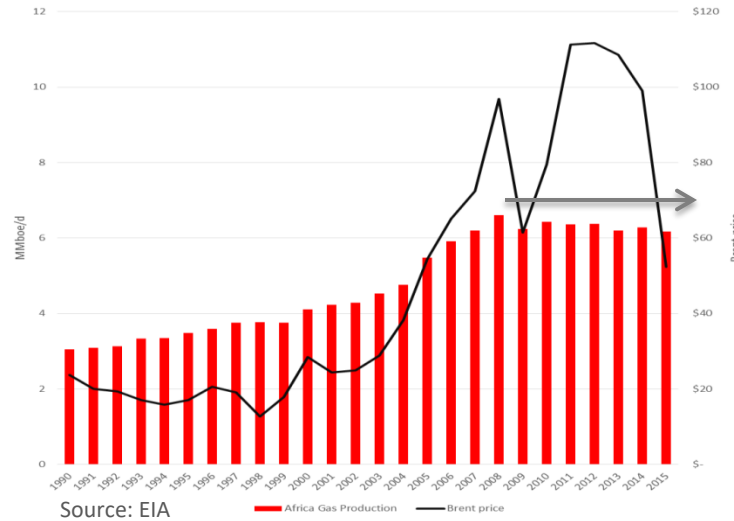
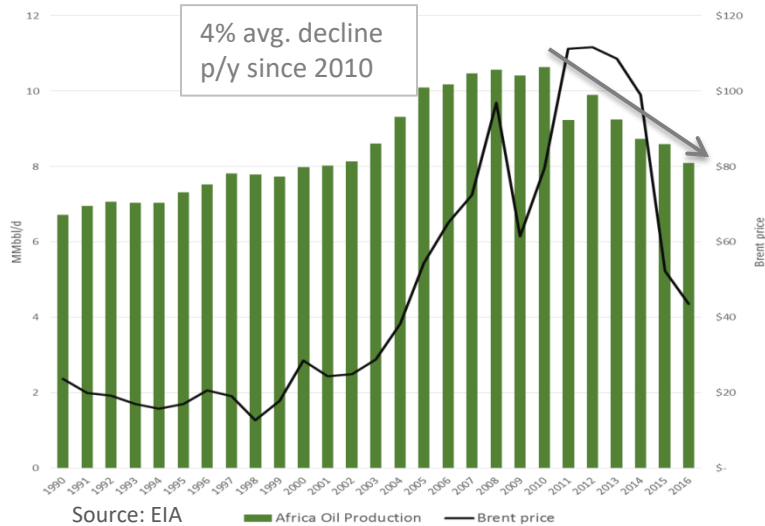


Natural Gas in Sub Saharan Africa Challenges and Opportunities

London
March 2018

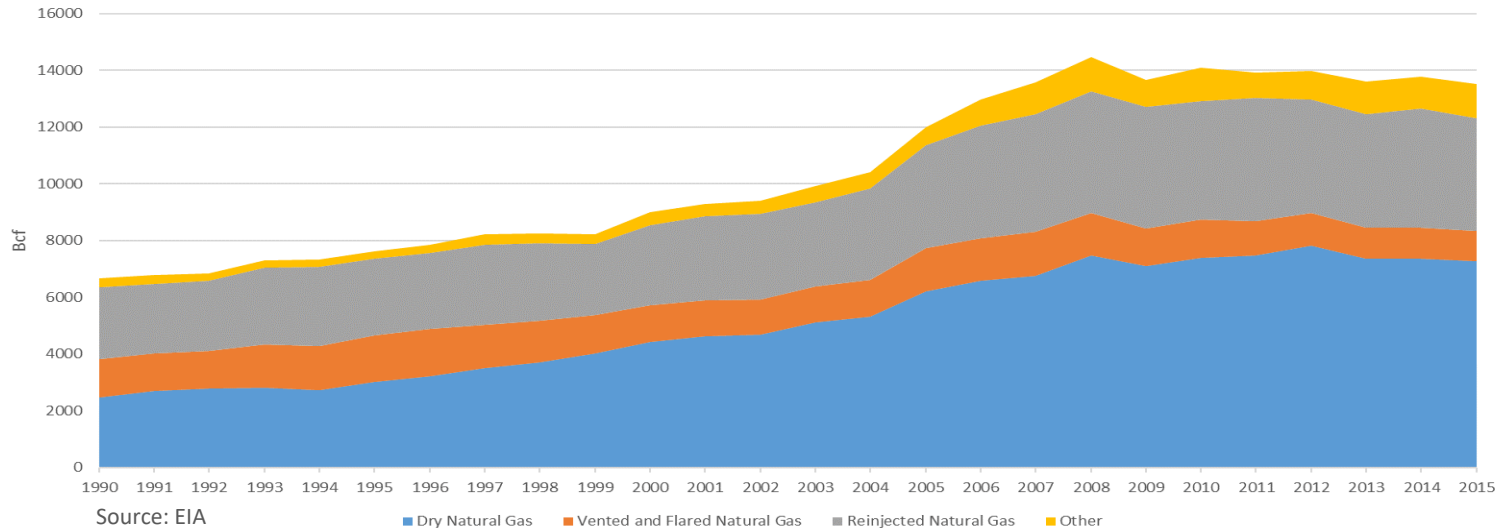
AFRICAN HYDROCARBON PRODUCTION HISTORY



- Hydrocarbon production in Africa is getting gassier

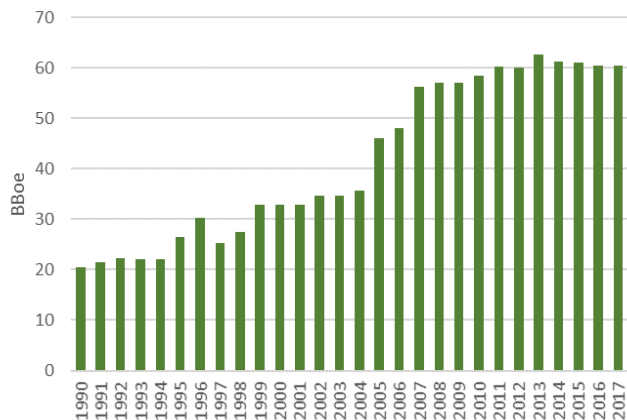
- Africa peak oil was 2010
- Africa peak gas is to come, major new near term start ups including Mozambique (Eni), Senegal/ Mauritania (Kosmos BP), Cameroon (Perenco), Ethiopia (China Poly) and Equatorial Guinea (Ophir)

AFRICA NATURAL GAS TRENDS

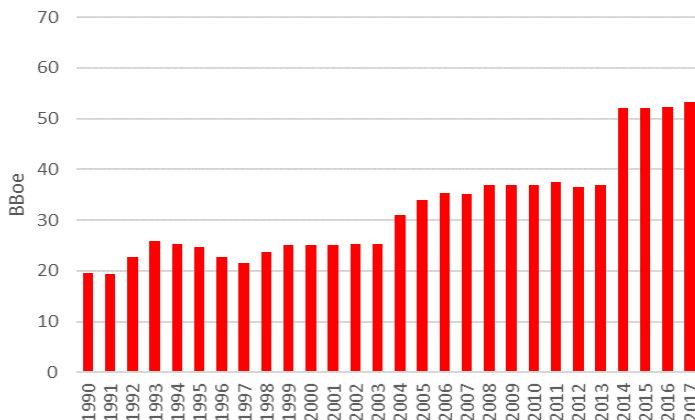


- A substantial proportion of African natural gas field production is flared or reinjected, but there is a clear long term growth trend in the sales of dry gas

SSA OIL AND GAS RESERVES TRENDS



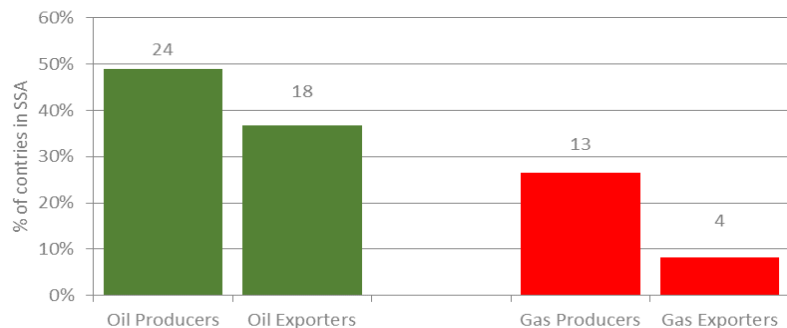
Source: EIA ■ Total Proved Oil Reserves



Source: EIA ■ Total Proved Gas Reserves

- **SSA reserves are getting gassier**
 - In recent years SSA gas reserves have increased markedly, with anticipated SSA natural gas FIDs, reserves will increase further in near term

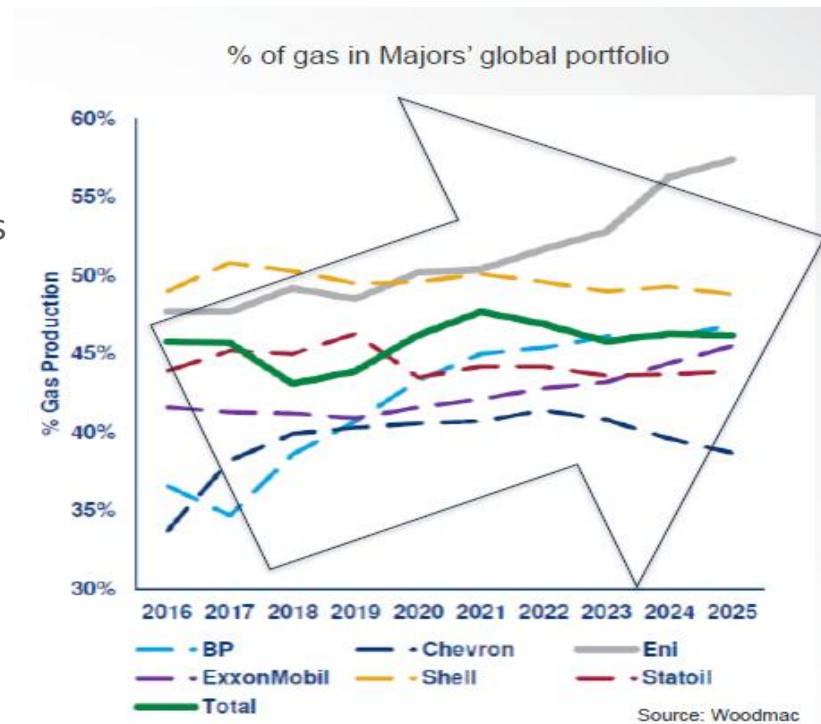
NATURAL GAS LESS MATURE THAN OIL IN SSA



- **49% of countries are oil producers, 27% are gas producers**
 - In SSA, there are 24 oil (2017, EIA) and 13 gas producing countries (2015, World Factbook)
 - Gas producers: Angola, Cameroon, Dem. Rep. of Congo, Rep. of Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Ghana, Mozambique, Nigeria, Senegal, South Africa, Tanzania
- **33% of countries are oil exporters and 8% of countries are gas exporters**
 - Meanwhile, there are 18 oil (2016, World's Top Exports) and 4 gas exporting (World Factbook and SLR analysis, 2018) countries
 - Gas exporters: Nigeria, Mozambique, Equatorial Guinea and Angola

WHY DOES NATURAL GAS MATTER IN THE CONTEXT OF SSA?

- Many majors are positioning for a gassier future both through exploration and M&A activities
 - Majors are prepared to invest \$bns in SSA gas assets
 - XOM in Mozambique
 - BP in Mauritania / Senegal
 - Woodside
 - This will catalyze gas infrastructure
- Disruptive technologies have started to drive and accelerate natural gas development
 - FLNG
 - Cameroon, Mozambique, Senegal / Mauritania, Equatorial Guinea + ?
 - FSRU
 - Egypt +?



NATURAL GAS IS DIFFERENT TO OIL

- Gas production is only possible as part of an integrated value chain

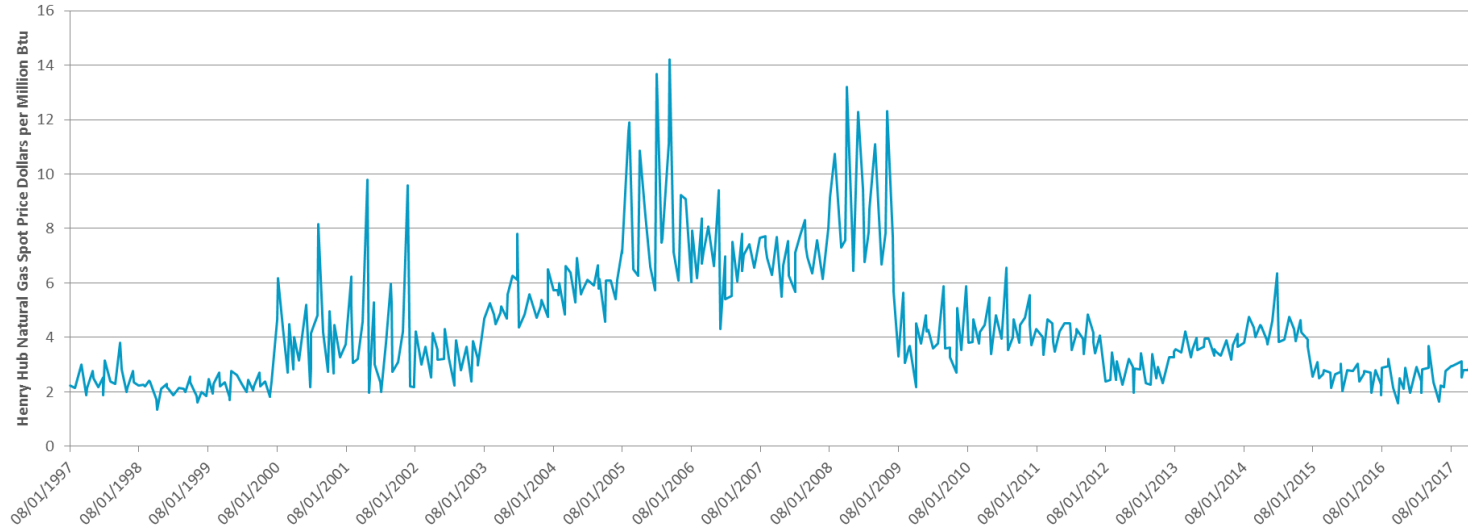


- In order to develop natural gas, a series of coordinated and integrated investments are required
 - In the event of exploration success host Governments have significant influence and may set prices in key end user markets, especially power. **Retail energy prices are politically sensitive.**
 - Anchor load is likely to be required, frequently domestic power generation
- **Natural gas developments have historically been associated with longer development lead times and long-term contract structures**
 - Ghana offshore oil Jubilee Phase One plateau 2 years
 - Ghana offshore gas Sankofa plateau 14 years
 - **For natural gas relative importance above ground risk is = or > than below ground risk**

KEY QUESTIONS ON GAS COMMERCIALISATION IN SSA

- What is the attitude and hydrocarbon / natural resource capacity of the host Government?
- Are Production Sharing Contract / licence gas terms in place before exploration?
- Does natural gas infrastructure and natural market already exist?
 - Probably not
- Two potential markets
 - International and Domestic
 - Is gas competitive with imports via FSRU?
- Are there enough resources for an anchor load client? Is there a clear anchor load client already?
- What is the nature of the local power market
 - Power market is often natural anchor market but African utilities can be challenging
 - Credit and contract performance risk

HENRY HUB NATURAL GAS PRICE



Source: EIA

- Low Henry Hub natural gas price combined with significant US liquefaction capacity is challenging the industry to improve the commerciality of FLNG projects
- FLNG projects that tap into stranded gas reserves are a potential “game changer”

FLNG's POTENTIAL

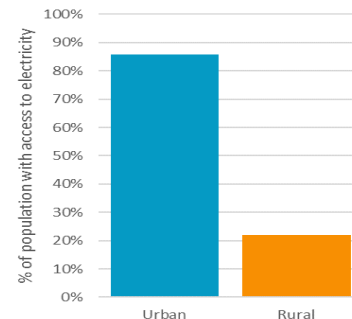
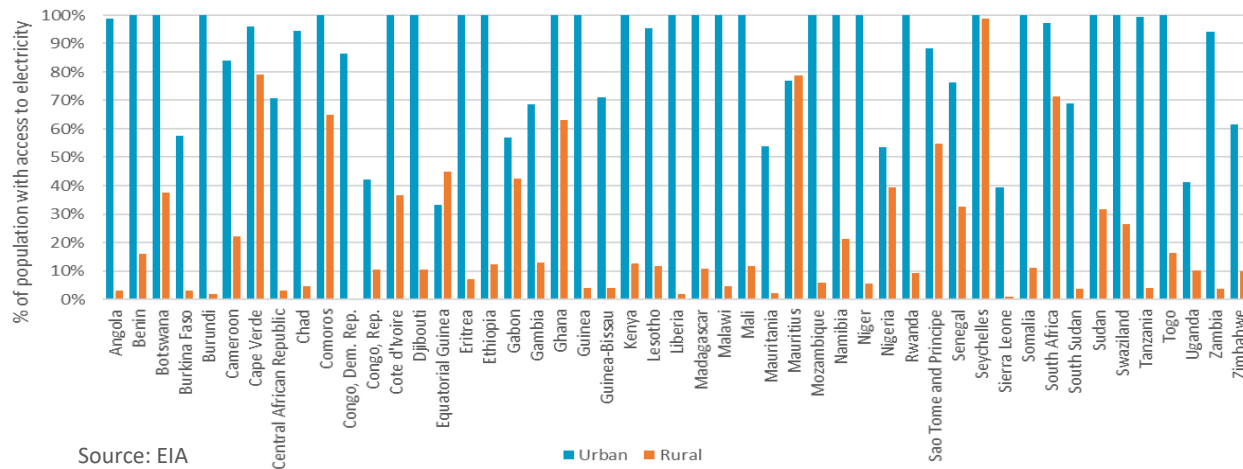
Project / Vessel	Status	Owner(s)	Location	MTPA
PFLNG Satu	Achieved FID, producing	PETRONAS	Kanowit gas field, offshore Sarawak, Malaysia	1.2
PFLNG - 2 / Rotan FLNG	Achieved FID, producing	PETRONAS	Block H, South China Sea, offshore Sabah, Malaysia	1.5
Coral South FLNG	Achieved FID, awaiting production	BP (production), Eni & ExxonMobil (development, vessel)	Rovuma Basin, Mozambique	3.3-3.4
GoFLNG Hilli Episeyo	In development	Golar, Perenco, Schlumberger, SNH	Offshore Cameroon	1.2
Scarborough FLNG	In development	Woodside Energy, BHP Billiton, ExxonMobil	Carnarvon basin, northwest Exmouth, Australia	3.6
Fortuna FLNG	In development	Ophir Energy, OneLNG	Block R, Equatorial Guinea	2.2-2.5
Prelude FLNG	In development	Shell	Offshore Australia	~5.3
CARIBBEAN FLNG	In development	Exmar	n/a	0.5
Delfin Deepwater Port Project	In development	Delfin LNG & Golar	Offshore Louisiana, Gulf of Mexico	4x 3.0
NEWAGE FLNG	In development	NewAge (and multiple partners)	Offshore Cameroon and Congo-Brazzaville	1.0-1.2
Greater Tortue FLNG	In development	Kosmos, BP	Tortue field, Mauritania / Senegal	2-3

Power Markets in Africa

- There are two power markets – urban and rural
- Two different business models:
 - Urban
 - Utilities, centralised generation, business with backup
 - Role of gas? Fuel supply to centralised generation
 - Rural
 - Renewables, e.g. solar + storage
 - Distributed generation and perhaps storage
 - Role of gas? Heat, single point loads
- Phone analogy

SSA POWER MARKETS:

URBAN VS RURAL ACCESS TO ELECTRICITY (2014)



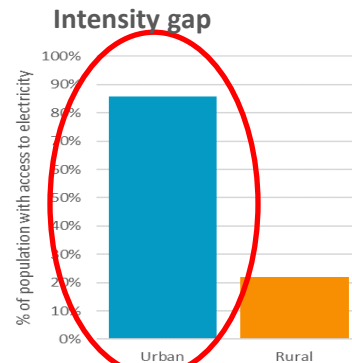
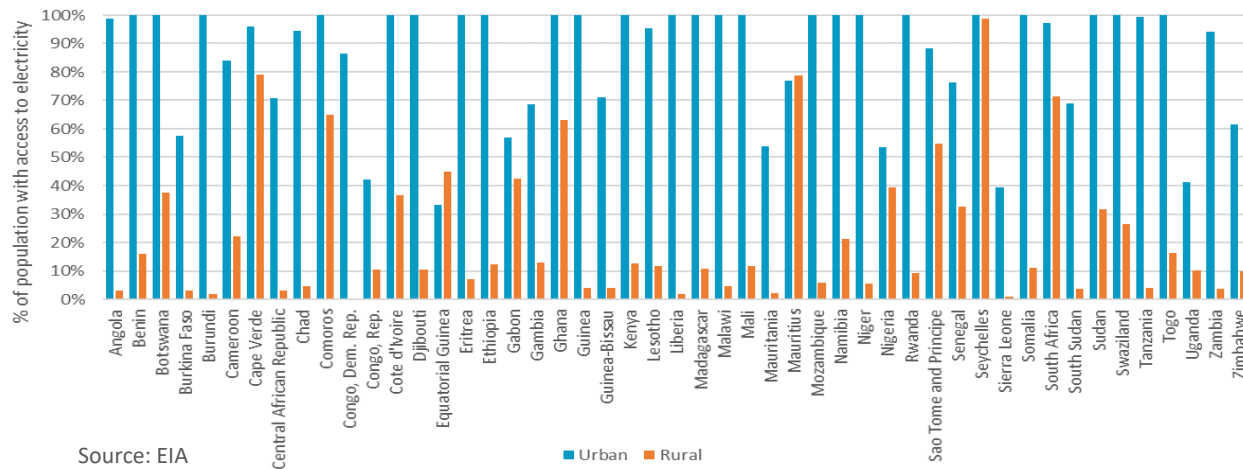
Source: EIA

Average access to electricity in urban vs rural areas in 49 SSA countries in 2014.

- The chart compares access to electricity in 49 SSA countries in urban vs rural areas in 2014
- 100% represents the total urban or rural population

SSA POWER MARKETS:

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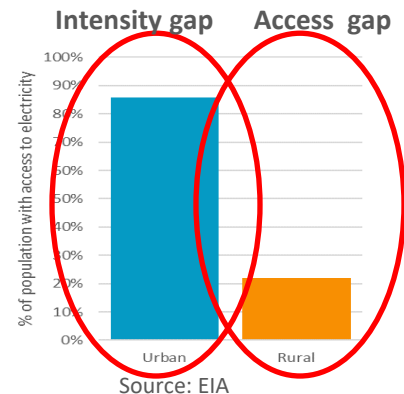
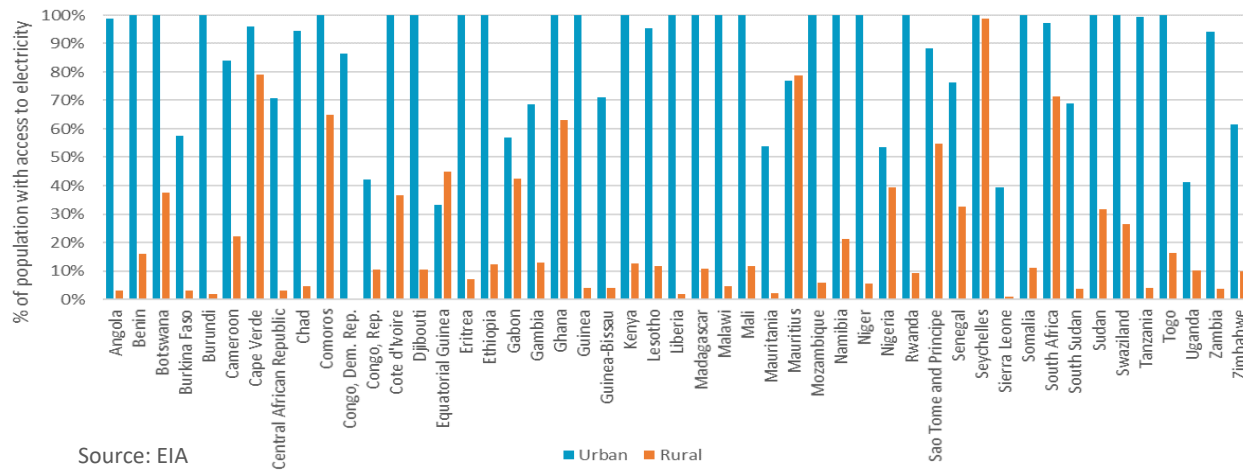
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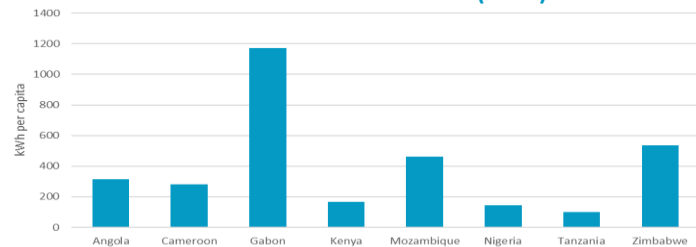


Average access to electricity in urban vs rural areas in 49 SSA countries in 2014.

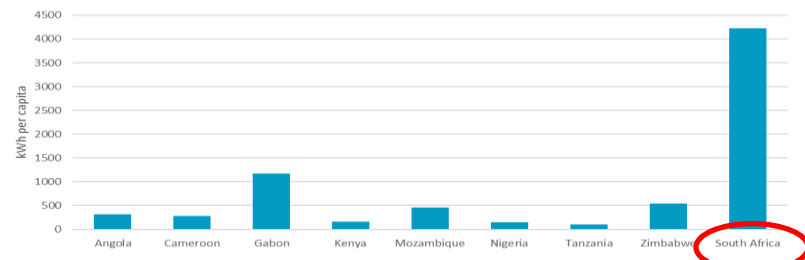
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SSA POWER MARKETS IN PERSPECTIVE:

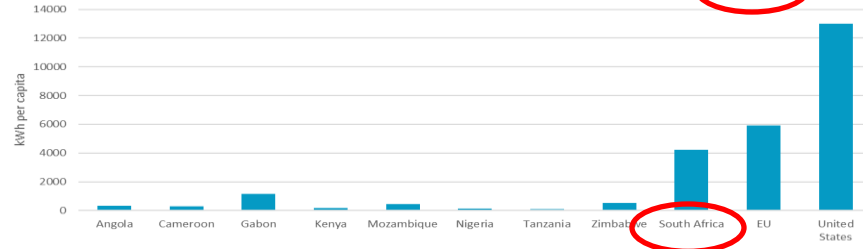
ELECTRICITY CONSUMPTION PER PERSON (2014)



Electricity consumption per capita in a sample of SSA countries excluding SA



Electricity consumption per capita in in a sample of SSA countries including SA



Electricity consumption per capita in the sample of SSA countries, including SA, compared to electricity consumption per capital in the EU and the United States

Source: World Bank

global environmental and advisory solutions



Case study Songo Songo, Tanzania

- Gas discovered by AGIP in 1974, c 1,000 Bcf recoverable, 200 km South of Dar
- Development stalled due to lack of market and challenging investment climate
- Project development crystallised in late 1990s based on integrated gas infrastructure and power plant conversion from liquid fuel to natural gas (initially 115 MW)
- Substantial donor support WB +
- First gas 2004
- Initial Gas infrastructure oversized
- Rapid development of power generation and industrial markets
- Further development in gas resources (Mnazi Bay, Killiwani N)
- Further infrastructure development
- Additional market development

Case Study Logbaba, Cameroon

- Logbaba field discovered beneath the city of Douala by Elf in 1954
- 2008/9 Victoria Oil and Gas entered Cameroon and drilled two wells
- 2009-2012 development of infrastructure and markets
- 2012 first production based on supply to industrials via grid
- 2015 gas supply to power generation
- 2015-2018 growth in supply as VOG acquires further supply (Matanda and Bomono¹) and undertakes additional drilling at Logbaba
- Estimated 121 bcf gross 2P reserves
- 50 km of pipelines to 32 customers
- Prices \$9 - \$16 mmbtu

¹ Subject to the Government's of Cameroon approval

Conclusions

- Natural gas in Sub Saharan Africa is less mature than oil and has often been overlooked
- There are natural gas based opportunities for both majors and independents in SSA
- Proven disruptive technologies are driving natural gas development in SSA
- Assessment and management of above ground risk is key
- The power market is often key
- Good opportunities exist for independents who are diligent and nimble