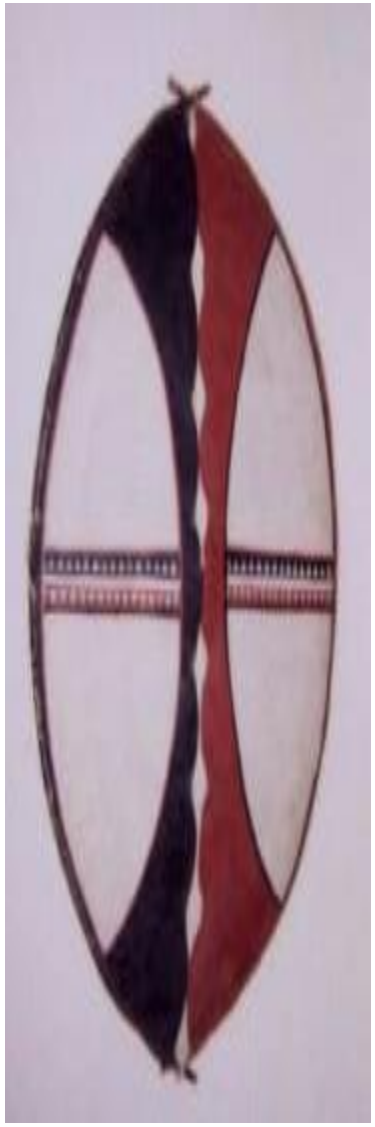
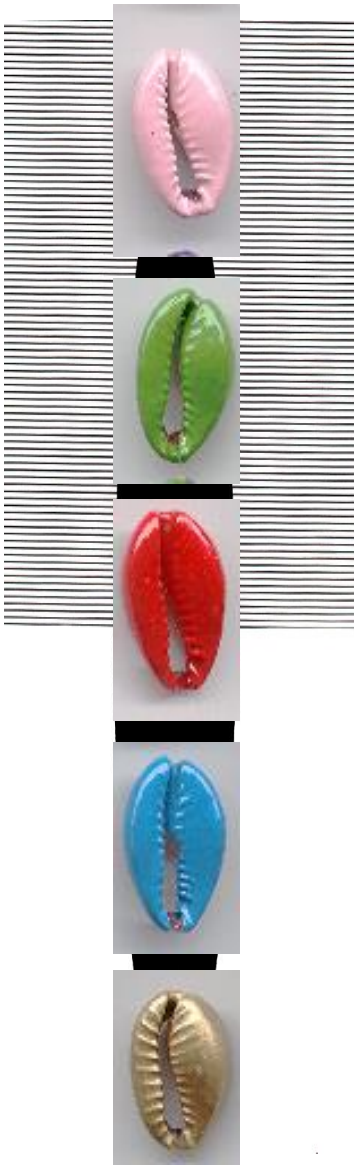


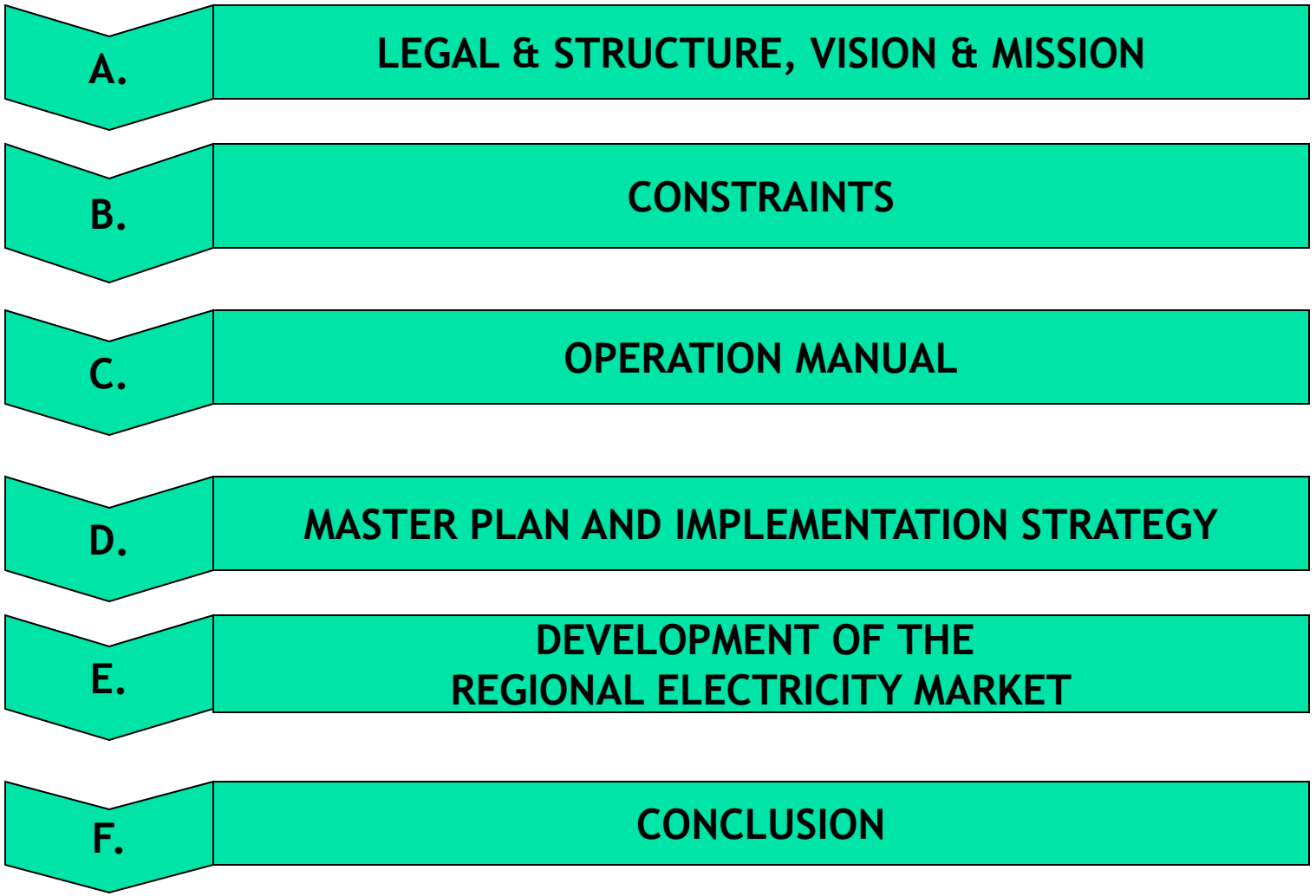
WEST AFRICAN POWER POOL

South Asia Regional Workshop on Competitive Electricity Markets

Colombo, SriLanka: March 18, 2014

Babatunde Adeyemo
Director, Information & Coordination Center




A.
LEGAL & STRUCTURE, VISION & MISSION
B.
CONSTRAINTS
C.
OPERATION MANUAL
D.
MASTER PLAN AND IMPLEMENTATION STRATEGY
E.
DEVELOPMENT OF THE
REGIONAL ELECTRICITY MARKET
F.
CONCLUSION

Location


ARCTIC OCEAN
Greenland
Svalbard (Nor.)
ARCTIC OCEAN
United States of America
Canada
Iceland
Norway
Sweden
Finland
Russia
United Kingdom
Denmark
Neth.
Ireland
Ger.
Pol.
Estonia
Latvia
Belarus
Ukraine
Kazakhstan
Mongolia
France
Italy
Rom.
Georgia
Bulgaria
Azer.
Uzb.
Kyrgyzstan
Tajikistan
Turkm.
Portugal
Spain
Turkey
Greece
Tunisia
Lebanon
Syria
Iraq
Afg.
Pakistan
China
N. Korea
S. Korea
Japan
Nepal
Bhutan
Morocco
Israel
Kuwait
Jordan
Saudi Arabia
U.A.E.
Oman
India
Laos
Taiwan
Western Sahara
Libya
Egypt
Mauritania
Mali
Niger
Chad
Eritrea
Yemen
Djibouti
Sudan
Bangl.
Burma
Thailand
Vietnam
Philippines
Cambodia
Malaysia
Sri Lanka
Senegal
Guinea-Bissau
Sierra Leone
Liberia
Cote d' Ivoire
Ghana
Togo
Nigeria
Cam.
C.A.R.
Ethiopia
Somalia
Gabon
Dem. Rep. of Congo
Uganda
Kenya
Tanzania
Rep. of the Congo
Angola
Zambia
Malawi
Namibia
Zimbabwe
Madagascar
Botswana
Mozambique
Swaziland
Lesotho
South Africa
Mexico
Guatemala
Honduras
Nicaragua
Costa Rica
Panama
Colombia
Ecuador
Ven.
Guyana
French Guiana
Suriname
Brazil
Peru
Bolivia
Paraguay
Chile
Argentina
Uruguay
PACIFIC OCEAN
ATLANTIC OCEAN
INDIAN OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
Indonesia
Papua New Guinea
Solomon Islands
Fiji
Australia
New Zealand

ECOWAS Fact File

- Fifteen countries
- Population 340 million (4th)
- Area: 5,112,903 km^2 (7th)
- Density 49.2/km^2
- Total available generation 10,000MW
- Av. Electricity Access: 70%

Legal and Governance

Creation of WAPP – Key Dates

Date	Policies / Decisions
December 1999	Creation of WAPP by the ECOWAS Heads of State and Government
January 2003	Adoption of Energy Protocol by the ECOWAS Heads of State and Government
January 2003	Creation of Energy Observatory by the ECOWAS Heads of State and Government
January 2005	Adoption of Revised Master Plan by the ECOWAS Heads of State and Government
January 2006	Adoption of Articles of Agreement for the establishment of WAPP by the ECOWAS Heads of State and Government
	ECOWAS Heads of State and Government establish WAPP as a specialized institution of ECOWAS

Creation of WAPP – Key Dates

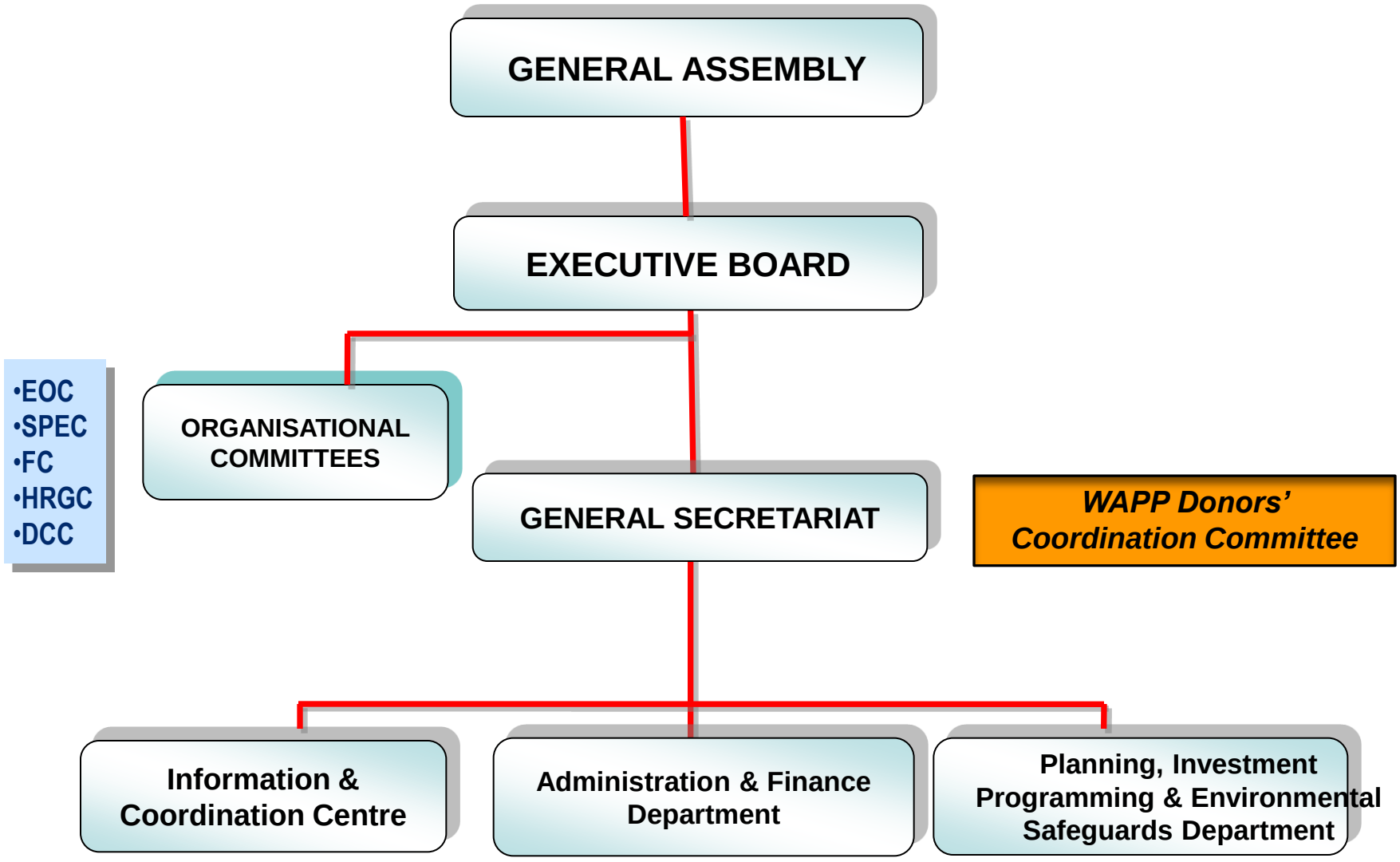
Date	Policies / Decisions
July 2006	National utilities in West Africa sign the Articles of Agreement thereby creating the General Assembly of the WAPP Organization
	WAPP General Assembly establish Executive Board and adopt 2006-2009 Business Plan for WAPP
January 2008	ECOWAS Heads of State and Government create the ECOWAS Regional Electricity Regulatory Authority
January 2008	ECOWAS Heads of State and Government adopt through Supplementary Act, the WAPP Transmission Line Implementation Strategy that approves the establishment of Special Purpose Companies under the frame work of public- public and public-private partnerships
February 2012	ECOWAS Heads of State and Government

WAPP MANDATE

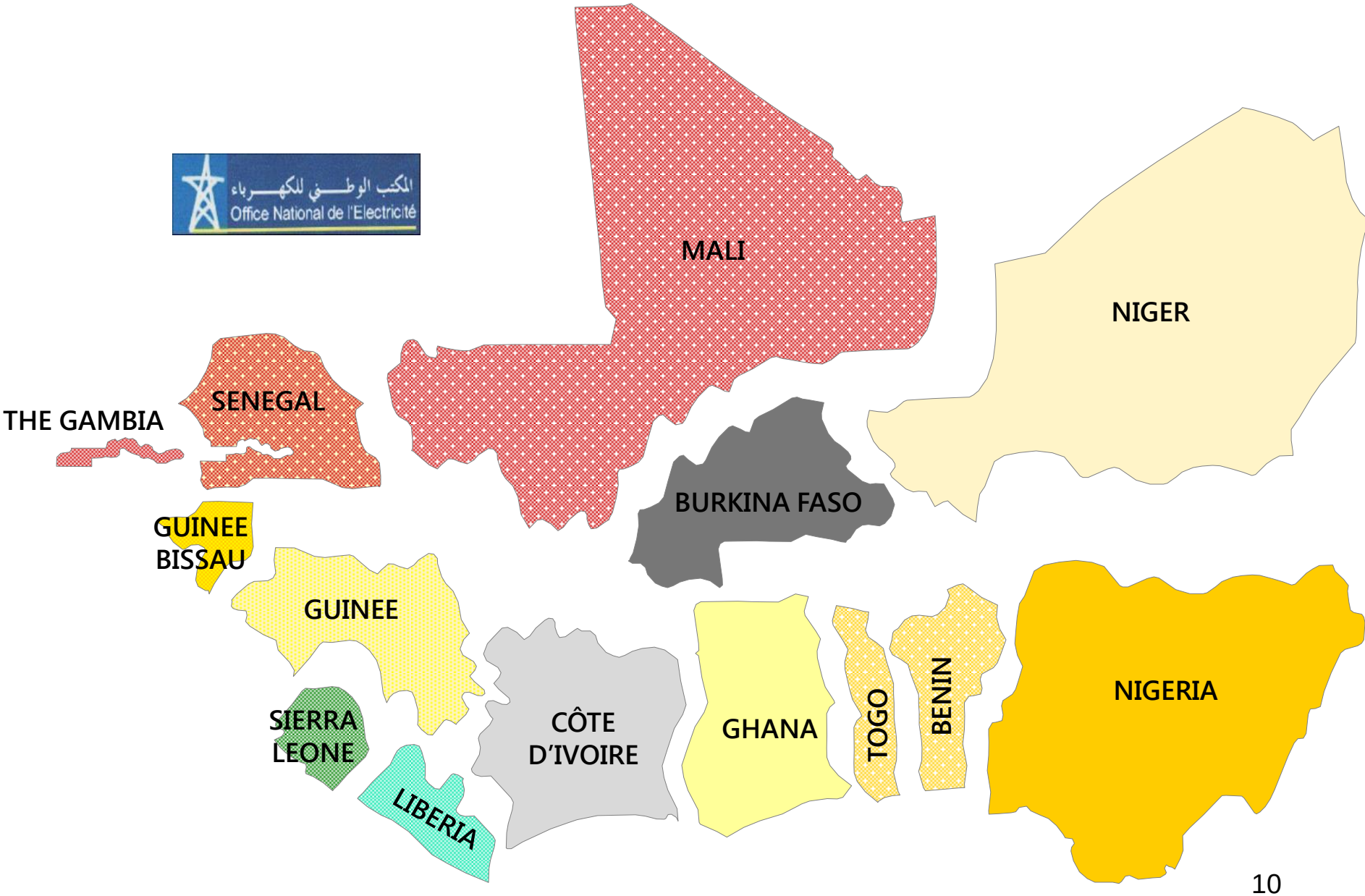
1. Vision of WAPP: To integrate the national power systems into an unified regional electricity market – with the expectation that such mechanism would over the medium to long term, ensure the citizens of ECOWAS Member States with a stable and reliable electricity supply at competitive costs

   Mission of WAPP: To promote and develop infrastructure for power generation and transmission, as well as, to assure the coordination of electric power exchanges between ECOWAS Member States

Organizational Structure

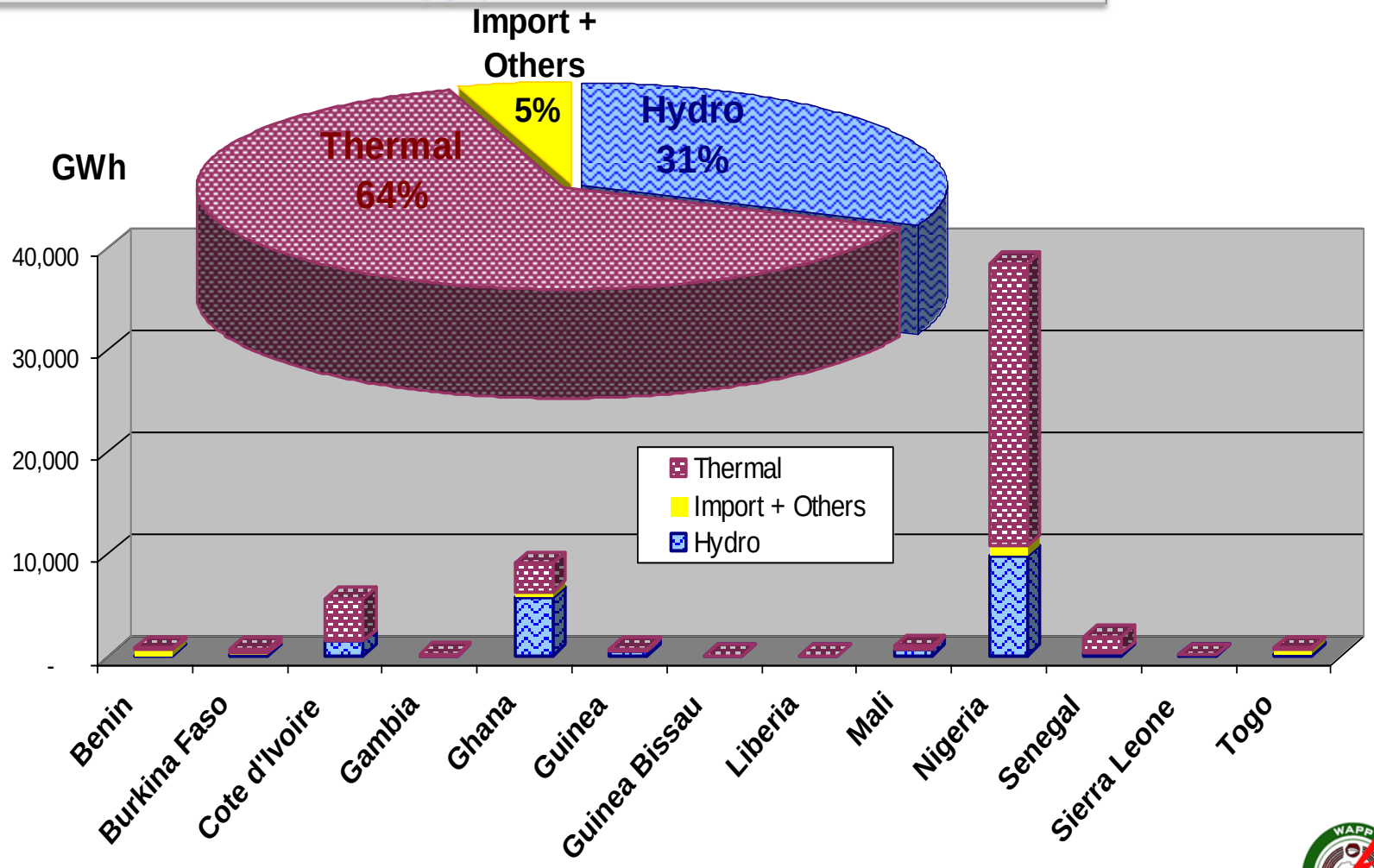


WAPP MEMBER COUNTRIES

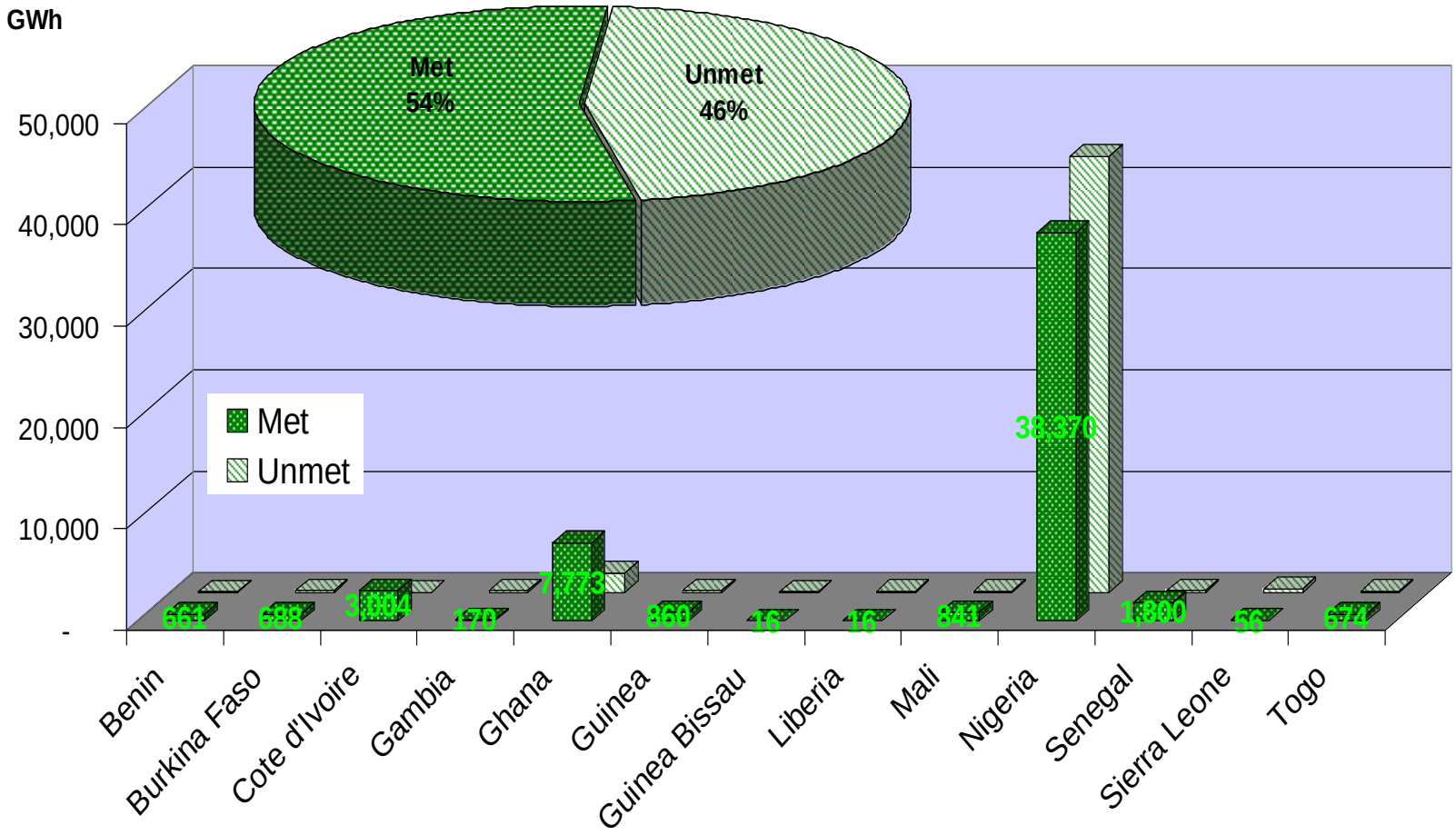


Constraints

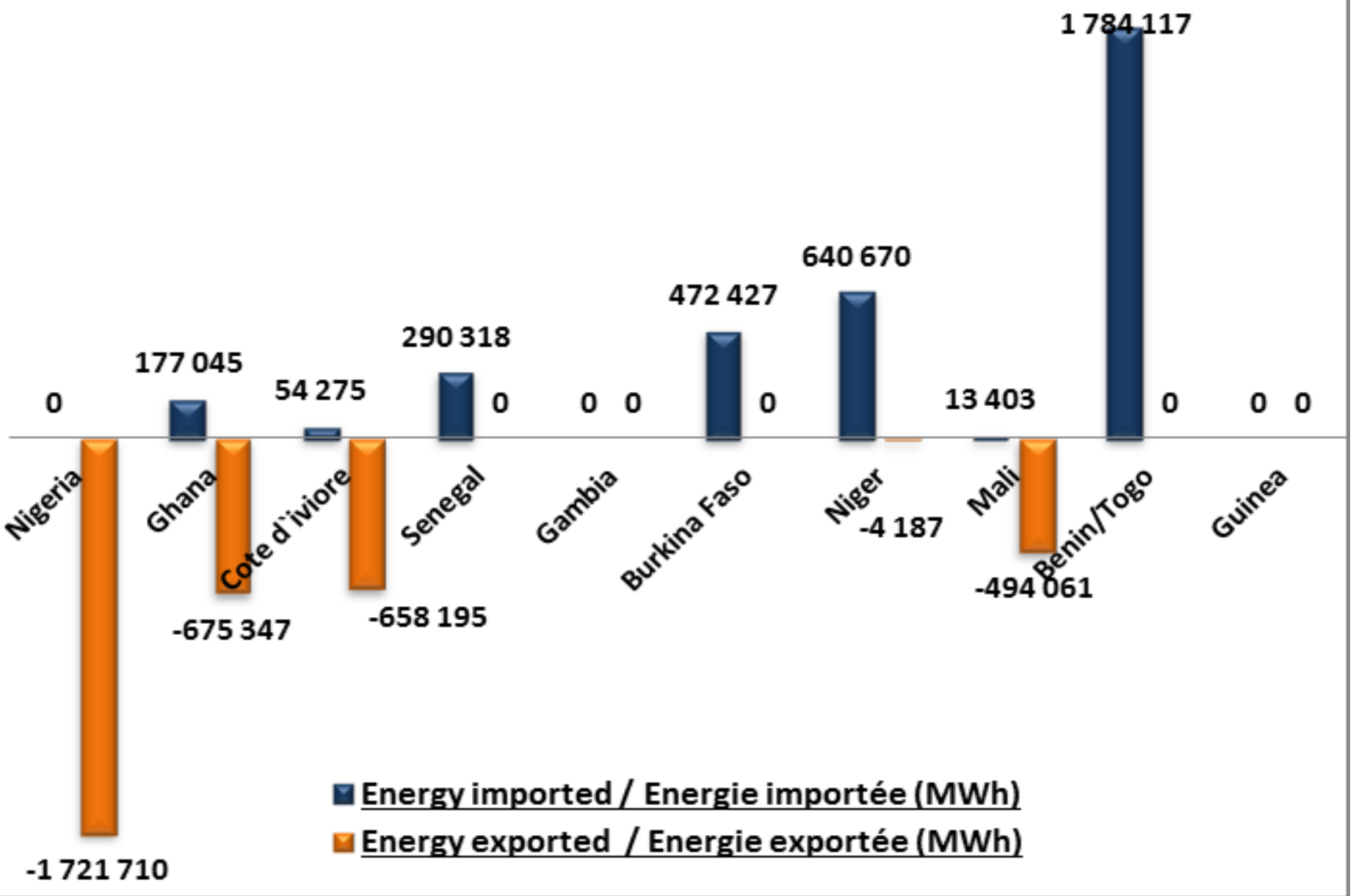
Status of Power Supply in ECOWAS: Supply Sources2



Status of Power Supply in ECOWAS: Demand-Supply Balance

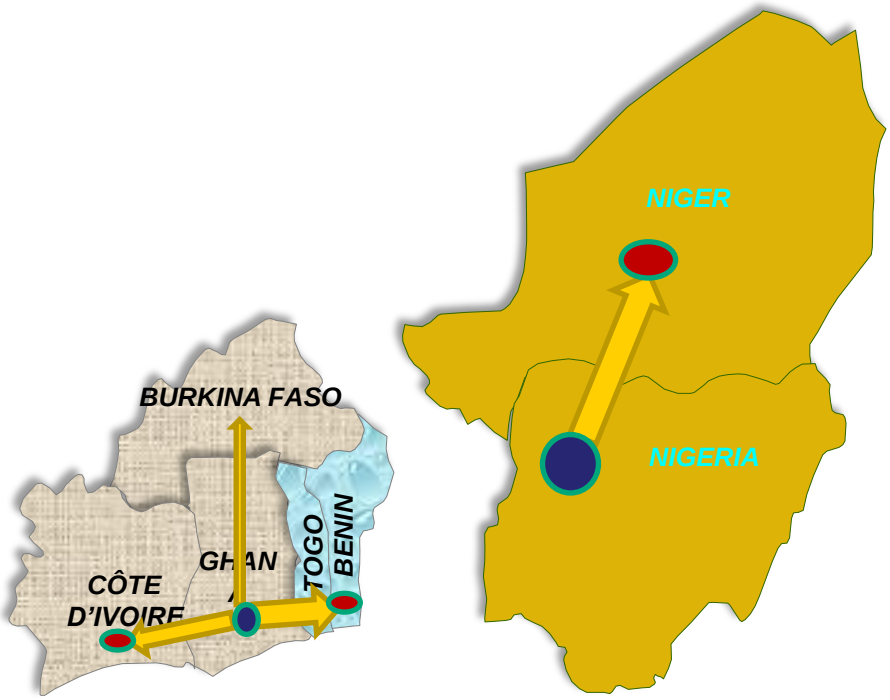


Cross Border Electricity Trading



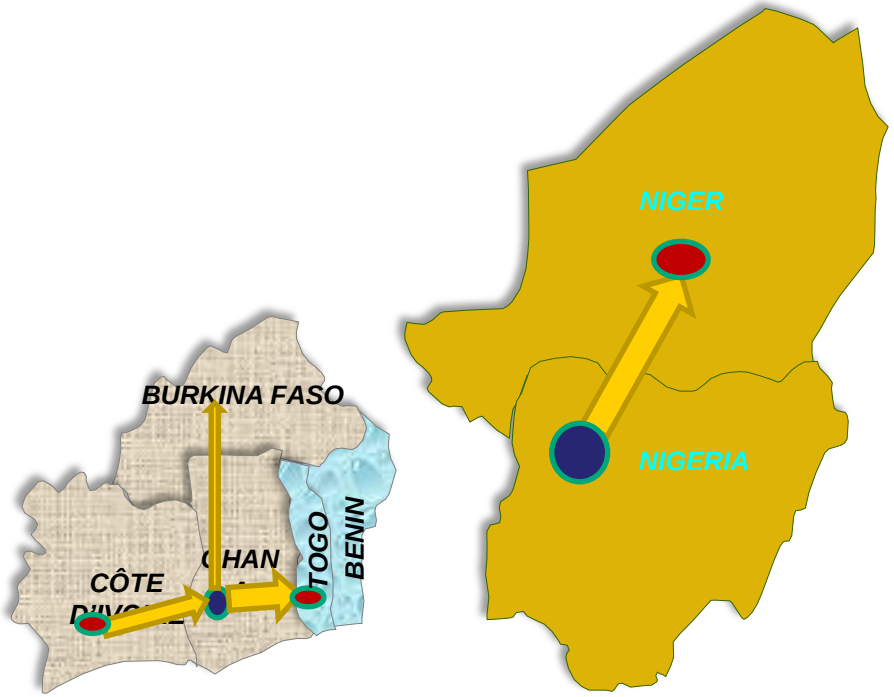
Cross Border (1979 – 1989)

- Ghana and Nigeria trade excess capacity



Cross Border (1990 – 2007)

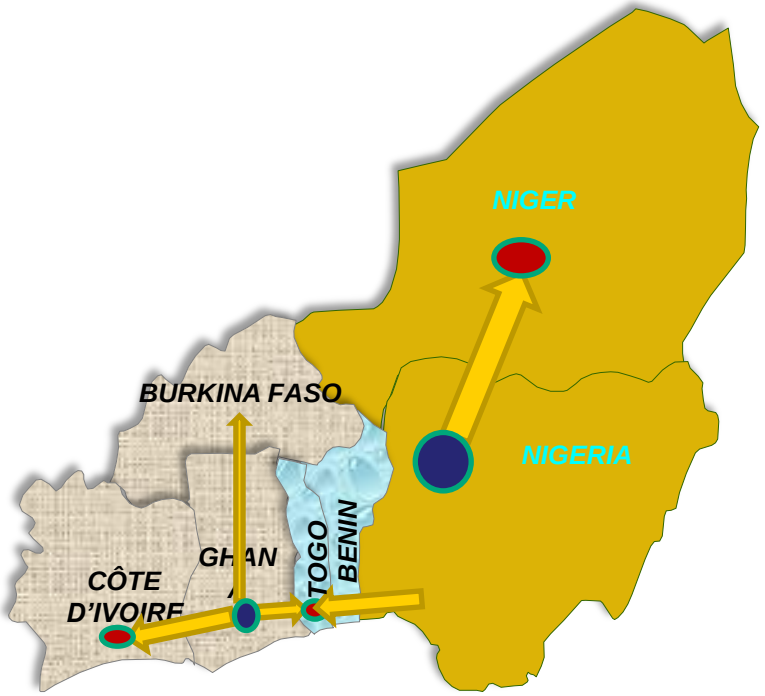
- Cote d'Ivoire doubled required national generation capacity and export excess to Ghana



Cross Border (2008 – till date)

Cross Border Flow (2007 -)

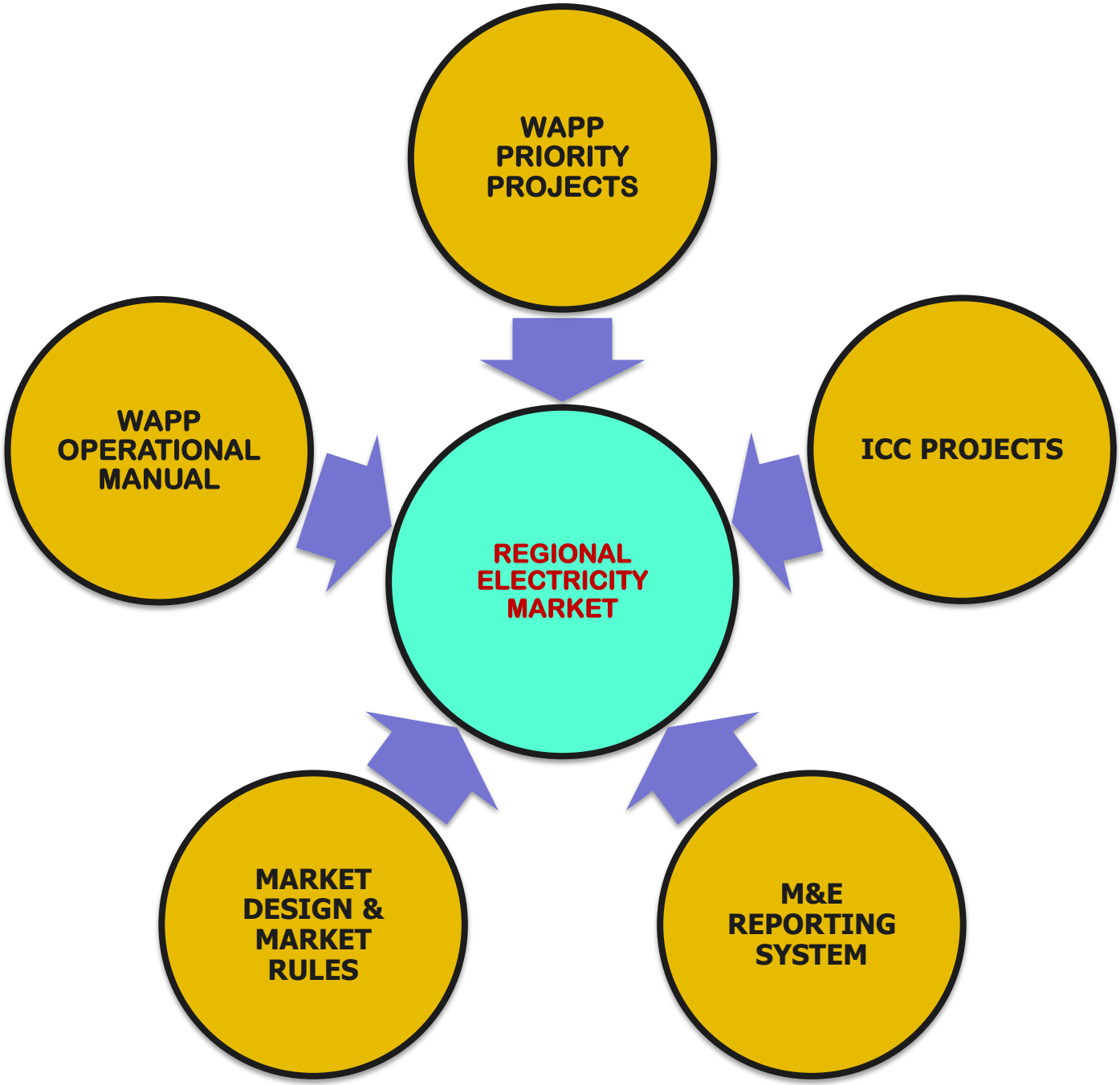
- Merged inteconnections



Initial Constraints

- Inadequate generation
  - Old aged generators
- Weak national transmission network
- Limited interconnection for cross-border electricity trade
- Low capacity diesel generators in the network
- Supply three land locked countries
- Lack of funding

Market Development Strategy


WAPP PRIORITY PROJECTS
WAPP OPERATIONAL MANUAL
REGIONAL ELECTRICITY MARKET
ICC PROJECTS
MARKET DESIGN & MARKET RULES
M&E REPORTING SYSTEM

WAPP Priority Projects

IMPLEMENTATION STRATEGY

- Mobilise resources for the preparation of Priority Projects;
- Ensure the preparation of the priority projects for financing;
- Mobilise resources for the implementation of the priority projects;
- Coordinate and monitor the implementation of the priority projects during their realisation;

IMPLEMENTATION MODELS

Traditional Model :
Implementation Committe to coordinate the activities in each concerned country

Regional Model: Creation of Special Purpose Company (SPC):

The Authority of ECOWAS Heads of State and Government adopted in January 2008 two (2) Supplementary Acts that govern the implementation of WAPP Priority Projects:

- Transmission Lines – Special Purpose Company jointly owned by ECOWAS Member States/WAPP Member Utilities;

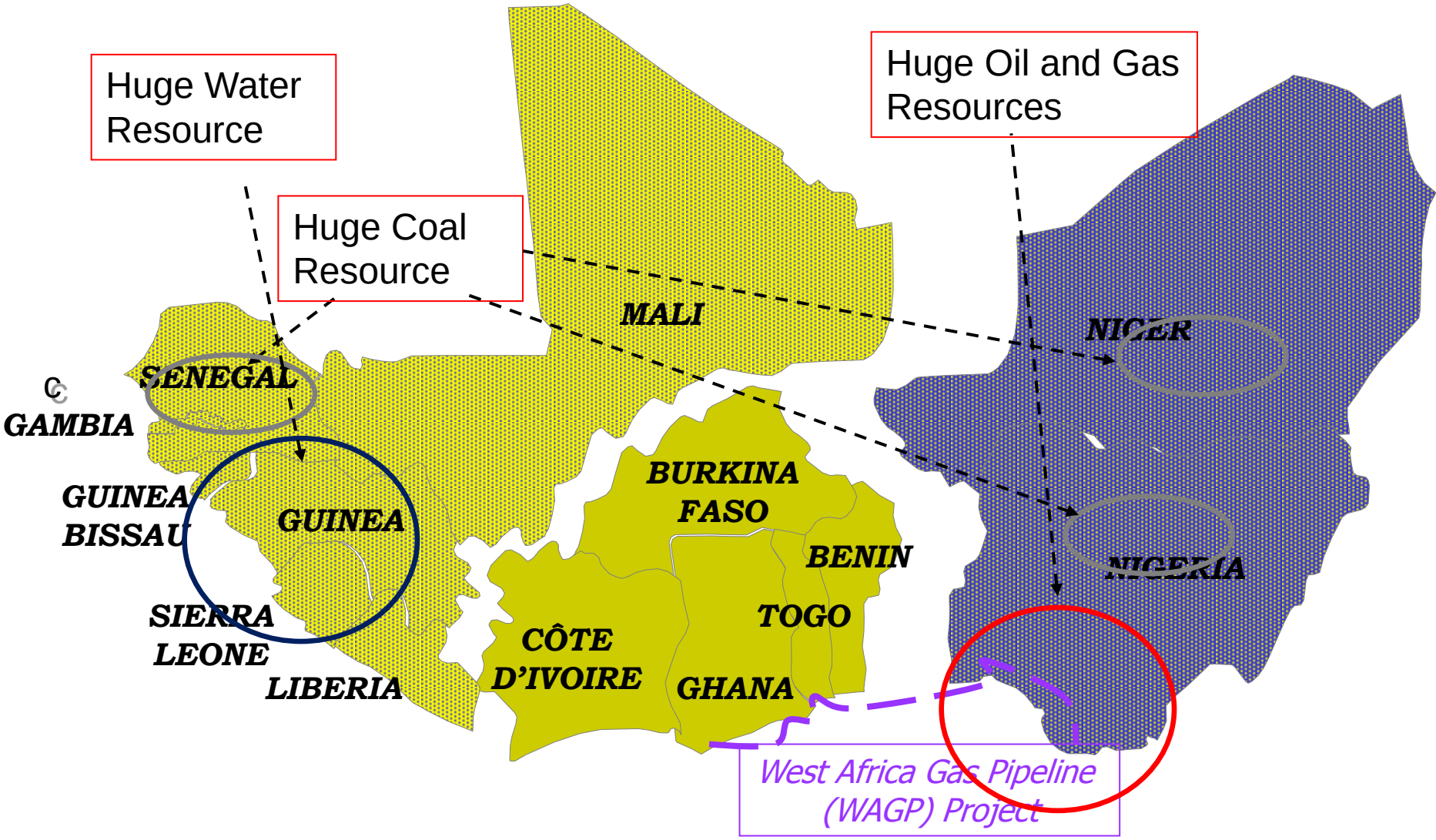
- Regional Power Generation Facilities – Special Purpose Company to be jointly owned by Private Partners and ECOWAS Member States/WAPP Member Utilities

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

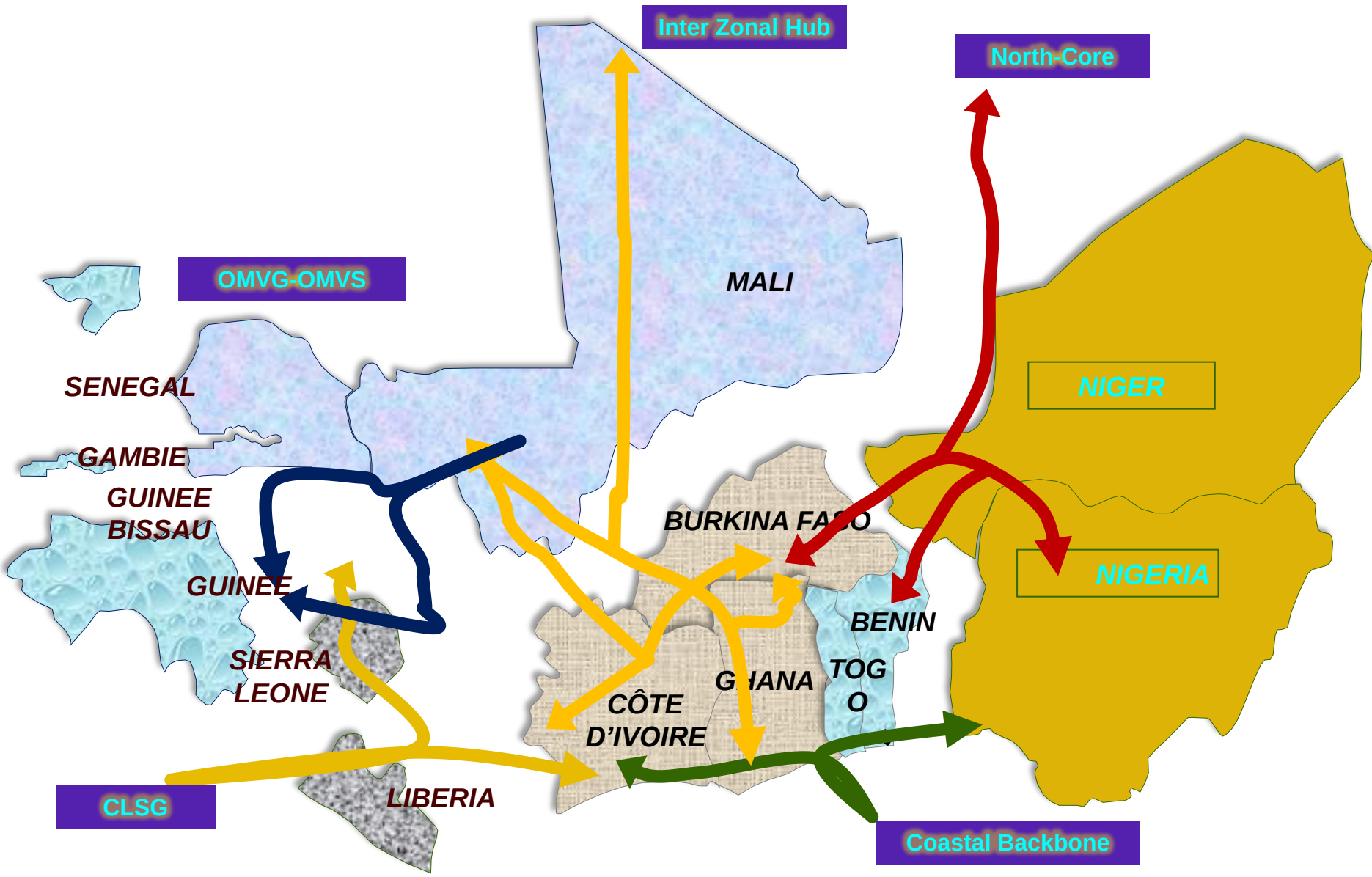
Utilization of Diverse Primary Energy Resources



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).

Project Implementation Strategy



PRIORITY PROJECTS

	Project	Commissioning
Coastal Transmission Backbone Sub-program		
	330 kV Aboadze (Ghana) – Volta (Ghana) - ***Operational***	*2010*
	330 kV Volta (Ghana) – Lomé "C" (Togo) – Sakété (Benin) – **Implementation**	2014
	330 kV Riviera (Cote d'Ivoire) – Prestea (Ghana) – **Pre-investment**	2016
	330 kV Nigeria – Benin Interconnection Reinforcement Project – **FINANCING REQUIRED for Pre-investment Studies (€2.9 million)**	2017
	330 kV Sakété (Benin) – Ikeja West (Nigeria) **– *Operational***	*2007*
Interzonal Transmission Hub Subprogram		
	330 kV Aboadze (Ghana) – Prestea (Ghana) – Kumasi (Ghana) – Han (Ghana – **Pre-investment**	2016
	161 kV Tumu (Ghana) – Han (Ghana) – Wa (Ghana); – **Implementation**	2014
	225 kV Bolgatanga (Ghana) – Ouagadougou (Burkina Faso) - **Implementation**	2016
	Han (Ghana) – Bobo (Burkina Faso) – Sikasso (Mali) – Bamako (Mali) - **Mobilisation of Financing (€172 million)**	2016
	225 kV Bobo Dioulasso (Burkina Faso) – Ouagadougou (Burkina Faso) **– *Operational***	*2009*
	Ferkéssedougou (Cote d'Ivoire) – Sikasso (Mali) – Ségou (Mali) – ***Operational***	*2012*
Northcore Subprogram		
	330 kV Birnin Kebbi (Nigeria) – Bembéréké (Benin) – Niamey (Niger) – Ouagadougou (Burkina Faso) – **FINANCING REQUIRED for Pre-investment Studies ((€5.3 million)**	2017

PRIORITY PROJECTS

	Projects	Commissioning
OMVG-OMVS System Development Subprogram		
	Projet Hydro-électrique de Félou (60MW) – **Implementation (€205 million)**	2015
	Projet Hydro-électrique Gouina (95MW) + 225kV Doublement de la ligne de transport - **Pre-investment**	2016
	Projets hydroélectriques Kaléta (240MW), Sambagalou(128MW) + 225 kV Ligne d'interconnexion – **Implementation, mobilisation of financing (€748 million)**	2015, 2018
	Development of Souapiti Hydropower Facility in Guinea (515MW) - **Pre-investment**	2018
Cote d'Ivoire - Liberia – Sierra Leone – Guinée (CLSG) System Re-development Subprogram		
	Côte d'Ivoire – Liberia – Sierra Leone – Guinea Interconnection Project - **Implementation (€323 million)**	2017
	Redevelopment of Mount Coffee Hydropower Facility in Liberia (64MW) – **Implementation (US$225 million)**	2017
	Development of 118 MW Kassa 'B' Hydropower Facility in Guinea – **Pre-investment**	2019
	Development of 86 MW Bikongor Hydropower Facility in Sierra Leone – **Pre-investment**	2019
	Development of 270 MW Tiboto Hydropower Facility in Guinea – **FINANCING REQUIRED for Pre-investment Studies (€0.5 million)**	2020

PRIORITY PROJECTS

	Projets	Mis en service
Strategic Generation Subprogram		
	450 MW WAPP Maria Gleta Regional Power Generation Facility in Benin – **Mobilisation of Financing (US$652 million)**	2017
	450 MW WAPP Domunli Regional Power Generation Facility in Ghana - **Mobilisation of Financing (US$652 million)**	2017
	450 MW WAPP Regional Power Generation Facility within OMVS Zone - **Conception**	2018

MV Cross Border (Energy for Poor)

Medium Voltage Cross Border Electrification Sub-program		
	Côte d'Ivoire – Liberia: (Electrification of 18 rural communities (131,000 habitants) in Liberia from Côte d'Ivoire – **Implementation (€9.65 million)**	JULY 2013
	Ghana – Togo: (Electrification of12 rural communities (42,500 habitants) in Togo from Ghana – **Commissioned (€3.6 million)**	2012
	Ghana – Burkina Faso: (Electrification of 7 rural communities(32 000 habitants) in Burkina from Ghana – **Commissioned (€1.5 million)**	2011

MV Cross Border (Energy for Poor)

Medium Voltage Cross Border Electrification Sub-program		
	Southern Togo – Ghana: (Electrification of 9 rural communities (16,141inhabitants) in Southern Togo from Ghana – **Implementation (€2.32 million)**	2015
	Northern Togo - Benin: (Electrification of6 rural communities (15,778 habitants) in Togo from Benin – **Implementation (€2.14 million)**	2015

MV Cross Border (Energy for Poor)

Medium Voltage Cross Border Electrification Sub-program		
	Burkina Faso and Niger : Under Development	€15 million
	Ghana - Burkina Faso: Under Development	
	Côte d'Ivoire - Burkina Faso: Under Development	
	Senegal and The Gambia: Under Development	
	Mali - Guinea: Under Development	
	Côte d'Ivoire and Guinea: Under Development	

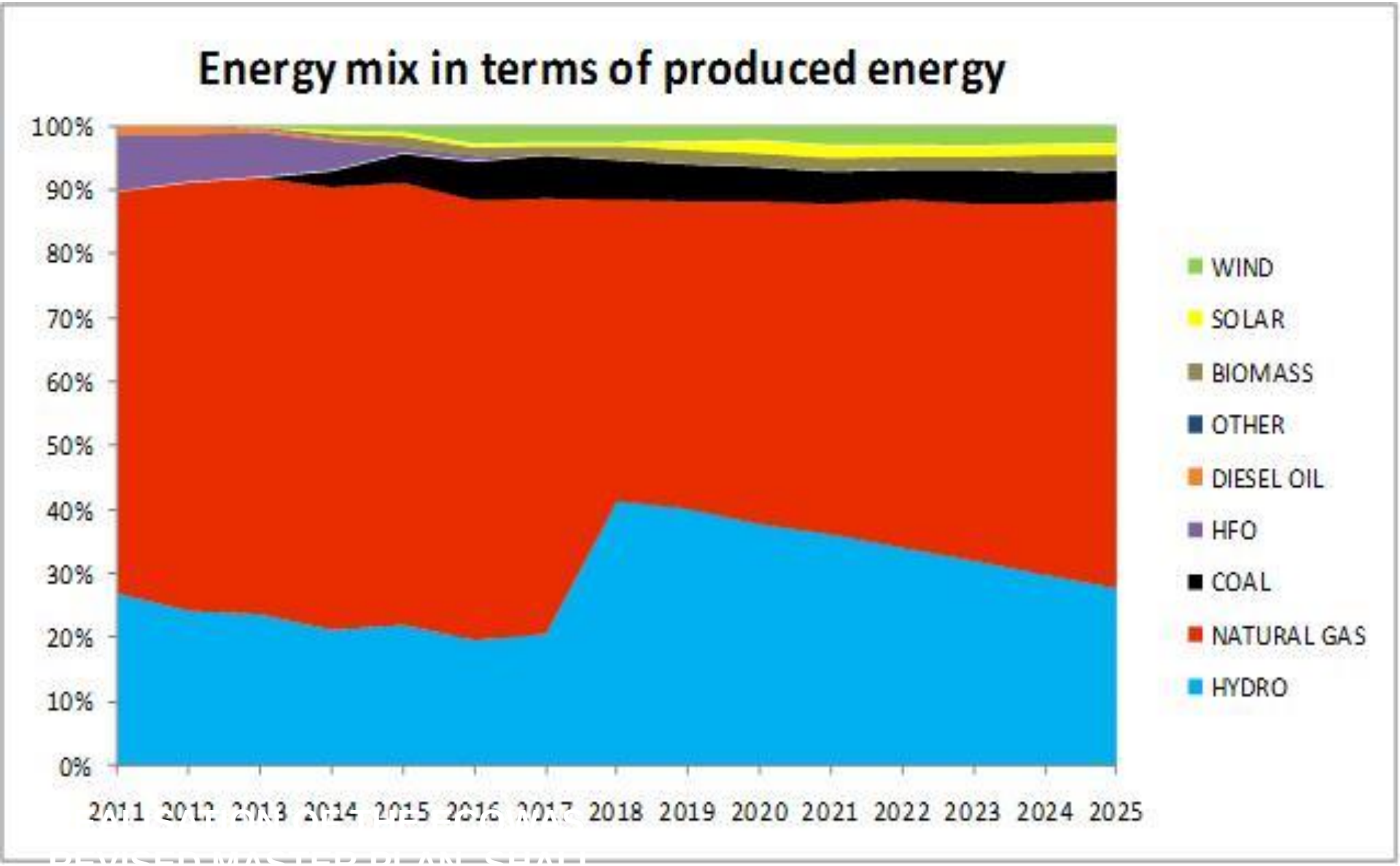
Updated ECOWAS Revised Master Plan

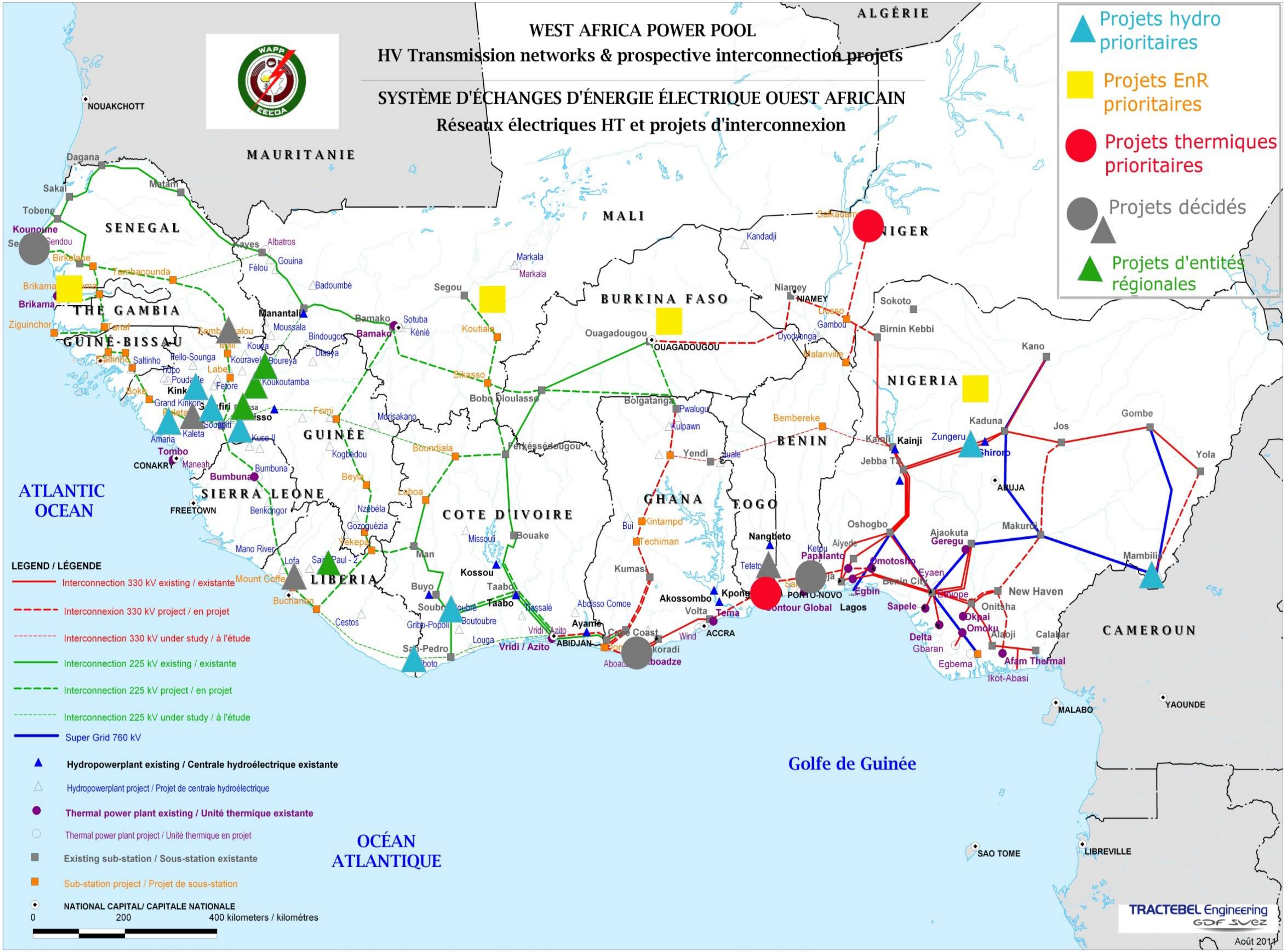
- ✓ Adopted by ECOWAS Heads of State and Government in February 2012 through Supplementary Act A/SA. 12/02/12
- ✓ Outcomes (2012-2025):

	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

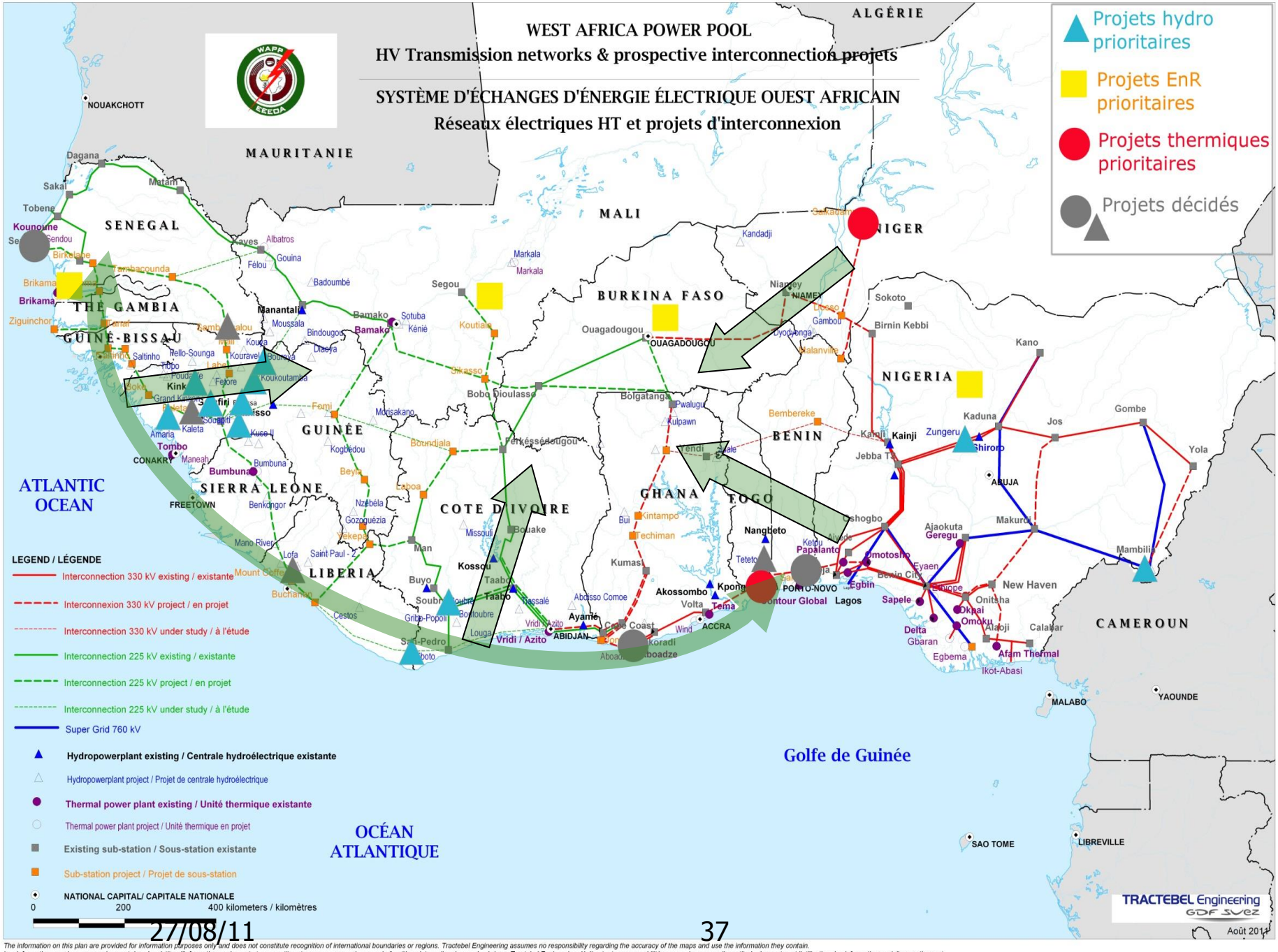
- ✓ Total Investment Requirement = US$26.416 billion

10% OF RENEWABLE ENERGY BY 2025





The information on this plan are provided for information purposes only and does not constitute recognition of international boundaries or regions. Tractebel Engineering assumes no responsibility regarding the accuracy of the maps and use the information they contain.
Les informations reprises sur ce plan sont données à titre d'information seulement et ne constituent pas une reconnaissance de frontières internationales ou de régions. Tractebel Engineering décline toute responsabilité en ce qui concerne l'exactitude des cartes et l'utilisation des informations qu'elles contiennent.



Generation Projects (2017)

Felou (Mali)	66MW
Maria Gleta (Benin)	450MW - WAPP Program
Domunli (Ghana)	450MW - WAPP Program
OMVS Region	450MW - WAPP Program
Souapiti Hydro	515 MW
Kassa 'B' Hydro	118 MW
Charbon (Senegal)	875MW
Sambangalou (Senegal/ Guinea)	433MW
Biu Hydro (Ghana)	600MW
NIPP (Nigeria)	6,000MW
Mount Coffee (Liberia)	66MW
Adjarala (CEB)	147MW

Expected Additional Generation by 2017	10,170MW

WAPP Operation Manual

WAPP OPERATION MANUAL

- 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 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
- **P5**: Emergency Procedures and Measures
- **P6**: Communication Infrastructures
- **P7**: Information Exchange between Control Areas
- **P8**: Training of Operators of the Interconnected Systems

STATUS OF APPROVAL WAPP OPERATION MANUAL

- WAPP Board Resolution 51/RES.20/20/04/09
- Defined and adopted the modalities for the implementation of WAPP Operation Manual for the WAPP interconnected system.
- During the eighth meeting of WAPP Executive Board held in Cotonou on April 26th, 2009

REGULATORY APPROVAL

- Submitted to ERERA for review and approval
- ERERA Consultant has presented draft final report to EOC
- ERERA final approval expected in the first quarter of 2014

Synchronization Project

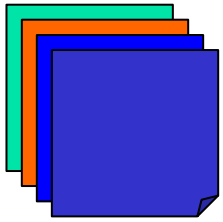
- World Bank Grant
- Synchronization of the interconnected systems and to the implementation of the Operation Manual.
- Supply and Installation of equipment to ensure secure and safe operation

MARKET-RELATED PROJECTS

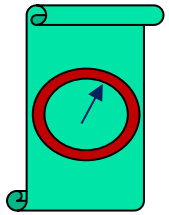
OSMP Manual

Identified Projects

Capacity Building



Operating Instruction & Procedure



Market Design & Rules

ICC Project

Synchronization Project

Justification for Regional Market

POLITICAL WILL

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

REGIONAL COOPERATION & LEGAL FRAMEWORK

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	❑ ERERA established by Supplementary Act A/SA.2/1/08
Regional Planning	❑ ECOWAS Master Plan implemented as WAPP Priority Projects

BASIS FOR REGIONAL MARKET

- Minimum Requirement for Regional Market

Technical Requirement

- Open access to the spare capacity in the transmission systems – Electricity exchange between WAPP Utilities
- Agreement on a method for payment of wheeling services – Power Purchase Agreement (PPA) between WAPP Utilities

Market Governance

- Operation Rules
- Trading Rules
- Regional Regulations

MARKET DESIGN AND RULES - OBJECTIVES

- Develop a Road Map required to transit from the present technical and commercial status to a regional electricity market and competitive wholesale market including time frame, resources.
- Appropriate model for actualizing the WAPP Regional Electricity Market.
- Develop electricity market rules such as: bidding process, physical spot market, financial market, clearing and settlement, and power balance mechanisms, including roles, responsibilities and interfaces between organizations.

WAPP Market Design

WAPP MARKET DESIGN

- Market Development is phased in accordance with **Implementation Road Map** that include condition precedent for the next Market Phase

- **Phase 1**: From now and 2015 approximately when most regional generation and transmission infrastructure are expected to be commissioned.
  - Appoint System Market Operator: which will begin developing market operation functions
- **Phase 2**: Formalized market - Short & Medium term electricity exchanges through day ahead market (DAM)
- **Phase 3**: a long term vision of a liquid and competitive market

WAPP Market Rules

CONTENT OF MARKET RULES

- 9 Chapters & 72 Articles

Containing

- Technical
- Commercial
- Financial
- Settlement
- Regulation
- Legal

❖ <u>Role & Responsibilities:</u>

- 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

STATUS OF APPROVAL OF WAPP MARKET DOCUMENTS

- WAPP Board Resolution 120/RES/.04/10/12
- Adopted the WAPP Market Design and WAPP Market Rules, Implementation Road Map
- Directive to submit the documents to ERERA for approval
- During WAPP Executive Board Meeting held in Cotonou on October 4th, 2012

REGULATORY APPROVAL

- WAPP Market Design and WAPP Market Rules Implementation Road Map have submitted to ERERA for review and approval
- ERERA has approved the Market documents
- ERERA has presented the Implementation Road Map to ECOWAS Ministers of Energy Meeting held in Yamoussoukro , May 2013

TRANSITION TO MARKET

- WAPP Board Resolution 120/RES/.04/10/12
- Adopted Resolution relating to 'Transition of WAPP Information & Coordination Centre to Regional System Market Operator'
- At nineteenth WAPP Executive Board Meeting held in Abuja on November 2, 2012

- General Assembly Decision WAPP/45/DEC.02/11/12
- Made a Decision relating to 'Transition of WAPP Information & Coordination Centre to Regional System Market Operator'
- At the Seventh Session of General Assembly held in Abuja on 2nd November, 2012

DIRECTIVE ON MARKET ORGANIZATION

- ECOWAS Ministers of Energy a Resolution No 6
- Resolution to commence organization of the ECOWAS Electricity Market
- At the eighth meeting of ECOWAS Ministers of Energy held in Yamoussoukro on 24th May, 2012.
- Recommended to Council of Ministers

- Council of Ministers Directive C/DIR.1/06/13
- Gave a Directive to commence organization of the ECOWAS Electricity Market
- At the seventh Session of Council of Ministers of ECOWAS held in Abidjan on 21st June 2012

Development of Infrastructure

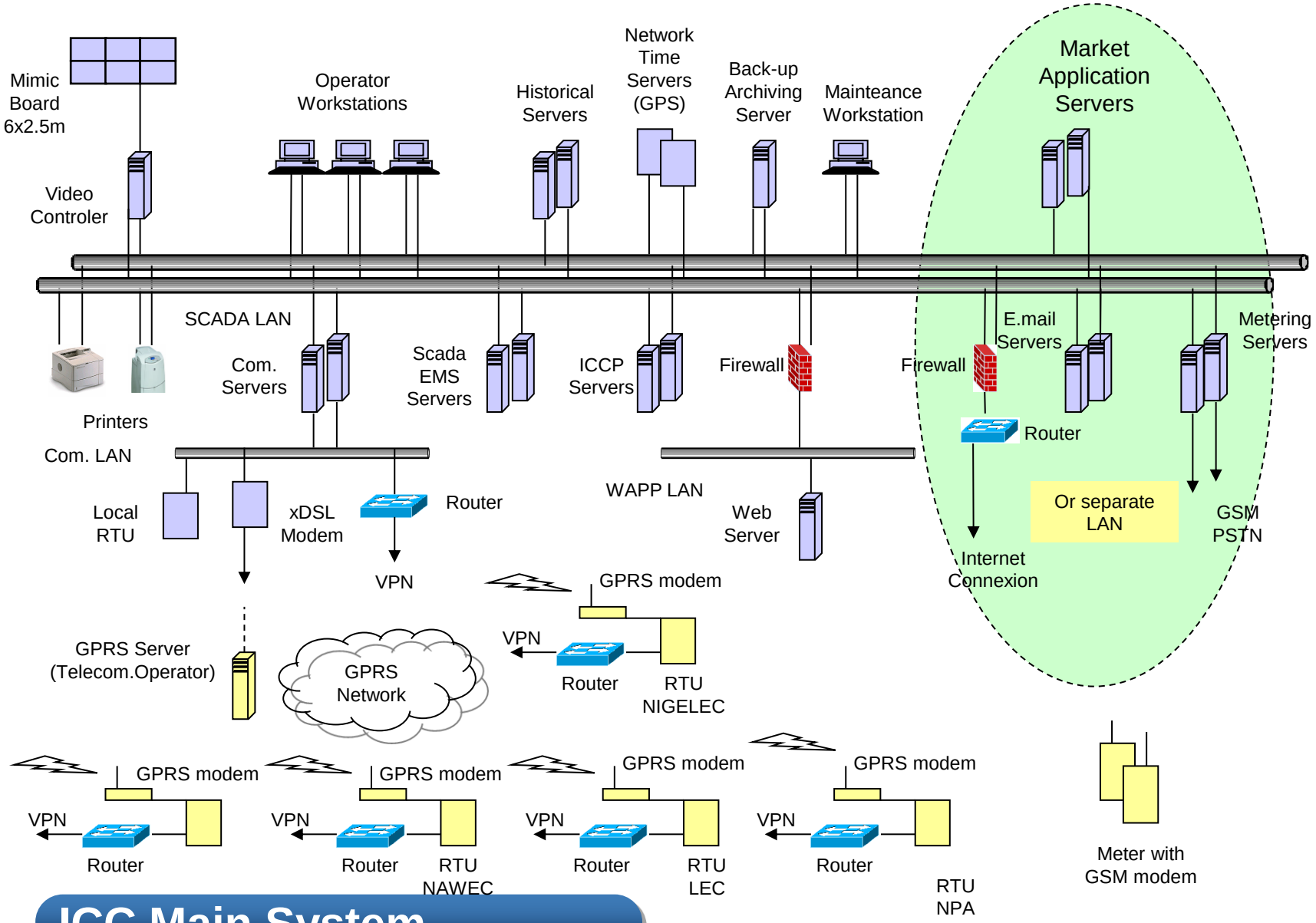
ICC Project –EU Grant

- EU has approved 30 million euro grant
- Supply and install equipment and software necessary for
  - Coordination of system operation,
  - Electricity market operation
  - Ensuring a reliable communication with Control Centers, WAMS equipment and actors of the electricity market
  - Installed in a new building to be erected in Calavi - Cotonou

ICC Project –EU Grant

- Supply and install communication equipment and software necessary for the market
- Communication network based on an optic fiber network
- Ensuring the proper communication rate between the different control centers
- Redundancy ensured with the realization of the future interconnections included in the WAPP Master Plan
- Including a technical assistance to the ICC and to the regional and national control centers.

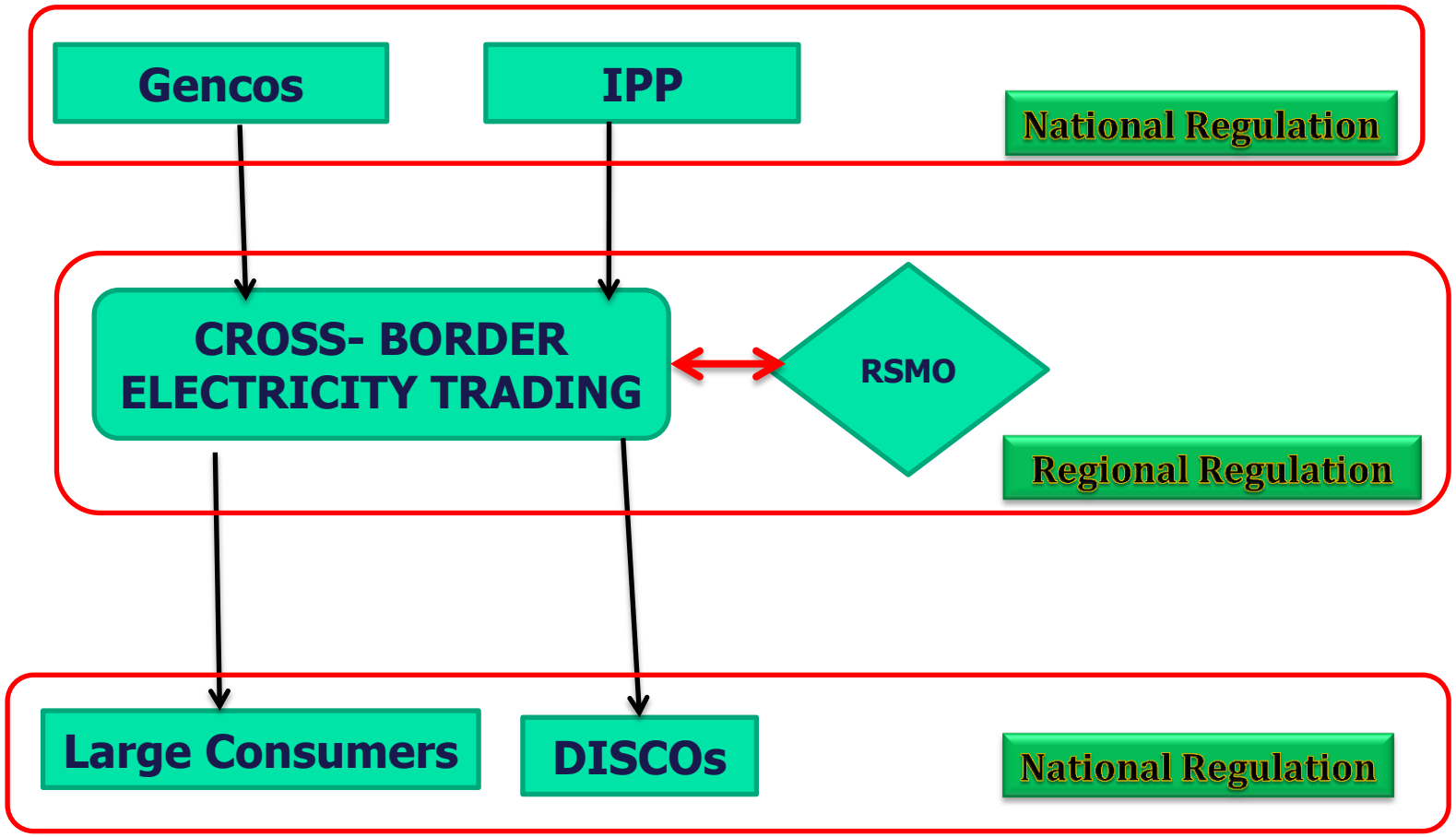
ICC Project –Design



ICC Main System

Implementation of Market Road Map

REGIONAL ELETRICITY MARKET



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 differents actors in the region
- Monitor and dispatch the exchanges
- Manage financial transactions
- Put in place Market Rules

Missions of ICC – Additional Roles

Centre of simulation

- Verify the global interconnected network : Criteria N-1, critical Incident,…
- Evaluate maximum capacity transfer (J-1, W-1, M-1)
- Share the results with other company

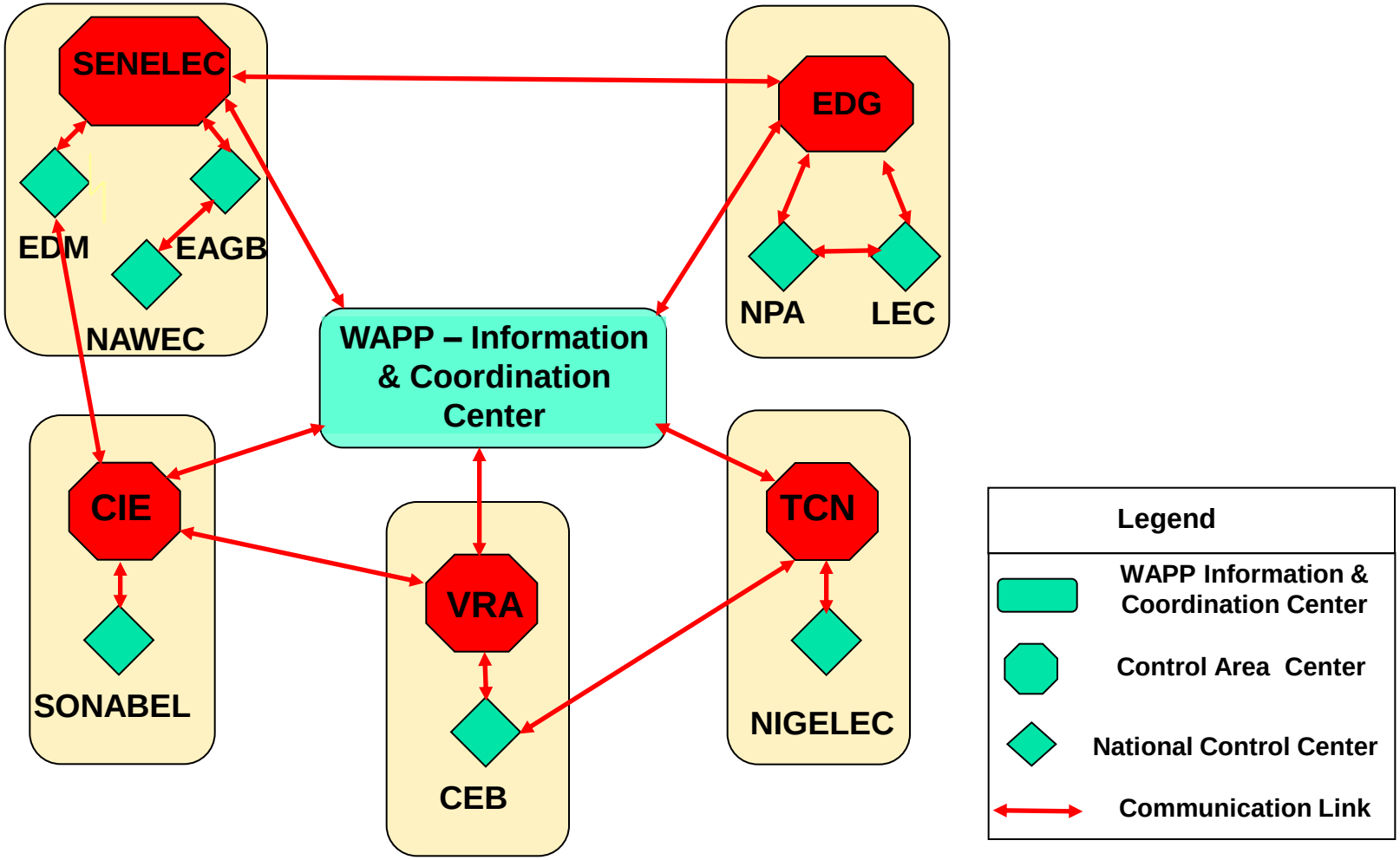
Centre de Coordination

- Coordination and monitor the reserve capacity et sa répartition
- Monitoring of the network (WAMS - Wide Area Monitoring System) and analyse of incident
- Coordination of maintenance of interconnections
- Coordination and monitor the harmonisation defense plans
- Monitor application of WAPP Operation Manual
- Coordination of medium and long term plan

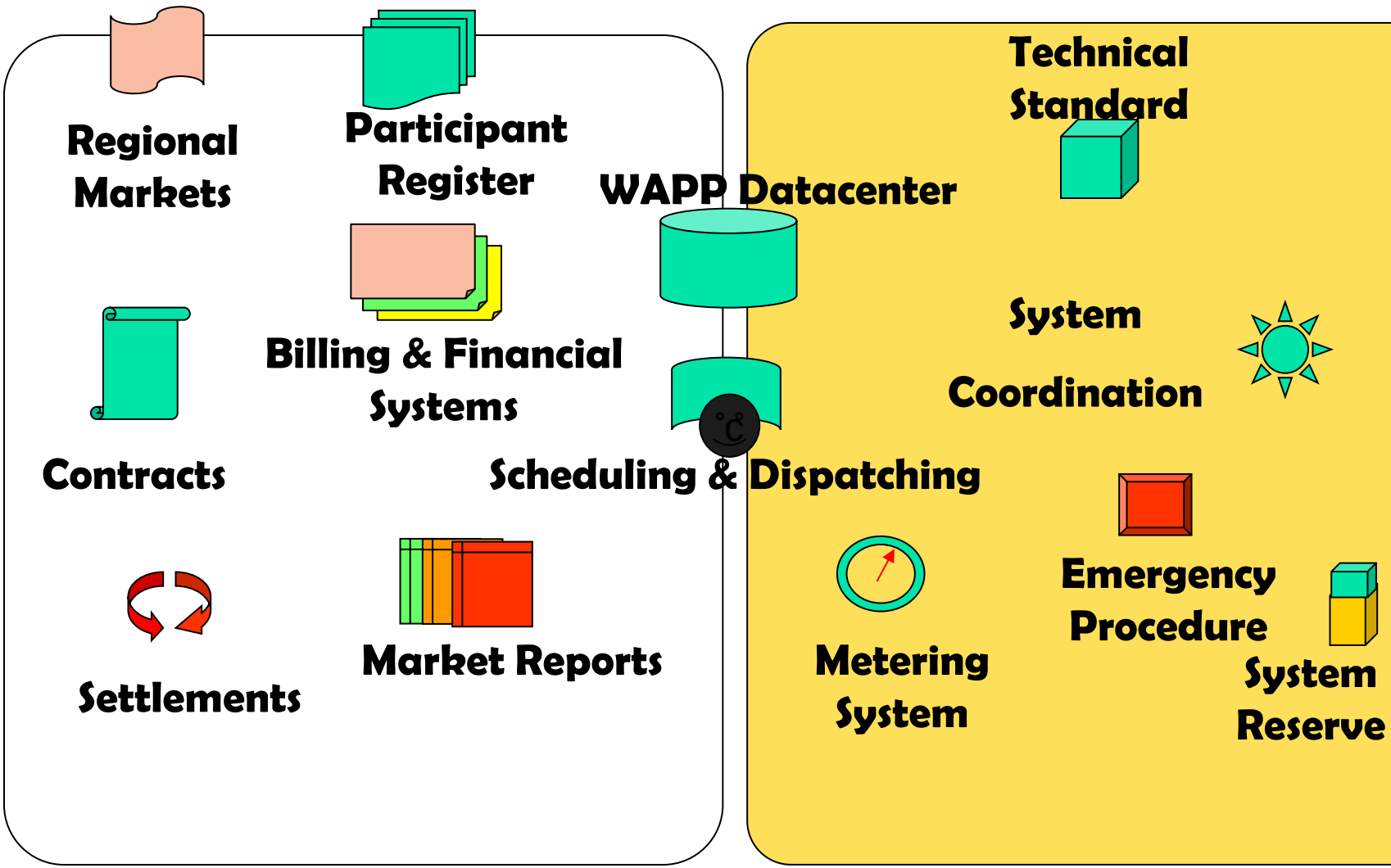
Centre of Information

- Centralize and put place database
- Develop Network Model
- Archive and share data and system information

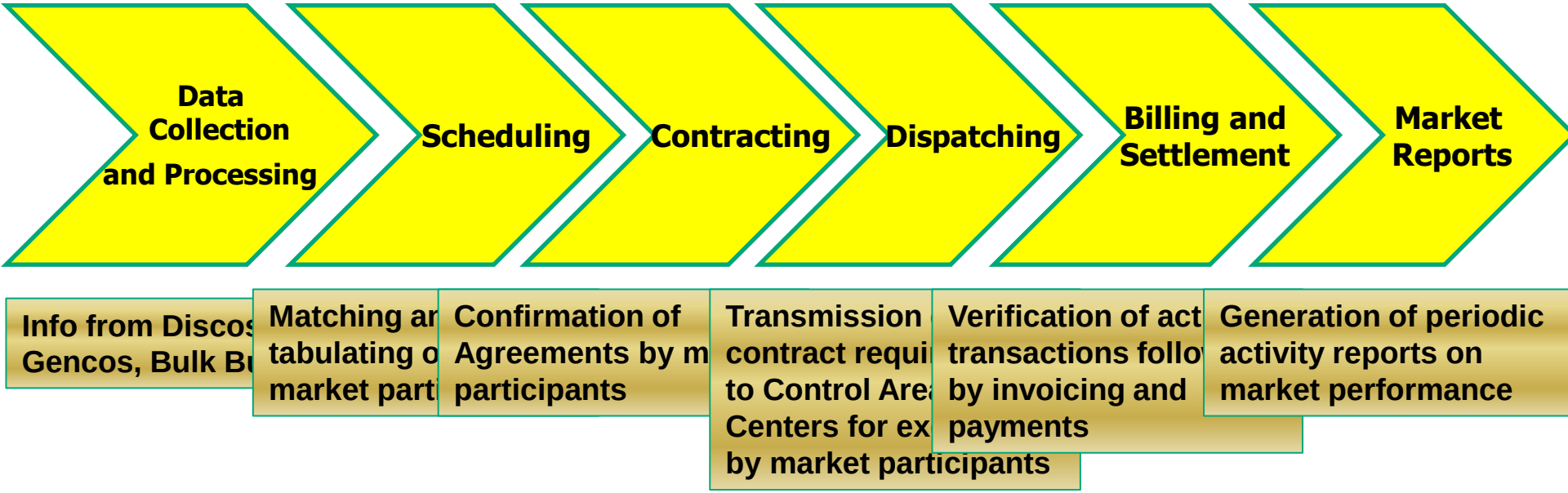
OPERATIONAL HEIRARACHY



FUNCTIONS OF WAPP-SMO (1)



FUNCTIONS OF WAPP-SMO(2)



Challenges

Challenges

- Transition to the Regional Electricity Market
- Put in place a Market Governance Structure
- Appoint of System Market Operator for implementation of the Regional Electricity Market
- Construct building to house WAPP Information & Coordination Center.
- Construct Communication and Data Communication infrastructure.
- Improve reliability of WAPP Interconnected network
- Capacity Building in Pool Operation and real-time Electricity Trading

Next Activities

- ICC has been appointed as the Regional Market Operator
- EU Grant secured to develop Infrastructure – Building, Communication & Data
- Employ additional to strengthen Human Resources required
- GIZ Funds secured to implement Training Plan -
- Develop Contract templates
- Develop procedures for :
  - for administration of contracts
  - registering of market participants
  - allocation of transmission capacity
- Synchronization of interconnections

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