INVESTMENT IN TRANSMISSION NETWORKS

ERERA/WAGPA REGULATORY WORKSHOP

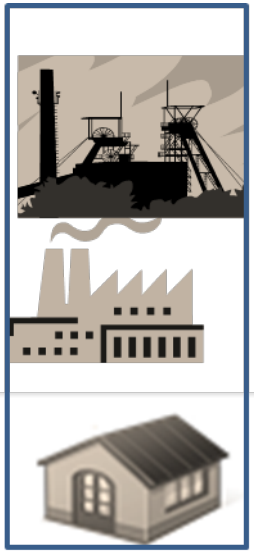
24 – 26 APRIL 2012, LOME, TOGO

Prof Jorry M Mwenechanya

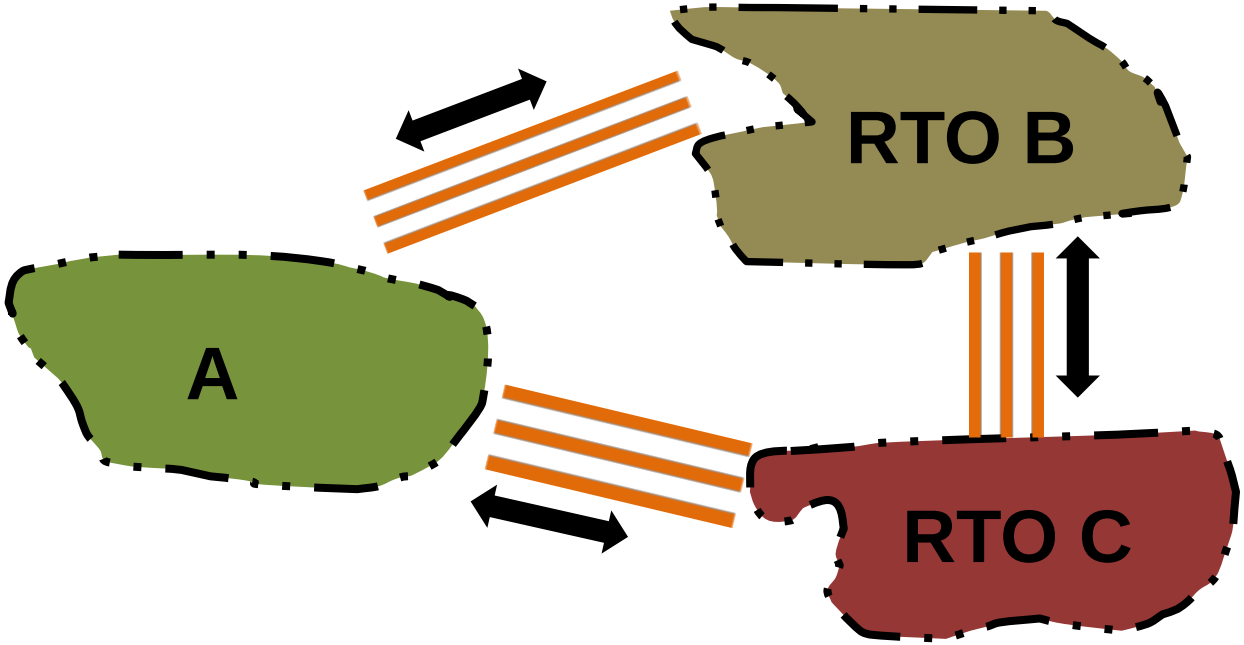
Presentation

- Enhancing adequacy
- Pre and Post Reform issues for G &T
- Regulatory challenges
- Need for investment
- Connecting grids

Transmission functions



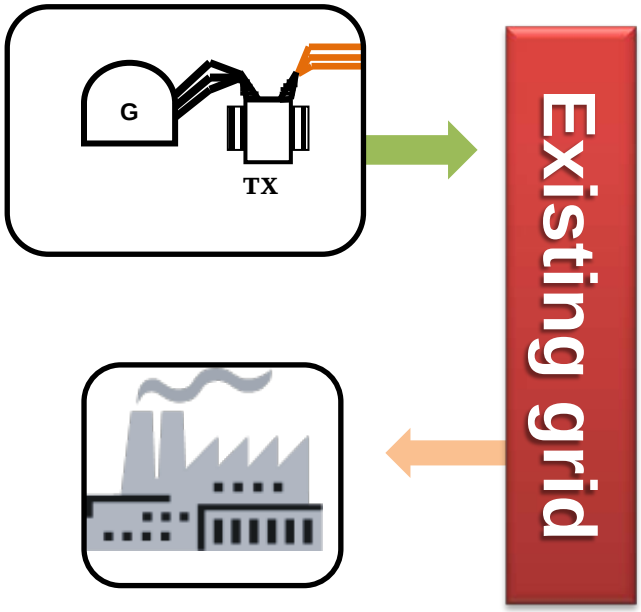
Transfer power from generators to loads



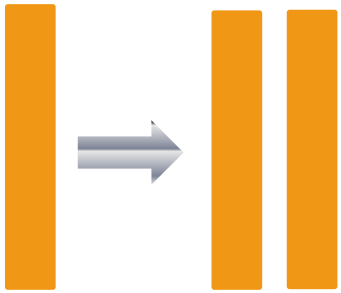
Interconnect power networks

Enhancing adequacy

Interconnect generation or load



Reduce congestion



Enhancing adequacy

Enhance system reliability (replace old technology)

PROTECTION

CIRCUIT BREAKERS

Enhance operating flexibility

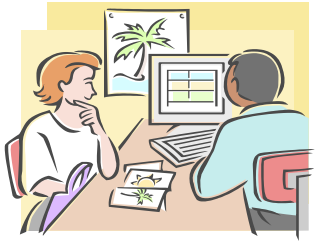
Add switching capability

Increase system efficiency

Replace high-loss equipment (Also DSM in distribution network)

Pre and Post Reform issues for Generation and Transmission

Coordination



BEFORE

- G &T Planned together in an integrated utility; National master plans in use

AFTER ...

- Generation and transmission planned separately; competition for generation, regulated transmission

Planning Information

BEFORE

- System adequacy is tested by modelling (line flows and bus voltages); Information readily available (or obtainable) in the utility

AFTER ...

- Modelling may be constrained by unwillingness of players to provide ‘sensitive’ commercial data

Level of Adequacy

BEFORE

- Determined by utility with approval of ministry of energy (as regulator), but Master Plans rarely implemented

AFTER …

- Generation and transmission generally inadequate, Approval of new generation and transmission by regulator/government

Pricing

BEFORE

- Embedded-cost pricing had little effect on either generation or transmission adequacy

AFTER …

- Real-time energy pricing will affect generation adequacy; congestion pricing will guide transmission investments and locations of new generation

Roles of markets and regulation

BEFORE

- State regulation and central planning dominate adequacy decisions (but all limited by lack of investment)

AFTER …

- In theory, markets dominate generation adequacy decisions and affect transmission adequacy decisions. Regulatory authority shifted from government to independent regulator

Cost Allocation in Unbundled Transmission

Technical requirements are the same as in a V.I. utility

BUT …

Additional requirement is that transmission should not constrain market transactions: economic dispatch

The benefits may accrue to producers and consumers in a different location from the transmission location

Questions arise about who pays for investment if it is purely for market facilitation.

Regulatory Challenge: Pricing transmission to promote investment and to ensure fair allocation of costs

ROR:

$$PQ = Br + E + d + T$$

Approval on the basis of revenue requirement may not provide sufficient safeguards against ‘over-investment’ or gold-plating

Unfair costs to customers

Approval on the basis of ‘used and useful’ notion could cause under-investment

Inadequacy, low reliability

Regulatory Challenge: Pricing transmission to promote investment and to ensure fair allocation of costs

PCR

$$P_0 = \frac{Br + E + d + T}{Q_0}$$

$$(P_{t+1} - Pt)/P_t = RPI - X$$

<u>The risks are essentially the same</u>:

If X is set too low, tendency will be to over-invest, if too high, there is likely to be insufficient investment

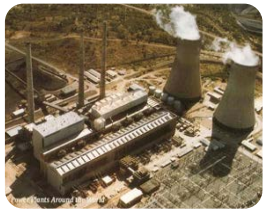
Additional challenge: Construction periods long, payback periods long, both far in excess of regulatory periods

Regulatory risk for investor: the likelihood that the regulator will not abide by initial agreements; tendency to renege due to political pressure or exogenous changes in the industry

Transmission Investment

Generation

Load



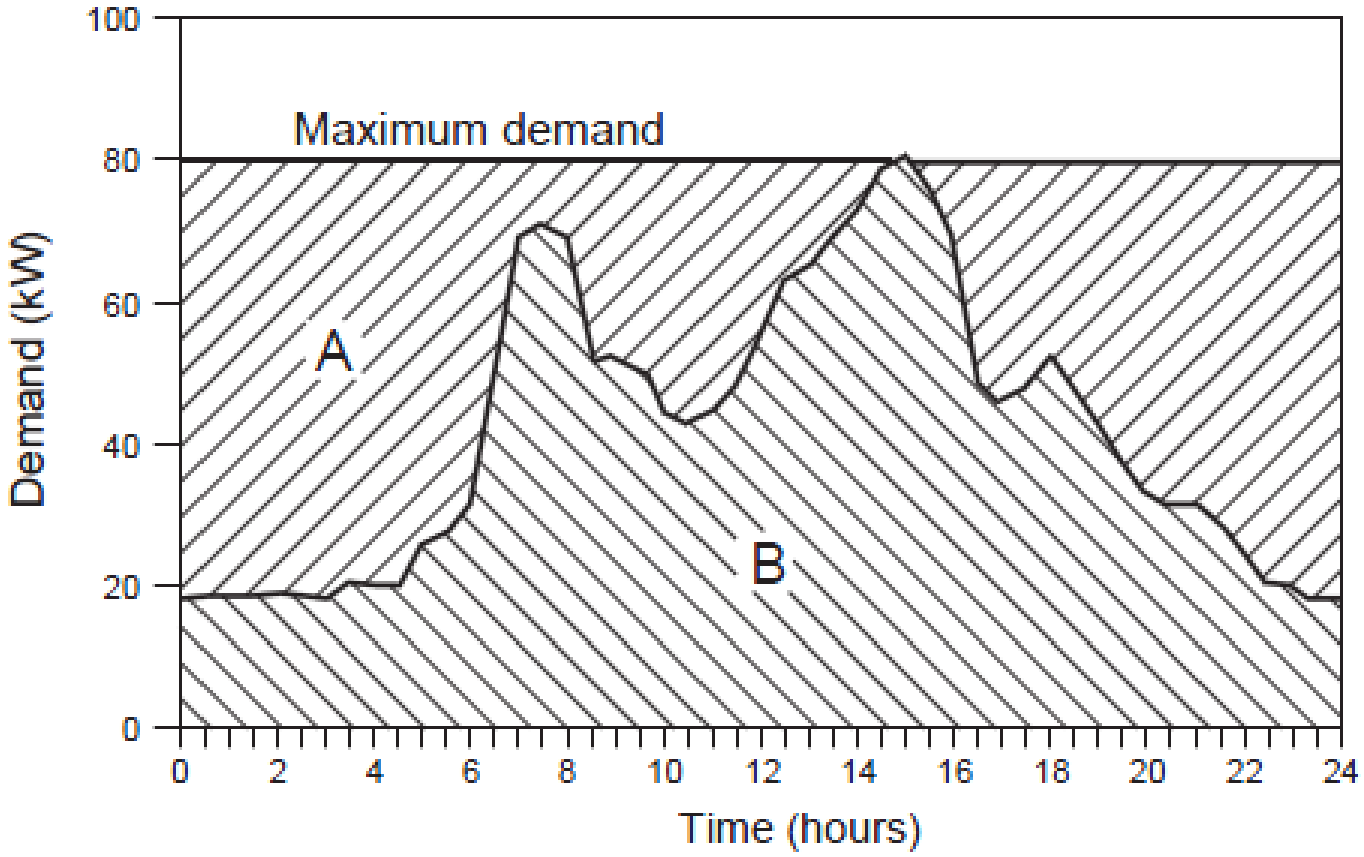
Network

Management

Assets

Sufficient transmission resources to support balance of load and generation

Typical daily demand curve



A: Additional potential energy if load is constant at MD, maximum demand

B: Actual energy used per day

http://www.youtube.com/watch?feature=player_detailpage&v=ASWa7Xs2FGo

California ISO DEMAND CURVE (select, right click; presentation mode: just click)

Capacity and reliability adequacy are interrelated concepts

Generation and transmission must have capacity to supply Maximum Demand,

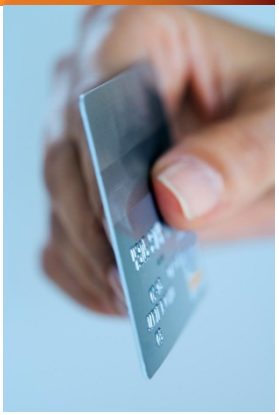
Transmission lines usually designed to meet projected demand for several decades: cost of transmission small compared to generation plant.

CONNECTING GRIDS

Justification for Interconnectors

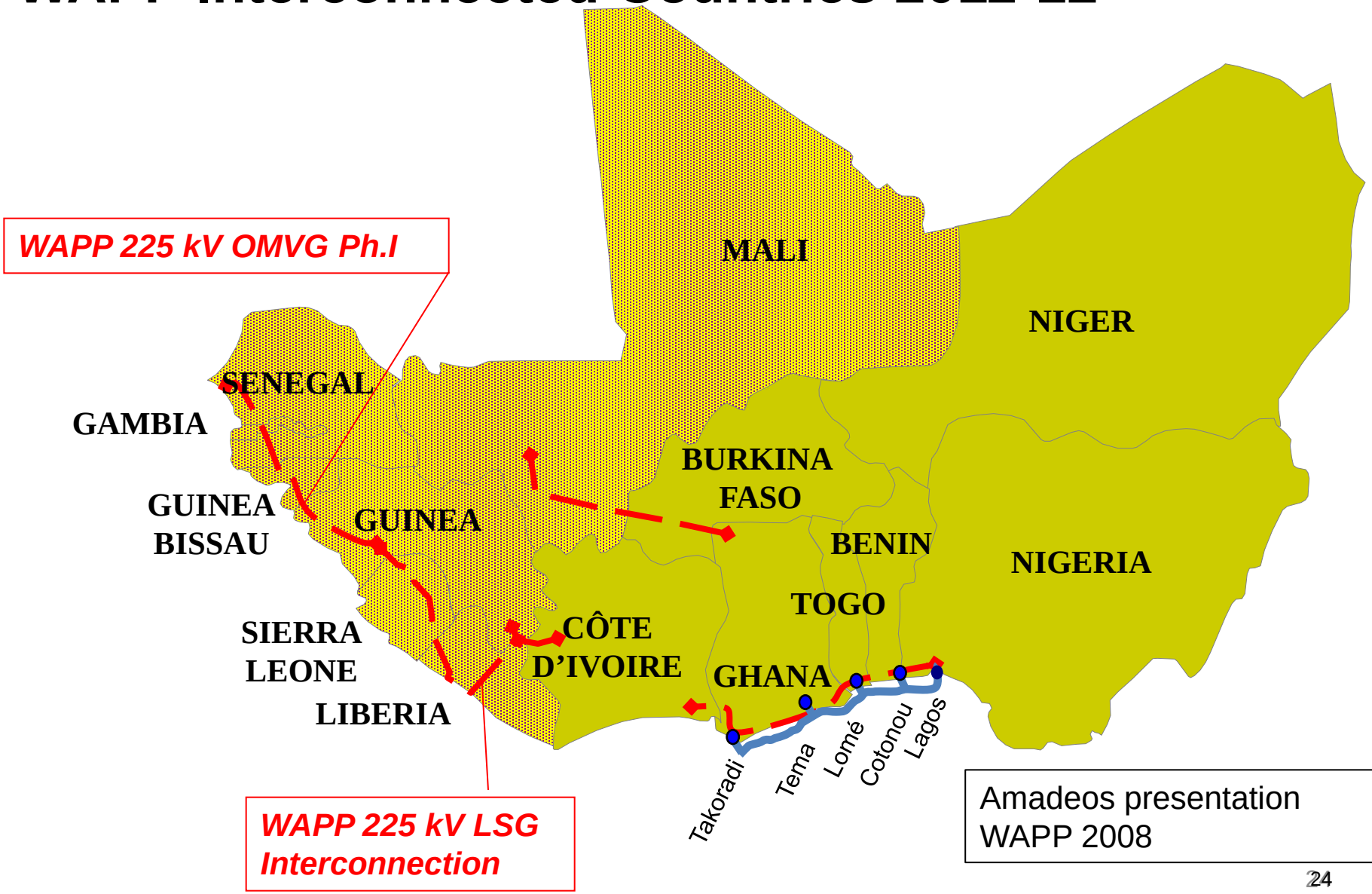
Shared generation resources:, hydro, thermal

Improved reliability: shared operating margins



Facilitate electricity markets: WAPP, EAPP, SAPP

WAPP Interconnected Countries 2011-12

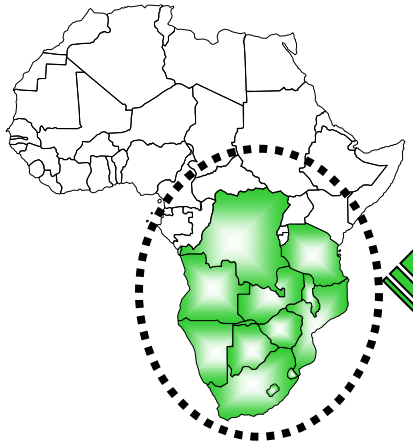


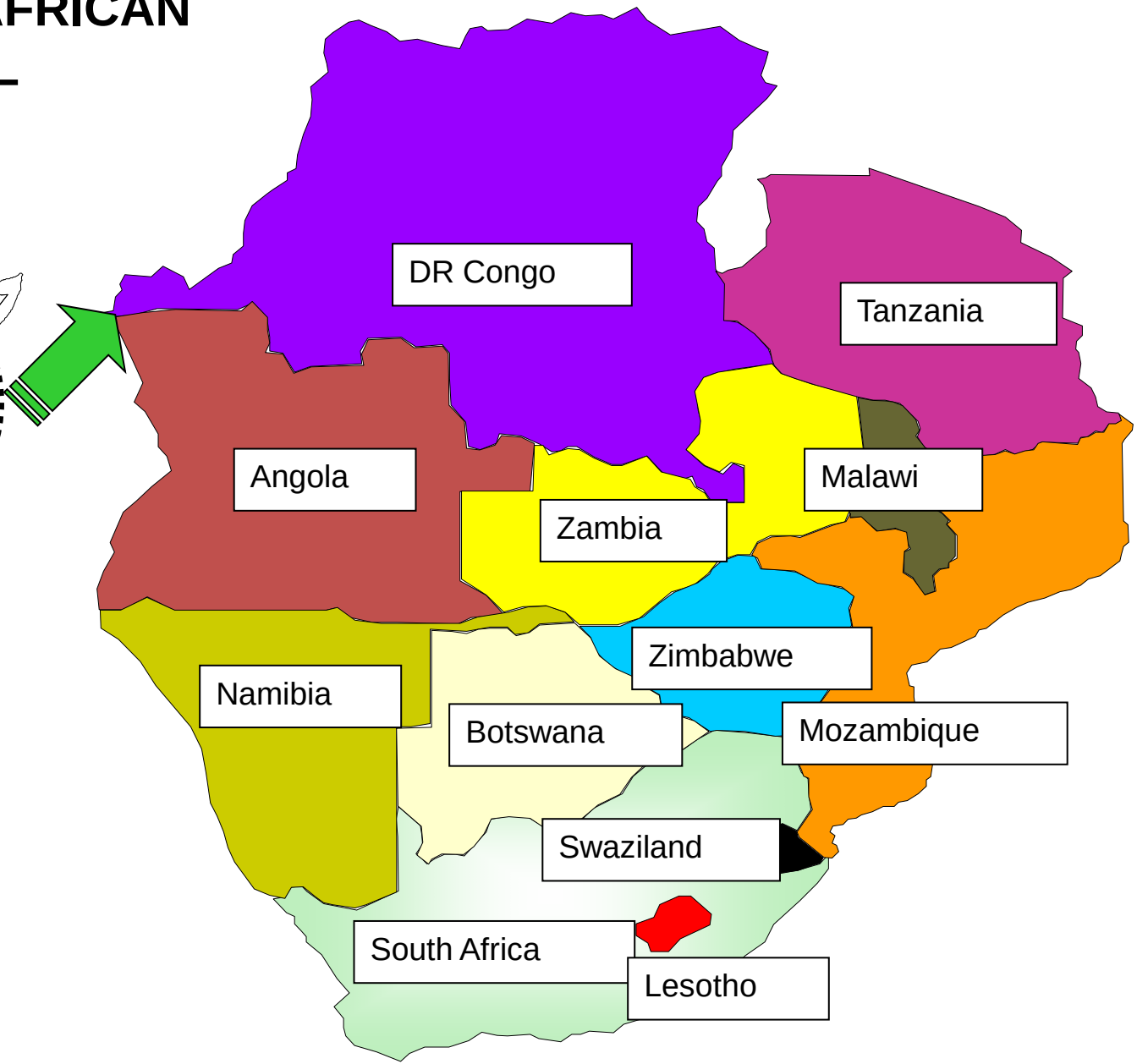
Amadeos presentation
WAPP 2008

USAID
FROM THE AMERICAN PEOPLE

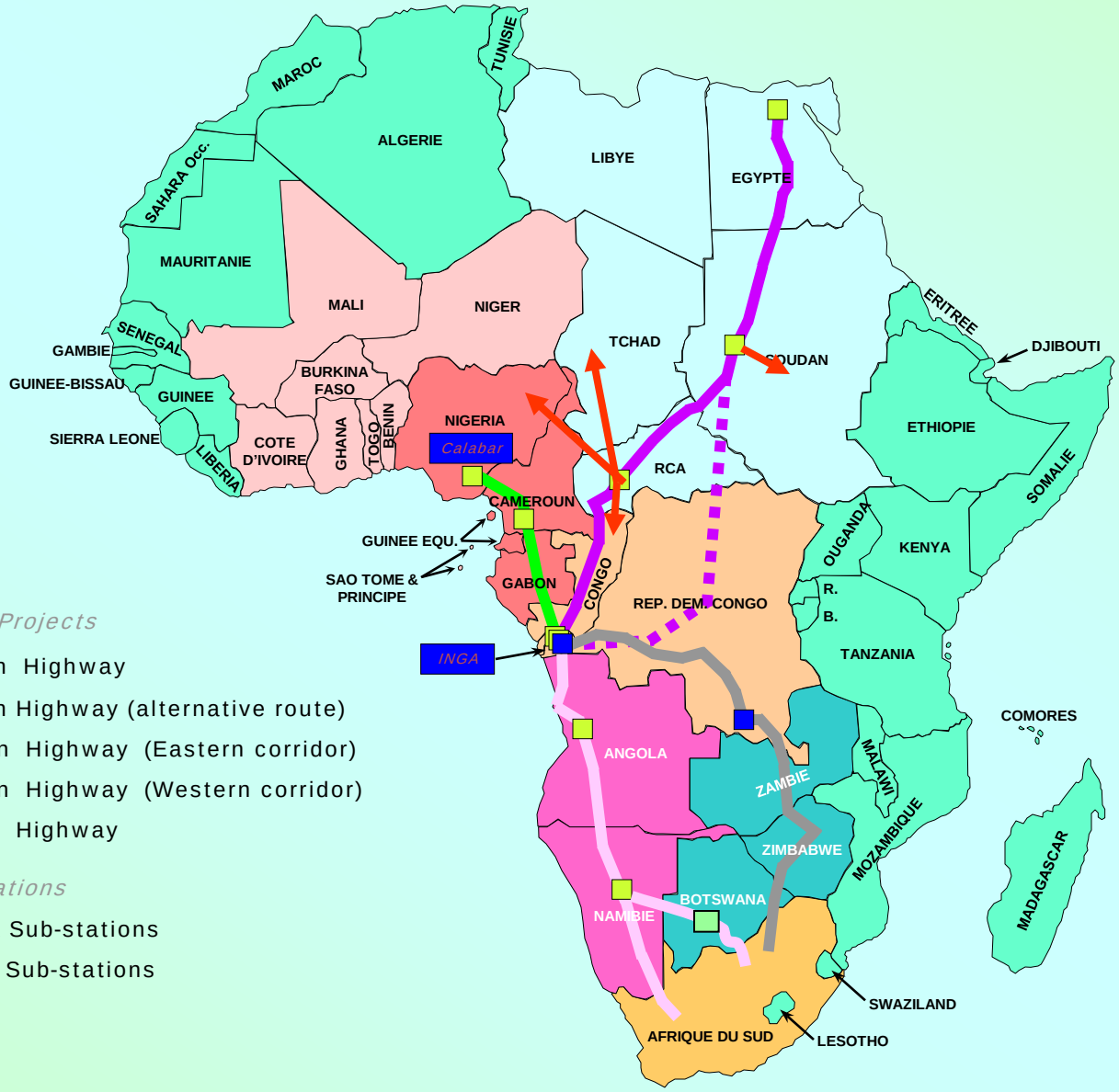
National Association of Regulatory Utility Commissioners

SOUTHERN AFRICAN POWER POOL





POTENTIAL OF THE INGA DAM OF THE DRC



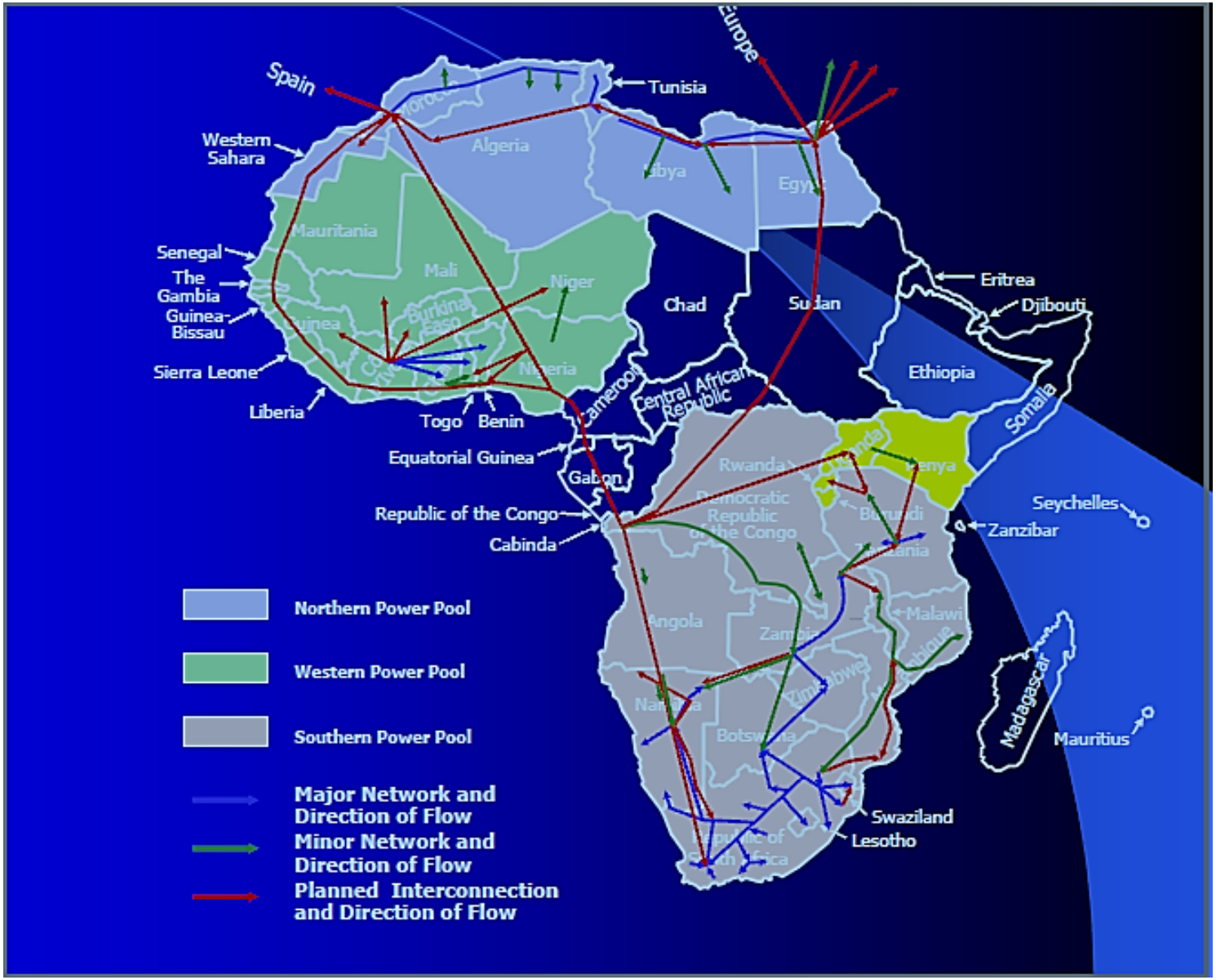
LEGEND

Interconnection Projects

- Northern Highway
- Northern Highway (alternative route)
- Southern Highway (Eastern corridor)
- Southern Highway (Western corridor)
- Western Highway

Converter Sub-stations

- Existent Sub-stations
- Planned Sub-stations


Europe
Spain
Tunisia
Western Sahara
Algeria
Libya
Egypt
Mauritania
Senegal
The Gambia
Guinea-Bissau
Mali
Niger
Chad
Sudan
Eritrea
Djibouti
Sierra Leone
Liberia
Togo
Benin
Nigeria
Cameroon
Central African Republic
Ethiopia
Somalia
Equatorial Guinea
Gabon
Rwanda
Kenya
Republic of the Congo
Cabinda
Democratic Republic of the Congo
Seychelles
Zanzibar
Angola
Zambia
Malawi
Zimbabwe
Namibia
Botswana
Madagascar
Mauritius
Swaziland
Lesotho
Northern Power Pool
Western Power Pool
Southern Power Pool
Major Network and Direction of Flow
Minor Network and Direction of Flow
Planned Interconnection and Direction of Flow

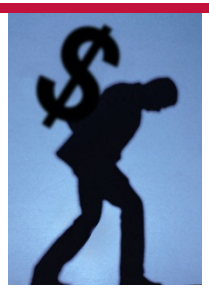
Some questions

How should regional investment be COORDINATED?

Partly depends on type of transmission management and ownership – Several examples worldwide of TRANSCOs and ISOs.

ZTK*: Each territory responsible for construction of in-country portion of interconnector; issues of pricing as yet unresolved; Committee of ministers from the three territories take decisions.

*Zambia-Tanzania-Kenya Interconnector



How should COSTS be allocated?

Investment may target customers in a different territory.

BUT…

Can be difficult to determine actual beneficiaries because of physics of electron flow

Such investments often have multiple benefits, including: improved reliability and reduced operating margins (more capacity available)

Example of DRC-Zambia Interconnector

What is the role of the regional REGULATOR?

Work with power pools to develop menus of investment options taking account of national frameworks, structures;

Determine pricing to stimulate necessary investment and equitable share of costs (beneficiaries should bear burden).

Should resist revision of regulatory regime *ex post*.

Regional regulatory imprimatur is desirable

End of slides