



AFRICA'S INTRA-REGIONAL, INTER-REGIONAL AND INTER-CONTINENTAL ELECTRICITY TRADE-TECHNO- POLITICO-ECONOMIC ASPECTS AND FUTURE PROSPECTS

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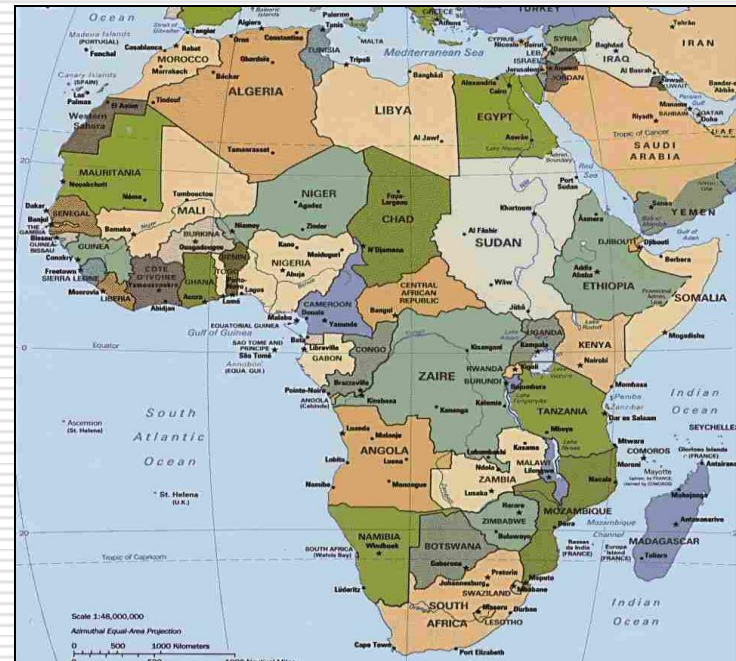
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3. ESTABLISHING ELECTRICITY INFRASTRUCTURE TO SUPPORT REGIONAL ELECTRICITY MARKET AND TRADE
4. TECHNO-POLITICO-ECONOMIC ASPECTS OF REGIONAL ELECTRICITY MARKET AND TRADE
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1. INTRODUCTION

1. East Africa Region
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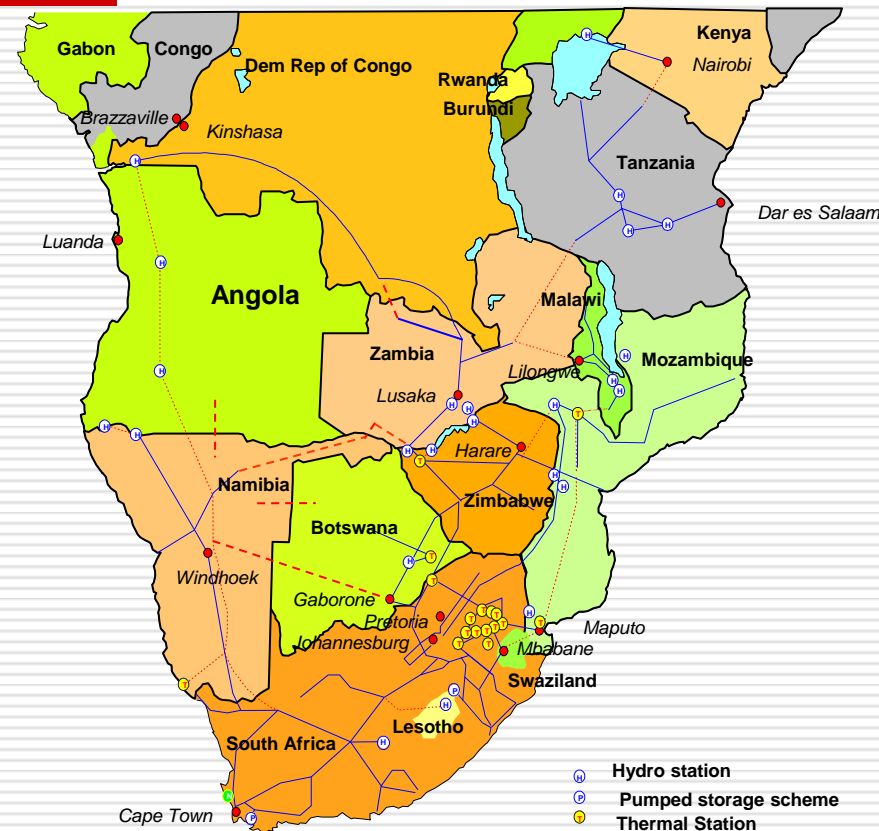


1. INTRODUCTION

Southern Africa Region

- ❑ Established SAPP (1995)
- ❑ Electricity is traded through bilateral contracts and STEM
- ❑ Capacity shortages
- ❑ Peak demand is forecast to 52,000 MW in 2012

SOUTHERN
AFRICAN
GRID

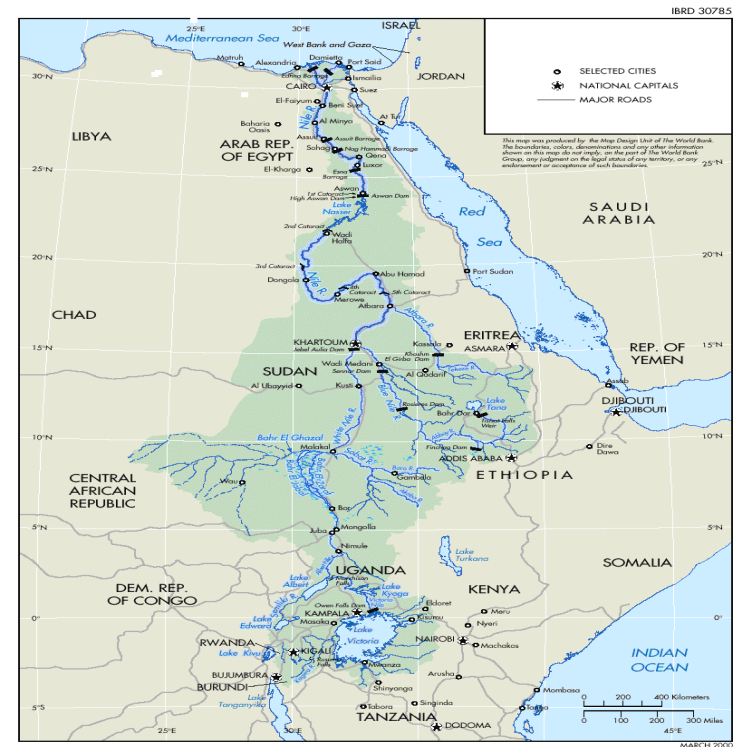


Hydro station
 Pumped storage scheme
 Thermal Station

1. INTRODUCTION

East Africa Region

- ❑ The countries signed MOU to establish the EAPP Pool in 2005
- ❑ The Electricity trade is limited to Kenya-Uganda and Burundi-DRC-Rwanda, networks; and it is through bilateral contracts.
- ❑ Regional power master plan and other studies are required to forecast investment and to establish the power trade.
- ❑ The hydropower potential of the River Nile and the Great Lakes is significant.



1. INTRODUCTION

West Africa Region

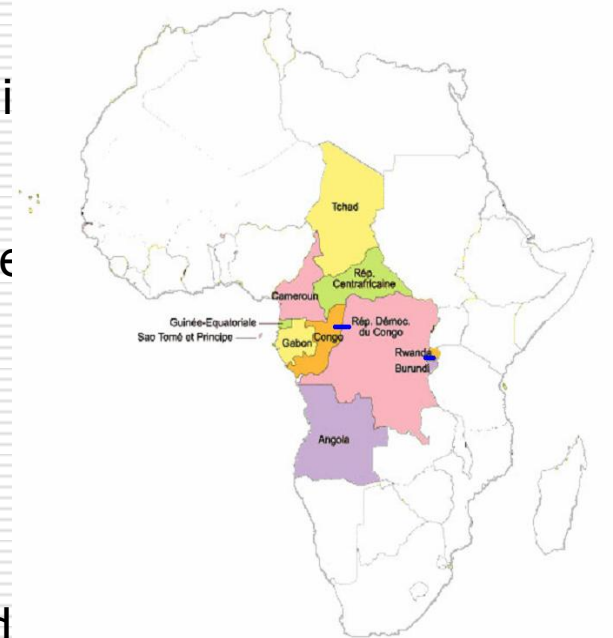
- ❑ WAPP established in 2000;
- ❑ The electricity is traded through bilateral contracts;
- ❑ Capacity shortages;
- ❑ The peak demand is forecast to 22,000 MW in 2020;



1. INTRODUCTION

Central Africa Region

- ❑ A decision was taken to create a power pool in 2003;
- ❑ The Region's hydropower potential is equivalent to 60% of the continent;
- ❑ DRC-Congo (Brazzaville) and DRC-Burundi/Rwanda are interconnected and the electricity is traded through bilateral contracts;
- ❑ A number of preparatory studies are required to prepare a business plan leading to power pool.



1. INTRODUCTION

North Africa Region

- ❑ Maghreb countries plan and operate systems under the framework of COMELEC
- ❑ COMELEC liaises with the EUROELECTRIC and Union of Arab Electric Utilities.
- ❑ The North-Africa (Morocco) exchanges electricity with the Spanish network.



2. AFRICA'S INTRA-REGIONAL, INTER-REGIONAL AND INTER-CONTINENTAL ELECTRICITY TRADE

1. INTRA-REGIONAL ELECTRICITY TRADE
2. INTER-REGIONAL ELECTRICITY TRADE
3. INTER-CONTINENTAL ELECTRICITY TRADE

2. AFRICA'S INTRA-REGIONAL ELECTRICITY TRADE

Southern Africa Region

A) Bilateral Agreements (2005)

- Exporters : ZESCO (80 MW), SNEL (210 MW), HCB (1620MW)
- Importers : ZESA (110MW), LEC(100MW), BPC (210MW), SEB(96MW), NamPower(300MW)
- ESKOM (Total Imports): 1550 MW; ESKOM (Total Exports): 1656 MW

B) Short-Term Energy Markets

Volume of Energy Sold : 20 Million kWh (**June 2006**)

Average Energy Price : USc 1.83/kWh

2. AFRICA'S INTRA-REGIONAL ELECTRICITY TRADE

North Africa Region

EXP/IMP	GWH
SPAIN/ONE	1561
ONE/SONELGAS	122
STEG/SONELGAS	88
LEC/EEHC	96
STEG/LEC	32

EXP/IMP	GWH
ONE/SPAIN	6
SONELGAS/ONE	103
SONELGAS/STEG	94
EEHC/LEC	163
LEC/STEG	0

2. AFRICA'S INTRA-REGIONAL ELECTRICITY TRADE

East Africa Region

Exporter /Importer	MW
UETCL/KPCL	30
UETCL/RWANDA	1
UETCL/Tanzania Mines	3

2. AFRICA'S INTRA-REGIONAL ELECTRICITY TRADE

Central Africa Region

- ❑ SNEL of DRC is a net exporting utility in the Region.
- ❑ Burundi, Rwanda, Congo imports from SNEL of DRC
- ❑ The electric utilities operate as the isolated system in Angola, Equatorial Guinea, Gabon, Cameroon, and Central African Republic.

2. AFRICA'S INTRA-REGIONAL ELECTRICITY TRADE

West Africa Region

- CEB imports from VRA over 161 kV lines
- CEB also imports from Ivory Coast via VRA system
- VRA imports from Cote D'Ivoire.
- CEB is also importing electricity from Nigeria.

Senegal River Authority (OMVS)

Manantali hydropower project (200 MW)

Beneficiaries: Mali, Mauritania and Senegal

Operational Management : Management Contractor

2. AFRICA'S INTER-REGIONAL ELECTRICITY TRADE

1. The Electricity Trade between the Eastern and Southern Africa
2. The Electricity Trade between the Eastern and North Africa
3. Development of Inga hydropower sites to promote inter-regional Trade

2. AFRICA'S INTER-REGIONAL ELECTRICITY TRADE

THE ELECTRICITY TRADE BETWEEN THE EAST AFRICA AND THE SOUTHERN AFRICA

- ❑ ZESCO supplies electricity to a border town in Tanzania over 66 kV lines;
- ❑ ZESCO, TANESCO and KPLC have prepared a feasibility study of a power interconnection, indicating the viability of power transfer of 200 MW from ZESCO to TANESCO/KPLC. The proposed power inter-connector requires the reinforcement of the electricity grid in Tanzania.

2. AFRICA'S INTER-REGIONAL ELECTRICITY TRADE

THE ELECTRICITY TRADE BETWEEN THE EAST AFRICA AND THE NORTH AFRICA

- ❑ The Nile Basin Initiative Agreements bind the riparian countries of the River Nile to prepare studies to develop hydro energy resource of the River Nile for regional benefits and for power exchange between them.
- ❑ Eastern Nile Power Trade Program Study

2. AFRICA'S INTER-REGIONAL ELECTRICITY TRADE

ROLE OF INGA HYDROPOWER SITES TO PROMOTE INTER-REGIONAL TRADE

- ❑ The hydropower potential of DRC is 100,000 MW including 40,000 MW of Grand Inga;
- ❑ Huge hydropower potential is to be developed to export power to major demand centers, namely Nigeria (West Africa), South Africa (Southern Africa) and Egypt (North Africa).
- ❑ Evacuating power from Inga hydropower sites requires constructing three power transmission highways:
 - i) Northern Highways (DRC-Congo-Chad-Sudan-Egypt)
 - ii) Southern Highway (DRC-Angola-Namibia/Botswana-RSA)
 - iii) Western Highway (DRC-Congo-Gabon-Cameroon-Nigeria)

2. AFRICA'S INTER-CONTINENTAL ELECTRICITY TRADE

North Africa (Maghreb)-Europe Electricity Trade

- Morocco and Spain trade electricity by means of two 400 kV sub-marine cables

- Europe-Maghreb Electricity Market requires several preparatory activities such as:
 - (i) A Strategic study for evaluating the power interconnections and prioritizing them;

 - (ii) Defining the eligibility criteria for accessing the networks in the wholesale electricity market;

2. AFRICA'S INTER-CONTINENTAL ELECTRICITY TRADE

North Africa (Maghreb)-Europe Electricity Trade

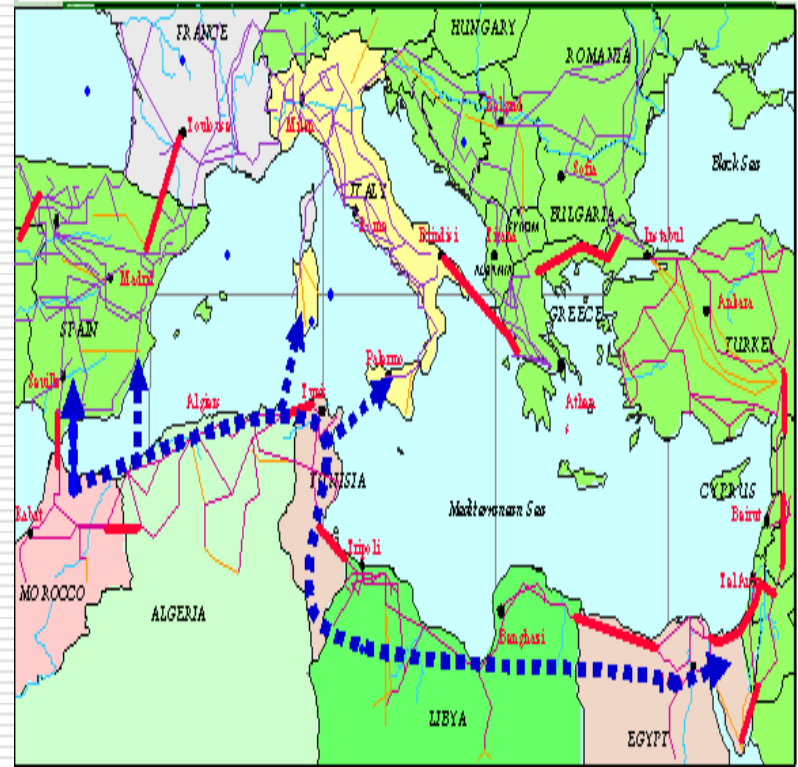
- (iii) Defining a mechanism to enable coordination between the market operators;

- (iv) Harmonizing the tariff setting formulae, practices, and legal and regulatory framework with the European system;...

2. AFRICA'S INTER-CONTINENTAL ELECTRICITY TRADE

North Africa (Maghreb)-Europe Electricity Trade

- Discussions are underway to establish Algeria-Spain, Algeria-Italy and Tunisia-Italy power interconnections.
- The capacity of Morocco-Spain sub-marine cable is already doubled.



2. AFRICA'S INTER-CONTINENTAL ELECTRICITY TRADE

North Africa-Middle East-Europe Electricity Trade

- The Egyptian system is interconnected with European system via Jordan-Syria-Turkey-Bulgaria system. An additional 400 kV power interconnection is planned between Turkey and Greece.
- The Egyptian system is interconnected with Libyan system, which is interconnected with Maghreb grid, which is interconnected with Spain.

2. AFRICA'S INTER-CONTINENTAL ELECTRICITY TRADE

The Electricity Trade between the East Africa –Asia system

- The hydropower rich Ethiopian system could be interconnected with the power system of Yemen, which is endowed with huge natural gas reserves. According to a pre-feasibility study, there is potential of exchanging 90 MW power between Ethiopia and Yemen via Djibouti.
- The Ethiopia-Djibouti-Yemen system is much more economic than Djibouti-Yemen system.

3. ESTABLISHING THE ELECTRICITY INFRASTRUCTURE TO SUPPORT REGIONAL ELECTRICITY MARKET AND POWER TRADE

Constraints

- ❑ The existing electricity generation and transmission facilities are capacity limited;
- ❑ Building new facilities is capital intensive and the countries need huge capital investment;
- ❑ Institutions, rules of the game and human resources are inadequately developed to handle the electricity trade;
- ❑ Quality institutions and enabling environment are needed to attract private investment;...

3. ESTABLISHING THE ELECTRICITY INFRASTRUCTURE TO SUPPORT REGIONAL ELECTRICITY MARKET AND POWER TRADE

Southern Africa Region

- ❑ In short-term, 4200 MW capacity addition is required to avoid power shortages;
- ❑ New build and reinforced transmission lines are required for relieving congestion and increasing the electricity trade;
- ❑ Power interconnections are also needed to connect the non-operating members to the grid, namely Tanzania and Angola.
- ❑ The volume of the electricity trade is expected to increase to 5000 MW in SAPP.

3. ESTABLISHING THE ELECTRICITY INFRASTRUCTURE TO SUPPORT REGIONAL ELECTRICITY MARKET AND POWER TRADE

West Africa Region

WAPP Coastal Transmission Backbone project :

- i) 330 kV Sakété-Ikeja West Line (Nigeria-Benin Interconnection)-complete
- ii) 330 kV Aboadze-Volta Transmission Line-ongoing
- iii) 330 kV Volta-Momé-Hagou-Sakété (Ghana-Togo-Benin Interconnection)

3. ESTABLISHING THE ELECTRICITY INFRASTRUCTURE TO SUPPORT REGIONAL ELECTRICITY MARKET AND POWER TRADE

West Africa Region

- WAPP Inter-zonal Transmission Hub Program :
 - i) 225 kV Bobo Dioulasso-Ouagadougou Transmission Line (Burkina Faso-Cote d'Ivoire) – ongoing
 - ii) 225 kV Ferke-Sikasso and 150 kV Sikasso-Segou (Cote d'Ivoire –Mali)
 - iii) 225 kV Ghana-Burkina Fasso Interconnection
 - iv) National Control Centers (VRA, CEB, SONABEL, Nigeria, Senegal, etc)

- *OMVG+OMVS Power System Development Program*
 - i) OMVS Felou 60 MW Hydropower Plant

3. ESTABLISHING THE ELECTRICITY INFRASTRUCTURE TO SUPPORT REGIONAL ELECTRICITY MARKET AND POWER TRADE

West Africa Region

- ❑ Studies are required to upgrade the national control centers with appropriate hardware and software
- ❑ A feasibility study is required to interconnect Cote d'Ivoire (Man) and Liberia (Manrovia)
- ❑ Studies are needed to interconnect LSG system to off-take power from WAPP

3. ESTABLISHING THE ELECTRICITY INFRASTRUCTURE TO SUPPORT REGIONAL ELECTRICITY MARKET AND POWER TRADE

East Africa Region

- Eastern Nile Power Trade Study
- The Nile Equatorial Lake Power Interconnection Study
- Feasibility study of Rusumo Fall Hydropower project
- Ethiopia-Kenya Power Interconnection Study
- Regional Power Trade Study

3. ESTABLISHING THE ELECTRICITY INFRASTRUCTURE TO SUPPORT REGIONAL ELECTRICITY MARKET AND POWER TRADE

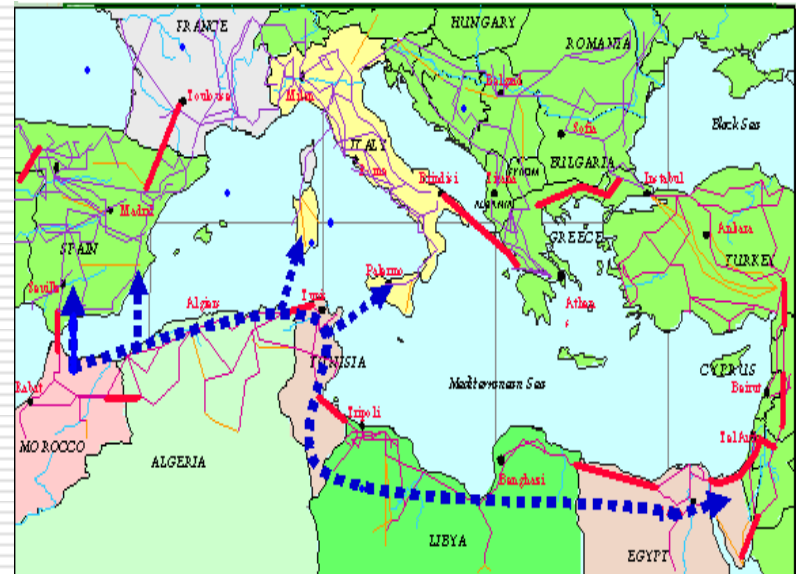
Central Africa Region

- ❑ Feasibility study of power interconnections between the countries of CEEAC is ongoing;
- ❑ An Integrated Regional Power Master Plan and the Plan of Action to establish the institutions to operate the Pool are needed;
- ❑ Studies are required to rank Inga hydropower sites for implementation; and
- ❑ Feasibility studies of the following power interconnections :
 - (i) Inga (DRC)-Cabinda (Angola)-Poine Noir (Brazzaville)
 - (ii) Inga-Calabar (Nigeria)
 - (iii) Chad -Cameroon

3. ESTABLISHING THE ELECTRICITY INFRASTRUCTURE TO SUPPORT REGIONAL ELECTRICITY MARKET AND POWER TRADE

North Africa

1. Egypt, Libya, Tunisia, Algeria, and Morocco are taking steps to reinforce the existing interconnections in 400 kV to increase volume of electricity trade in the region.
2. A strategic study is underway to establish the regional electricity market in Maghreb countries.



4. TECHNO-POLITICO-ECONOMIC ASPECTS OF THE REGIONAL ELECTRICITY MARKET AND TRADE

- Technical
- Financial
- Politico-economical
- Legal

4. TECHNO-POLITICO-ECONOMIC ASPECTS OF THE REGIONAL ELECTRICITY MARKET AND TRADE

Technical

1. The congested transmission lines reduce the volume of electricity trade;
2. The missing transmission links prevent non-connected utilities/consumers getting benefits of regional integration;
3. Inadequate transmission system distracts private investment in the electricity generation and in industries (Soda Ash project in Tanzania);
4. Reactive power planning is essential for healthy grid.

4. TECHNO-POLITICO-ECONOMIC ASPECTS OF THE REGIONAL ELECTRICITY MARKET AND TRADE

Financial

1. Preparing a pool wide merit-order schedule and economic dispatch of generating units is desirable;
2. Like SAPP Coordination Centre, a brokerage agency is necessary for operating the regional energy markets in other Regions;
3. A “Fair and Equitable Price” to both buyer and seller should be established ;
4. A “Wheeling Rate” to be paid to third party should be established. Realistic power system models should be used considering the presence of IPP and co-generators.

4. TECHNO-POLITICO-ECONOMIC ASPECTS OF THE REGIONAL ELECTRICITY MARKET AND TRADE

Politico-economical

1. The NEPAD supports the pooling of resources and establishing the regional electricity markets;
2. Regional Economic Communities are not specialized in handling the electricity business. Hence new institutions, namely the power pools are required for running the electricity business on regional basis;
3. The regional electricity market transcends national borders, regional regulatory agency is needed to monitor and regulate the overarching matters and to demonstrate a long-term visibility, in terms of financial and economic frameworks for investors.

4. TECHNO-POLITICO-ECONOMIC ASPECTS OF THE REGIONAL ELECTRICITY MARKET AND TRADE

Legal

1. The Energy Market Reform is critical for introducing competition in attracting private investment and improving efficiency of electric utilities;
2. To mitigate investor-perceived risks, the constituents of the power pools need to agree on the common Energy Protocol as well as the steps to internalizing the protocol into their legal systems.

4. TECHNO-POLITICO-ECONOMIC ASPECTS OF THE REGIONAL ELECTRICITY MARKET AND TRADE

Legal

3. Harmonization of the Energy Market Reforms is needed on region-wide basis to deepen the ethos of regional integration.
4. Given the multinational nature of a power pool, there is need to create a regional agency to smoothen the operation of the power pools and to supervise and regulate technical and financial aspects.

4. TECHNO-POLITICO-ECONOMIC ASPECTS OF THE REGIONAL ELECTRICITY MARKET AND TRADE

Legal

- (i) Compliance with electricity grid codes and technical standards;
- (ii) Compliance with the common provisions of the Energy Protocol;
- (iii) Ensuring the harmonized Electricity Market Reform policies;
- (iv) Regulating the use of capacity of inter-utility transmission line and the price of usage of the facility; and
- (v) Facilitating the independent power producers and non-utility generators as well as encouraging competition in the regional electricity market progressively.

5. HARNESSING OF ENERGY RESOURCES

- The success of the regional electricity markets depends on the availability of sufficient electricity generation capacity to meet the combined demand of the region, among other factors. Hence, developing electricity generation projects exploiting indigenous energy resources is a must.
- Therefore, this section rightly presents salient trends exhibiting investment in exploiting energy resources in Africa with expectation and dynamics revealed.

5. HARNESSING OF ENERGY RESOURCES

Southern Africa

- ❑ Botswana: Mammabula coal-fired power plant in Botswana to supply power to Eskom of South Africa
- ❑ Zambia: Itezhi-Tezhi, Kafue Gorge Lower and Kariba North Bank hydropower projects
- ❑ Mozambique: Temane Combined Cycle power plants
- ❑ South Africa: Medupi, Kusile and Ingula

5. HARNESSING OF ENERGY RESOURCES

Central Africa

- ❑ Developing hydropower sites in DRC and Cameroon, is the main plank of this region;
- ❑ Inga Hydropower sites

5. HARNESSING OF ENERGY RESOURCES

Central Africa

- ❑ Rusumo Fall and Ruzizi III hydropower projects will integrate the Eastern and Central Africa
- ❑ Reinforcement of Burundi-Rwanda-DRC interconnection will further assist in exploiting the hydropower resource of the Region.
- ❑ Kivu methane gas project in Rwanda

5. HARNESSING OF ENERGY RESOURCES

Central Africa

- Memve'ele (200 MW) hydroelectric power plant in Cameroon to supply power to Yaoundé and Equatorial Guinea.

5. HARNESSING OF ENERGY RESOURCES

Eastern Africa

- ❑ Most of Ethiopia's hydropower potential remains unexploited.
- ❑ The country has set a target of installing 4000 MW additional capacity by 2015. Gibe III (1800 MW) is under implementation.
- ❑ The private investment is not yet on the ground to developing hydroelectric projects.

5. HARNESSING OF ENERGY RESOURCES

Eastern Africa

- ❑ Uganda's Bujagali hydropower project-PPP
- ❑ Tanzania's natural gas and coal resources are attracting private investors, in the case of Kenya it is the geothermal energy which is luring private investors;
- ❑ Because of emerging opportunities of electricity trade, Ethiopia, Tanzania and Kenya are discussing steps to inter-connect their power systems. Ethiopia-Kenya Power Interconnection

5. HARNESSING OF ENERGY RESOURCES

North Africa

- ❑ Independent Power Producers own and operate the power plants in Tunisia, Egypt and Morocco; these plants are driven by fossil fuels (natural gas), and wind energy
- ❑ Algeria and Morocco are spearheading the implementation of hybrid solar-natural gas-fired combined cycle power plants.
- ❑ Wind and Solar Energy projects are being implemented

5. HARNESSING OF ENERGY RESOURCES

Western Africa

1. **M**odels to develop energy resources:
 - Manantali project-OMVG-Regional Integration
 - West Africa Gas Pipe line project (WAGP)-PPP
2. Nigeria is able to leverage her petroleum resources to enable private investors to implement gas fired power plants.

5. HARNESSING OF ENERGY RESOURCES

To sum up:

(i) Natural gas, hydropower, solar energy, wind and coal are main energy resources that are being exploited with both public funding and private investment. Since Nuclear energy conference held in Algeria, countries are also discussing the way forward to exploit the nuclear fuels of the continent.

(ii) The private investment flow will with the progress on electricity markets reforms and regional power pools.

6. CONCLUSIONS

To carry out the electricity trade, it is necessary to :

- (i) Establish the regional power pools/regional electricity markets;
- (ii) Carry out soft studies that are prerequisite to establishing and operating the power pool;
- (iii) Construct the regional power interconnections;
- (iv) Establish the institutions: regulators, energy brokerage agency, etc to demonstrate the long-term commitment and visibility;

6. CONCLUSIONS

To carry out the electricity trade, it is necessary to :

- (v) Reform the electricity supply industry to (i) reduce transactions costs (ii) improve efficiency of electric utilities (iii) attract private investment in the electricity generation segment;
- (vi) Harmonize the energy market reforms on region wide basis in order to deepen the ethos of the regional integration;

6. CONCLUSIONS

To carry out the electricity trade, it is necessary to :

- (vii) The power sector reforms should go hand-in-hand with establishing the regional electricity market;
- (viii) Develop institutions to promote the public-private partnerships to implement the electricity generation projects, exploiting indigenous energy resources; and
- (ix) Take steps to minimize human resource gap to operate the power pool and to man the institutions.

6. RECOMMENDATIONS

East and Central Africa Power Pools

1. Prepare studies: (i) integrated regional power master plan (ii) common energy protocol and (iii) business plans.
2. Mobilize financial resources for implementing the projects of the Business Plan
3. Take steps to establish a regional regulatory agency to monitor and control the overarching technical, commercial and legal aspects of the electricity trade.

6. RECOMMENDATIONS

Southern Africa

1. Harmonize the reform policies so that the electricity sector is attractive to investors.
2. Grant open access to IPP and non-utility generators
3. Reinforce the capacities of the interconnected grid.
4. Mobilize financial resources to interconnect the non-operating members to the grid.

6. RECOMMENDATIONS

Southern Africa

Convert the Southern Africa Region Regulators Association into a Regional Regulatory institution to monitor, and regulate the overarching technical, financial and legal aspects of the electricity trade in the Region.

6. RECOMMENDATIONS

Western Africa

1. Implement the West Africa Power pool projects;
2. Establish a multinational regional regulator to monitor and regulate the overarching technical, financial and legal aspects of the electricity trade.

6. RECOMMENDATIONS

North Africa

1. Reinforce the capacities of the power interconnections in accordance with the recommendations of ELTAM study and establish a regional electricity market .
2. Establish a multinational regional regulator to monitor and control the overarching technical, financial and legal aspects of the electricity trade.
3. Take steps towards establishing the Euro-Maghrebien electricity market.

Thank you for your kind attention

