drillinginfo
better, faster decisions

AFRICAN GAS – WHERE'S THE DOMESTIC MARKET ?

Andrew Hayman
with contributions from Tom Richards & Emma Woodward

March 2016

Outline

What has oil and gas done for standards of living in Africa ?
The UN Human Development Index

Power generation – is this the African panacea ?

How much gas & where's it currently going ?

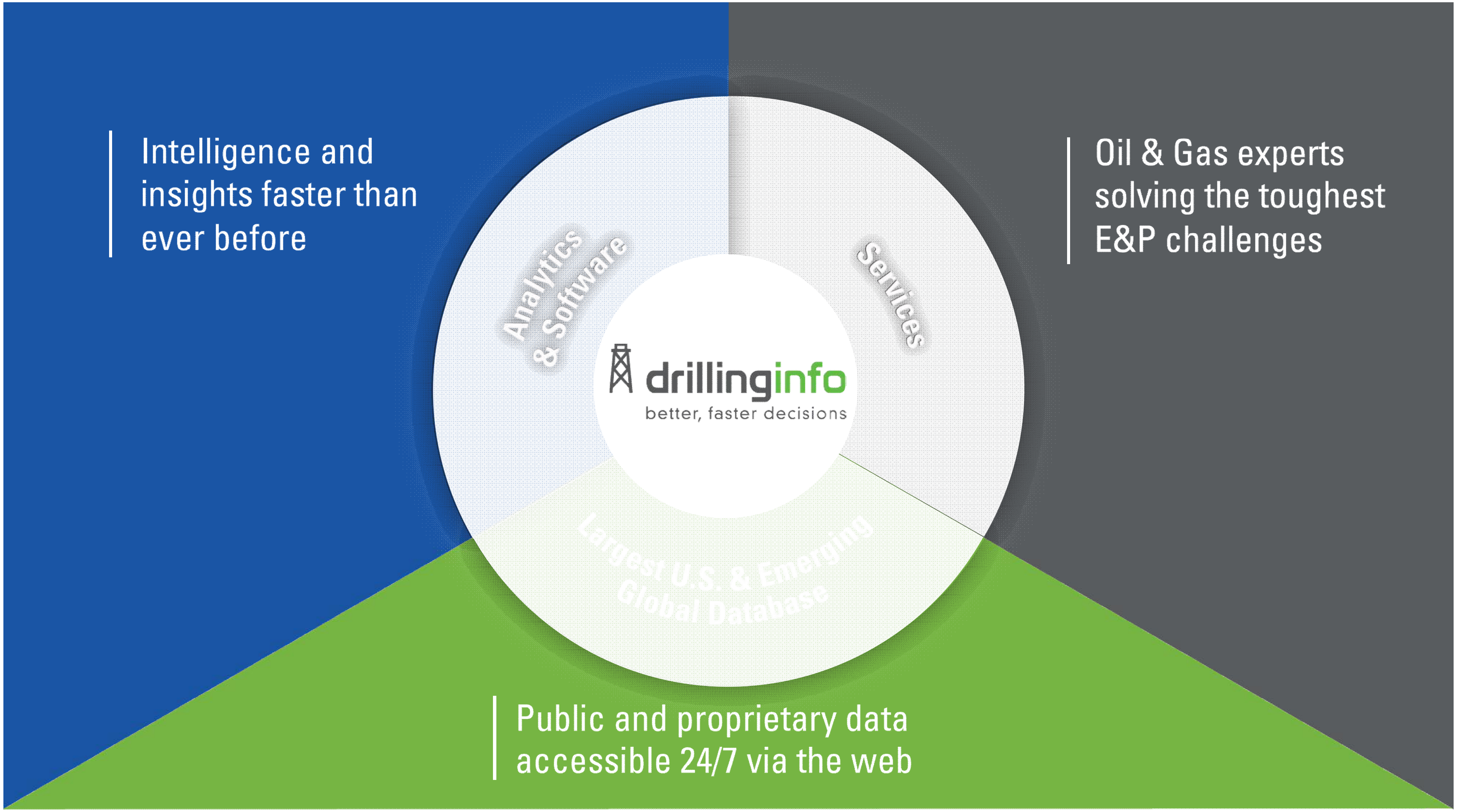
Sub-Saharan Africa gas developments, with focus on domestic usage:

- East and Southern Africa
- West Africa

Summary

DRILLINGINFO

COMPETITIVE DIFFERENTIATORS: First Web Enabled | Always Up-to-Date | Proactive, Customizable Alerts



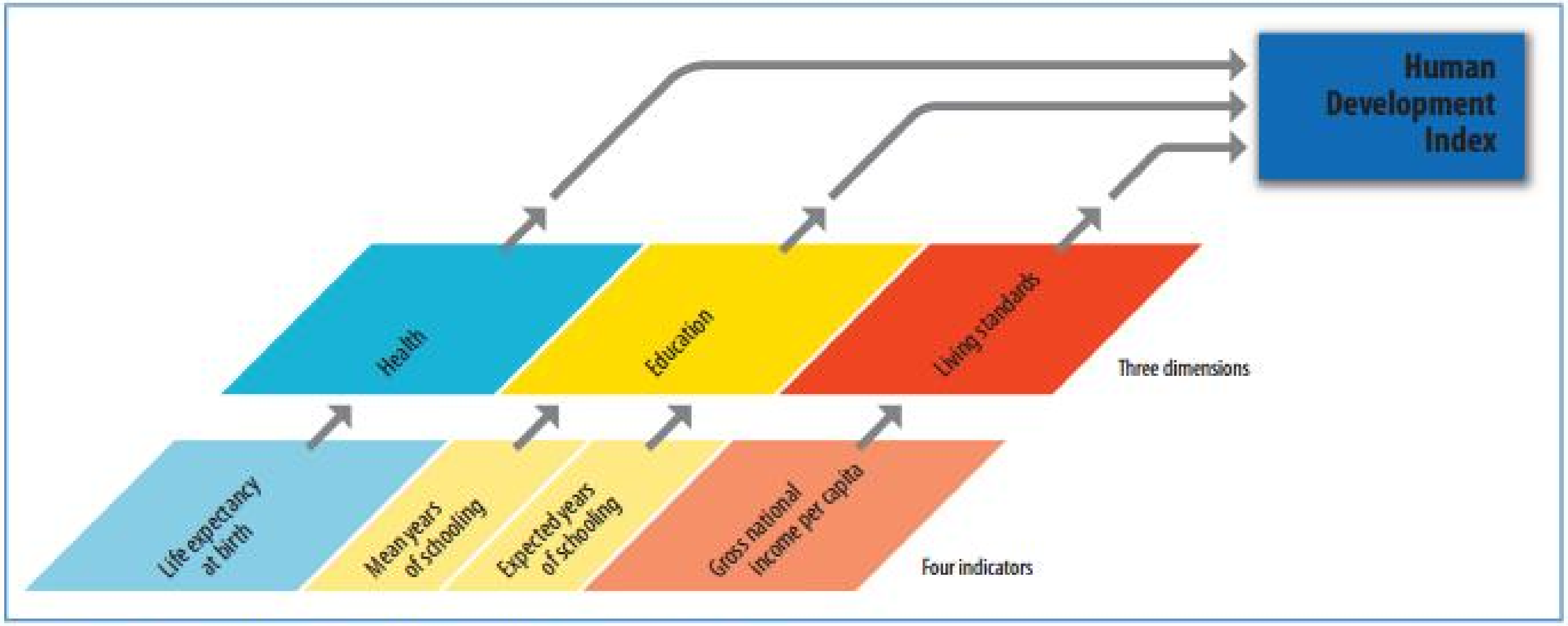
Oil and Gas - what's it all done for me ?

Samburu Tribe, Kenya – photo Jimmy Nelson BV

How do we measure progress

- The UN Human Development Index

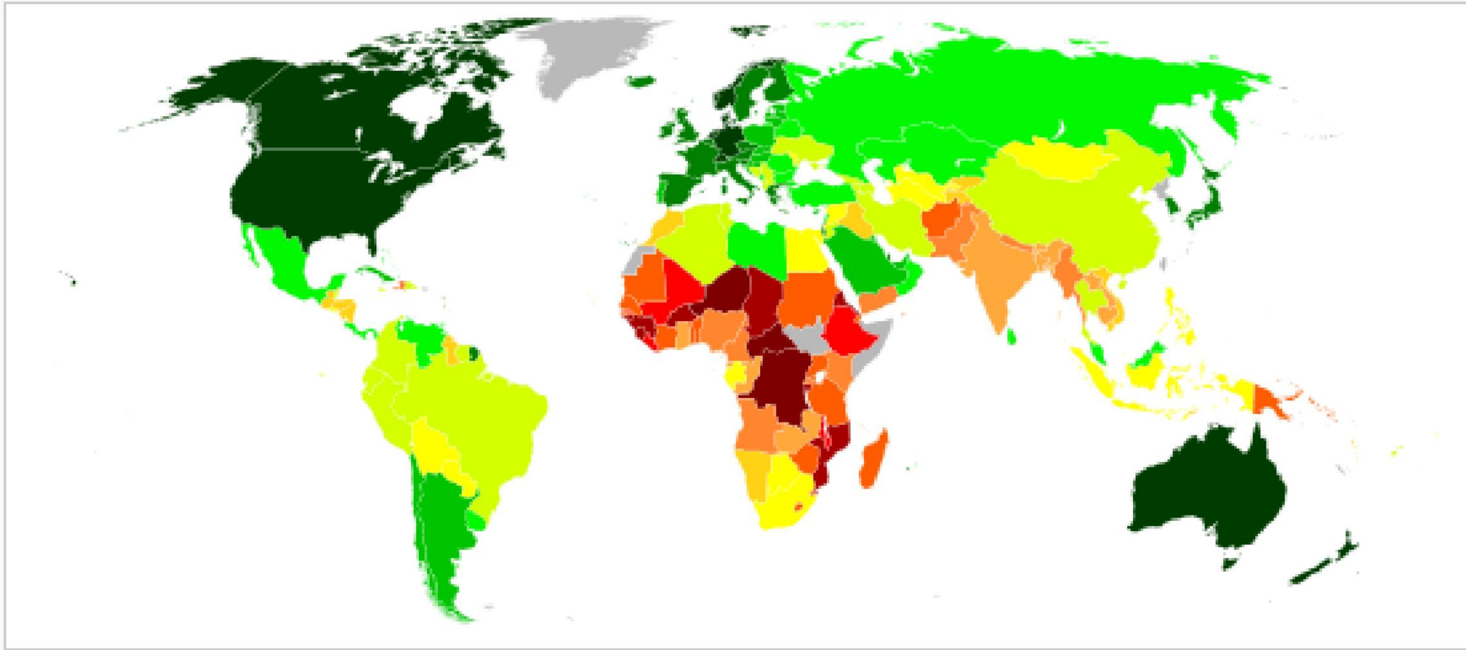
The HDI—three dimensions and four indicators



Note: The indicators presented in this figure follow the new methodology, as defined in box 1.2.

Source: HDRO.

Human Development Index



World map indicating the Human Development Index (based on 2013 data, published on July 24, 2014).[1]

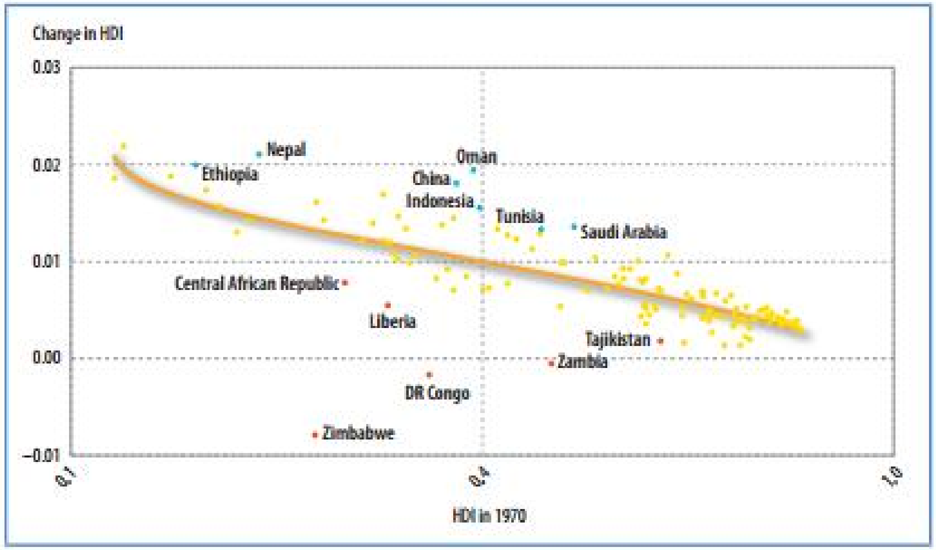
0.900 and over	0.650–0.699	0.400–0.449
0.850–0.899	0.600–0.649	0.350–0.399
0.800–0.849	0.550–0.599	0.349 and under
0.750–0.799	0.500–0.549	Data unavailable
0.700–0.749	0.450–0.499	

HDI progress from oil and gas – globally ?

Indonesia
Malaysia
Algeria

FIGURE 2.2 **Top movers vary across regions, but bottom movers are concentrated in Africa**

Top and bottom movers as measured by deviation from fit, 1970–2010



Note: HDI values in 1970 are in logarithmic scale.

Source: HDRO calculations using data from the HDRO database.

TABLE 2.2 **Fastest progress in human development comes in different ways**

Top movers in HDI, nonincome HDI and GDP, 1970–2010

	Improvements in		
Rank	**HDI**	**Nonincome HDI**	**Income**
1	**Oman**	Oman	China
2	**China**	Nepal	Botswana
3	**Nepal**	Saudi Arabia	South Korea
4	**Indonesia**	Libya	Hong Kong, China
5	**Saudi Arabia**	Algeria	Malaysia
6	**Lao PDR**	Tunisia	Indonesia
7	**Tunisia**	Iran	Malta
8	**South Korea**	Ethiopia	Viet Nam
9	**Algeria**	South Korea	Mauritius
10	**Morocco**	Indonesia	India

Note: Improvements in HDI and nonincome HDI are measured by the deviation from fit—how well a country does relative to other countries starting from the same point (see box 2.1). Improvements in income are measured by the annual percentage growth rate in per capita GDP.

Source: HDRO calculations using data from the HDRO database.

Electricity consumption promotes development

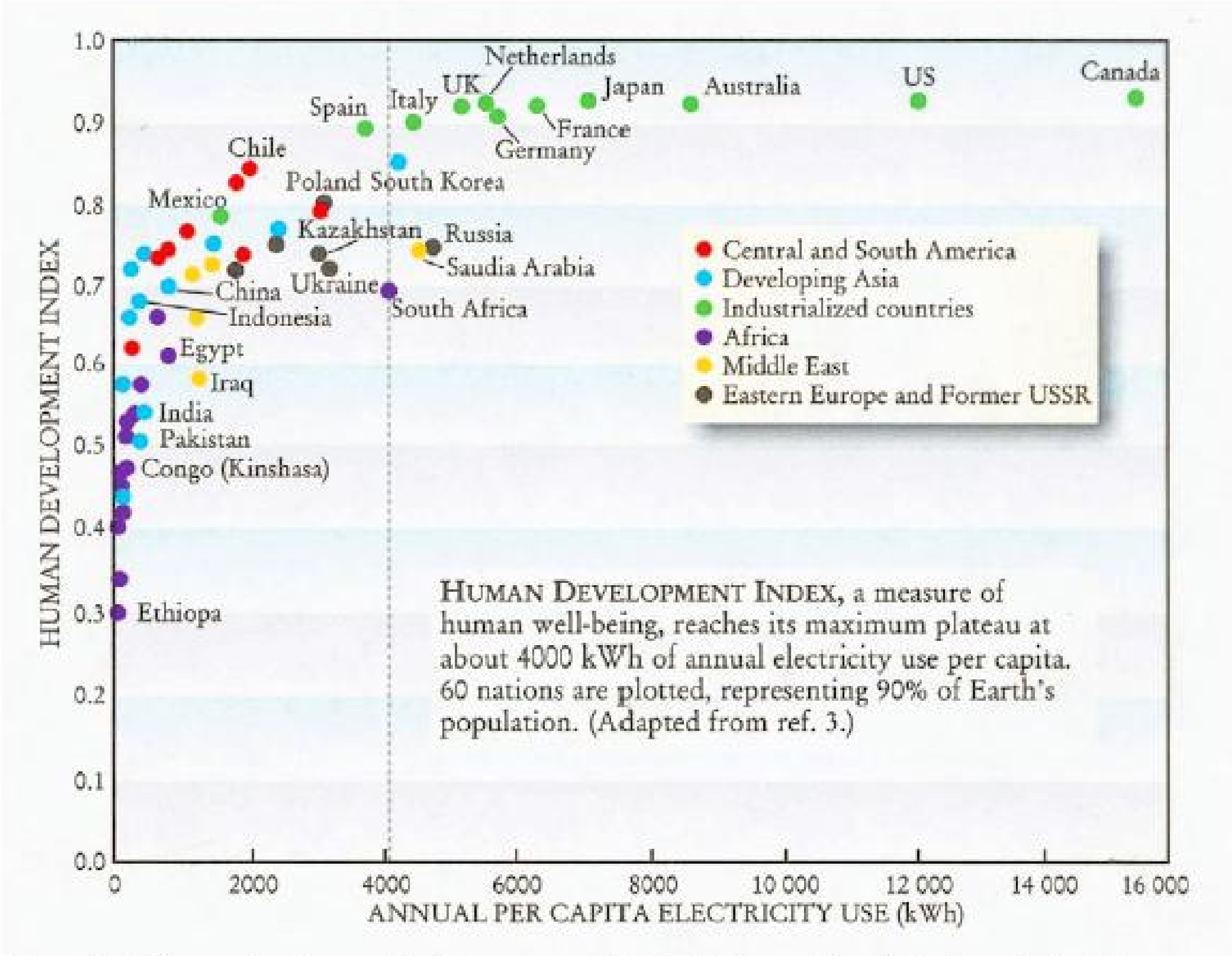
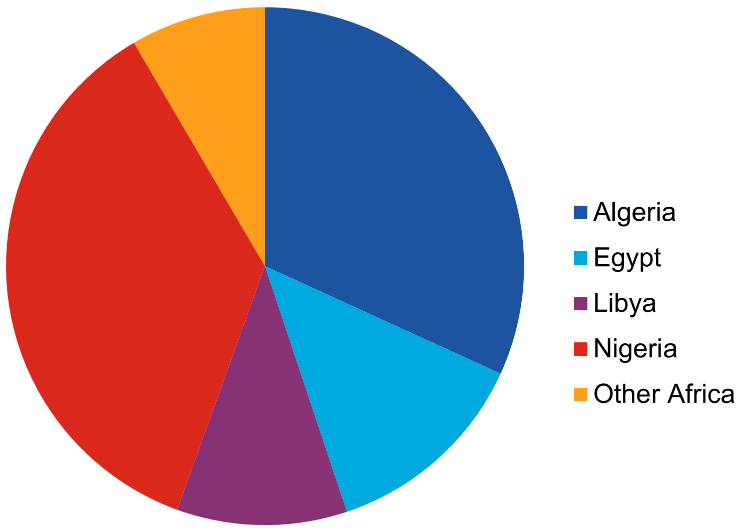


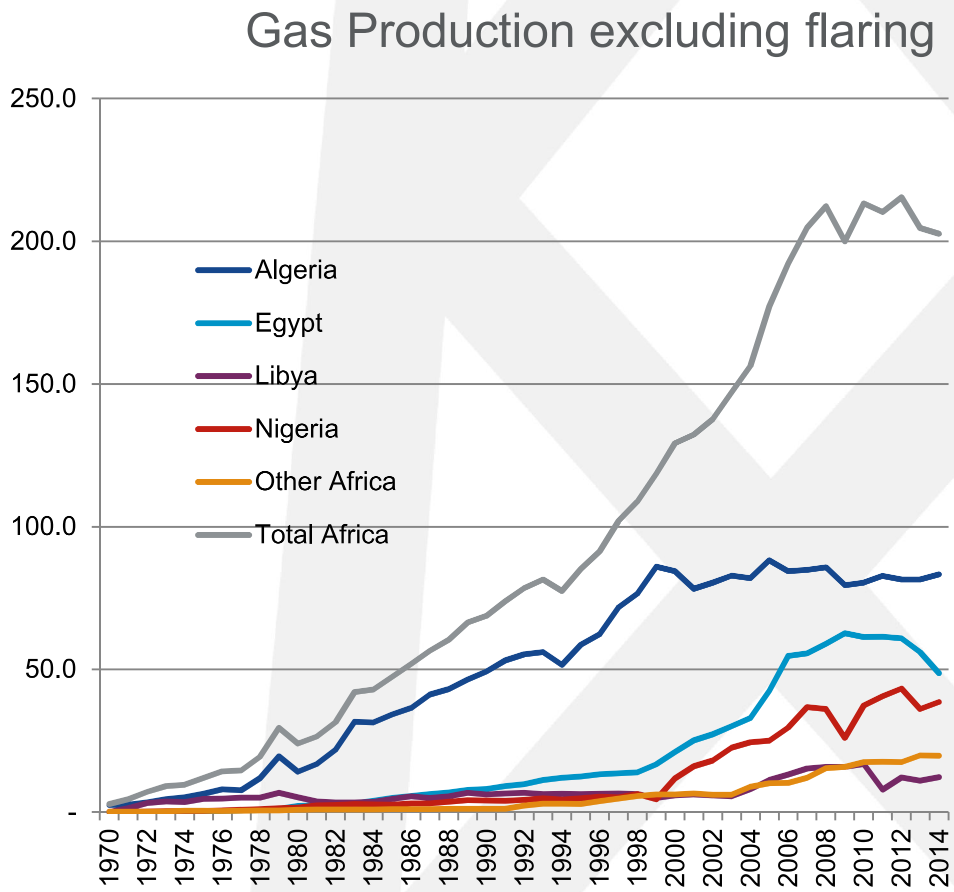
Figure 1.2. Human development index vs. per capita electricity use for selected countries. Taken from S. Benka, *Physics Today* (April 2002), pg 39, and adapted from A. Pasternak, Lawrence Livermore National Laboratory rep. no. UCRL-ID-140773.

Current Africa Gas Reserves and Production



500 Tcf proven end 2014

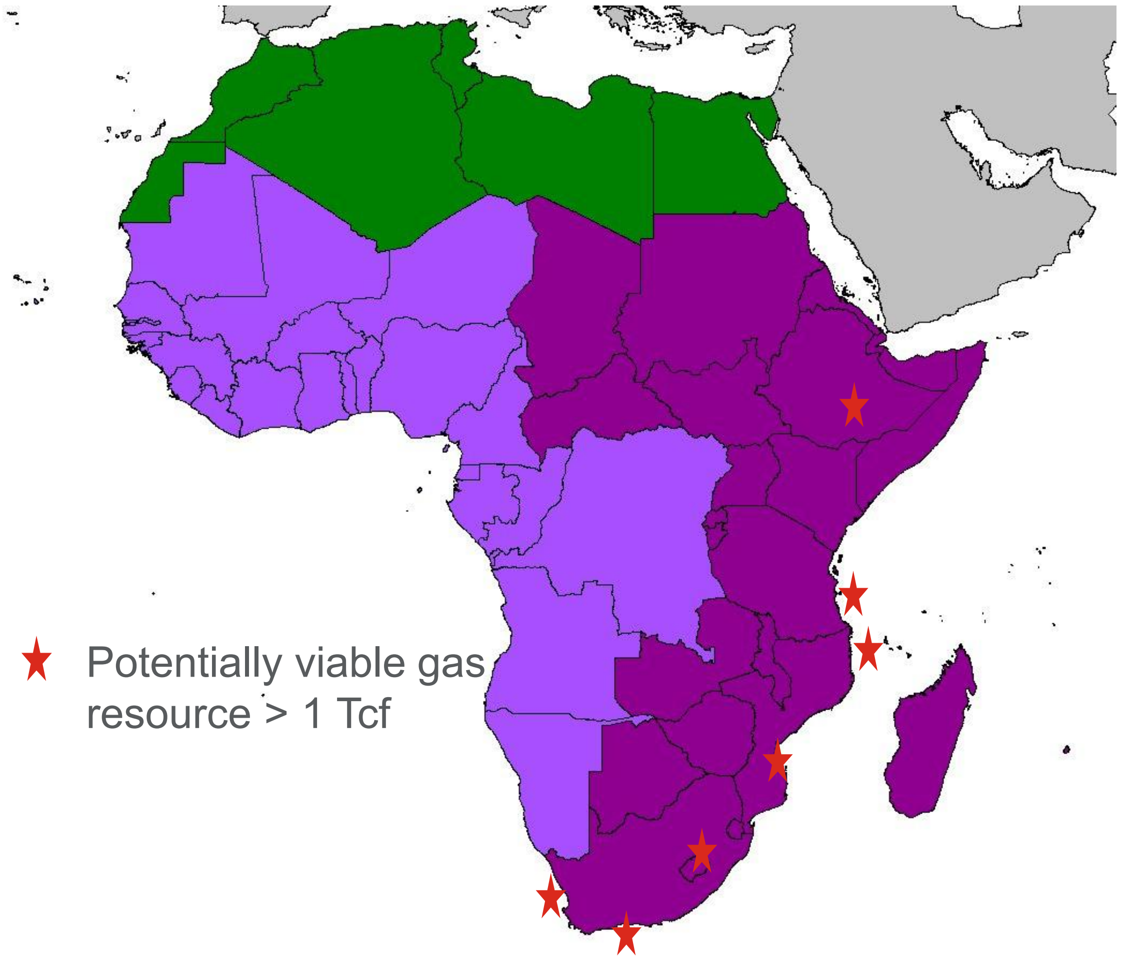
(BP Statistical Bulletin)



drillinginfo better, faster decisions

East & Southern Africa

- Regional gas resources 2C – 250 Tcf
- >200 Tcf discovered in 10 years
- Very minor 2C resources added *onshore*
- The elephant in the room is Karoo shale gas (estimated recoverable resources 55 to 450 Tcf), *but severe environmental concerns*



drillinginfo
better, faster decisions

Macro-Economic Picture –
East Africa – eyes on Asian market @ $ 8 - 10 / MMbtu

Size of LNG carriers is doubling from 135,000 to 270,000 tonnes

Potential LNG Export Projects:

- Ethiopia / Djibouti
- Tanzania
- Mozambique

Small-scale LNG plants still generally a concept, not a reality

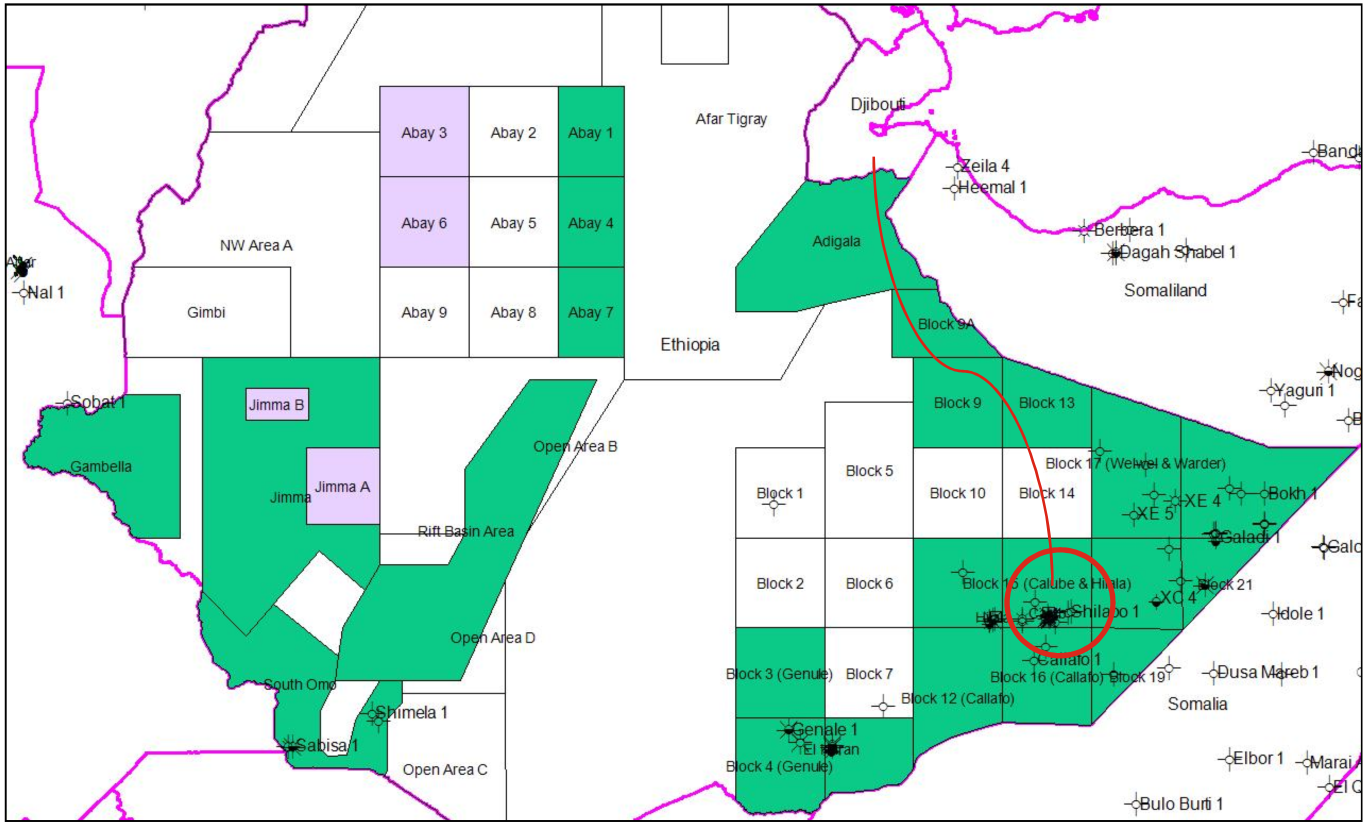
Ethiopia – Calub / Hilala (ca. 3 Tcf 2C Resources)

Poly-GCL
$5 billion investment
LNG to China 1 train
5MM t/a

No domestic gas provision for Djibouti or Ethiopia

High risk from security point of view (Al-Shabaab, OLF)

Classic hi-tech China-Africa project with no direct benefit to the man in the street



"In the past 10 years, China's LNG technology and equipment capacity have developed by leaps and bounds (CNOOC)"

drillinginfo
better, faster decisions

Kenya – Bogal and Sala don't work for gas-to-power

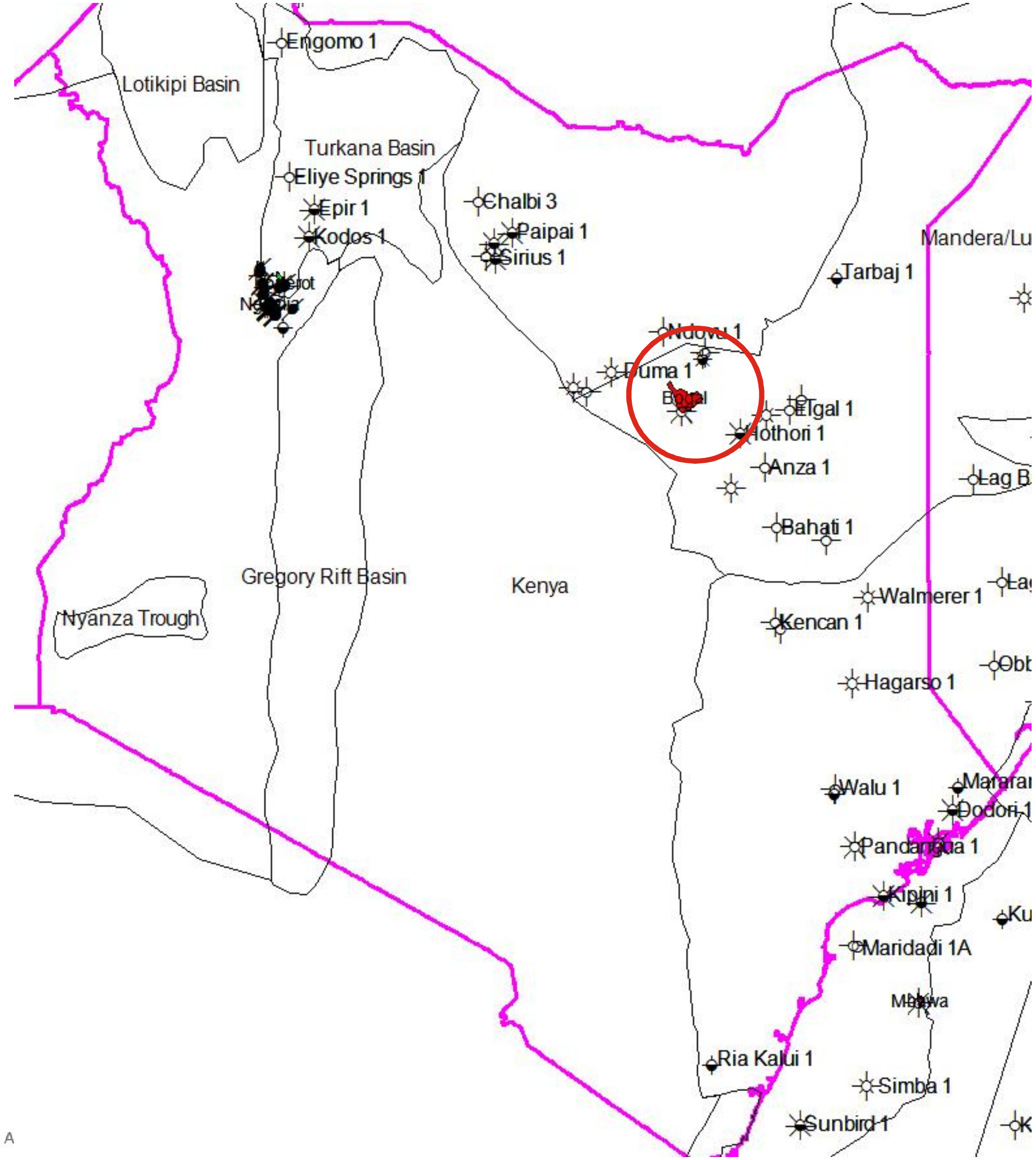
Gas to power promoted – Bogal 1 or Salah 1 (Anza Graben)

President Uhuru demands progress, but no success

Distance to consumers ?

Current electricity capacity 1.5 GW

Mid-Term energy options ?? Hydro, Solar, Wind – reduce biomass consumption



better, faster decisions

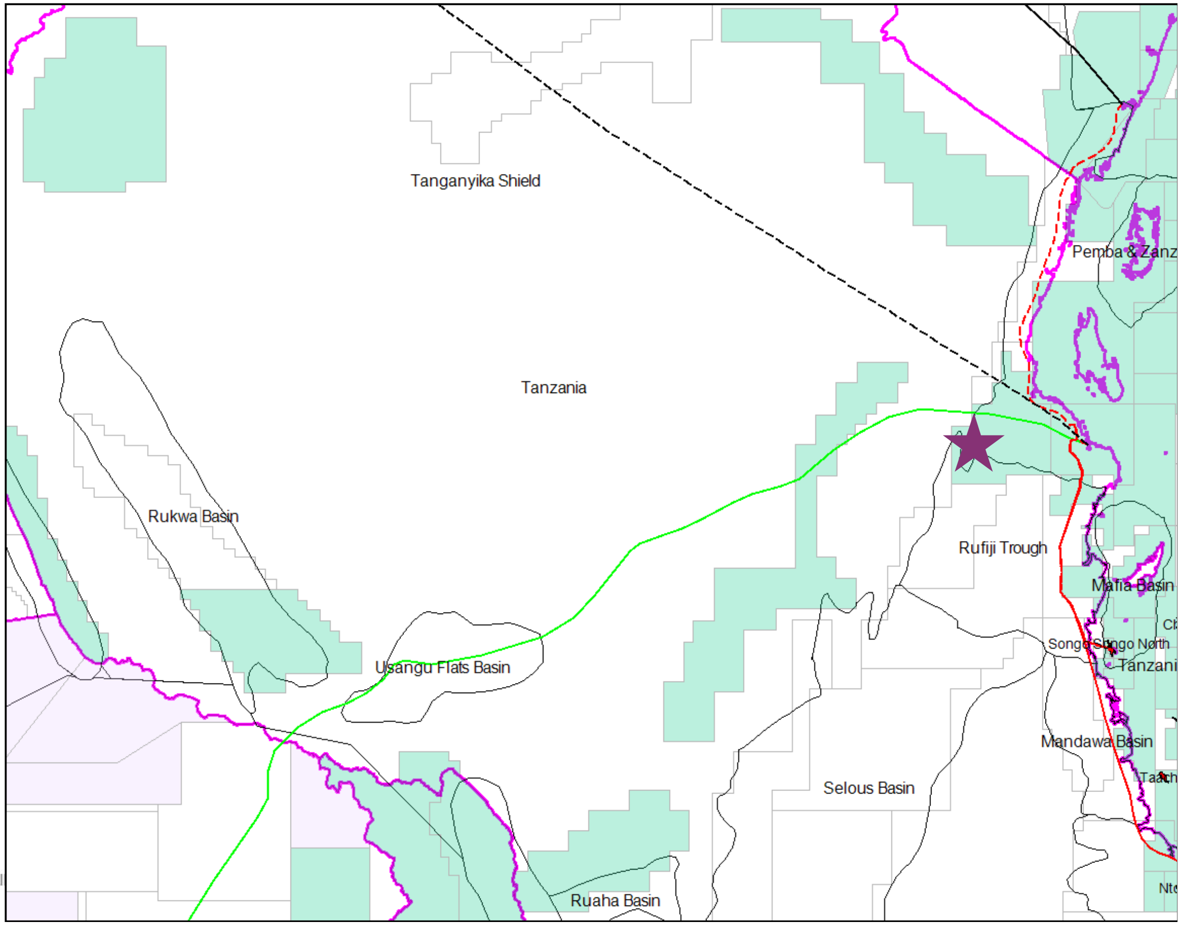
Tanzania – Highlights 2014-2016

Gas infrastructure: Completion in Q1 2016. Two-part gas development plan: gas for domestic; gas for export

Tanseco – paying off debt to Orca

Medium Term: gas from Songo-Songo, Mnazi Bay, Kiliwani North, Ntorya

Exciting new gas discovery close to Dar – Dodsal (2.7 Tcf quoted - TBC) ★



drillinginfo
better, faster decisions

Mozambique – gas veterans

Export to SA since 2004

Sasol – building a local gas industry, involved in gas-to-power

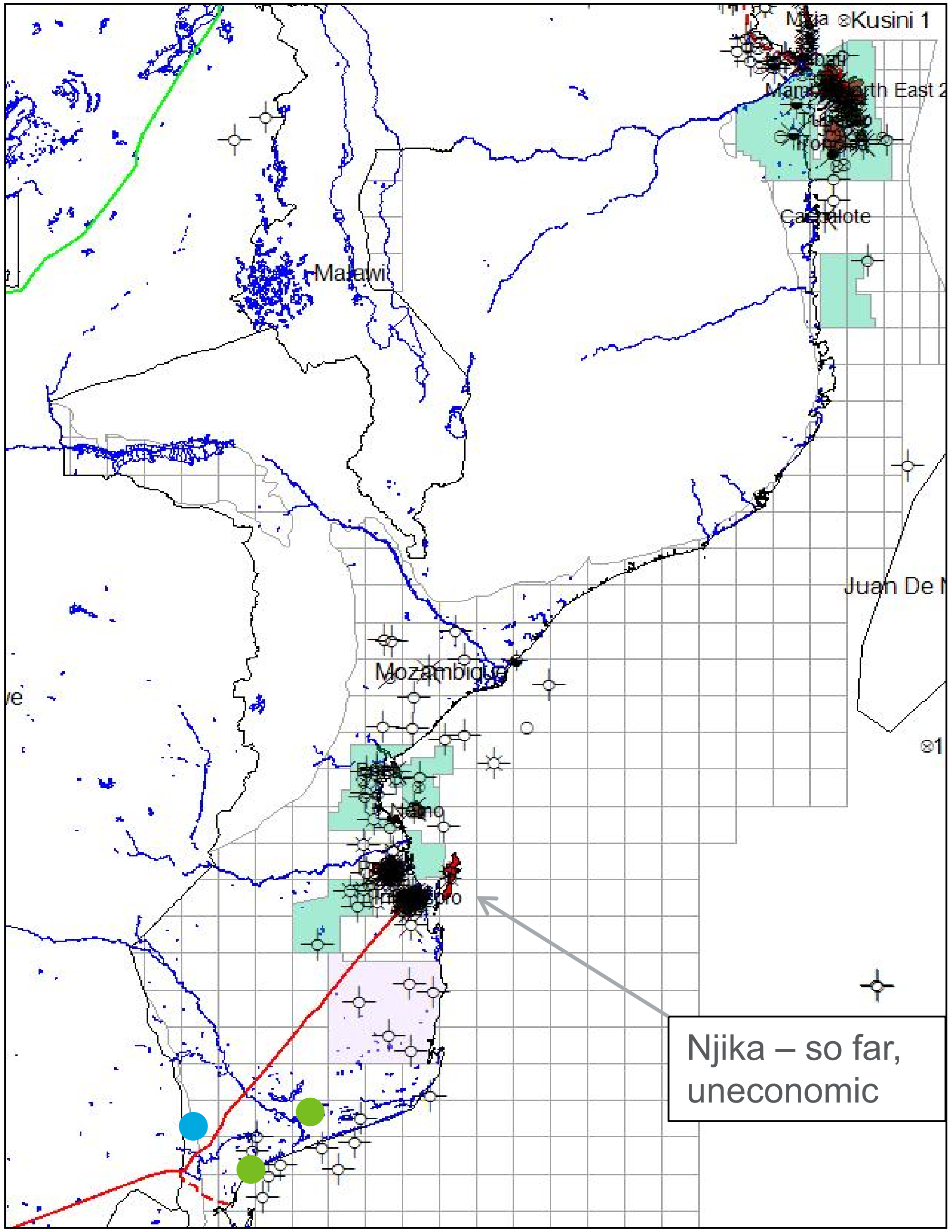
Hydro-power (Cahora Basso Dam)

Electricity – Sasol 175 MW Ressano Garcia plant ●

Next gas steps by EdM:

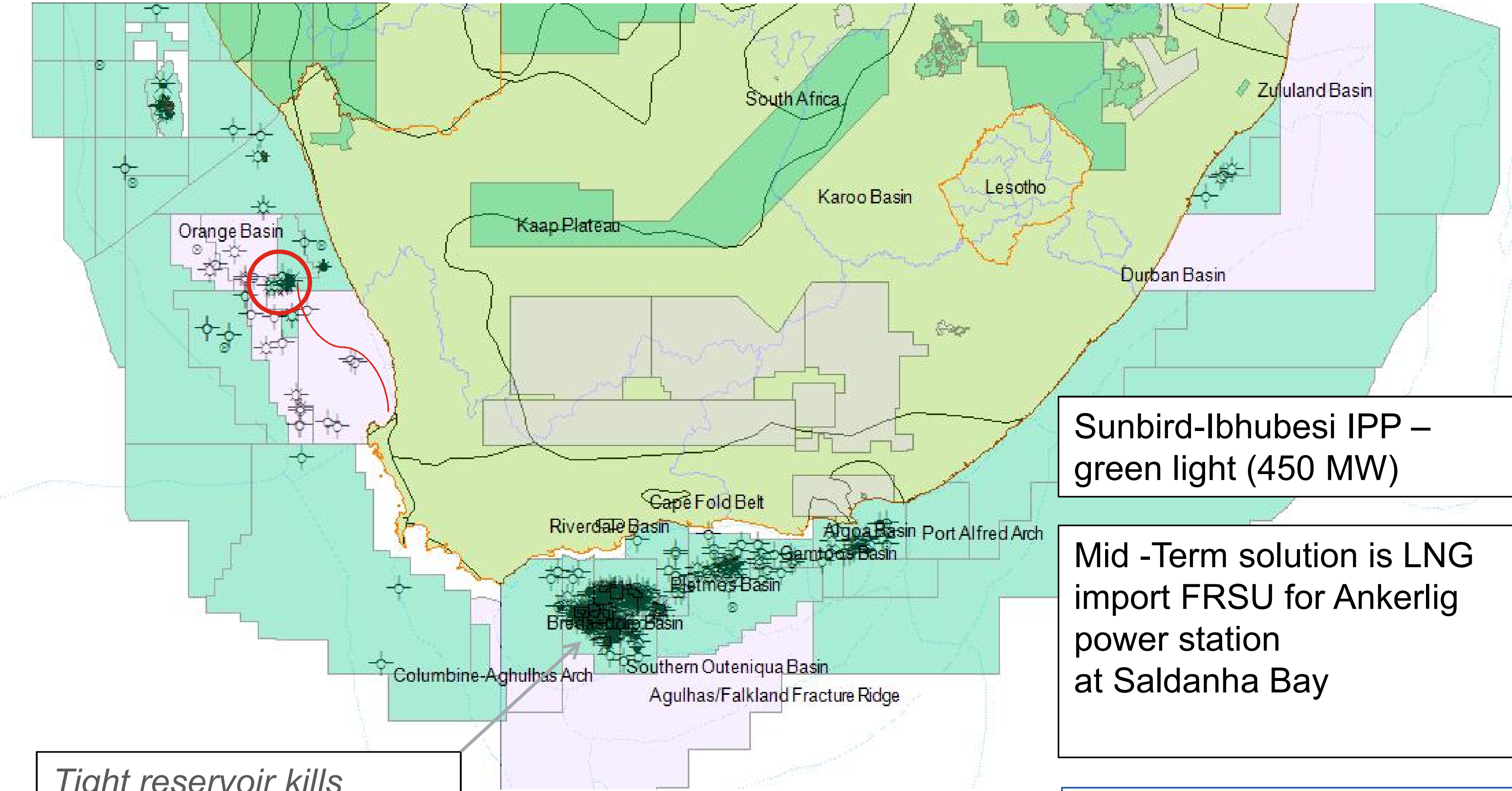
Maputo (IHI-Sumitomo) 120 MW ●

Chokwe, Gaza Province 50 MW ●



drillinginfo
better, faster decisions

South Africa – catastrophic power deficit - government blows hot and cold on gas-to-power …



Sunbird-Ibhubesi IPP – green light (450 MW)

Mid -Term solution is LNG import FRSU for Ankerlig power station at Saldanha Bay

Tight reservoir kills Ikhwezi (F-O) project

Karoo shale gas ?

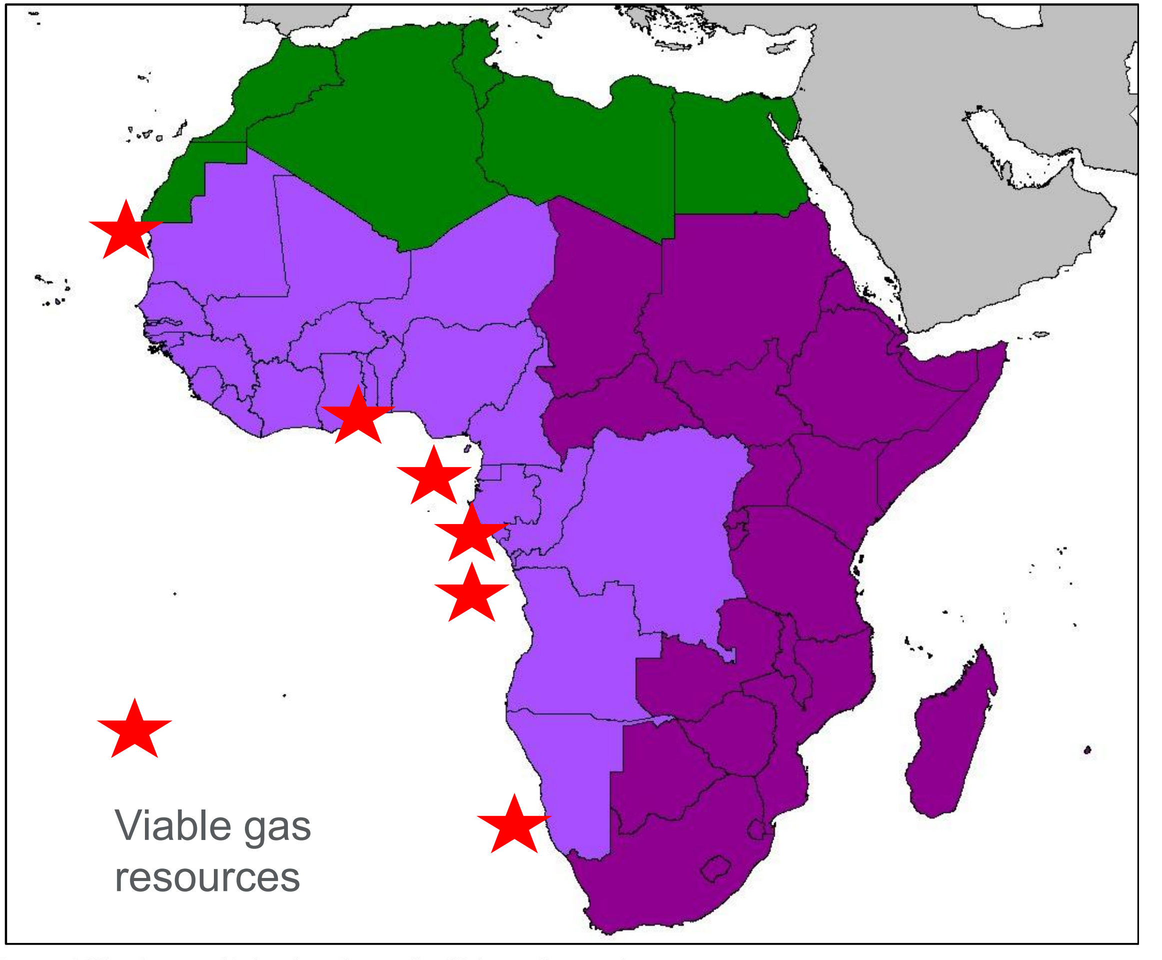
drillinginfo
better, faster decisions

Macro-Environment for West African Gas

Atlantic Basin market – (used to be great for oil and gas exports to US)

Proximity for exports of gas to Europe

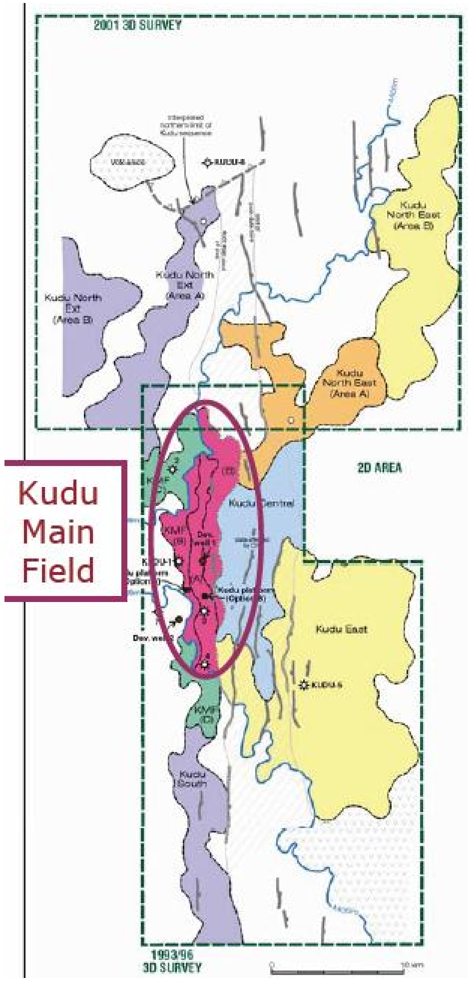
Risk: Proximity for potential US LNG exports into West Africa



drillinginfo
better, faster decisions

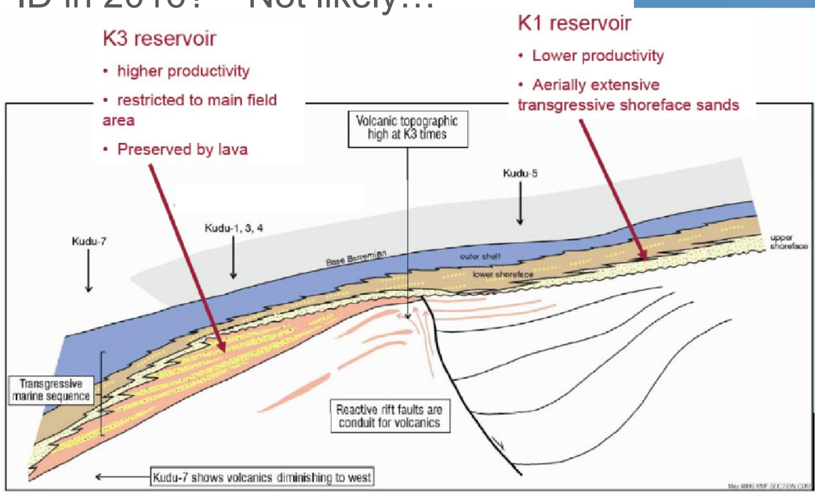
Namibia – the lost orphan - Kudu

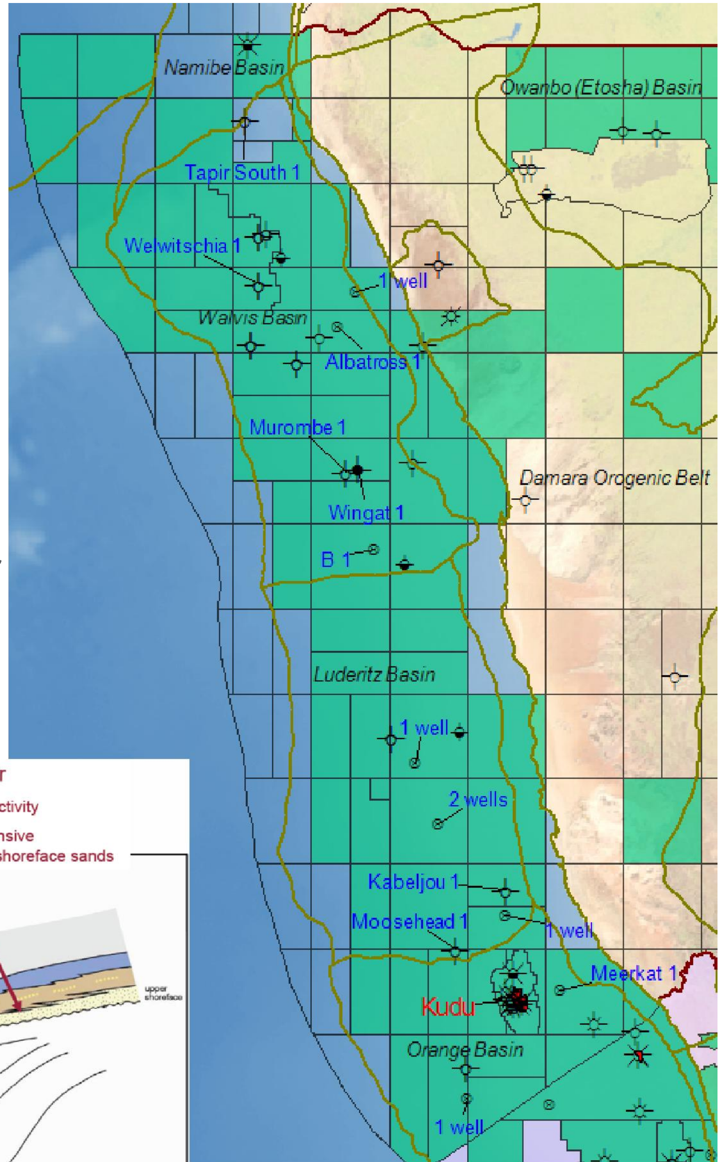
Won't happen right now although government still appears to be working on it



- Discovered 1974
- 1.3 Tcf gas proven GIIP
- Planned development to supply 800MW power plant (with 400MW to be supplied to Zambia & South Africa)
- Estimated cost US$1.2 billion.
- Tullow withdrew from licence on FID

- BW Offshore now selected as preferred technical operator & supplier of FPS system, although Finance Minister has stated project economically unfeasible
- FID in 2016? – Not likely…





Angola

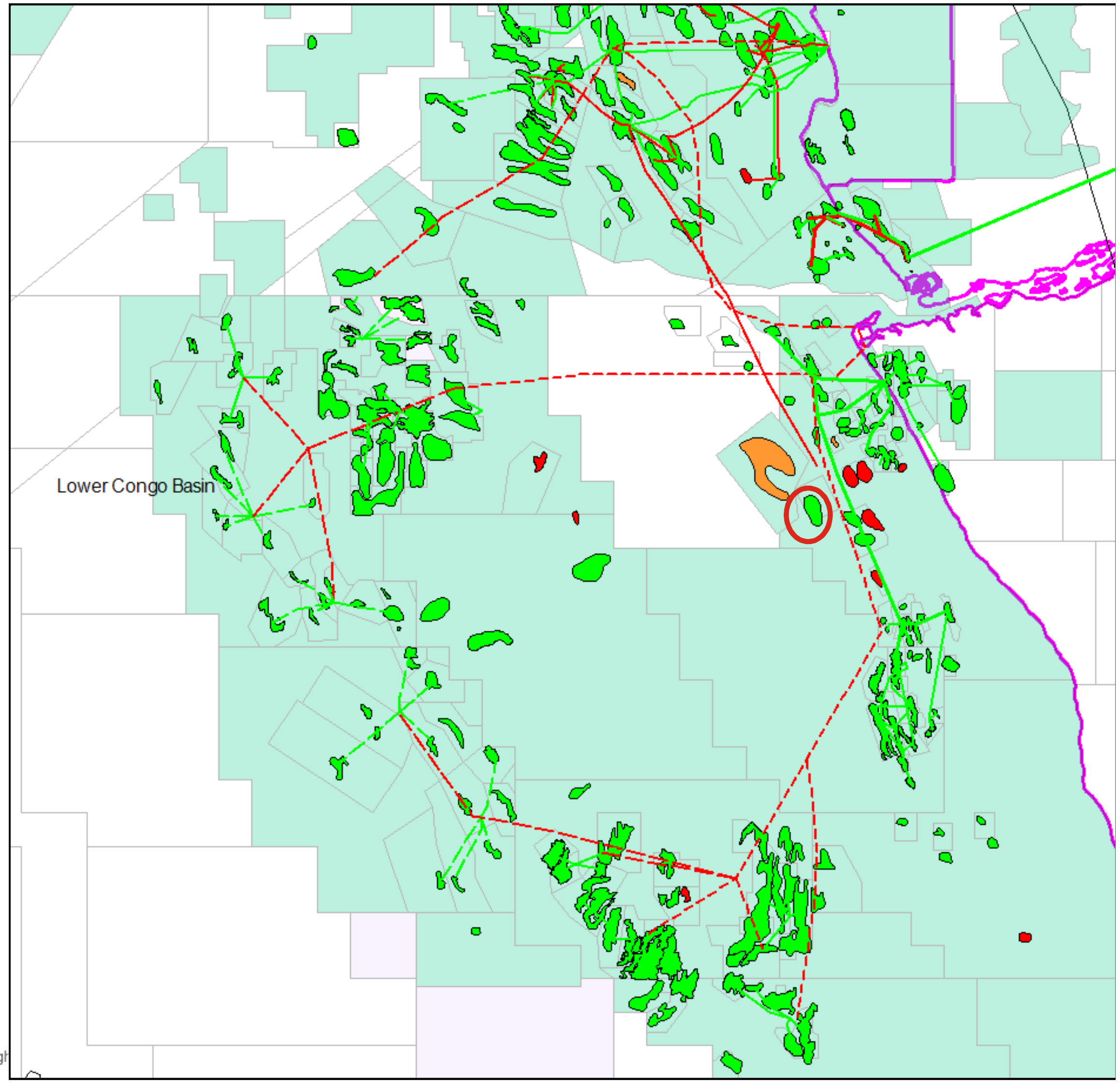
Lots of gas – 11 Tcf (2C)

Deep water gas (Block 0, 14, 17, 31)– but for export via Angola LNG

"Angola LNG Phase II" - Sonagas exploration - maybe convert to a domestic project (Quiluma … IPPs)

Sonangol has been awarded numerous specific gas concessions in last few months (Garoupa West ; 6/16 – Cegonha

Gas-to-power projects (Soyo, Cabinda)

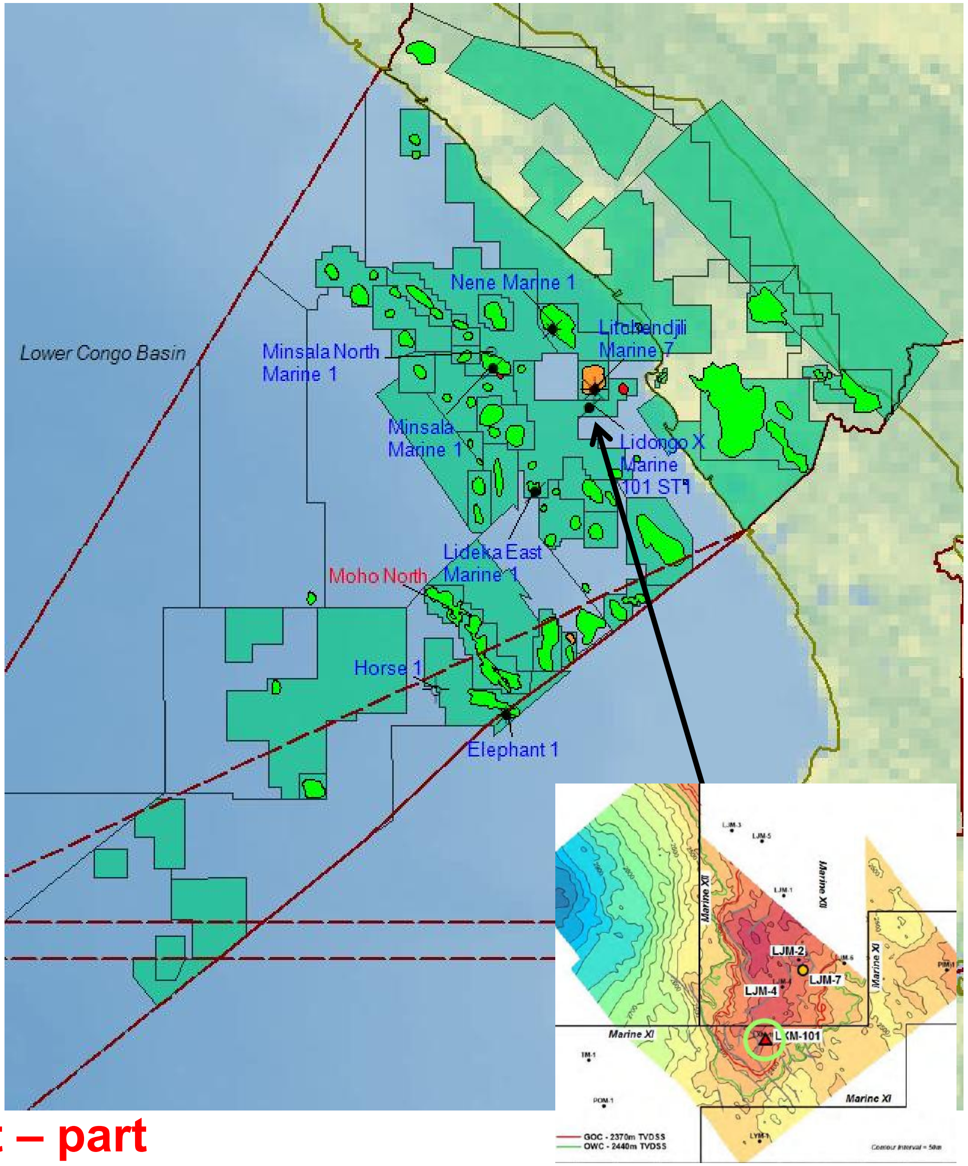


drillinginfo
better, faster decisions

Congo

Major Recent Exploration Success including lots of gas in shallow water
Eni – Nene Marine, Litchendjili, Minsala Marine
Soco – Litchendjili Ext, Lideka E

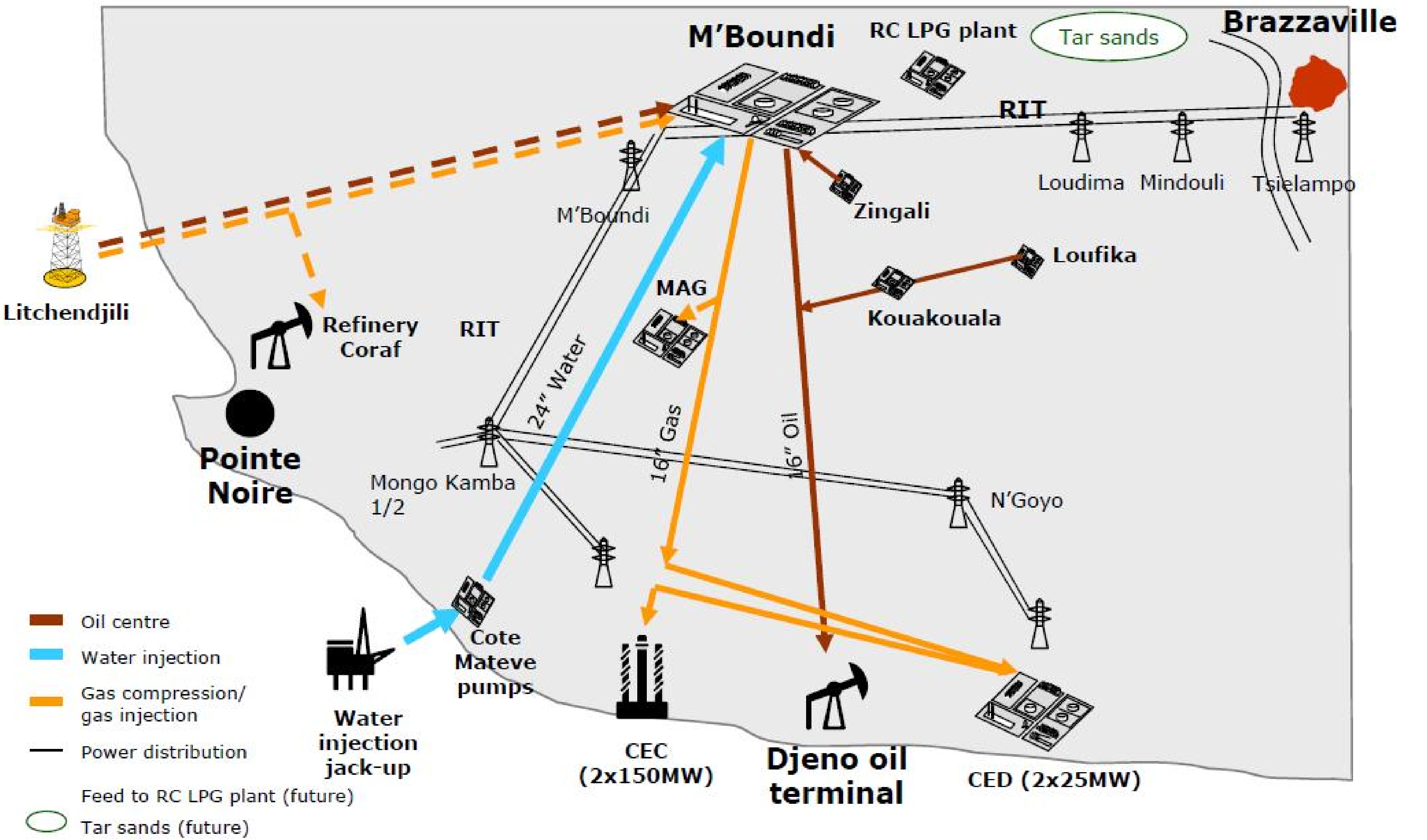
- Nene Marine onstream January 2015
- 1.2 Bbo & 1Tcfg
- Discovered February 2013
- First phase production 7,500 boe/d
- To ramp up to 140,000 boe/d
- Total of 3.5 Bboe discovered on Marine XII
- Litchendjili gas expected onstream Q3 2015
- New legislation – yet to be ratified, includes ban on gas flaring



Eni plans for 175 MW power plant – part of industrial masterplan

drillinginfo
better, faster decisions

Congo - Eni – Plans for Infrastructure



New planned Djeno gas-fired power station 450 MW

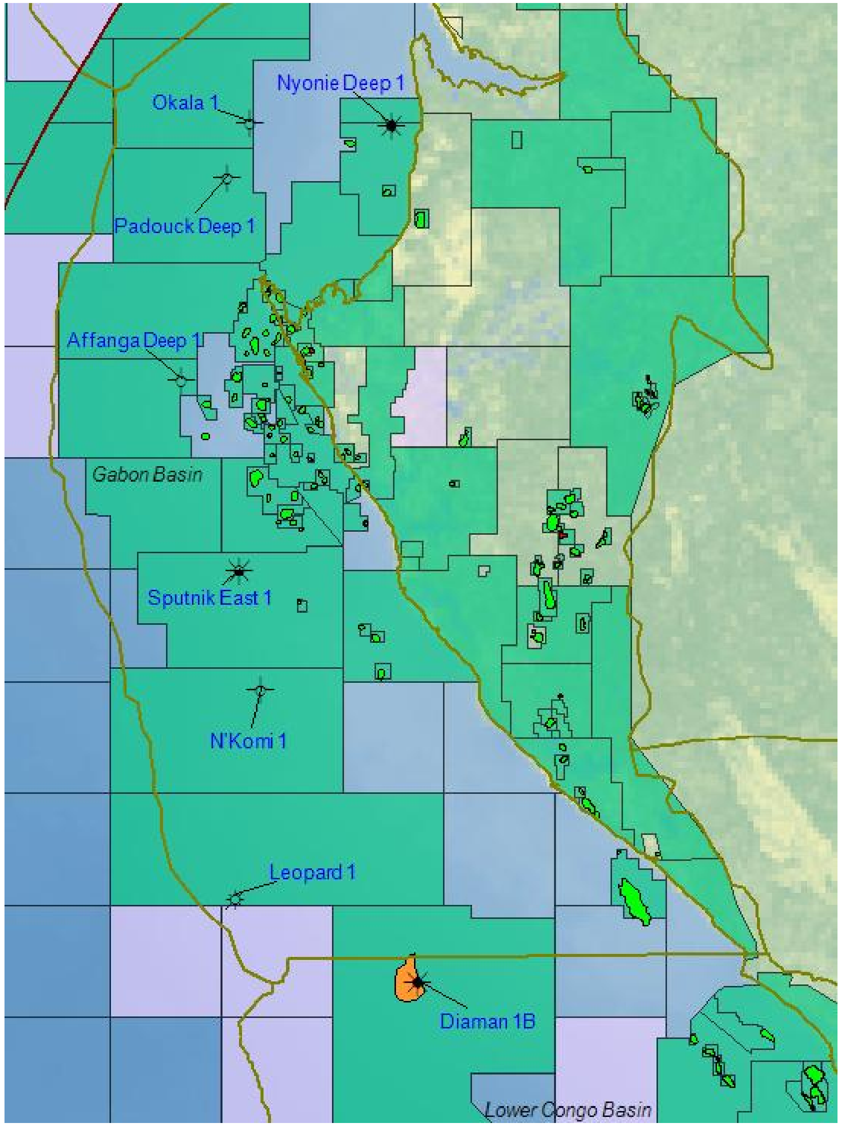
Gabon

Government is early signatory of UN flares-out initiative (by 2030)
Minister wants to develop a gas industry
Long-term gas flaring and some gas re-injection

Recent gas resource additions:

Diaman (Total)
Leopard (Shell) “Multi-Tcf”
Nyonie Deep (Eni) – 500 MMboe

But virtually no domestic gas market, as of today (minor GTP projects)

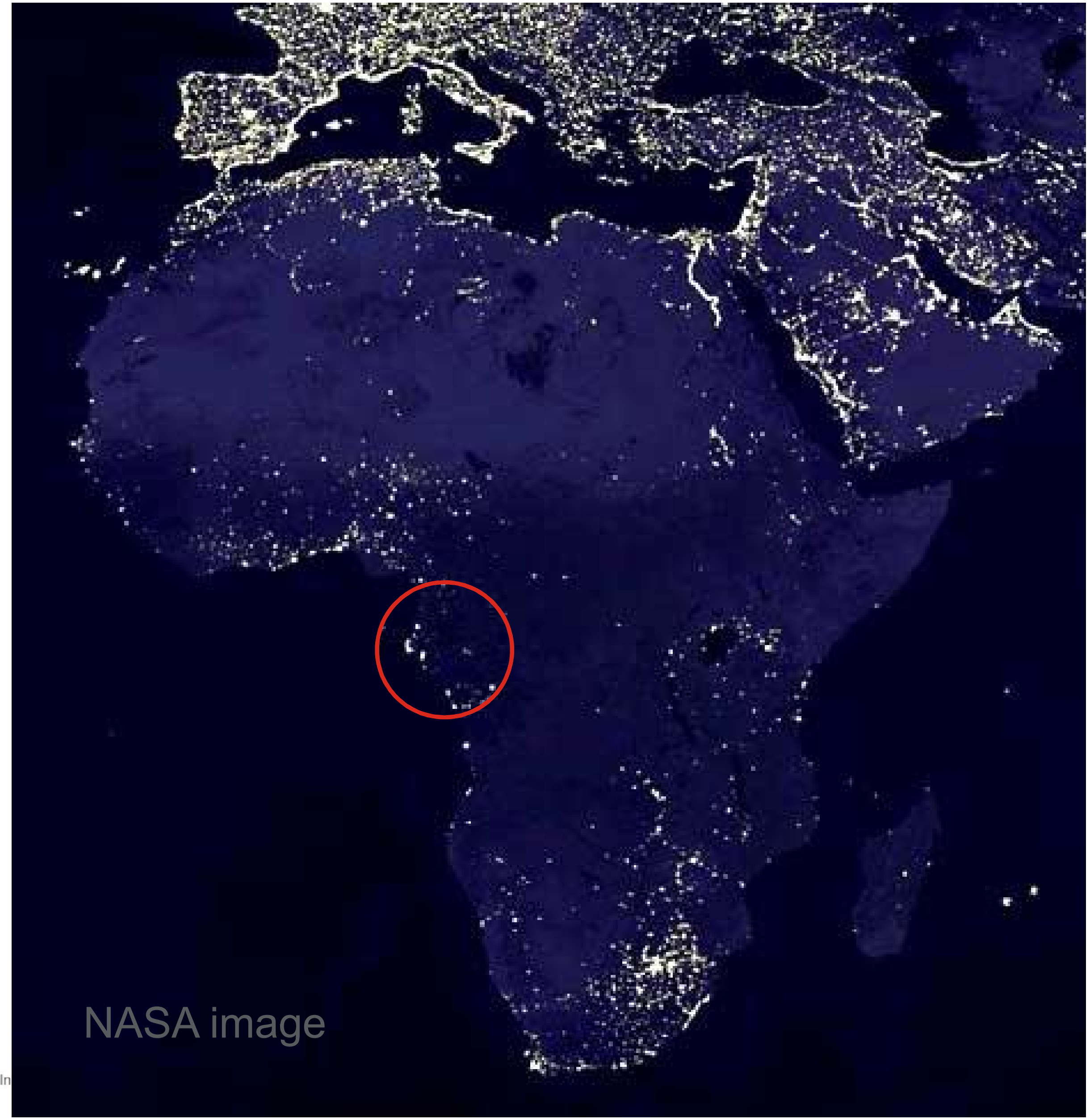


Gabon

Gas flaring still a major problem

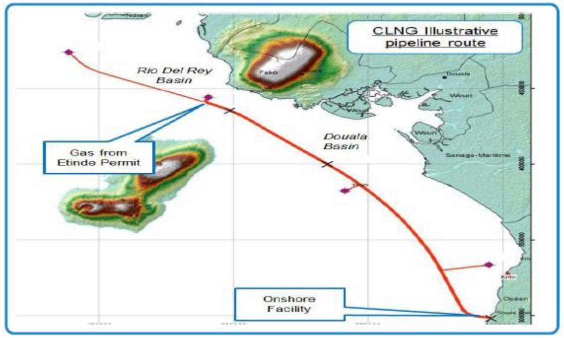
71 Bcf produced of which 51 Bcf flared (2011 – EIA latest data)

Improvements since then by Perenco, Total



drillinginfo
better, faster decisions

Cameroon – local markets

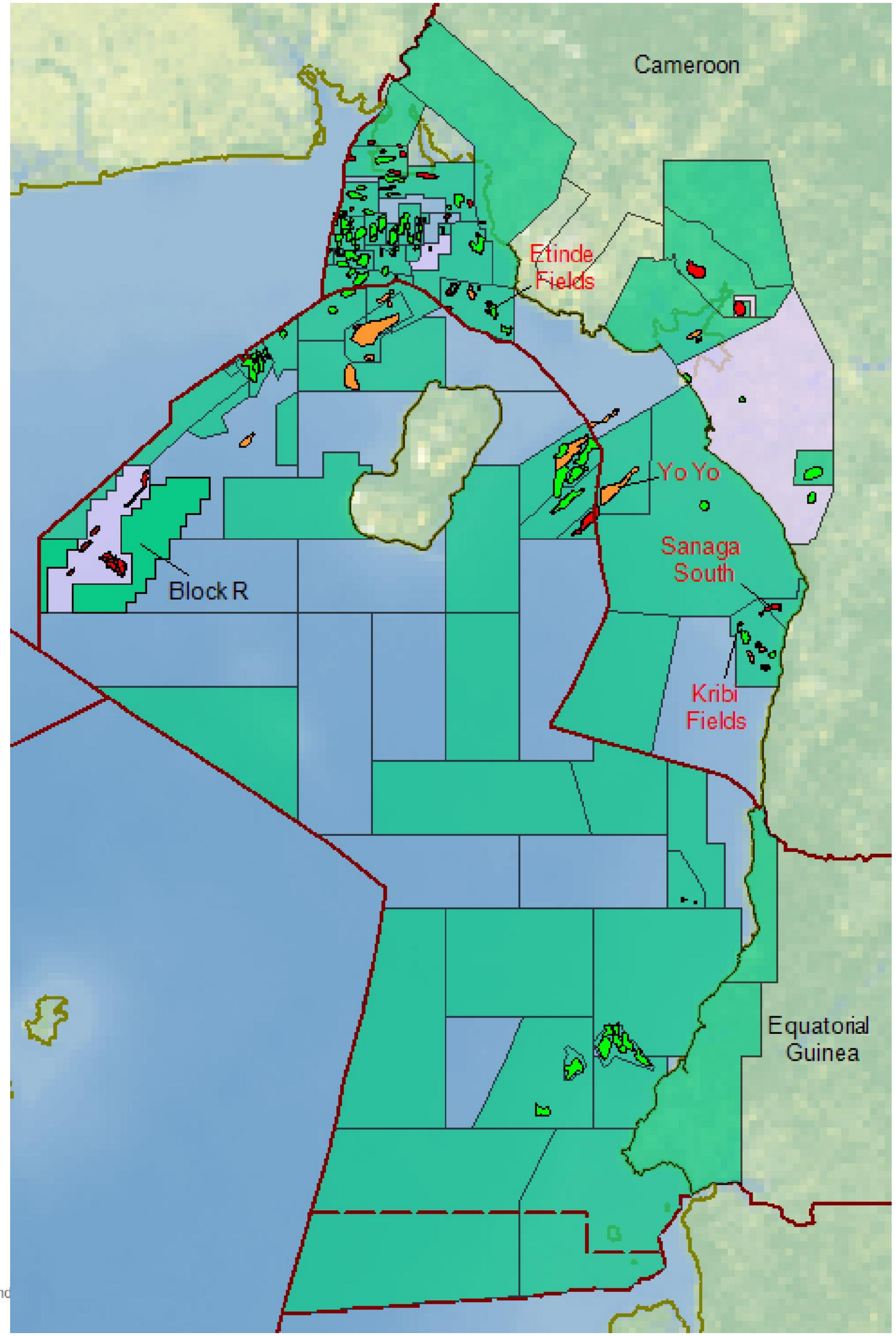


Logbaba (Victoria Oil and Gas)
- Growing industrial market in Douala

Sanaga Sud (Perenco)
- Options include fertiliser plant

Matanda Gas-condensate (Glencore)
Bomono (Bowleven)

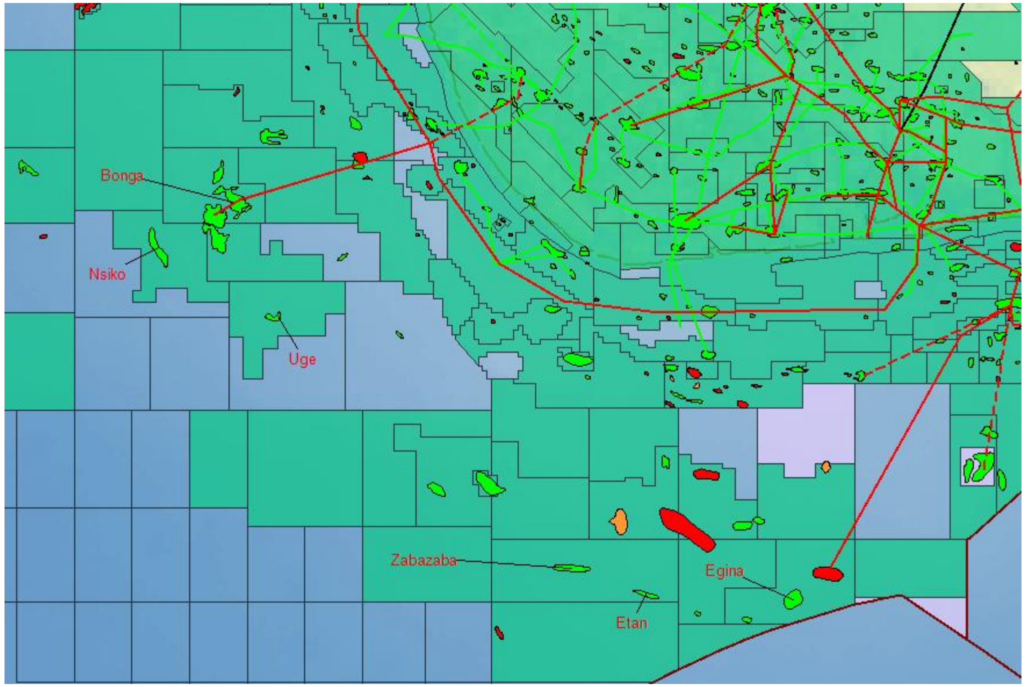
SNH cites 4 Tcf gas
National power deficit
Difficult regulatory environment

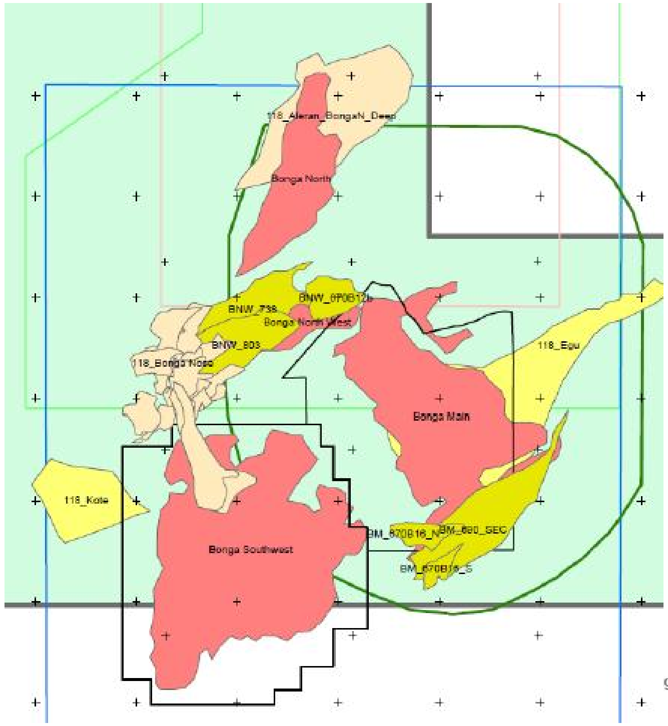


Nigeria

Deepwater Gas Reserves
- Bonga
- Erha
- Akpo

Deepwater Resources:
- Bonga SW
- Usan-Ukot
- Nnwa-Doro (10Tcf)
- N'golo
- Bosi



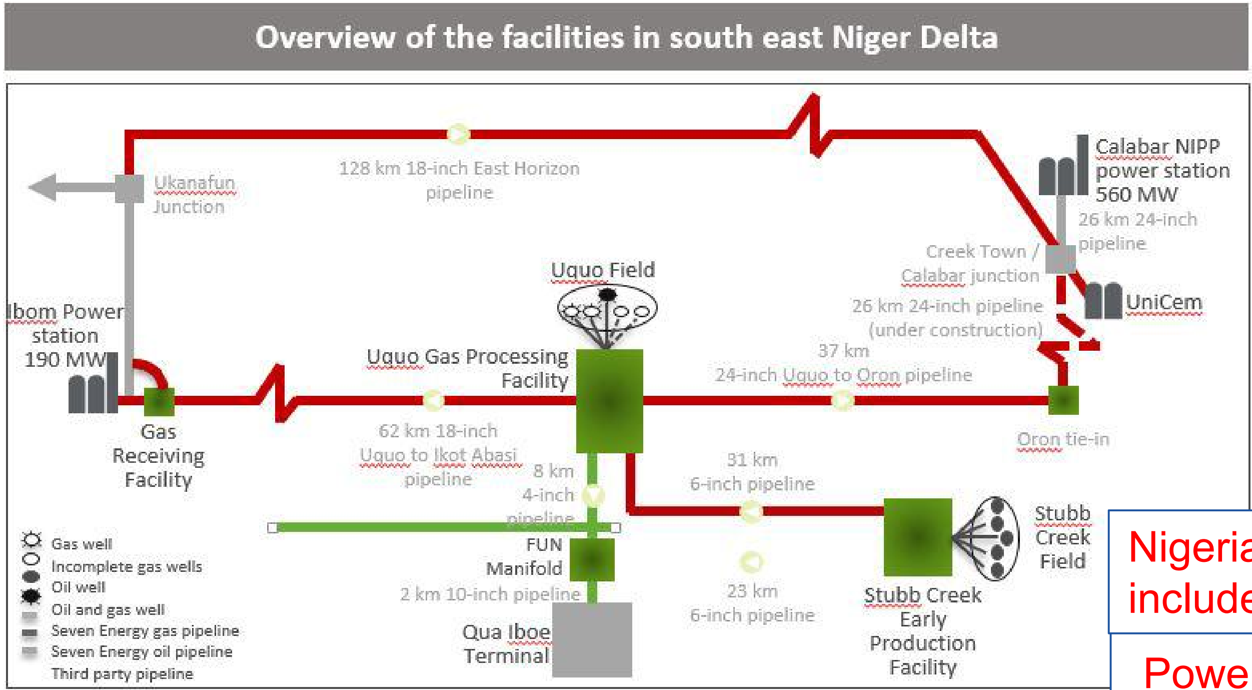


In case we forgot: gas enough for NLNG train 7, OK LNG, Brass LNG…. and much more

Nigeria – one example of success in gas to power

UQUO marginal field (Seven Energy / Frontier Oil)

64 MMscf/d in 2015 @ $3.4 / Mcf
To expand to 175 MMscf/d
Last reported resources 600 Bcf



Nigerian Gas Master Plan ought to include up to 20 GW in IPPs

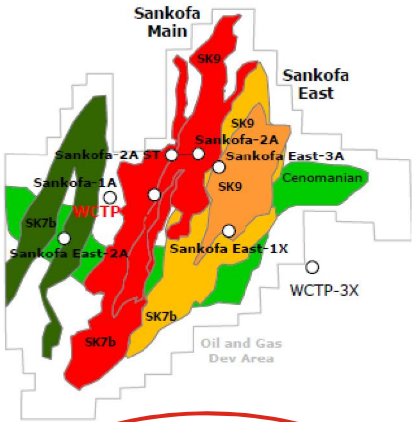
Power Sector Reform Roadmap (2013) - ambitious targets to increase installed hydro to 5,690 MW, thermal to over 20,000 MW and renewable 1000 MW capacities by 2020

drillinginfo
better, faster decisions

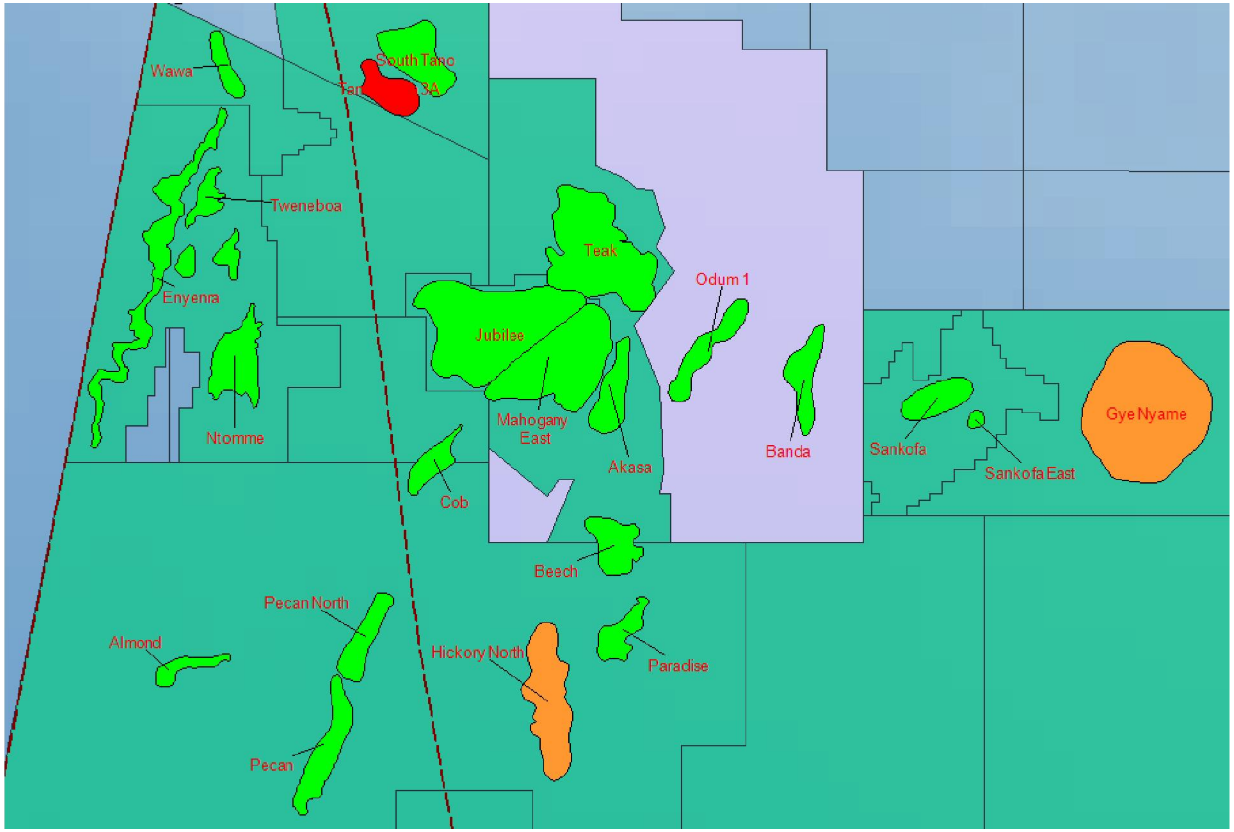
Ghana

- Jubilee gas pipeline complete

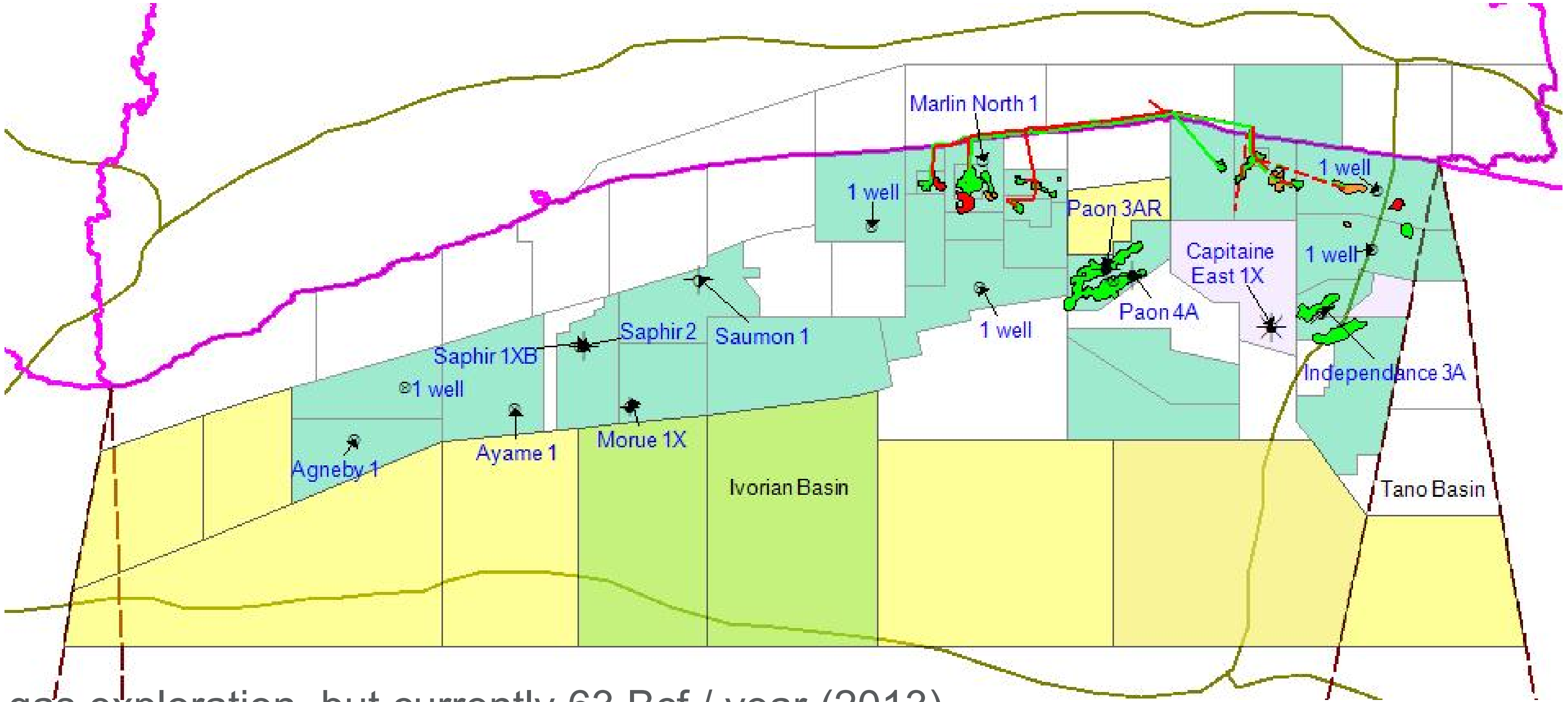
- Jubilee & Sankofa-Gye Nyame gas to go
to Ghana National Gas Company-operated Atuabo plant
World Bank guarantees on finance



Discovered Volumes:
OOIP 490 Mbbls
GIIP 1.2 Tcf



Cote d'Ivoire



No specific gas exploration, but currently 63 Bcf / year (2013) being used for power generation (Azito – 430 MW) :

- Foxtrot
- Lion
- Espoir
- Marlin

No routine flaring

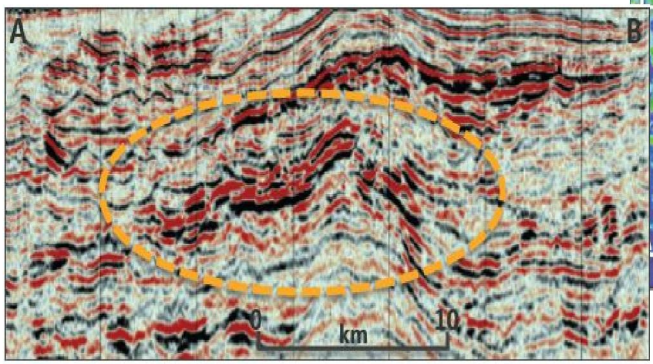
Songon gas to power project – FRSU import - 375 MW Phase I

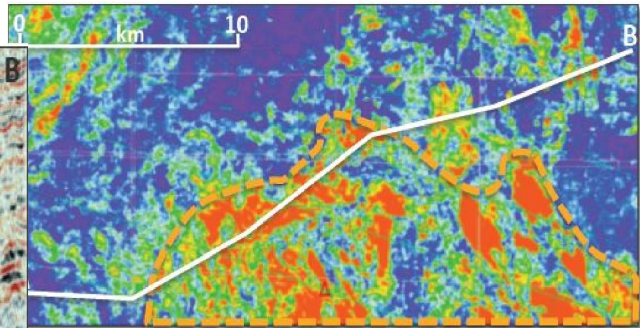
drillinginfo
better, faster decisions

Finally - Mauritania – Tortue (Ahmeyim)

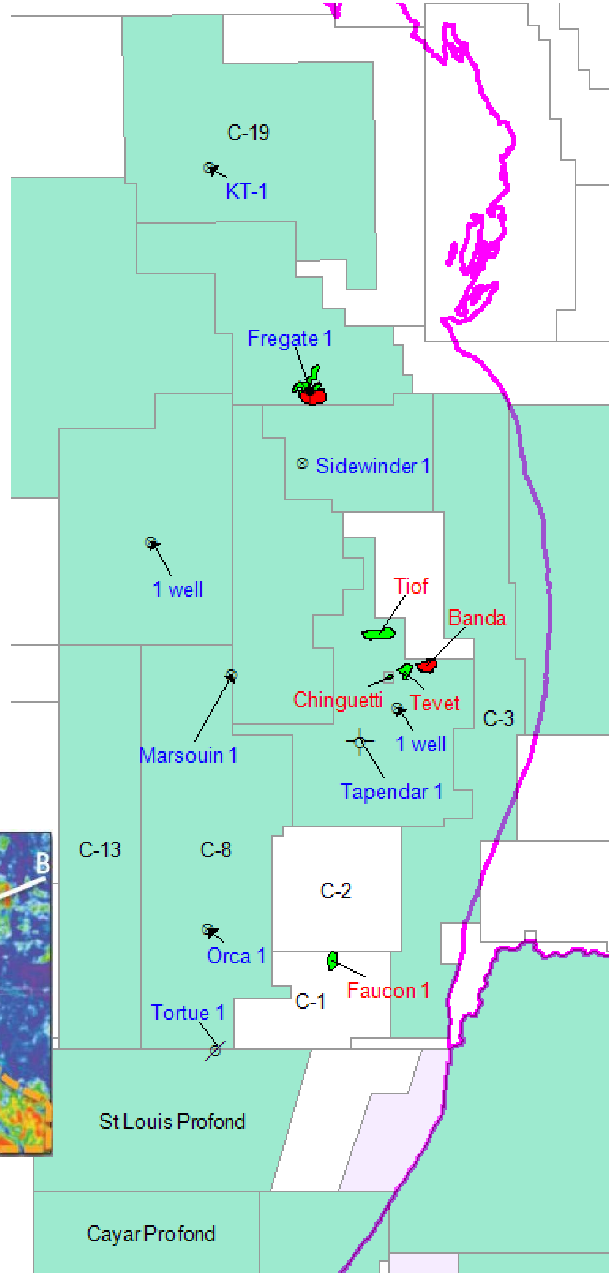
- Kosmos Greater Tortue – 17 Tcf (P mean) in 2700m WD
- Straddles frontier
- Older gas discoveries – Tevet, Banda – not commercialised

No domestic gas market – at all
Possibly no landfall, ever
Cross-border unitisation required





Tortue 1 prospect – Source: Kosmos



drillinginfo
better, faster decisions

Summary: Domestic gas promotes African development and complies with COP21 by reducing emissions

East Africa

Tanzania – Songo-Songo, Mnazi Bay, Dodsal discovery

Mozambique – Pande-Temane contributing to various GTP schemes

West Africa

Angola – So-called **LNG Phase II** likely to be for gas projects in the domestic market
Congo-B – unlike many IOCs, Eni grasps the nettle of industrial development
Nigeria - loads more IPPs to be commissioned – room for 10 x 250 MW

Ghana – mid-term development looks good

Gabon – maybe a domestic industry by 2030 deadline for flares-out ?

drillinginfo
better, faster decisions


POWER
Off Grid Electric