The Challenges of Operationalizing Power Pools in Africa

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Operationalizing power pools: Introductory remarks

- Regional electricity integration and cooperation through grid interconnections and power pooling is recognized as:
  - a cost-effective means of ensuring reliability of supply;
  - in line with WSSD/JPOI and NEPAD energy objectives
- Power pools adopted as the best "strategy" to deal with the evenly distributed energy resources and Africa's energy problems.

Operationalizing power pools: Introductory remarks (cont'd)

- But power pools can be made operational only in regions with:
  - fairly developed grid interconnections;
  - adequate generating capacity to meet demand of the pool;
  - a legal framework for cross-border electricity exchanges;
  - trust and mutual confidence among pool members; and
  - regional regulation and mechanism for dispute resolution.
- Most of the sub-Saharan African power pools do not meet these requirements.

Operationalizing power pools: Overview of Africa's power sector

- Africa is fairly endowed with significant energy resources for electricity generation, but they are unevenly distributed.
- Oil & gas reserves in North Africa and the Gulf of Guinea; but oil or gas fields in other areas; e.g. Sudan, Ethiopia, Chad, Mozambique, Namibia, and Tanzania.
- Hydropower potential in Central and Eastern Africa with highest potential in DRC, Ethiopia and Cameroon.
- Coal deposits in Southern Africa, but predominantly South Africa with 90% of the 55 billion tons total reserves.
- Geothermal energy in East Africa region (Kenya, Ethiopia and Djibouti). Highest wind power potential in North Africa (Morocco and Egypt) and Southern Africa.

Operationalizing power pools: Overview of Africa's power sector

- Electricity generation patterns are as follows:

  - Africa's share in the world's electricity production is 3%
  - Hydro-based electricity is contributing ±18% of the total.
  - 5 countries in North Africa accounting for more than 1/3.
  - South Africa alone accounting for ±45% in 2001/2002).
  - The 5 North African countries and South Africa are still accounting for more than 75% of total electricity generated
  - Sub-Saharan Africa (excluding South Africa) accounted for ±22% of electricity generated in Africa in 2002.

Operationalizing power pools: Overview of Africa's power sector

- Electricity consumption patters are as follows:
  - Africa's share in world's electricity consumption is ≤3%
  - Africa's average was ± 500 kWh/cap in 2001 and 2002,
  - North African countries reached 1000 kWh/cap in 2002.
  - South Africa consumed more than 4000 kWh/cap in 2002
  - SSA region consumed about 405 kWh/cap in 2002
  - SSA region (excluding South Africa) had an average electricity consumption of about 140 kWh/cap in 2002.

Operationalizing power pools: Benefits of power pooling

- Benefits to be expected from developing interconnections and operating power pools include the following:
  - reduction capital and operating costs through improved coordination among power utilities;
  - optimisation of generation resources with large units;
  - improved power system reliability with reserve sharing;
  - enhanced security of supply through mutual assistance;
  - improved investment climate through pooling risks;
  - coordination of generation and transmission expansion;
  - increase in inter-country electricity exchanges; and
  - development of a regional market for electricity.

Operationalizing power pools: Constraints to pool development

- Major constraints/challenges to power pools development and operation include:
  - Lack of trust and confidence among pool members;
  - Underdeveloped transmission networks and tie lines;
  - Inadequate generating capacity and reserve margin;
  - Difficulties of mobilizing investment for power projects;
  - Lack of legal framework for electricity trading;
  - Lack of rules for access to the transmission grid, including setting wheeling charges; and
  - Lack of regional regulation and appropriate mechanism for dispute resolution.

Operationalizing power pools : Interconnections in North Africa

- The Arab Maghreb Union (UMA) countries are grouped within COMELEC (Comité Maghrebin de l'Electricité).
- Egypt is connected to UMA countries through the 220kV Libya-Tunisia interconnection.
- Egypt is also connected to the Middle East through 500kV/400kV Egypt-Jordan interconnection .
- Finally, Egypt-Libya-Tunisia-Algeria-Morocco (ELTAM) interconnection is being linked to European electricity system through Morocco-Spain interconnection.
- It forms the southern part of the future Mediterranean Electricity Ring (MEDRING).

Operationalizing power pools: Creation of Power pools in SSA

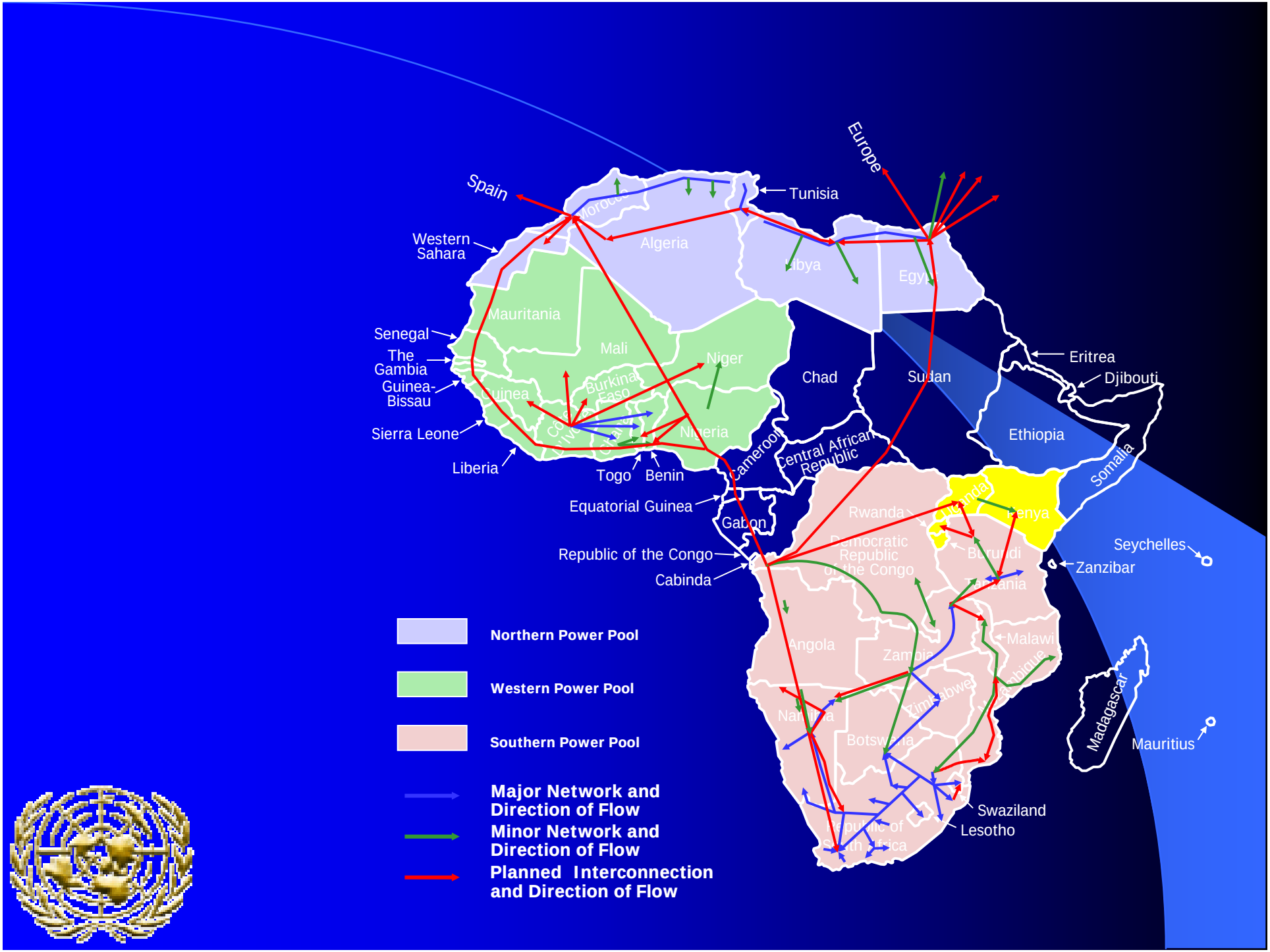
- There are four power pools established in SSA region:

  - The Southern African Power Pool (SAPP) created in 1995 with the signing of IGMoU by 12 SADC countries.

  - The West African Power Pool (WAPP) launched in 2000 with the signing of IGMoU by the 14 ECOWAS countries.

  - The Central African Power Pool or Pool Energétique d'Afrique Centrale (PEAC) established in April 2003 with the signing of IGMoU & IUMoU by 11 ECCAS countries.

  - The East African Power Pool (EAPP) launched in February 2005 with the signing of IGMoU by East African countries member of COMESA and Nile Basin Initiative (including Egypt and Tanzania).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Eritrea
Djibouti
Burkina Faso
Guinea
Sierra Leone
Liberia
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Togo
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Central African Republic
Ethiopia
Somalia
Equatorial Guinea
Gabon
Rwanda
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Kenya
Republic of the Congo
Cabinda
Democratic Republic of the Congo
Burundi
Seychelles
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Angola
Zambia
Malawi
Mozambique
Zimbabwe
Namibia
Botswana
Madagascar
Mauritius
Swaziland
Lesotho
Republic of South Africa
Northern Power Pool
Western Power Pool
Southern Power Pool
Major Network and Direction of Flow
Minor Network and Direction of Flow
Planned Interconnection and Direction of Flow

Operationalizing power pools: SAPP's legal framework

- SAPP's operation is governed by of 4 agreements:
  - the intergovernmental MoU established the SAPP;
  - the inter-utility MoU established SAPP's basic management and operating rules;
  - the Agreement between Operating members established the specific rules of operation and pricing; and
  - the Operating guidelines provide standards and operating guidelines.
- The intergovernmental MoU is being revised to include other major players on the regional power market, such as IPPs (HCB for Cahora Bassa) and ITPs (MOTRACO).

Operationalizing power pools: Interconnections within SAPP

- New interconnections added to SAPP grid system during the last ten years include:

  - 400 kV South Africa – Zimbabwe through Botswana interconnector completed in Oct. 1995;

  - 535 kV HVDC Mozambique(Cahora Bassa) - South Africa interconnector rehabilitated in Oct. 1997;

  - 400 kV Mozambique(Cahora Bassa) - Zimbabwe interconnector completed in Dec. 1997;

  - 400 kV South Africa-Namibia interconnector (Sept.1999)

  - Two 400 kV Motraco power lines linking South Africa to Maputo (Mozambique) via Swaziland for power supply to Mozal (Aluminium smelter) completed in Sept. 2000.

Operationalizing power pools: SAPP Development

- A twenty-year generation and transmission expansion plan was developed for the SAPP using a Purdue University planning model.
- The pool plan considers 2 generation development options:

  (i) intensive development of hydro at Inga in DRC; and

  (ii) modest hydro development on the Congo river and construction of gas-fired thermal plants further South
- The pool plan reveals that coordinated planning can result in costs savings of US$3 billion over individual utility expansion planning (US$8 billion vs US$11 billion).
- The SAPP Coordination Centre is considering revising the SAPP Pool Plan.

Operationalizing power pools: Planned SAPP interconnections

- The planned interconnection projects include:
  - The 330 kV Zambia - Tanzania power line;
  - The 220 kV Mozambique – Malawi power line
  - Reinforcement of the 220 kV DRC – Zambia power line
  - The HVDC Western Power Corridor (Westcor) project, linking DRC, Angola, Namibia, Botswana and South Africa with two 1,500MW converter stations and converter stations – HVDC transmission lines.
  - Westcor project includes construction of the 3,500 MW Inga 3 hydropower station.

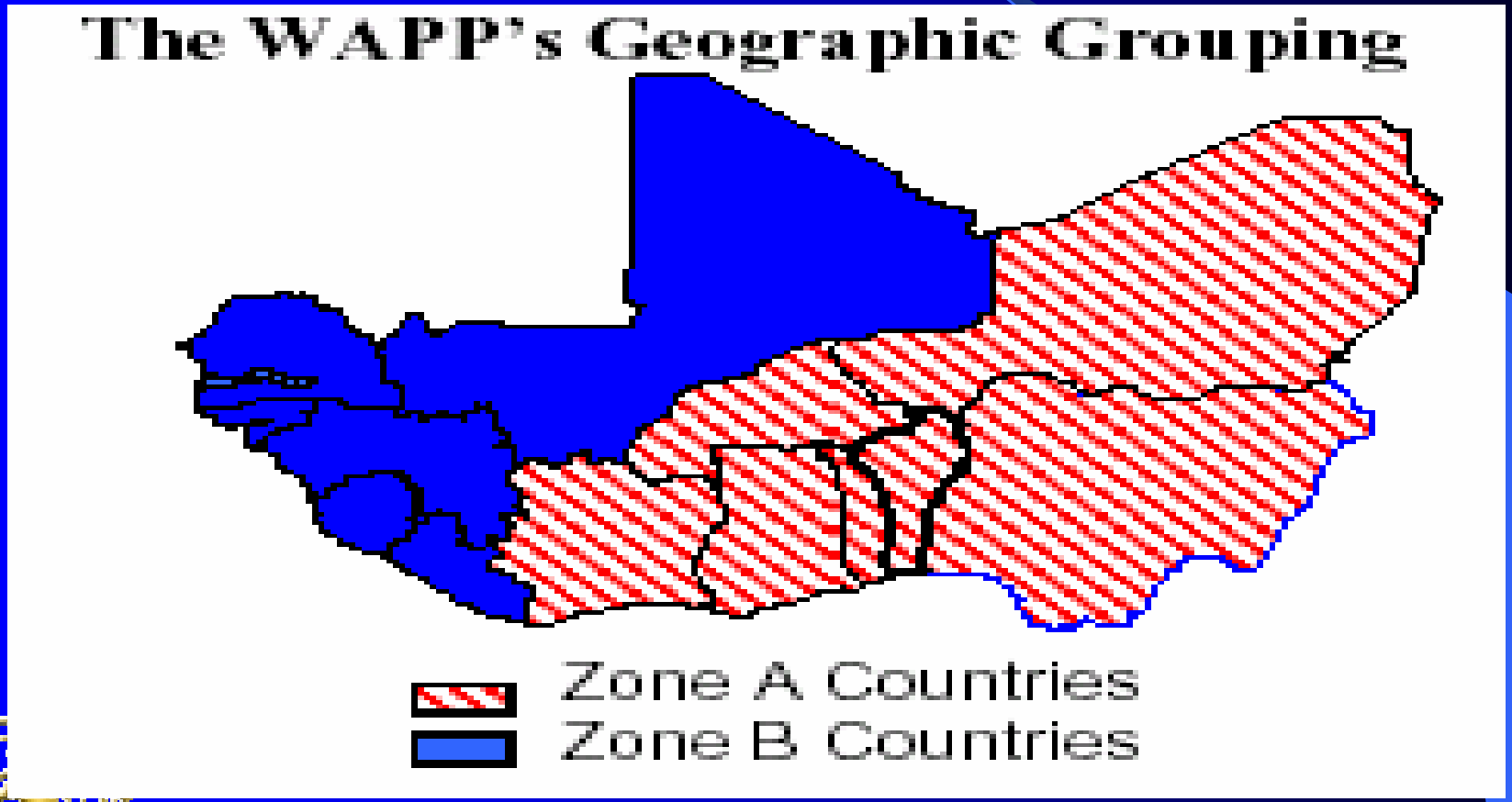
Operationalizing power pools: WAPP Legal framework

- The legal framework governing WAPP, include:
  - The Intergovernmental MoU signed by ECOWAS Energy Ministers in October 2000.
  - The Inter-utility MoU and MoU between the transmission system operators signed by the general managers of power utilities in March 2001.
- The ECOWAS Energy Protocol was signed by the Heads of State and Government in January 2003 providing a secure legal framework for investment in the energy sector.
- The ECOWAS Energy Information Observatory launched in 2003 serves as a focal point for investors interested in financing WAPP priority projects.

Operationalizing power pools: Interconnections within WAPP

- At the launching of WAPP in 2000, interconnected power system was limited to Nigeria- Niger and the mini-power pool formed by Côte d'Ivoire, Ghana. Togo and Benin
- WAPP's IGMoU provides for evenly splitting the 14 WAPP countries into Zone A and Zone B.
- Zone A includes countries with interconnected systems; while Zone B includes underdeveloped interconnections.
- The 330 kV Nigeria-Benin interconnection will enable all Zone A countries to operate as power pool.

Operationalizing power pools: Interconnections within WAPP



Operationalizing power pools: WAPP planned interconnections

- Cooperation within OMVS-sponsored Manantali hydropower station allowed the interconnection of Mali, Senegal and Mauritania in 2002.
- The African Development Bank (ADB) is financing the study on Sambangalou hydropower development project within OMVG, including the interconnection of Guinea, Guinea Bissau, Gambia and Senegal.
- There are plans to connect Côte d'Ivoire and Mali thereby connecting Zone A to Zone B
- Plans to connect Ghana and Burkina Faso are also at an advanced stage of preparation.

Operationalizing power pools: PEAC legal framework

- The PEAC legal framework include:
  - The intergovernmental MoU signed by the ECCAS Energy Ministers in April 2003
  - The inter-utility MoU signed by the General Managers of the national power utilities also in April 2003.

Operationalizing power pools: PEAC Development

- The power sector within PEAC is the less developed in the whole of Africa.
- Most of the 11 PEAC member countries have small and isolated power systems.
- The only existing interconnections and cross-border electricity exchanges involve:

  - the 220 kV Congo-DRC interconnection; and

  - the mini-power pool formed by eastern DRC, Rwanda and Burundi with SINELAC (Société Internationale d'Electricité des Pays des Grands Lacs) as operator.

Operationalizing power pools: PEAC Development

- The priority action undertaken by PEAC include:
- The study on a Regional Master Plan for power development within the Central Africa region with financing from USAID; and
- Feasibility study for the interconnection of electricity of ECCAS member countries with a grant provided by the African Development Bank (ADB) through ECCAS Secretariat.

Operationalizing power pools: EAPP legal framework

- The EAPP legal framework is provided by:
- The intergovernmental MoU signed by the Energy Ministers of 9 countries member of COMESA and the Nile Basin Initiative (NBI) in February 2005; and
- The inter-utility MoU signed the General Managers of the power utilities of the above member countries.

Operationalizing power pools: Interconnections within EAPP

- Cross-border electricity exchanges among East African Community (EAC) exist since the mid-1950s through the Uganda-Kenya interconnection.
- Cross-border electricity exchanges also exist between countries of the Great Lakes community (CEPGL); i.e., eastern DRC, Rwanda and Burundi since the 1960s.
- Rwanda and Uganda are connected at the level of border towns in 30 kV, and there are plans to link the two countries by a 132/110 kV the transmission line.
- Kenya and Tanzania have completed a feasibility study for linking Nairobi to Arusha by a 220 kV transmission line.

Operationalizing power pools: Interconnections within EAPP…

- There are also plans to interconnect:
  - Ethiopia with Sudan by a 220 kV power line;
  - Ethiopia with Djibouti with a 220 kV power line;
  - Sudan with Egypt by linking Merowe hydropower station to Aswan dam;
  - DRC with Egypt through Inga-Aswan HVDC transmission line; and
  - Ethiopia with Kenya.

Operationalizing power pools: Concluding remarks

- The issue of operationalizing power pools in Africa can best be addressed by making a clear distinction between North Africa and sub-Saharan Africa regions.
- In North Africa, Maghreb and Mashrek countries are already interconnected and the issue is to:

  - promote inter-country electricity trade; and

  - upgrade the transmission network to meet EU standards.

Operationalizing power pools: Concluding remarks

- In sub-Saharan Africa, making operational (operationalize) existing power pools requires a case by case approach.
- SAPP has a fairly developed generation and transmission infrastructure to operate a regional power market.
- WAPP has two-tier approach to operating a regional power market starting with Zone A countries where inter-country electricity exchanges already exist.
- EAPP, while being the last power pool to be established, has the potential to be rapidly operational.
- PEAC has no adequate generation and transmission infrastructure to become operational in the near future.

Thank you