

Global Cycles & Influence of Looming Knowledge Gap to replace Future Oil Reserves



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27th February 2018



Specialist A&D Services to the International Upstream Oil & Gas Industry



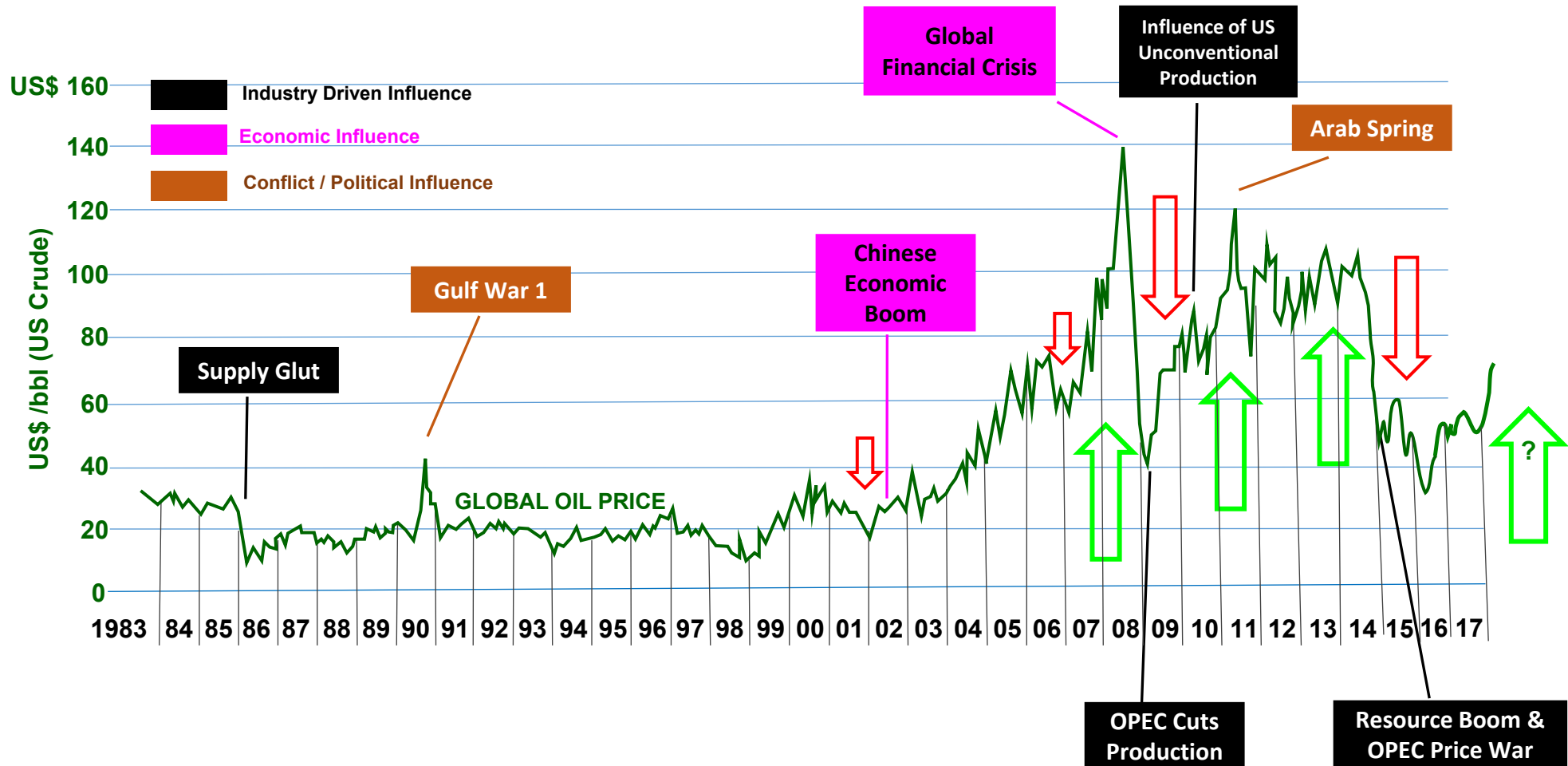
Contents

- **Global Cycles**
- **Current Cycle Status**
- **Some Facts about Finding Reserves**
- **Future Challenges**



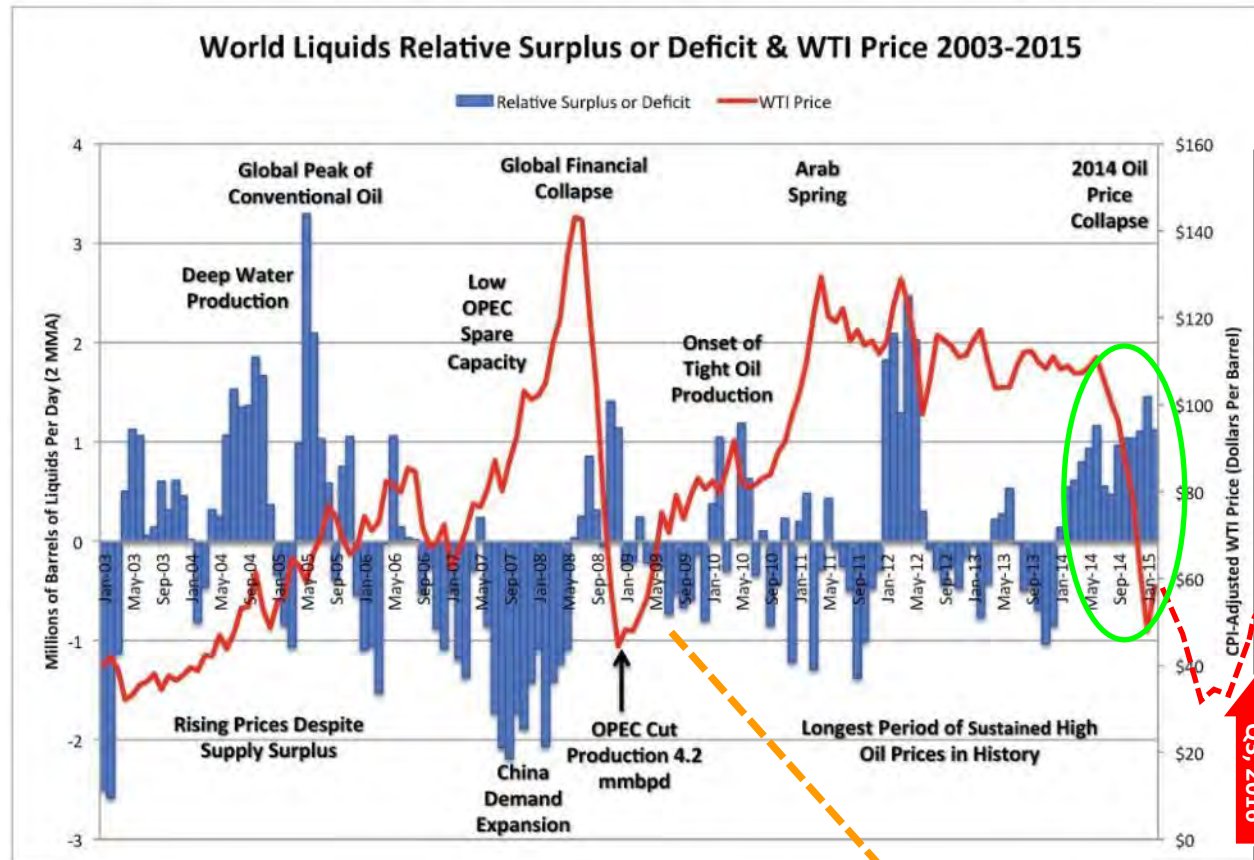
Global Cycles

Driven by oil price



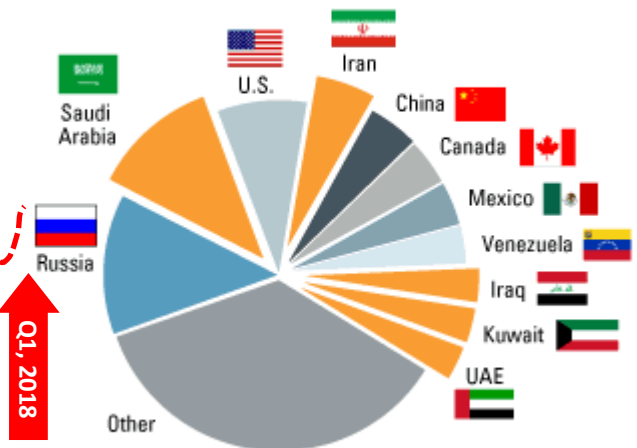


Historical Supply & Demand....recent oversupply



Much of Global Oil Production Comes from the Middle East

Oil production as a % of world total as of 2009

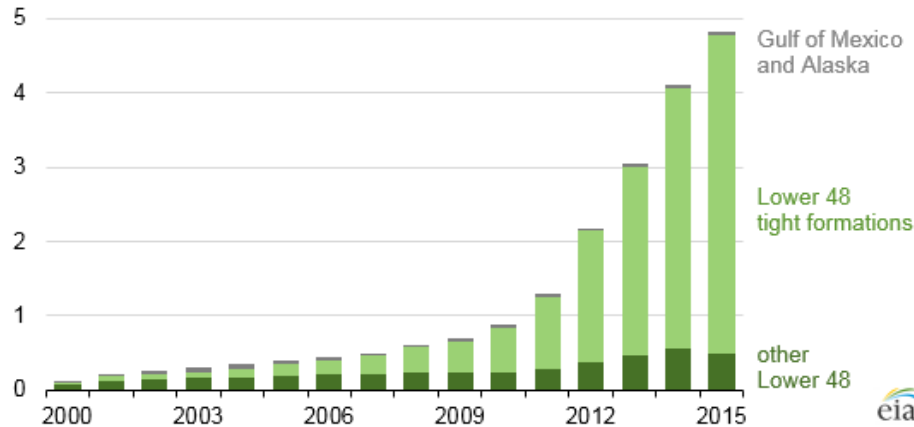


Global Supply Split as of 2009



US Resource Supply Influence

Oil production from hydraulically fractured wells in the United States (2000-2015)
million barrels per day



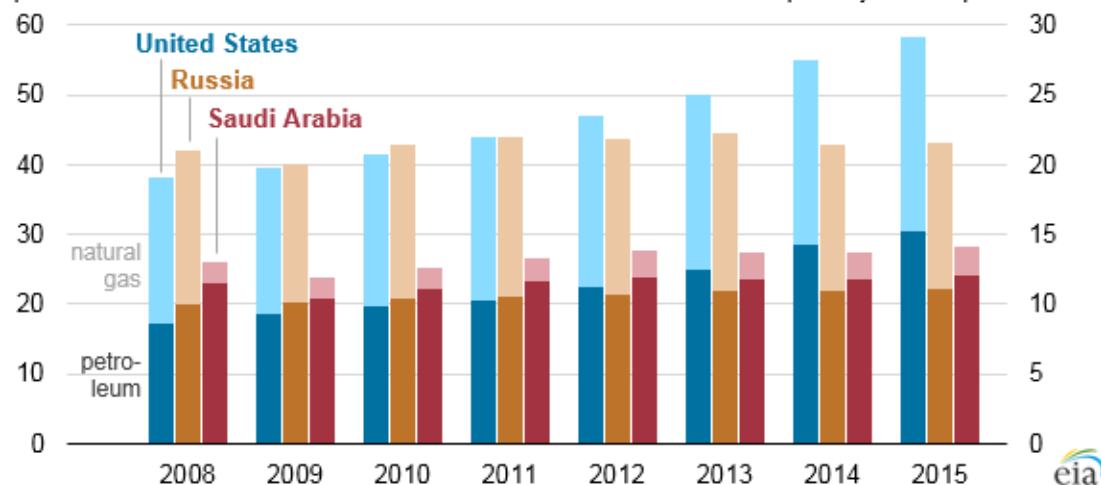
- **In May 2015 Short-Term Energy Outlook (STEO), U.S. petroleum and other liquid fuels production is expected to decline from 15.0 million barrels per day (b/d) in 2015 to about 14.5 million b/d in both 2016 and 2017.**
- **In contrast, STEO forecasts Russian liquid fuels production to remain at about 11.0 million barrels per day through 2017.**
- **There was no indication that Saudi Arabia planned to reduce its level of petroleum production.**

United States was largest producer of petroleum and natural gas hydrocarbons

In United States, crude oil and condensate accounted for ~ 60% of the total petroleum hydrocarbon production in 2015.

Source: U.S. Energy Information Administration

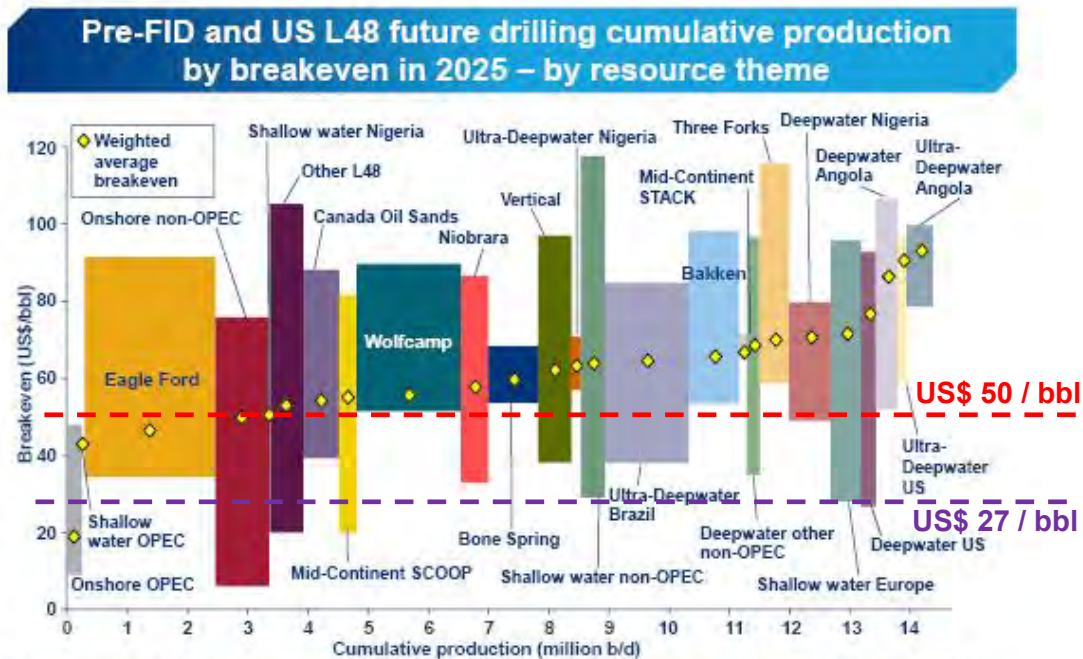
Estimated petroleum and natural gas hydrocarbon production in selected countries
quadrillion British thermal units million barrels per day of oil equivalent





Breakeven Cost Comparison

Forward look at Breakeven By Play Location

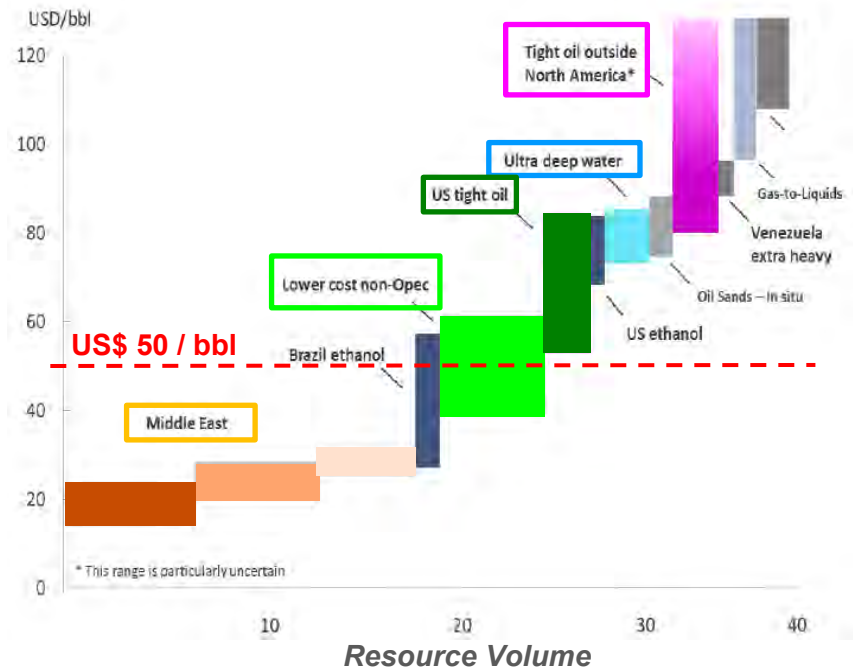


Source: Wood Mackenzie, onshore breakevens at 10% discount rate, offshore at 15% discount rate, breakevens in US\$ Brent equivalent

Wood Mac Analysis & Views:

- 50% of production from future developments uneconomic at US\$ 60/bbl (includes conventional projects Pre Final Investment Decision [FID] + future drilling onshore US L48 which are critical to future oil supply)
- By 2025 production from Pre-FID projects + L48 could be 17million bopd where only 7.6 million bopd comes from projects that are commercial at US\$ 60/bbl
- Over 22 million bopd likely to be needed by 2025 to meet demand & supports ~min US\$ 70 BOPD**

Global Resource Breakeven By Theme





[View on Current Cycle Status](#)



Global Demand

What the experts say:

Figure 1 – Global Oil Demand Growth by Product

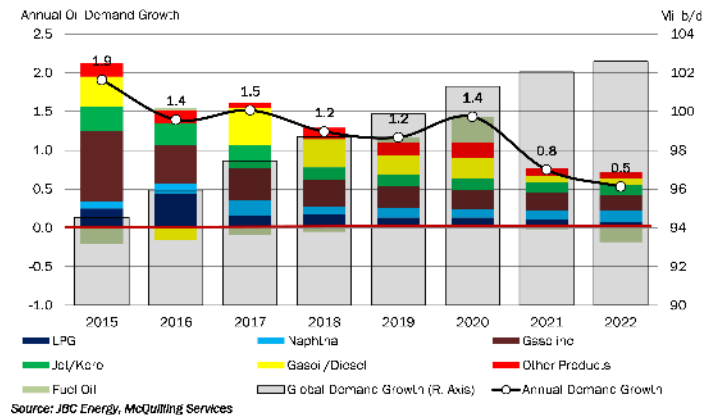
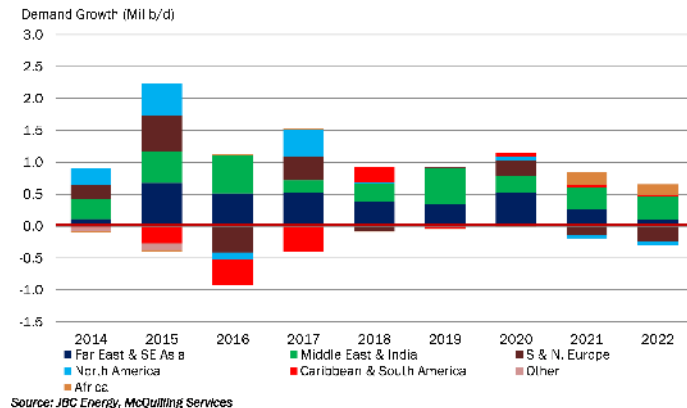


Figure 2 – Global Crude Demand Growth by Region



The Only Way seems to be UP!

2017: Global oil product demand rose by approximately 1.5 million b/d amid a combined 884,000 b/d of additional gasoline and diesel/gasoil demand.

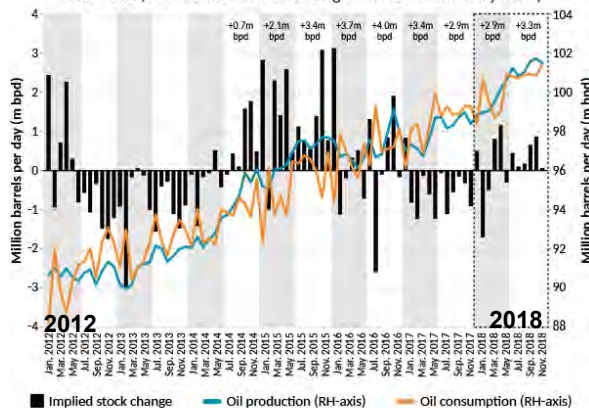
2018: Global demand levels are poised to rise 1.3% year-on-year amid higher requirements for all refined products excluding fuel oil.

By Region:

- India will require over 210,000 b/d of additional crude in 2018, and between 2018-2022 is expected to increase by 1.9% per annum.
- South East Asia and the Far East are also projected to demand a *considerable* amount of crude next year as growth is on track to rise 10.8% and 6.1%, respectively.
- Middle East crude demand is on track to rise by 3.0% per annum so expected to increase at a greater rate than the East over the long-term, as Saudi Arabia and various other nations seek to diversify away from traditional upstream revenues

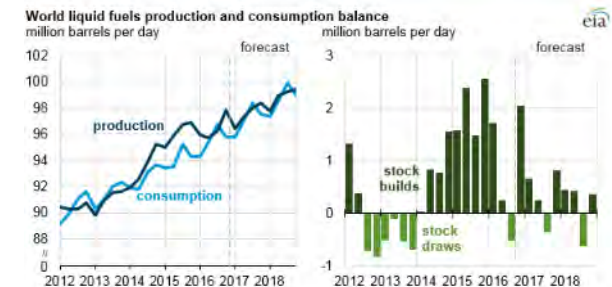
Global oil production – consumption and implied stock change

2012-2018 (accumulated stock building in numbers since July 2014)



Influence of storage?

Global crude oil balances expected to tighten through 2018





US Resource Play Viability

...one opinion?

• Shale Plays:

- LOW Risk Oil which requires high cost investment to generate oil
- BUT.....very rapid decline.....especially if the money to invest dries up!
- Stop investment and oil stops!

• Conventional Plays

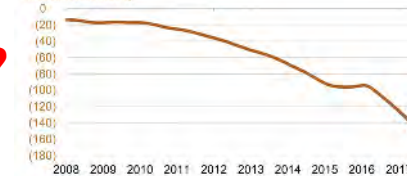
- HIGH Risk but much higher value success
- The right technical work improves chance of success if exploration is properly risked
 - Peer Review Farmins prove this with 50% difference of success
 -BUT not funded by inexperienced markets

• The US Resource 'Bubble' ...is it a ponzy Scheme?

- Very High Cash flow burn evidence
- ...Few US Resource Players can show positive cash flow and/or equity values even before 2014 price Crash
- What happens IF markets see their investment is not making the money predicted!
- Likely to be part of Re-Balancing in world new Energy Mix

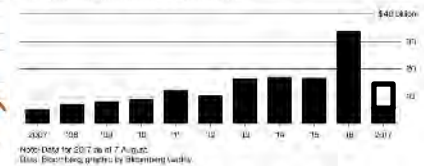


Permian Region
Legacy oil production change



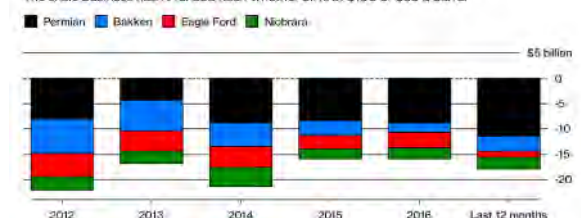
Shale Sale

Equity finance by US E&P companies picked up in 2013 as the shale boom accelerated and then spiked in 2016 to help cope with low oil prices.



Burn Baby Burn

The shale business hasn't funded itself whether oil is at \$100 or \$50 a barrel





Thoughts & Observations

- **Current Price controlled by:**

- OPEC 'Floor' - Saudi's controlling threshold price & member nations
- North American Fracing 'Ceiling' - Pure economics

- **Resource Play Oversupply**

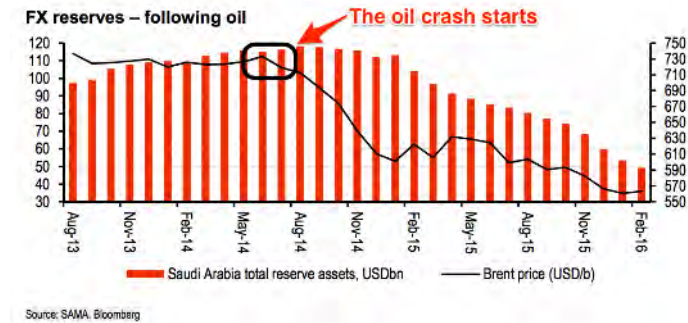
- Resources plays still only provide 10% of worlds oil
- ...but enough by 2015 to have caused 4+% oversupply & the crash

- **Conventional Field Decline** (*Still responsible for 90% Worlds Production*)

- 5-9% average annual decline of worlds biggest conventional fields
 - Based on Est. US\$ 750 Billion needed to maintaining this production decline
 - Post 2015 price crash, Est. less than US\$ 300 Billion has been invested annually (i.e. 50% of what is required to maintain pre-crash decline for 3+ years!)
- **When will the declined of conventional production fall below the ability of US resource plays to fill the gap?**
- Committed pre-crash field developments countered some of the conventional declines....Until now or when the supply of new development, not commissioned after 2015, catches up!

- **The New World Energy Mix**

- Efficiencies & input from Renewables
- When will oil become the new coal....(i.e. renewables & electric cars take over?)





Replacing Hydrocarbons - *Food for Thought*

- **Political enthusiasm meets reality!**

- Few people doubt the use of oil over the next century will decline with renewables & rapidly advancing technology (*i.e. solar, wind & battery technology - electric cars*)**but by when?**

- **Going Electric**

- BUT is it truly realistic that all cars will be electric by 2025 (**7+ years time!**) when some manufacturers are say they will stop making combustion engines
- Car use in the UK grew rapidly from the 1930's but steam trains were only replaced by diesel in the mid 1960's (*i.e. 30+ years lag & beginning of the technology change and ultimate decline of coal*)
- Can the current power infrastructure of most western nations cope with all the new electric cars?
- Can these countries entire power infrastructure be upgraded in the time available? Really!

- **Car Reality**

- Average House in US has a 10 Amp capacity but a TESLA Charge station needs 75Amps
 - For even 50% of an average road of 25 houses to have an electric car would totally overload the existing power infrastructure
 - Cost effectiveness of electric Vs fuel: Simple maths shows Electric is currently around US\$ 0.74 cents / mile Vs US\$ 0.10 / mile for fuel
 - Costs to buy: US\$ 46,000 Vs US\$ 20,000 average for a fuel car!
- Where is the massive extra power going to come from when it does happen?
 - Wind & Solar may contribute, New Power Stations (How long does it take to plan and build a new power station!)
 - What will fuel them! Nuclear?
-**Gas surely!** As evidenced by most Majors publically declaring this as their new focus & strategy!





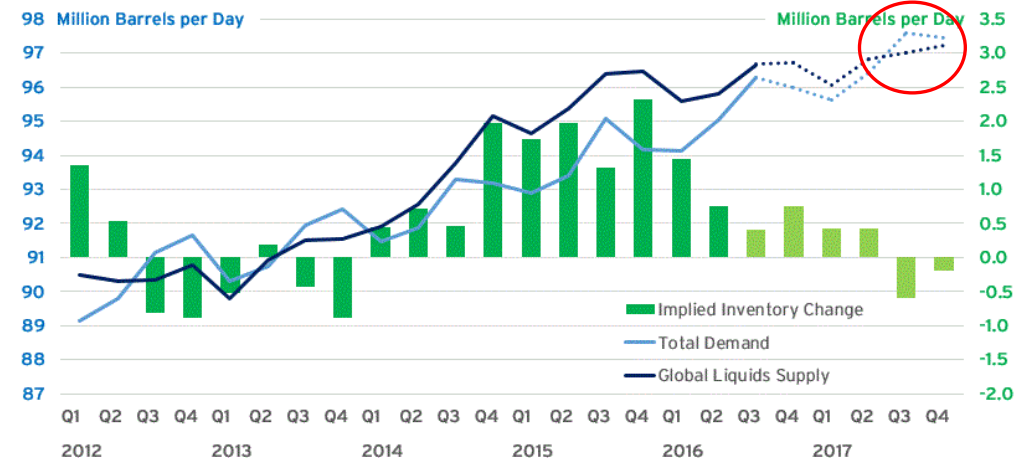
Discovery Black Hole

“In April 2016, Wood Mac predicted a potential shortfall of 4.5 million b/d of global oil supply by 2035, unless discoveries exceed the current annual average of 8 billion barrels.

According to the energy research group, the volume of conventional oil discovered over the past four years has more than halved compared with the previous four-year period, falling from 19 billion barrels/year to 8 billion barrels between 2012-15.”



Global Oil Supply and Demand Balance, 2012-Present

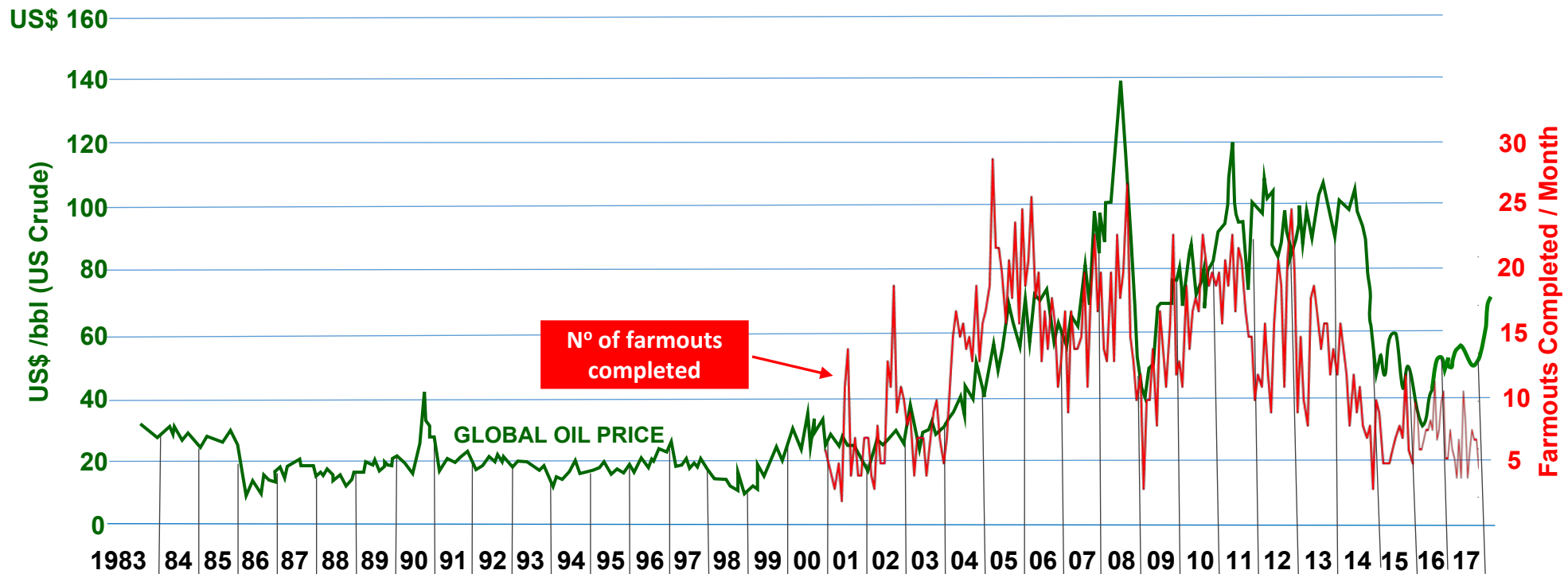


Source: SAFE analysis based on data from EIA



Global Deal Flow

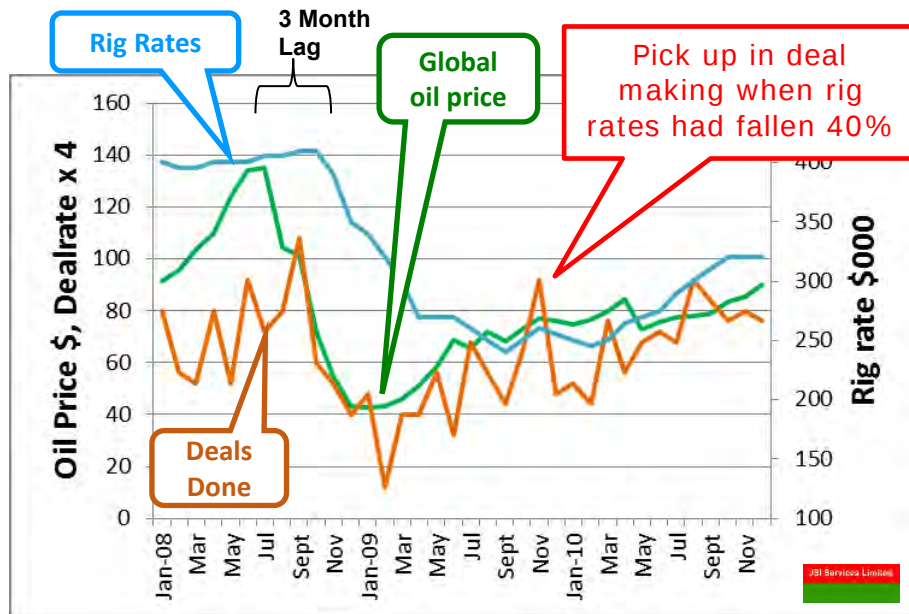
Historical Events Vs
Global Upstream Farmout Deal Flow (Excluding North America)
2000 – 2016





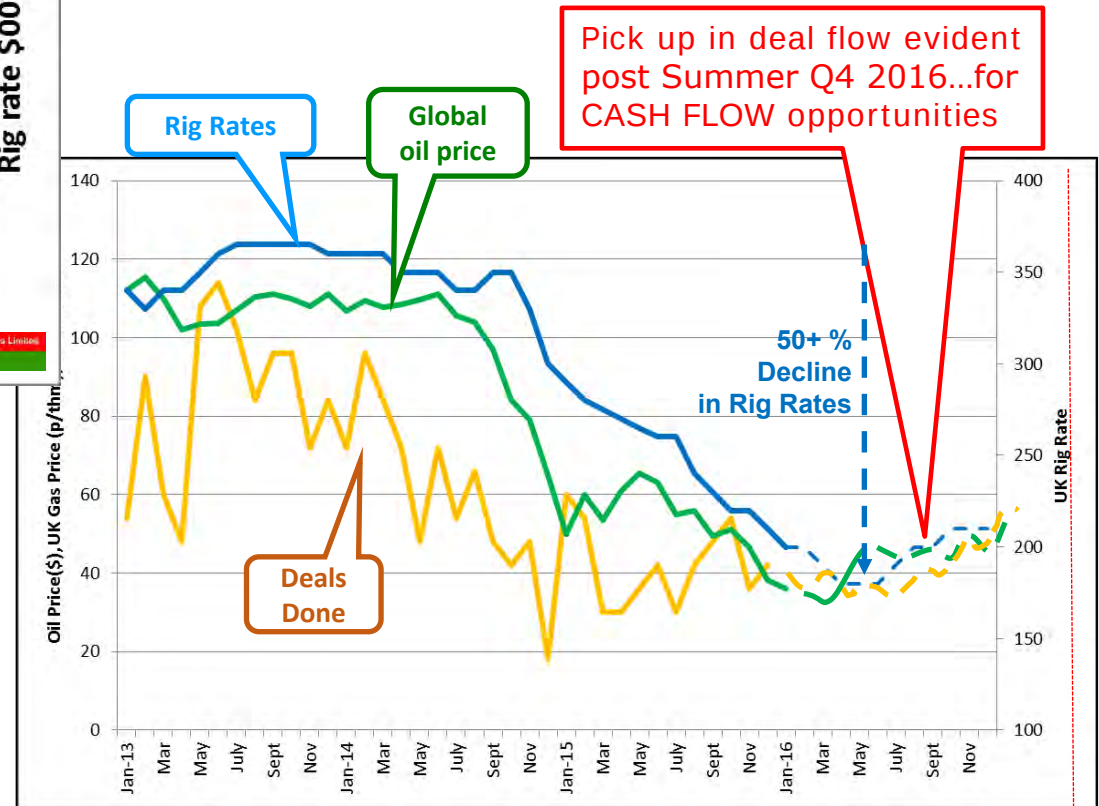
Past & Present Exploration Deal Flow Cycles?

History Repeating Itself?



2014 - 16 Over Supply

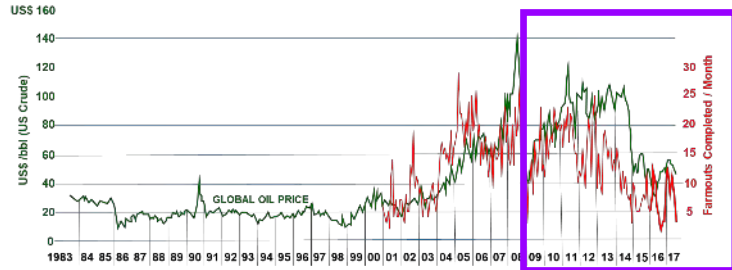
- Costs now up to 50+% lower
- 5-9% annual decline of existing fields
- Long terms demand will only increase
- Funds needed to maintain this decline halved with crash (US\$ 600 Bn → US\$ 300 Bn)
- Over supply < 4%
- Natural loss of essential 30+ year GG&E expertise (few to follow due to 84-03 crash)





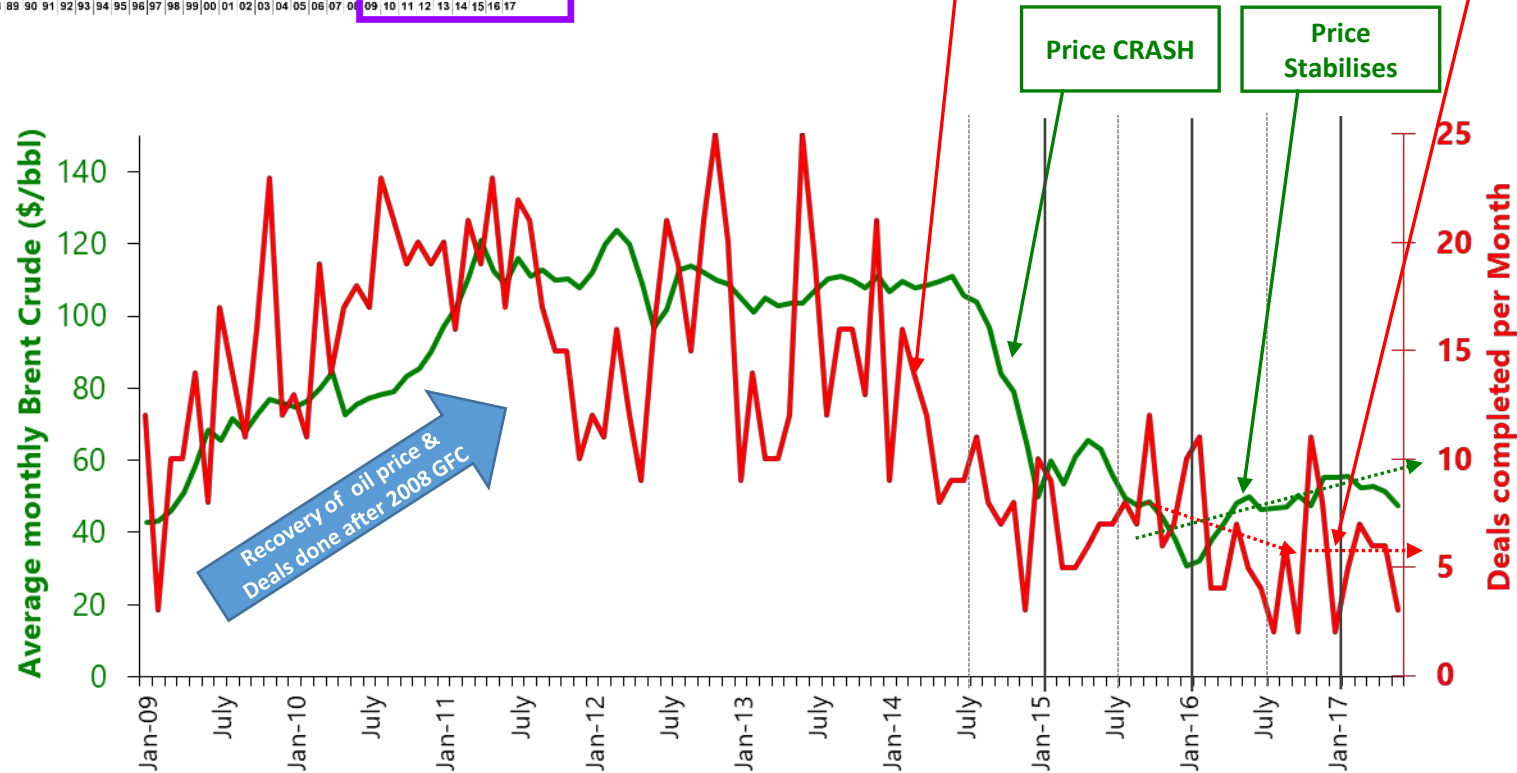
Global Deal Flow: 2009 - 2018

Global Upstream Farmout Deal Flow (Excluding North America)



Deal flow slows before oil price crash due to huge cost increases so deals became too expensive

Too early for deals to be closed, BUT clear evidence of renewed interest in looking for deals that would complete in 6-12 months time



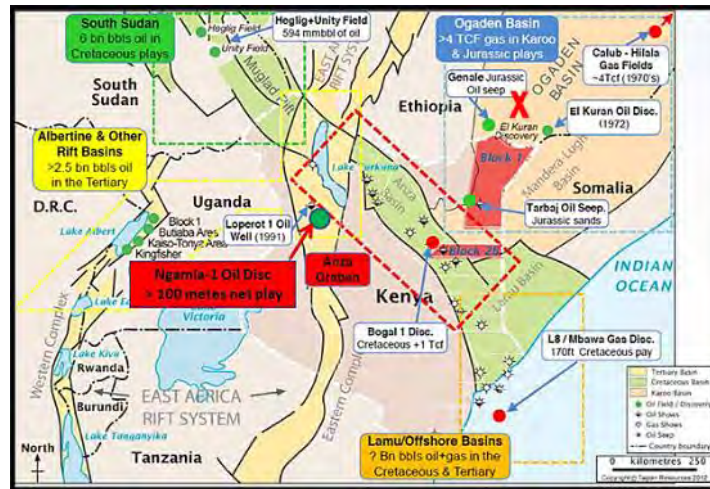
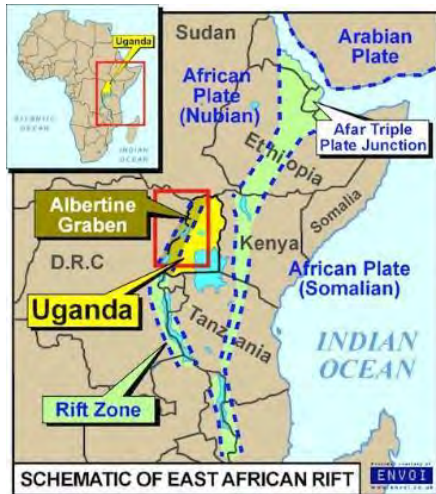


Facts About Finding Hydrocarbons

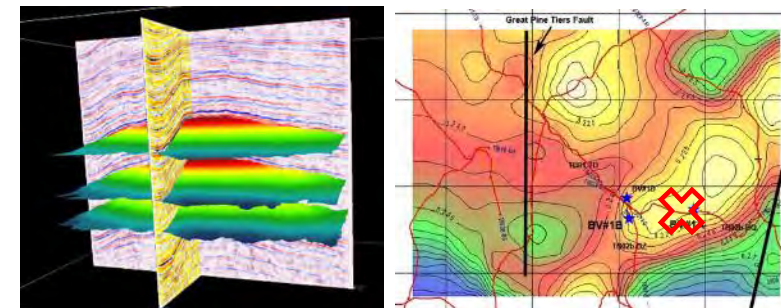


Finding Oil & Gas

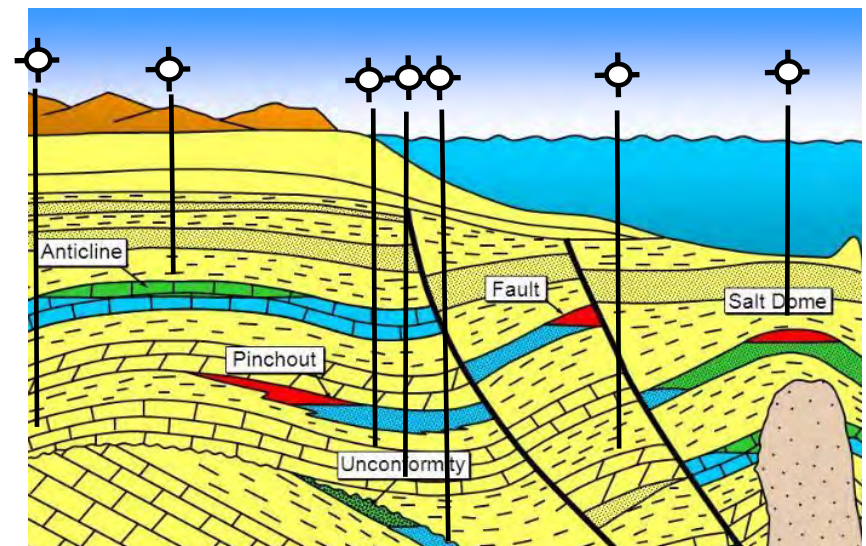
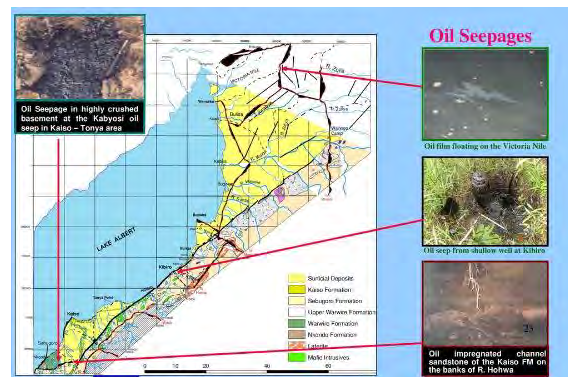
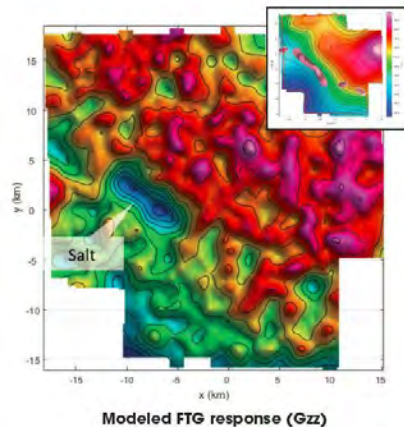
1. REGIONAL EVALUATION, BASIN MODELLING, LICENCE APPLICATION



2. SEISMIC ACQUISITION, PROCESSING, INTERPRETATION & WELL SELECTION

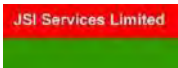
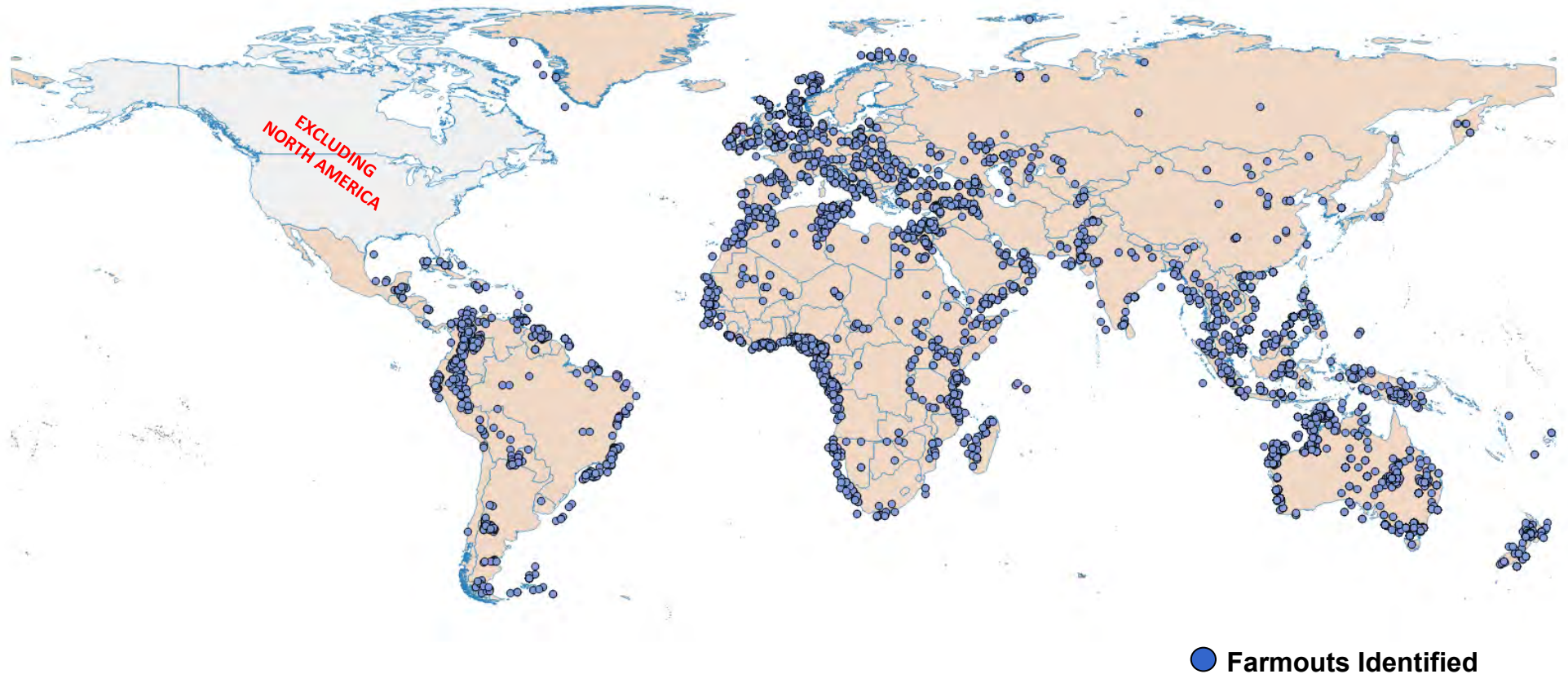


3. PLAN FOR THE RISK = ~85% Failure





Global Deals 2000-2016



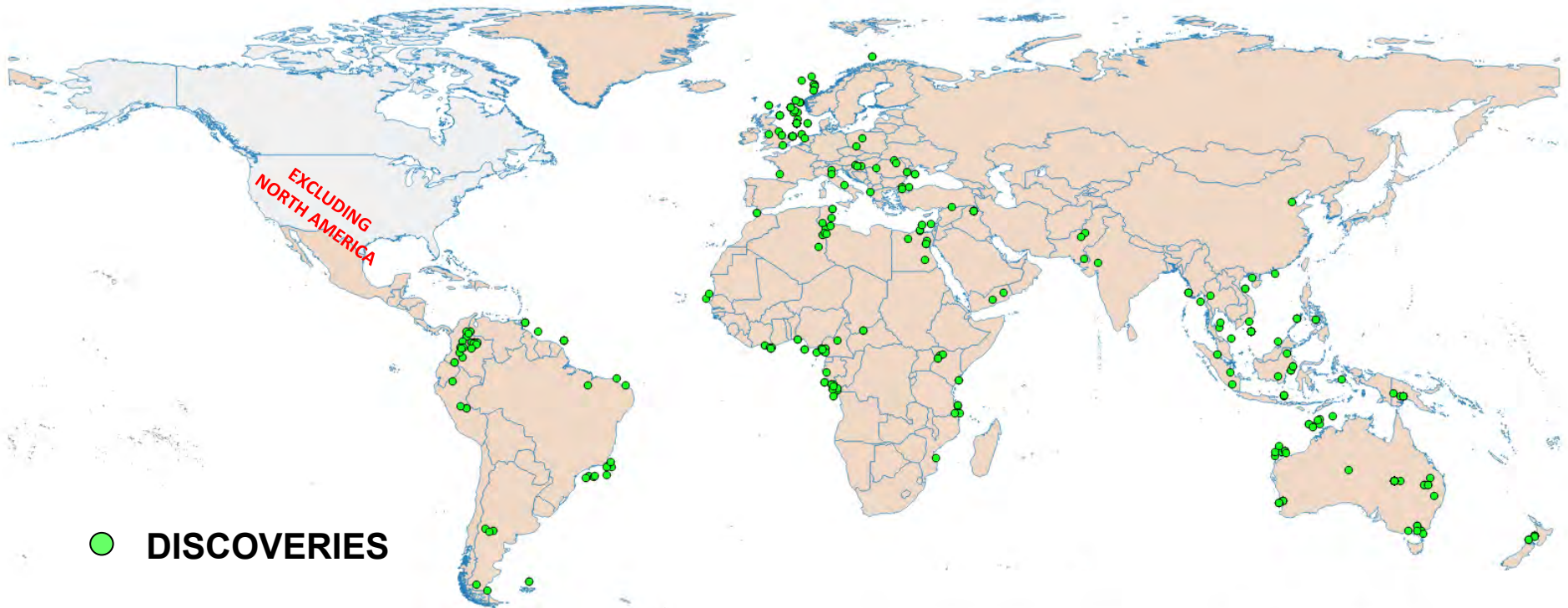
Over 5,600 deals identified worldwide, excluding the USA and Canada

Source: JSI GUD Database



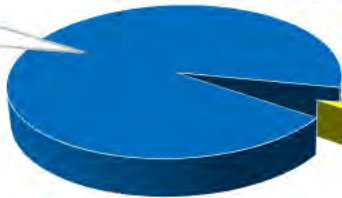
Global Deal Discoveries

2000 - 2016



Unsuccessful
5254
94%

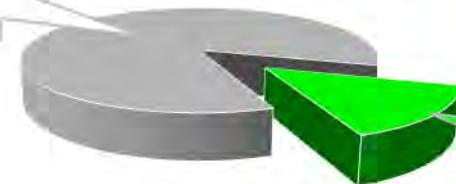
Global Total FO that
led to Discoveries



Discovery,
356, 6%

Drilled &
Unsuccessful
2050

Global FO Drilled
& Successful Discoveries



Successful
356
15%

JSI Services Limited

Source: JSI GUD Database

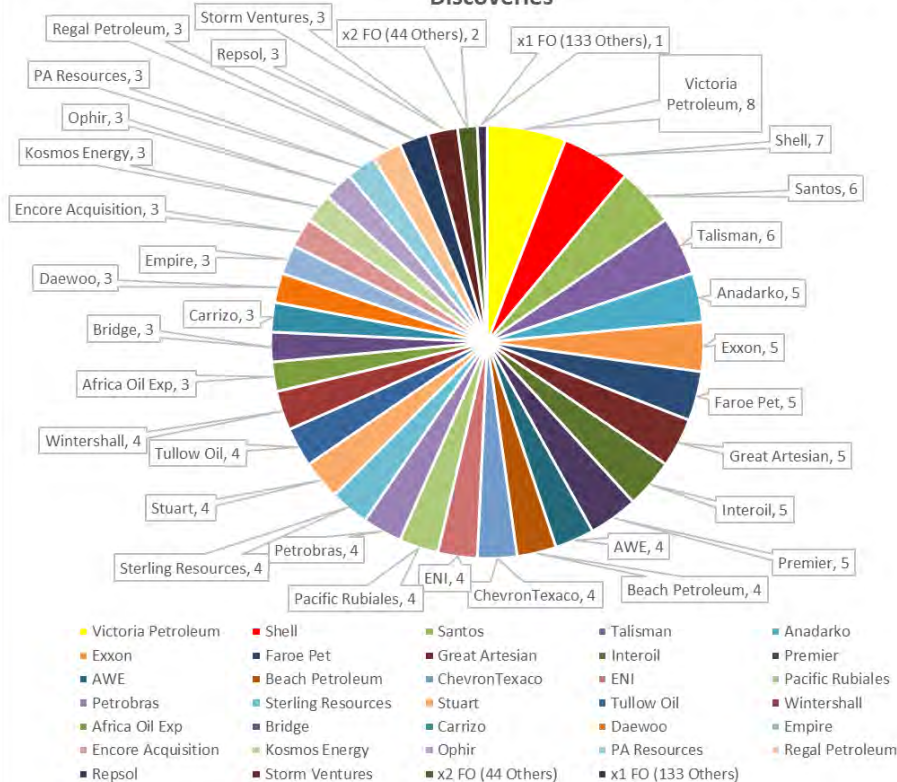


Success Breakdown

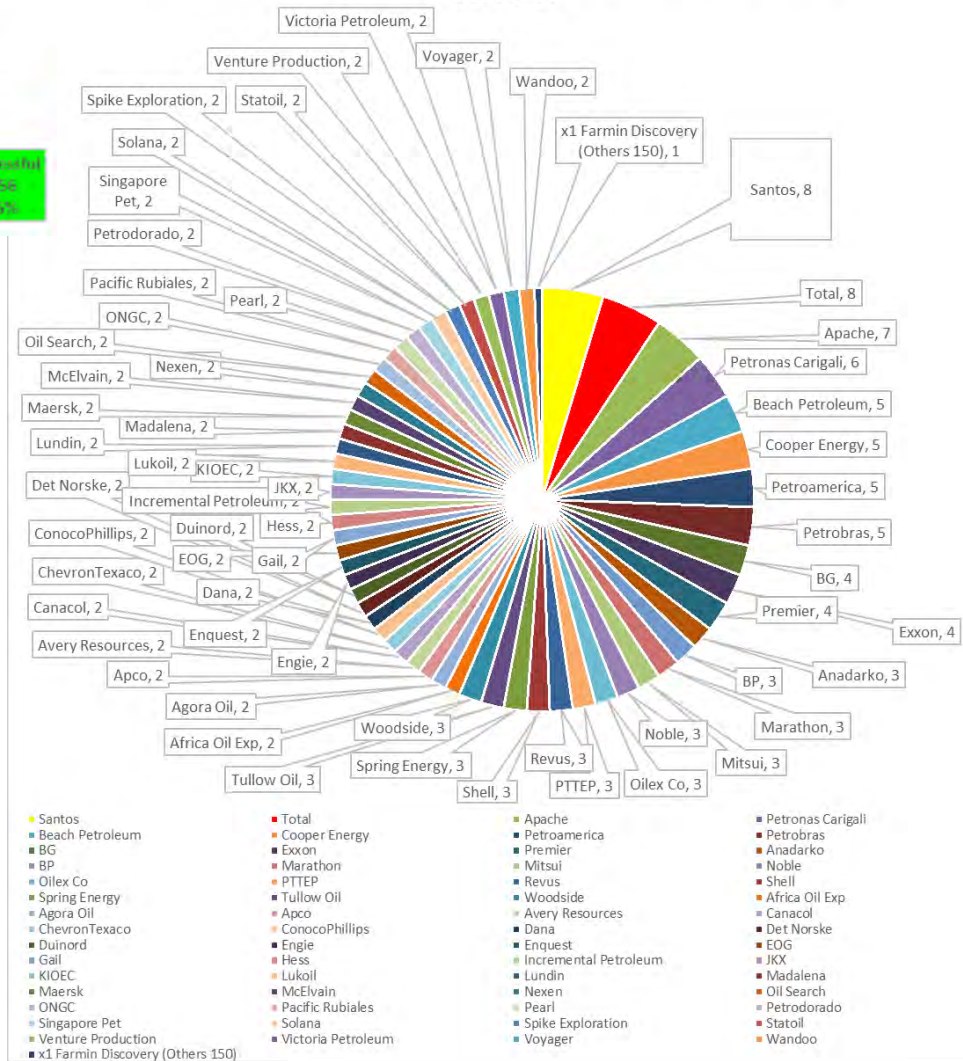
Deals Completed & Drilled



Summary of Companies that that Farmed out wells drilled that led to Discoveries



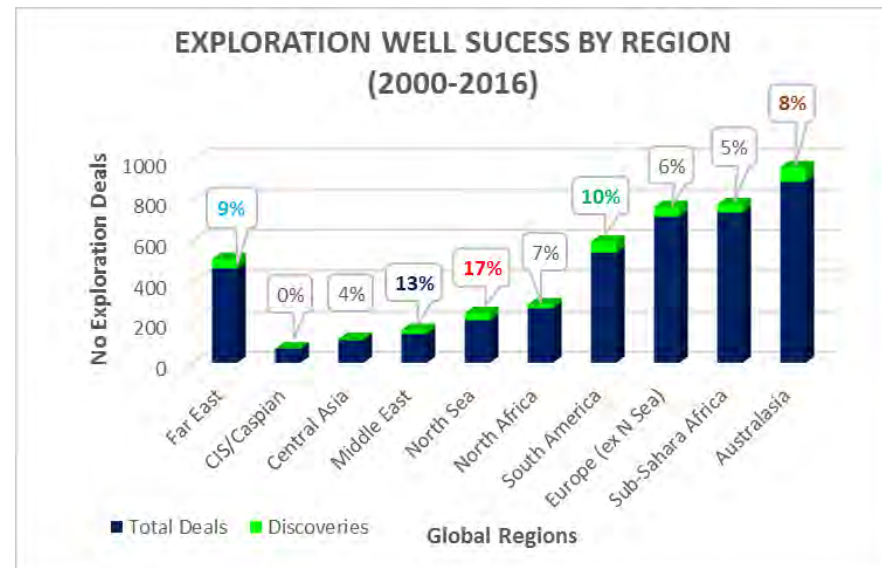
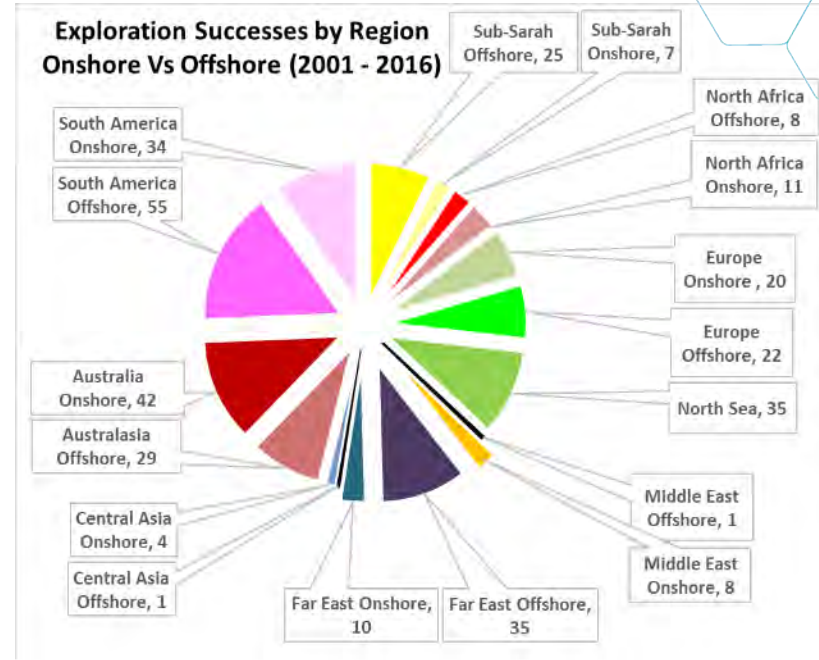
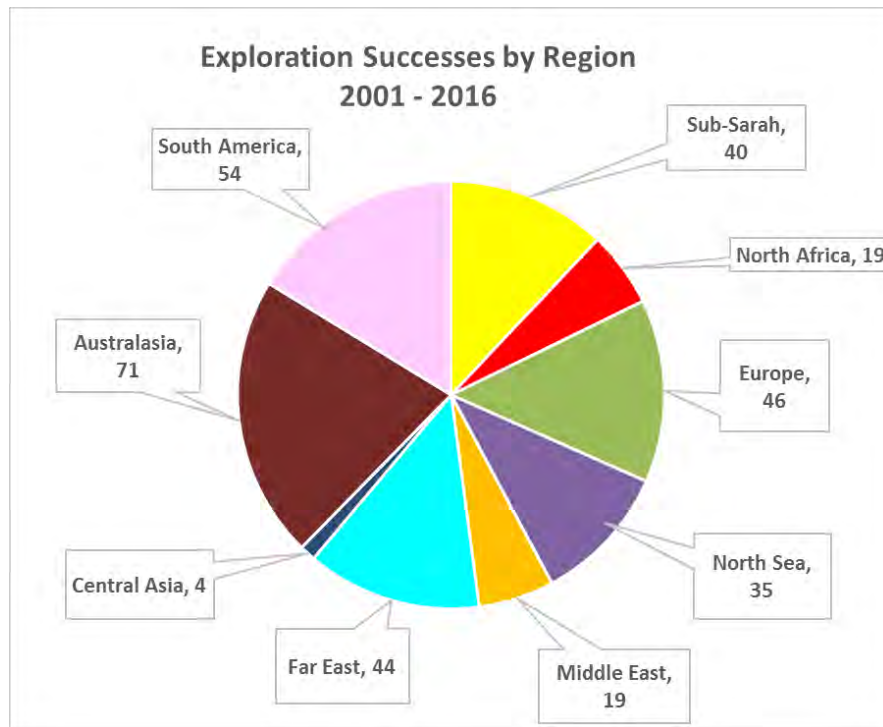
Summary of Companies that that Farmed Into wells drilled that led to Discoveries





Success Breakdown

By Region





Global Deal Statistics

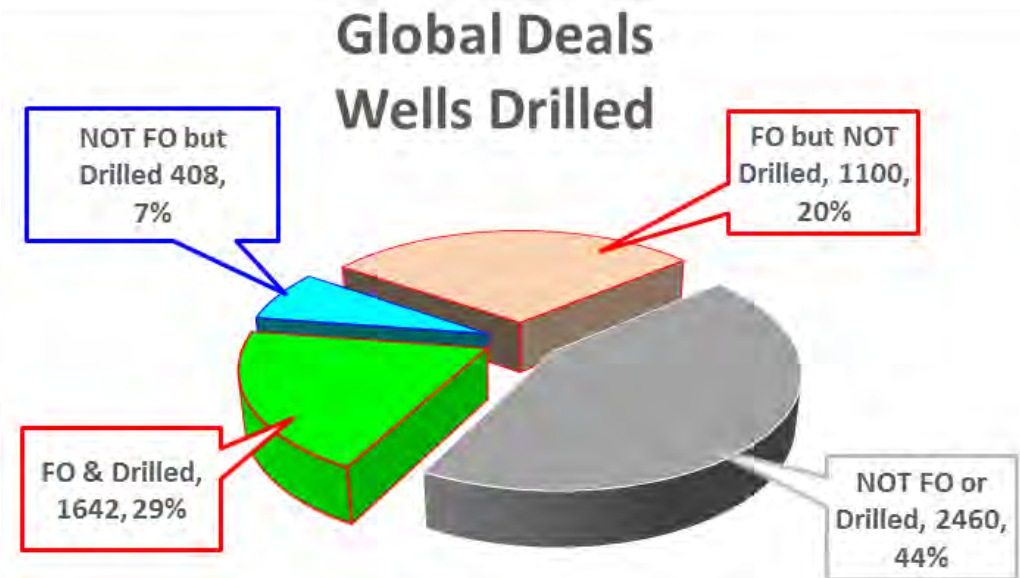
Deals Completed & Drilled



1 : 2

Deals Farmed Out

(Vs Common quote 1:100 deals reviewed might get done)



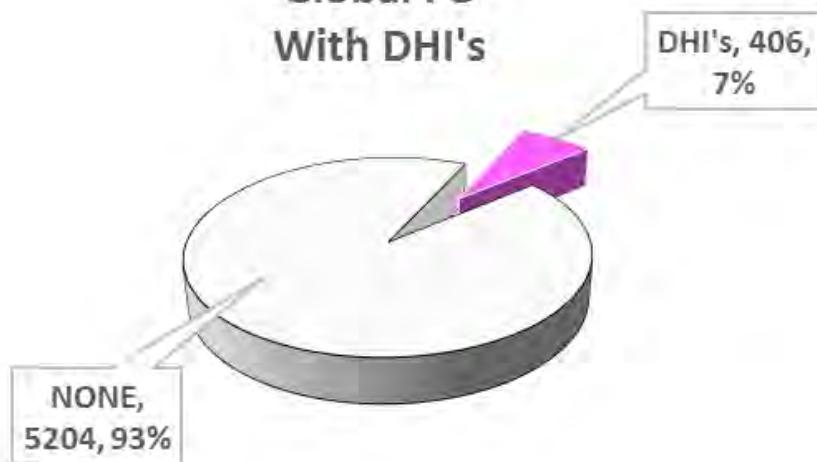
- Only 60% of Deals Completed were then drilled.....so
- 40% Deals Completed did NOT get drilled
- but....14% not completed were still drilled of which 42 were discoveries (i.e. 10% not FO were but drilled as Discoveries)
- Compares to 314 discoveries from Deals Completed = 20%
- **Chance of Success = 50% less if not Farmed Out!**



Global Deal Statistics

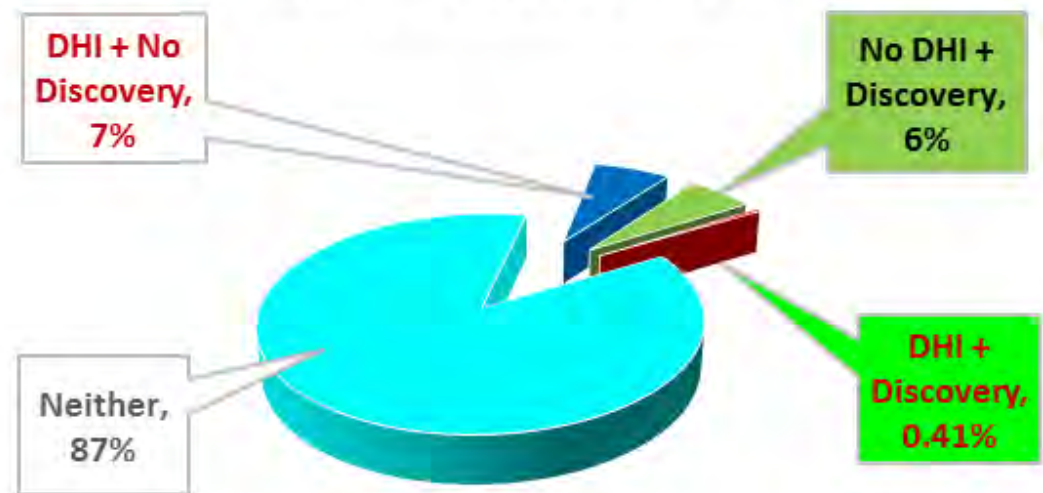
DHIs

Global FO
With DHI's



Small number of
Potentially Risk Reduced Deals

Global Deals
DHI's Vs Discoveries

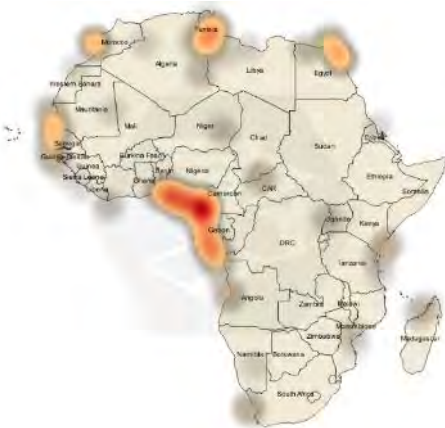


.....DHI's have limited Success



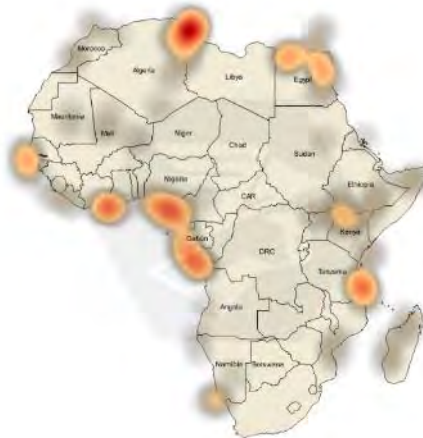
EXAMPLE: African Deals over Time

2001-2005



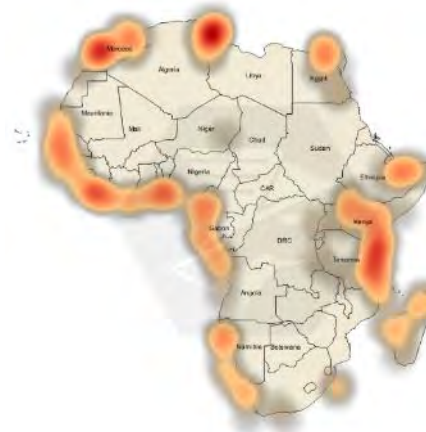
Heat map shows majority deals in West African producing region before & after oil price rise in 2003

2006 - 2010



Gradual spread of deal making areas after sustained increased in oil price

2011 - 2015



Land Grab continues during higher oil price period

2016

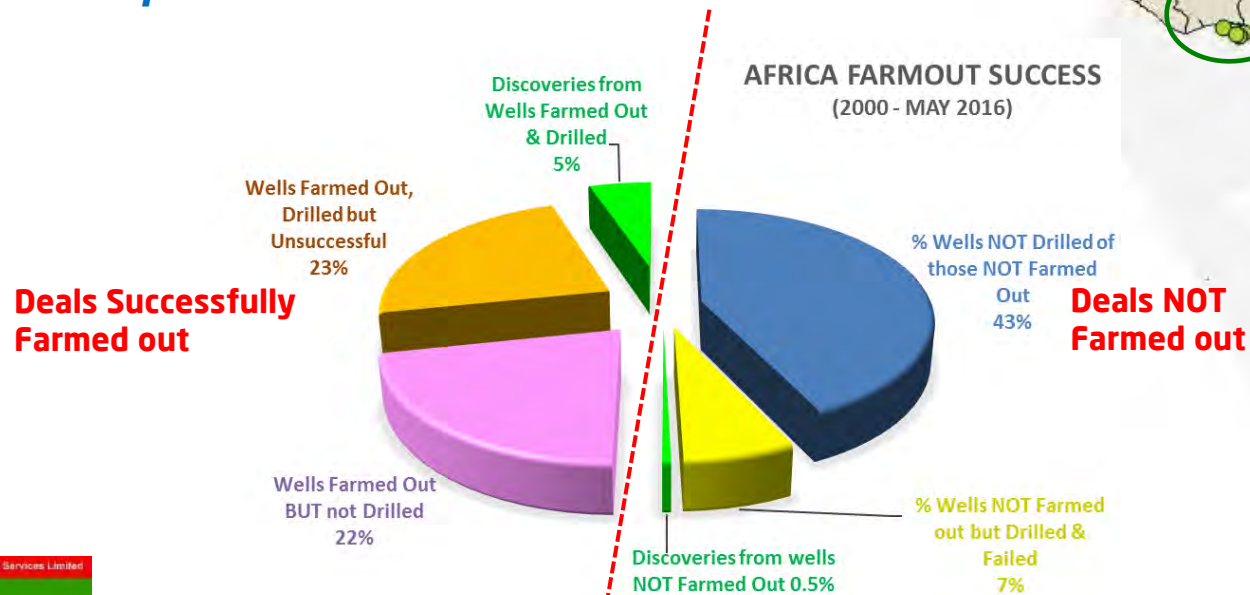


Curtailed focus of current deals in period of maximum price decline



African Deals Drilled & Discoveries

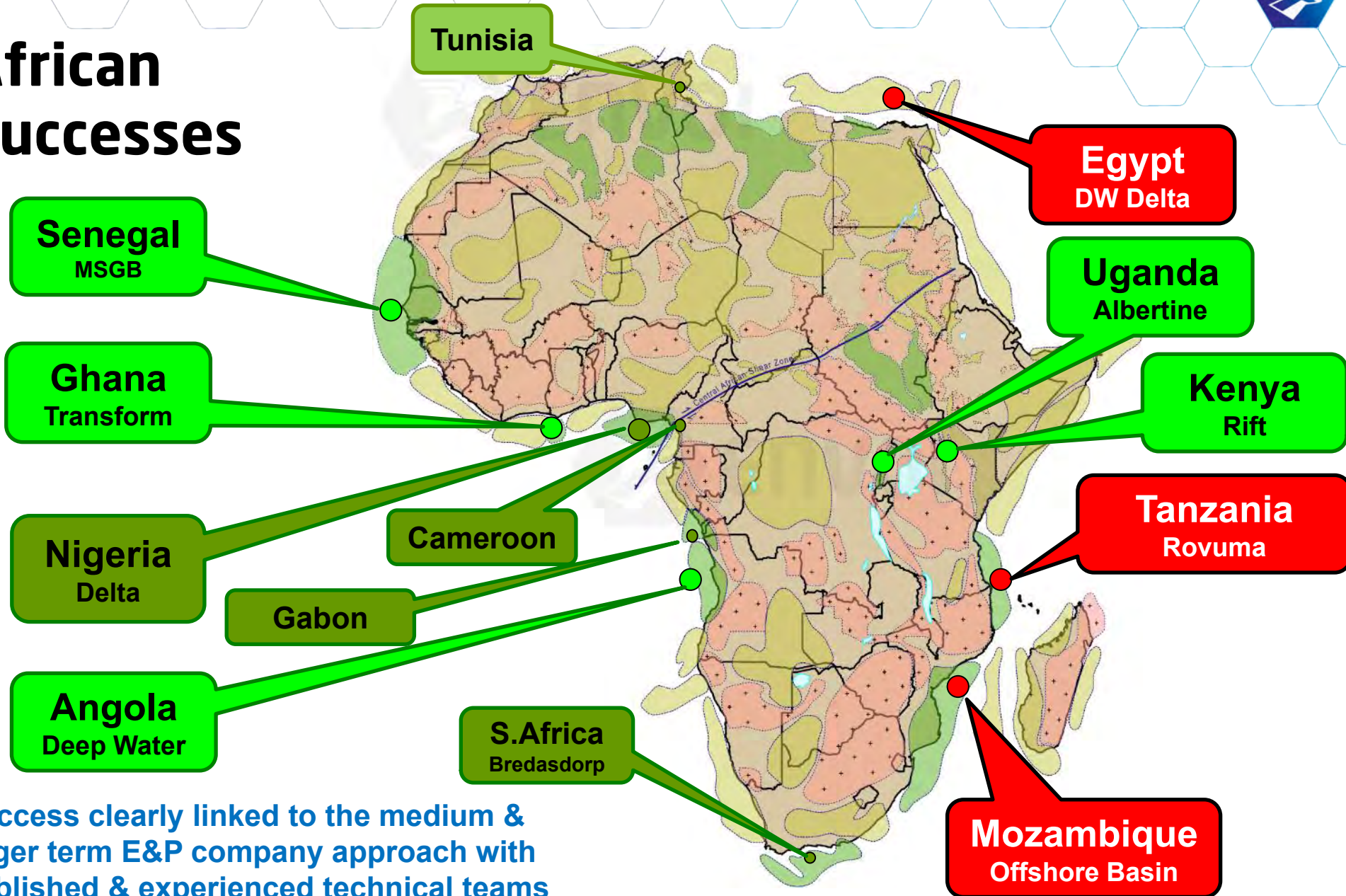
- Total 43 wells drilled announced as discoveries
- 15% of all deals drilled
- 5% of all deals identified
- *A precious few!*



● Drilled discovery



African Successes

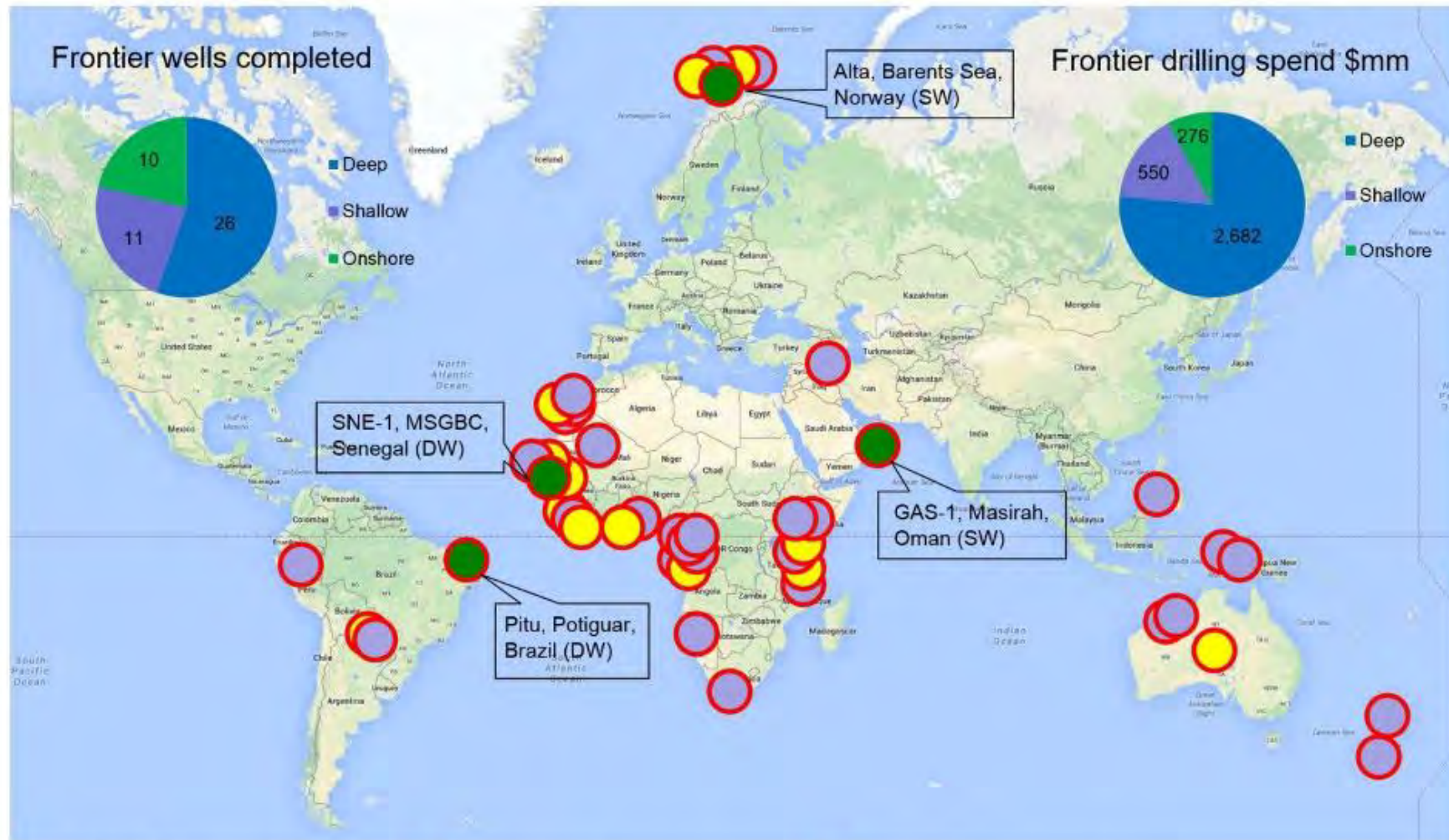


Success clearly linked to the medium & longer term E&P company approach with established & experienced technical teams



Funding Exploration

Historic Global Frontier 'Commercial Success'?



Likely Commercial discovery



Technical discovery



Frontier unsuccessful



The Challenges



Biggest Future E&P Challenges?

Unlocking the new plays and resources in frontier basins which are often in politically difficult & sensitive areas likely to be severely limited by:

- **Future E&P Funding**

- Exploration (*High Risk, high margin and reserves replacement*)
- Production (*Low Risk but small margin*)
- Technology & Research (*Risk reducing E&P tools*)

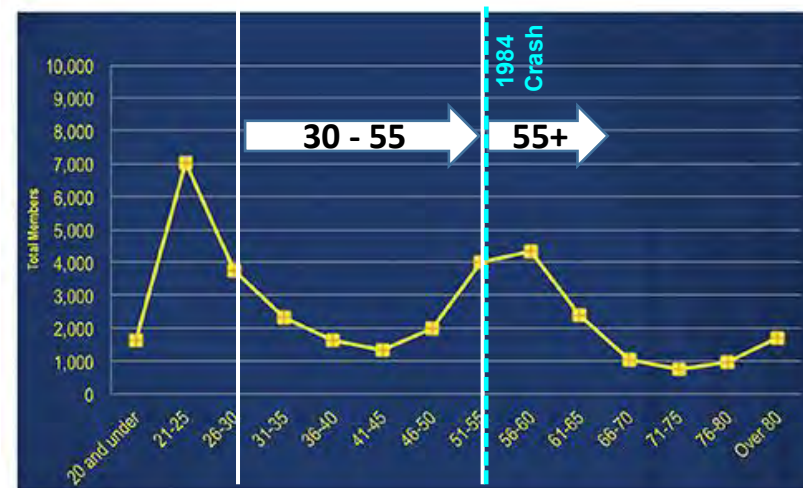
- **Short termism**

- Overcoming the difference in industry & investor expectations
- Change in Global Financial Funding / Investing Metrics (*Transition to CASH away from Asset Values*)

- **Knowledge Loss**

- Experienced technical (G&G + engineering) staff needed to successfully replace, find and exploit enough hydrocarbons commercially

AAPG Member Demographics



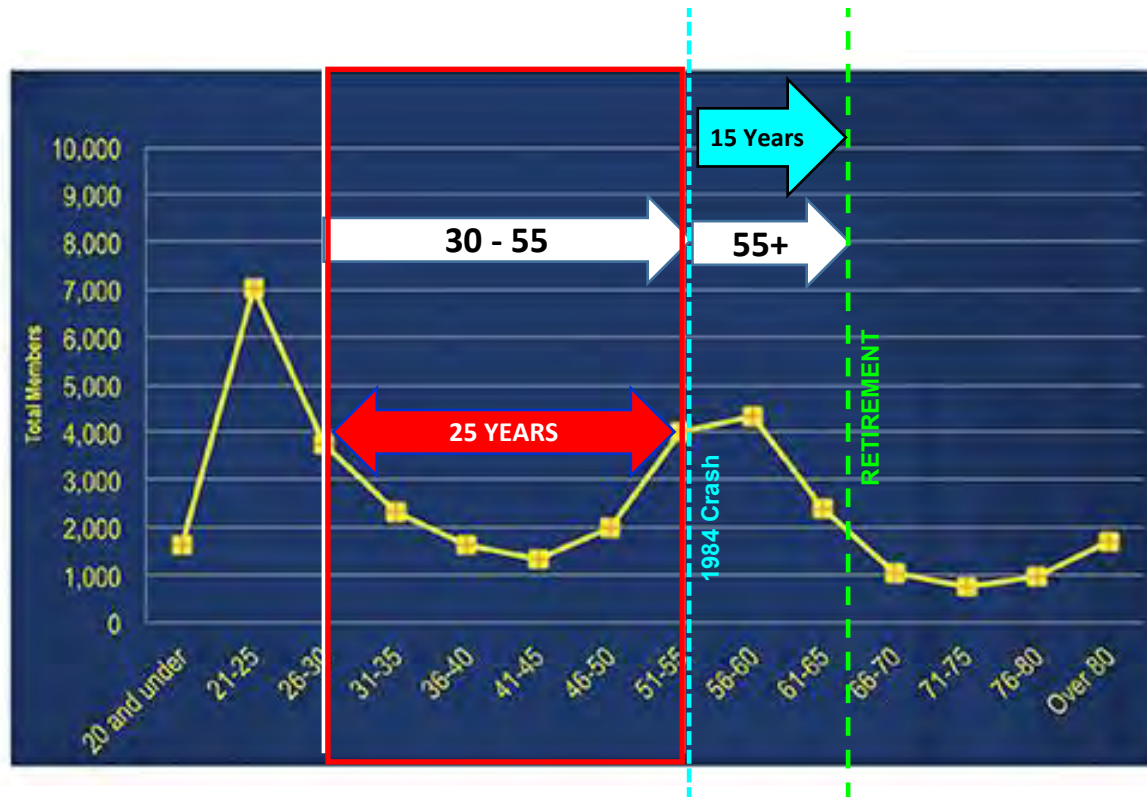


The G&G Age Gap?

1984 – 2003 Crash (Sustained Period of US\$ 10 – US\$ 27/bbl)

- **Exploration** (*High Risk, high margin and reserves replacement*)

AAPG Member Demographics

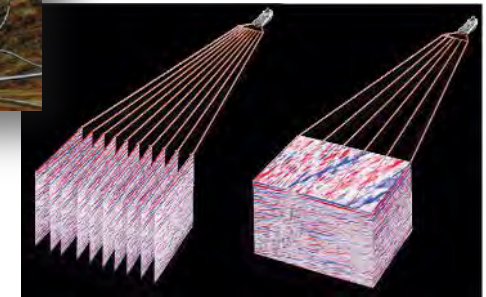
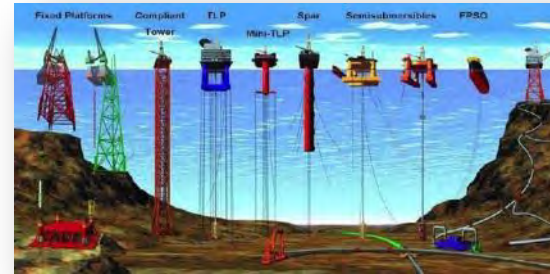




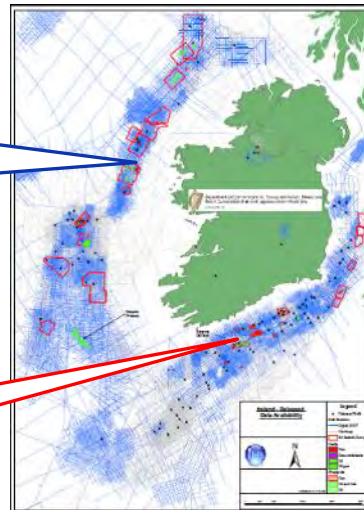
TECHNOLOGY Unlocking the Global Frontiers

- **Technology Advances**

- *Deeper Water Drilling Rigs*
- *Subsea & FPSO Development*
- *Gradiometry (Hi Res Gravity)*
- *Broadband 3D & PSMD Seismic*

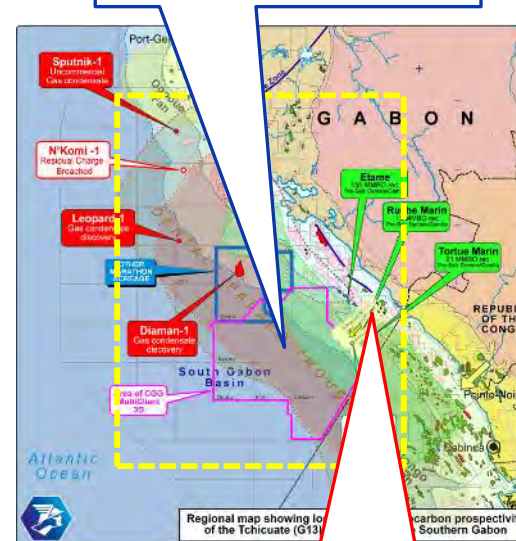


Opening New Deeper Water Frontiers e.g. Atlantic Margin Ireland

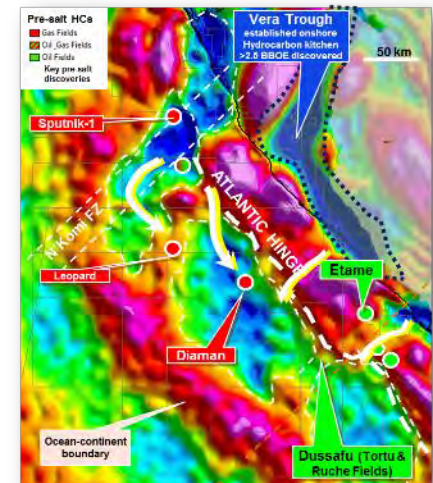


Revisiting New Plays in Proven Basins

Opening New Deeper Water Frontiers e.g. Atlantic Margin Gabon



Revisiting New Plays in Proven Basins





Some Conclusions

- **Exploration is not easy**
 - Essential to have the right technical people defining where to drill appropriately risked
- **The Price is Coming Back**
 - Upstream A&D will grow progressively (...likely to be different)
 - Could come back more quickly than expert consensus predicts
 - Is everyone ready?
 - Hope for better financial & risk management by E&P Companies
 - Past Experience?
- **Experience Legacy**
 - How does the industry fill the looming G&G knowledge gap?



The Solution?

.....some thoughts on bridging the G&G knowledge / experience gap



- **G&G Technology Advances (Increased R&D)**
- **Harness & Record Experience before its too late**
- **Pay for experience to say involved & mentor**
- **Massive upscale of training by 1st or 3rd generation**
- **Hope for Sustained High Commodity Price to pay for it**



27 February – 1 March Islington, London
PROSPECT AND PROPERTY EXPO

APPEX

GLOBAL 2018

Additional data courtesy of:
JSI GUD Database

JSI Services Limited

THANK
YOU!





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