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AFRICAN REGIONAL TRANSMISSION PROJECTS: STATUS MEMO

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Kirkos sub city, House No.513
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Ea Energy Analyses
Frederiksholms Kanal 4, 3. th.
1220 Copenhagen K, Denmark

Energinet.dk
Tonne Kjærvej 65
7000 Fredericia, Denmark

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List of terms and abbreviations

CAPP	Central African Power Pool
COMELEC	Comite Maghrebin de l'Electricite / The Maghreb Electricity Committee
DRC / RDC	Democratic Republic of the Congo / République Démocratique du Congo
DS	Detailed Study
EAPP	Eastern Africa Power Pool
ECCAS	Community of Central African States
ECOWAS	Economic Community of West African States
ELTAM	Egypt – Libya - Tunisia – Algeria – Morocco
ESIS	Environmental and Social Impact Study
EU – ACP	European Union - African, Caribbean and Pacific Group of States
FS	Feasibility Study
MEDRING	Mediterranean Ring, i.e. countries around the Mediterranean basin
MoU	Memorandum of Understanding
OMVG	Organisation pour la Mise en Valeur du Fleuve Gamble / Gambia River Basin Development Organization
OMVS	Organisation pour la Mise en Valeur du Fleuve Sénégal / Senegal River Basin Development Authority
RSA	The Republic of South Africa
SAPP	Southern African Power Pool
SNEL	Société Nationale D'électricité, the national electricity company of the Democratic Republic of the Congo
SVC	Static VAR (volt ampere reactive) compensator
ToR	Terms of Reference
WAPP	West African Power Pool
ZESA	Zimbabwe Electricity Supply Authority
ZESCO	Zambia Electricity Supply Corporation Limited
ZIZABONA	Zambia, Zimbabwe, Botswana and Namibia

Introduction

The purpose of the current Memo is to describe the status – and to discuss the potential implications – of the regional transmission projects in the surrounding power pools in order to provide broader context to the regional interconnection planning activities of the Eastern Africa Power Pool (EAPP). In addition to the overview of the regional transmission projects envisioned by the surrounding power pools, the current Memo also provides an outline of the Grand Inga project and the interconnections associated with the development thereof due to the very considerable power production potential of the Grand Inga site.

The Memo starts out with presenting the outline of the envisioned development of the Grand Inga site and the interconnectors associated with it, followed by an overview of the transmission project plans in the surrounding power pools (in alphabetical order), and concludes with a discussion and implications section summarizing the most relevant prospective developments to the EAPP in the region.

Grand Inga site: envisioned development and interconnectors

In March 2011, the “Hydropower development of Inga site and associated transmission lines” study was commenced, financed by the African Development Bank. The study proposes the optimal strategy for developing the Inga site on the Congo River, as well as analyses the available studies on Inga III.



Figure 1: Location of the Inga site in the DRC. Source: (International Rivers, 2013)

The study envisions rehabilitation of the existing Inga I and Inga II sites, as well as proposes the development of Inga III at 4800 MW (preliminary proposal). The estimated total capacity of Grand Inga site (via step-wise development) is to exceed 42 000 MW, as illustrated in Figure 2:

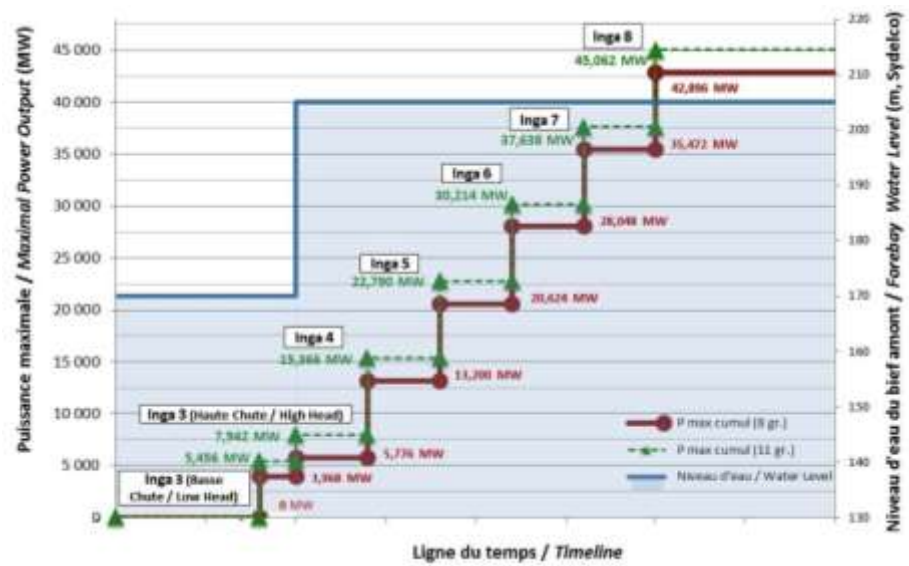


Figure 2: Maximal power installed at the Inga hydroelectric site: the proposed step-wise development. Source: (SNEL)

Along with the projected rapidly growing DRC's domestic power demand, the power demand in all of the surrounding power pools is also expected to increase substantially. In particular, the following countries are identified as the prospective export markets for the power produced at the Grand Inga site (AECOM & EDF, 2011):

- Republic of South Africa (part of the Southern Africa Power Pool, SAPP)
- Egypt (Part of the Eastern Africa Power Pool, EAPP)
- Nigeria (Part of the West African Power Pool, WAPP)

An illustration of the identified markets and the level of projected power exports is provided in Figure 3:

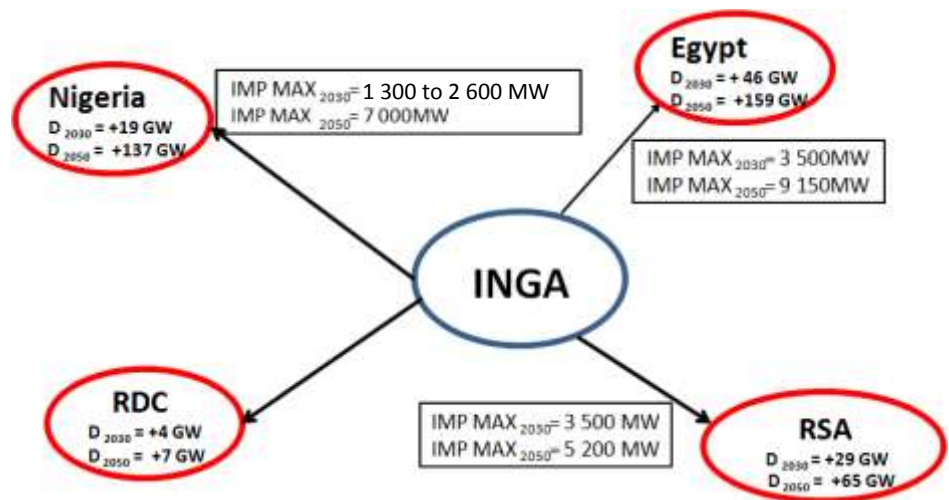


Figure 3: Growth in the power demand per country as well as the estimated level of power exports from the Grand Inga site to each country by 2030 and 2050, respectively¹. Illustration source: (Ministry of Water Resources and Electricity of the DRC, 2013) based on (AECOM & EDF, 2011)

The main focus of the pre-feasibility study is on the transmission line to South Africa, East corridor (i.e. from Inga to Kolwezi within DRC and terminating in Witkop in the RSA – outlined in green in Figure 4). The proposed design of the transmission line is a DC line with no energy delivery in the transit countries (i.e. Zambia and Zimbabwe).

¹ D₂₀₃₀ of +46 GW means that the power demand in Egypt is projected to increase by 46 GW by 2030. The upper limit of power imports assumed at 5% to 10% of the total domestic demand in each country in 2030 and 2050, respectively.

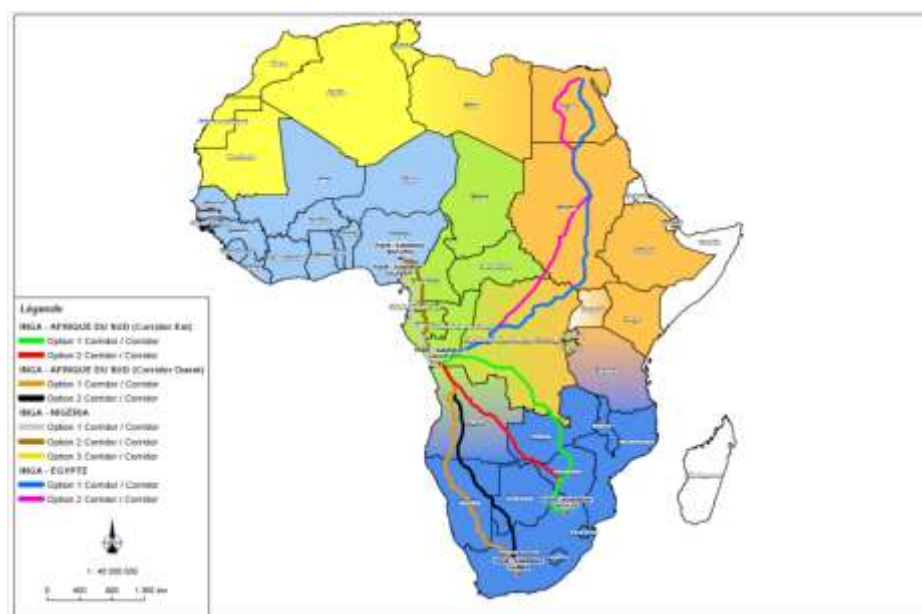


Figure 4: Transmission line projects analysed in the pre-feasibility study. Geographical color-coding of the power pools: COMELEC – yellow, EAPP – orange, WAPP – light blue, CAPP – green, SAPP – dark blue. Source: (AECOM & EDF, 2011)

A summary of the specifications and costs of the different transmission projects analysed in the pre-feasibility study is provided in Figure 5:

Figure 5: Summary of the characteristics and the cost estimates of the analysed transmission projects in the pre-feasibility study. Capacity represents the power delivered at the final destination. Source: (AECOM & EDF, 2011)

Project	Voltage (kV)	Capacity (MW)	Length (km)	Total cost (M USD 2011)
Inga – Luanda (Angola)	400 AC	700	400	560
Inga – RSA (West corridor)	±600 DC	1750	3450	2 620
Inga – RSA (East corridor / Kolwezi)	±600 DC	1750	3757	3 244
Inga – Calabar (Nigeria)	±500 DC	1300	1669	1 155
Inga – Cairo (Egypt)	±600 DC	3500	5351	7 521

A cooperation Treaty has been signed between the governments of the DRC and South Africa in 2013 envisioning joint development of the Inga III site. South Africa has committed to purchase 2,500 MW of the total 4,800 MW generated, making South Africa the key buyer of Inga III electricity. Inga III project is envisioned to cost USD 12 billion (Sanyanga, 2013), (ICA, 2014), and

expected to be completed by 2022 (based on information provided by the SNEL, the commissioning could be expected as early as 2020). The International Development Association of the World Bank has approved USD 73 million (with the African Development Bank contributing additional USD 33 million) in March 2014 for a technical assistance project for the Inga III and mid-size hydro development (World Bank, 2014).

Nigeria has expressed interest in additional 2,400 MW to be generated by the next phase of Inga III, the 7,200 MW Haute Chute (High Fall) which would raise the dam by 40 metres (African Energy, 2014).

The assessment of the Grand Inga project indicates that from purely techno-economic perspective, the project is feasible and competitive. I.e. the costs of transmission infrastructure development in addition to the generation costs would not be prohibitive in terms of delivering power at competitive prices to e.g. South Africa. The successful implementation of the project is, however, greatly dependent on the ability of the parties involved to overcome the financial, technical, regulatory, cultural and governance challenges associated with the development of transnational infrastructure projects in Africa generally (World Economic Forum / BCG, 2014), further amplified by the magnitude of the Grand Inga project, as well as the challenging investment climate in the DRC in particular (International Rivers, 2013).

The Central African Power Pool (CAPP)

The Central African Power Pool (CAPP) was established in January 2004 by the Heads of States and Governments of Economic Community of Central African States (ECCAS). CAPP is a specialized institution in charge of energy policy coordination and implementation, and it covers 10 countries (CAPP, 2011):

- Angola, Burundi, Cameroon, Central African Republic, Congo, DRC, Chad, Equatorial Guinea, Gabon, Sao Tomé & Principe and Chad (a map presented in Figure 6).

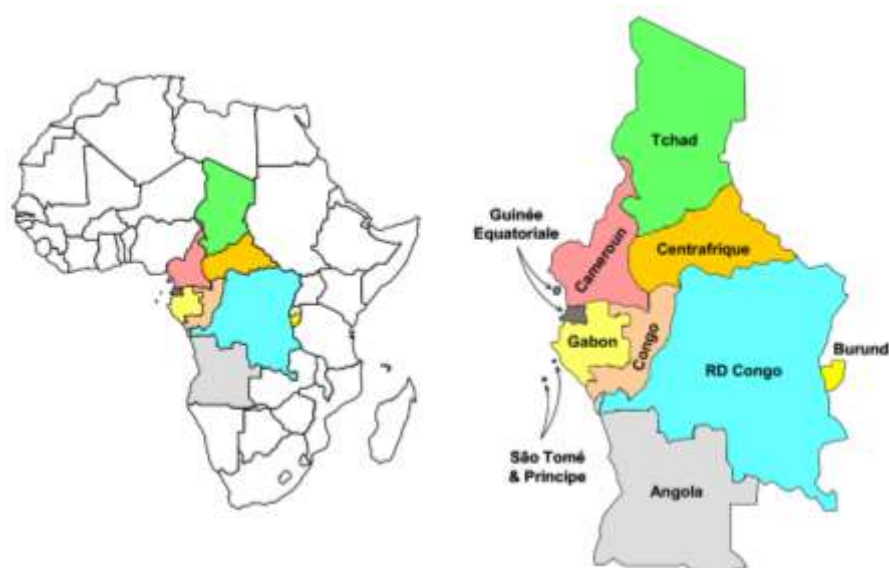


Figure 6: Geographical overview of the member states of the Central African Power Pool. Image source: (CAPP, 2011)

In November 2010, “Study on Interconnection Projects in Central Africa Region” analysis was finalized, helping to define the overall interconnection strategy up to 2030 and to identify the priority projects to be developed in the medium term. The priority projects comprise the following (ICA, 2011):

- Establishment of a transmission ‘backbone’ by linking Angola to Chad (including connection with the DRC, Congo, Equatorial Guinea, Gabon and Cameroon)
- Connection between Cameroon and the Central African Republic
- Connection between the DRC and the Central African Republic

The specifications of the envisioned transmission projects of the CAPP are summarized in Table 1:

Table 1: Priority transmission projects within the CAPP. Table source: (ICA, 2011)

Interconnections	Sub-station	Voltage kV (AC)	Capacity MW	Length km	Total cost US\$m
Angola-DRC	Maquelo do Zombo – Inga 3	400	800	192	187.29
Congo - Gabon	Mongo Kamba –Bongolo – Chutes de l’Impératrice	400	600	482.1	435.13
Gabon – Equatorial Guinea	Ntoum - Bata	400	600	271.4	296.65
Equatorial Guinea - Cameroon	Bata – Merve’ele	400	600	95.4	146.22
Cameroon - Chad	Maroua – N’Djamena	220	125	205.8	115.71

Other priority projects (not covered by the above-mentioned study) include the following (ICA, 2011):

- Inga (DRC) – Cabinda (Angola) - Pointe Noire (Congo) interconnection
- Gabon: Chute de l'Impératrice-Ntoum transmission line
- Cameroon: Memve'Ele-Maroua transmission line

Table 2 provides an overview of the current status of the CAPP transmission investment and studies projects:

Table 2: CAPP priority projects and their status. Source: (ICA, 2011)

Project	Status
Inga (DRC) – Cabinda (Angola) - Pointe Noire (Congo) interconnection	<ul style="list-style-type: none"> - Detailed studies are being carried out - Memorandum of Understanding between the states and the utilities has been signed - Investment funding (estimated at 175 MEUR) yet to be mobilized - Considered to be a critical link to export the generation from Angola and Congo
Cameroon – Chad interconnection	<ul style="list-style-type: none"> - A pre-feasibility and feasibility study has been conducted within the framework of the “Study on Interconnection Projects in Central Africa Region” - An Inter-Government MoU has been signed - A preliminary study and an enhanced preliminary design study are being carried out, USD 4.6 million financing provided by the African Development Bank (AfDB, 2013) - Investment funding (estimated at 89 MEUR) yet to be mobilized.
Inga (DRC) – Calabar (Nigeria) interconnection linking Cameroon, Congo, DRC, Equatorial Guinea, Gabon and Nigeria	<ul style="list-style-type: none"> - A feasibility study has been carried out to establish an interconnection between CAPP and WAPP - The draft ToR has been prepared - An inter-government MoU between 8 concerned states has been signed - Funding gap for undertaking the study estimated at 3.1 M USD
Inga (DRC) – Burundi and Inga – East DRC interconnections	<ul style="list-style-type: none"> - The ToRs are being prepared - Funding of the studies is yet to be mobilized
DRC – CAR interconnection	<ul style="list-style-type: none"> - Funding for the studies of the 100 km 132 kV line from Bangui (CAR) to Libenge (DRC) has been mobilized - The interconnection project has been approved by the African Development Bank in 2012 (to take place following Phase I, the rehabilitation of power plants in the CAR and the DRC and the transmission project studies) - USD 46 million grant has been awarded to CAR and USD 6.6 million to the DRC, respectively for Phase I (Global Transmission, 2013), (AfDB, 2011)

The Maghreb Electricity Committee (COMELEC)

As of 1989, COMELEC is the specialized agency of the Union of Maghreb Arab (UMA) comprising of five member states:

- Algeria, Libya, Mauritania, Morocco, and Tunisia

The development of the interconnection projects has been analysed in 2 major studies (ICA, 2011):

- Between North African countries (Egypt – Libya - Tunisia – Algeria – Morocco, a.k.a ELTAM Study completed in 2004) resulting in a proposal of linking the 5 countries with a 500/400 kV transmission line. An implementation plan over the 2010 – 2015 period based on the study results was agreed upon by the 5 countries
- Between Mediterranean countries (Mediterranean Ring, a.k.a MEDRING Study completed in 2003) analysing the establishment of an interconnection loop linking the countries around the Mediterranean basin as illustrated by Figure 7:

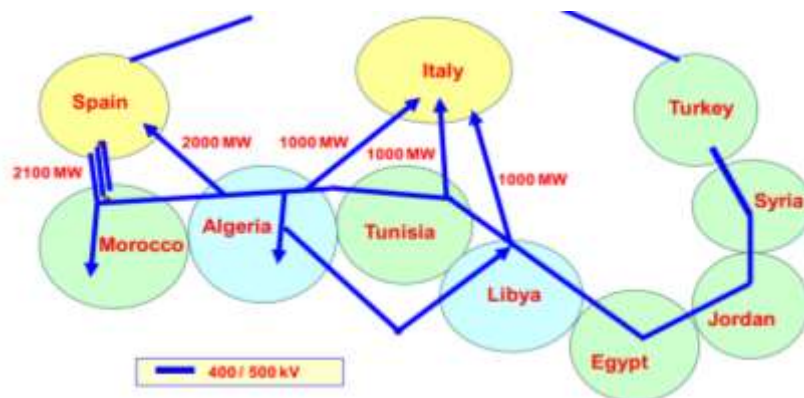


Figure 7: An illustration of the proposed interconnections among the MEDRING countries (ICA, 2011)

Table 3 provides an overview of the COMELEC transmission projects:

Table 3: Transmission projects within the COMELEC. Table source: (ICA, 2011), (Shuja Al-Baqmi, 2013), (Kotiuga, 2010)

Project	Voltage (kV)	Capacity (MW)	Length (km)	Total cost (M USD)
ELTAM Interconnector (Egypt, Libya, Tunisia, Algeria, Morocco)	400 / 500	-	-	-
Submarine cable (Tunisia – Italy)	400 HVDC	1000	200	-
Submarine cable (Algeria – Spain)	400 HVDC	2000	250	1,080
Submarine cable (Algeria – Italy)	400 HVDC	1000	330	945
Submarine cable (Libya – Italy)	400 HVDC	1000	520	1,215
Libya - Algeria	400 HVAC			
Saudi Arabia – Egypt	± 500 HVDC	3000	1400	1,600

Status of the COMELEC transmission projects is provided in Table 4:

Table 4: COMELEC transmission projects and their status. Source: (MED-EMIP, 2010), (ICA, 2011), (Shuja Al-Baqmi, 2013), (Daily News Egypt, 2013)

Project	Status
Interconnection between ELTAM	<ul style="list-style-type: none"> - 400 kV interconnection already operational between Algeria and Morocco - Algeria - Tunisia (up to Jendouba) implemented at 400kV but being operated at 225 kV - Tunisia – Libya interconnection at 400 kV scheduled for 2015 (currently Libya is connected to Tunisia and Egypt at 220 kV) - Morocco – Algeria - Tunisia transmission system already operating under synchronous mode with the European grid
Algeria - Spain	<ul style="list-style-type: none"> - Algeria has launched “Algeria 2000 MW” project entailing 2000 MW generation capacity, 1200 MW out of which are to be exported to Spain - The investment cost is to be shared between RED Electrica (Spain) and SONELGAZ (Algeria)
Saudi Arabia – Egypt	<ul style="list-style-type: none"> - Feasibility Study completed - Tender in progress, tendering to take place in packages as opposed to a turnkey project - Saudi Arabia is to pay 60% of the cost, Egypt 40%, respectively - Project implementation expected to take 2-3 years
Tunisia – Italy	<ul style="list-style-type: none"> - Feasibility Report 2006 - Project being implemented
Algeria – Italy	<ul style="list-style-type: none"> - Feasibility Study completed in 2004
Libya – Italy	<ul style="list-style-type: none"> - Feasibility Study completed in 2007
Libya - Algeria	<ul style="list-style-type: none"> - Planned project

It should be noted that there is a plan to create a DC connection between Libya and Egypt due to severe stability issues in the operation of the current 220 kV AC connection at times of the Libya – Tunisia interconnection being simultaneously active (Global Transmission, 2009).

Southern Africa Power Pool (SAPP)

The Southern Africa Power Pool (SAPP) was created in August 1995 at the Southern African Development Community (SADC) summit held in South Africa (SAPP, 2013). SAPP has been mandated by the SADC to promote electricity trading among the SADC member states. SAPP is comprised of the following 12 countries (ICA, 2011):

- Angola, Botswana, the DRC, Lesotho, Malawi, Mozambique, Namibia, the Republic of South Africa, Swaziland, Tanzania, Zambia and Zimbabwe

Three categories of priority transmission projects have been brought forward (ICA, 2011):

- Category A: transmission projects to alleviate congestion (removing constraints for regional trade and the development of the Day-Ahead market)
 - Interconnection capacity between Zambia, Zimbabwe, Botswana and Namibia (ZIZABONA)
 - Transmission capacity within Zambia (Kafue-Livingstone), within the existing Central Transmission Corridor involving the utilities in Zambia (ZESCO)- Zimbabwe (ZESA)-Botswana (BPC) and RSA (Eskom)
- Category B: transmission projects to interconnect non-operating members
 - Main focus on evacuating power to Tanzania from Zambia and Mozambique
 - Connecting Namibia to Angola
- Category C: transmission projects related to new generation projects
 - Implementation of Mozambique Backbone for evacuating power to the South as well as the development of the second Mozambique-Zimbabwe Interconnector (associated with the development of Moatize 600MW and Mphanda Nkuwa 1500MW in North Mozambique)
 - Development of the second Zimbabwe - RSA Interconnector (associated with the development of new hydropower plants in Zambia of 750 MW, Zimbabwe of 300 MW and Zambia / Zimbabwe of 1600 MW)
 - Development of the second DRC-Zambia Interconnector (required after the rehabilitation of the Inga I and II sites in the DRC, and the development² of Inga III of 3500 MW)

Figure 8 provides an illustration to selected transmission projects within SAPP:

² Please note that the level of envisioned capacity for Inga III varies depending on the source. The Grand Inga pre-feasibility study (cited earlier) proposes Inga III development at 4800 MW (AECOM & EDF, 2011)



Figure 8: An illustration of the proposed interconnections among the SAPP countries. Image source: (ICA, 2011)

The following interconnector and regional transmission projects have been designated for fast-track implementation by the SAPP Executive Committee in order to complete the region’s interconnectivity and relieve congestion on the regional grid to facilitate electricity trading (SAPP, 2013):

- Zimbabwe-Zambia-Botswana-Namibia Transmission Project (ZIZABONA)
- Mozambique-Malawi Interconnector
- Central Transmission Corridor (CTC)
- Namibia-Angola Interconnector and
- Zambia-Tanzania-Kenya Interconnector

A summary of the specifications of the envisioned transmission projects within the SAPP is provided in Table 5:

Table 5: SAPP transmission project specifications. Source: (ICA, 2011), (SADC, 2012), (World Bank, 2012), (AllAfrica, 2012), (EU-Africa Infrastructure Trust Fund, 2011)

Category	Project	Voltage (kV)	Capacity (MW)	Length (km)	Total cost (M USD)
A	Zimbabwe, Zambia, Botswana, Namibia (ZIZABONA)	400	650	408	223
	Zimbabwe, Central Transmission Corridor (CTC)	400	650	280	100
	Zambia, Central Transmission Corridor (CTC)	132		840	163
	Kafue – Livingstone (Zambia)	330	600	341	110
B	Zambia, Tanzania, Kenya	400 HVAC	400	700	860
	Namibia – Angola				250
	Mozambique – Malawi				93
C	DRC - Zambia	330	600		94
	Mozambique Backbone	400 HVAC / 800 HVDC	3,100	1,340 / 1,250	1,700

In addition, Malawi has received a USD 350 million grant from the Millennium Challenge Corporation with the aim to rehabilitate and upgrade its generation, transmission and distribution assets (MCC, 2013).

It should also be noted that there has been renewed interest in the development of the 1,600 MW Batoka Gorge hydro power project between Zambia and Zimbabwe. The project is expected to cost USD 2.5 billion. The World Bank is supporting the Zambezi River Authority to update the feasibility study (World Bank, 2013).

Status of the SAPP transmission projects (SAPP, 2013) is provided in the table below:

Project	Status
Zimbabwe –Zambia – Botswana – Namibia Interconnector (ZIZABONA)	<ul style="list-style-type: none"> - The Intergovernmental Memorandum of Understanding has been signed by the Governments of Botswana, Namibia, Zambia and Zimbabwe - The Joint Development Agreement has been signed by NamPower, ZESA and ZESCO - The financial closure of the project was set for the end of 2013 with commercial operation targeted for 2016 - The SAPP have issued Request for Expression of Interest for consultancy services – to be financed by the grant received from the African Development Bank (SAPP, 2013)
Mozambique- Malawi Interconnector	<ul style="list-style-type: none"> - Assigned high priority following delays in implementation - Mozambique-Malawi interconnection Agreement signed on April 3, 2013 - Feasibility study to be updated - Financing yet to be secured (formal requests submitted by Mozambique to a number of international institutions)
Central Transmission Corridor (CTC)	<p>Zimbabwe:</p> <ul style="list-style-type: none"> - Marvel - Insukamini line: designs completed, tendering in progress - New SVC at Sherwood: tender completed - Alaska - Sherwood line: revisiting Environmental Impact Assessment for tendering - Orange Grove - Triangle line: contract negotiations on-going - Project intends to relieve transmission congestion in Zimbabwe (increase the wheeling capacity in the ZESA network) <p>Zambia:</p> <ul style="list-style-type: none"> - ZESCO has secured USD 163 million loan from Nordea Bank AB (Sweden) and the Standard Bank of South Africa for an electrification project connecting the North-West Province (and parts of Western Province) to the national grid - The project is to provide points for future interconnection with Angola (Lusaka Times, 2014) - The European Investment Bank has granted a USD 30 million fund to upgrade the Kafue – Livingstone transmission line in Zambia (European Investment Bank, 2012)
Zambia – Tanzania – Kenya Interconnector	<ul style="list-style-type: none"> - Funding secured by TANESCO for phase 1, construction is ongoing for the Iringa – Shinyanga 400 kV interconnector - Feasibility studies completed (financed by the government of Norway) for the Singida – Arusha portion - Feasibility study completed in 2012 (World Bank financing) for the Iringa - Mbeya portion - Zambia has requested to relocate the interconnection point from Kasama to Kabwe area (in Zambia); the relocated part is under FS - The project intends to interconnect Tanzania with the rest of the SAPP

Namibia-Angola Inter-connector	<ul style="list-style-type: none"> - The initial Terms of Reference for the feasibility studies have been formulated by the SAPP Coordination Centre (SAPP-CC), revision and discussion with Namibia and Angola in progress - The project intends to interconnect Angola with the rest of the SAPP
DRC – Zambia inter-connector	<ul style="list-style-type: none"> - Construction of the Karavia - Luano 220 kV interconnector has started on DRC side - CEC is to re-tender due to cost increase by the current contractor, construction start set to 2nd quarter of 2013 - Commissioning was planned for June 2013 on the DRC side
Mozambique Transmission Backbone Project	<ul style="list-style-type: none"> - Environmental Impact Assessment study completed and approved - Shareholder structure review on-going - The transmission project connecting the Central and Southern regions of the country is planned in conjunction with the development of the Mphanda Nkuwa (1,500 MW) and Cahora Bassa North (1,245 MW) hydropower projects
Botswana North West Transmission Project	<ul style="list-style-type: none"> - Feasibility study completed in January 2013 - Evaluation of funding options on-going - The project intends to connect the North-West region of Botswana to the national grid

West African Power Pool (WAPP)

The West African Power Pool (WAPP) is a specialized institution of the Economic Community of West African States (ECOWAS) tasked with ensuring regional power integration and realization of a regional electricity market. It covers 14 of the 15 countries of the regional economic community (WAPP, 2014):

- Benin, Ivory Coast, Burkina Faso, Ghana, Gambia, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo

The priority projects adopted by ECOWAS and to be implemented by WAPP are divided into the following main subprograms:

- Subprogram A: establishment of a Coastal Transmission Backbone (Ivory Coast, Ghana, Benin/Togo, Nigeria)
- Subprogram B: development of inter-zonal transmission hubs (Burkina Faso, OMVS via Mali, Mali via Ivory Coast, LSG via Ivory Coast)
- Subprogram C: establishment of North Core transmission (Nigeria, Niger, Burkina Faso, Benin)
- Subprogram D: Gambia River Basin Development Organization (OMVG) and Senegal River Basin Development Authority (OMVS) power system development (The Gambia, Guinea, Guinea Bissau, Mali, Senegal)

- Subprogram E: Power System re-development (Ivory Coast, Liberia, Sierra Leone, Guinea)
- Subprogram F: WAPP strategic generation (development of Emergency Power Supply Security Plan)

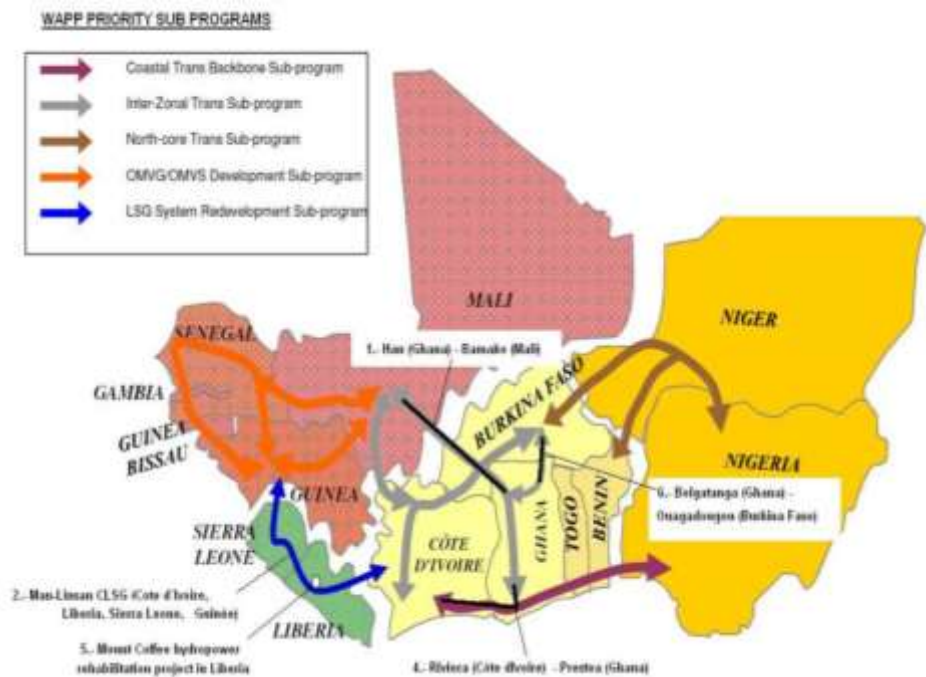


Figure 9: An illustration of the proposed priority project subprograms within the WAPP. Image source: (ICA, 2011)

As of 2011, parts of these subprograms have been or are being implemented by the WAPP (as illustrated by Table 6) and a revised version of a Master Plan is being finalized for updating the priority projects. There has been most progress in the Coastal transmission backbone subprogram (Subprogram A) and the Inter-zonal transmission subprogram projects (Subprogram B).

Table 6: Status of the WAPP priority transmission projects per subprogram. Table source: (ICA, 2011)

Project Status	Number	Investment Cost US\$ m	Subprogram (c.f. 2.1)	Interconnections
Implemented	3	226.3	A,A,B	1.Nigeria-Benin 2. Within Burkina 3. Within Ghana
Being implemented	4	954.3	A,B,B,D	1. Ghana-Togo-Benin 2. Ghana-Burkina 3. OMVG 4. Côte d'Ivoire-Mali
Feasibility study completed	2	702.3	E, C	1.Côte d'Ivoire-Liberia-S. Leone-Guinea 2.Nigeria-Benin-Niger-Burkina
Ongoing pre-investment study*	4	442.4	D,B,B,B	1.Côte d'Ivoire-Ghana 2.Within Ghana 3.Ghana-Mali 4.Guinea-Mali
Pre-investment study to be conducted	1		D	OMVS
TOTAL	14	2325.3		

*2004 Master Plan estimation.

According to the "Update of the ECOWAS Revised Master Plan for the generation and transmission of electrical energy" completed in 2011 (Tractabel Engineering), the features and status of individual transmission projects are as follows (see Table 7):

Table 7: WAPP transmission project features and status in detail. Source: (Tractabel Engineering, 2011), (AfDB, 2013), (African Energy, 2014)

Project	Voltage (kV)	Length (km)	Total cost (M USD)	Status
Ségou (Mali) - Ferkessédougou (Ivory Coast)	225	370	175	Construction in progress
Bolgatanga (Ghana) – Ouagadougou (Burkina Faso)	225	206	74	Construction in progress
Coastal Transmission Backbone (along the coast from Nigeria to Ivory Coast)	-	-	84 (3) 57 (4)	1) Nigeria – Benin: commissioned 2) Volta – Aboadze (Ghana): commissioned 3) Volta (Ghana) - Lomé (Togo)- Sakete (Benin): under construction 4) Aboadze (Ghana) – Riviera (Ivory Coast): FS and ESIS in progress
North Core (Nigeria – Niger - Burkina Faso - Benin)	330	832	540	FS completed Expected commissioning: 2017-2019
Kayes (Mali) – Tambacounda (Senegal)	225	280	65	Feasibility study (FS) in progress
Ghana - Burkina Faso - Mali	225	742	230	FS and Environmental and Social Impact Study (ESIS) completed, complementary studies in progress
OMVG : loop between Senegal, The Gambia, Guinea-Bissau and Guinea	225	1709	715	Detailed Study (DS) and ESIS completed Expected commissioning: 2015-2017 The World Bank is considering providing the financing, decision expected in November 2014 (African Energy, 2014)
Interconnection project CLSG	225 Double circuit	1360	490	FS completed, ESIS in progress Expected commissioning: 2015 The African Development Bank Group approved provision of financing in 2013 amounting to EUR 145 million, comprising ca. 40% of the total project cost (AfDB, 2013)

Figure 10 provides a detailed illustration of the existing and proposed transmission lines in the WAPP region:



Figure 10: A detailed illustration of existing and proposed interconnections within the WAPP. Image source: (Tractabel Engineering, 2011)

There have also been medium voltage cross-border projects initiated and funded within the framework of the First Energy Facility of the EU-ACP Program, the status of these projects is summarized in Table 8:

Table 8: Status of the medium voltage cross-border projects within the WAPP. Table source: (ICA, 2011)

Name	Investment cost US\$ m	Status
1. Ghana-Togo 2. Ghana-Burkina	19.810	Implemented
3. Côte d'Ivoire-Liberia		Being implemented
4. Togo from Benin 5. Togo from Ghana	4.6	Implementation to start in Sep. 2011
TOTAL	24.4	

Discussion and implications

As demonstrated by the pipeline of international transmission projects within each African regional power pool, the vision of interconnecting all African countries is under way to be realised. Many energy resources exist in Africa, e.g. the large hydro potentials in central Africa (DRC, South Sudan, and Ethiopia). A significant part of the potential can deliver electricity at such a low price, that long transmission (also at length of 4,000 km) projects become relevant to compete with oil, natural gas or coal-fired electricity generation. Many different transmission project are under way, so major steps in the direction of the vision will be taken in 2020 and 2030.

In terms of implications of the regional interconnection projects on the planning activities within the EAPP, the following issues should be highlighted:

- Burundi and the DRC are members of both the EAPP and CAPP. Tanzania is member of the EAPP and SAPP. These countries will play an important role as regional interconnectors.
 - The Zambia – Tanzania – Kenya transmission line which will provide a strong link between the EAPP and the SAPP is already under way. In addition, there are substantial further developments envisioned both in generation capacity, increased integration as well as grid enforcement within the SAPP (most notably Zambia, Zimbabwe and Mozambique), potentially enabling genuine inter-regional power trade including South Africa, the largest load centre of the region.
- The Grand Inga is expected to be developed in several steps until 2040 and can be expected to cover local demand and to export electricity to South Africa and Nigeria. The interconnection between Grand Inga and Egypt, the third load centre in Africa, is the least preferred option based on current assessments.
 - Interconnection with Egypt would be the longest in terms of distance (therefore the most expensive), and it should also be noted that there are other abundant hydro resource sites located closer to Egypt (e.g. Ethiopia).
- The Egypt – Saudi Arabia interconnector, though primarily intended to alleviate short-term balancing challenges of the two countries, could

potentially serve as a critical connection point between the Middle Eastern power systems and the EAPP.

From an EAPP point of view the interconnectors and trade beyond EAPP, is expected to be in the north (Egypt – Libya – Tunisia) and the south (Tanzania – Zambia/Mozambique – Zimbabwe/South Africa).

The main barrier for the development of the interconnected Africa is not the narrow technical/economical business cases of the transmission projects (and the hydro power projects). Rather, the lack of political stability and lack of maturity of public institutions and business environment can in many situations hinder the investment in economically sound projects.

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