

# The roadmap to a fully integrated and operational East African Power Pool



# Preface

Though the East African region holds an immense reservoir of potential energy resources, the post 1990 period has been characterised by perennial power deficits which have escalated into a crisis in recent years. Responding to these challenges, a number of countries comprising the Common Market for Eastern and Southern Africa (COMESA) regional economic bloc agreed in 2005 to create a regional power market dubbed the East African Power Pool (EAPP). Currently in its preliminary stage, the EAPP envisages the evolution of a fully integrated and operational power market in a period of about 30 years from inception. This publication discusses the critical success factors that must be addressed if the aspiration of a fully integrated and operational power market in the East African region is to be translated into reality.





# Abbreviations

Unless the context otherwise requires, the following terms have the meaning attributed to them as set out below:

CAPP	Central African Power Pool;
COMELEC	Comité Maghrebin de d'Electricité;
COMESA	Common Market for Eastern and Southern Africa;
EAPP	East African Power Pool;
ECOWAS	Economic Community for West African States;
IG-MOU	Inter-Governmental Memorandum of Understanding;
IU-MOU	Inter-Utility Memorandum of Understanding;
NEPAD	New Partnership for African Development;
PIDA	Programme for Infrastructural Development in Africa;
RECs	Regional Economic Communities;
SADC	South African Development Community;
SAPP	Southern African Power Pool;
WAPP	West African Power Pool.



# Introduction

The last century has demonstrated that every aspect of human development is woven around a sound and stable energy supply with electricity stock in its various forms being the most optimised source. Widespread access to electricity is a prerequisite for sustaining economic growth. Countries need clean, reliable and affordable electricity to grow their economies, maintain a sustainable standard of living for its people, as well as meeting their other aspirations.

Governments in developing countries are concerned that past efforts to develop national power grids capable of delivering reliable power supply to their citizens at affordable prices have fallen short of expectation.<sup>1</sup> The post 1990 period has for instance seen Africa endure power deficits which have adversely affected economic growth and productivity. Africa's power trials can be explained by a number of reasons. The most compelling are insufficient maintenance of existing facilities and inadequate planning. Whilst financing is a key barrier to growing generation capacity, the level of power deficit could have been reduced considerably if adequate planning and maintenance were applied.

The most recent years have witnessed a reinvigoration of efforts to integrate power systems via power pools within the respective regional economic communities (RECs) in Africa as a means of addressing the continent's power challenges. African governments are increasingly interested in new regional, bilateral or multilateral approaches that emphasise better coordination and 'pooling' of their efforts to create more robust regional power grids with the potential of lowering capital investment requirements across the region and reducing system operational costs.<sup>2</sup>

A strong working power pool mitigates the risks connected with investment in the power sector which increases the opportunities for financing. Through its ambitious Programme for Infrastructural Development in Africa (PIDA), the New Partnership for African Development (NEPAD) secretariat is working together with the various RECs and respective governments to identify priority projects and attendant financing

requirements to expedite the integration of Africa's power systems into regional pools.

The present efforts to integrate countries' power systems are exploiting earlier cross border interconnection facilities, electricity exchange and trade which can be traced as far back as the 1950's. One limitation of earlier bilateral system interconnections is that they did not provide for coordinated planning of expansion of generation capacity. As a result, the hitherto exporting countries ran out of surplus generation capacity to meet their own growing power demands, as well as their exportation obligations. The renewed efforts are emphasising the integrated planning of power generation and transmission among the participating countries. Regional power pools are therefore the basis for creating the appropriate institutional framework for cross border electricity trade.

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<sup>1</sup> Armar, A. "Building Regional Power Pools. A Toolkit." The World Bank, Washington, DC (2009) page 2

<sup>2</sup> Ibid

There are presently four regional power pools in Africa albeit at different stages of development set out in the table below together with Nordel which is one of the world's foremost electricity markets all the nascent power pools would aspire to evolve into.

Power pool	Discussion
COMELEC <sup>3</sup>	COMELEC is a specialised energy agency of the Union of Maghreb Arab (UMA) comprising five states namely Algeria, Libya, Mauritania, Morocco and Tunisia.  COMELEC member countries except Mauritania are connected to a regional electricity network in the Maghreb region. Regional power trade in this pool presently accounts for 5% to 16% of interconnection capacities.
SAPP <sup>4</sup>	SAPP is a specialised energy agency for the Southern African Development Community (SADC) and was founded in 1995.  Its membership presently comprises Angola, Botswana, Lesotho, the DRC, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.  Power trade under the auspices of this pool presently ranges from 6% to 15% of the power generated in the region.
WAPP <sup>5</sup>	WAPP is a specialised energy agency for the Economic Community for West African States (ECOWAS). It presently has 15 member states namely Benin, Burkina Faso, Cape Verde, Ivory Coast, Gambia, Ghana, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo.  Power trade in the pool is presently estimated at about 6.9% of the power generated in the region.
CAPP <sup>6</sup>	CAPP is a specialised energy agency for the Economic Community for Central African States (ECCAS). Membership includes Angola, Burundi, Cameroon, Chad, Congo, Gabon, Equatorial Guinea, Central African Republic, Democratic Republic of Congo and Sao Tome.  There is very minimal regional power trade taking place under the auspices of the pool because of the absence of interconnection facilities. Power is presently exchanged between DRC and Congo, DRC and Zambia as well as DRC to Burundi, CAR, Rwanda and Angola.
Nordel <sup>7</sup>	Nordel is a regional organisation of the transmission system operators (TSOs) of Nordic countries. It represents a well-functioning, robust regional organisation set up that has evolved through all phases of the almost 40 year process underpinning the development of a common Nordic electricity market. Nordel is considered as a model for multi country power pooling mechanisms.

This paper highlights the benefits of power pools as well as the critical success factors that must be addressed if the nascent EAPP is to be translated into a fully integrated and operational power pool premising upon the evolutionary experience of some of Africa's earlier power pools and Nordel.

<sup>3</sup> [http://www.icafrica.org/fileadmin/documents/Knowledge/Energy/ICA\\_RegionalPowerPools\\_Report.pdf](http://www.icafrica.org/fileadmin/documents/Knowledge/Energy/ICA_RegionalPowerPools_Report.pdf)

<sup>4</sup> ibid

<sup>5</sup> ibid

<sup>6</sup> ibid

<sup>7</sup> Supra at I page 12

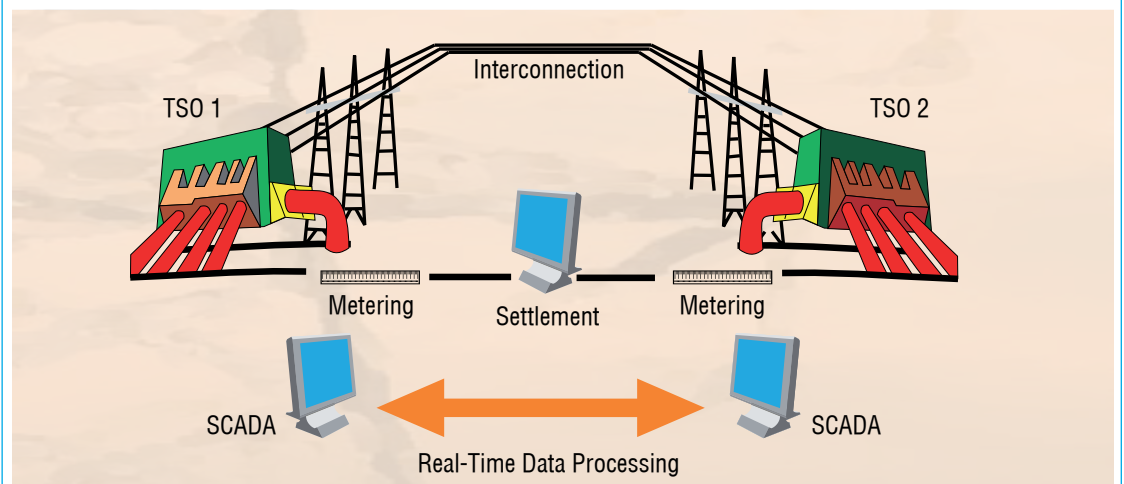
### 3. Overview of the East African Power Pool in perspective

A power pool can be defined as an arrangement between two or more interconnected power systems that plan and operate their power supply and transmission in the most reliable and economic manner given their load requirements. Thus when utilities form a group to consider their joint generation resources and needs and agree to plan and operate their system to improve reliability and economics, they are pooling.<sup>8</sup> The figure below provides an illustration of what integrated power systems look like.<sup>9</sup>

In a more technical sense, power pooling can be described as follows: *The control areas are the smallest units of an interconnected power system. In a power pool, these units are responsible for coordinating the planning and operation of the generation facilities and transmission networks in their areas. They can be established by a single utility or two or more utilities that are tied together by sufficient transmission and contractual arrangements. All the utilities within a control area operate and control their combined resources to meet their loads as if they were one system. Because most systems are interconnected with neighbouring utilities, each control area must ensure that its load matches its own supply resources plus power exports or imports to the other control areas.*<sup>10</sup>

A cross-border interconnection facility basically allows electric power to be interchanged between two or more national power grids (see schematic below). A cross-border interconnection facility comprises not only a transmission line, but also ancillary facilities (switchgears, and control and protection equipment) in the adjacent substations or elsewhere in the national power grids to be connected. To compensate for the reactive power generated by the transmission line, additional reactors may be needed.

There is absolutely no guarantee that the adjacent national power grids can be operated together, no matter what the properties of the cross-border interconnection facility are. The operability of the interconnected national power grids do not depend only on technical properties, but also on decisions the responsible transmission system operators (TSOs) need to take on key nontechnical issues. TSOs perform a number of key functions in real-time, including (a) monitoring, control, and coordination of operations and (b) scheduling and settlement of energy exchanges between national power grids. To accomplish those tasks, TSOs rely on real-time data processing hardware and software systems, comprising supervisory control and data acquisition (SCADA) and energy management system (EMS).



<sup>8</sup> USAID, Sub-Saharan Africa's Power Pools: A Development Framework, prepared by the PA consulting Group for the June 2-5, 2008 Leon H. Sullivan Summit VIII Conference in Arusha, Tanzania

<sup>9</sup> Supra at 1 page

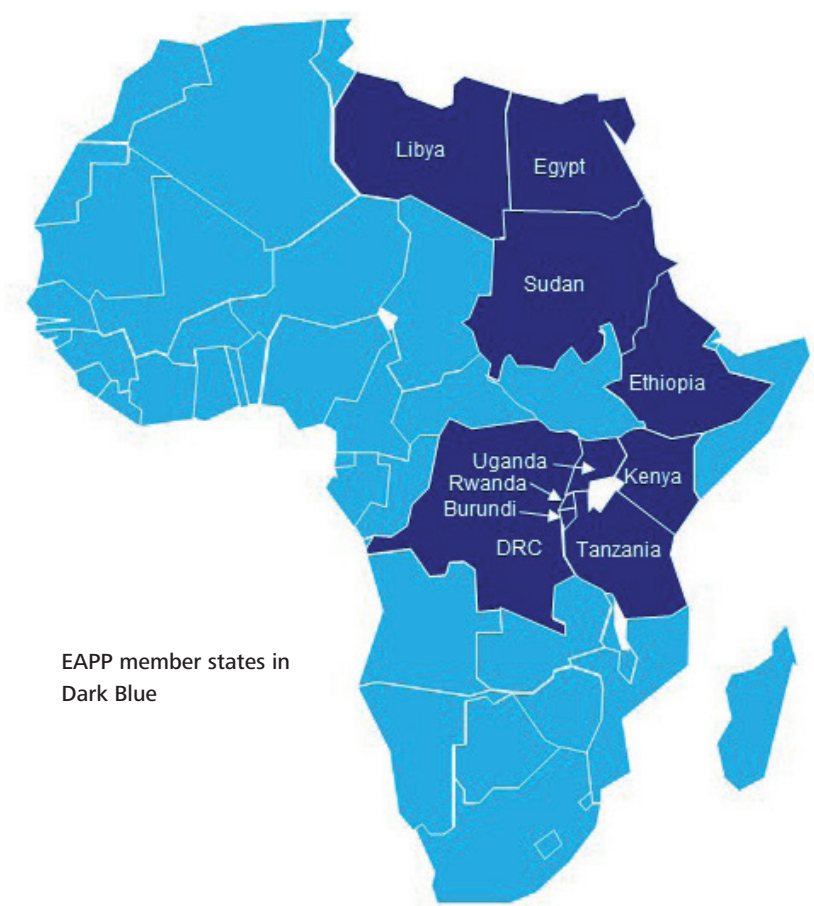
<sup>10</sup> Ibid

The EAPP embodies a regional institution established as a specialised agency of the COMESA REC to enhance energy interconnection and related matters in the region.<sup>11</sup> EAPP was created in February 2005 when 7 member countries signed an IG-MOU paving the way for the conclusion of an IU-MOU by the respective national utilities. The creation of EAPP is based on agreement rather than law. The IG-MOU enabled its establishment while the IU-MOU defined the fundamental principles for its management and operation. The EAPP/EAC Interconnection Code provides the rules and standards for technical planning and operation of the EAPP interconnected transmission system.

Membership to the EAPP comprises public or concessionary utility companies in charge of power generation, transmission and distribution in the region. There are presently ten member countries constituting the EAPP following the later entry of Uganda, Burundi and Tanzania as is set out in the table below. Djibouti is yet to join.

Country	Utility
Burundi	Régie de Production des Eaux et de d'Electricité (REGIDESO)
DR Congo	Société Nationale d'Electricité (SNEL)
Egypt	Egyptian Electricity Holding Company (EEHC)
Ethiopia	Ethiopian Electric Power Corporation (EPPCO)
Kenya	Kenya Electricity Generation Company ( KenGen)
	The Kenya Electricity Transmission Company (Ketraco)
	Kenya Power and Lighting Company (KPLC)
Libya	General Electricity Company of Libya (GECOL)
Rwanda	Electricity Water and Sanitation Agency (EWSA)
Sudan	National Electricity Corporation (NEC)
Tanzania	Tanzania Electric Supply Company Ltd (TANESCO)
DR Congo- Rwanda- Burundi	Société International d'Electricité des Pays des Grands Lacs (SINELAC)
Uganda	Uganda Electricity Transmission Company Limited (UETCL)

<sup>11</sup> Article 182 of the COMESA treaty





The Conference of Ministers according to the terms of the IG-MOU is the supreme governing body that delivers strategic guidance and oversight to the Steering Committee and also approves memberships to the pool, regional master plans and other pertinent related matters. The Steering Committee which comprises member utility firms constitutes the Executive Arm responsible for policy formulation and execution. The Executive Secretariat located in Addis Ababa, Ethiopia handles the day to day activities of the pool.

The objectives of the EAPP include:

Objective	Discussion
Security of power	Secure power supply for the countries of the region.
Energy resources	Optimise the use of energy resources available in the region by working out regional investment schemes in power generation, transmission and distribution taking into account the socio-economic and environmental aspects of the members.
Power supply	Enhance power supply in the region by using power system interconnections and increasing power exchanges between countries.
Cooperation	Negotiate cooperation agreements in the power sector.
Investment	Create a conducive environment for investments in the energy sector.
Electricity market	Facilitate in the long term development of an electricity market.

Countries in the region have in the past adopted inward looking policies aimed at planning and developing their power systems in an isolated manner with a view to satisfying their national demand growth. Bilateral power exchange agreements have existed between some countries in the region as shown in the table below. However, the volume of power exchange is not significant and exporting parties have frequently been unsuccessful in their commitments to deliver the power in accordance with their contractual obligations because of the deficits in their systems.

Previous system interconnectors
• DRC, Burundi and Rwanda interconnected from a jointly developed hydro power station Ruzizi
• Uganda and Rwanda cross border electrification
• Uganda and Kenya cross border electrification
• Uganda and Tanzania cross border electrification
• Kenya and Tanzania cross border electrification

# 4. Benefits of integrated power

The domestic power demand in most developing countries is insufficient to justify bigger power plants that can exploit economies of scale. Power pools increase market size in addition to improving the economy of scale and economics of mega power projects. Interconnection of physical power infrastructure can therefore reduce the market, volume and other related risks which may enhance the credit rating of the region for project financing purposes thereby making the development of a country's or sub region's capital intensive power projects more attractive to both domestic and international investors and to bilateral and multilateral lenders.

To achieve energy security and reliability, a complementary power generation mix is usually recommended. Power pools can therefore contribute to the growth of more environmentally friendly sources of energy such as hydropower, geothermal and other green power sources such as solar and wind energy. The development of energy resources such as hydropower relies on power interconnections for delivery to major load centres.

Power pools can be used to promote competition in the generation segment in a larger interconnected system. In excess capacity systems, it's possible to ensure through the merit order practice that the cheapest power is carried out first. This can result in competition in the generation segment to ensure that they generate the most competitive and economic power.

Given that power pools are aimed at increasing power generation, electricity reserve margins are also improved. Electricity reserve margin represents the measure of available capacity over and above the capacity to meet peak demand levels. A strategy of maintaining power reliability is always having more supply than what may be required. Given the connected difficulties of forecasting future power demand, it is always critical to maintain a healthy power reserve margin as building new generating capacity can take years.

# 5. Critical success factors for the regional integration of the EAPP

The EAPP region is presently experiencing various challenges which must be adequately addressed if the envisioned fully integrated regional power market is to be realised. It is not only insufficient power generation that stands in the way of the EAPP but the absence of interconnectors to wheel power across borders as well. The need for investment in power generation facilities and high voltage power lines cannot be overstated as the discussion below articulates. To overcome these challenges, the region must establish itself as a favourable destination for investment and financing.

## 5.1 Legal and regulatory framework

The starting point towards the formation of any regional power pool is for the regional governments and the operators of the respective national grid system to define a common legal and regulatory framework to facilitate achievement of regional objectives. This initially involves consensus building activities that involve the preparation, negotiation and adoption of two key documents, namely the IG-MOU and the IU-MOU.<sup>12</sup>

The IG-MOU permits the respective utilities to enter into contracts but also provide guarantees resulting from power interconnection contracts. The IU-MOU that is signed among the participating national power utilities defines ownership of assets and other key rights such as the development of future substations as well as putting in place and enforcing rules of practice covering technical planning, operations and commercial aspects of power system integration.<sup>13</sup>

The respective regional government and the national utilities comprising the EAPP already took the initial step in 2005 of signing the IG-MOU and IU-MOU that set out the operational framework for the evolution of the pool towards full integration. In 2006, the pool was formally endorsed as a specialised energy institution of the COMESA. This is clearly a step in the right direction and mirrors what other pools such as the SAPP and WAPP have initially done as a first step in creating regional power markets.

## 5.2 Harmonisation of legal and operational framework

Though not a precondition for the establishment of regional power pools, harmonisation of the legal and operational framework is critical. Harmonisation ensures that the legal and operational norms across the power pool partners are similar. Harmonisation must be emphasised especially where private investment participation in the power sector is envisaged because it assures a high degree of certainty and predictability about transmission line access, revenue flow and the resolution of disputes that may arise.

An interconnection code that provides a framework for the implementation of satisfactory operational security and reliability as well as encouraging the integrated planning of generation capacity and transmission planning among others has already been prepared to provide a benchmark for the harmonisation of operational standards of the EAPP.

## 5.3 Increasing power generation capacity

The region is presently plagued by power capacity shortages. Unless there is investment undertaken to generate sufficient power that can cater for both the domestic and export needs, the envisioned EAPP shall not take off. A study commissioned by the East African Community whose report was issued in 2011 identified a number of regional power generation projects that could be undertaken to tackle the challenge of power supply shortages in the region both in the short term and in the long term. These generation projects blend hydropower, nuclear, geothermal and thermal sources. The investment requirements to realise this aspiration are substantial and will require the participation of private investors to help each country achieve its projected generation capacity. Attracting private investment calls for a review of the fiscal and legal regimes to create the most favourable environment. It is anticipated that investment in these projects will enhance generation capacity as is tabulated below.

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<sup>12</sup> Supra at 1 page 3

<sup>13</sup> Ibid

#### Present and future potential generation resources <sup>14</sup>

Country	Existing 2012 MW	Future 2013-2030 MW	Total 2030 MW	Demand 2030 MW	Surplus 2030MW
Burundi	49	422	471	385	86
Djibouti	123	187	310	198	112
East DRC	74	1,117	1,191	179	1,012
Egypt	25,879	46,570	72,449	69,909	2,540
Ethiopia	2,179	13,617	15,796	8,464	7,332
Kenya	2,051	6,288	8,339	7,795	544
Rwanda	103	411	514	484	30
Sudan	3,951	11,310	15,261	11,054	4,207
Tanzania	1,205	4,881	6,086	3,770	2,316
Uganda	822	2,531	3,353	1,898	1,455

#### 5.4 Bilateral and multilateral agencies

The role of bilateral and multilateral agencies in the integration of power pools in the developing world cannot be overstated. They do not only provide catalyst funding for the power projects to take off but are also involved in providing technical support in the formation of these power pools. The World Bank and African Development Bank, for instance, are working with respective governments to fund some of the power projects being undertaken in their countries. There is therefore need to continue engaging with these bodies who may provide catalyst funding for any envisioned project financing deals to take off in addition to technical and advisory support which is neutral and independent counsel capable of fostering common understandings as well as encouraging consensus among the partner states.

#### 5.5 Independent regional regulator

Power pools such as the WAPP and SAPP are mulling the idea of an independent regional regulator. The regulator will supervise and control the various aspects pertaining the operation of power pools including, but not limited, to compliance with electricity codes and technical standards, controlling the use of transmission lines as well as regulating the price of transmission lines and facilitating the entry of Independent Power Producers (IPPs) and other private actors thus promoting competition in the pool progressively.

The EAPP has already established an Independent Regulatory Board to execute the mandates set out above. There is however still need for an amendment in the electricity legislations of the member countries of the pools to empower the regulator to make binding decisions.

Proponents of an independent regulator contend that this creates certainty about the enforcement of standards which further improves the investment climate for the private investors.

#### 5.6 Designing a regional power trade market

Unless a power pool has an established power market, it cannot thrive. This involves the design of the electricity market as well as establishing the rules to regulate it. A phased approach to the evolution of a regional market for the EAPP has been proposed but the design of regional market rules is underway. In early years of the pool, it is common that bilateral contracting is the dominant mode of trading power though as the pool evolves further short term energy markets and day ahead markets can be introduced.

The EAPP must therefore develop the rules that will govern the regional market as well the necessary hardware and software that will support the electricity trade and exchange.

<sup>14</sup> Eastern Africa Power Pool regional power system master plan and grid code study page 4-19

### 5.7 Cross border interconnection facilities

The integration of national power grids requires the availability of cross interconnection facilities through which national power utilities can exchange energy. Pool interconnection facilities comprise not only a transmission line but also ancillary facilities such as switch gears and control equipment. The facilities also require the acquisition and deployment of other hardware and software systems (metering, data collection and real time processing of information) to ensure that the individual national power grids are able to function as one on a common operational and commercial platform.

The EAPP master plan has identified a number of power system interconnections that must be established to facilitate the exchange of power with the pool. Construction is underway for some of these projects while funding is being solicited for others.

These projects are shown below.<sup>15</sup>

Interconnection line	Type	Comments
Tanzania-Kenya <sup>16</sup>	400KV	The Kenya-Tanzania interconnection is to become a critical link in a future regional power pool, facilitating power exchange and the development and integration of electricity markets between Burundi, DR Congo, Rwanda, Uganda, Kenya and Tanzania. Not yet commissioned. <sup>17</sup>
Rusumo-Rwanda-Burundi-Tanzania	220 KV	The 80-MW Rusumo Falls run-of-river hydro project will be constructed along the Kagera River in Rwanda, and will provide power to neighbouring countries Burundi and Tanzania as well. Transmission lines are expected to be commissioned by 2018.
Ethiopia-Kenya	500 KV	A 1100 km long 500 kV DC transmission line with a power transfer capacity of 2,000 MW is at an advanced stage of implementation. Feasibility studies have been completed and consultancy services for detailed design are being sought. Construction was expected to start in early 2012. <sup>18</sup>
Ethiopia- Sudan	500KV	This shall facilitate the wheeling of power from Ethiopia to Sudan. Feasibility study completed
Egypt-Sudan	600 KV	This is aimed at enhancing power trade between the two countries. Feasibility study completed
Uganda- Kenya	220KV	This is aimed at transmitting power from the Bujagali Hydro Power Station to the Kenya frontiers. Construction is underway
Uganda- Rwanda	220 KV	Aimed at transmitting power from the Mbarara North substation to the new 220 KV Mirama substation. Construction is underway
Rwanda-DRC	220 KV	Part of the wider strategy of creating a transmission network in the region to facilitate power trading. Construction is underway
DRC-Burundi	220 KV	Part of the wider strategy of creating a transmission network in the region to facilitate power trading. Construction is underway
Burundi-Rwanda	220 KV	Part of the wider strategy of creating a transmission network in the region to facilitate power trading. Construction is underway

<sup>15</sup> Ibid page 5-3

<sup>16</sup> <http://www.ketraco.co.ke/projects/planned/Kenya-Tanzania-Interconnection.html>

<sup>17</sup> Ibid

<sup>18</sup> ibid



# Conclusion

The aspiration of the COMESA states to create a fully functional, integrated and competitive power pool is not an event but rather a journey that will take time and hard work to realise. The evolutionary journey of Nordel into a robust and successful multi-country power pool took nearly 40 years. It would probably take the same amount of time or more for the EAPP. The electricity trade presently taking place under the auspices of the EAPP relates to the pre pool bilateral power exchange that existed between some of the member countries from the mid-1950. The biggest obstacles to the full integration and functioning of the EAPP are the lack of transmission facilities as well as insufficient power generation capacity. The region needs significant investment in new generation and transmission grid infrastructure. The huge investments that are needed must not only come from national and donor resources but also private sector financing.

There is also need to forge real political commitment to regional solutions to electricity supply and to promote competition in electricity markets in the long term. Other considerations to keep in mind include a robust framework for power trading to take place, arrangements for systems operations, a system for equitably setting the tariffs for use of the transmission infrastructure as well as agreed principles and procedures for dispute resolution.



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