



Supergiant Field

Sirte Basin, Libya

9 Bbbl STOOIP, 300 wells

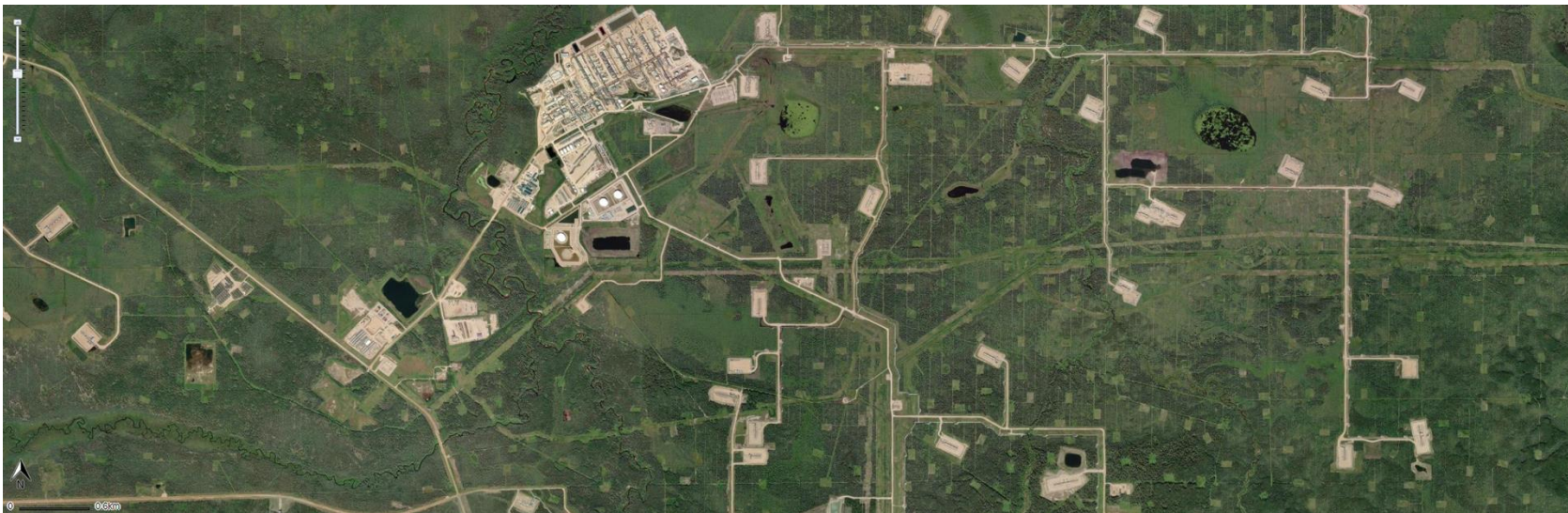
ESPS, no IOR/EOR



INTERNATIONAL OPPORTUNITIES FOR THE INDEPENDENT GEOLOGIST

SIPEs TALK 7/20/2023, Houston Petroleum Club

This presentation is an exhortation to seize an opportunity (it's a big opportunity!)



Cenovus Christina Lake Project

Alberta Oil Sands

SAG-D injection scheme

World's largest steam flood



THE SPEAKER – EARLY INTEREST IN GEOLOGY

Grew up in NE OH, travel peaked interest in geology



Shale cliffs, Vermilion River OH



Grand Canyon



Mt. St. Helens

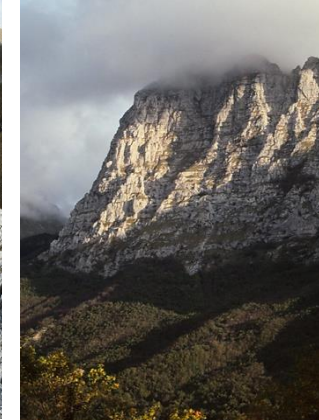
Undergrad in Minnesota, off-campus study Le Marche (Italy)



Iron ore mining



Monte Bove, Sibellini Apennines



Elba Island

Grad School, UT/Austin



Enchanted Rock



Santa Elena Canyon, Big Bend NP




West Irian, Indonesia (MS thesis field area)



Puncak Jaya, Grasberg copper mine

THE SPEAKER – EARLY CAREER

Shell (2001-2014) 



The Hague, Netherlands



Lagos, Nigeria



Alberta Oil Sands
Steepbank River AB



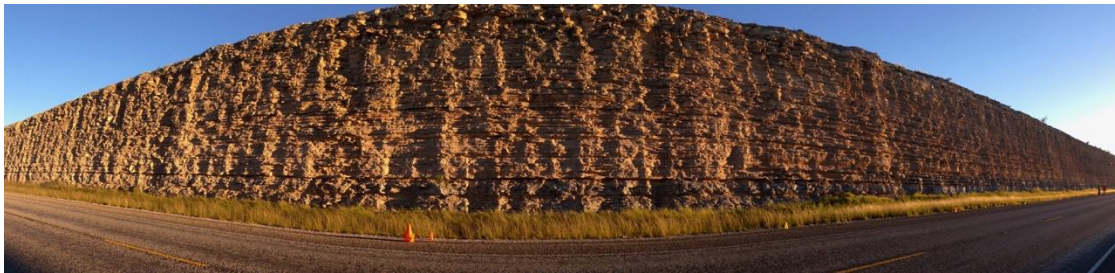
Tanqua Karoo, S. Africa
Channelized turbidites



Gordo 'Megabed', Spain
Submarine slump

Book Cliffs UT
Shoreface/estuarine
analog

ConocoPhillips (2014-Q4/2015)



Eagle Ford
Spacing Pilots


ConocoPhillips

Dear Roy:

As a result of recent business decisions, this letter constitutes notification regarding your layoff from the company. Your employment will end by layoff on October 30, 2015. Please review the "Leaving the Company Summary" for information on your pay and participation in employee benefit plans.

To assist and support you during the upcoming weeks, you will be provided with a severance package pursuant to the severance plan applicable to you. Additionally, based upon your needs

Life is a journey, not a destination!

NEW PARADIGM AS CONSULTANT

MBA, Texas A&M
Mays B-school



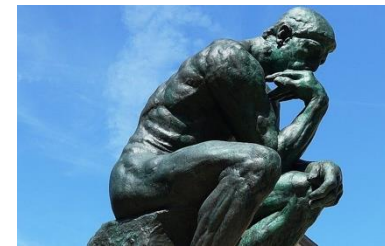
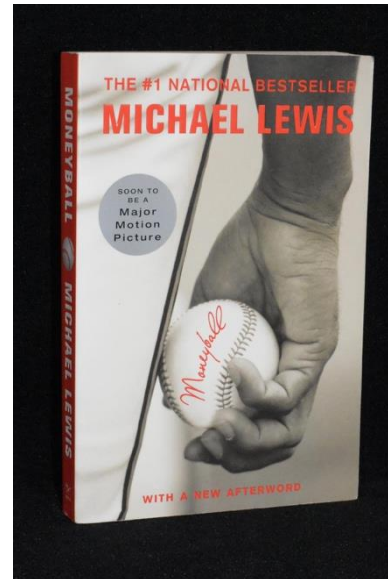
- Finance/Strategy always big MBA draws (track to IB/consulting)
- My favorite classes were strategic marketing, management accounting, operations & supply chain

For Consultants

- **Market segmentation is key**
- A company is a collection of contracts, nothing more; short-term engagements can be lucrative

Started with 2 short-term contract assignments – 1 NOC, 1 small international independent

Embrace “Gig Economy”



Best-in-class operators



Who could use some help?

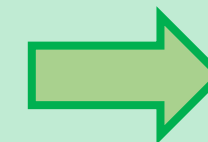
Job-seeker



Problem-solver, entrepreneur

Skills assessment

- | | |
|---------------------------------|-----------------------------------|
| ✓ Development Geoscience | ✓ Seismic Interpretation |
| ✓ Field Development Planning | ✓ IOR/EOR |
| ✓ Reservoir Modeling | ✓ Analogs |
| ✓ Subsurface Integration | ✓ Competitive Intelligence |



**Market
Segmentation**

E&P INDUSTRY, MARKET SEGMENTATION

US industry

- Focused on abundant, increasingly mature unconventional 'shale' resources
- More wary of political risk (which is real) ... but let's not write off continents at a time!

Define niche

- ✓ **Development Geoscience**
- ✓ Field Development Planning
- ✓ Reservoir Modeling
- ✓ Subsurface Integration
- ✓ Seismic Interpretation
- ✓ IOR/EOR
- ✓ Analogs
- ✓ **Competitive Intelligence**



Apply learnings from US/Canada, North Sea

- **Brownfield (re)dev**
- **Nearfield exploration**
- **Marginal fields**



Reservoir characterization
Reservoir simulation
Locate unswept hydrocarbon

Recomplete
Infill drilling
Artificial lift

IOR
EOR
Gas monetization

***** CONSULTANTS SHOULD COMPETE ON QUALITY. DO NOT COMPETE ON PRICE *****

MARKET SEGMENT



IOCs (majors, super-independents)

Well-capitalized

Don't need help

NOCs (Wide range in capability)

Enormous STOOIP/GIIP volumes
Legacy mature fields

Disinclined to explore
Favor low-cost bidders

Political interference
Local content

Indigenous independents

Local knowledge
Politically favored

Capital-constrained?

New entrants

Eager to impress technically
Politically-favored if local equity

Capital-constrained?

YOU'RE SKEPTICAL

You're probably thinking ... international arena is *challenging and risky*

Go back to first principles

- **Petroleum System** – Source, Migration, Accumulation, Reservoir, Trap
- **Sedimentology** – Superposition, Walther's Law
- **Sequence stratigraphy** – eustasy, accommodation
- **Stress-strain, structural styles** ... Mohr's Circles
- **Acoustic impedance** – 2-D/3-D seismic interpretation
- **Petrophysics** – GR, NEU/D, Res (Archie's Equations)
- **STOOIP** = $A * H * N_t G * POR * S_o / B_o$
- **Flow barriers, drainage radii** – field development planning



Hoosiers, starring Gene Hackman

Scene – measuring court dimensions in 'big arena', same as familiar home court

First principles apply! Formation names and tectonic juxtapositions vary.

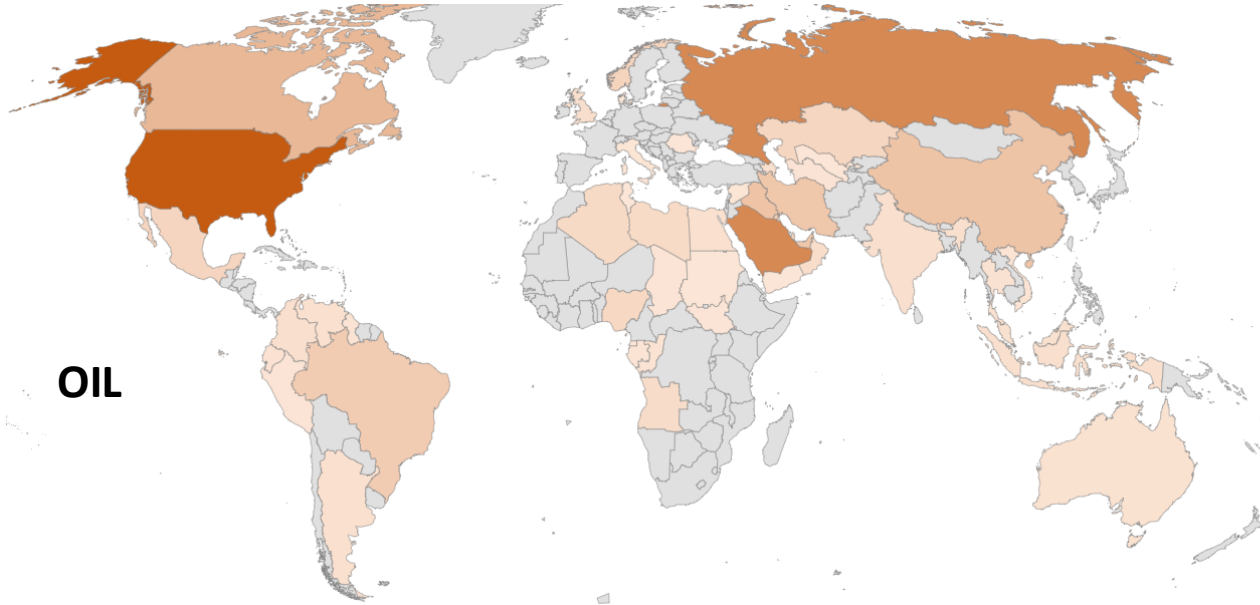


You can do this!

- ✓ Mitigate risk (local partners)
- ✓ Draw on analogs
- ✓ Patience required

SIZE OF THE PRIZE, WHERE ARE THE HYDROCARBONS? (~170 MMboepd)

OIL



Global oil production – 102.5 MMbbl/d

- **USA 13.5 MMbbl/d, other 89 (OPEC 27.5)**
- Artificial lift and Improved Oil Recovery (IOR) prevalent in NAM & worldwide, uneven quality/reliability
- ‘Unconventional’ 10 – USA 9, other 1 (Canada, Argentina)
- Enhanced Oil Recovery (EOR) >2.5 – USA 0.5, other 2 (Canada)
 - *Thermal EOR* ~2 – USA 0.25, other 1.65 (Canada)
 - *CO₂ EOR* 0.3 – USA 0.25, other 0.05 (Canada)
 - *Chemical EOR* 0.3 – USA 0.05, other 0.25 (China)

GAS



Global gas production – 400+ bcf/d (67 MMboepd)

- **USA ~107 bcf/d, other 300 (Russia 60)**
- ‘Unconventional’ 75 – USA 60, other 15 (Canada, Oman)
- LNG 52 – 12.5% of global gas trade
 - 48 bcf = 1 mt LNG, 400 mtpa

	USA	CANADA	RoW	TOTAL
Wells	925000	200000	850000	2000000
Horizontals	150000	20000	60000	250000

COUNTRY ENTRIES – CASE STUDIES

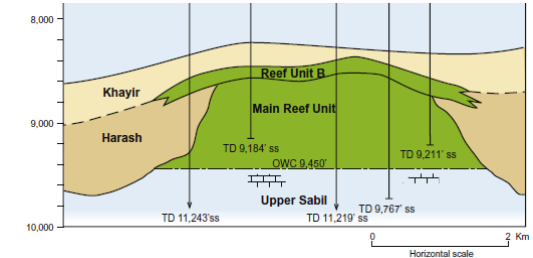
International only for majors and super-independents? 🤔



Armand Hammer
Sirte Basin, Libya



- Occidental tiny Bakersfield-based firm
- 0.1-800 kbopd 1959-1969
- Libyan secondary lease rounds, 1960s
- Digital seismic, gravimetry
- Basement highs, patch reefs (Intisar-D)



Roy Huffington, Huffco
Kalimantan, Indonesia



- GoM depositional analogs, initially seeking oil; shift to LNG focus
- Shallow offshore Badak gas field, 1972
- PT Badak, Bontang LNG

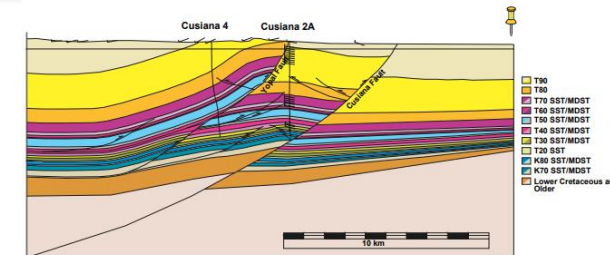


TRITON

Dallas-based explorer
Colombia, Equatorial Guinea



- Cusiana Field acreage acquired 1982, farmout to BP/Total (Colombia)
- Ceiba Field, offshore EG 1999
- Hess acquired Triton in 2001 (\$3.2B)



United Meridian Energy, **Equatorial Guinea** (1995)

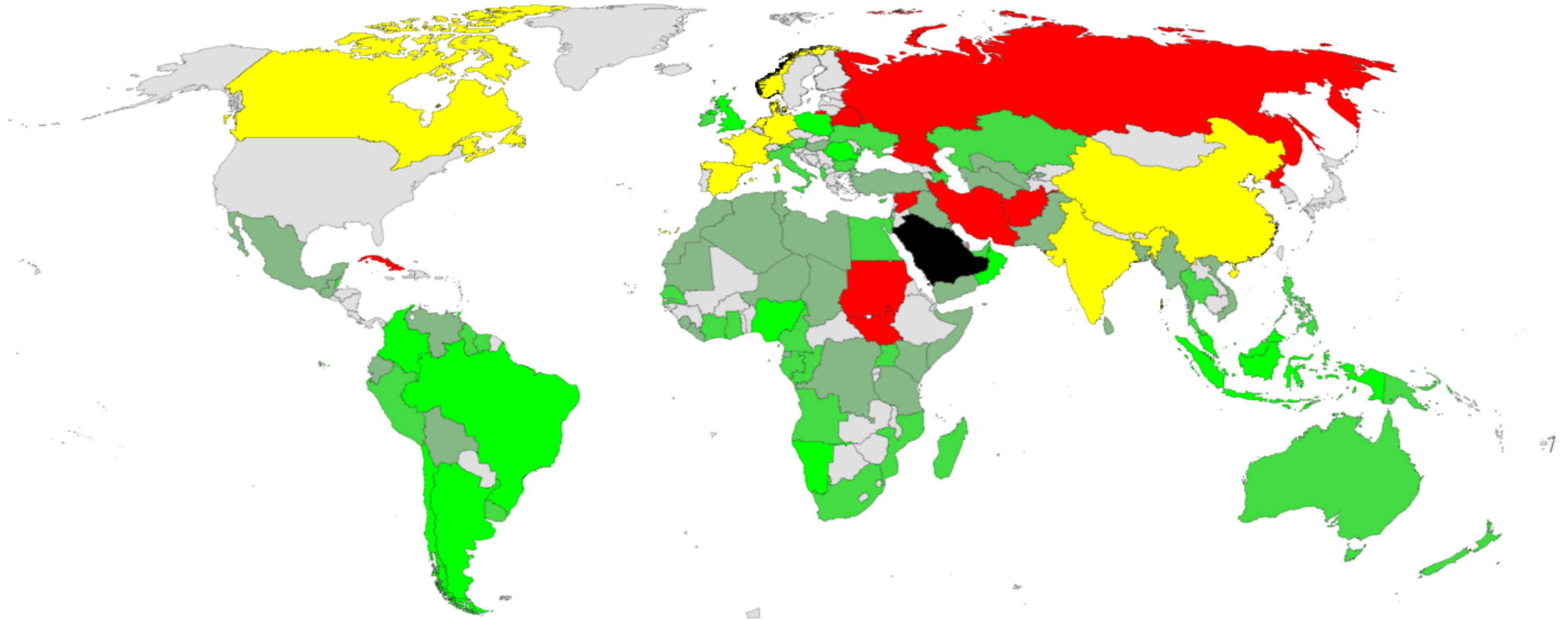
Belize Natural Energy, **Belize** (2005)

Tullow Oil, **Uganda** (2006), **Ghana** (2007)

Interoil, **Papua New Guinea** (2007)

BUT THESE ARE ALL GREENFIELDS, WHAT ABOUT BROWNFIELDS?

ACCESSIBILITY, WHERE ARE THE OPPORTUNITIES?



Don't need help

- Surplus of trained professionals



No-go

- Generally-Embargoed Country Status (GEC)
- Insecurity



NOC monopoly

- Zero opportunity for individual consultants



Highly challenged

- Resource available
- Hindered by lack of security, preferred access for strategic partner



Intriguing

- Ample resources
- Politically-challenged

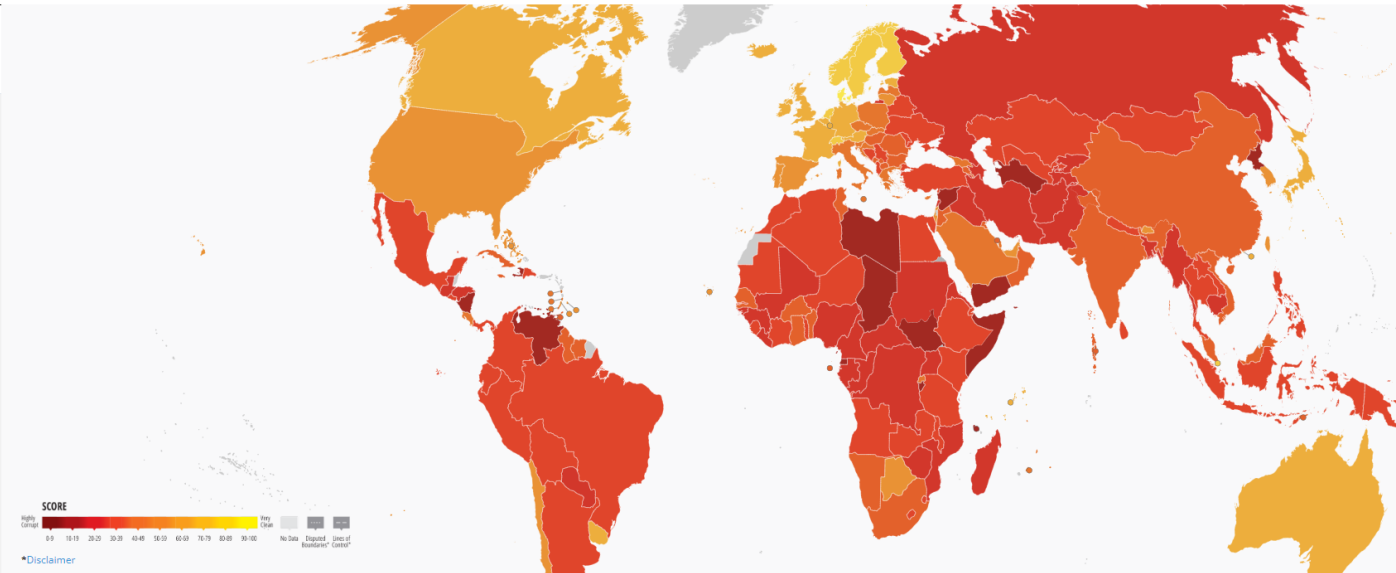


Most interesting

- Ample resources
- Driver (indigenous independents, mature fields, poorly-run NOC, etc.)

CORRUPTION, EXPORT CONTROLS/SANCTIONS

Score	Country	Rank
90	Denmark	1
87	Finland	2
87	New Zealand	2
84	Norway	4
83	Singapore	5
83	Sweden	5
82	Switzerland	7
80	Netherlands	8
79	Germany	9
77	Ireland	10
77	Luxembourg	10
76	Hong Kong	12
75	Australia	13
	Canada	14



Transparency International Corruption Perceptions Index (2023)

www.transparency.org

Norway (4)	Oman (70)	Angola (121)
Canada (12)	China (76)	Mexico (126)
Australia (14)	T & T (76)	Gabon (136)
UK (20)	Guyana (87)	Russia (141)
USA (24)	Colombia (87)	Nigeria (145)
UAE (26)	Kazakhstan (93)	Iran (149)
Qatar (40)	Argentina (98)	Iraq (154)
Saudi Arabia (53)	Brazil (104)	Azerbaijan (154)
Malaysia (57)	Algeria (104)	Turkmenistan (170)
Romania (63)	Egypt (108)	Libya (170)
Kuwait (63)	Indonesia (115)	Venezuela (177)

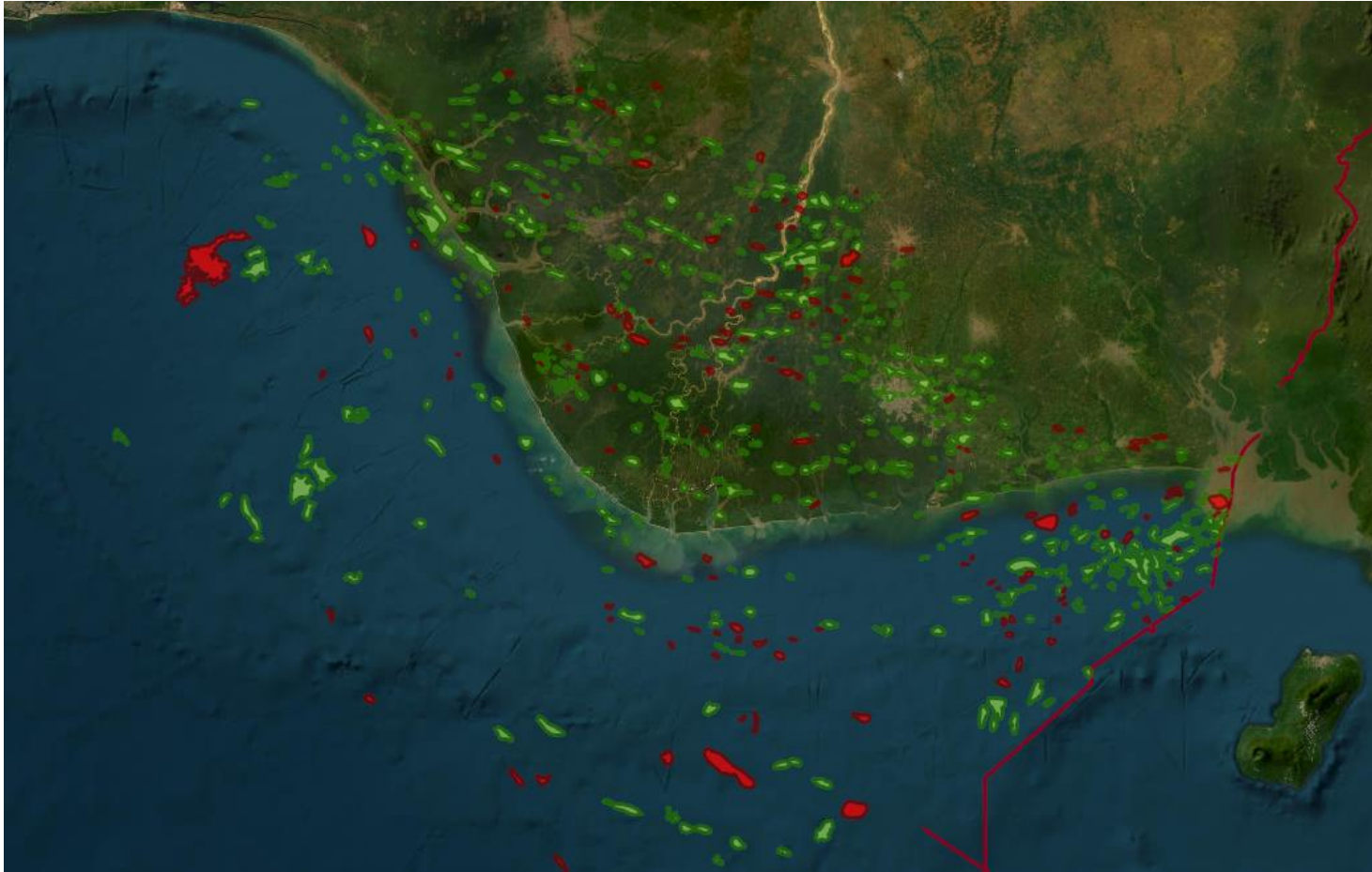
Foreign Corrupt Practices Act (FCPA)

- Enacted 1977; **Illegal to pay gov't officials** for special consideration
- 1998 amendment targeting foreign firms paying bribes in USA
- **Panalpina Case (2010)**, \$236M settlement related to expediting fees in multiple countries, oilfield services; Transocean, Shell, Noble paid Swiss logistics firm.
- Transparency, compete on quality

Export Control & Sanctions

- **GEC (Generally Embargoed Countries)** – Cuba, Iran, North Korea, Syria, Crimean Ukraine
- **Highly Restricted** – Russia, Belarus, Venezuela
- Less relevant to knowledge transfer, but software/technology subject to restriction (geosteering, encryption)
- Blocked persons, and entities majority-owned by blocked persons
- US Dep't of the Treasury ... **check the rules!**

SEEK ADVICE, WORK WITH LOCAL PARTNERS



Oloibiri Field

OML 29

First production 1958



Bonga FPSO

OML 118, deep water

First production 2005



NLNG

6 trains, 22 mtpa

Bonny Island

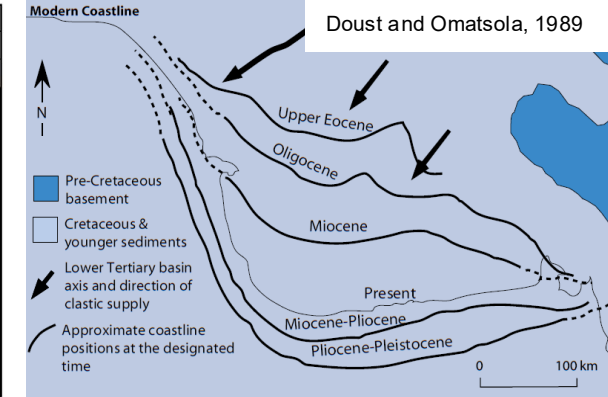
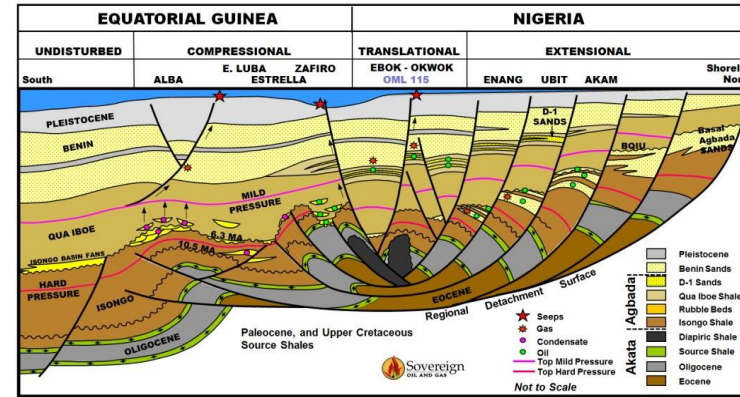
1999-2007

- ✓ **761 fields/discoveries**, 644 with oil (remainder GC)
- ✓ **163 Bbbl STOOIP** (73.2 onshore, 57 shelf, 33 deep water)
- ✓ **36 Bbbl cumoil from 303 fields** ... 7700 wells (~5800 producers) ... **6 MMbbl/well cumoil**
- ✓ **63 Bbbl EUR ... 27 Bbbl remaining?** 12 onshore, 7 shelf, 8 DW

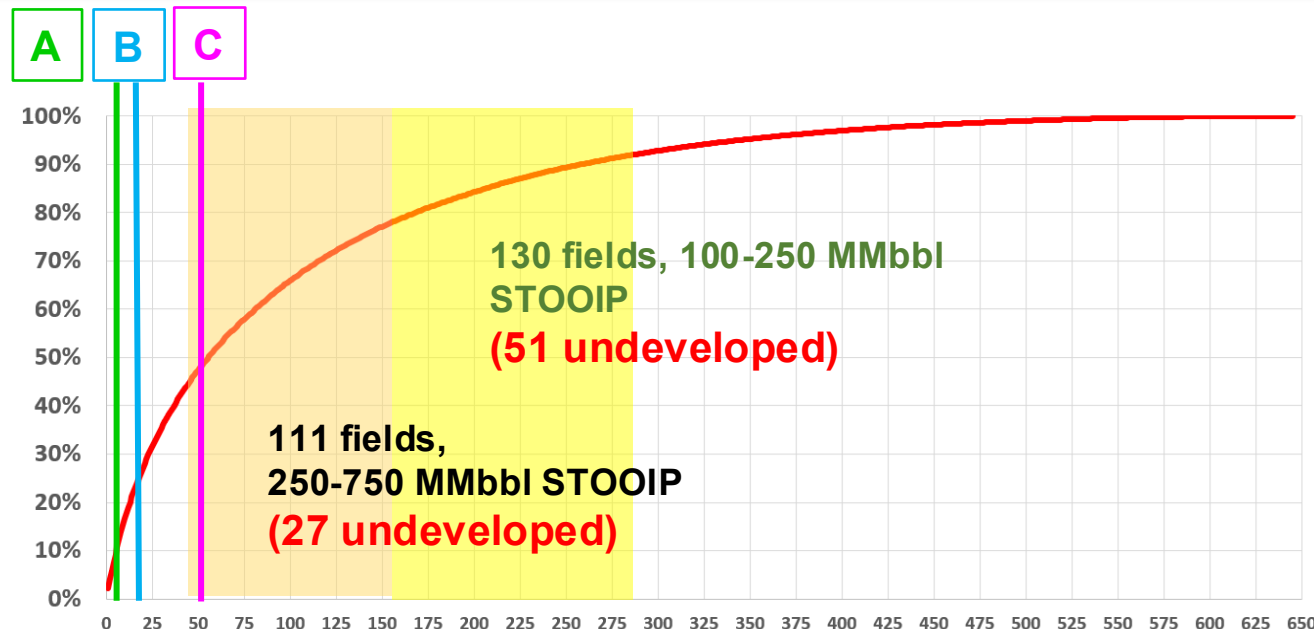
NIGERIAN E&P, NIGER DELTA PETROLEUM GEOLOGY AT A GLANCE

Petroleum System – S. M. A. R. T.

- ✓ **Source** – organic-rich layers in Akata Shale
- ✓ **Migration** – faults and high-permeability layers
- ✓ **Accumulation, Reservoir** – Agbada clastic shoreface and estuarine channel sequences onshore, shallow shelf (Oligocene-Pliocene); channelized turbidites offshore (Miocene)
- ✓ **Trap** – three-way dip closures against faults with shale drape



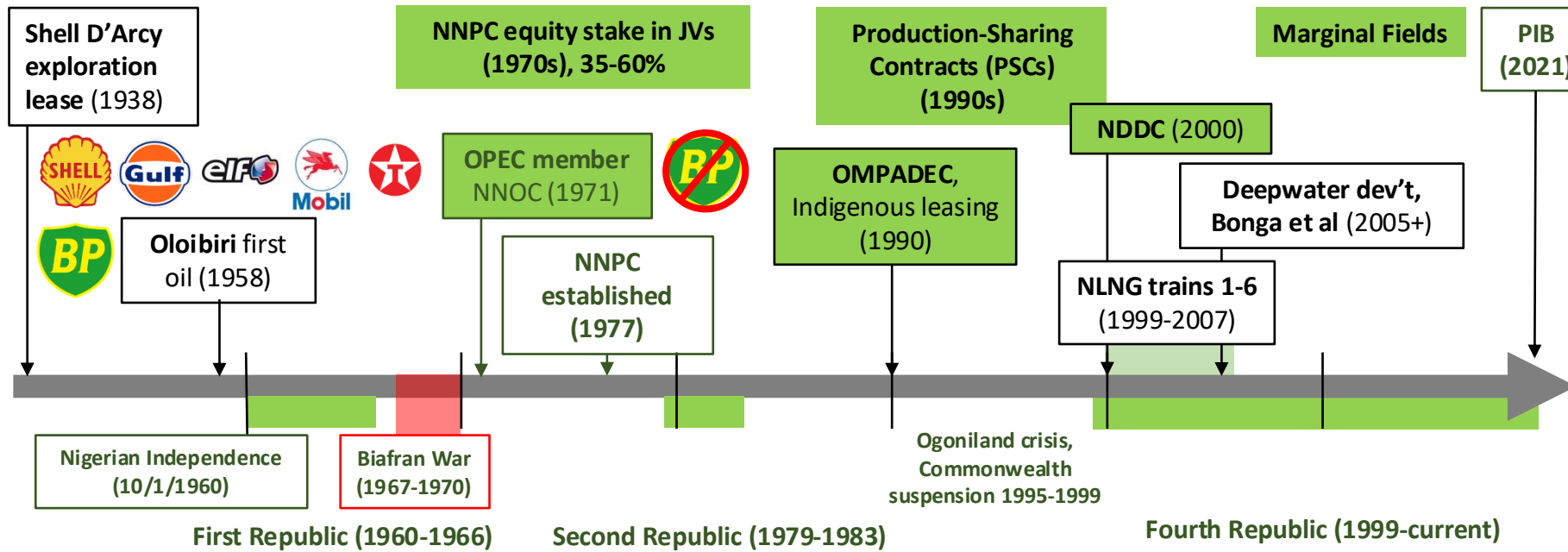
- Early accommodation in Benue Trough, failed Cenozoic rift
- Accreting **depobelts** bounded by regional south-dipping listric faults, wave-dominated Niger Delta on Atlantic passive margin (EXTENSION)
- Toe-of-slope thrusts (CONTRACTION)



Field size distribution makes Nigeria attractive

- **163 Bbbl STOOIP**
 - 644 oil fields in Niger Delta, adjacent basins
 - Biggest field (Bonga), *only 2.2% of total STOOIP*
 - Fragmented structural/depositional trends
- A) 10% of STOOIP in 6 fields 2600-3600 MMbbl (2 undeveloped)
 B) 25% of STOOIP in 18 fields 1630+ MMbbl (4 undeveloped)
 C) 50% of STOOIP in 56 fields 750+ MMbbl (8 undeveloped)

HISTORY OF NIGERIAN O&G, OPPORTUNITIES IN 2024

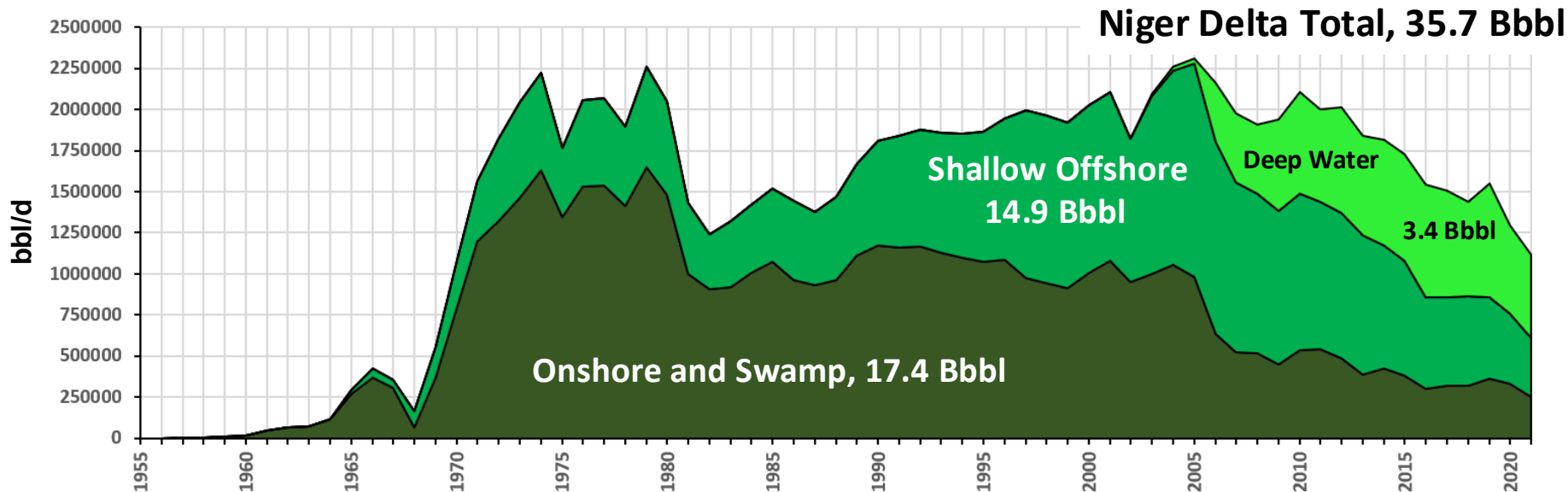


Policy influences exploration and capital allocation

- Resource nationalism
- Tax regimes
- Security considerations
- Incentives

Current trends

- Majors divesting swamp, shallow offshore, buyers?
- Indigenous independents
- More assertive NNPC?

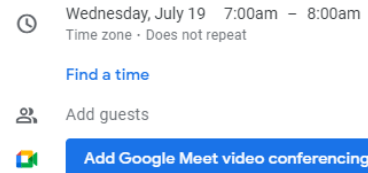


Opportunities

- ✓ Infill drilling
- ✓ Artificial lift
- ✓ IOR (limited waterflood swamp, shallow offshore)
- ✓ EOR (0 applications)
- ✓ Offshore gas
- ✓ Deeper exploration >10k' TVDss

COVID drove remote work capability

Collaborative work



- *Face-to-face interaction important at project outset*
- Much work can be done remotely
- Savings on business travel

Hardware

- Virtual machines, significant CAPEX savings
- Hard disk storage (<\$50/Tb)

Software-as-a-Service (SaaS)

- Avoid costly site licenses
- Flexibility for short-term work



Approach clients with ideas

- Identify asset upside, match with analogs
- ***This is not prospect generation!***

Literature sources

- ✓ Industry press
- ✓ University libraries (UT)
- ✓ AAPG Datapages (\$300/yr)
- ✓ SPE OnePetro (\$5-10/paper)

Private databases

- ✓ Can secure lower price as consultant, pass on to client
- ✓ IHS EDIN, granular E&P G&G PE

Seek networking opportunities, be an extrovert

Devise plan to access decision-makers, when receptive

- ✓ College/grad school alumni
- ✓ Trade associations
- ✓ LinkedIn Premium (search capability)



“If you build it, they will come”

INTERNATIONAL CONSULTING – IN SUMMARY ... IT CAN BE DONE

STUDY NEW BASINS/FIELDS, especially AAPG-designated ‘super basins’

In locales with elevated political/security risk, now is the time to study. When conditions improve, that is the time to act!

PURPOSEFUL NETWORKING

Focus on problem-solvers in complementary disciplines, team-building, foreign nationals

GO BACK TO FIRST PRINCIPLES, REPACKAGE OFFERING

Be positive – think about how a project CAN work; it’s easy to find reasons it can’t



BREADTH > DEPTH

- **What technologies unlock value?** Start conversations, bring in experts from network...
- Familiarize yourself with solutions in adjacent/related disciplines (water handling, gas monetization, etc.)
- Development concepts (FPSO, SSTB, manned/unmanned platforms, EOR/IOR, value drivers for local markets)

WORK WITH TRUSTED LOCAL PARTNERS (especially applicable to Nigeria case study shown)