Nile Basin Initiative

Regional Power Trade Project

Review of Hydropower Multipurpose Project Coordination Regimes

Issues Paper
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LIST OF ACRONYMS AND ABBREVIATIONS

ADB	- Asian Development Bank
AfDB	- African Development bankBO - Build and Operate
BOO	- Build-Own-Operate
BOOT	- Build-Own-Operate-Transfer
BOT	- Build-Operate-Transfer
COM	- Council of Ministers
DBFO	- Design, Build, Finance, Operate
DIZ	- Direct Impact Zone
DRC	- Democratic Republic of Congo
EAC	- East African Community
EAPP	- East African Power Pool
EFR	- Environmental Flow Requirement
EMP	- Environmental Management Plan
ENCOM	- Eastern Nile Council of Ministers
ENSAP	- Eastern Nile Subsidiary Action Program
ENSAPT	- Eastern Nile Subsidiary Action Program Team
ENTRO	- Eastern Nile Technical Regional Office
EPC	- Engineering, Procurement and Construction
FIRR	- Financial Internal Rate of Return
GEF	- Global Environmental Facility
GDP	- Gross Domestic Product
IADB	- Inter-American Development Bank
IDP	- Irrigation Development Plan
IEA	- Initial Environmental Assessment
ILA	- International Loan Agency
IMF	- International Monetary Fund
IPP	- Independent Power Producer
LV	- Lake Victoria
LVB	- Lake Victoria Basin
LVBC	- Lake Victoria Basin Commission
MDB	- Multilateral Development Banks
MIGA	- Multilateral Investment Guarantee Agency
MoU	- Memorandum of Understanding
NBI	- Nile Basin Initiative
NBICOM	- Council of Ministers of NBI
NEL	- Nile Equatorial Lakes
NEL-CU	- Nile Equatorial Lakes Coordination Unit
NELSAP	- Nile Equatorial Lakes Subsidiary Action Program
NGO	- Non-Governmental Organization
Nile-COM	- Nile Council of Ministers
Nile-SEC	- Secretariat of the Nile Basin
O&M	- Operation and Maintenance
PPA	- Power Purchase Agreement
PPP	- Public-Private Partnership
RCU	- Regional Coordination Unit
RPTP	- Regional Power Trade Project
SAP	- Subsidiary Action Program
SAPP	- South African Power Pool
SDO	- Social Development Office

SINELAC	- Societe Internationale des Pays des Grand Lacs
SIZ	- Secondary Impact Zone
SVP	- Shared Vision Program
SPC	- Special Purpose Company
SSEA	- Strategic Social and Environmental Assessment
TIZ	- Tertiary Impact Zone
TOR	- Terms of Reference
TSO	- Transmission Systems Operator
USD	- United States Dollar
WB	- World Bank

FOREWORD

The Review of Hydropower Multipurpose Project Coordination regimes is the result of a literature study based on documents available in NBI-RPTP's library and other literature found on the Internet and from other sources[1]. All data refers to these documents. There have been no field studies carried out regarding this paper. The conclusions from the various reports are synthesized and summarized in the compendium and conclusions and recommendations are given on the basis of an analysis of the input from the reports. The Final Report comprises two documents, a "Best Practice Compendium" and an "Issues Paper". A common Executive Summary for the two papers is included in the "Best Practice Compendium". The executive summary has been written in bullet point form for easy usage in decision making.

In this report, the term Multipurpose Project (MPP) is used for project that have more than one use, for example hydropower production and irrigation, regardless if the project was planned for multipurpose or single

The Compendium has been elaborated by Tore Hagen, Leif Lillehammer and Suha Satana and supported by Gerya Güvenc, under the supervision of the RPTP office in Dar es Salaam, with considerable input from the stakeholders that participated in the NBI-RPTP Workshop on the "Review of Hydropower Multipurpose Project Coordination Regimes" held 26th – 28th May 2008 in Dar es Salaam.

[1] However, a big bulk of the data from the LHWP is derived from the consultants own participation in the Lesotho Water Sector Improvement Project.

1. INTRODUCTION AND BACKGROUND

1.1 The Nile Basin Initiative

The Nile Basin Initiative (NBI) is a partnership of the riparian states of the Nile[2]. The NBI seeks to develop the river in a cooperative manner, share substantial socioeconomic benefits, and promote regional peace and security. The NBI started with a participatory process of dialogue among the riparian states that resulted in the agreement on a shared vision; to "achieve substantial socioeconomic development through equitable utilization of, and benefit from, the common Nile basin water resources", and a Strategic Action Program to translate this vision into concrete activities and projects[3].

1.2 Strategic Action Program

The NBI's Strategic Action Program is made up of two complementary programs. The basin-wide *Shared Vision Program* (SVP); to build confidence and capacity across the basin, and the Subsidiary Action Program (SAP); to initiate concrete investments and action on the ground at sub-basin levels. The programs are mutually reinforcing in nature. The SVP, which focuses on building regional institutions, capacity and trust, lays the foundation for unlocking the development potential of the Nile, which can be realized through the SAP. These investment-oriented programs are currently under preparation and implementation in the Eastern Nile and the Nile Equatorial Lakes Regions (ENSAP and NELSAP). The SVP includes seven thematic projects related to environment, power trade, agriculture, water resources planning and management, applied training, communication and stakeholder involvement, and macro-economics. An eighth project, the SVP Coordination Project, aims at building capacity at the NBI secretariat for program execution and coordination. The SVP is being executed by the Secretariat of the Nile Basin (Nile-SEC) on behalf of the Nile Council of Ministers[4] (Nile-COM). In executing the program, the NBI is supported by a Technical Advisory Committee drawn from participating member countries.

1.3 The Eastern Nile Subsidiary Action Program (ENSAP)

The Eastern Nile Subsidiary Action Program (ENSAP) is an investment program by the Governments of Egypt, Ethiopia and the Sudan under the umbrella of the Nile Basin Initiative (NBI). It is led by the Eastern Nile Council of Ministers (ENCOM), comprised of the Water Ministers in the three Eastern Nile countries, and an ENSAP Team (ENSAPT) formed of three technical country teams. The objective of ENSAP is to achieve joint action on the ground to promote poverty alleviation, economic growth and reversal of environmental degradation. Management and coordination for the preparation of ENSAP projects is undertaken by The Eastern Nile Technical Regional Office (ENTRO) in Addis Ababa, Ethiopia. ENTRO also builds capacity and strengthens institutions and provides secretariat support to ENCOM/ENSAPT. ENTRO has a Social Development Office (SDO) that supports all ENSAP projects through: capacity building in social development, input to project design, formulation of guidelines, initiation of pilot and background studies and analysis.

[2] The Nile riparian countries include Burundi, Democratic Republic of Congo, Egypt, Ethiopia, Kenya Rwanda, Sudan, Tanzania, and Uganda. Eritrea is currently in the NBI as an observer.
[3] Nile Council of Ministers, Policy Guidelines for the Nile Basin Strategic Action Program, February 1999
[4] Ministers in charge of water affairs in the Nile Basin member states.

1.4 Nile Equatorial Lakes Subsidiary Action program (NELSAP)

The Nile Equatorial Lakes Subsidiary Action program's (NELSAP) mission it to contribute to the eradication of poverty, to promote economic growth, and to reverse environmental degradation in the NEL region. NELSAP oversees implementation of the jointly identified SAPs and promotes cooperative inter-country and in country investment projects related to the common use of the Nile Basin water resources.
The Nile Equatorial Lakes region includes the six countries in the southern portion of the Nile Basin—Burundi, Democratic Republic of Congo, Kenya, Rwanda, Tanzania and Uganda—as well as the downstream riparians Egypt and Sudan. NELSAP is expected to be a long-term program, with multiplier effects in broader economic integration as the program shows results on the ground. Facilitation of project preparation and implementation is undertaken by the NELSAP Coordination Unit, NEL-CU.

1.5 The Nile Basin Regional Power Trade Project

The Nile Basin Regional Trade Project (RPTP) is one of eight projects implemented under the SVP of the NBI. The project aims to facilitate the development of the regional power markets among the nine Nile Basin Initiative countries and build analytical capacity to manage the Nile Basin Resources in keeping the Vision articulated by the Nile riparians.

Inexpensive and reliable supply of electricity is a critical input for economic growth, employment generation and poverty alleviation. As such, the long term objective of the Nile Basin RPTP is to contribute to poverty reduction in the region by assisting the NBI countries in developing the tools for improving access to reliable, low cost, sustainably generated power. An important element in achieving this goal is to create a conducive conductive environment for the facilitation of power markets and trade opportunities among the countries participating in the Nile Basin Initiative. The creation of a regional electricity market can play a key role in furthering cooperation among the Nile Basin states and in ensuring that the hydropower resources of the Nile Basin are developed and managed in an integrated and sustainable manner. The preceding and necessary condition for the power trade and power markets development is the creation of bilateral or multilateral tie lines among some or all of the NBI countries.

The Regional Power Trade Project is expected to deliver against the following two results:

(i) ***Deliver Technical Assistance;*** focused on providing the countries with tangible results for achieving compatibility in the policy and regulatory environment, establishing common technical operating standards and access rules, and fostering the appropriate framework within which trade can occur. This will include providing training, commissioning key studies, as well as promoting dialogue between the key players in the region.

(ii) ***Facilitate infrastructure development for power trade;*** by promoting key regional investments, particularly backbone interconnections, in coordination with the SAP and organizing investment seminars, among others.

2. PREREQUISITES FOR DEVELOPMENT OF MULTIPUROSE PROJECTS IN THE NBI AREAS

2.1 Introduction

The driving force for the development of the majority of multipurpose projects to be developed in the NBI area will be the need for power and development of hydropower projects. Further is irrigation and water supply of great importance followed by flood control and inland navigation on the Nile and it tributaries. Recreation is normally not a highly utilized function of dams in Africa, although many have great potentials for it, for example boating and associated tourism.

This paper will particularly discuss the impact power trade between the NBI countries will have on the development of multipurpose projects, and it is therefore important to have an overview of the power system in the NBI countries and the basic grid infrastructure, as well as the prospect for power trade. This chapter will therefore give a basic overview of the power sector in the NBI countries, the existing and planned transmission network, the existing and planned power trade and institutional constraints.

Most of these issues are elaborated in several reports, among others in the report regarding “Institutional, regulatory and cooperative framework model for the Nile Basin power trade”, prepared by Mercados in association with Nord Pool Consulting and CEEST.

2.2 Size of the power sector

The NB region is vast (around 5,000 km from north to south and 2,500 km from east to west in some parts), and is additionally involving multiple countries. In comparison the longest distance east to west in Europe is 3,500 km and in the US, from east to west,4,200 km. The region has also different landscapes, desert, mountains, forests. It is a real challenge, from the technical and economical point of view, to develop the required infrastructure that could link all the countries.

Although heterogeneous in size, and except for Egypt (clearly of another scale), the countries’ power sectors can be basically grouped in three types according, exclusively, to their size:

(i) Small systems: Uganda, Rwanda, Burundi
(ii) Intermediary systems: Kenya, Tanzania, DRC (considering the high unavailability), Ethiopia, Sudan.
(iii) Large systems: Egypt

This pattern implies that many of the countries have power sectors with comparable size, which facilitates development of trade. On the other hand, there are small systems which may need a special treatment to be fully incorporated to regional trade.

The size of the countries’ power sectors vary widely and are illustrated in the following table.

Country	Total installed capacity (MW)	Consuption per capita (kWh)	Transmission and distribution losses (% output)	Investment in energy projects 2000-05 (MUSD)
Burundi	27	22	30.7	No data
DRC	2,415 3)	98	21 2)	No data
Egypt	20,508 1)	1350 1)	13.1	678
Ethiopia	767 1)	28 1)	17	300
Kenya	1,177	132	18.7	189 4)
Rwanda	57	28	20.7	0
Sudan	838 1)	95	14.7	No data
Tanzania	1,016	92	23	372 5)
Uganda	400	67 2)	32 2)	142

Table 2.1 Power Sector Data for NBI countries

Primary Source: Mercados/NordpoolCEEST Stydy on Power Trade 2007
Secondary source: World Development Indicators 2007, World Bank Publications
1) Source: Eastern Nile Power Trade Study
2)Source: Information provided by Member Countries 2008
3) Available capacity 1,217 MW
4) When 2000 – 05 data is not available, 1995 – 99 data is used
5) Tanzania has experienced 100% increase in energy infrastructure within a decade, which is worth mentioning
6) Source: World Development indicators 2007, the World Bank Publications

It must also be pointed out that the size of the system is not a unique indicator; the systems' quality and current condition are also very important. This point will be approached later, but it is noteworthy that, for example, DRC is actually a large system from the point of view of nominal installed capacity, but currently in DRC a sizable part of this capacity (50% aprox) is unavailable due to lack of maintenance.

It is also important mentioning that heterogeneity in size can be a barrier, but it can also be an opportunity to foster trading. Heterogeneity transforms into a barrier when bigger countries try to "abuse their dominant position" in the region. However, it can also be an opportunity for smaller countries since bigger ones provide them an "infinite" market where they can sell or buy. Large systems also provide "economies of scale" and the required "volume" in an industry where scale and volume are important.

2.3 Existing transmission lines and power trade

The basic grid infrastructure is described in the report titled "Institutional, regulatory and cooperative framework model for the Nile Basin power trade", prepared by Mercados in association with Nord Pool Consulting and CEEST.

Infrastructure is one of the key elements that enable regional trade of electricity; without infrastructure it is obvious that trade will not be possible. Moreover, infrastructure needs to be adequate for the trade to be free of obstructions. Power trade infrastructure encompasses cross border interconnectors and domestic transmission systems which can accommodate flows that are originated in another country and transit to a third country.

Although there are interconnectors in the region, these are limited in number and capacity.

The following cross border connections can be mentioned (existing or planned):

Existing:

- Ruzizi: Rwanda – Burundi – DRC to share the hydro power plant of 36 MW.
- Burundi – Rwanda (through SINELAC)
- Uganda – Kenya (30 MW)
- Uganda – Rwanda (5 MW)
- Uganda – Tanzania (9 MW)

The following table lists planned transboundary transmission lines between the NBI countries, and the current status:

Connections	**Status**
DRC – Sudan - Egypt	Feasibility study to be updated
Ethiopia – Sudan - Egypt	Feasibility study ongoing
Ethiopia – Sudan	Committed for construction
Kenya – Ethiopia	Feasibility study ongoing
Kenya - Uganda	Seeking financing
Kenya – Tanzania	Seeking financing
Tanzania – Rwanda - Burundi	Feasibility study ongoing
Uganda - DRC	MoU signed for undertaking feasibility study
Uganda - Rwanda	Seeking financing
DRC - Burundi	Seeking financing
DRC - Rwanda	Seeking financing
Burundi - Rwanda	Seeking financing

Table 2.2 Planned transboundary transmission lines between NBI countries

Source: Information provided by Member Countries 2008

An overview of transmission networks, including interconnections, in the whole Nile basin is given in figure 4.1. There are three clearly distinct main clusters, in the NELSAP, ENSAP and lower Nile (Egypt) regions respectively.

ENSAP

The "Eastern Nile Power Trade Program Study" (EDF and Scott Wilson, 2007) summarizes the current power trade and transmission situation in the NELSAP area as follows:

Egypt

Egypt is interconnected with Libya and Jordan. These interconnections are used for emergency situations and for power trade between Egypt and Jordan. Exports and imports measured from 2003 to 2005 represented less than 1% of total Egyptian electrical generation, but 20% of Jordanian generation. An export balance of 20 GWh to Libya and of 680 GWh to Jordan were measured in 2004/2005.

The existing transmission system is equipped with a double circuit 500 kV backbone along the Nile river, from Aswan High Dam (2 100 MW) to Cairo (main load centre), and a single circuit (500 KV) from Cairo to the interconnection with Jordan. A 132 kV and 220 kV circuit follows the 500 kV backbone along the Nile river. The delta zone is supplied with a meshed 220 kV network, and extends towards west to Libya with a double circuit interconnection. An extension of the 500 kV network is currently under construction from Cairo 500 to Sidi Krir in West Delta. It is also the first milestone to reinforcement of the interconnection with Libya in 500/400 kV.

Ethiopia

The Ethiopian system consists mainly of 230 and 132 kV lines. The 230 kV network extends from Addis Ababa about 400 km eastward to Dire Dawa, about 300 km southward to Shashemene and about 1000 km northward to Tekeze and Gonder.
Three 230 kV substations supply Addis Ababa, that represents 60% of the total demand.

A 400 kV network will be soon erected to evacuate the generation of Gilgel Gibe II HPP until Addis Ababa. Ethiopia will be interconnected with Sudan with a 230 kV double circuit line between Gonder and Gedaref in Sudan. The commissioning is expected in year 2008.

Sudan

At present there is no international power trade between Sudan and the neighboring countries. This is partly because until today there were no transmission facilities to enable such trade.

The Sudanese system consists mainly of 110 and 220 kV lines. The system includes a 800 km 220 kV double circuit line from Roseires HPP, located in the south close to Ethiopia border, to Khartoum along to the Blue Nile River. A 110 kV double circuit ring supplies Khartoum, that represents 50% of the total load. This 110 kV ring is connected to the 220 kV system with two 220/110 kV substations at Eid Babiker and Kilo X.

In the coming year 2007, the network will be reinforced with a 500 kV double circuit line from Merowe HPP (installed capacity 1 250 MW) to Khartoum and a 500 kV single circuit line between Merowe and Atbara located on the Nile, 300 km north east of Khartoum. In the next years, NEC intends to extend its 220 kV system by about 2000 km of new lines.

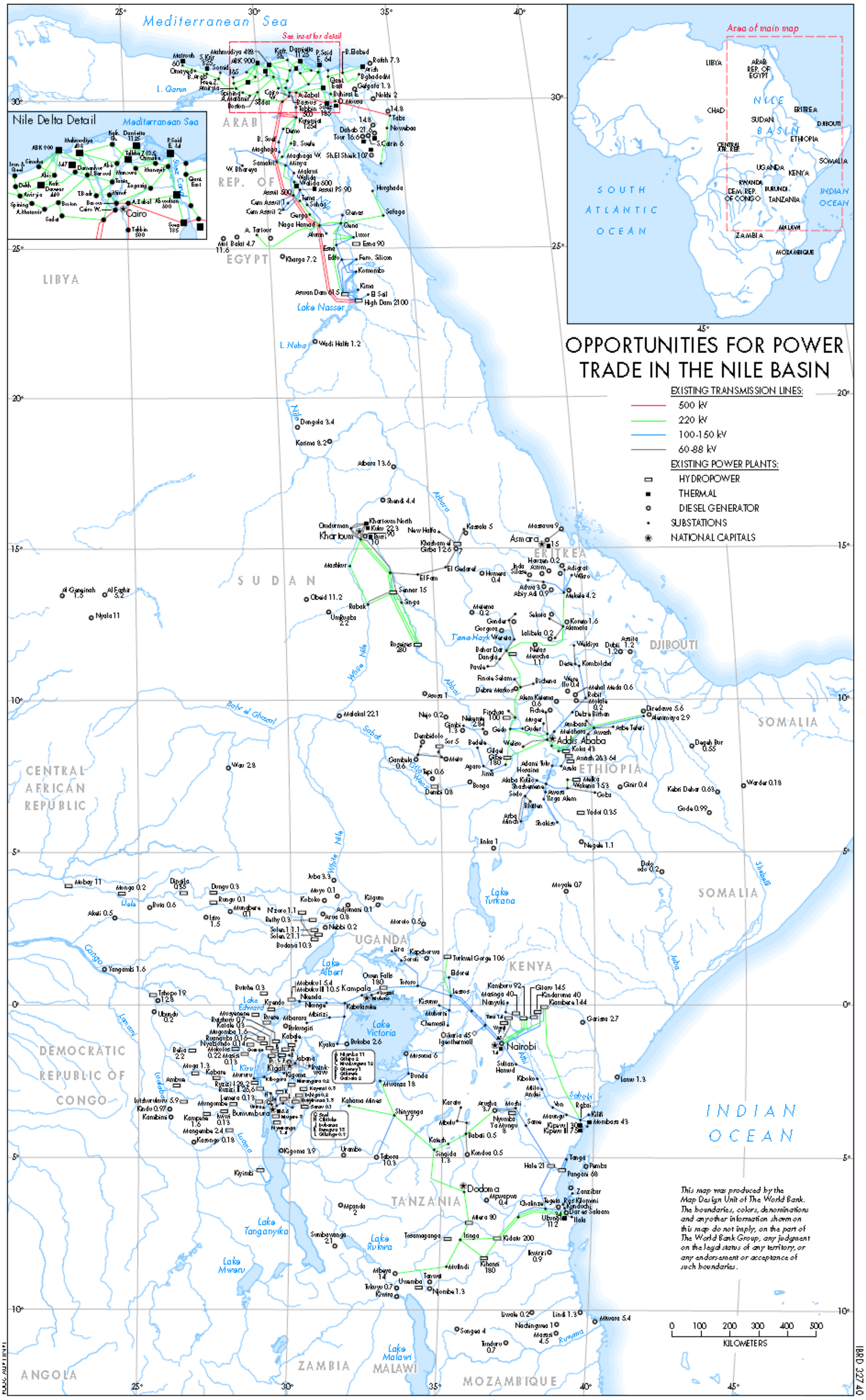

Figure 2.1 Transmission network in the NBI countries

Interconnecting the ENSAP system

Due to the long distance se0parating Ethiopia from Egypt, only a DC link would allow a huge power transfer between the two systems. However, with a presence of the Sudanese system. that allows to control the voltage along the interconnection path, AC alternatives could also be competitive solutions to interconnect the three systems.

Four views have been selected to interconnect the systems, two AC options and two DC options. The interconnection points are the following:

- In Egypt: High Dam for the AC alternatives and Assiut for the DC alternative.
- In Ethiopia: Border HPP and Mandaya HPP for the AC alternatives and Mandaya HPP for the DC alternatives.
- In Sudan: Merowe HPP and Hasaheisa 500 kV substation for AC views. One DC view passes through Sudan without taping station, the other one with a tapping station in Khartoum (Markhiat 500 kV substation).

NELSAP

The “East African Power master Plan” (BKS Acres (PTY) Ltd. 2005) summarizes the current power trade and transmission situation in the NELSAP area as follows:

Uganda

The main transmission voltage in Uganda is 132 kV with the sub-transmission system operating at 66 kV. Generation at Nalubaale and Kiira Power Stations (Owen Falls) is transmitted to the east via a 117 km double circuit 132 kV transmission line to the Tororo substation at the border with Kenya. The double circuit line continues to Lessos substation in Kenya. From the Tororo substation a 132 kV transmission line extends 260 km to the northwest to supply the town of Lira. To the west of Nalubaale and Kiira, a double circuit line and a single circuit line serve the load centre of Kampala and the west of the country. A 132 kV line crosses the Tanzanian border and supplies the Kagera region in Tanzania.

Kenya

Kenya’s transmission system comprises 220 kV, 132 kV and 66 kV transmission lines. The system load is concentrated in Nairobi and Mombasa. From Mombasa, a single circuit 132 kV transmission line runs northwest to Nairobi (440 km). From Nairobi a double circuit 132 kV line extends to the Ugandan border and then continues to Nalubaale hydro power station in Uganda (a total distance of 518 km) passing by Olkaria I and II and Lessos.

From the Rabai 220 kV substation, near Mombasa, a 416 km long 220 kV single circuit line runs to Kamburu via Kiambere. Two single circuit 220 kV lines connect Kamburu to Nairobi (108 km) terminating at Dandora substation. In addition, there is another 220 kV line connecting Kiambere to Dandora via the Embakasi substation in Nairobi. The Turkwel hydro station is connected to the grid at the Lessos 132/220 kV substation via a 230 km 220 kV transmission line.

There is a new 220 kV double circuit line between Nairobi and Olkaria that began service in late 2004. The next transmission development planned is a 132 kV transmission line from Sondu Miriu to Kisumu in 2007, according to the latest KenGen update as well as the 115 km Kamburu-Meru 132 kV line and the Olkaria – Lessos 220 kV line that is planned to be constructed as soon as possible.

Tanzania

The transmission voltages in Tanzania are 220 kV, 132 kV and 66 kV. Dar es Salaam is the major load centre. The bulk transfer of energy is carried out on the 220 kV system. From Ubungo, on the coast, two 220 kV transmission lines extend west to Iringa via Morogoro, Kidatu and Kihansi. From Iringa a single circuit 220 kV line goes to Mwanza in the north, via Mtera, Dodoma, Singida and Shinyanga. At Singida a 220 kV line feeds Arusha to the east and at Shinyanga a 220 kV line feeds Bulyanhulu. From Iringa the 220 kV single circuit line continues southwest to Mufindi where it turns west to Mbeya.

Rwanda-Burundi

According to the SSSE assessment (SNC Lavalin 2005) there is currently an interconnection between Rwanda and Burundi but there is none connecting the districts of Kigoma or Kagera in Tanzania to either of the countries. To ensure that any power development option can be of regional benefit, the following for transmission are planned:

- A 100 km, 110 kV line from Kigoma, Rwanda to Rwegura, Burundi,
- A 150 km, 132 kV line from Kabarondo, Rwanda passing near Ngara to Biharamuro in Kagera Province of Tanzania
- A 200 km, 132 kV line from near Ngara, Tanzania to Gitega, Burundi,
- A 240 km 110 kV line from Gitega, Burundi through Bururi to Kigoma, Tanzania

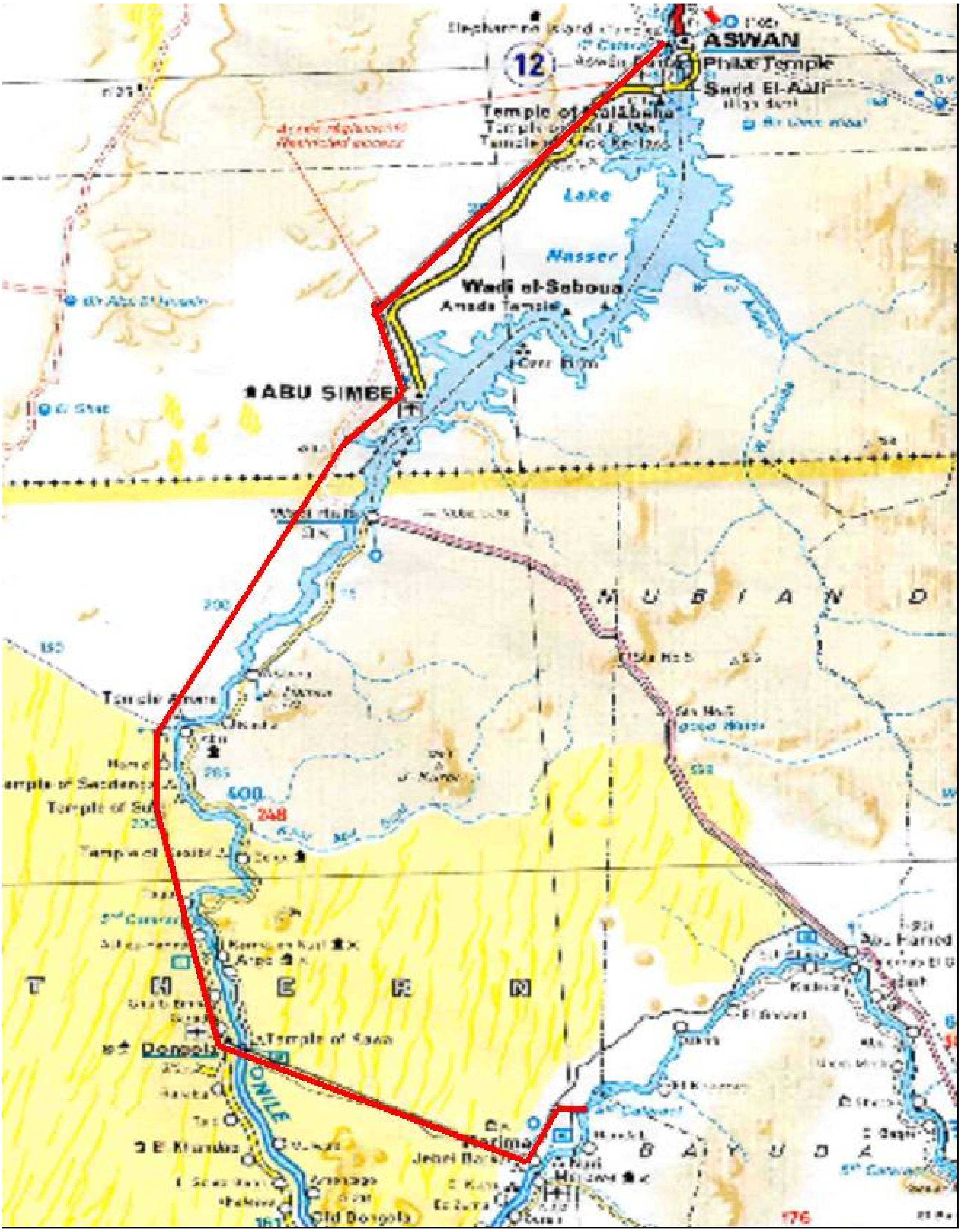

Figure 2.2 Planned line route between AHD and Merowe

(EA Power Trade Study)

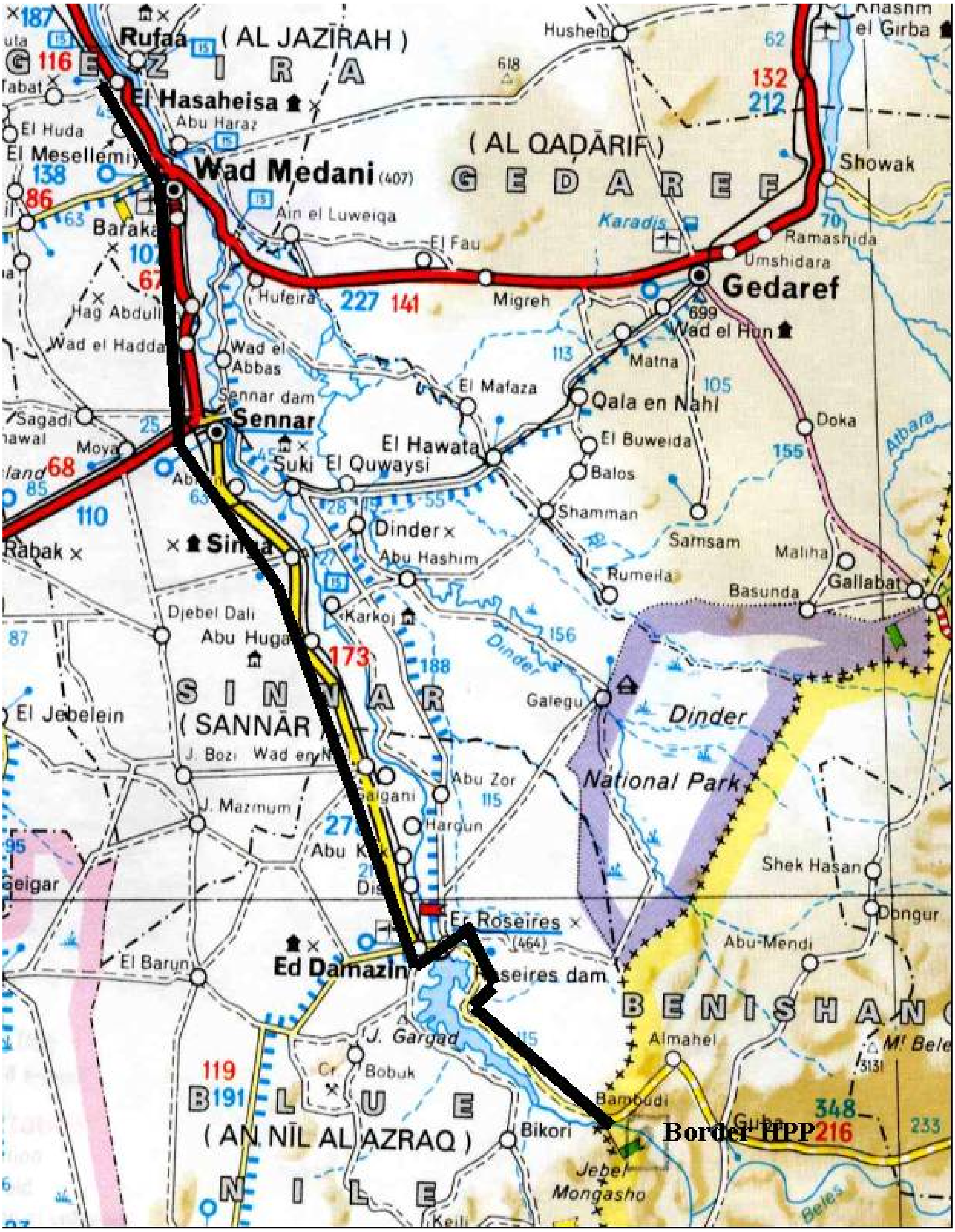

Figure 2.3 Planned line route between Hasaheisa (Sudan) and Border HPP

(EA Power Trade Study)

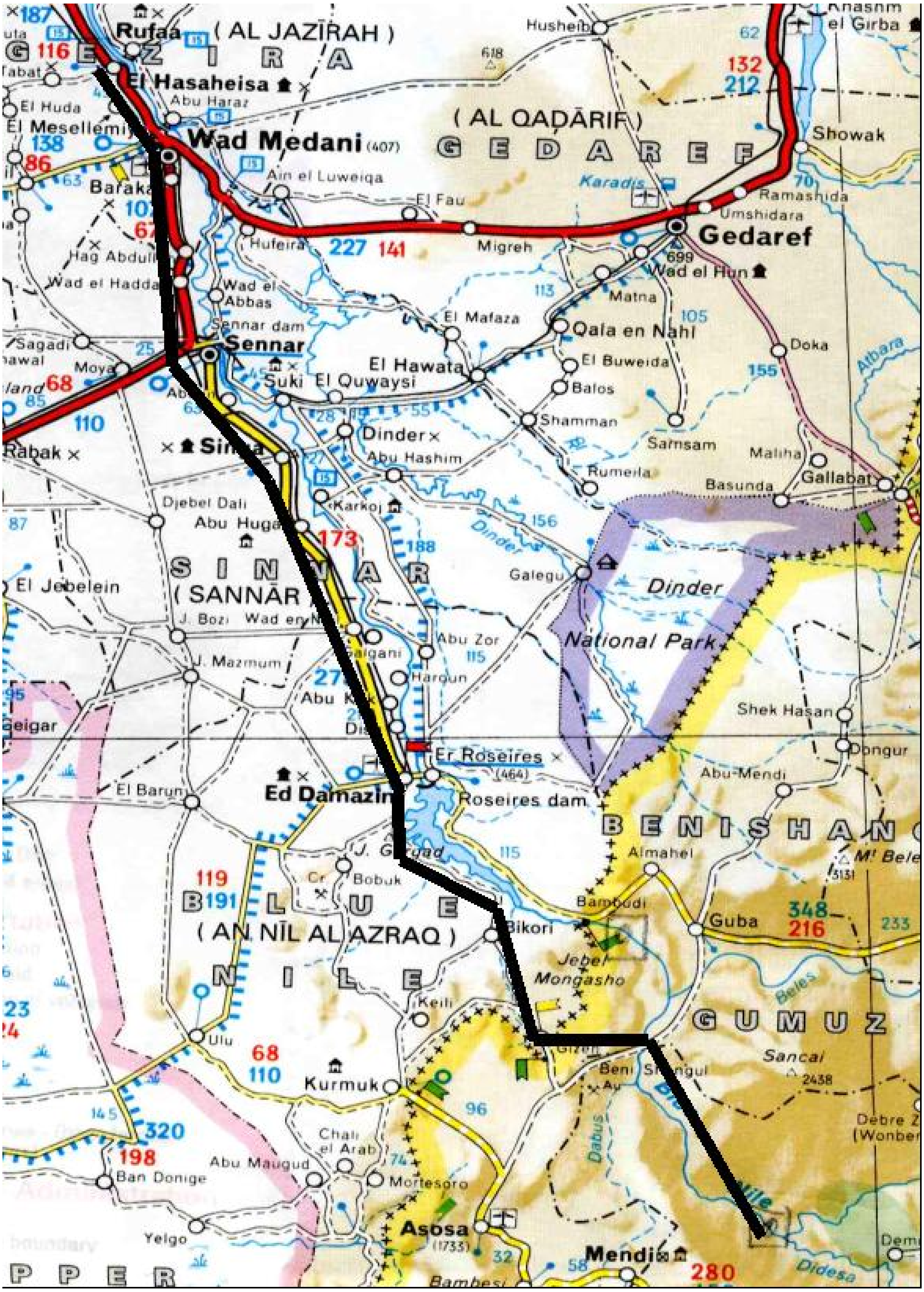

Figure 2.4 Planned line route between Hasaheisa (Sudan) and mandaya HPP
(EA Power Trade Study)

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Figure 2.5 Existing Grid System in East Africa

Figure 2.6 Envisaged Grid System in East Africa

<u>Democratic Republic of Congo</u>
The DRC, Rwanda and Burundi have jointly developed the The Ruzizi I and II power plants with an aggregated installed capacity of 55 MW with and annual average production of 289 GWH. The three countries are interconnected with transmission lines from Ruzizi to Kigali and Bujumbura, respectively (See figure 4.4).

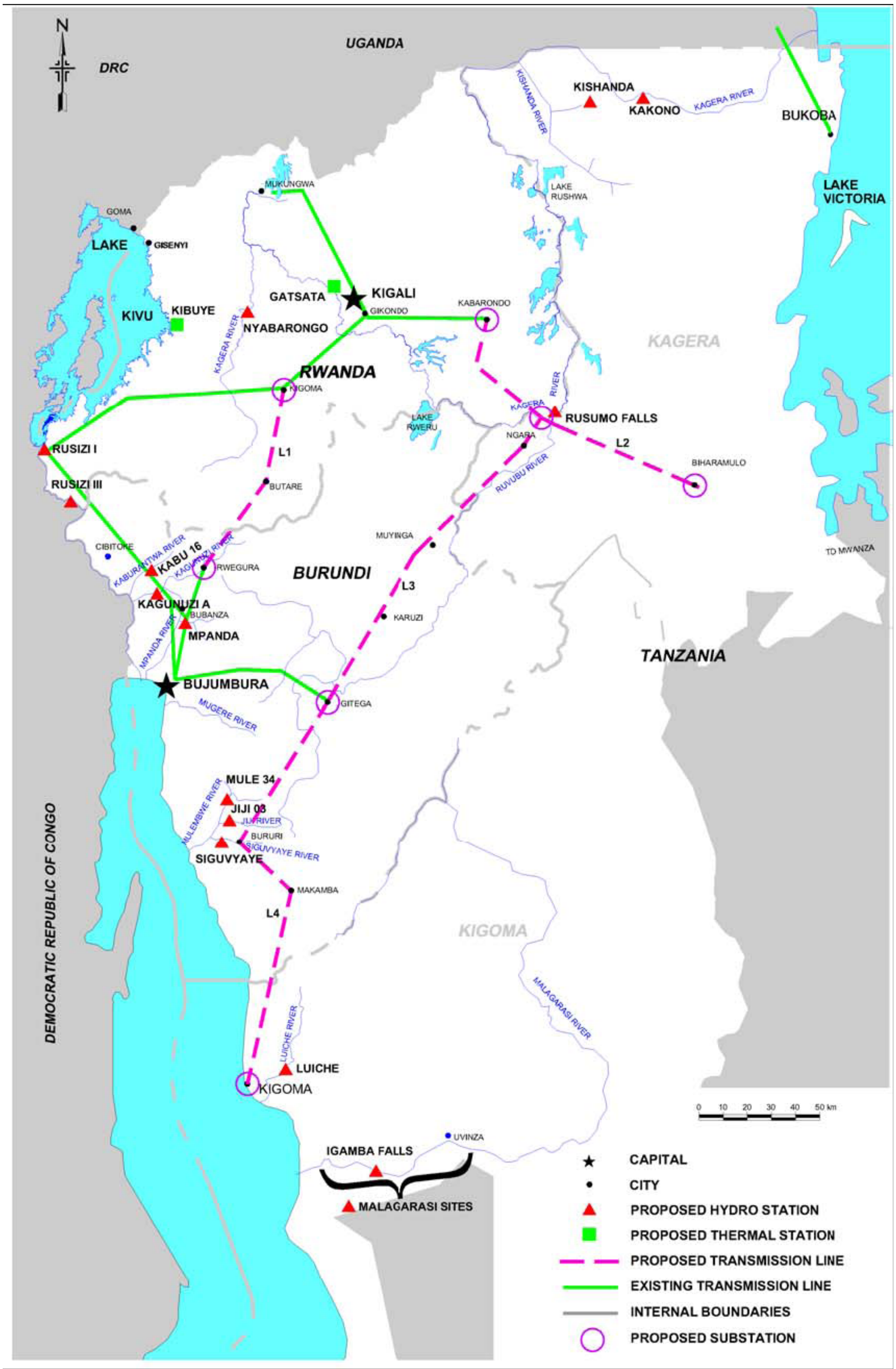

Figure 2.7 Grid in Rwanda, Burundi and Western Tanzania

2.4 Power Trade

For multipurpose schemes to deliver successfully, the planning must consider all aspects of the multipurpose use. As the NBI countries are in the process of introducing a regional market for power trade, the planning of multipurpose projects must take this into account. In this respect it is important to understand the dynamics in an open power trade market. This is discussed in Chapters 2.2. and 2.3, specifically for the Nile Basin area. However, first we do discuss some general issues in the transition from controlled to competitive markets whereupon the various Nile basin states reside currently in different stages[5], although a regional market is planned for.

2.5 Potential benefits with power trade in the NBI area

Potential benefits of power trade are identified in the Scoping Study carried out by Norconsult and Statnett (2004).

The potential benefits of power trade among the Nile Basin countries are rooted in cost savings in the supply of power from cooperation as opposed to independent expansion of national power systems. Specifically, such savings may be realized through the following:

- a reduction in operation costs due to economic power exchange;
- lower investment costs in additional supply due to least-cost development of energy resources from a regional—as opposed to a national perspective;
- spinning reserve requirements as a proportion of peak load; and coincident peak load relative to average load.

In addition, these factors enhance robustness in dealing with unexpected events.

Significant environmental benefits could emerge in this region if regional power trade were developed on a least-cost basis. Such benefits could result from water conservation and land protection effects, and from a reduction in greenhouse gas and other pollutant emissions caused by a shift from thermal to hydropower-based generation.

Certain power system considerations in relation with these indicated cost savings and environmental benefits are discussed in the following subsections.

Hydro-hydro complementarity

Two (or more) hydropower-based systems are complementary to each other (or one another) in the following cases:

- There is a difference in the distribution pattern of water runoff over the year
- There is a difference in hydrology over the years
- There is a difference in reservoir capacity between the systems.

Such differences often exist when two or more river basins are in question. They result in differences in the marginal cost of power generation by season and by year. From these cost differentials, benefits from power trade can emerge. For example, a system operator can avoid spilling water during wet periods if it can release water as power export. And during dry periods the operator will be able to import power and consequently avoid load shedding or save water.

[5] Two existing power trade arrangement currently exist in the Nile Basin states (see chapter 2.4)

Hydro-thermal complementarity

A hydropower-based system has marginal costs of generation based on hydrological parameters. This means that inflow varies over the course of the year and from dry to wet years. Consequently, when the hydropower-based system in some periods has a surplus of energy, water is spilled. In other periods, an energy deficit may in the worst case prevent the hydropower-based system from meeting demand.

Thermal generation has high variable operating costs relative to a hydropower scheme. Savings in variable operations costs can therefore be achieved by using hydropower when available.

Some thermal plants have high start-up costs, while hydropower-based plants or systems have comparatively low start-up costs. To cover a short-term increase in demand, it will often be less expensive for an operator of a thermal-based system to purchase power from a neighboring hydropower-based system than to start up another thermal unit.

Mutual assistance in case of disturbances and maintenance
In case of short-term maintenance or forced outages a system operator can buy power from a neighboring system instead of applying load-shedding or starting generators out of merit order.

Reduced reserve capacity
In an environment without any trading of power, each system has to be self sufficient. Consequently the combined investments in capacity are higher and system reliability lower than if both systems could benefit from trade. An interconnected system with trading capabilities improves the possibilities for mutual assistance during extreme situations such as an exceptionally dry year, shortage of fuel, or forced outages of units in one system, and thus reduces the need for combined reserve capacity.

Economies of scale in new generating capacity
A small power market cannot benefit from economies of scale in large-scale power generation alternatives because there is not sufficient purchasing power to exploit the full capacity of the project. In other words, a low capacity-utilization factor results in a low return on capital invested - at least in the early years until demand picks up. By combining two or more small power systems through interconnection, the combined power demand can become sufficient to make an investment in a relatively large low-cost hydropower plant economically viable.

2.6 Transition from controlled to competitive market

The characteristics of a controlled market are that the price for electricity is determined by the Government. In most cases there is one vertically integrated state utility operating with monopoly on generation, transmission, distribution and retail as well as wholesale of electricity.

A competitive market is characterized with:

- The electricity price is determined by supply and demand – not by Government
- There is an open market for trading electricity and a Power Exchange where the electricity is traded
- There is open access to the transmission network for all suppliers
- The power marker is regulated (but not controlled)

Most of the systems in the Nile Basin states are in the transition between a controlled and competitive market with the Egyptian being the most mature and that of for example DRC lagging somewhat behind due to lack of maintenance etc, although power trade is currently taking place with Rwanda and Burundi.

In general however, markets that have been a success, are in general characterized with the following prerequisites:

- A minimum of infrastructure is required to physically enable power exchange
- The laws and regulations must be adapted to allow a competitive power market
- There must be transparent and non-discriminatory access to the transmission network
- The institutional capacity of all participants in the power market (governmental and private) must be built to be able to operate in the market
- The countries where the power trade shall take place must have adopted the principles of market economy
- Vertically integrated state monopolies must be unbundled to create competition
- The conditions in the power market must be predictable, i.e there must be political decision and long-term firm commitment on power sector reform including that electricity prices will be determined by the market
- The tariffs decided by the Governments shall not be uniform, allowing for spot prices, term contracts etc – time of the day use tariffs, seasonal variations, determined in a competitive market. A consequence of this is that it must be accepted that shortage of capacity could result in dramatically increased electricity prices.

NBI Countries	Level of power sector reform toward liberalization
Burundi	Completed in 2000
DRC *	Completed in 1994
Egypt *	Completed in 1988
Ethiopia	Completed in 1997
Kenya *	Completed in 1997
Rwanda	Initiated sectoral reform plans (by 2005)
Sudan	Completed in 1998
Tanzania *	Under approval (2008)
Uganda	Completed in 1999

Table 2.3 Level of power sector reform toward liberalization

Source: Project Appraisal Document for Regional Power Trade Project, NBI SVP, Nov 2005
**Information provided by member countries 2008*

A controlled market with a vertically integrated state monopoly for power generation, transmission and distribution will go through a transition period before it reaches a competitive market. During the transition period the vertically integrated utility is unbundled into one (or more) generation companies, a single transmission company and one or more distribution companies.

Some of the trends seen from the introduction of a free power market are as follows:

- Introduction of competitive power markets has been most successful in mature power systems
- There is no interim solution between controlled and competitive market model, and consequently the transition, once decided, has to be fast
- The timing for the introduction of a free power market should coincide with the fulfillment of all critical prerequisites

2.7 Principles for power trade in the NBI area

The NBI Power Trade General Concept is described in the report regarding "Institutional, regulatory and cooperative framework model for the Nile Basin power trade", prepared by Mercados in association with Nord Pool Consulting and CEEST.

The region is characterized by large disparities in terms of power sector structures and regulatory environments. The existence of vertically integrated state owned companies and private sector participation restricted only to Independent Power Producers is however quite generalized. There is disparity in terms of policies and objectives for the power sector, and of financial as well as human resources. This is among the most significant issues related to the NBI's Power Trade concept.

Under these circumstances, the proposed general approach for the NBI Power Trade is based on the following principles, taking advantage of lessons learned and experiences from other regional initiatives, and already amply discussed in other reports:

- Regional regulation, perceived as the rules for cross border trading, should not interfere with national legal/regulatory frameworks, and if necessary, limit that interference only to unavoidable issues (so, the alternative of introducing deep reforms to national legal/regulatory frameworks or of moving towards uniform national legal/regulatory frameworks to base the regional trading system is rejected)

- Cross border trading regulation will apply only to the interconnection points between countries. From those points towards the countries' interior, the only valid legal/regulation framework that applies will be the one ruling each country's power sector.

- The NBI's Power Trade Regulation will only rule over transactions that require systematic treatment, because of the benefits that this brings to the member countries' catering their common interests. However, for other activities whose benefits can only be measured in terms of the perception of the individual countries, decisions and rules under which these activities will be decided and/or implemented are left to the parties to do so (typical example, as later further developed, are the investments of regional reach).

- The NBI Power Trade Model is based on the principle of minimizing mandatory obligations to countries and market participants (utilities and others), and creating the proper frameworks so as to let the economic interests of the parties to be the real drivers for the regional integration. Only **win – win deals** will promote the regional integration on a sustainable basis

- The proposed model minimizes, at least during the initial stages, permanent structures and staff, as a way to improve its sustainability by reducing the financial burden.

2.8 Barriers for power trade in the NBI area

The same report identifies the main barriers for power trade in the region. The report also addresses actions to be taken to overcome these barriers.

Cross border trading in the power sector normally has several benefits for the countries involved in this trading. However, initiating trade and making it fluid among participants may sometimes be not so easy. Based on other experiences of successful and unsuccessful initiatives, the following elements can be highlighted (but no limited to) as hurdles or barriers for the development of power trade:

(i) Poor performance of many of the state-owned utilities, rendering them unable to fully conduct normal commercial activities.
(ii) Long distances involved, and the challenging geographical and natural environment.
(iii) Disparity in the countries' power sector size.
(iv) Weaknesses of the national grids, which require strengthening (and hence investment) before trading is possible.
(v) Lack of infrastructure, such as power transmission interconnections, regional/interregional co-ordination centers or control centers. Energy strategies that rely on self-sufficiency.
(vi) Difficulty in obtaining project financing for cross–border transmission interconnections, and the difficulty (and complexity) of raising government guarantees for cross-border deals.
(vii) Lack of a (commercial/legal/regulatory) framework for transactions to take place.
(viii) Lack of agreement on the tariff system to remunerate the use of transmission infrastructure.
(ix) Lack of institutions to give regional trading political legitimacy and to play the coordinating and energy trade enhancement role. In some cases exactly the opposite happens and there exist several institutions with conflicting interests and overlapping mandates that require reconciliation and coordination.
(x) Lack or non coordinated legal framework for energy trade.
(xi) Lack of general harmonization of technical codes, specifications and standards.
(xii) Lack of trading mechanisms in the energy sector, which is much more complex than trading of other goods or commodities.
(xiii) Lack or scarcity of qualified human resources to manage technical / commercial /regulatory aspects of cross border trading.

2.9 Existing power trade between NBI countries

According to the Scoping Study for "Opportunities for Power Trade in the Nile Basin" carried out by Norconsult and Statnett in 2004, there are only two areas in the Nile

Basin where power trade is currently undertaken. The first of these comprises Democratic Republic of Congo-East, Burundi, and Rwanda. The second area includes Uganda and Kenya. Uganda also supplies small isolated canters in Rwanda and Tanzania. There is also a scope for Tanzania to be interconnected to Kenya in view of transmission distances, hydropower complementarily, and power markets.

2.10 Planned power pools

The Norconsult/Statnett Scoping study states that studies for the interconnection of the grid in Tanzania and the Democratic Republic of Congo-East–Burundi–Rwanda grid have been undertaken in connection with the possible development of the Rusumo Falls hydropower plant. According to this study, such an interconnection is technically feasible. It is also possible that other isolated centers in the north-western part of Tanzania could be served, either from the Democratic Republic of Congo-East/Burundi/Rwanda grid or from Uganda. Consequently the grid in Tanzania could be interconnected with grids in Kenya/Uganda and with the Democratic Republic of Congo-East/Burundi/Rwanda grid. If these views materialize, power trade could be undertaken in this whole area—which are referred to as the Nile Equatorial Lakes (NELSAP) region – as discussed above - and include Burundi, Democratic Republic of Congo/East, Kenya, Rwanda, Tanzania, and Uganda.

As already discussed above, the remaining countries—Ethiopia, Eritrea, Sudan, and Egypt—are called the Eastern Nile region (ENSAP). The power grids in these countries are all isolated, except that of Egypt, which recently have established interconnections with other Mediterranean countries. A proper assessment with regard to the unit cost of generation for the Ethiopian hydropower projects is of vital importance for the evaluation of the economic viability of power system interconnections and trade in the Eastern Nile region. These studies are now underway or completed. In view of transmission distances and power markets, the power grids in Ethiopia and Sudan could be interconnected and thereby enable power trade between the two countries.

The calculation of unit cost of generation for the Ethiopian candidate hydropower project does not include benefits arising from multipurpose water use further downstream in Sudan and Egypt. This is also important for the assessment of power trade benefits in the Eastern Nile region. The power market in Eritrea is small and the study related to power export based on indigenous gas reserves is important to assess its position.

Another possibility for power exchange and trade is the interconnection of the grids in Ethiopia and Egypt. This will most likely evolve gradually by first interconnecting Sudan either to Egypt or to Ethiopia. Interconnection of Ethiopia and Egypt could also be done directly. In any case, this is more of a medium-term development and has to be evaluated in a broader perspective, also including multipurpose water use.

A long-term scenario that has been discussed from time to time is a power transmission line from Inga Falls, in Democratic Republic of Congo, to Egypt and Europe.

An important finding of this study is that all of the development plans analyzed here assume power exchange between the countries at current levels. Consequently, balances between demand and supply, including reserve margins, are envisaged to be covered by national generating facilities. This shows that the region’s countries plan future development of the power subsector in the traditional way, without any major new interconnections, including increased exchange and trade of power.

Another important characteristic observed in the plans is that there is either balance or deficit in generating capacity and/or energy generation in almost all of the power systems. The future generation expansion plans normally envisage reasonable reserve margins and some surplus at points in time when comparatively large power plants are commissioned.

Four countries—Uganda, Tanzania, Sudan, and Ethiopia—have considerable national hydropower resources which are well above the domestic needs of these countries in their present long-term subsector planning periods. If some of the planned projects are advanced or other projects are introduced, there could be scope for net export to neighboring countries with resulting reduction in thermal generation, which has environmental consequences. Another interesting finding is that there is hydrological complementarities between different parts of the Nile Basin, which is advantageous for the operation of hydropower generation facilities in neighboring power systems.

Transmission distances in the Nile Equatorial Lakes in general, and also between Ethiopia and Sudan are acceptable for the transfer of reasonable amounts of power. Transmission facilities between the power systems are, however, not sufficiently developed and this presents a severe constraint to increased trade of power.

In light of all this, basin wide trade is unlikely to emerge in the near future. However, in the Nile Equatorial Lakes some limited power trade is currently undertaken and could further develop significantly in the short term. In the Eastern Nile, however, power trade potential exists, but this potential needs to be evaluated in the context of a broader multipurpose approach to water resources development and management.

2.11 Institutional Constraints and Possibilities

The institutional framework for power trade in the NBI is formed by the institutions involved in one way or another in power trade, the relationship among these institutions, the rules, regulations and agreements that are needed to establish and manage power trade in the region. Among all these rules, regulations and agreements, the most important is the **"Treaty"** which represents the initiative's "kick off", provides legitimacy to all further developments required as well as provide the capacity to enforce decisions.

An detailed overview of the institutional framework in the NBI countries is described in the report regarding "Institutional, regulatory and cooperative framework model for the Nile Basin power trade", prepared by Mercados in association with Nord Pool Consulting and CEEST.

The Treaty

The Treaty is embedded in a document that sets out the nature the Power Trade in the NBI region, giving to it the proper political and institutional status, and specifically establishes the principles for power trade in the region, creates the key institutions, establishes their roles and relationship with other institutions: regional institutions, domestic institutions and already existing institutions or programs within the NBI.

Regional NBI Power Trade is considered as yet another initiative within the NBI; therefore, it needs the approval of the highest authority of the NBI, the Council of

Ministers of NBI. The NBICOM should give clearance to this initiative, so Ministers in charge of electricity issues of the member countries sign the Treaty. This way, the procedure complies with the formal requirements of the NBI. The highest authority in power trade matters will be the Council of Ministers of in charge of electricity (Power Trade Council of Ministers), which will coordinate with the COM when needed (in all matters that involve water issues).

2.12 Identification of actors in then regional power trade

Power trade actors are all institutions, companies, organisations that have a role in power trade as participating in a commercial transaction, or as being part of the ruling institutions. These actors can be distinguished as domestic and regional. In the following point we will elaborate upon who these actors are in power trade for each stage in the implementation of power trade in the region.

Stage 1 – Preparatory stage

Stage I is a preparatory stage where trading continues "as is" and the initial studies and agreements are reached so that the NBI Power Trade regime in the region can begin. The different actors are:

- Ministers in charge of electricity
- Transmission System Operators (TSO)
- Regulatory Authority

- NBI Council of Ministers
- NILESEC
- NBI Power Trade Council of Ministers
- NBI Power Trade Secretariat
- NELSAP
- ENSAP
- EAPP
- Working Groups

Stage 2 – Intermediate stage

Stage II consists basically of bilateral trading between contiguous countries. The different actors of this stage are:

- Ministers of Energy
- Transmission System Operators (TSO)
- Domestic Agents
- Regulatory Authority
- NBI Power Trade Council of Ministers
- Steering Committee
- NBI Power Trade Secretariat
- NELSAP
- ENSAP
- EAPP

Stage 3 – Final stage

Stage III consists in trading between countries not necessarily contiguous and agents authorised in national systems are also allowed to participate in regional trading. The different actors of this stage are:

- Ministers of Energy
- Transmission System Operators (TSO)
- Domestic Agents
- Regulatory Authority

- NBI Power Trade Council of Ministers
- Steering Committee
- NBI Power Trade Secretariat
- NELSAP
- ENSAP
- EAPP
- Regional Regulator
- Regional System/Market Operator (RSO)
- Regional Courts of Justice
- International Courts

The articulation of institutions in the NBI power trade is visualized as follows in the "Mercado – report":

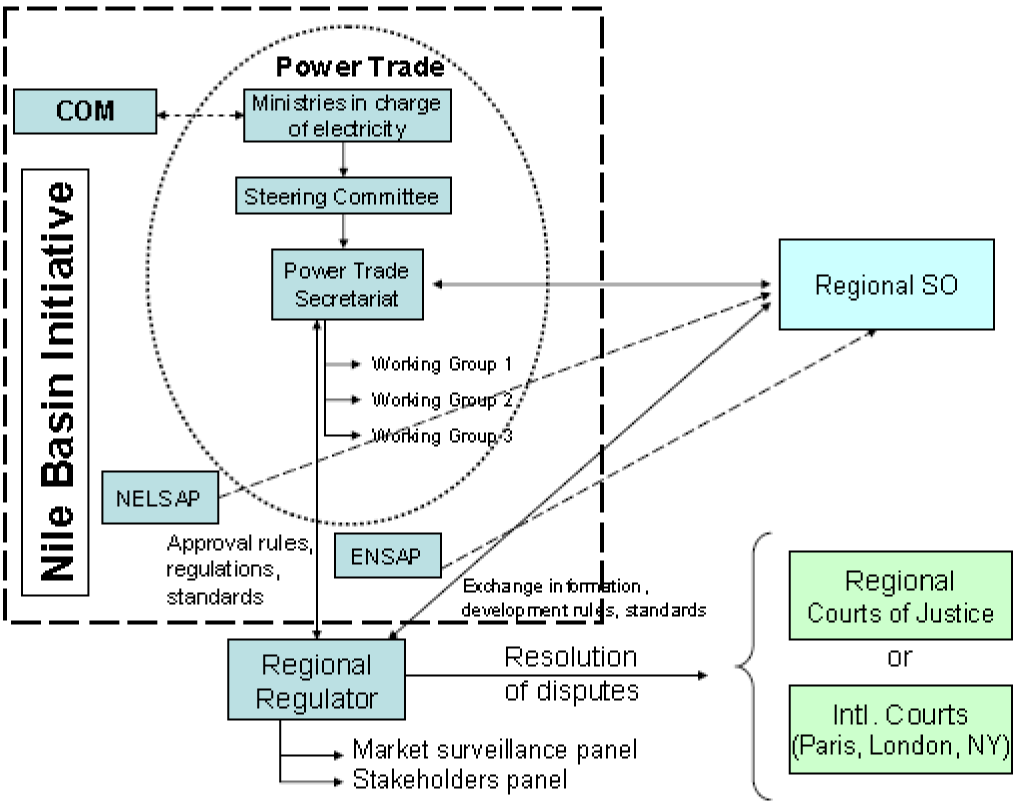

Figure 2.8 Articulation of institutions in the NBI Power trade (Source: Mercados, Nord Pool and CEEST 2007)

3. POTENTIAL FOR DEVELOPMENT OF MULTIPURPOSE PROJECTS IN THE NBI AREA

Development of key multipurpose projects can be of importance for the planned regional grid, by delivering power besides its other multiple uses to the expanding power pool. Below are a short description of the potential multipurpose projects in the area and an identification of the most promising regimes.

3.1 Potential multipurpose projects in the NBI area

Potential hydropower projects in the NBI countries have been identified in the Preliminary Basin Wide Study. In addition, The East African Power Master Plan Study gives a comprehensive overview of the power sector for the NELSAP area.

Based on the projects listed in the Preliminary Basin Wide Study, the most relevant planned multipurpose projects in the Nile Basin were selected and listed in table 4.1.

Five of these projects were then selected for further studies.

3.2 Identification of projects for case study

Two criteria have been used for selection of projects for further investigation and review. These criteria were
(a) the transboundary nature and
(b) the degree of being a multipurpose endeavor.

The five projects listed below have been selected (outlined in bold in the table). These projects provide a representative sample of the potential projects which are currently under construction or being planned.

In the ENSAP area:

- Karadobi (Ethiopia)
- Mandaya (Ethiopia)

In the NELSAP area:

- Kakono (Tanzania)
- Rusumu Falls (Rwanda, Tanzania, Burundi)

Table 3.1 Most relevant planned multipurpose projects

Project name	Owner	Country	Purpose	Installed Capacity MW	Relevance for the study
Nile Equatorial Region					
Bujagali		*Uganda*	*Hydropower mainly*	*200 + 50 MW*	*Impacts on recreation and whitewater rafting, cascade effects with Owen Falls*
Kakono		*Tanzania*	*Multipurpose (HP, Water Supply and Irrigation)*	*53 MW*	*Multipurpose and cascade with Rusumo*
Masigira		*Tanzania*	*Hydropower mainly*	*118 MW*	*Environmental flow very important. Lake Nyasa.*
Rusumo Falls		*Tanzania, Rwanda, Burundi*	*Multipurpose*	*61,5 MW*	*Will benefit 3 countries (Tanzania, Rwanda, Burundi), storage during dry periods, irrigation, environmentally sensitive*
Mutonga		*Kenya*	*Hydropower mainly*	*60 MW*	*Sedimentation problems. Catchment management important*
Songwe		*Tanzania, Malawi*	*Multipurpose cascade*	*Total 330 MW*	*River basin development with 3 reservoirs. Flood protection and storage. Transboundary in nature, but not part of Nile.*

Project name	**Owner**	**Country**	**Purpose**	**Installed Capacity MW**	**Relevance for the study**
Stieglers Gorge		*Tanzania*	*Multipurpose but main focus hydropower*	*2100 MW*	*Size, environmental controversy, flood protection, irrigation*
Egypt					
Assiut, Damietta and Zefta projects		*Egypt*	*Hydropower + irrigation*	*40 MW, 13 MW and 5,5 MW respectively*	*Multipurpose. Cascade development with Aswan high and old dams*
Ethiopia					
Halele Worabesa		*Ethiopia*	*Main focus on hydropower. Flood protection*	*Stage 1:96 MW* *Stage 2: 326 MW* *Total: 422 MW*	*Multipurpose. Development of two cascade projects*
Chemoga Yeda		*Ethiopia*	*Hydropower*	*Stage 1: 162 MW* *Stage 2: 118 MW* *Total: 280 MW*	*Development of 5 dams. Impact on environment and flows. Resettlement (Not very attractive to this discussion?)*
Baro 1, 2 and Genji		*Ethiopia*	*Multipurpose but focus on Hydropower*	*200, 500 and 200 MWs respectively*	*Basin development, big size and environmentally sensitive. Close to Sudan hence may have benefit of silt minimization*
Karadobi		*Ethiopia*	*Multipurpose*	*1600 MW*	*Includes flood control, irrigation, and navigation potential on the Nile in Ethiopia, Sudan and Egypt*

Project name	**Owner**	**Country**	**Purpose**	**Installed Capacity MW**	**Relevance for the study**
Mandaya		*Ethiopia*	*Multipurpose*	*2000 MW*	*The Mandaya project offers high potential for multi-purpose benefits through integrated planning taking account of potential for flood alleviation and regulation of flows for downstream areas and users. Thus it is transboundary in nature.*
Beko Abo		*Ethiopia*	*Multipurpose*	*2100 MW*	*Multipurpose. Irrigation of land and water for domestic use*
Geba 1 and 2		*Ethiopia*	*Multipurpose*	*215 and 157 MWs respectively*	*Multipurpose – Hydropower and Irrigation. Close to Sudan hence may have benefit of silt minimization*
Awash IV		*Ethiopia*	*Multipurpose*	*38 MW*	*Multipurpose. Irrigation of land and water for domestic use*
Border		*Ethiopia*	*Multipurpose*	*1200 MW*	*Located at the border to Sudan*
Sudan					
Sabaloka		*Sudan*	*Multipurpose*	*90 MW*	*Close to confluence of white and blue Nile. Problems with flooding due to reservoir construction*
Shereiq		*Sudan*	*Multipurpose*	*315 MW*	
Dagash		*Sudan*	*Multipurpose*	*285 MW*	

Project name	Owner	Country	Purpose	Installed Capacity MW	Relevance for the study
Rumela		*Sudan*	*Multipurpose*	*30 MW*	*Prime function is irrigation with the possibility to include 3x10 MW Francis Units*
DRC					
None multipurpose project/issues identified as yet, needs more in depth study					

3.3 Karadobi Multipurpose Project, Ethiopia

The Karadobi Study is mainly based on information from the pre-feasibility study carried out by Norconsult/Norplan/Lahmayer in 2006, supplemented from information obtained from NBI RPTP and Ethiopian Electric Power Corporation databases and the Preliminary Basin–Wide Study (2008).

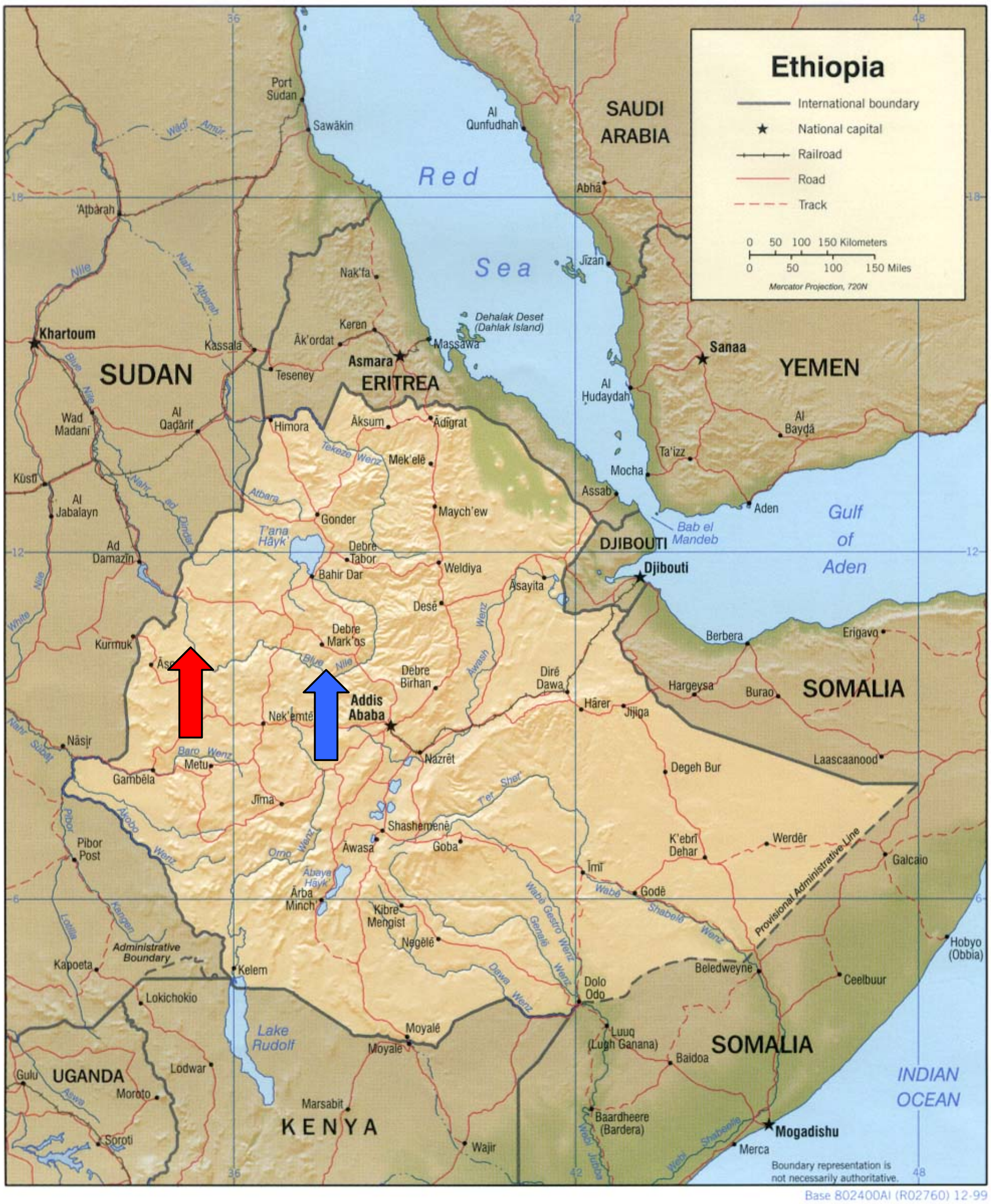

Figure 3.1 Map of Ethiopia showing approx location of Karadobi (Blue arrow) and Mandaya (Red arrow)

Source: www.lib.utexas.edu/maos

Karadobi Multipurpose Project is located in the Abay River, north west of Addis-Ababa, 55 km south of Debre Markos and downstream of the confluence of Abay and Guder rivers.

Project description

The Karadobi MPP constitutes the following salient features:

<u>Technical data</u>

Type of Dam	RCC
Height	250 m
Crest length	684 m
Catchment area	66,910 km^2
Mean natural inflow	649 m^3/sec (20.5 km^3)
Full Supply Level	1146 masl
Mean Operating Level (MOL)	1100 masl
Total Storage	40.2 km^3
Live Storage Maximum	17.3 km^3
Surface Area	460 km^2
Rated head (max)	214 m
Rated total flow	800 m^3/sec
Installed Capacity	8 x 200 MW
Total Generation Capacity	1600 MW
Firm energy	9.3 TWh/year
Average energy	9.7 TWh/year
Additional Average energy	2.6 TWh/year
Plant factor	66%

Figure 3.2 The Blue Nile near Karadobi dam site

Source: SWECO Archive – Lars Ødegaard

Usage

- Hydro power production
- Irrigation
- Flood control

Cost of Project and Financing Arrangements

Project costs $ 2,231 M
(including Transmission lines inside Ethiopia $ 314 M)
Generation cost $ 52 /MWh

Project financing is not yet determined, but is expected to be financed by external financiers.

Implementation

Construction period 7.5 years
Filling time > 4 years

Benefits and Impacts

Benefits

Hydropower and Irrigation
The Karadobi project will result in a significant increase of firm regulated flow of more than 300 m^3/s additionally in the dry period November/December-June. There is no downstream irrigation potential within Ethiopia. The additional regulated flow creates a large potential for irrigation as well as additional energy supplied within Sudan. The detailed plans for irrigation in Sudan are not known or studied as yet. Typically only some 20% of water abstracted for irrigation returns to the river and it may be discussed if irrigation and/or combined hydropower/irrigation use of water is more economic than hydropower alone. From the power master plan in Sudan it is demonstrated that additional power of 480 MW and firm energy of 2606 GWh can be produced without any need of additional investments. Assuming cost sharing of the dam investment cost at Karadobi, the financial rate of return for the downstream plants on investing in a share of the cost of Karadobi dam is calculated to be more than 40%.

Transmission
Both Egypt and Sudan can benefit from transmission of the apparently cheap reliable power from the Karadobi project. The proposed transmission line Roseires - Aswan dam can accommodate all additional power produced along the Main Nile in Sudan and may also accelerate the development of the proposed dams, since there seems to be a potential market in Egypt exceeding the capacity of Karadobi.

Flood Control
Flood control can be provided both in volume and peak. Floods with return periods exceeding one in 100 years can be controlled at Karadobi. Since details of the flood levels and affected areas have not been available in this study, no economic benefits have been calculated, but they are anticipated to be significant. The 1998 flood reported to have caused damages in the range of 450 MUSD in Sudan could have been greatly reduced, which demonstrates the potential.

Sedimentation
The Karadobi reservoir will trap sediments with a trap efficiency of 85% and effectively reduce sediment inflow to downstream reservoirs with 60-100 million tons annually. The trapping of sediments may also have a positive impact on operation of downstream water treatment plants along the Nile in the form of reduced sedimentation tank area and

reduced use of chemicals. The economic value of the sediment reduction is probably significant, but will require further studies to present firm values.

Anticipated Impacts

Evaporation
The Karadobi project alone will result in an evaporation loss of 0.3 Bm^3 per year in the Nile system. If the equivalent reservoir storage volume of 17 Bm^3 is transferred from Aswan to Karadobi by operating Lake Nasser at correspondingly lower levels, a net reduction of evaporation loss in the Nile flow below Lake Nasser of 1.5-2.5 Bm^3 per year can be achieved. The Karadobi capability for flood control will reduce downstream flooded areas and thereby also reduce evaporation losses during flood inundation periods. This can also prove to be valuable as part of the water conservation program. One such proposed water conservation measure is the proposed construction of the Jonglei canal along the White Nile in Sudan. The Jonglei canal will increase flood levels downstream and this can be mitigated by the Karadobi reservoir.

With an unchanged regulation regime of reservoirs downstream of Karadobi and particularly at Lake Nasser, creation of the Karadobi reservoir will imply increased evaporation in the Nile Basin. Increase of evaporation can only be avoided by permanently changing the regulation regime at Lake Nasser so that its average operating surface area can be reduced. The Pre-feasibility Study did not evaluate whether such changes are likely to be implemented in practice.

Socio-economy

The reduced risk for flooding is assumed to generally be a positive impact for those who live in flood prone zones. The extent of recessional agriculture along both the Blue and Main Nile in Sudan has not been confirmed and the impact of such flood control on the recessional agriculture will need to be studied carefully in the next stage of the study. The feasibility of compensating floods will be examined.

- There will be a potentially very serious loss of resources and income generating opportunities for some of the estimated 4,700 households in the DIZ. An estimated 3,511 ha of cultivated land and 28,629 ha of grazing land will be lost.
- There will be a likely negative impact on a proportion of the 18,000 ha used for recession agriculture in the SIZ in Sudan.

Ecology

- A total of 45,500 ha of land will be inundated in the direct impact zone (DIZ) including between 820-900 ha of vegetated wetland, 216 ha of riverine woodland, 6,066 ha of undisturbed woodland and 23,116 ha of partially disturbed dryland woodland.
- On the aquatic ecology side, the Karadobi dam will constitute a complete barrier to fish migration both upstream and downstream. However, from what is known of the fish fauna in the Abay at this time, this impact is not considered serious.

CO_2 -emission savings
The Karadobi project will provide carbon emission savings compared to equivalent thermal generation

Compliance, Mitigation Measures, Public Participation and compliance with today's standards

The initial environmental assessment (IEA) report has been prepared for the purpose of commenting on the likely environmental, socioeconomic and cultural impacts arising from the development of a dam and reservoir on the Abay River (the Karadobi hydropower project) at pre-feasibility level. The IEA divides the study area into:

- Direct impact zone (DIZ) including the reservoir area, works area and access routes
- Secondary impact zone (SIZ) along the Abay/Blue Nile from the Karadobi tailrace outlet to Khartoum in Sudan
- Tertiary impact zone (TIZ) along the main Nile from Khartoum to Lake Nasser.

In order to mitigate/compensate for the negative aspects surrounding project implementation a comprehensive management programme would need to be introduced. This would have to include:

- An environmental flow requirement (EFR) to safeguard ecology, economy and livelihoods downstream
- A livelihood safeguard program for the DIZ, where approximately 28,600 persons will be affected. The program may have to involve resettlement of a portion of the people who cannot maintain income or sufficient means of production in situ.
- A comprehensive environmental management plan (EMP) to govern the development.

Provisional environment costs for the mitigation/compensation are estimated to be a capital amount of USD 46.5 million and an annual recurrent construction phase amount of USD 2.2 million. This gives an estimated total for the construction phase of USD 55.1 million.

3.4 Mandaya Multipurpose Project, Ethiopia

The Mandaya Study is based on information obtained from NBI RPTP and Ethiopian Electric Power Corporation databases.

The Mandaya project site is located on the Blue Nile (Abbay River) some 20 km downstream of its confluence with the Didessa River. The catchment area for the Mandaya project comprises some 128,729 km2 of the Blue Nile river basin. The headwaters of the Blue Nile are in the mountains surrounding Lake Tana. The Didessa river is one of the largest tributaries of the Blue Nile and drains an area to the west of Addis Ababa.

Much of the upper part of the basin comprises the highland plateau with elevation generally exceeding 2000 m. The plateau exhibits extensive level areas with intensive agriculture divided by incised valleys. The Blue Nile flows generally within a deeply incised gorge which has a relatively gentle gradient falling some 530 m over some 600 km from an elevation of El.1030 m at Kessie bridge to El. 500 m at the Sudan Border.

Project description
An initial review of the Mandaya project concluded with a development of a dam 0f 200 m in height, with a full supply level of up to El. 800 m. A reconnaissance overflight revealed that the potential reservoir area appeared to be largely unpopulated. No roads, tracks or settlements were observed in the reservoir area. In general, the reservoir area was found to be covered with undisturbed open woodland.

Figure 3.3 Mandaya dam site

Source: EN Power Trade Study

<u>Technical data</u>

Type of Dam	RCC
Height	200 m
Spillway Gates Discharge	12 gates, 16 m wide and 18 m high
Capacity of Spillway	30,000 m^3/s
Installed capacity:	2,000 MW
Firm energy:	11.2 TWh
Average energy:	12.1 TWh

The pre-feasibility study concludes that A development at Mandaya with a full supply level of El. 800m would capture some 94.4% of flow for energy generation with only 5.6% of flow lost to spillage. Firm energy generation would amount to 92% of total generation as a result of the improved flow regulation with live storage of 154% of MAF. This development is clearly far superior to the lower level option proposed by USBR in terms of energy generation and provision of regulated flow downstream in Sudan. The pre-feasibility study recommends a full supply level of Mandaya reservoir of El. 800 m for future development.

<u>Usage</u>

- Hydro power production
- Irrigation
- Flood control

Cost of Project and Financing Arrangements

Total cost of project is estimated to 2,400 MUSD (pre-feasibility study) inclusive 22 MUSD for environmental mitigation measures.

The Mandaya hydropower project has been selected as part of the least cost development plan within the generation planning analysis for commissioning in approximately 2020 in advance of the Karadobi and Border projects.

The regional power trade development, including the interconnector linking Ethiopia to Sudan and Egypt, has been found to be economically attractive based on fuel cost savings in Sudan and Egypt in a loose pool arrangement with net benefits (10% discount rate) of up to USD 2,590 million as shown in Table E.12, below.

Project financing is not yet determined, but is expected to be financed by external financiers.

Implementation

Preparation	4	years
Construction period	6	years

Benefits and Impacts

Benefits

Hydropower

The prime benefit for the project is production of hydro power, which is calculated in the Pre-feasibility study to be 12.1 TWh average energy output per year for the main alternative.

In addition it is estimated that when Mandaya is in operation, it will give an uplift on the energy production on the Roseires and Merowe MPPs in Sudan. the total uplift in energy production from present, will be between 1,255 GWh and 2,211 GWh, depending on flushing operation at Roseires.

Flood control

Operation of the Mandaya project will alleviate flooding in Sudan as a result of the substantial degree of flow regulation. Under a typical flood year water levels in Khartoum would be reduced by some 1.5 to 2 meters.

CO_2 -emission savings

The pre-feasibility study estimates that the Mandaya project will provide carbon emission savings of some 424 million tonnes of CO_2 compared to equivalent thermal generation based on a 50/50 gas-fired CCGT / coal fired thermal generation mix.

Anticipated Impacts

Impacts on generation on High Aswan in Egypt

The filling of the Mandaya reservoir will result in a reduction of water level in Lake Nasser / Nubia and consequently reduce the generating head at High Aswan power station. A reduction in water level at High Aswan by some 12 meters would be expected in the early years as Mandaya reservoir fills. Average reduction in energy generation at High Aswan over the 50-year simulation period due to the reservoir filling and operation of the Mandaya project has been calculated as 202 GWh/year, although the reduction in generation will be greater in the early years.

Evaporation
A similar positive impact on evaporation as described under the Karadobi case, will also apply for Mandaya. As Karadobi and Mandaya will be in cascade, the positive effect will occur when the first of the two projects are implemented,.

Impacts on natural and social environment
The Mandaya project will inundate an area of some 574 km^2 consisting mainly of open woodland. The reservoir area is sparsely populated and the displaced population has been estimated at approximately 600 people.

As for Karadobi, there will be a likely negative impact on a proportion of the 18,000 ha used for recession agriculture in the SIZ in Sudan.

3.5 The Rusumu Falls and Kakono Multipurpose Projects, Kagera Basin

The Rusumu Falls Hydropower and Multipurpose project is located in Kagera river on the border of Rwanda and Tanzania, and the main road connecting the two countries passes over the project site. It is a joint development between Burundi, Rwanda and Tanzania within the overall Kagera Basin Integrated Development Framework, which is part of the NBI and its Nile Equatorial Lakes Subsidiary Action Program, NELSAP.

The Kakono project is situated further downstream the Kagera river in Tanzania near the Ugandan border approximately 90 km to the west of Bukoba and Lake Victoria.
Both projects are best evaluated power development options in the SSEA for the Nile Equatorial Lakes Region (conducted by SNC Lavalin 2007), and Rusumo will potentially increase benefits for the downstream Kakono project, thus they are analyzed here together as a basin development option and a combined multipurpose operation regime.

Project description

The Rusumu Falls and Kakono Projects constitutes the following salient features (elaborated extensively from Lavalin 2008):

<u>Technical data</u>

The ***<u>Rusumu Falls</u>*** would comprise a conventional gravity dam in the main river channel with a full supply level of 1325 m, approximately 5 metres above normal river levels. The raised river levels from the forebay would result in some flooding upstream in the Ruvuvu River, and would marginally affect levels in Lake Rweru, approximately 70 km upstream on the Nyabarongo River. The dam would be 12 metres high, and include spillway gates. Power facilities would include intake above the dam, a 460 m power tunnel and a three unit powerhouse with an installed capacity of 61.5 MW under a head of 35 m.

The ***<u>Kakono project</u>*** would comprise a 35 m high concrete gravity dam and spillway and earthfill dam, with a full supply level of 1182 m. The dam would create a small reservoir with live storage equal to 30 hours of plant output. Power facilities would include intake in the dam, and a two unit powerhouse at the toe of the dam with an installed capacity of 53 MW under a head of 26 m. Reservoir would extend 40 km, however be about 15 km^2 in area. Firm energy and flows would be increased if Rusumo dam is constructed. Potential multipurpose downstream benefits from increased dry weather flows at Kyaka irrigation project have been included in the evaluation.

<u>Usage</u>

Rusumu Falls

- Prime usage of Rusumu Falls is to produce hydroelectric power for the new backbone regional grid. A nominal 10 km of 110 kV has also been included in the project.

- Rusumu Falls will increase downstream flows in dry periods and will thus have a useage as a storage reservoir to mitigate droughts.
- Rusumu Falls will potentially improve the viability of the Kakono hydro project and the Kyaka irrigation project.

Kakono

- The Kakono project was primarily identified for power production and power is planned to be delivered to the new regional backbone grid at Rusumu Falls over a 150 km 110 kV line.
- The Kakono is also planned for delivering water supply to downstream irrigation with a potential of 70 000 ha.
- The Kakano will also, as Rusumu Falls, increase downstream dryweather flow and can thus also be a storage reservoir for drought periods.

Cost of Project and Financing Arrangements

Total project cost of *Rusumu Falls*, including an environmental mitigation allowance (slightly above 5 million USD), is estimated to 130 million USD, with a cost of firm energy (usc/kWh) at 4.73.

Total project cost of Kakono is 100 million USD, including an environmental mitigation allowance of 4 million USD. Cost of firm energy is 8.76 usc/kWh.

Both projects are proposed as best development options in the SSEA (2005 a,b and 2007) with a staged development starting with Rusumu Falls as soon as possible and Kakono between 2014-2018.

At least for the Rusumu Falls it is anticipated to blend private and public financing that would be financially viable and provide operational sustainability to the project (WB 2006)

Benefits and Impacts

Benefits

Hydropower
Rusumu Falls is strategically placed in the region to strengthen electrically the backbone transmission system required for the benefits of regional power planning for the riparian states as well as to meet the new loads from the mines in the Kagera district that are being implemented. With the connection of *Kakono* to this grid by the 150 km line even longer term demands are covered.

Irrigated agriculture
Rusumu Falls and Kakono will jointly improve the viability of the downstream Kyaka irrigation project. Development of irrigated agriculture together with energy (Kakono, Rusumu Falls and others) is one of the main goals of The Kagera River Basin Organization. Thus multipurpose use of these two dams is embedded within this institutional framework. For Kakono, actually, generation cost assuemes that 50% of the dam cost is allocated to downstream irrigation project at Kyaka.

Reservoir and drought storage
Both reservoirs will facilitate increased flows during dry periods facilitating water supply and irrigation water. As such their seasonal operation to mitigate the effect of dry periods and droughts should be integrated.

Other benefits

At least the Rusumu Falls project will provide support to targeted local communities and businesses, e.g. small scale investment in both public and private domains, micro finance schemes and social development funds, creating incentives that makes the local community stakeholders and advocates of the project, fully benefiting from economic opportunities

At the regional level, the project will increase access to affordable electricity which would contribute to an increase in economic activity and private sector development, as well as investment in social infrastructure and services (WB 2006).

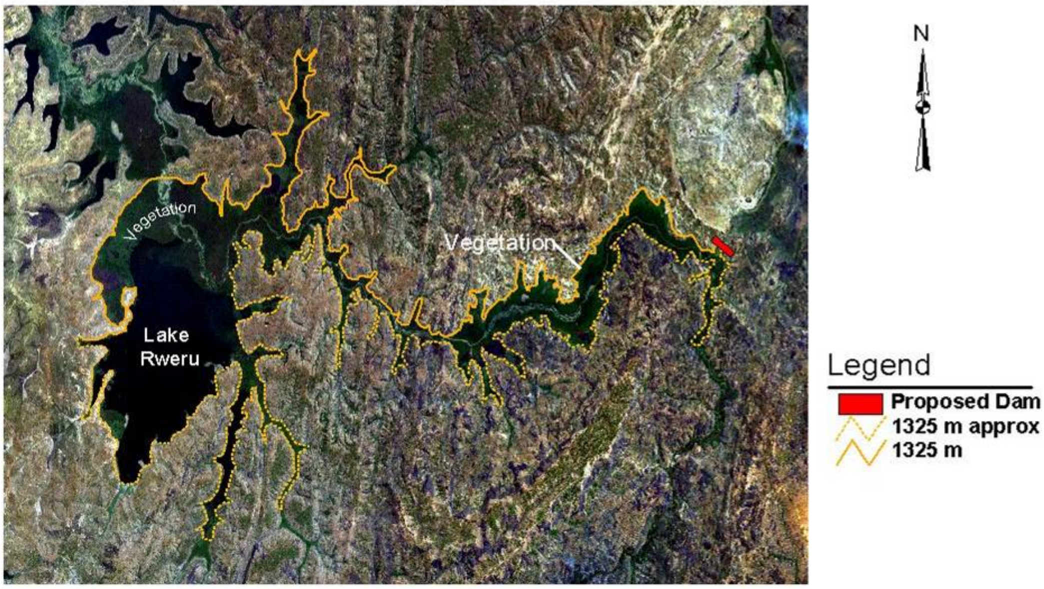

Figure 3.4 Upstream flooding from the Rusumu Falls reservoir.

Source: SSEA (2008)

<u>Anticipated Impacts</u>

Rusumu Falls

- There is a possible upstream flooding in the Ruvuvu and Nyabarongo Rivers and in Lake Rweru which should be confirmed by impacts assessment (see satellite photo of estimated reservoir limits in figure 5.1). Upstream flooding from the dam is estimated as in the order of 400 km^2 , that includes 125 km^2 of existing lake and 250 km^2 of existing wetlands and 15 km^2 of valley slopes.
- If the reservoir is used for seasonal storage, the operation of Rusumu may influence level of Lake Victoria.
- There will be a reduction in downstream flood flows and levels that could affect wetlands, including in the Akagera National Park. Reduction of wetlands can also potentially affect migratory birds.
- A Run-of-River option would reduce the extent of reservoir area. Whichever design option is selected the sedimentation issue needs to be taken into account.
- Approximately 3000 persons upstream of the dam may be affected and some displaced.
- There will be a possible increase in water areas upstream that could increase health risks due to bilharzia and malaria.

Kakono

- The planned reservoir area of 1500 ha will flood part of the Minziro Forest Reserve.

- Peak operation of the power plant could provide daily peaking, with consequent downstream flow and level variations over 75% of the year, with impacts on aquatic and riparian fauna, as well as livelihoods along the river.
- Depending on reservoir solution and peak operation there is a possibility for significant ressetlement

Mitigation Measures, Public Participation and compliance with today's standards
For both projects neither an EIA nor a resettlement plan has been elaborated, thus to comply with today's standards this has to be elaborated following World Bank operational rules (this should include that for the transmission line extension and upgrading also). If both projects are planned for and implemented cumulative effects of the developments should also be assessed.

For both project design can be re-evaluated so as to minimize reservoir impacts on natural habitats. Furthermore operation rules can be determined so as to alter riverine habitats at a minimum, especially in protected areas. Also, a mitigation plan to prevent increase of malaria and bilharzia should be developed.
To comply with today's standards full participation and transparency is required related to stakeholder involvement.

According to WB (2006) most of the above is planned for within the environmental management programs of the Rusumu falls project, however it will additionally include watershed management and restoration, amongst others for decreasing rate of erosion and siltation of the reservoirs, and also programs for HIV/AIDS prevention and as reported in the project benefits, programs for enhancing local economic activities.

If proper mitigation measures and plans are implemented related to the above, with public participation as a core, the process for both Kakono and Rusumu Falls will comply with today's standards.

4. STAGED DEVELOPMENT OF HYDROPOWER MULTIPURPOSE PROJECTS COORDINATION REGIMES IN THE CONTEXT OF A REGIONAL POWER MARKET

4.1 Main considerations for multipurpose projects

In terms of financing, most multipurpose dams are still being funded by the public sector, at least in the developing world, through the ILAs on a long-term concessional basis. Although such schemes will not be immune to the wider pressures towards privatization of infrastructure development, multipurpose projects are difficult to fund privately because they share many of the problems of hydropower (section 3.1) and, in addition, have the following factors to take into account:

i) Potential water management conflicts.

ii) They are usually reservoir projects.

iii) Multiple beneficiaries result in a complicated and potentially vulnerable contract structure.

iv) Lack of financial viability.

From the host government's viewpoint the regulatory issues are more severe than for hydro alone, because a multipurpose project can exercise control over a large area of the river basin in terms of determining downstream flow patterns and water availability. The situation is complicated because of the necessity to protect not only the position of existing projects but also the rights of future projects yet to be developed.

Thus water rights issues are almost always sensitive and loom particularly large because no government can afford to commit itself for a long period to methods of reservoir operation which it may subsequently wish to change. Yet, to the private sector, the limits with which it is free to operate the reservoir and use water will be crucial to the income of the project and the profitability of the investment.

Against this background it is not surprising that there have been very few privately financed multipurpose schemes. One of the few exceptions is the Cascecnan Transfer Project in the Philippines which has been described in the Best Practice Compendium.

4.2 General problems related to the power sector in the Nile Basin countries

Regulatory framework

Legal structure is of crucial importance. The power sector reform towards liberalization is the main issue of the region. Countries do not have harmonized legal frameworks. This situation causes problems regarding trans-boundary projects. Deficiencies in the legal framework can be a constraint in attracting the investment. DRC is an example case in this sense. With the highest hydropower potential in the region (close to 450,000 GWh/year[6]), underutilization of this resource is very much associated with the fact that there has not been any government policy or documents towards power sector reform. Naturally, the private sector would prefer to launch projects in countries which have completed the reform process. This creates a negative process which results in a concentration of new hydropower projects in those countries already benefiting from them, instead of attracting investment to the underutilized areas. Therefore, harmonization of legal framework is a top priority both for elimination of conflicts between trading countries and efficiency in investment.

[6] The second largest potential is in Ethiopia, around 130,000 GWh/year.

Unbundling of power utility

Unbundling is one of the requirements of full power sector reform. The monolithic public utility goes through “unbundling” in order to separate the undertakers of generation, transmission and distribution processes (Per Ljung, 2000, page 5). Therefore, when the sector reform is completed, the public utility is not only privatized but also unbundled. Unbundling prevents creation of private monopolies as it allows for competition between different producers and distributors. This competition increases quality of service and also benefits the end user via price competition. Unbundling is crucial as it enables involvement of different parties and promotes cost-sharing among them. Therefore, for example, the generation company no longer carries the cost of investment in transmission lines and distribution. These services are undertaken by different companies which are efficient in each field. This increases efficiency in usage of generated electricity as there is an opportunity for more investment in transmission lines and cheaper distribution after unbundling.

Generally, distribution is the first item to be privatized and opened to competition. Later, generation is transferred to the public corporations. In most cases, transmission is the last item to go through privatization as breaking up the transmission network is not efficient, so it remains as one corporate, either public or private.

This process is especially noteworthy for African countries where underinvestment in physical transmission lines results in serious problems with electrification of countries, whether or not they have power generation units. Hence, hydropower plant construction could only be an initial step towards power-trading in the region which should be followed by construction of national and regional transmission lines. The below chart describes how unbundling process takes place and works.

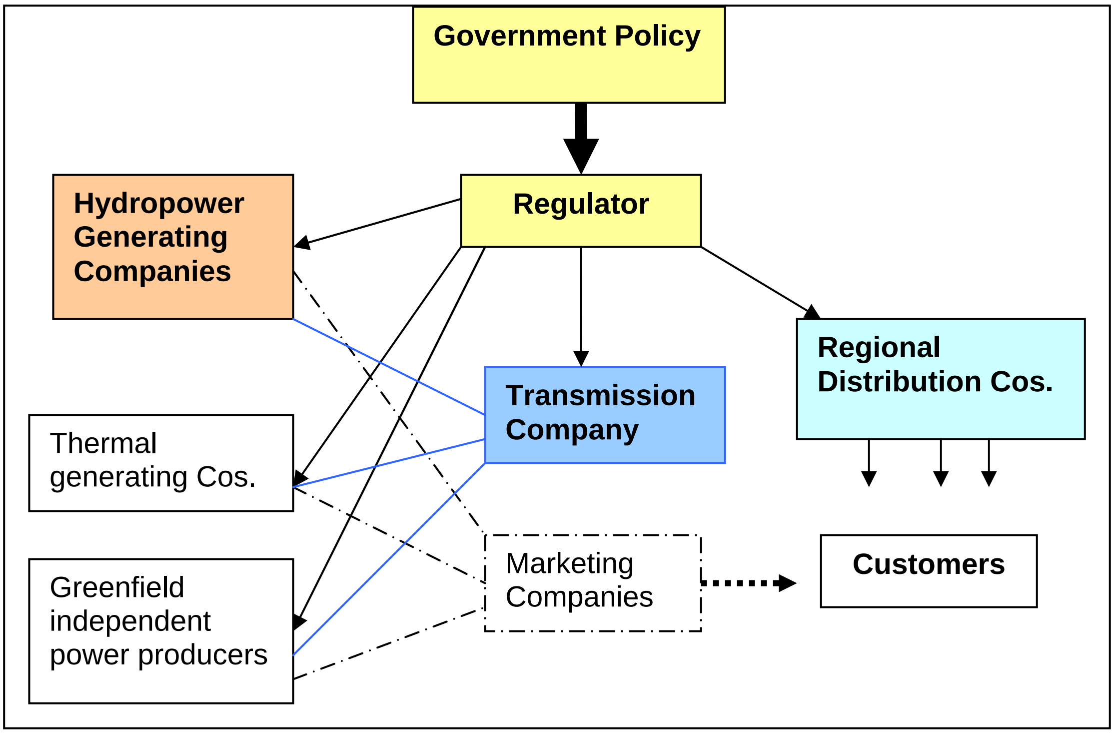

Figure 4.1 A Stylized Model For Emerging Power Sector Structure in Developing Countries

Cooperation among Public Bodies

Multipurpose hydro projects mainly require cooperation among public authorities which are involved in different sectoral activities. As discussed earlier, water supply and power generation appear to be among the main purposes of dams. Thus, the two major institutions expected to work in cooperation are energy and water utilities, to which an agriculture utility could perhaps be joined where deemed appropriate. Bureaucratic structures should be eased to minimize any discouraging factor for the private sector involvement. Water management is a politically sensitive issue especially in countries prone to droughts or floods. Additionally, there should be participatory mechanisms for public bodies in charge of environment and settlement affairs to cooperate and offer expertise especially during the impact assessment processes. Finally, this bureaucratic cooperation is not limited to the public institutions of a single country. Especially when potential conflicts and clashes between upstream and downstream countries are recognized, it is apparent that regional projects require also intergovernmental cooperation and consensus.

4.3 Intra-regional financing opportunities and sub-regions

Nile Basin Initiative is not the only institution aiming at power trading in the region. Member countries are also organized under other structures as listed in table 1.2. This diversity of organizations could be an opportunity for joint action in different instances but may also create certain issues related to tendencies of allegiance to the specific sub-regions.

NBI Countries	NBI	SAPP (South African Power Pool)	EAC (East African Community)	EAPP (Eastern Africa Power Pool)
Burundi	✓			✓
D.R. Congo	✓	✓		✓
Egypt	✓			✓
Ethiopia	✓			✓
Kenya	✓		✓	✓
Rwanda	✓			✓
Sudan	✓			✓
Tanzania	✓	✓	✓	
Uganda	✓		✓	

Table 4.1 Regional initiatives and power pools involving NBI member countries

Source: Information from NBI Member Countries (PTC) 2008

As discussed in detail in the earlier chapters of the Issues Paper, the Nile Basin Initiative consists of two sub-regions; ENSAP (the Eastern Nile Subsidiary Action Program) and NELSAP (Nile Equatorial Lakes Subsidiary Action Program). Situational analysis shows that sub-regional integration and concerted action have been more successful than partnerships across the NBI region as a whole. Geographical and historical contexts influence the power structures among countries. Upstream-downstream tension also translates into setting of different priorities and discourages a unified approach to multipurpose hydropower projects. Another important point is that although there are planned projects to increase the capacity of transmission lines, these projects largely remain sub-regional. Tanzania-Kenya-Uganda-Rwanda- DRC have connected transmission lines, whereas Ethiopia-Sudan-Egypt are working on to improve their transmission line connections. However, transmission lines which connect ENSAP and NELSAP together are still insufficient and require further investment. The following table shows the state of transmission lines in 2004 where progress and expansion are ongoing.

Power grid	Share in the total installed capacity	interconnectedness	Distance to the nearby grid
DRC [1] – Burundi - Rwanda	9.2 %	Tradition of common operation	
Tanzania	3.7 %	isolated	200 km from Kenya-Uganda grid
Kenya-Uganda	5.8 %	strong	More than 200 km to the DRC-Rwanda-Burundi Grid
Ethiopia	2.8 %	isolated	Almost 1000 km to the Kenya-Uganda grid
Sudan	3.1 %	isolated	320 km to Ethiopian grid,
Egypt	75.4 %	isolated	800 km to Sudanese grid

Table 4.2 Existing power grids in the NBI region

Source: Eastern Nile Power Study, Mercados/NordpoolCEEST Stydy on Power Trade 2007(See Table 2.1)
1) Total installed capacity in DRC included

The current lack of full integration between the two sub-regions also causes limitations on intra-regional financing opportunities. Below, table 1.3 displays the current concessional flows to NBI countries. When looked in detail, we can see that MDB flows differ significantly from country to country, and from institution to institution. Tanzania received 261 million USD from IDA and 123 million USD from regional development banks while paying off its 38 million USD debt to IMF. On the other hand, Egypt took a minor 28 million USD support only from IDA, none from IMF and paid off outstanding debt to the regional development bank. Egypt certainly is a regional leader in most economic measures, such as access to electricity with 98%, followed by 15% of that of Sudan. Egypt also has relevant experience in power sector liberalization and large hydropower projects. Regarding the high GDP of the country, Egypt could have a key role in provision of funding, as seen in the support given to some Ethiopian dam projects. Yet, what remains as a concern is, taking the case in point, how to effectively negotiate with Egypt to provide funding for a project that is in the NELSAP sub-region. Especially if the project has an irrigation component, it would be quite unlikely that Egypt, a downstream country, would be enthused to provide funds as the planned projects would not only have very limited power benefits to ENSAP, but also risk the water security of the country.

NBI Countries	IDA* (International Development Association)	IMF**	Regional Development Banks**
Burundi	18.9	21.1	5.9
DRC	255.9	39.4	22.5
Egypt	27.8	0.0	-0.4
Ethiopia	161.8	-4.0	127.0
Kenya	-20.1	66.5	19.0
Rwanda	46.7	-2.0	35.1
Sudan	-1.3	0.0	0.0
Tanzania	260.5	-38.1	122.8
Uganda	111.7	-30.2	63.7

Table 4.3 Flow of Concessional Development Funds to NBI countries by 2005 (US$ million)

*IDA is the concessional loan window of the World Bank Group
** non-concesssional flows are excluded.
Source: World Development Indicators 2007, the World Bank Publications.

Water supply could emerge as a key motivation to overcome the regional lack of integration in the power sector and funding problems as downstream countries always have a priority to secure their water flows whereas upstream countries have an underutilized hydropower potential. Again, Egypt's right to secure the flow to Aswan Dam translates into the fact that irrigation schemes for upstream countries are not potentially feasible as the return of irrigation water back to the river flow is around 20% only. On the other hand, hydropower use of water provides for almost 100% return to the mainstream Nile. Therefore, the share of each purpose in a multipurpose project also influences the potential financial resources.

Hence, when discussing multipurpose projects in the NBI, sub-regions, their contextual characteristics and priorities of these countries could be definitive as they propose crucial constraints. The challenge lies in finding the optimum. Yet, if these positions are clarified, bargained and agreed upon, sub-regional developments have the potential to integrate the two sub-regions in keeping with the basic cooperation premises of the NBI apparatus.

4.4 Harmonization of tariffs

Based on the understanding acquired from the discussion of the regulatory framework in the previous section, harmonization of tariffs among riparian countries comes to the forefront as a requirement for efficient power trading. Starting with the choice of currency to eliminate exchange rate risk, this harmonization should consider demand and supply profiles of the countries. When harmonization is not completed, power trading cannot be efficient as higher-tariff countries would attract more investment and lower-tariff countries can fail to benefit from new projects.

4.5 Stages in development of power trade in the NBI area

Based on the previous conclusions in this paper, the most likely scenario is to develop power trade through 3 stages:

- Stage 1 will comprise the trade which is presently taking place on a bilateral level between the countries (Uganda and Kenya, Democratic Republic of Congo and Rwanda and Burundi, Rwanda and Tanzania) and gradually expand the bi-lateral trade
- Stage 2 will expand these areas to a sub-basin level (NELSAP and ENSAP)
- Stage 3 will be the final stage when the demand increases and the power system matures, the power trade can be expanded to connect the whole NBI area.

4.6 Hydro Specific Problems

Risk and cost-sharing considerations between the private and public parties constitute the crux of the PPP negotiations process. To highlight this fundamental centerpiece of the PPP connection, we have to take a close look at the interplay between risks and costs within the context of hydropower projects, and how this particular aspect would impact the project finances, and hence impact the ultimate mode of cooperation. Large hydropower projects have certain characteristics, as listed by Head (2000, page 16) as follows:

- Difficulty in structuring procurement contracts,
- Potential conflict between the interests of the system and the private developer,
- Unusually high construction risk,
- Hydrological risk,
- Environmental sensitivity and costs,
- High front-end costs,
- High proportion of local costs,
- Heavily capital-intensive nature, and
- Long payback periods.

Furthermore, the method leading toward procurement schedules and concession agreements[7] is also critical in defining the respective roles of the parties, and as such, they have a bearing on risk and cost sharing as well highlight potential areas of discord related to the soundness and accountability of the agreements. Experience has shown that hydro requires a different regulatory environment (ibid) and greater care. More stakeholders are affected and a greater public support is needed to make projects workable and viable in the private sector.

Clash of interests may occur as the private party aims to <u>minimize financial costs and maximize financial benefits</u> whereas the public party aims to <u>minimize economic costs and maximize economic benefits</u>. This means that the private developer does not necessarily have concerns regarding the overall economic impact of the project. Similarly, the public party may not always place its priorities on the profitability of the project so as to meet the costs. Are these divergences possible to reconcile? This is the basic question that needs to be addressed, and highlighted as an essential issue to be listed in this chapter.

Construction risk is generally on the private sector in PPP. This risk is coupled with hydrological risk, too. Risk-sharing mechanisms or certain guarantees from the public sector may function as compensation of the risk- bearing.

Generally speaking, environmental sensitivity is not a key concern for the private party- *per se.* However, regulations and requirements, such as environmental impact assessment, are part of the costs. The private sector faces a dilemma between confronting a negative social image and legal liability resulting from non-compliance with the environmental agenda, while having to deal with increased costs as a result of cutting down on the environmental hazards which come with full compliance. Again, public interest would aim to minimize these effects without trading off the private sector participation. Unlike the private producer, the government is responsible to the local protestors and environmental NGOs and is expected to have proper enforcement mechanisms to regulate the private party.

Front-end costs include transaction, engineering costs, and consulting fees, known as “soft costs”. The complex financing structure of PPP hydropower projects increase front-end costs.

[7] *Thematic review III.2 trends in financing: 43* http://www.dams.org/docs/kbase/thematic/tr32main.pdf

Development of an appropriate tariff structure should duly consider the front-end costs and the long construction period. Similarly, mastery over the operation and maintenance costs is vital to ensure profitability of a project. Hydropower is very capital-intensive and payback periods are very long. Hence, credit agencies should carefully balance the longer life time of the project with the amount, repayment terms and risks associated with the credit to be supplied.

4.7 Financing model for multipurpose projects

The key issues arising from the trends in multipurpose project financing are (Head, 2000 in Per Ljung *et a*l.page 5):

- The willingness (or otherwise) of host governments to allow private control over any strategically important water project can influence all other downstream projects in the river basin.
- The reluctance of the private sector to get involved with projects that it views as being complicated and circumscribed with potential bureaucratic hurdles because of the involvement of many parties.
- The regulatory controls that would be needed to achieve a sensible balance between the interests of the private investor, the consumer and the host government, are complicated and not easily replicable from project to project, hence resulting in limited experience to be acquired from each and every case.
- The public sector has an even larger role to play than for private hydro in terms of providing funding for projects that may be financially only marginally viable in their entirety, but for which discrete elements may well be viable.
- Most multipurpose projects require dams, and a balanced approach is needed to firstly weigh the benefits and costs, and then to streamline the consultation and permitting process. Without such clearance already in place, the private investor will not be attracted.

Important practical issues related to specific costs and revenues consist of (a) resettlement and environmental costs, (b) risk sharing and (c) cost sharing. Below is a discussion of these matters in order.

Resettlement and environmental costs

Trans-boundary nature of a multipurpose dam is a challenge when it comes to the non-economic costs, i.e. resettlement and environmental costs. Careful calculation and inter-governmental agreements are necessary for avoiding future conflicts and cost minimization. Countries already suffering from resettlement issues and conflicts may hesitate to host a new project. The key issue here is to maintain how the potential host country will be convinced to bear these costs and to specify the cost-sharing between the private sector and the governments of the concerned riparian countries.

Risk sharing

Risk sharing is the core of financing and PPP. Before sharing the risks, parties should recognize the risk factors such as:

- hydrology
- construction
- geology
- capital investment
- marketing

- production
- operation

Once agreed on each risk factor, risk-sharing generally depends on the level of profitability, costs and duration.

Cost sharing

When we look at the different components of a multipurpose hydropower dam, we observe that the revenue-generating capacity of each particular purpose exerts an influence on its financing structure. Definition of costs, similar to risks, is the initial step for cost-sharing.

Offtake agreements are one of the main sources of funding for multipurpose projects. However, when parties aim for PPP in a multipurpose project, the main challenge is that not all purposes are equally profitable to attract private sector involvement and hence not all costs are recovered easily. For example, users are generally not charged for irrigation water, especially in developing countries like the Nile basin riparian states. Similarly, water supply does not promise high returns and mostly carried by the public sector due to its tendency to generate a loss rather than profit. Most of the time, the poor (especially the rural poor) use more water in their economic activities than the urban population. If the water pricing scheme is not sensitive to the user profile (i.e. based solely on the quantity), it puts the pricing burden on the poor and thus creates a conflict with the developmental goal of similar projects[8]. However, power generation is an attractive economic activity among the purposes of a multipurpose hydropower dam, which could be supportive for water usage purposes.

As mentioned earlier in this report, active engagement in power generation implies some commitment in transmission and distribution aspects, which could be profitable enough to attract private investment and hence provide support for the irrigation and water supply purposes associated with the same dam. Also, almost all the water used in power generation goes back to the river flow, which means that it is re-usable by the downstream users as long as suitable conditions prevail, such as sufficient hydrological head and physical investment opportunities for diversions etc. Therefore, a proper cost-benefit analysis is crucial for maintaining financial support for all purposes of a dam. Although it is very unlikely that water supply will support financing for the power purpose, the contrary is very much possible, as also mentioned in the aims of Kakono and Rusumo Falls projects, and hence should be encouraged. Thus, offtake agreements, needs assessment in water usage and energy, and the level of private sector involvement, should be taken into consideration if the aim is proposing a financing agreement to utilize the revenue-generation aspect of power for the development of water supply and irrigation schemes.

Longer term water policy must certainly encompass a diverse set of constituents such as water-pricing, maintenance of existing water pipes to decrease leakages, encouragement of sustainability principles in irrigation, and PPP in operation and management of these activities. All of these endeavors involve consumption of water. Multipurpose projects gain further in significance because they differentiate between use of water and consumption of water, with resulting efficiencies for enhancing financing options. Hence, allocation of revenues of one purpose (which uses water, i.e. hydropower) to finance another (which consumes water, i.e. irrigation or water supply) appears as a challenging avenue for multipurpose hydropower projects to fulfill and exploit its “multipurpose” nature efficiently.

[8] See the example on Niamey: “where the average price paid by the poorest 20% of households is roughly 2.6 times higher than the price paid by the richest 20%”. Quoted from Auriol and Blanc (Jan. 2007), Public Private Partnerships in Water and Electricity in Africa, Agence Française de Développement Working Paper No:38.

5. EXAMPLE ON HOW MULTIPURPOSE OPERATING REGIMES CAN BE IMPLEMENTED IN THE ENSAP AND NELSAP SUB-REGIONS

Issues related to the multipurpose hydro projects designed to promote power-trading in the Nile Basin span over a wide range from general problems of the region to the project-specific matters in the individual countries. Hence, for purposes of clarity, we will adopt some sort of a zooming-in approach to discuss the topics, working gradually from the general to the specific.

5.1 Ranking of development options

The SSEA report for the NELSAP region describes in detail the different stages of the process leading to the development of hydropower projects. The same stages are also valid for multipurpose projects while including multipurpose capability as part of the option analysis. The development process can be defined with the following steps:

Policy review

Review of the energy policy, legal and administrative frameworks and take steps to change these to allow free trade of power.

Energy needs assessment

Assess the energy needs (Load forecast assessment) and needs for irrigation, water supply and flood control. The needs assessment provides the fundamental input to the planning process. It serves as a component for subsequent consideration, evaluation and comparison of options (power generation and multipurpose).

Screening of development options

Screening and Identification of new power options with multipurpose capabilities. The objective of the screening is to eliminate those projects unlikely to be implemented – for a variety of reasons – during the planning period. The screening criteria used in the SSSE Assessment could be used as a guideline for the screening process:

- Quality and availability of data
- Options with no severe negative social or environmental impacts that are likely to be mitigated or offset
- Options with an estimated firm energy cost less than a specified amount per kWh.
- Options with a minimum project size
- Multipurpose use should be evaluated

Comparative analysis

When development options are selected after the screening, comparative analysis of the options should be carried out. The analysis could be a multi-criterion analysis including multipurpose capabilities as a parameter as well as assessment of the cumulative impacts for each sequence of the development and evaluation of requirements for mitigation measures for selected options.

With this method, each option is scored against each criterion on the basis of qualitative and quantitative indicators and not simply ranked from the most preferred to the least preferred. Percentage points are associated with each criterion as an indication of their relative importance (the sum of the weights must add to 100). The final value score of each option is obtained as a weighted average of the scores for the individual criteria. The process should be transparent and participatory; stakeholders should participate in the selection and ranking of criteria.

Risk analysis.

Risks should be identified and be used to assess the overall level of risk of each development option. Typical risks will be:

- Risk of opposition from internal or external groups
- Risks related to institutional and legal framework
- Use of local resources
- Increased risks to public health
- Risks to designated habitats or natural sites
- Risk of sedimentation
- Hydrological risk
- Financial risks

5.2 Description of case studies

In order to illustrate how staged development can be implemented on hydropower multipurpose coordination regimes in the NBI area, in the context of a power trade scenario, the Karadobi and Mandaya projects have been selected as case studies from the ENSAP area, and Rusumo and Kakono projects have been selected as case studies from the NELSAP area respectively. The characteristics of these projects are described in table 5.1 and 5.2. Furthermore, the proposed grid connection to Kakono and Rusumu is given in Figure 5.1.

The tables list some of the parameters to be evaluated in a ranking of the projects. The staged development will be decided taking into consideration the demand for electricity, irrigation, need for flood control and other multipurpose use, combined with a ranking of the projects on a technical/economic, environmental and social basis.

Table 5.1 Characteristics of projects for case studies in ENSAP and NELSAP areas

	Karadobi	Mandaya	Rusumo	Kakono
Installed capacity (MW)	1 600	2 000	61.5	53 (run-of-river)
Annual average energy (GWh)	9 700	12 100	308	126
Total reservoir storage (mill m^3)	40 200	49 200		
Power Supply	Potential PS to Ethiopia, Sudan and Egypt	Prime benefit is power production. Extra benefit uplift of production in Merowe and Roseires	Potential PS To National Grids In Rwanda And Tanzania	Potential PS to Ethiopia, Sudan and Egypt
Transmission	Transmission line to Debremarkos (Ethiopia) and Roseires (Sudan)	Transmission to Debremarkos (Ethiopia) and Meringan (Sudan)		Transmission line to Rusumo
Irrigation	300 m3/sec increase of firm regulated flow Nov – June. Irrigation potential in Sudan	Unknown potential	Improve Kyaka Irrigation Project Develop more agriculture	Improve Kyaka Irrigation Project Develop more agriculture
Flood Control	Can control 100 years flood	Alleviate floods in Sudan due to high degree of flow regulation	-	-

	Karadobi	Mandaya	Rusumo	Kakono
Water supply	WS potential	_	Small, net gain of water downstream	Small, net gain of water downstream
Project cost w/o transmission(USD)	1 917	2 272	130	100
Transmission cost (USD)	314	N/A		
Environmental Impacts	Positive impact on evaporation Changes in flow regime downstream Change in ecosystem Inundate 45.5 km^2 woodland and vegetated wetland. barrier to fish migration Negative impact on land used for recession agriculture in Sudan	Positive impact on evaporation Changes in flow regime downstream Change in ecosystem Inundate 574 km^2 open woodland. Reduce water level in Lake Nasser reservoir (Aswan)	Changes in flow regime downstream	Approx 1500 ha of Minziro Forest Reserve will be inundated Daily peaking operation will cause flow level variations
Social Impact	Loss of cultivated land and grazing land for 4 700 housholds	Resettlement of 600 people	Approx. 3000 people upstream will be affected, some must be resettled	Resettlement depending upon choice of reservoir size

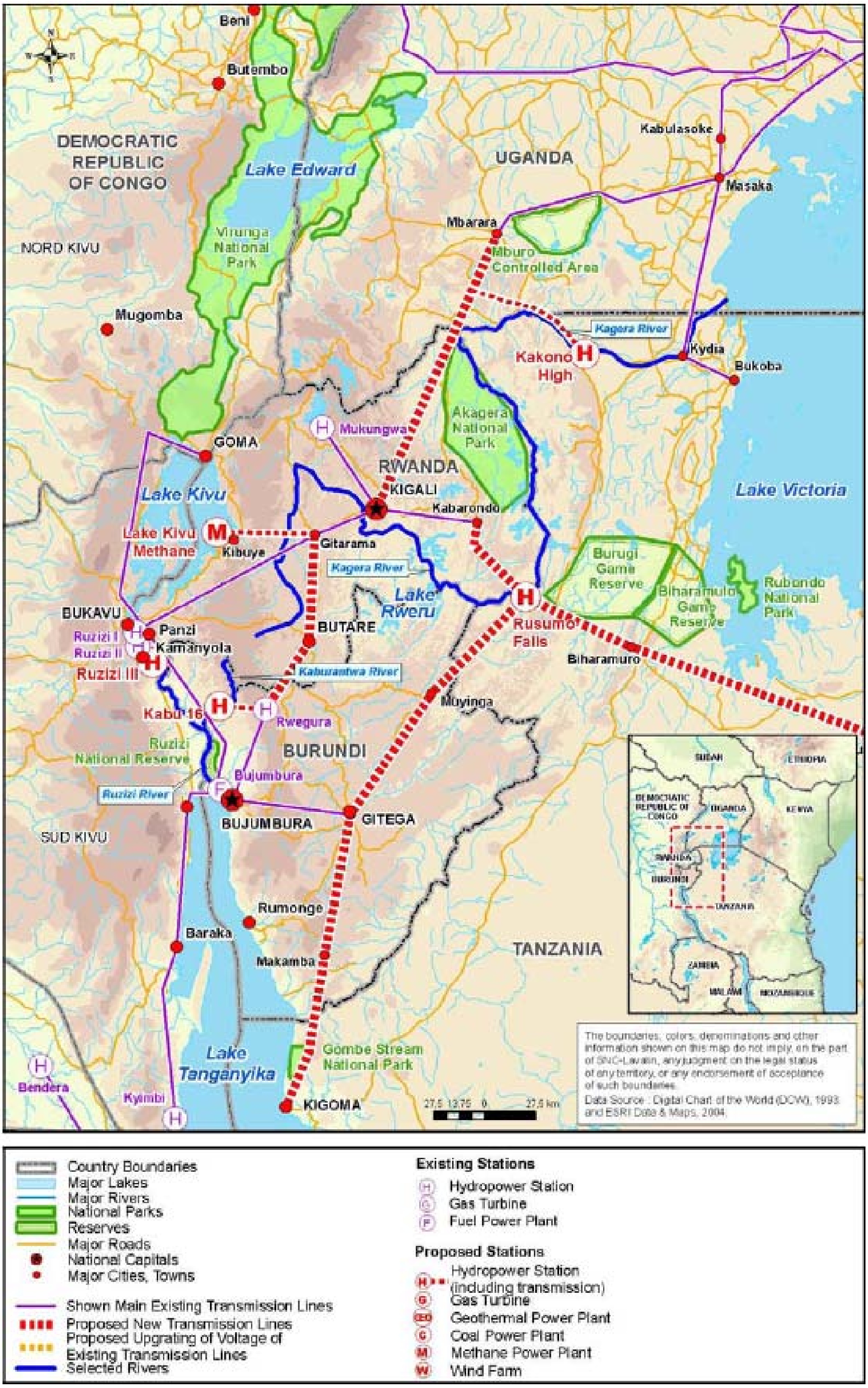

Figure 5.1 Existing and proposed grids in Rwanda, Burundi and East Tanzania

5.3 Economic and Financial Analysis of the Planned Projects

The planned dams are listed according to their multipurpose components in table 2.1. As will be observed, the common denominator for all the dam projects is that they all involve both power and irrigation. Water supply and flood control are shared by three schemes, while only once case involves a purpose different from power, irrigation, water supply and flood control.

	PURPOSE				
Project	Power	Irrigation	Water supply	Flood control	Other
Karadobi (Ethiopia)	✓	✓		✓	
Mandaya (Ethiopia)	✓	✓		✓	
Rusumo Falls (Tanzania)	✓	✓	✓		✓
Kakono (Tanzania)	✓	✓	✓		

Table 5.2 Planned projects and purposes

To have a fuller appreciation of the distinctions between economic and financial analysis, that really set apart the public and private concerns, we present a brief exposition on the concepts of economic and financial analysis in order to clarify what is intended by each type of analysis.

Parameter	Financial Analysis (Private Sector Concerns)	Economic Analysis (Public Sector Concerns)
Focus:	Net returns to equity capital or to the private group or individual.	Net returns to society.
Purpose:	Indication of incentive to adopt or implement	Determine if government investment is justified on economic efficiency basis.
Prices:	Prices received or paid either from the market or administered.	May require “shadow prices” e.g. monopoly in markets, external effects, unemployed or underemployed factors, overvalued currency.
Taxes:	Cost of production.	Transfer of payments and not an economic cost.
Subsidies:	Source of revenue.	Transfer of payments and not an economic cost.

Interest and Loan Repayment:	A financial cost; decreases capital resources available.	A transfer payment and not an economic cost.*
Discount Rate:	Marginal cost of money; market borrowing rate; opportunities cost of funds to individual or firms.	Opportunity cost of capital; social time preference rate.
Income Distribution:	Can be measured as net returns to individual factors of production such as land, labour, and capital but not included in the financial analysis.	Is not considered in economic efficiency analysis. Can be done as separate analysis or as weighted efficiency analysis with multiple objectives.

Table 5.3 Distinctions between financial and economic analysis
**unless external loan.*
Source: adapted from Fred J. Hitzhuson, "The Economics of Biomass for Energy: Towards Clarification for Non- Economists", mimeo, Ohio State University, 1982.

Being motivated by different incentives, the disparity between the private and public sectors becomes more pronounced when we investigate the differences between the financial and economic analysis.

Proceeding further with the financial and economic analysis of the planned projects in the Nile Basin region, using the data derived from the pre-feasibility studies of each project, we can present the below summary for the principal efficiency parameters, followed by a description of the essential project features.

Karadobi Dam (Ethiopia)

Energy cost	3.75 US cent/kWh	Annualized cost of total energy
NPV	1896 USD mill	Net Present value
EIRR	18.2 %	Economic Internal Rate of Return
Payback	5 years	Payback Period
B/C	2.2	Benefit- Cost ratio
Real Discount Rate	10%	Opportunity cost of capital

Table 5.4 Economic Analysis of Karadobi dam (based on Roseries Dam)

Energy cost	2.51 US cent/kWh	Annualized cost of total energy
NPV	2,522 USD mill.	Net Present Value
FIRR	25.1%	Financial Internal Rate of Return
Payback	3 years	Payback period
B/C	2.6	Benefit - Cost ratio
Interest rate	7%	Opportunity cost of capital

Table 5.5 Financial Analysis of Karadobi dam (based on Roseries Dam)

Karadobi is a multipurpose hydropower project with additional elements of irrigation and flood control. The Karadobi Project has been chosen as a case to understand the possible economic benefits to be derived from planned projects under NBI. The criterion for its selection was based on the fact that it had more data available on the non-power costs and benefits of the project, and hence offered a possibility for investigation. Since its pre-feasibility and feasibility studies have been completed, Karadobi could ideally offer a good basis for review, but the full data set were not made available to the consultant.

Irrigation

In the case of Karadobi multipurpose project, it should be kept in mind that it is a part of the large Irrigation Development Plan (IDP) undertaken by the Ethiopian government, composed of four dams to support irrigation, together with hydropower. All NBI projects related to irrigation in Ethiopia, including Karadobi, are to be implemented under the IDP by the Ethiopian government. Their benefit/cost ratio for these projects must higher than unity and the IRR must exceed 10%[9].

- Irrigation Development Plan (IDP) incorporates approximately 250,000 hectares, or 35% of the estimated total irrigable land in the Blue Nile basin, providing water for producing crops estimated at 325 USD per hectare.
- 44% of the planned reservoir capacity is in Karadobi, with 32.5 billion cubic metres[10]
- At the tandem, the capacity of Karadobi is approximately 68% of the annual runoff in the basin.
- 12% of the capacity, 3.9 billion cubic metres will be used for irrigating the Beles catchment.
- Increases in agricultural production resulting from the new irrigation projects are expected to reduce the national cereals deficit by 11% and the deficits in seed cotton and sugar crops by 24% each.

Flood control

In the pre-feasibility study for Karadobi Multipurpose Project[11], it is stated that the flood control can be provided both in volume and peak. Floods with return periods exceeding one in 100 years can be controlled at Karadobi. Since details of the flood levels and affected areas have not been available in this study, no economic benefits have been calculated, but they are anticipated to be substantial. However, 1988 and 1998 floods in Sudan could give an idea on potential benefits of flood control purpose of Karadobi project:

- Simulations have shown that the damage costing 450 MUSD caused by 1988 and 1998 floods in Sudan could have been avoided or greatly reduced if a reservoir operation rule for flood control was adopted. However, a reservoir option would have caused reduction in power production as less water is released for hydropower use.
- Additionally, some 6,000 M m^3 water could have stayed in the reservoir.

<u>Cost of Project and Financing Arrangements</u>

Project costs	$ 2,231 M
(including transmission lines	$ 314 M)
Generation cost $ 52 /MWh	

Project financing is not yet determined, but is expected to be financed by external financiers.

9 Water Sector Development Program, Ch6: Irrigation Development Program
10 Block, J., Integrated Management of the Blue Nile Basin in Ethiopia: Hydropower and Irrigation Modeling, IFPRI Discussion Paper 00700, May 2007
11 Pre-feasibility Study of Karadobi Multipurpose Project, Federal Democratic Republic of Ethiopia Ministry of Water Resources, Sept 2006

Mandaya Multipurpose Project in Ethiopia

Item	*Cost (Million USD)*
Environmental Mitigation	***22.0***
Access Roads and Infrastructure	***86.3***
Reservoir Clearance	***39.7***
Civil Works	
Diversion works	***60.6***
RCC Dam and spillway	***1,283.4***
Powerhouse and tailrace	***116.4***
Switchyard and Buildings	***5.5***
Civil contingencies	***219.9***
Mechanical and Electrical Plant	***334.4***
Sub-total	
Engineering and Construction Management	***216.8***
Owners Administration	***86.7***
OVERAL TOTAL	***2,471.7***

Table 5.6 Mandaya Project Cost Estimates

Rusumo Falls and Kakono Multipurpose Projects

<u>Cost of Project and Financing Arrangements</u>

Total project cost of *Rusumu Falls*, including an environmental mitigation allowance (slightly above 5 million USD), is estimated to 130 million USD, with a cost of firm energy (c/kWh) at 4.73. Total project cost of Kakono is 100 million USD, including an environmental mitigation allowance of 4 million USD. Cost of firm energy is 8.76 c/kWh.

Both projects are proposed as best development options in the SSEA with a staged development starting with Rusumu Falls as soon as possible and Kakono between 2014-2018. At least for the Rusumu Falls it is anticipated to blend private and public financing that would be financially viable and provide operational sustainability to the project (WB 2006).

5.4 Reflections on Options of Future PPPs for the Planned Projects

In the above projects, the high level of FIRR estimates and cost-benefit ratios (available only for Baro I and II, and Genji and Karadobi projects) indicate that there would be a strong incentive for private sector involvement in these projects, because the projects appear to be promising in terms of returns and private sector benefits. However, it should be remembered that the most appropriate financial models would come only after detailed design and where the concerned governments will express their preferences as to how they would like to handle the financing aspects. The detailed design will also re-estimate the FIRRs and B/C ratios and help reconfirm the initial expectations.

One drawback with all of the pre-feasibility level economic and financial analysis is that the efficiency parameters all seem to have been estimated on the basis of stand-alone multipurpose projects and not within the context of an integrated regional power trade prospect. Consideration of the regional dimension will most likely enhance the efficiency parameters, and help bring about more conducive profiles (cash flows) that would attract private investment.

It appears that all of these projects would be suitable ground for launching a PPP. The PPP options consist of (a) privatization, (b) concessions, and (c) operation and maintenance arrangements. To recap the earlier discussion, it is believed that a major part of the discussion and ultimate negotiation for the financing of these projects will involve the financing of capital investment, and financing of the operation and maintenance. As far as the asset ownership, within the context of a basin management, all projects will most likely involve more of public ownership than private ownership. Hence, there would be a strong incentive to render operational the principle of transfer (abbreviated as the T in the BOT and BOOT arrangements).

Listed below are generic descriptions of various PPP or (P3) options. The below schema ranks the options in a spectrum, from the lowest level of private involvement (arm's-length outsourcing of operations and maintenance contracts), through the intermediate level (concessions), to the highest level of private involvement (pure privatization or divestiture):

Model	PPP Option	Financier: Private or Public		Asset Ownership
		Capital Investment	Operation and Maintenance	
Privatization	Divestiture and BOO	PRIVATE	PRIVATE	Private or Private+Public
Concession	BOOT/BOT/DBFO	PRIVATE	PRIVATE	Private or Private+Public
	Concession	PRIVATE	PRIVATE	Public
	Lease	PRIVATE	PRIVATE	Public
Operation and Maintenance	Management Contract	PUBLIC	PRIVATE	Public
	Service Contract	PUBLIC	PUBLIC+PRIVATE	Public

Table 5.7 Financing options for the planned projects under PPP arrangements

Adapted from Jones, Public Private Partnerships for Ontario Hospital Projects, 2001

There seems to be limited scope for wholesale privatization of the multipurpose projects. Depending upon the findings of the detailed designs, it is highly likely that the country governments would be more in favor of concession type PPP arrangements. These concessions would be in the form of BOOT, BOT, leases and other type of concessions, as shown in the above table. Both privatization and concessions would be characterized by a conspicuous and dominant role of the private sector for both financing of the capital investments as well as assuming financing and operational responsibility for the consequent O&M, whereby the public sector would eventually become the owner of these assets.

The DBFO is a further option that could be considered. It involves **design, build, finance and operate**. The ownership element linked with the "T" is implicit here, as it is implicitly assumed that asset ownership remains public. Hence, the option offers an opportunity for sharing responsibility for the design of the projects (here meaning detailed design), and hence being reassured that the detailed project design is sound and complies with international standards.

Politically, this concession option would be more feasible, and hence represent the more likely evolution for the circumstances in the Nile Basin, where a basin wide charter and agreements between member countries are still in the making.

In the particular case of multipurpose projects, it is still highly unlikely that the water supply and irrigation aspects will be successful in attracting much foreign investment. However, participation of local investment as private sector participation should not be ruled out. Financing opportunities from within the basin may become possible, and should hence be encouraged, especially for those projects involving minimal consumption of water – such as run of the river hydro projects. Reportedly, the lower stream countries Sudan and Egypt will have an incentive in maintaining the high discharges, and are likely to shown interest in financially viable upstream projects in the basin.

6. REFERENCES AND SUPPORTING LITERATURE

BKS Acres (2005): The East African Power Master Plan. Final Phase II Reports. East African Community (EAC).

ENTRO: Pre-feasibility study of the Mandaya Hydropower Project – Executive Summary

ENTRO (2007): Eastern Nile Power Trade Program Study EDF/Scott Wilson

John E. Beasant-Jones, (Sept 2006). Reforming Power Markets in Developing Countries: What Have We Learned?, Energy and Mining Sector Board Discussion Paper, No:19, World Bank Document

Maria Teresa Diokno-Pascual and Shalom MK Macli-ing: The Controversial Casecnan Project

NBI-NELSAP (2005): Strategic/Sectoral, Social and Environmental Assessment of Power Development Options in The Nile Equatorial Lakes Region. Stage I and II. Synopsis of the Final Report. SNC Lavalin and Hydro Québec International.

NBI-RPTP (2007): Institutional, Regulatory and Cooperative Framework Model for the Nile Basin Power Trade. Synopsis Final Report and Specific Deliverable Reports (Annexes). MERCADOS, NOR POOL and CEST.

NBI-RPTP (2008): Preliminary Basin Wide Study. Final Report. Draft. SNC Lavalin in association with ISL, Vincent Roquet and GIBB.

NBI-RPTP (2008): Review of Environmental Impact Assessment Frameworks and Procedures in Regional Power Investment Projects. Final Draft Report. TECSULT.

NBI-SVP (2006): Water Policy Guidelines and Compendium of Good Practice

NBI – WRPMP. (Riddel, P. ed.). 2008. Draft Requirements Analysis and DSS Design Report. Needs Assessment and Conceptual Design of the Nile Basin Decisions Support Consultancy.

NBI-WRPMP (2006): Baseline and Needs Assessment of National Water Policies of the Nile Basin Countries: A Regional Synthesis.

NBI - UNDP/World Bank Energy Sector Management Assistance Program Opportunities for Power Trade in the Nile basin Final Scoping Study (Norconsult and Statnett 2004)

Ministry of Water Resources – FDR of Ethiopia: Feasibility Study of Baro 1 & 2 Multipurpose Projects – Executive Summary (Norplan/Norconsult/Lahmeyer 2006)

Ministry of Water Resources – FDR of Ethiopia: Pre-Feasibility Study of Karadobi Multipurpose Project – Executive Summary (Norplan/Norconsult/Lahmeyer 2006)

Norwegian Ministry of Foreign Affairs - Power Sector Task Force (NORAD 2005/2006): Proposed Strategies and Actins to promote Norwegian effort for the Power Sector in developing Countries (Main Report and Working Papers)

Ministry of Natural Resources, Royal Kingdom of Lesotho. 2007. Lesotho IWRM Strategy. (Lillehammer, L. ed.). Sweco Grøner and WL Delft Hydraulics.

The 1929 Nile Water Agreement: Legal and Economic Analysis

World Bank (2003): Water resources and environment, Technical Note. G.3, Wetlands management, Prepared by Davis R. and Rafik H., Series Editors, Washington, DC

World Commission on Dams (2000): Dams and Development, The Final Report, the Knowledge Base (case studies, thematic reviews, cross-check survey, submissions)

World Commission on Dams (2000): Case Study: The Glomma and Laagen River Basin in Norway (The Norwegian Institute for Nature Research, The Eastern Norway Research Institute and The Glommen and Laagens Brukseierforening)

World Commission on Dams (2000): Case Study: Kariba Dam – Zambia and Zimbabwe (Soils Incorporated (Pvt) Ltd, Harare, Zimbabwe in association with Chalo Environmental & Sustainable Development Consultants, Lusaka, Zambia)

World Commission on Dams (2000): Thematic Review III.2:. Multipurpose Dams. International Trends in Project Financing. (Head, C.R. 1999)

World Water Assessment Project (2006). Water – a shared responsibility. World Water Development Report. Chapter 20 – Senegal River Basin. UN – Water.

Internet References:

www.calenergy.com/html/projects5b.asp

www.sanroquedam.ph/content.php

http://www.norad.no/items/9506/38/0370788909/Fin%20Models%2021%2008%2007%20Annexes%201-5.doc

http://www.dams.org/docs/kbase/contrib/eco079.pdf

http://jnnurm.nic.in/presentation/PPP.pdf

http://info.worldbank.org/etools/docs/library/240335/Financing%20of%20Private%20Hydropower%20Projects..pdf

http://www.citizen.org/cmep/Water/cmep_Water/reports/burkina

http://www.dme.gov.za/pdfs/energy/cabeere/case_bethlehem.pdf

http://sec.edgar-online.com/1997/11/13/12/0000950131-97-006756/Section13.asp

http://info.worldbank.org/etools/docs/library/240335/Financing%20of%20Private%20Hydropower%20Projects..pdf

http://www.entrepreneur.com/encyclopedia/term/82206.html http://www.businessdictionary.com/definition/debt-financing.html

http://siteresources.worldbank.org/INTENERGY/Resources/WBEnergyLecture2005TEGI050124VFCBiebuyck.pdf

http://acpbusinessclimate.org/documents/E-Zine5-EN3.pdf

http://www.wds.worldbank.org/servlet/WDSContentServer/IW3P/IB/2007/03/13/000104615_20070313144224/Rendered/INDEX/RDPMP010PID010Appraisal0Stage0March013.txt