



Distribution & Commercial Committee Meeting

Presented by:
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Director Information & Coordination Center

Cotonou, 23 June 2014

Contents

- Electricity in ECOWAS
- Generation & Transmission Priority Project
- Grid Operation
- Regional Electricity Market
- ECOWAS Energy Efficiency Initiative

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ECOWAS Fact File

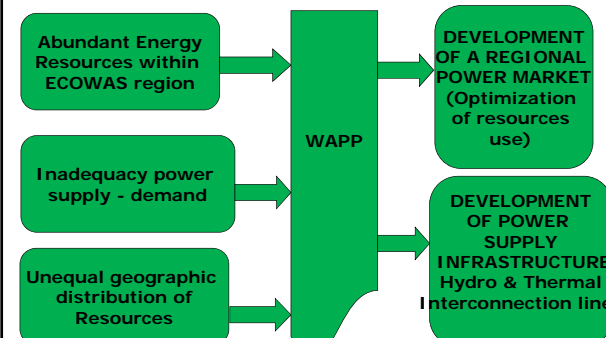
- ❖ Fifteen countries
- ❖ Population 340 million (4th)
- ❖ Area: 5,112,903 km² (7th)
- ❖ Density 49.2/km²
- ❖ Total available generation 10,000MW
- ❖ Av. Electricity Access: 70%

ECOWAS VISION

ECOWAS VISION

- develop interconnection and power exchange between Member States
- harmonize legislations and standards of the power sector operations
- create an open and competitive regional electricity market
- use gas flared in Nigeria to feed Power stations in neighbouring countries (WAGP)
- promote and protect private investments in energy projects

Establishment of WAPP
Rationale of the WAPP



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graph LR
    A[Abundant Energy Resources within ECOWAS region] --> WAPP[WAPP]
    B[Inadequacy power supply - demand] --> WAPP
    C[Unequal geographic distribution of Resources] --> WAPP
    WAPP --> D[DEVELOPMENT OF A REGIONAL POWER MARKET (Optimization of resources use)]
    WAPP --> E[DEVELOPMENT OF POWER SUPPLY INFRASTRUCTURE Hydro & Thermal Interconnection line]
  
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ECOWAS Energy Protocol

- ❖ Supporting ECOWAS regional goals
 - ❖ Increased access to energy
 - ❖ Stable and reliable electricity supply – affordable and sustainable
 - ❖ Achieving the Millennium Development Goals
 - ❖ Peace and security
- ❖ Balanced development of the diverse primary energy resources of the ECOWAS member states for their mutual benefit
- ❖ Long-term cooperation in the energy sector
- ❖ Uninterrupted energy transit, and
- ❖ Increased cross-border electricity trade.

ECOWAS Energy Protocol**Infrastructure Development
(2004 WAPP REVISED MASTER PLAN AND
UPDATED IN 2012)**

In 2004, the 1999 ECOWAS Energy Master Plan was revised in order to:

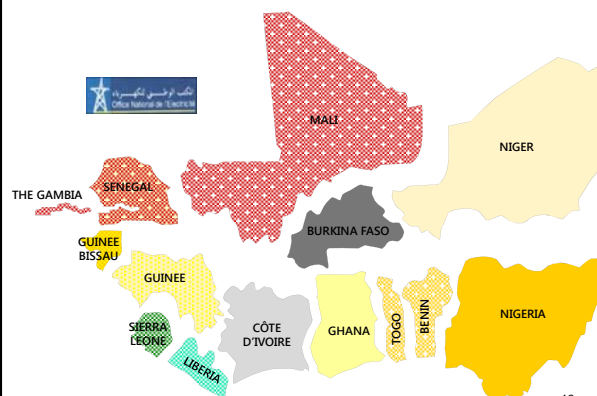
- ❖ Define the long-term vision and implementation strategy for the regional transmission system
- ❖ Establish the capital costs of the regional transmission investment program over the next 17 years (2020 horizon), more specifically over the first 4 years (2004-2007) and
- ❖ Establish the stability, reliability and operability of the regional systems
- ❖ The Project were classified into WAPP Priority Projects

THE WAPP**WAPP VISION**

- ❖ The vision of the West African Power Pool (WAPP) Organization is to integrate the operations of the national power systems into a unified, sustainable regional electricity market, with the ultimate goal of providing the ECOWAS Member States with stable and reliable electricity supply at affordable cost

WAPP MISSION

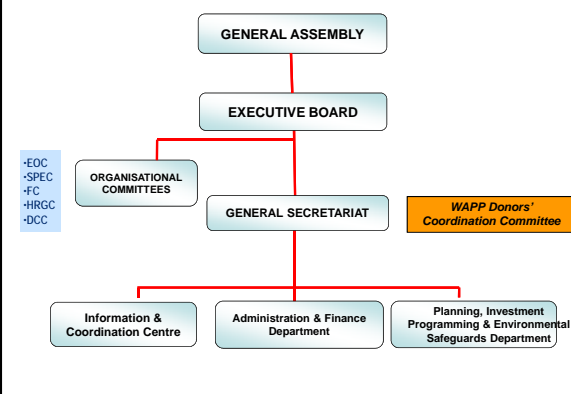
- ❖ Facilitate infrastructure development
 - ❖ Transmission interconnections
 - ❖ Exploit primary energy resources
 - Gas (Nigeria)
 - Hydro (Guinea, Sierra Leone, Liberia, etc.)
- ❖ Develop common harmonised codes & standards to facilitate trade and development
 - ❖ Operating manual (OSMP)
 - ❖ Planning & design criteria
- ❖ Develop and improve energy trading
 - ❖ System monitoring & coordination
 - ❖ Standard agreements (trading, wheeling, power purchase)
 - ❖ Electricity market (rules, governance, metering, settlement)

WAPP MEMBER COUNTRIES

Member Utilities in 2014 (25#)

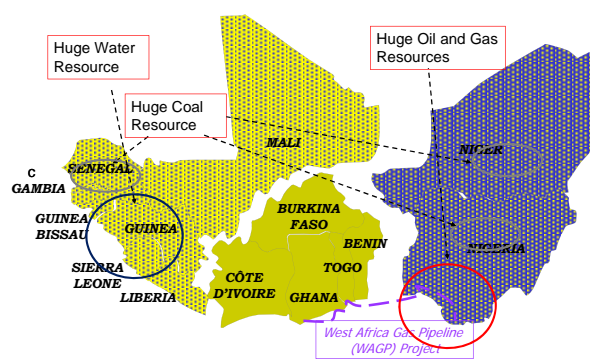


Organizational Structure

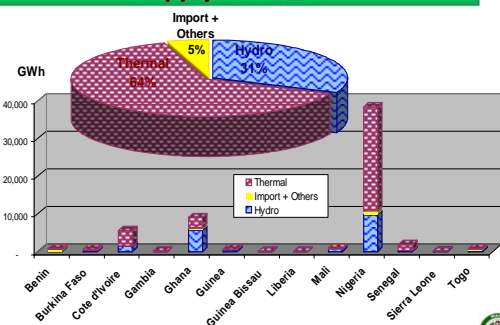


WAPP Network Data

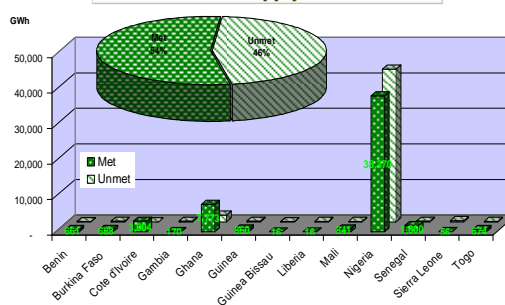
Utilization of Diverse Primary Energy Resources



Status of Power Supply in ECOWAS: Supply Sources

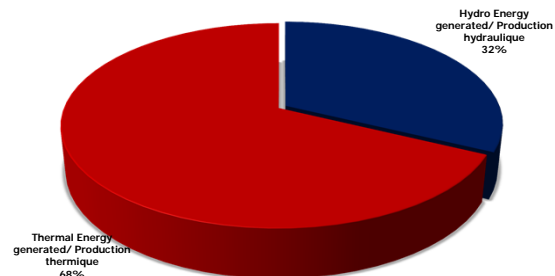


Status of Power Supply in ECOWAS: Demand-Supply Balance

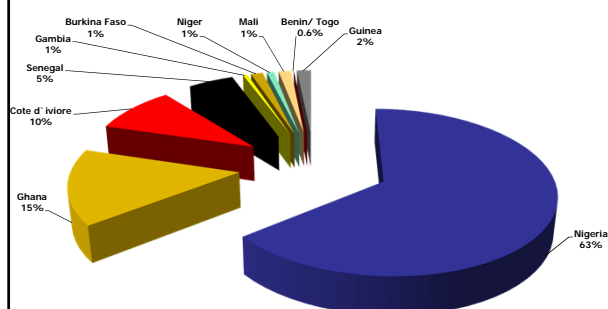


Operations Monitoring

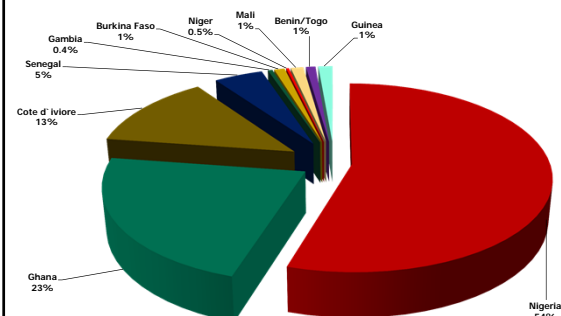
PERCENTAGE RATIO OF TOTAL ENERGY GENERATED (HYDRO vs THERMAL)



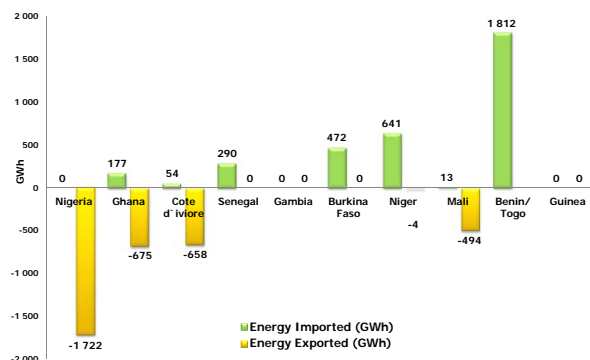
INSTALLED CAPACITY IN PERCENTAGE -COUNTRY 2012



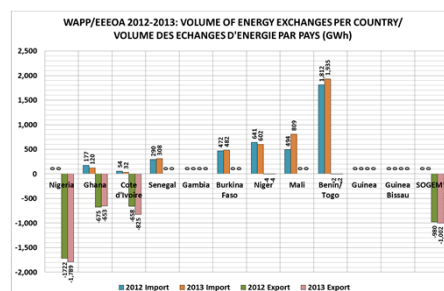
PERCENTAGE RATIO OF ENERGY GENERATED PER COUNTRY



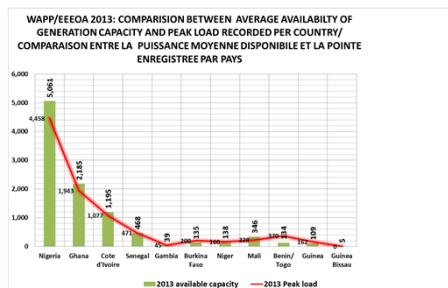
ENERGY TRADING AT INTERCONNECTION



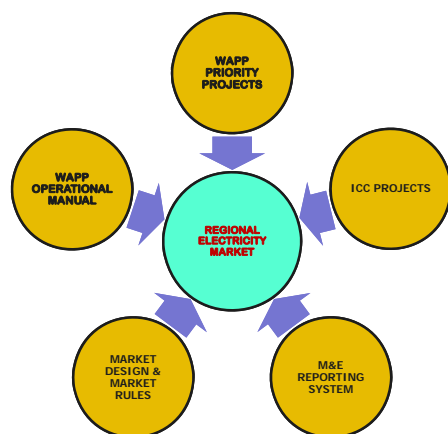
Cross-Border Trading



Availability vs Peak



Power Pool Operation



Benefit of Power Pooling

Benefits to be expected from developing interconnections and operating power pools

- ❑ optimized generation resources with large units, **gas and water**
- ❑ improved power system reliability with reserve sharing, **more robust grid and shared responsibilities**
- ❑ enhanced security of supply through mutual assistance, **assistance during crises**
- ❑ reduced capital and operating cost through improved coordination among power utilities, **coordinated dispatch and maintenance**
- ❑ increase in inter-country electricity exchanges, **regional integration**
- ❑ development of a regional market for electricity, **regional competition**
- ❑ coordinated generation and transmission expansion

Constraints to Power Pool Development

Major constraint / challenges to development and operation of power pools

- ❑ Lack of trust and confidence, Inter Governmental MoU
- ❑ Inadequate generation and reserve margin, **regional expansion project**
- ❑ Underdeveloped transmission network and tie lines, **regional expansion project**
- ❑ Difficulties of mobilizing investment for power projects, **regional expansion plan**
- ❑ Lack of legal framework for electricity trading, **regional market rules**
- ❑ Lack of rules for access to transmission grid, **Energy Protocol**
- ❑ Lack of regional regulation, **regional regulator for cross border trading**

Operational Risks and Effects

Operational Risks

- ❑ Gas Supply
- ❑ Synchronization of Interconnection
- ❑ N-1 Criteria
- ❑ Cost Reflective Tariff

Effects

- ❑ PPA not being honoured
- ❑ Shortages in all countries
- ❑ Lack of liquidity (low revenue)

Generation and Transmission Priority Project

Implementation Strategy - WAPP Priority Projects

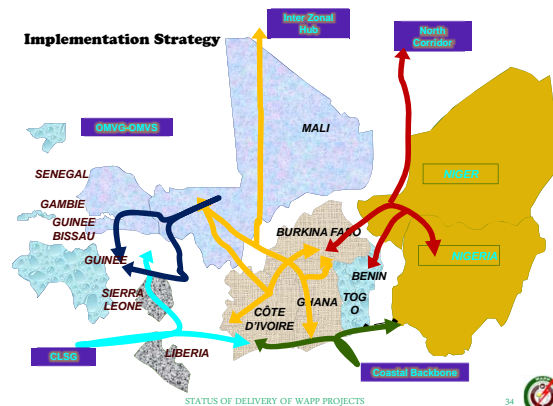
1. Coastal Transmission Backbone *Subprogram* (Côte d'Ivoire, Ghana, Benin/Togo, Nigeria).
2. Inter-zonal Transmission Hub Sub-program (Burkina Faso, OMVS via Mali, Mali via Côte d'Ivoire, LSG via Côte d'Ivoire).
3. North-core Transmission Sub-program (Nigeria, Niger, Burkina Faso, Benin).
4. OMVG/OMVS Power System Development Subprogram (The Gambia, Guinea, Guinea Bissau, Mali, Senegal)
5. Côte d'Ivoire-Liberia-Sierra Leone-Guinea Power System Re-development Subprogram (Côte d'Ivoire, Liberia, Sierra Leone, Guinea).
6. WAPP Strategic Generation Subprogram (Emergency Power Supply Security Plan).

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ECOWAS Revised Master Plan

- The first Master Plan for WAPP adopted by ECOWAS Council of Ministers in 1999 through Regulation C/REG.7/12/99
- Master Plan was revised in 2005 and adopted by the ECOWAS Heads of State and Government through Decision A/DEC.7/01/05
- The Revised Master Plan is being implemented as WAPP Priority Projects (Generation and Transmission)
- Utilizing diverse energy source in the region for generation
- Construct transmission lines to interconnect countries of West Africa

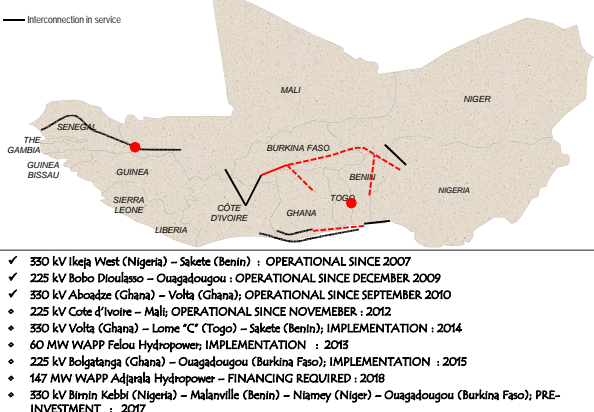
Implementation Strategy



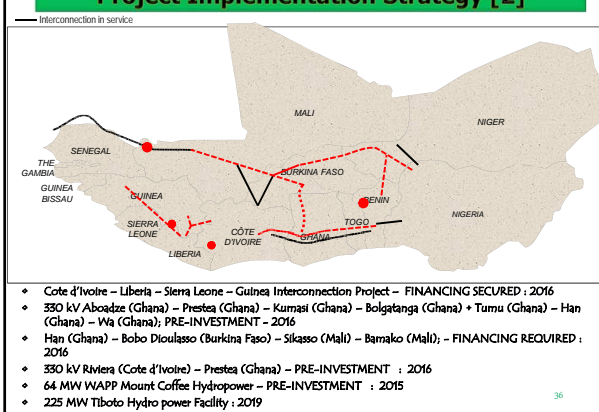
STATUS OF DELIVERY OF WAPP PROJECTS

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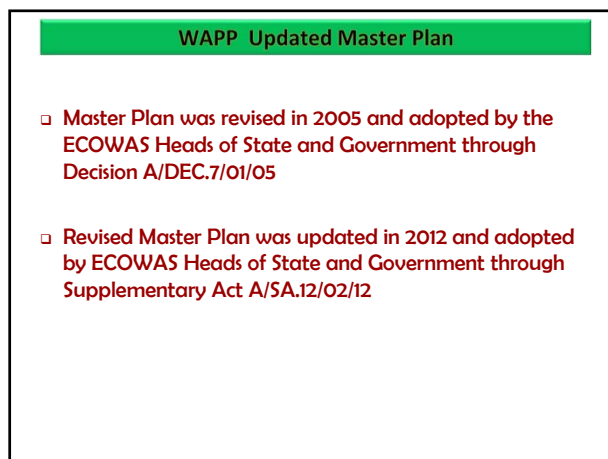
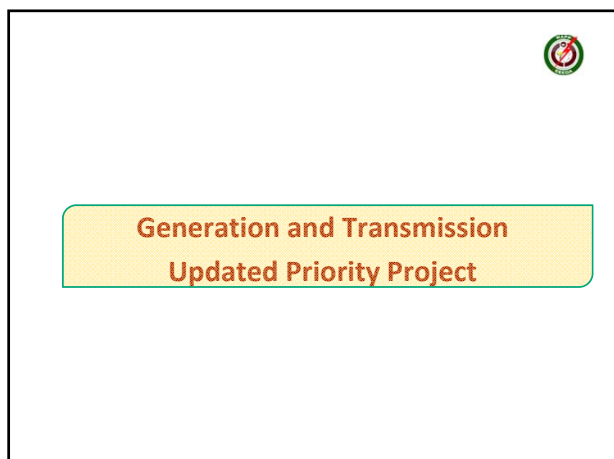
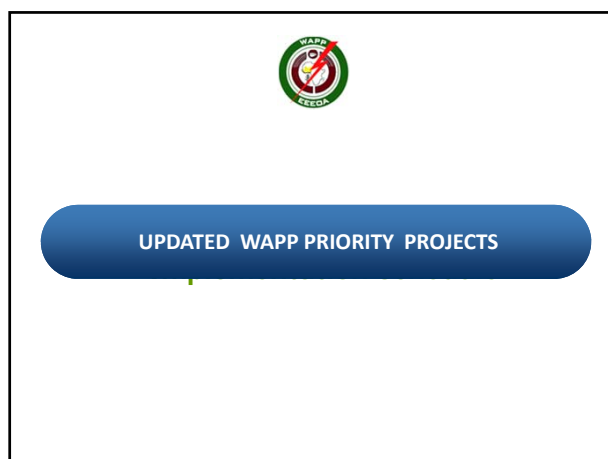
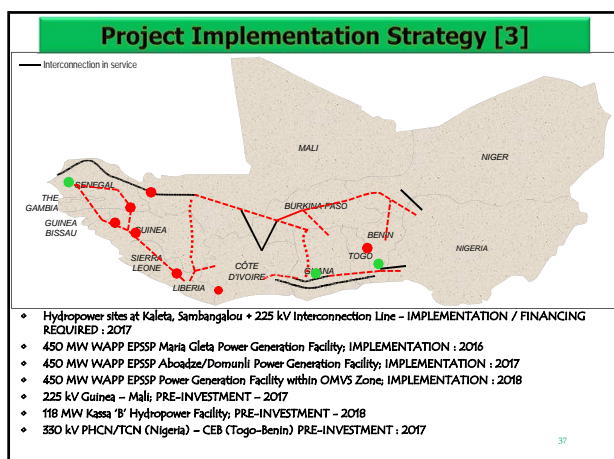
Project Implementation Strategy [1]



Project Implementation Strategy [2]



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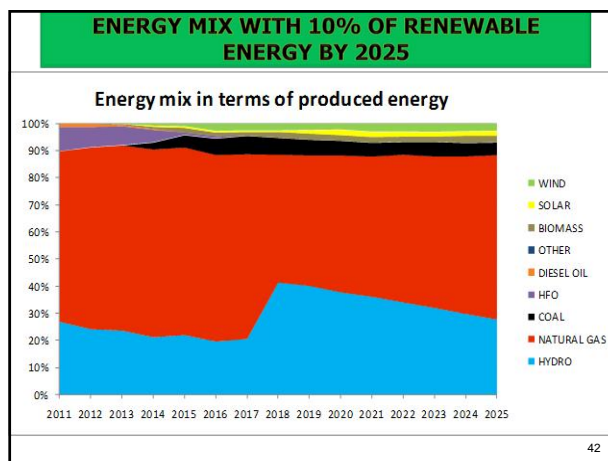
Updated ECOWAS Revised Master Plan

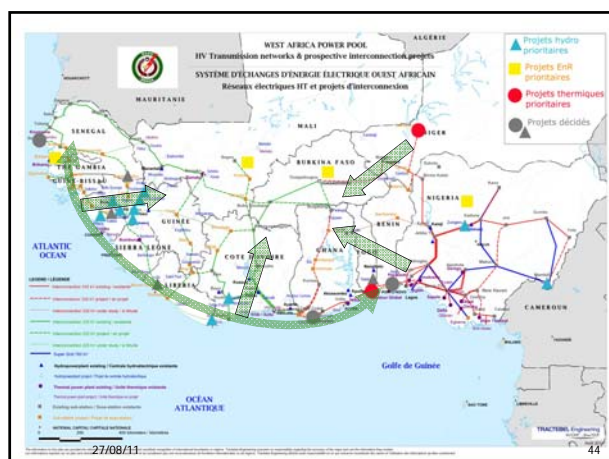
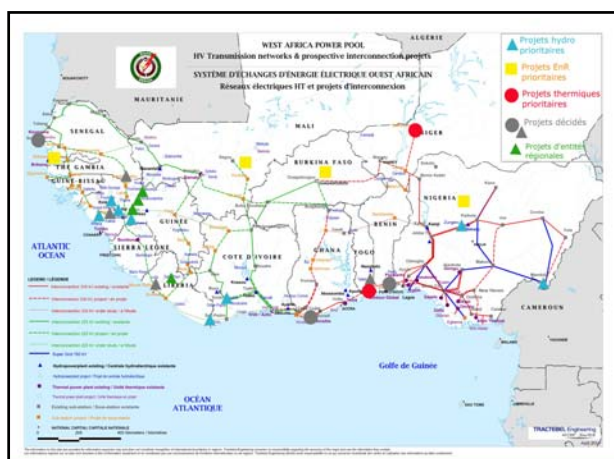
✓ Adopted by ECOWAS Heads of State and Government in February 2012 through Supplementary Act A/SA. 12/02/12

✓ Outcomes (2012-2025):

	No.	Cost (US\$ million)
Hydropower Projects (7,092 MW)	24	13,803
Thermal Power Projects (2,375 MW)	5	4,263
Renewable Energy Projects (800 MW)	4	1,893
Transmission Line Projects (16,000 km)	26	6,457

✓ Total Investment Requirement = **US\$26.416 billion**





POLICIES OF OPERATION MANUAL

- ❑ **P1:** Load Frequency Control
- ❑ **P2:** Interchange Scheduling and Accounting between Control Areas
- ❑ **P3:** Security of Interconnected System
- ❑ **P4:** System Operational Planning
- ❑ **P5:** Emergency Procedures and Measures
- ❑ **P6:** Communication Infrastructures
- ❑ **P7:** Information Exchange between Control Areas
- ❑ **P8:** Training of Operators of the Interconnected Systems



MEDIUM VOLTAGE CROSS-BORDER PROJECTS

Status of Implementation of MV Cross Border Projects 1st ACP-EU Energy Facility



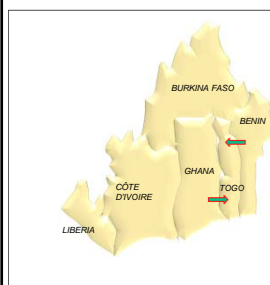
- ✓ Fully funded by EU together with SONABEL, VRA, ECG, CEB, CEET, CI-Energies, LEC.
- ✓ Ghana - Togo: Completed and commissioned.
- ✓ Ghana - Burkina Faso: Completed and commissioned
- ✓ Cote d'Ivoire - Liberia:
 - Works in Cote d'Ivoire Completed
 - Works in Liberia ongoing and expected to be commissioned in 2015

STATUS OF DELIVERY OF WAPP PROJECTS

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Status of Implementation of MV Cross Border Projects 2nd ACP-EU Energy Facility

Southern Togo - Ghana and Northern Togo - Benin :



STATUS:

- Fully funded by EU together with ECG, CEB, and CEET
- Preparatory Studies (Line Route Survey, ESIA and Technical Feasibility Studies) have been completed and Final Reports submitted;
- Preparation of Bidding Documents being finalised.

NEXT STEPS:

- WAPP to launch Bidding Documents and conclude Contractor Selection process

Information & Coordination Center

WAPP ICC – Objectives

- ❑ Promote operational coordination between Transmission and Generation WAPP Members and
- ❑ Actual day-to-day information sharing/exchange between WAPP Information & Coordination Center and Control Area Centers.
- ❑ Facilitate efficient trading of power between entities in the different countries that are interconnected in the region

ICC Program & Activities

- ❑ Facilitate the development of technical norms and standards for the collection and treatment of useful information for the efficient operation of the national and interconnected electric net works;
- ❑ Support and monitor the technical performance of the electricity utilities;
- ❑ Publish and distribute printed reports as necessary;
- ❑ Develop and maintain electronic databases of relevant technical information

ICC Program & Activities

- ❑ Collection and analysis of country data
- ❑ Development regional operations manual & Implement procedures
- ❑ Development and harmonisation of regional technical operating and planning standard
- ❑ Specify infrastructure requirements for ICC Information & Coordination Centre (computing, equipment, telecommunications, GIS, physical environment)
- ❑ Establish Cooperation Agreement

ICC Program & Activities

- ❑ Develop implementation plan for a regional electricity market, including market rules, governance / institutional arrangements, standard contracts, wheeling charges, specification of software and equipment requirements
- ❑ Establishment of website for outreach and data exchange
- ❑ WAPP Information & Coordination Centre Building
- ❑ Publish data reports

Roles and Responsibilities

Missions of ICC – Additional Responsibilities

Support national and control area centres in operation of interconnected system

- ❑ Coordination Centre
- ❑ Information Centre
- ❑ Centre for simulation

Act as transparent and independent regional electricity market operator

- ❑ Coordination between the different actors in the region
- ❑ Monitor and dispatch the exchanges
- ❑ Manage financial transactions
- ❑ Put in place Market Rules

Strategy for System Reliability

- ❑ WAPP Operation Manual was developed with the support of a consultant from EDF under USAID Technical Assistant in 2008.
- ❑ The WAPP Operation Manual contains policies for operations security and mitigation plan.
- ❑ The WAPP Operation Manual governs the operation of WAPP interconnected network (Grid Code)
- ❑ A Gap Analysis of the Manual has been done to determine the equipment and programs required to fill the gap

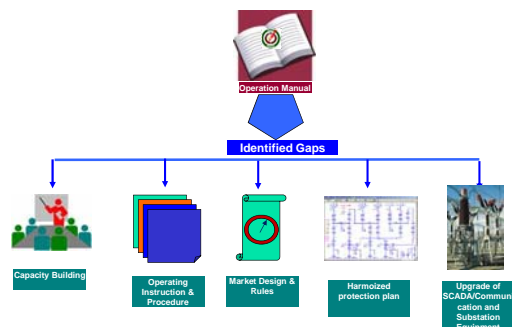
WAPP OPERATION MANUAL

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- ❑ The WAPP Operation Manual contains policies for operations security and mitigation plan.
- ❑ The WAPP Operation Manual governs the operation of WAPP interconnected network (Grid Code)
- ❑ A Gap Analysis of the Manual identified programs required for unified regional integration

Policies of Operation Manual

- ❑ **P1:** Load Frequency Control
- ❑ **P2:** Interchange Scheduling and Accounting between Control Areas
- ❑ **P3:** Security of Interconnected System
- ❑ **P4:** System Operational Planning
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- ❑ **P8:** Training of Operators of the Interconnected Systems

GAP ANALYSIS OF OPERATION MANUAL



WAPP System Reliability

Reliability Condition Precedent

- ❑ Improve Generation
- ❑ Better Frequency Control
- ❑ Better Voltage Profile
- ❑ Harmonize of Protection
- ❑ Apply Specific Procedure and Operating Instructions at interconnections
- ❑ Kainji & Jebba Hydropower Stations to provide primary frequency control – rehabilitation NBA funding by World Bank
- ❑ Establish Control Area Centers

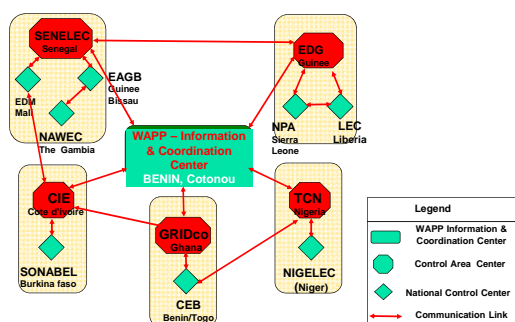
WAPP Integration Project -Status

- ❑ **Scope of the Contract :**
 - Phase 1: Studies, Bidding documentation for necessary additional equipment, Procurement services – 1 year
 - Phase 2: Owner's Engineer mission – 2 years
- ❑ **Detailed Scope Phase 1:**
 - Review of Operating Rules in WAPP Interconnected Countries
 - Calibration of the existing system model – including measurement campaign on site
 - Static and dynamic system simulations
 - Back to Back DC link alternative in Sakété Substation
 - Proposals for adaptation of existing operating rules
 - Implementation Preparation
 - Competences development
 - Procurement services
- ❑ **Project situation:**
 - RFP issued to preselected consultants on 31st March 2014.
 - Proposals to be submitted on 26th May 2014.

6/25/2014

ICC Projects situation

Operations Hierarchy



Reliable Operations – Short term

- ❑ WAPP has secured \$21million grant from the World Bank for Integration of WAPP Networks
- ❑ The objective is strengthen network reliability through
 - technical assistance and
 - Procurement and installation of equipment for the secured synchronization
- ❑ Implementation of harmonized Protection
- ❑ Implementation transmission priority project that facilitate the N-1 conditions
- ❑ Establish Reliability Management Committee

Reliable Operations – Medium & Long Term

- ❑ The long term strategy to ensure a more and reliable operations includes
- ❑ Implement smart grid solutions:
 - ❑ Power System Stabilizer (PSS) on generators
 - ❑ Phasor Measurement Units (PMU)
 - ❑ Wide Area Measurement Systems (WAMS)
 - ❑ Install Static Voltage Compensation (SVC) system
- ❑ Develop system defence scheme

WAPP ICC Project

WAPP ICC PROJECT

- ❑ WAPP obtained a KOICA grant from South Korean Government and appointed KEPCO to do a study to design the communication and data infrastructure required for the implementation of ICC Project.
- ❑ KEPCO submitted the final reports on the Feasibility Study and Basic Design of the WAPP ICC Project in June 2009
- ❑ The KEPCO proposed the project be implemented in three phases at an estimated cost of \$135million
 - ❑ Phase 1= \$26.7;
 - ❑ Phase 2 = \$83.5;
 - ❑ Phase 3 = \$25.2

WAPP Integration Project -Status

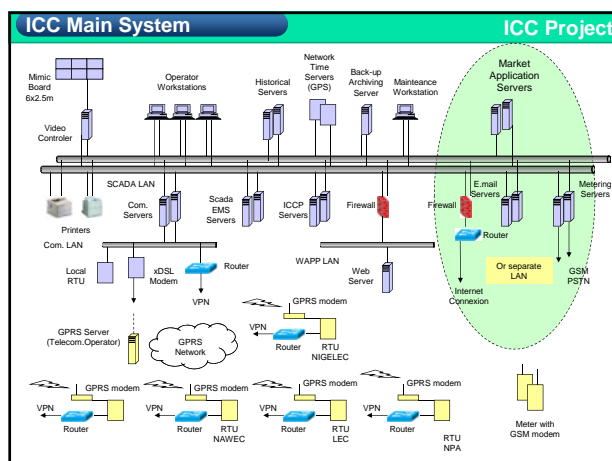
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6/25/2014

ICC Projects situation

Implementation of ICC Project

- ❑ WAPP applied for €60 million EU grant to implement the ICC Project, which includes installation of equipment for
 - Communication network
 - SCADA
 - Metering
 - Data Center
 - Hardware & Software for ICC
 - Construction of WAPP Headquarters Complex in Calavi
- ❑ Funding gap of \$57.5million



WAPP DARK FIBRE PROJECT

- ❑ The World Bank sponsored a study for determine the viability of the utilizing dark fiber installed on WAPP Utility's member high voltage transmission line the following documents were developed.
 - ❑ **Technical & Commercial**
 - ❑ **Management & Regulatory Structure**
- ❑ The study was done to complement the communication requirement of the ICC Project.
- ❑ Investment cost to enhance the Western and Eastern Rings is estimated to cost \$36.9 million

Dark Fibre Implementation Strategy

- ❑ Form a WAPP Dark Fiber Leasing Consortium
- ❑ Appoint Management Consultant
- ❑ Provide services to GSM operators
- ❑ Provide reliable telecommunication medium for the WAPP ICC

Development of Regional Electricity Market

JUSTIFICATION OF REGIONAL MARKET

Political Willingness

- There is a political decision and instruments for the development of the regional market
- Resources are complementary in the region which suggests strongly the benefits of an integration in a regional market (oil and gas in the east mainly and hydro in the west)

Regional Planning

- There are trades already ongoing in the region which demonstrates the capacity and willingness of countries to trade
- There is infrastructure being developed for regional trading

LEGAL FRAMEWORK FOR REGIONAL MARKET

Economic Cooperation

- **The ECOWAS Treaty**

Energy Act

- **The ECOWAS Energy Protocol**
Establish legal framework for securing competitive market

Reforms

- **Unbundling of the large Utilities**
(Nigeria, Ghana, Senegal)

Regulation

- **Supplementary Act A/SA.2/1/08** Establishing the ECOWAS Regional Electricity Regulatory Authority **ERERA**

Regional Planning

- **Articles of Agreement** of the West African Power Pool Organisation and Functions (October 2005) (**WAPP**)

Minimum Requirement Regional Market

Technical Requirement

- Open access to the spare capacity in the transmission systems
- Agreement on a method for payment of wheeling services
- *Agreement on which assets constitute the regional network and the manner to pay for the use of these assets (transmission tariff)*

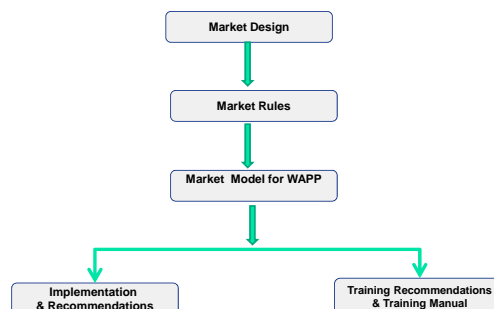
Market Governance

- Operation Rules
- Trading Rules
- Regional Regulations

WAPP MARKET DEVELOPMENT

- A consultant, Mercados, was selected to develop the WAPP Market Design and WAPP Market Rules
 - **Road Map**
 - **WAPP Market Design;**
 - **WAPP Market Rules**
 - **Implementation Plan**
 - **WAPP Training Plan**
- The Executive Board approved that the WAPP Market Design and WAPP Market Rules be submitted to ERERA for approval

ELECTRICITY IMPLEMENTATION ROAD MAP



WAPP Market Design

MARKET DESIGN STRUCTURE

- The description of each Market Phase is made in an ordered manner following the next structure:
 - Market phase general description (introduction)
 - Conditions precedent to pass from one Phase to the following
 - Registration of Market Participants
 - Transactions in the market
 - The role of the Regional Market Operator during the implementation
 - The role of the domestic TSOs during the Phase
 - The Regional Transmission Network
 - Planning Regional Projects

MARKET PHASES

- **Phase 1:** From now and 2015 approximately when most regional transmission infrastructure is expected to be commissioned. Main characteristics of this phase would be:
 - The ICC has been appointed as the Regional System Market Operator begin developing market operation functions
- **Phase 2:** based on the preparations carried out during the first phase, activities will include but not limited to the following:
 - Short term exchanges through day ahead market (regional optimization model)
 - Independent Regional (System and) Market Operator
- **Phase 3:** a long term vision which would include:
 - A liquid and competitive market in the region.
 - Possibility of trading different product integrating other markets: market for some ancillary services, financial products.

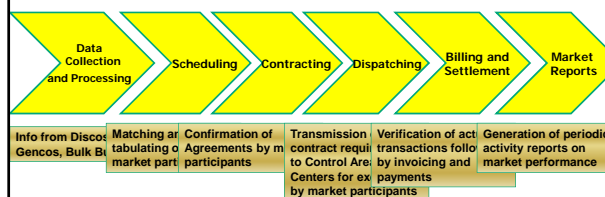
WAPP Market Rules

MARKET RULES

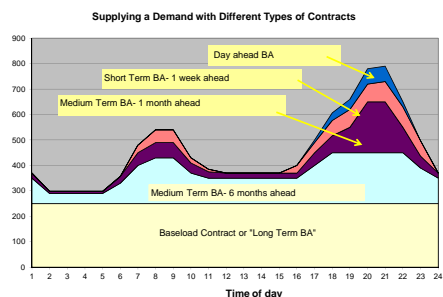
- 9 Chapters & 72 Articles
- Containing
 - Technical
 - Commercial
 - Financial
 - Settlement
 - Regulation
 - Legal
- Operations Hierarchy:
 - WAPP ICC: >
 - Control Area Center ->
 - National Control

Chapter I: Introduction and Objectives
 Chapter II: General Conditions
 Chapter III: The SMO
 Chapter IV: The Control Areas
 Chapter V: The Domestic TSOs
 Chapter VI: Market Phase 1
 Chapter VII: Market Phase 2
 Chapter VIII: Governance
 Chapter IX: Miscellaneous

TYPICAL TRANSACTION IN THE MARKET

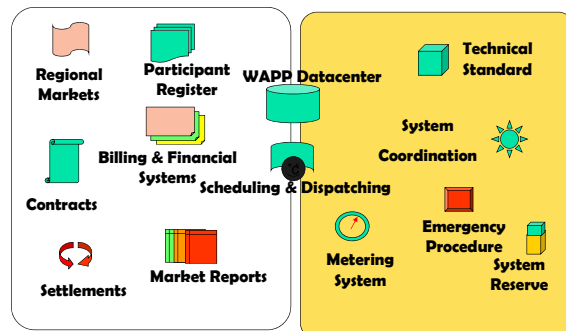


ELECTRICITY MARKETS



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REGIONAL SYSTEM MARKET OPERATION



Capacity Building

TRAINING NEEDS

Compulsory Training

- Implementation Road map
- WAPP Market Design
- WAPP Market Rules
- Operation Procedures
- WAPP Operation Manual

Additional Training

- International experience
- Microeconomics
- Power Pool & Market Operation

TRAINING PLAN

Training Implementation Strategy

- **Model 1** – Establish an Independent Stand-alone Regional Centre for Training
- **Model 2** – Add-on a “Power Sector Trade Capacity Building Program” to an Existing Entity in the Region
- **Model 3** - Starting a “WAPP Capacity Building Program” as a Specific Program
- **Workshops** – Dissemination of Operation Manual, Market Implementation Road & Market Rules (60 participants)
- **Certification Program** – System Operation and Engineer

TRAINING CATEGORIES

- ❑ **Compulsory Training** : subjects that are compulsory for professional staff from WAPP Secretariat as well as staff from utilities involved in power trading in one manner or another should know in detail the subjects included in this category.
- ❑ **Additional Training Needs**: the subjects included in this category are basic and somehow necessary for a better comprehension of power trading in general terms and power trading at regional level.

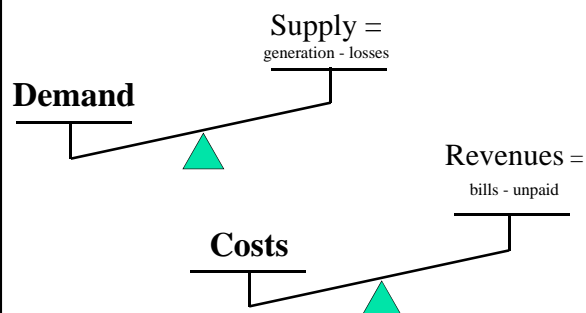
TRAINING PLAN 1

Compulsory Training

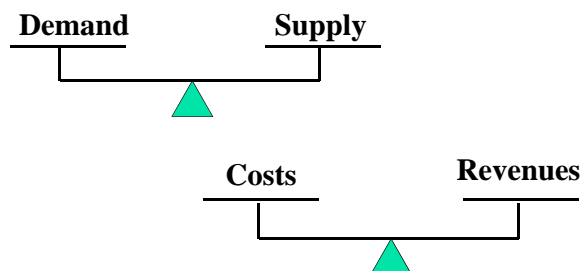
- Implementation Road map
- WAPP Market Design
- WAPP Market Rules
- Operation Procedures
- WAPP Operation Manual

Distribution Delima

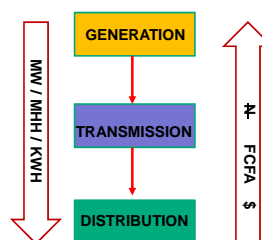
How can utilities go from the double crisis ...



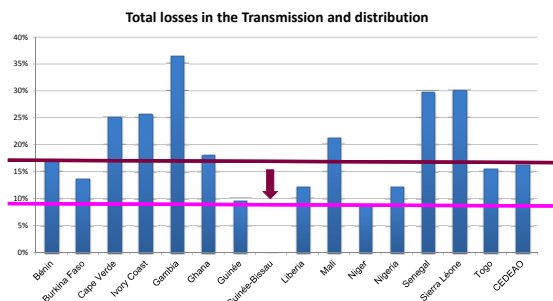
... to a double equilibrium?



ELECTRICITY VALUE CHAIN



verview of total energy losses



ECOWAS Energy Efficiency Policy



- Main objective
 - Double annual improvement in energy efficiency by 2020, to levels comparable to world leaders
- Six specific targets have been defined
- Five initiatives on: *Lighting; Standards & Labels; Cooking; Electricity Distribution; Buildings*

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Specific targets



- Phase out inefficient incandescent lamps by 2020
- **Reduce average losses in electricity distribution from the current levels of 15 - 40% to below 10%**
- Achieve universal access to safe, clean, affordable, efficient and sustainable cooking for entire ECOWAS population by 2030
- Establish an ECOWAS technical committee for Energy Efficiency Standards and Labels; adopt initial region wide standards for lighting by 2014
- Improve energy efficiency in buildings

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THANK YOU



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