AFRIMARI

Electricity in Africa.....at least some bits of it!

Bob Middleton

(I'm doing this 'cos Gemina asked me to)

Who is he?

First Independent Power Project (IPP)..Europe

Biggest IPP....China

Slowest IPP....India

Green IPP.....solar UK

Fuels Coal, oil, gas, LNG, sun, water

Environmental ..ESIA, best use of fuel and waste

What's this talk about?

Some aspects of electrical Power Generation in Africa (mostly sub-Saharan)

The broad picture

A few examples mostly related to LNG and gas

The future is.....

Some numbers

1 billion people....57 nation states plus or minus a few from time to time

2000 African languages

several thousand ethnic groups, 250 in Nigeria alone

Speakers... 120 m French , 300 m English in Nigeria/S Africa/Ghana/Kenya

Diversity, heritage, tradition are major factors influencing drivers for economic change. Impact on pace?

Approximately 500m Africans have little or no electricity

More numbers, the Economy. You know all this already but.....

Africa's GDP is approx 3% of the World GDP but has 17% of the world's population

Global GDP rank South Africa-28, Angola-59, Ghana-83.....(UK 7th)

BUT Ghana's GDP growth rate was **14%** in 2010 ....Nigeria **8%,** Egypt **5%,** (UK 2% in the same period....)

Some States in Africa are amongst the fastest growing economies in the world

The availability of reliable low cost power is vital to maintain this pace and to help to provide electricity for all

Can more be done to support the high growth scenario? Electrical power is a generator.... of wealth

- Increase MW capacity...the entire installed capacity in Sub-Saharan Africa is less than that of Argentina
- Improve reliability/performance...average industrial blackouts happen approx 60 days per year
- Lower Costs.....power prices often 50% higher than in developed economies

Constraints: volume, reliability and cost

Africa has the resources

Lot of water for hydropower ....sometimes...some places....not reliable

Sunshine....mostly...small scale solar to date...cost

Wind....Kenya 300 MW Lake Turkana

Huge oil and gas resources.... and some coal

Who is here to help

- **Who is here to help (?)** Middle East is pushing at the door...India looking hard... the USA (legacy and sentiment)....the World Bank wanting to help..... with governance
- Banks African Development Bank, Afrexim, Standard Bank.... lots more
- China China China China and more China.....in exchange for resource!

Three fundamentals

Making electricity

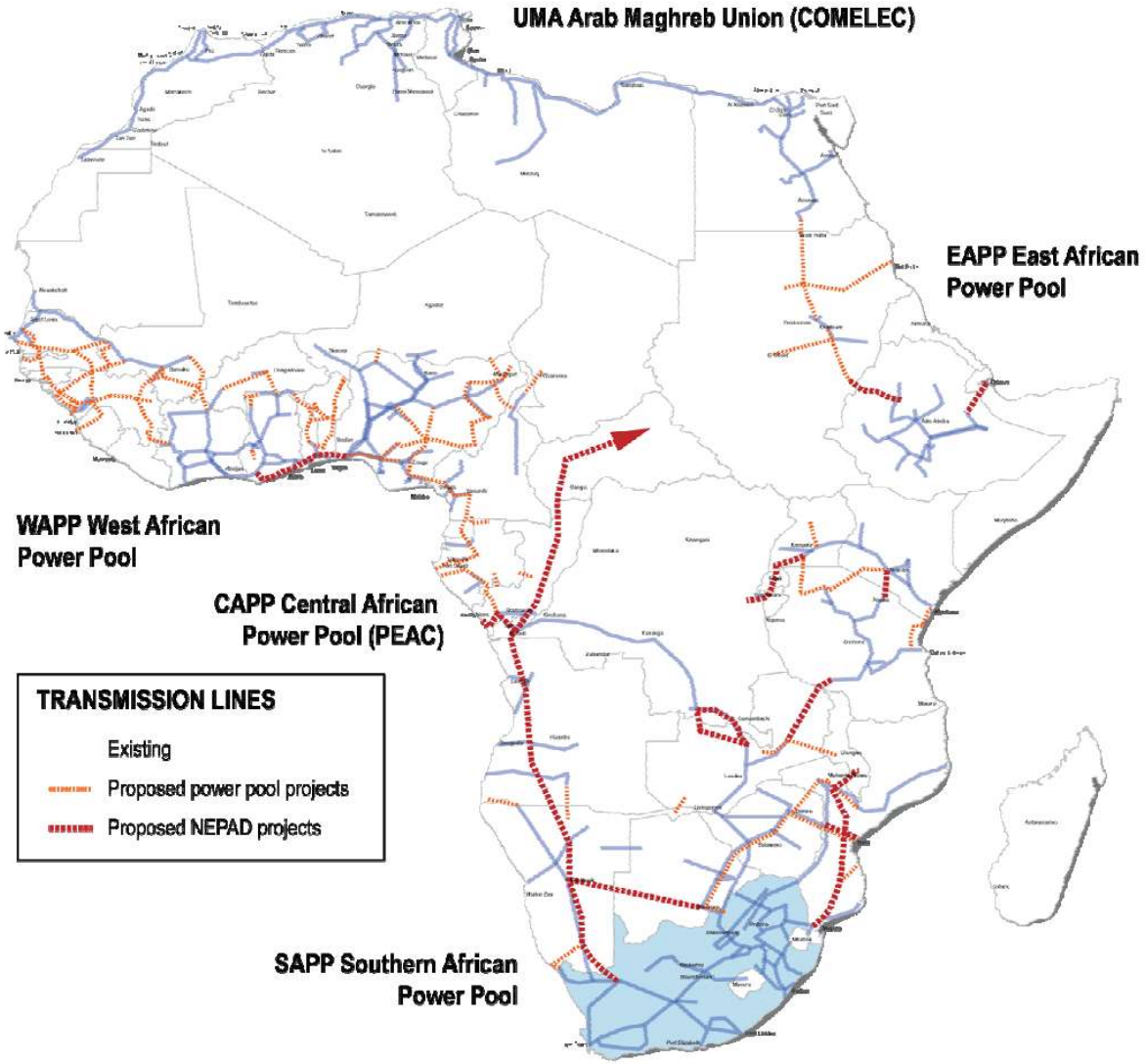
Moving electricity

Money for projects and a return on investment
(Credit worthiness or support prevails)

Generating power and Moving Electricity

- Integrated power networks are a given in the developed world: European grids work, interconnectors are common.
- Africa is at an early stage of building integrated networks: Power Grids exist but its a work in progress.
- Transmission is one of the essential features of Regional Development

Power Grids


UMA Arab Maghreb Union (COMELEC)
EAPP East African Power Pool
WAPP West African Power Pool
CAPP Central African Power Pool (PEAC)
SAPP Southern African Power Pool
TRANSMISSION LINES
Existing
Proposed power pool projects
Proposed NEPAD projects

Lets Focus on West Africa

Why?

All of the elements for development are on the ground:

Potential for even higher growth

Electrical power is a political high priority

Natural resources aplenty

Regional coordination...ECOWAS

ECOWAS Role?

- ECOWAS (Economic Community of West African States).....founded in **1975.....** 15 States with overarching intentions for improving economies and quality of life

- West African Power Pool (WAPP).....a main focus created in **1999.....** Energy Department established in **2006**

330 kv transmission network is the backbone of moving energy

WAPP building and commissioning still in progress

Examples of a few other things going on in the West African power scene

Energy Sector Privatisation.... Nigeria

Investment from Abu Dhabi....TAQA

IPP interest....Contour Global

Power plants, ports, infrastructure...China

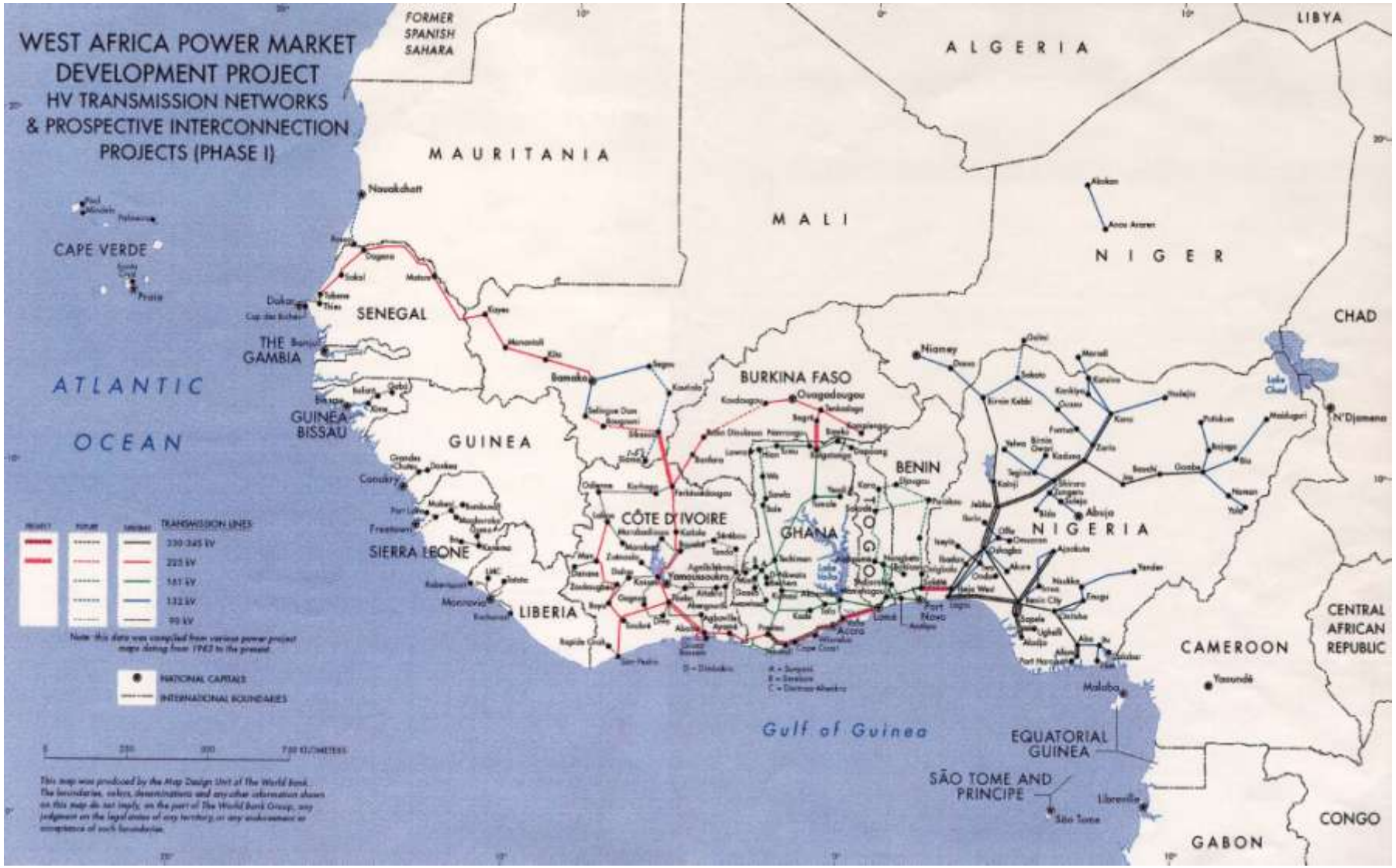
Offshore oil and gas...Tullow

LNG exports from Bonny

Power for Mining


MALI
NIGER
SENEGAL
GAMBIA
GUINEA
GUINEA - BISSAU
BURKINA FASO
BENIN
NIGERIA
COTE D'IVOIRE
GHANA
TOGO
SIERRA LEONE
LIBERIA
CAPE VERDE

West African Power Pool



Current WAPP activities

Ghana exports some power

Benin and Togo import power

Nigeria exports/imports power

Mali exports hydro power

Senegal imports and will export

States are looking to be hubs...eg Maria Gleta

Its working and more is being done

Fuel Situation in West Africa

Hydro variable due to weather and draught

Majority of major power plants are in the coastal region.... Oil imports are “easy”

In the meantime small gensets are everywhere (Aggreko and Caterpillar) flexible, mobile but very high cost (10 times the “could be” price)

Gas is seen as the long term lowest cost fuel option.
Onshore....Nigeria Offshore...Ghana

West African Gas Pipeline

The best means of moving gas around the region is the West African Gas Pipeline....(WAGP)

- An offshore pipeline built with the intention of transporting gas from gas-rich Nigeria to Benin, Togo and Ghana
- Intention to extend westwards to Cote d'Ivoire
- High pressure line (150 bar), design flow of 474 mmscuf/d flow ie can supply more than 2000 MW of Combined Cycle power plants.

West African Gas Pipeline originates from Itoki, Nigeria...

West African Gas Pipeline (WAGP)

Gas transmission system extending from the ELPS to landfalls in Benin, Togo, and Ghana

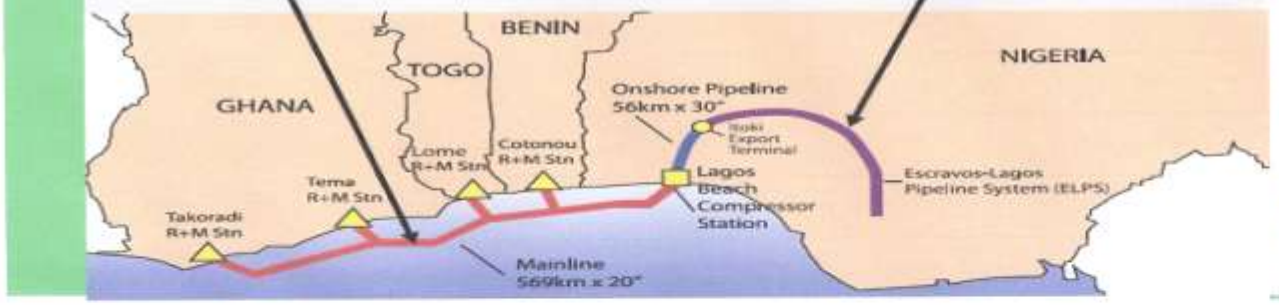
System capacity:

Initial 170 MMscfd

Final 474 MMscfd

Objective: Transport Nigerian produced natural gas to commercially viable markets in Benin, Ghana & Togo

Existing Escravos-to-Lagos Pipeline System (ELPS) Capacity: 600 mm SCFD owned and operated by Nigerian National Petroleum Corporation (NNPC).



WAPCo Ownership Structure

Chevron	36.9%
	24.9%
	17.9%
	16.3%
BENGAZ	2.0%
	2.0%

Is the WAGP working?

Project conceived in 1982.....678 km of 20 inch offshore pipe. Commercial gas supplies started in 2010

Nigeria is main gas supplier **but** reduced volumes now due to domestic needs taking priority...Domestic Supply Obligation

Pipeline fractured in a pirate incident in mid-2012. **WAGP still out of service and due back Aug 2013**

A Specific Example: Ghana

Ghana needs more than **5000 MW of power by 2016** to maintain its growth rate.....an increase of 3000 MW from today

As a result of the WAGP experience Ghana is now looking for alternative gas supplies....

Ghana's options

Become independent of the WAGP by using Jubilee gas from the western end of Ghana....not sufficient at this time...

Import gas from other sources....where?

LNG and regasification...an attractive option

Ghana and LNG

- The regasification of LNG as a short term fast track fix has been under discussion for more than 10y.....Nigeria exports 27m tonnes pa...to Asia!!
- Higher cost than natural gas but seen as an interim solution
- Floating LNG and regasification is the favoured means of delivery (FSRU)
- Major FSRU players (Excelerate Energy, Golar, Hoegh) have been in discussions as service providers...in some cases for several years

Floating Regasification (FRSU) technology (1)

- Typically permanently moored/berthed
- Can operate either dockside or at an offshore platform berth
- LNG delivered either across a dock or by Ship to Ship transfer

FSRU technology (2)

LNG Regasification vessel can operate as an FSRU

- Key difference - can also regasify offshore via buoy system
- Can also be used to transport the LNG

The future for Ghana electricity is:-

- Secure independence from the WAGP by importing regasified LNG by FSRU located at a strategic position
- Develop its own gas resources..Jubilee
- Continue with WAGP involvement
- Displace oil firing by gas and continue to improve efficiency reliability and cost reduction
- Structure the gas supply industry to support the above.....encourage IPPs.

The future for Africa good!

....recognition that things need to move faster

Outside support driven by the constructive tensions of East vs West

...recognition of the value of natural resources

Facing the challenges of diversity, political process and appetite for investment

But it still takes longer than it should

What next.....

Thank you!

(Can we stop for a glass of wine now please?)