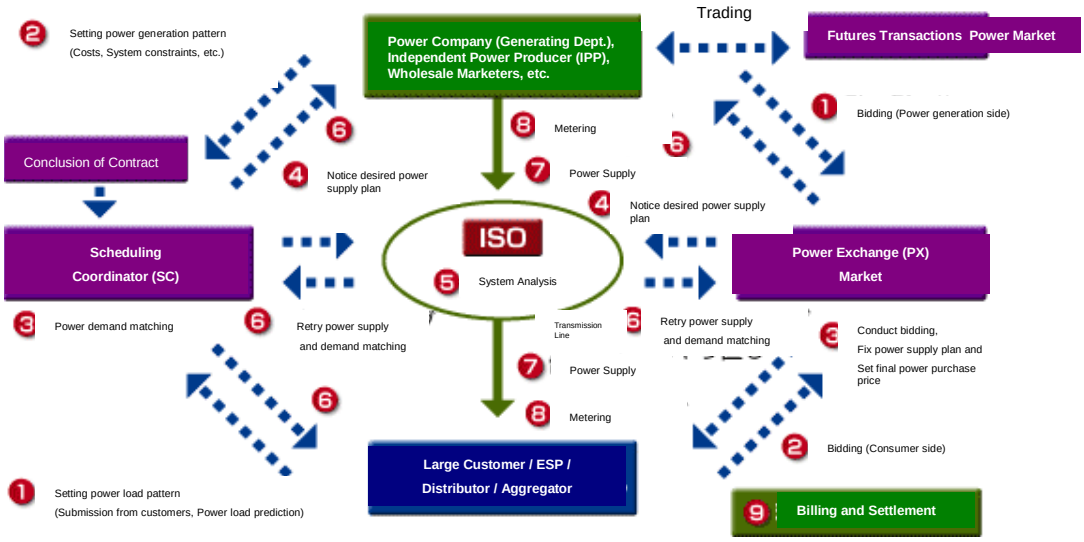


Figure 5.2.3 Trading Flow in the Hybrid (Nord Pool-type) Power Market

Source: Yokoyama, Power System and Efficient Energy Use in Power Liberalization Era (Part 1/2) (2007) and Mitsubishi Electric Corp. website http://www.mitsubishielectric.co.jp/shoene/kouza/vol04/index.html

5.2.2 Examination of Region Cooperation in USA and Challenges

(1) Structure of the Power Sector in the USA

The power crisis in California during the summer of 2000 & the beginning of winter in 2001 and the massive blackout in New York in August, 2008 had caused concern that the

maintenance plan for supply reliability formulated in the USA did not function adequately. On the other hand, reforms from the Department of Power Generation & Transmission preceded by the federal statement and the regulatory reform for the electrical industry had been enforced separately. The regulatory reform centers on retail liberalization by the state. The disparity of the regulatory reforms had caused complications to the structure of the electrical industry, multifunction and decentralization of the power suppliers who has taken on the stable power supply. In consideration of such situation, the power sector had been revised to aim at securing of stable operation of the power system and investment promotion for the transmission network, and the Energy Policy Act had been enforced in 2005.

The Department of Energy (DOE) has the responsibility to make public policy on the power administration in good part, and the Federal Energy Regulatory Commission (FERC) is the regulatory agency that puts restrictions on power transport among several states, along with .natural gas and oil.

The FERC certifies the Electric Reliability Organization (ERO) and the ERO implements to certify the organizations that draw up the development plan for the transmission network. At present, the North American Electric Reliability Council (NERC), which is a self-regulating organization, is certified as the ERO last July, 2008.

The NERC is taking an active role in increasing the reliability of large-scale transmission networks together with entities from eight (8) areas.

The Independent System Operator (ISO) mainly operates the intra-state transmission network as well as one across the several states occasionally. The Regional Transmission Organization (RTO) which has similar functions with the ISO has been established in order to operate transmission networks in broader areas.

Furthermore, the Regional Reliability Council (RRC) has been formed by the RTO and ISO in several areas, and they are involved tasks such as the confirmation of the compliance of reliability standards and making regulations in line with the regional circumstances in conjunction with NERC. (Refer to the Fig. 5.2.4)

All power companies in the USA are under the control of the FERC. On the other hand, the bigger organization NERC covers all the jurisdictional areas of FERC, along with several power companies in Mexico and Canada.

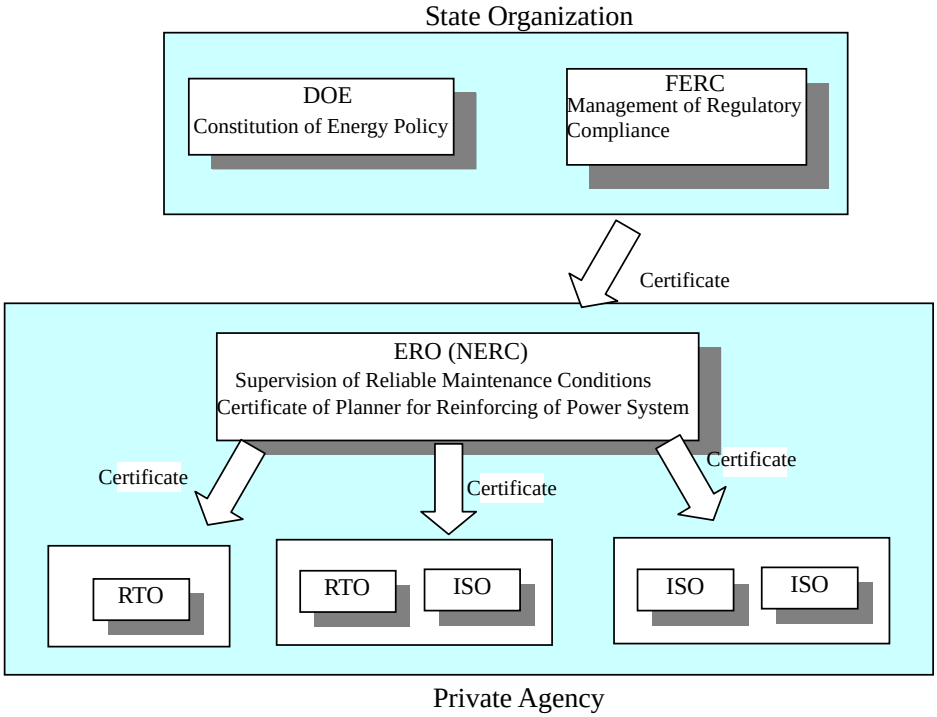


Figure 5.2.4 Organization Chart for Power Sector in North America

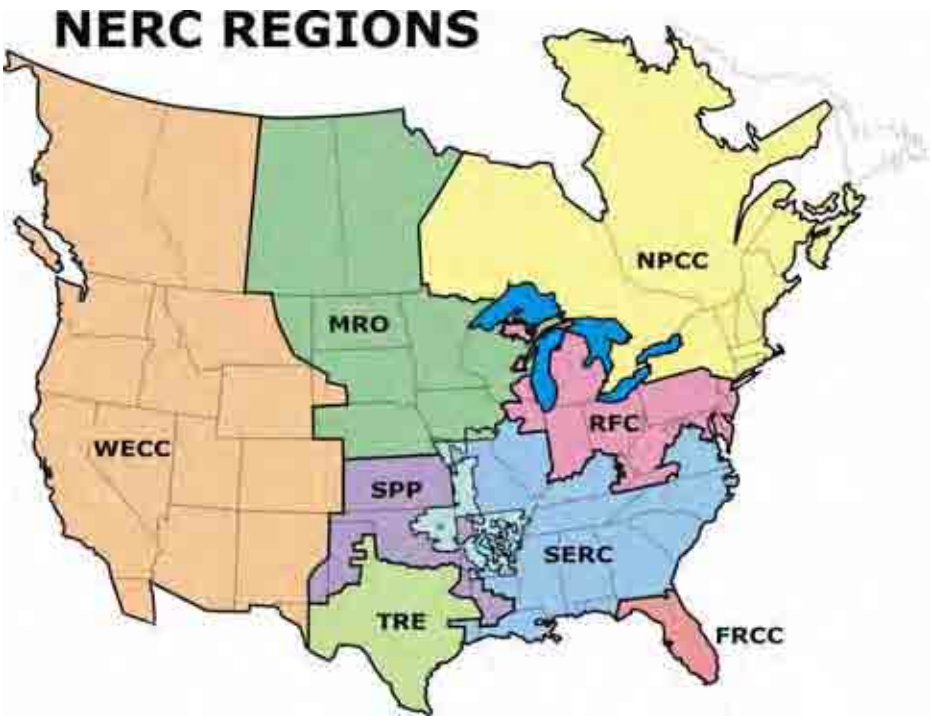


Figure 5.2.5 Regional Reliability Council (RRC) in North America

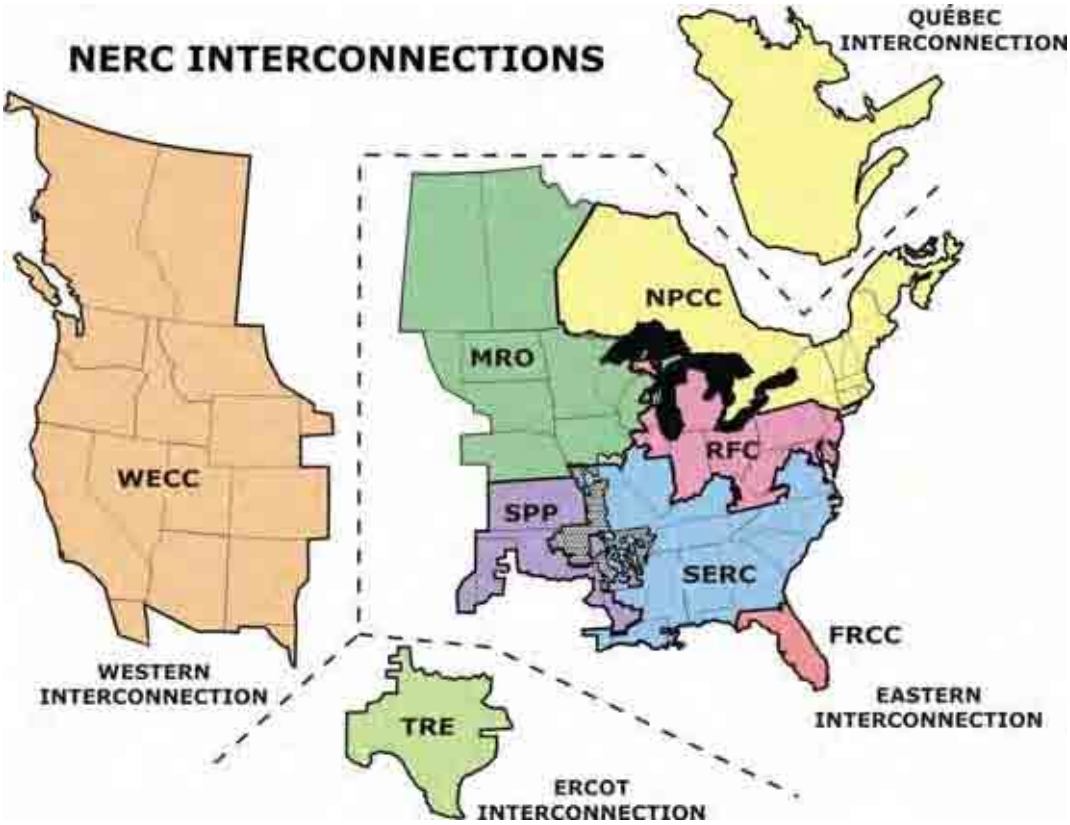


Figure 5.2.6 Interconnected Power System for North American Electric Reliability Council (NERC)

(2) System Maintenance and Operation rule in USA

The Reliability Standard which is constituted by the NERC is mentioned regarding the maintenance rule of the transmission system in USA. The stipulation in the Reliability Test is variously-mentioned in order to forcibly take a countermeasure in case of any violations against the said standard would be happened.

Table 5.2.1 Reliability Standard in USA

Adjustment of Demand and Supply
Protection of Important Infrastructure Facilities
Telecommunication System
Response and Preparation in Emergency
Design of Facilities, System Interconnection and Maintenance
Power Interchange Plan and Coordination
Operation and Coordination for Maintenance of Reliability at the System Interconnection
System Establishment and Data Creation for System Analysis
Nuclear Energy
Certificate of Organization
Human Resource Development and Qualification
System Protection and Control
Operation of Transmission Network
Development Plan of Transmission Network
System Voltage and Reactive Power

5.2.3 Examination of Regional Cooperation in West Africa and Challenges

In West Africa, the establishment of the West African Power Pool (WAPP) as a subordinate organization of ECOWAS was resolved at the Heads of States meeting in December 1999 and the project was officially launched in 2000.

According to a survey, only one third of the 230 million potential customers within the WAPP region have power supply. 46 percent of power demand that is not satisfied. By country, only about one quarter of the people have power in all other countries except Ghana, where about 50 percent of Ghanans have power. This shows that the percent of people who have power in this region is not high, compared with people in other Sub-Saharan regions.

The following table shows WAPP member states and member companies:

Table 5.2.2 WAPP Member States and Member Companies

1	BENIN	1	Société Béninoise d'Énergie Électrique(SBEE)
2	BURKINA FASO	2	Société Nationale d'Électricité du Burkina(SONABEL)
3	COTE D'IVOIRE	3	Société d'Opération Ivoirienne d'Électricité (SOPIE)
		4	Société de Gestion du Patrimoine du Secteur de l'Electricité (SOGEPE)
4	GHANA	5	Volta River Authorithy (VRA)
		6	Electricity Company of Ghana (ECG)
5	GAMBIA	7	National Water and Electricity Company (NAWEC)
6	GUINÉE	8	Electricité de Guinée (EDG)
7	LIBERIA	9	Liberian Electricity Corporation (LEC)
8	MALI	10	Energie du Mali (EDM)
9	NIGERIA	11	Power Holding Company of Nigeria (PHCN)
10	SENEGALL	12	Société d'Électricité du Sénégal (SENELEC)
11	SIERRA LEONE	13	National Power Authority (NPA)
12	TOGO	14	Communauté Électrique du Bénin (CEB)

A systematic linkage is secured mainly in the two systems in the WAPP—Senegal-Mali, in connection with development of the Senegal River area, and Benin-Togo-Ghana-Ivory Coast. In addition, Nigeria and Benin were interconnected in 2007. Although there are small linkages including one between Nigeria and Niger, five countries, namely Liberia, Sierra Leone, Guinea, Guinea-Bissau and Gambia, are not connected with any country at all.

The WAPP puts the following five linkages as priority in the transmission line construction program:

- ✓ Coastal Transmission Backbone Subprogram
  (Cote d'Ivoire, Ghana, Benin/Togo, Nigeria).
- ✓ Inter-zonal Transmission Hub Sub-program
  (Burkina Faso, OMVS via Mali, Mali via Cote d'Ivoire, LSG via Cote d'Ivoire).
- ✓ North-core Transmission Sub-program
  (Nigeria, Niger, Burkina Faso, Benin).
- ✓ OMVG/OMVS Power System Development Subprogram
  (The Gambia, Guinea, Guinea Bissau, Mali, Senegal)
- ✓ Liberia-Sierra Leone-Guinea Power System Redevelopment Subprogram
  (Liberia, Sierra Leone, Guinea).

Source： Materials distributed at the WAPIC meeting held in Abuja in 2007, available on the WAPP website

The following are two priority projects as posted by ECOWAS on its website and explained to assistance organizations:

Tabel 5.2.3 WAPP's Priority Transmission Lines

Section	Voltage	Value (USDm)	Distance(km)	Assistance organization
225 kV Bobo Dioulasso-Ouagadougou Transmission Line (Burkina Faso)	225kv	90		AfD, WB, Danish Credit, Nordic Fund, FMO, DANIDA
Volta-Mome Hagou Sakete (Ghana-Togo-Benin Interconnection)	330kV	97	340	WB, AfDB, IsDB, BOAD, EBID

The main power generation plans in the region are as follows:

- Combined cycle with the use of Nigerian gas after the completion of the West Africa gas pipeline from Nigeria to Ghana: Benin, Ghana and Togo
- Hydraulic power development related to Gambia River area development (OMVG): Guinea; 240MW Kaleta, etc.
- Hydraulic power development related to Senegal River area development (OMVS): Mali; 62MW Felou, etc.

The following are the major assistance from other regions to the WAPP:

- ✓ The United States has provided advisory and technical assistance through the USAID with the time limit of September 2008 (with an extension option of up to another ten years). It also formulated a five-year development plan (USD7m). It also assists in the personal exchanges between the WAPP and its member corporations and the US power pools through the US Energy Association.
- ✓ French AFD provides funds (€5m) for the establishment of a regional entity to regulate power trade between countries within the region. The French Ministry of Foreign Affairs also provides support.
- ✓ The World Bank provided aid in 2006 to formulate the WAPP project plans for 2006-2009.
- ✓ As part of assistance for African, Caribbean, and the Pacific countries (ACP), the EU decided that the ACP-EU Energy Facility provides technical assistance for four Sub-Saharan power pools and the African Forum for Utility Regulators. In December 2007, it decided to provide grant aid (€3m) to the WAPP through the EU-Africa Infrastructure Trust Fund. This will be allocated for the preliminary survey of two projects for systematic linkages of Ivory Coast-Liberia-Sierra Leone-Guinea.
- ✓ In December 2007, South Korea agreed to provide aid (USD 2.5m) to support the preparation of the Feasibility Study (F/S) and basic design of the WAPP's Information and Coordination Center slated to be established in Cotonou in Benin.

5.2.4 Examination of Regional Cooperation in Indochina

Table 5.2.4 shows the joint projects of IPP and the interregional connections in the Indochina power sector.

Table 5.2.4 Joint Projects in Indochina Power Sector

Theun Hinboun Hydropower Station	Run-of-river type hydropower station located in the center of Lao PDR. The portion of the power is consumed in Lao PDR, however, large part of it is exported to Thailand by 230 kV double circuits. Capacity:210 MW, Commissioning: 1998, Cost: around 240 million USD, Equity Ratio: EdL (Lao PDR) 60%, MDX Lao Company (Thailand) 20%、Hydropower AB (Norway) 20%
Houay – Ho Hydropower Station	Reservoir-type hydropower station located in the southern Lao PDR. 98% of generation is exported to Thailand through 230 kV transmission line and remaining 2 % is consumed in Lao PDR. Capacity: 152 MW, Commissioning: 1998, Cost: around 248 million USD, Equity ratio: EdL (Lao PDR) 20%, Suez Energy International (Belgium) 60%, Houya Ho Thai (Thailand)20% (just after commissioned, Daewoo (Korea) provided equity capital, however, transferred in 2002)
Nam Theun 2 hydropower station	The IPP project of the hydropower plant in Lao PDR exporting the power to Thailand funded by the World Bank, ADB and the private captal JV (EDF, EGCO, ItalThai and LHSE). Under construction to be commissioned in the end of 2009.
Vietnam-China interconnection	There are 110 kV and 230 kV transmission lines supplying the power from China to Vietnam. By 220 kV, the load around 200 MW in the northern Vietnam that is separated from the main grid is supplied from China.
Vietnam-Lao PDR interconnection	The connection points at the border supplied from Vietnam with 35 kV and 22 kV. Each is composed of medium voltage distribution lines and its capacity is around a few MW. The tariff is the same as for the medium voltage in Vietnam
Vietnam-Cambodia interconnection	Seven connection points at the border supplied from Vietnam with 35kV. The tariff is around 7 cent/kWh. The project of the 220 kV power transmission line to Phnom Phen is now on going by co-financing of ADB and WB. The transmission line in the Vietnam side has been already completed. The power transmission will be 80 MW when commissioned and will be increased up to 200MW in the final stage.
Thailand-Lao PDR interconnection	Two 230 kV transmission lines owned by IPPs import power from Houay Ho and from Thuen Hin Beun in Lao PDR. 115 kV transmission lines connecting Lao PDR and Thailand. 22kV distribution lines from Thailand.
Thailand-Cambodia interconnection	The 115 kV transmission line has been commissioned from Watthana Nakhon in Thailand to Battanbang substation in Cambodia.
Lao PDR-Cambodia interconnection	The construction of the 115 kV transmission line from Lao PDR to Strung Treng in Cambodia has been determined by

	the funding of the World Bank. The feasibility study has been carried out by the WB fund.

There are various international frameworks regarding the development in the Mekong region. The main frameworks sponsored by public organizations are as shown in Table 5.2.5.

The following table shows the various regional cooperation programs of the development in the Mekong region that are hosted by international public institutions.

Table 5.2.5 Regional Cooperation Program in Mekong Region (Advocates indicated by underlines)

1. Mekong River Committee（MRC）－Established in 1957（Re-Established in 1995） UNDP assisted to establish the former Mekong River Committee, Committee for Coordination of Investigations of. the Lower Mekong Basin, with Cambodia, Lao PDR, South Vietnam, Thailand in 1957. It is intergovernmental authority, which was rebuild as the Mekong River Committee to manage and develop the water flow in the basin. Executive office was originally located at Bangkok, and then moved to Phnom Penh in 1998, is in Vientiane from 2004. This committee is the world's first international authority which specializes in development of the Mekong basin.
2. Asian Highway（AH）－Launched in 1959, Framework within ESCAP Economic Commission for Asia and the Far East (ESCAP, former ECAFE) formulated an idea to link 15 Asian countries in a plan of their Asian Highway in 1959 (650,000km, 40 routes). It had not made any progress in the 1960-70s due to the escalation of the conflict in Indochina region. End of the cold war and acceleration toward market economy helped to promote the plan. It was expanded to total length of 140,000 and 55 routes in the latest plan.
3. HAPUA (Heads of ASEAN Power Utilities/Authorities) －Started in 1997 Head of ASEAN power utilities / authorities agreed to develop and improve its power system (ASEAN Power Grid(APG)) and develop the framework of power exchange in 1986. The authority was established by the chiefs of the governments and power utilities in order to study the plan, construction and maintenance of APG. The office of the authority is located in ASEAN Center of Energy (ACE) in Jakarta. HAPUA developed the ASEAN Interconnection Master Plan Study; AIMS for the sake of interconnection planning in the region. According to the study, the large power development will be necessary to meet the power demand by 2015, however, it is difficult for small countries to recover their investment costs only by the electricity revenue. Hence, it is promoted to co-develop the power plants with large demand countries and it is required to construct inter-regional power transmission systems. HAPUA started to review the inter-regional power system plan and launched the working group as AIMS2 in Da Nang in November 2007.
4. GMS Economic Cooperation Program, Started in 1992、ADB ADB has established the GMS Economic Cooperation Program with Cambodia, Laos, Myanmar, Vietnam, Thailand and Yunnang of China as Greater Mekong Sub-region in Manila in 1992 . See to section 2.3.3
5. AEM-METI Economic and Industrial Cooperation Committee－Started in 1994

（Reformed in 1998）、JAPAN

ASEAN Economic Ministers-Ministry for International Trade and Industry (AEM-MITI) Consultations developed a Working Group on Economic Cooperation in Indochina and Myanmar(IC-WG) to assist Indochina countries which are applying for membership of ASEAN. In 1998, AEM-METI Economic and Industrial Cooperation Committee (AMEICC) was established. It aims to enhance industrial cooperation, improvement of ASEAN's competitiveness and development cooperation assistance to the new member countries.

6. Forum for Comprehensive Development of Indochina （FCDI） Started in 1995, JAPAN

Former Japanese prime minister, Mr. Miyazawa, proposed this meeting and the first meeting was held at Tokyo in 1995, chaired by Japan. GMS countries of 24 excluding Myanmar and international institutes attended the meeting, however, it has not second meeting so far and only HI-FI plan (HI-FI plan for Private Sector Development in the GMS) utilizes the a part of the this framework.

7. ASEAN Mekong Basin Development Co-operation（AMBDC） Started in 1996, ASEAN（Malaysia）

It was established in 1996, in order to rectify disparities between ASEAN countries and countries applying for ASEA and promote economic cooperation. It resumed the operation from 2000 after Asian currency crisis.

8. Initiative for ASEAN Integration （IAI） Started in 2000, ASEAN（Singapore）

It was established in order to narrow the gap between original six ASEAN countries and new membership countries and improve competitiveness of the region.

9. the Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy (ACMECS) Started in 2003, Thailand

The former prime minister, Mr. Thaksin, advocated the Economic Cooperation Strategy (ECS) to reduce the economic gap among Cambodia, Laos, Myanmar and Thailand and improve the income level as Bagan Declaration in 2003. Later, Viet Nam joined the ACMECS. It planned the projects in the five fields, trading and investment, agro-industry, transportation, tourism, and human resource development and are requesting cooperation to Japan, Germany, France, Australia and ADB.

1） Policy of Japanese Economic Cooperation

Japanese assistance to the Indochina region launched from the war reparations has become full-scale since the 1990’s through the end of the Cold War and the peace process in Indochina. After that, Japan has maintained to be the top donor. In recent years, the major emphasis has been placed on Cambodia, Lao PDR, Vietnam (CLV) and the Japanese government has taken a positive stance to support them. The recent progress on the development of Indochina countries has been largely due to Japanese ODA. The support program for the five Indochina countries originated from the Japanese war reparations after World War II. The total amount of reparations and sub-

reparations achieved has reached more than 180 billion JYN.

In 2004, 1.5 billion USD for three years was allocated as support for the development in the Mekong region, represented by “the development of the triangle area between Cambodia, Laos and Vietnam”, as the least developed area and the major emphasis has been placed on CLV.

Furthermore, in 2007, Japan promised an ODA expansion for the next three years to the CLV countries as the “Japan-Mekong Region Partnership Program” with the aim to strengthen the relations of Japan and the five countries of Indochina. On the other hand, direct foreign investment by Japan to Cambodia, Laos and Myanmar is less than by China. It is difficult to recognize that the ODA contribution brings about the priming effect on private investment.

In the future, the supports with grasping the needs of the respective countries for economic development will be required, although the experiences in Japan will be still viable. Table 5.2.6 shows the economic cooperation projects to the five Indochina countries.

Table 5.2.6 Economic Cooperation to the Five Indochina Countries

		Cambodia	Laos	Myanmar	Thailand	Viet Nam
Economic Cooperation in 2004 (million USD)	1st 2nd 3rd	JPN: 86.4 ADB: 78.8 USA: 48.1	JPN: 71.7 ADB: 39.1 WB: 29.2	JPN: 26.8 GB: 12.0 CEC: 11.1	CEC: 18.3 DK: 11.1 USA: 10.1	JPN: 615.3 WB: 435.7 ADB: 179.3
Bilateral Economic by Japan in 2005 (Billion Japanese Yen)	Rank ¥ Loan Grant TA	8th 3.18 69.09 45.93	19th - 42.35 25.76	- - 17.17 16.41	- 354.53 2.36 35.53	3rd 908.20 44.65 56.61
Accumulated Bilateral Economic by Japan by 2005 (Billion Japanese Yen)	¥ Loan Grant TA	133.19 1,090.67 392.48	164.30 1,061.77 410.97	4,092.72 1,772.55 326.29	20,447.53 1,589.86 2,002.45	10,982.13 1,186.10 671.26
Accumulated total direct investment from '95 to '04 (million USD)	Total Japan China (+HK)	1,764.1 3.5 119.4	519.3 19.0 34.4	3,792.5 119.3 347.4	33,420.6 8,785.0 2,549.6	16,203.9 2,474.0 1,447.0

Source: OECD/DAC, The Ministry of Foreign Affairs of Japan – Country Data Book, JETRO Investment Statistics, Japan ASEAN Center

2) ADBGMS Program

ADB started the program called "the Greater Mekong Subregion (GMS)" targeted on the six countries by gathering the five Indochina countries and Yunnan Province of China in Manila.

The GMS program is a regional cooperation program among the Mekong Region, Cambodia, Lao PDR, Myanmar, Thailand, Vietnam and PR China under the support of ADB. The funds are provided to projects involving energy, transport, environment, tourism, and trade facilitation. The program is aimed at contributing to the region's economic development through improvement of infrastructure to share and develop the natural resources of the countries in the region. The program aims to establish fair and free trade for regional productions and for peoples up to 2012. The difference between ADB and the Mekong River Committee is that ADB can make faster decisions and implantation from planning to the financing by coordination among the member countries as a secretariat office. The areas targeted to be developed covers from support to infrastructure installation to software infrastructure such as capacity building or the development of the legal system. Major importance is put on close border development.

As one of the activities in the GMS Program, the five Indochina countries and PR China established the power forum, EPF (GMS Electric Power Forum) in 1995 and the expert group, EGP (Experts' Group on Power Interconnection and Trade) under the leadership of ADB. The forum is based on the following philosophies; i) enhancing power system reliability, ii) coordinating construction and operation of power system, iii) reducing the cost of facilities and operation, and iv) sharing the benefit of interregional connections. Based on the discussions in the meetings, the "Policy Statement on Regional Power Trade in Greater Mekong Sub-region" was concluded in the 9th GMS Ministerial Meeting in 2000 and the IGA: "Inter-Governmental Agreement on Power Trade in the GMS" was concluded in 2002. This latter agreement determined the holding of the RPTCC: Regional Power Trade Coordination Committee. Using these occasions, the field was set out where the donors such as the World Bank, Japan, France, Australia and Sweden would aim at the establishment of an interregional power trade market in a coordinated manner. Since 2004, six RPTCC meetings have already been held and two subgroups (FG: Focal Group、PWG: Planning Working Group) have been set up for working-level consultations on priority issues.

The establishment of the power trade market is planned taking the following steps based on the GMS Program. The current stage is "Stage1".

Stage 1: Power trade between countries

Stage 2: Power trade based on the PPAs among almost all the GMS countries through development of the interregional connections. The transmission constraints limit the power trade.

Stage3: Carrying out interregional power trade by enhancing the capacity of interregional connections.

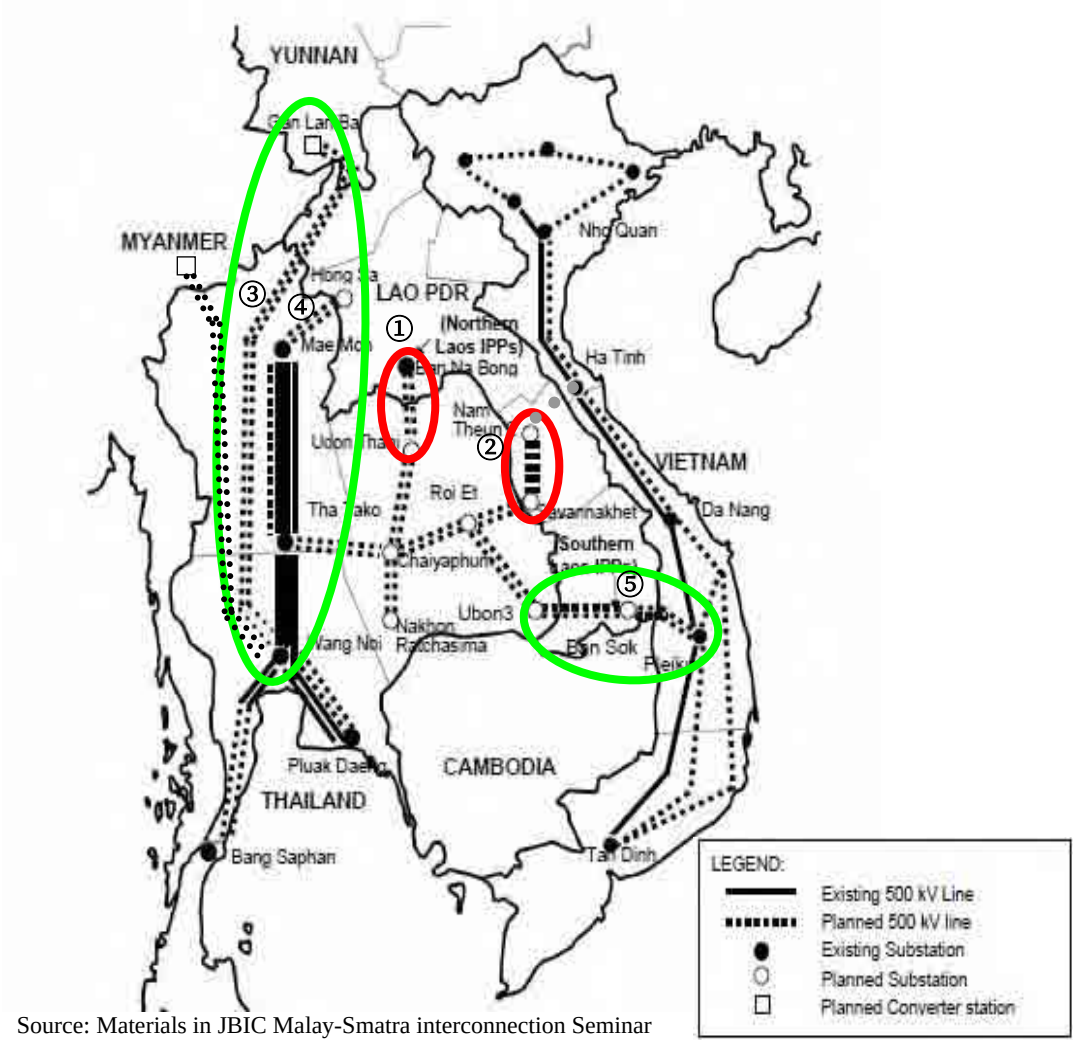
Stage4: Establishment of a competitive regional energy market participated in by multi-players

In 2003, the power development program of GMS interregional connections was first planned through the ADB's Technical Assistance summarized as "Indicative Master Plan on Power Interconnection". Based on the results of this study, the construction of the Nam Thuen 2 hydropower station, Nam Ngum 2 and 3 hydropower stations and related transmission lines have been started.

As the first interregional connection described as the most effective transmission line recommended in the master plan, the feasibility study of Thai-Lao PDR-Vietnam Interconnection was carried out by ADB. However, the first plan of the interconnection

between Ha Tinh in Vietnam, Nam Thuen 2 – Roi Et in Thailand had been stopped because of rejection of the connection by the Nam Thuen 2 Power Company. In this regard, coordination with the private sectors should be considered in the early planning stages.

Figure 5.2.7 shows the plan of the bulk power interconnections studied in the ADB Master Plan. The red circled areas indicate the transmission lines under construction or near construction (①500kV Na bong – Udon3、②500kV Nam Theun2 – Savananchet) and the green circled areas are the transmission lines for which a Feasibility Study has already been done. (③500kV HVDC Yunnan – Laos – Thailand, ④500kV Hong Sa – Mae Moh, ⑤500kV Ubon3 – Ban Sock – Pleiku). Many progressing projects are related to the development of large power plants.



Source: Materials in JBIC Malay-Smatra interconnection Seminar

Figure 5.2.7 Plans of 500 kV in ADB GMS MP

3) Mainstream Development of Mekong River

Cambodia, Lao PDR, Vietnam and Thailand are the members of the Mekong River Committee established in 1999. Each country is expected to coordinate its interests regarding the development of mainstream dams. On the other hand, PR China is not a member of MRC, but just an observer, but it tends to strengthen the political power of the committee. PR China has steadily developed the hydropower dams in the mainstream of Mekong River.

In such a situation, the rising oil prices and living with power shortages in Thailand and Vietnam, the development plan for hydropower mainstream dams in the countries located in the lower-stream of Mekong had rapidly increased in 2007.

Now China, Russia or other domestic companies, which aim at the power import to Thailand or Vietnam, are implementing the construction of the hydropower plants of IPPs and undertaking feasibility studies. Attention is paid to the impacts on the environment and ecologic system and the coordination among the members of MRC.

4) Involvement of PR China

Before the Asian currency crisis in 1997, Thailand, as one of the first ASEAN countries, had an effect on other Indochina countries. Actually still now, Thai-Bahts are used as the more reliable currency than the national ones in Lao PDR and Myanmar. However, the influence of Thailand has been declining after the crisis and China is making its presence in investment or financial support.

China is considering the promotion and development of its inland region through economic cooperation with ASEAN countries, including the five countries of Indochina. Furthermore, China expects the promotion of trade and investment among the region scheduled in ASEAN countries. Yunnan province, which has the capacity to supply power to one fourth of China, transmits the power to the large energy-consuming eastern region. It is examining to export power in the future, with a plan to sell the power to Thailand or Vietnam through the hydropower station under construction across the Mekong River.

The amount of economic cooperation with China is considered to reach 1.5-2 billion USD per year. Although it is difficult to grasp its value precisely, in recent years, China has accelerated economic cooperation with Lao PDR and Cambodia that have to be dependent on their neighboring countries and Myanmar that is isolated from the international society due to human right issues. The political and economic influence of China on Lao PDR has rapidly widened although Lao PDR only paid attention to the traditional “special relations” with Vietnam. The construction of Nam Ngum 5, Nam Lik, Nam Ou8, Xepon 2, Nam Den, Nam Tha1, Nam Khan2, 3, Nam Bak1, 2 as IPPs and their related transmission lines and substations is supposed to be implemented through the support and investment of China.

China will also boost its presence in Cambodia. China plans to construct the IPPs and their related transmission lines.

The support of China is important for Myanmar because China does not intervene in the human right issues of Myanmar. The IPP joint venture with Thailand is ongoing before the project of Tasan hydropower station (7,000MW) will be implemented. A project to

construct natural gas pipelines is also planned with the support and investment from China.

Table 5.2.7 shows the direct investment of China to the five Indochina countries.

Table 5.2.7 Direct Investment of China to the five Indochina Countries (Unit: 1 million USD)

	1995	2002	2003	2004	'95 – '04
Cambodia	NA	49	26	33	111
Lao PDR	1	1	2	0	33
Myanmar	3	5	0	5	18
Thailand	2	20	21	1	51
Vietnam	7	9	1	86	189

Source: ASEAN Statistical Pocketbook 2006

4) Private Investment

With regards to private investments in the five Indochina countries, the investments for Lao PDR, Cambodia and Myanmar are relatively low. However, hydropower stations for power export to Thailand and Vietnam will be constructed by utilizing the hydropower resources of Lao PDR. Table 5.2.8 shows private investments from China for the five Indochina countries.

Table 5.2.8 Status of Private Investment on Five Indochina Countries (1990-2006)

	Energy		Telecommunication		Transportation		Water Works	
	Number	Million USD	Number	Million USD	Number	Million USD	Number	Million USD
Cambodia	8	231	5	331	5	445	0	0
Lao PDR	4	2,586	2	198	2	0	0	0
Myanmar	2	719	0	0	1	50	0	0
Thailand	55	12,244	8	14,254	17	3,576	14	596
Vietnam	10	2,715	2	946	3	115	2	213

Source: WB Private Participation in Infrastructures Database

As to trade and investment of Japan to the five Indochina countries, the Economic Partnership Agreement (EPA) just recently came into effect. During the continuation of the negotiation with Vietnam in November, the ASEAN-Japan Comprehensive Economic Partnership (AJCEP) came into effect. Enhancement of future trade and investment with Japan is therefore expected.

5.3 Issues and Framework of Regional Cooperation in the Power Sector

5.3.1 Issues of Regional Power Sector

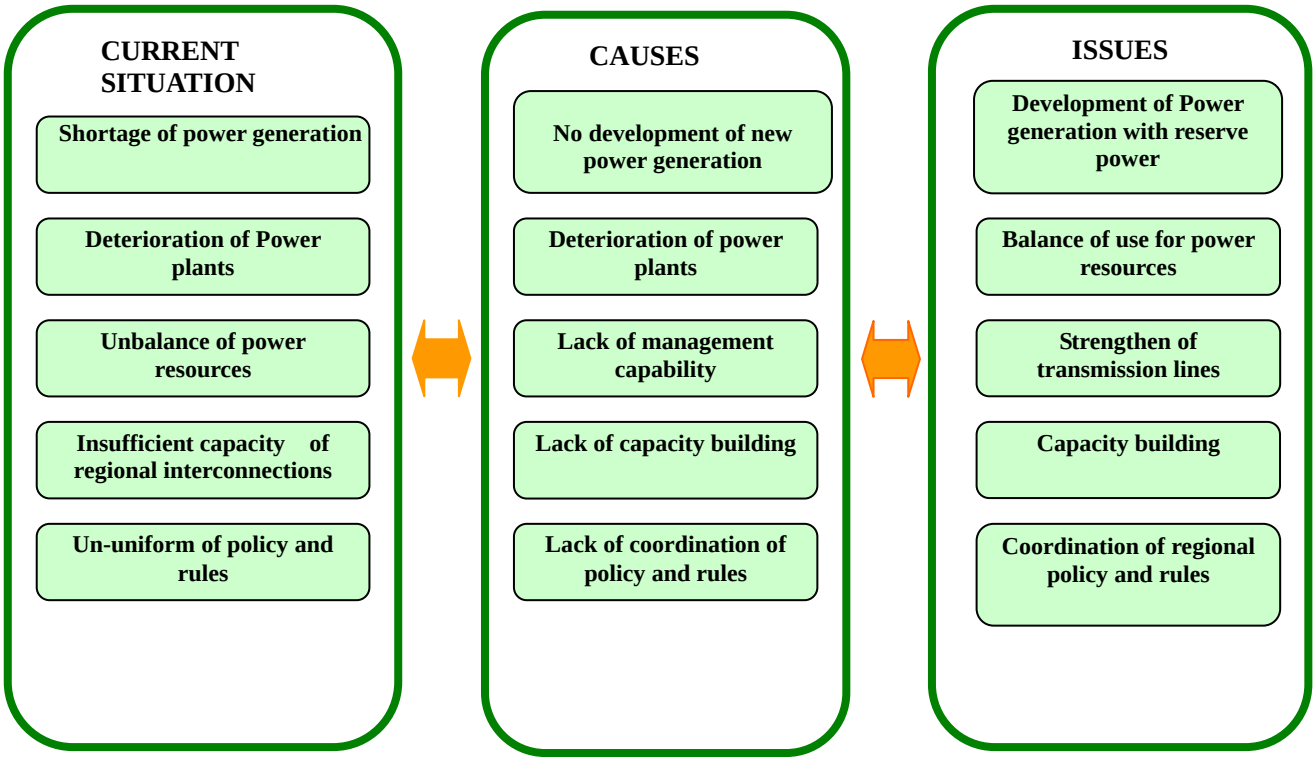
The Study on issues of regional power sector was focused on the Southern Africa Power Pool (SAPP), which has experiences as the power pool. The East Africa Power Pool (EAPP), on the other hand, has just started its functions although an interconnected transmission line exists between the two countries of Uganda and Kenya.

Since its establishment in 1995, the SAPP aimed at maintaining a stable and reliable power supply to supplement the electricity shortage of the member-countries with the electric power flexibility in the region. The SAPP has been managed through the initiative of the Republic of South Africa, which is the largest power generation as well as consumption country, sharing 80% or more of SAPP. The SAPP has the power system composition that surplus power of South Africa chiefly supply to the neighboring countries, although the interconnections across the member-countries exist to enable regional power exchange, except the power supply from Cahora Bassa hydro power plant in Mozambique to South Africa.

It was reported that the power crisis of South Africa that had become serious at the end of last year was caused by the more rapid increase of power demand at a higher rate than the economic growth in spite of such situation was forecasted in several years. Due to the power crisis, the electric power supply from South Africa to the neighboring countries was reduced by 10%, in which situation is against the original policy of SAPP, which aims to cooperate mutually and supplement the power shortage within the region.

Several causes of the power crisis were put forward and the shortage of available power in South Africa was cited as the major reason. which resulted in surplus electricity fell into the minus, and it was also pointed out, from the viewpoint of regional power flexibility, that development of new power generations and/or strengthen of transmission lines in the region have not been implemented. To achieve and secure stable and reliable power supply entirely in the region, the key issue is to stabilize the power sector in South Africa, which is the largest country in the SAPP, for the development of regional power sector.

As the result of the study with the analysis of current situations and issues of the regional power sector in Chapter 3 and Chapter 4, the framework on regional cooperation in the SAPP and EAPP is proposed as shown in the diagram below.



FRAMEWORK FOR REGIONAL COOPERATION

1. **Development of Power Generation**
2. **Regional Interconnections**
3. **Interconnection between SAPP and EAPP**
4. **Energy Conservation**
5. **Capacity Building**
6. **Harmonization and Cooperation of Power Pool**

The above frameworks were proposed as countermeasures to solve the issues in the regional power sector and the basic policy of each framework is described as follows.

1) Development of Power Generation:

Power generation plants have to be developed, utilizing the primary energy resources of SAPP (hydro potential in the northern part, coal in the southern part, and natural gas in the eastern part) with the aim of a stable and effective power supply in the region.

2) Regional Interconnections:

To optimize electric power flexibility in the region, the regional power networks with sufficient capacities of interconnected transmission lines as well as domestic power system transmission lines have to be strengthened.

3) Interconnection between SAPP and EAPP:

The SAPP and EAPP have to be aimed at more wide-ranging electric power flexibility with mutual interconnections to enable effective use of the electric power resources and save on power costs.

4) Energy Conservation:

Reduction of power consumption through energy conservation on the demand side, increase of available power on the power generation side, and reduction of transmission losses on the delivery side have to be effectively made.

5) Capacity Building:

To maintain the power plants sound for a long term, staff training for operation & maintenance and for enhancement of management abilities has to be conducted.

6) Harmonization and Cooperation of Power Pool:

Assistance to the member-countries in the Power Pools has to be made to coordinate policies, rules and systems design that will foster regional cooperation.

5.3.2 Framework of Regional Cooperation of Power Sector

In order to find out measures for issues on the regional power sector, it is necessary to take account of several factors such as the member country's policies, socio-economic conditions, energy balances, and electric power resources. The electric power development plans and the effect of the benefit, though the frameworks of the regional cooperation of the power sector were presented in the foregoing paragraph. Moreover, the trend of donors' support to African countries, particularly China's recent interest in participating in the African markets should also be considered. Taking these aspects into consideration, the framework outline of regional cooperation is described below.

1) Development of Power Generation

The most important issue of the power sector is how to secure a stable and reliable power supply. To achieve this goal, it is necessary to produce an electric power surplus power of 10 to 15%, which is assumed to be the standard for a steady power supply. The present surplus power in SAPP should have been a minus considering the current power crisis of South Africa, however the surplus power of SAPP in 2007 was reported at +4%. It is thus necessary to review the regional electric power development plan from the viewpoint of the composition of current power resources, which rely on 80% power supply from the coal-fired power plants in South Africa. Based on the electric power master plan being executed by SAPP, the power resource balance was reviewed and it was recommended to shift the coal-fired power of South Africa into hydropower in the northern part of the region as an alternative.

The coal-fired power plants of South Africa greatly contribute to cheap power supply with the underground resource of the home country, and they are essential as base load in future, too. However, as seen in the current power crisis, the unbalanced composition of power supply with coal being relied on as a single power resource will cause a serious problem on power balance. Therefore, multi-use of electric power, with two or more power resources become greatly effective for power supply and indispensable the spreading influence when one resource face the difficulty of supply. South Africa has announced the development plan for nuclear power generation as a new base load power, and to enhance nuclear power generation to 20,000MW by 2025. The development of a huge potential hydropower resource extending to the northern part of SAPP (DRC, Angola, Zambia, and Tanzania and Mallawi and Mozambique) will be greatly effective for power balance. From the viewpoint of regional cooperation by the electric power flexibility, the huge hydro resource is a valuable electric power resource

to enable mutual flexibility of power resources consisting of coal-fired power, nuclear power in the southern part and gas-fired power in the eastern part. Although hydropower generation has meteorological risks while power generation using fuel is free from these risks. With the advantage of several countries having hydropower potential, power exchange between neighboring countries can make best use of each other to supplement water shortage from a micro-viewpoint. From the macro-viewpoint, on the other hand, the development plan which enable to have a flexibility of regional power exchange among the hydro resource in the northern part, coal-fired and nuclear resources in the southern part and gas-fired power in the eastern part, is quite effective for solve of issue of regional electric power generation.

Moreover, from the environmental viewpoint, the extension of the existing power station or the run-of-the-river type hydropower generation that does not need a large-scale dam is more desirable in hydropower development. In addition, the development of pumped storage hydropower generation that uses at night time the surplus electricity from nuclear energy, is also effective from the viewpoint of efficiency. This is being developed as the base load of South Africa and Japanese technology can be best used in this field. It is therefore necessary to match the future development plan for the pumped storage hydropower generation with the planning of operation of the 20,000MW of nuclear power over the next 20 years. Construction of the Ingula pumped storage hydropower dam envisioned to generate 1,332MW has already started in South Africa.

2) **Regional Interconnections**

After the electric power development plan has been established, it is necessary to prepare the plan for the network of transmission lines that will concurrently convey the generated power to the demand side. The power generated will become effective only if the transmission network has the reliability and capacity to match the generated power. In this aspect, the present regional network does not necessarily have sufficient capacity to transmit the power. For example, the 500kV direct current transmission line in DRC, which extends to about 1,700km, is envisioned to convey power from Inga 1&2 to Zambia. However, the existing 220kV transmission line between DRC and Zambia does not have sufficient capacity for power transmission from Inga. It is thus indispensable to construct transmission lines having enough capacity corresponding to the electric power development plan, not only for interconnections between countries, but also as domestic transmission lines.

On the other hand, the electrification ratio is in an extremely low level of 30% or less in

many of subject countries. As a priority issue, improvement of the electrification ratio and enhancing the transmission lines, distribution lines and independent power supply etc. is required. Regional interconnection through and across countries will be helpful in improving the electrification ratio. The synergy effect can be expected by dispersing the electric power from the interconnections around the border area in the country being concentrated the power demand in urban areas.

It is important to establish the electric power development plan in each country having compositions of power generation, transmission lines, distribution lines, and rural electrification, with a close relationship to the regional electric power development plan.

3) Interconnection between SAPP and EAPP

The SAPP is working on Electric Power Development concerning power flexibility in the region and the examination of the transmission line plan, etc. and aims at getting the move from being a Cooperative Pool to a Competitive Pool. SAPP is reviewing the electric power development master plan of the region to deal with the current situation. On the other hand, the EAPP has just been established and is not yet functional, although regional interconnection between Uganda and Kenya is already existing. It is important for SAPP to establish a policy of regional cooperation as well as the enhancement of human resources and facilities. The electric power development master plan covering some countries has been prepared, but the master plan covering all the countries of eastern Africa as a whole is a pressing need. In addition to the assessment of electric power flexibility within the EAPP, the possibility of interconnections with SAPP, which has abundant electric power resources, should be considered for more effective electric power flexibility. A decrease in power cost can be expected if or when interconnection between EAPP and SAPP can be realized, with power exchanges at peak time since the difference of one hour between the SAPP and EAPP is an advantage in electric power flexibility.

4) Energy Conservation

Increase of the available power from the generating facilities is pointed out as an issue of the regional electric power sector. The available power against the whole installed capacity of power generation in SAPP was 83.6%, corresponding to power losses of 9,300MW or 16.4% of the whole installed capacity. The reason for the decrease in available power may be due to a reduced supply of the primary energy for power generation. In case of hydropower generation, the output varies depending on the water volume and in addition, it is also very possible that the power generation capacity is

decreased because of the sedimentation of the dam. On the other hand, it was reported as one of reasons of the current power crisis is the unscheduled forced shutdown due to damages of deteriorated coal-fired power plants in South Africa. Countermeasures for environmental impacts such as air pollution, or the plant design for the quality of the fuel are required for coal-fired power plants. Moreover, the decrease of power generation efficiency due to the deterioration of power plants constructed more than 20 years ago is thought to be a cause of the power crisis. In order to increase the available power, inspection of the operating conditions of all thermal power and the hydropower plants in the region is necessary. As a result of the inspection, countermeasures to improve power generation capacity should be formulated.

In addition to the improvement of power generation ability, another essential countermeasure to ensure stable and reliable power supply is to reduce transmission losses of transmission and distribution lines. The resistance loss of the electric wires used for the power lines is a major cause for transmission loss. Besides such technical losses, non-technical losses, which is caused by an incomplete tariff collecting system and loss of measuring meters due to deterioration, often become a serious problem particularly in developing countries. Transmission loss in these countries is at a relatively high level of 20-30%, while that in advanced countries like Japan, it is 10% or less. Non-technical loss often originates from the problem of tariff collection system and then a fundamental improvement including the management system is required. During this study, details of transmission loss are not collected, but it was reported that Tanzania, Malawi, Swaziland, and Angola in SAPP and Ethiopia in EAPP have high transmission losses and thus, immediate measures are required.

The South African Government has announced a Demand Side Management (DSM) scheme that reduces power consumption on the customer side to counter against the power crisis which was caused by the rapid growth of power demand. This so-called “Marshall Plan” aims at reducing the overall consumption by 10%, with individual targets of 10% for industry, 10% for household, 5% for agriculture, and 20% for hotel & shopping malls. The 10% overall reduction in consumption corresponds to a savings in electrical power of 3,600MW at peak time (approximately equal to South Africa’s peak power consumption in 2007, 36,000MW x 0.1). The technical assistance for energy conservation by Japan, which is the most advanced country in this field, is effective to implement the energy conservation measures.

5) Capacity Building

A power plant consisting of two or more components requires appropriate maintenance

for these components in order to operate the plants continuously for a long time. The maintenance works should be managed from both technical and financial aspects. As the function of power plant will be decreasing by the passage of time, the degree of deterioration should be adequately monitored by conducting regular inspection on daily monthly, and yearly bases, or if overhaul is required. The power plant should be maintained soundly by replenishing consumable materials and spare parts at the appropriate time. Such proper maintenance works will result in keeping the damage to a minimum although it is unavoidable. After-sales services of the Contractor or the manufacturer is limited only for repair works or supply of parts with costs, although they conduct technical training for operation and maintenance during the construction period. This means that operation and maintenance works are turned over to and succeeded by the utilities and they are requested to maintain and train the abilities for proper operation and maintenance. The ZESCO training center in Zambia, which is adjacent to the Kafue Gorge hydro power plant, was built at the same time as the construction of the power plant in 1971. The training center has been operating well and trainees from Zambia as well as from other African nations are accepted. The training center is evaluated highly and is a good model of a well-functioning training center. At present, the center offers 37 training courses, mainly on hydropower system, control system and power transmission system. In recent years, the number of trainees has been steadily increasing, and thus, the training facilities are required to be expanded under this situation. It is expected that enhancing the training center facilities will greatly contribute to improve the abilities for operation and maintenance management of utilities in African nations.

On the other hand, it was reported that one of reasons for the power crisis in South Africa is the inability for operation and maintenance management of the power plants by the designated staff. Education of the staffs, which have basic technology and expertise of an advanced professional skill, is required to secure stable electric power supply. The utility company should maintain and impart the technology through their own training system. Eskom has its own training center in Eskom College, but technical training has been entrusted to each power plant's on-the-job training. Training in Japan targeted for the executive staff of African nations is recommended and will be very effective for strengthening of staff capacity for operation and maintenance by giving them the chance to be introduced to the modern and latest technology in Japan.

6) Harmonization and Coordination of Power Pool

In order to enhance the coordination within and among the SAPP and/or EAPP, it is

essential to strengthen functions of power pool systems within and among these pools. Given this, there is an urgent need for support on policy-making and institutional system designs and for the implementation of developed policies and strategies, aiming at strengthening effective coordination among the member-countries.

The following five (5) strategies are the recommended directions of project implementation, where tools and techniques adopted by the Japanese government in projects of other developing countries can be fully utilized.

a) Build a Framework that Contributes to the Sharing of Information
Promote sharing of power sector policy and institutional systems among the SAPP and EAPP countries, and build a platform (database) upon which actions leading to coordination can be facilitated.

b) Development of Human Resources and Upgrade Skills in Policy-Making and Institutional Designs toward Coordination
Keeping coordination in mind, develop human resources and implement training leading to the acquisition of skills to build power sector policies/strategies and intuitional systems

c) Support for the Initiation of Process of Improvement Toward the Building Common Policies and Institutional Systems
Implement support for the formulation of common processes and simplification of the procedures to build policies/strategies and institutional systems and leading to coordination

d) Strengthen Functions, Networking, Standardize Governmental Regulatory Institutions and Power Suppliers
Taking into consideration that networking alone will be insufficient between governments, regulatory institutions, and power suppliers, build a framework to strengthen the functions of theses various bodies in order to improve regional coordination and promote networking and standardization between them.

e) Strengthen Coordination with International Agencies
In order to facilitate the strengthening of coordination of the SAPP and EAPP, strengthening coordination with international agencies such as AU and NEPAD will be essential. Moreover, transfer of technologies and funds involving bilateral and multi donors will be essential, and formulating a coordination strategy with such agencies will be necessary.