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تاريخ المحاضرة: 2022-08-13

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Libyan Oil Sector - Challenges and Prospects

Dr. Nagmeddin Abdalla Arifi

13 August 2022

Outlines

- Infrastructure Development
- Exploration Activities
- Reserves
- Production, Exports, and Revenues
- Future Potential
- Conclusions and Recommendations

Libyan Oil Sector - Challenges and Prospects

Infrastructure Development

Infrastructure Development

1955 Petroleum Law

- Petroleum law was issued.
- 1st concession was granted to Esso standard.
- By the end of the year, 39 concessions were granted to several companies.

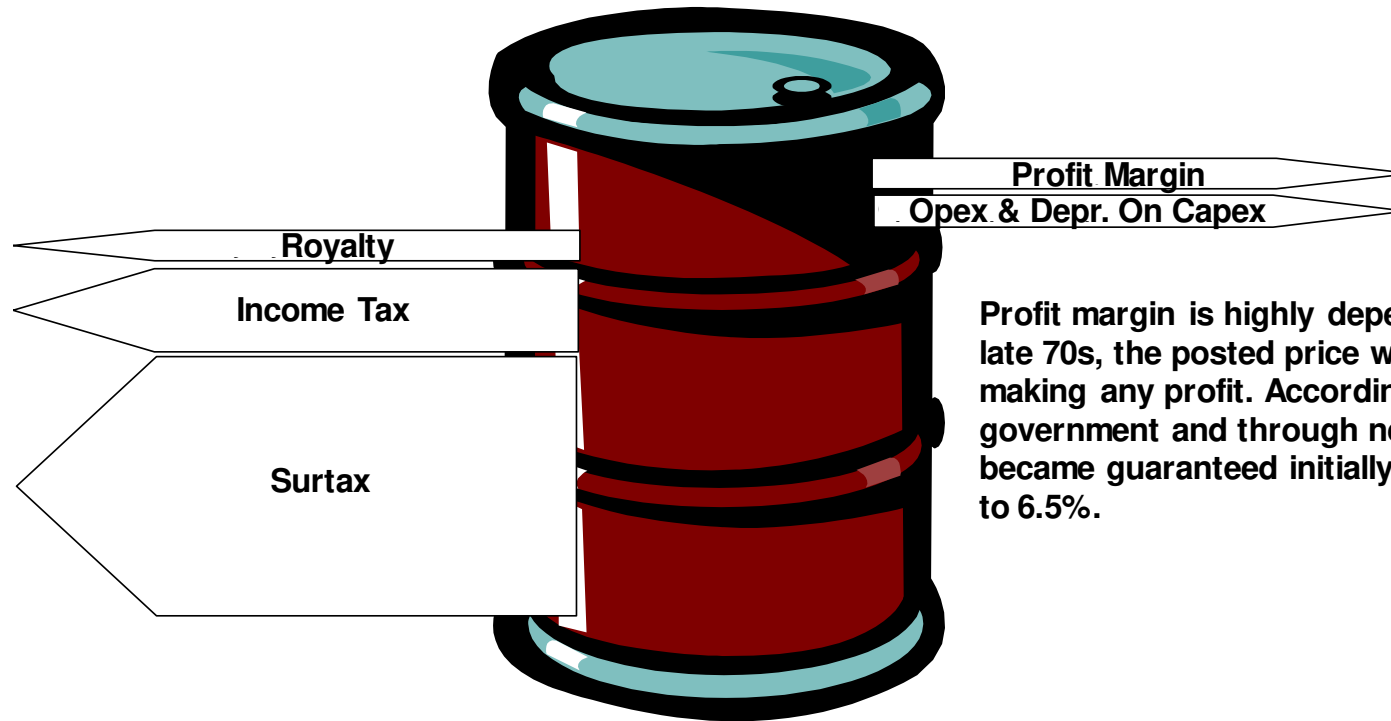
Infrastructure Development

1955 Concession Agreement Fiscal Policy

Oil Revenue Distribution

LIBYAN GOVERNMENT

COMPANY



Profit margin is highly dependent on the posted price. In the late 70s, the posted price was so high it prevented IOCs from making any profit. Accordingly, in 1980 IOCs objected to the government and through negotiations the profit margin became guaranteed initially at 5%, which was later amended to 6.5%.

* Royalty is 16.67% per bbl based on posted price

* Income Tax is 65% of taxable profit based on posted price

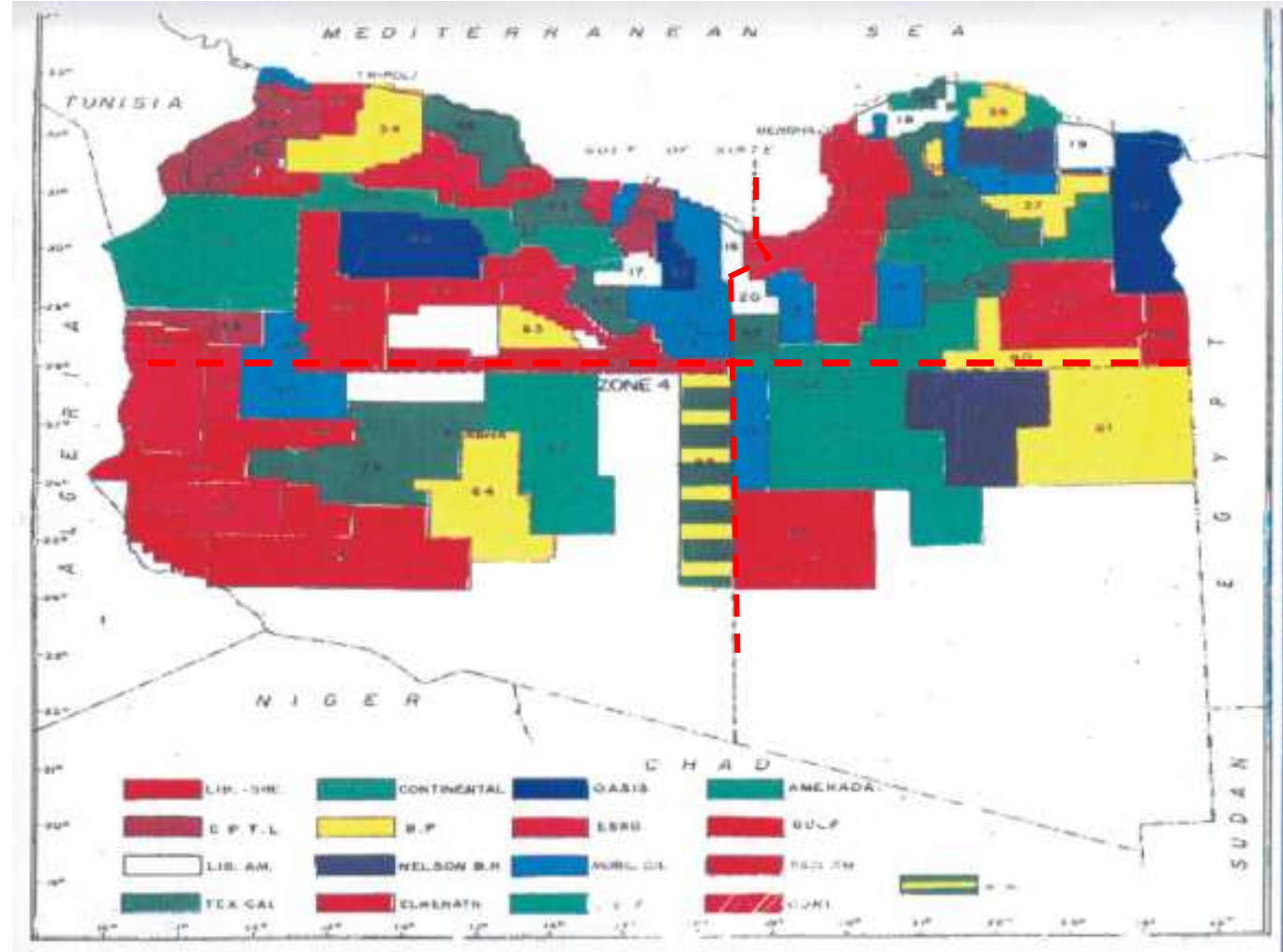
* Surtax is sales less (Opex, Royalty, Inc. Tax) and its calculated using the TPC = Market Price - Profit Margin

Infrastructure Development

1956 Concessions

- A total of 85 concessions were granted

- ✓ Esso
- ✓ APOC
- ✓ Mobil
- ✓ Shell
- ✓ Chevron
- ✓ Gulf Oil
- ✓ Texaco
- ✓ Libyan American
- ✓ Conoco
- ✓ Amerada
- ✓ Nelson Bunker Hunt
- ✓ Elwerath
- ✓ Other IOCs



Infrastructure Development

1957

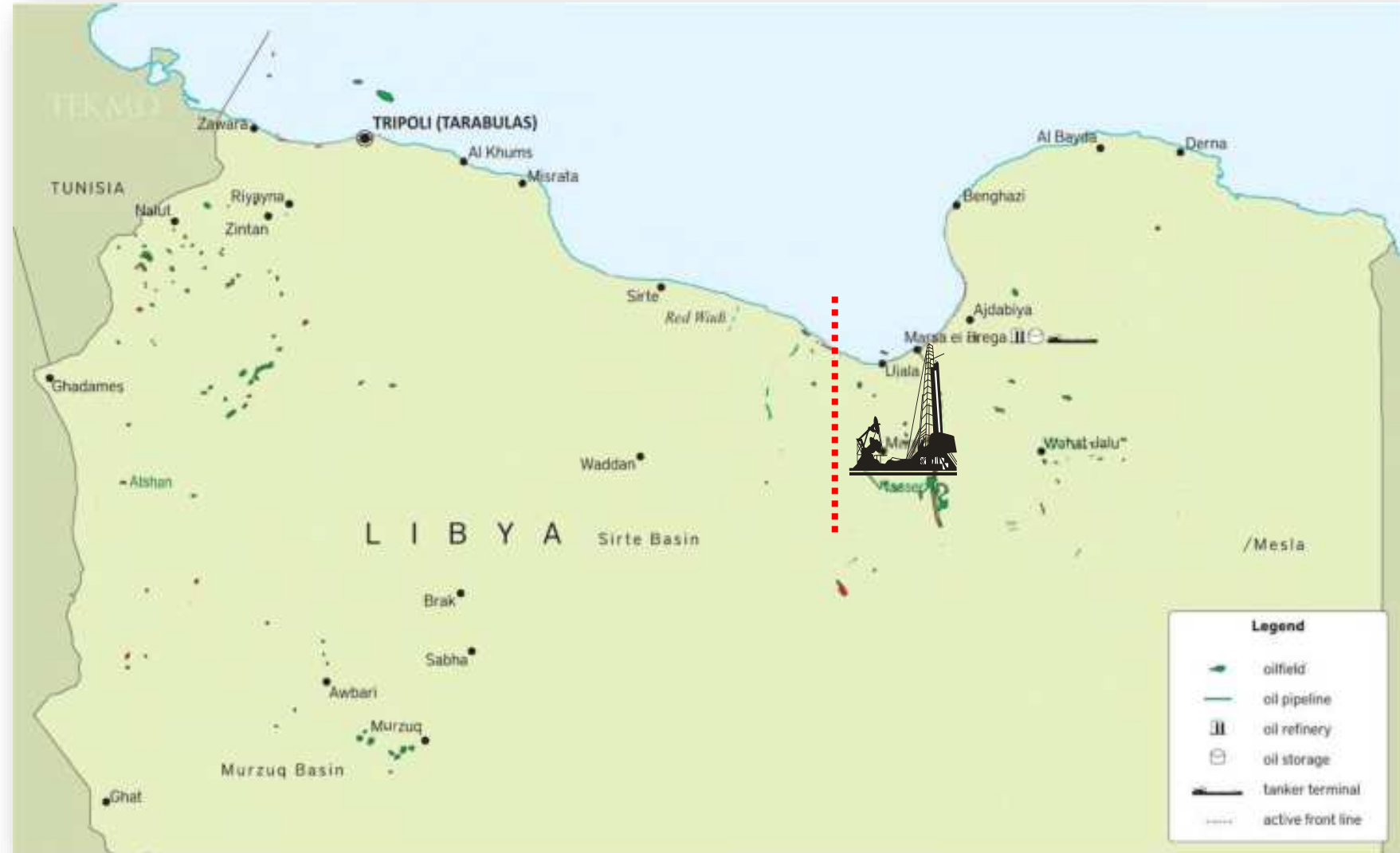
- First hydrocarbons discovery by Esso (Atshan)
 - ❖ 508 BOPD
 - ❖ API 44.5
- Atshan was later abandoned; considered uneconomical at the time



Infrastructure Development

1958

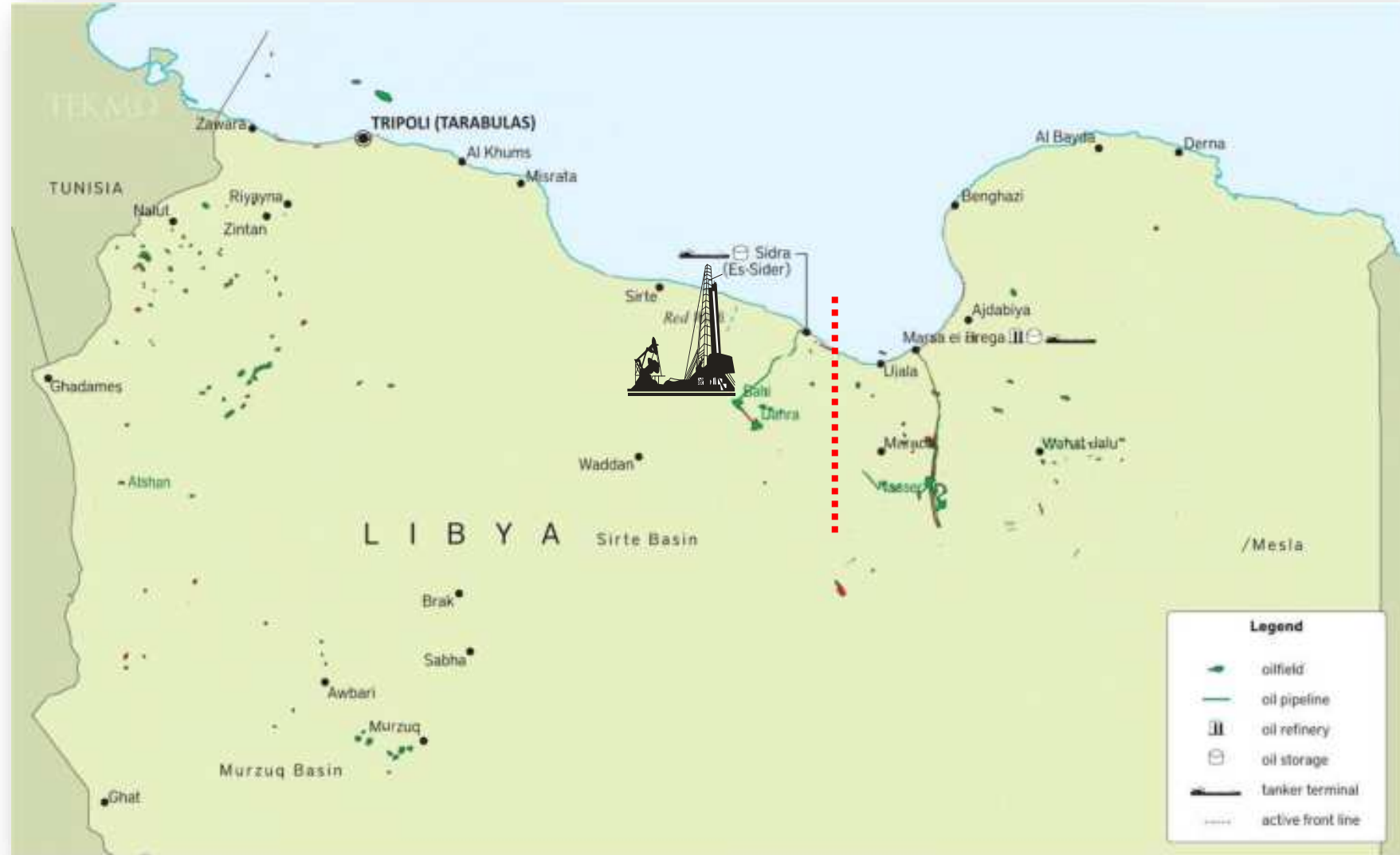
- First major discovery by Esso (Zelten field, later named Nasser)
- Well C1 was tested at:
 - ❖ 17500 BOPD
 - ❖ 37 API



Infrastructure Development

1958

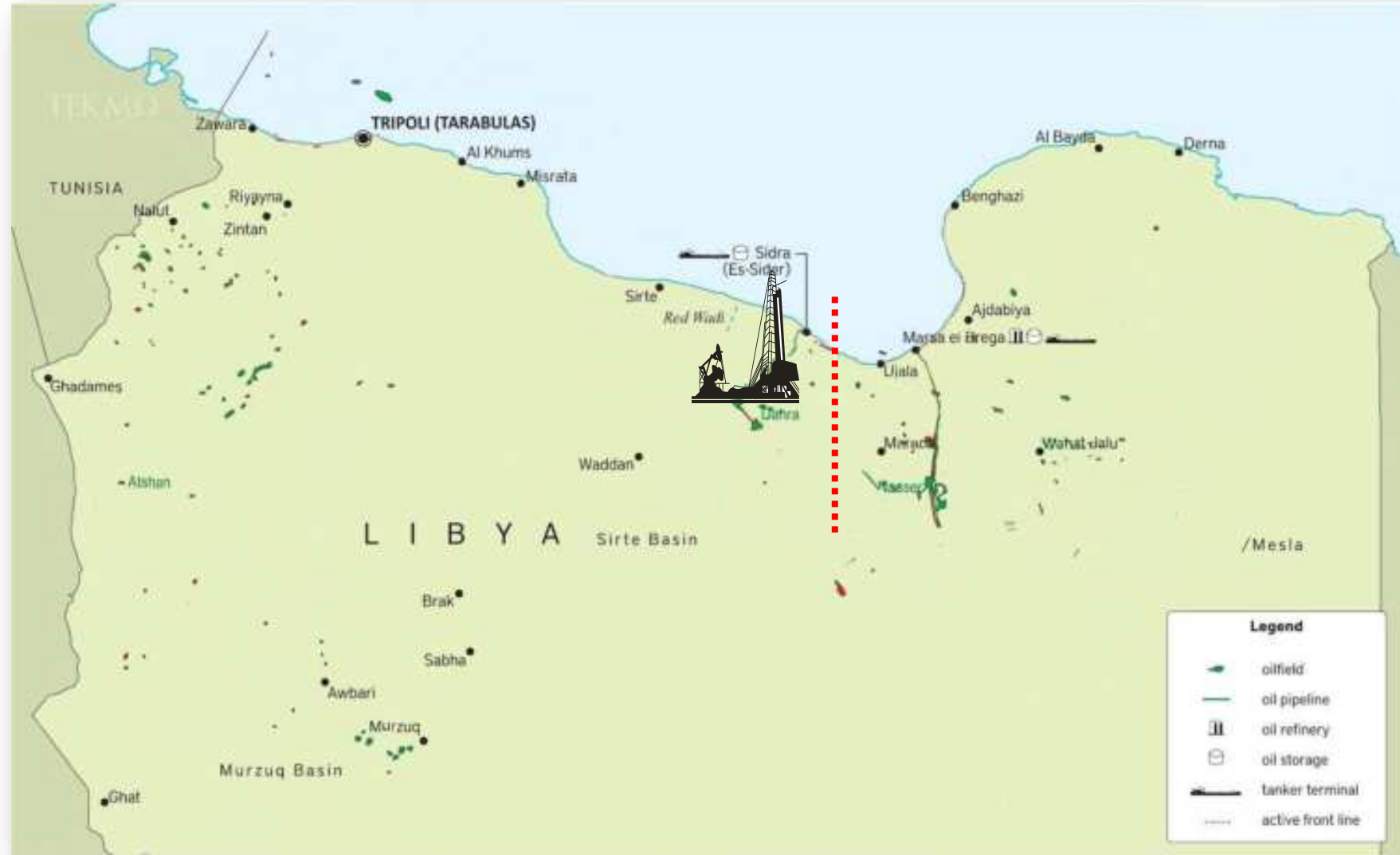
- Second discovery by OASIS (Bahi)
 - ❖ 500 BOPD
 - ❖ API 39
- Bahi was considered uneconomical. However, this field was put on production in 1970.
- **OASIS Group:**
 - ❖ Conoco
 - ❖ Marathon
 - ❖ Amerada Hess



Infrastructure Development

1959

- First major discovery by OASIS in concession 32 (Dahra Field)
- Well was tested at:
 - ❖ 1062 BOPD
 - ❖ 41 API



Infrastructure Development

1961

- The first shipment of oil through Marsa El-Brega (ESSO) Terminal
- A total of 97 exploratory wells and 130 development wells were drilled
- OPEC was created



Infrastructure Development

1962

- OASIS began exporting oil through Es-Sider Terminal



Infrastructure Development

1963

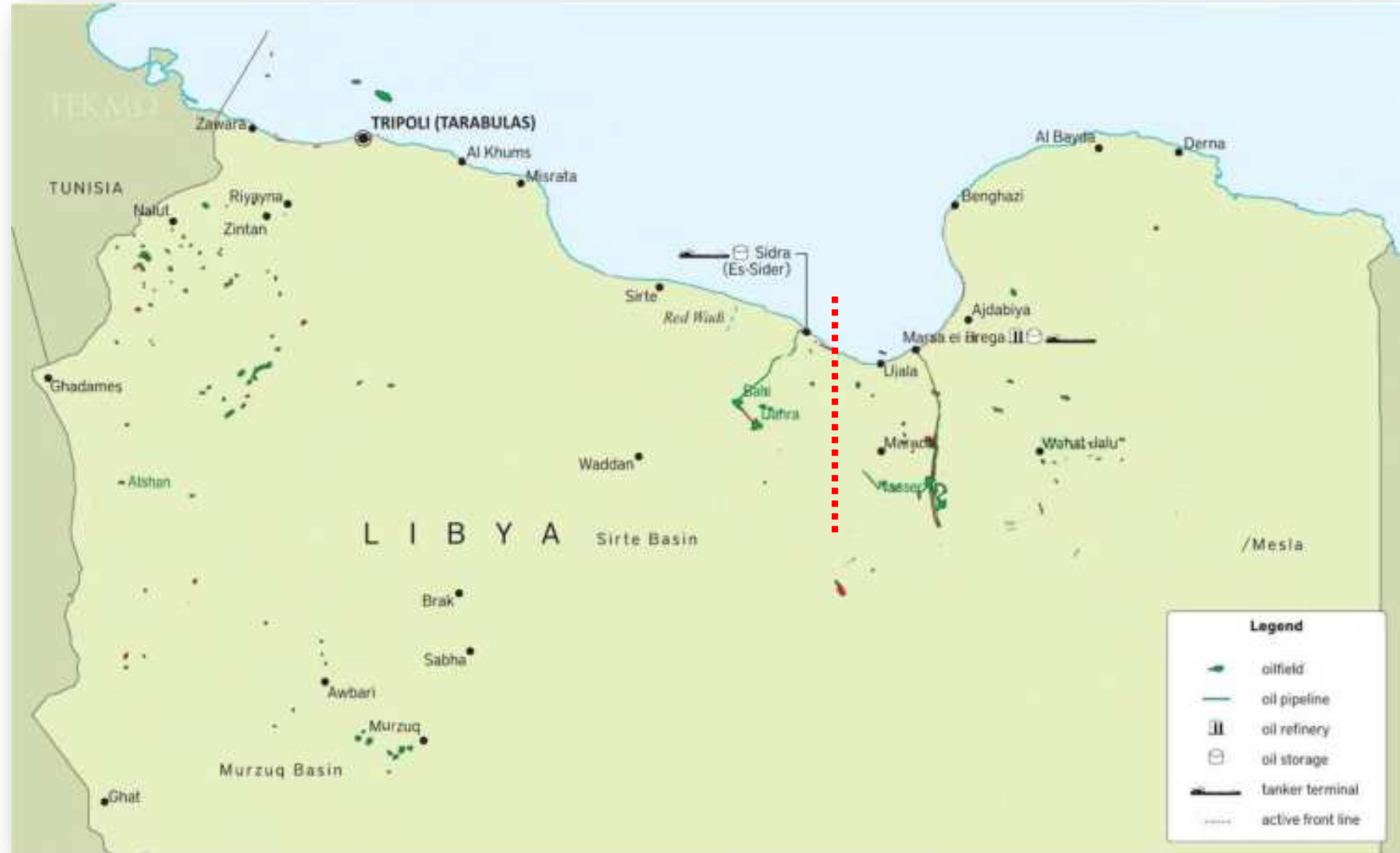
- Abolition of the Federal Government and Unification of the Kingdom of Libya.

ليبيا دولة موحدة

- Libya became a member of OPEC



Organization of the
Petroleum Exporting Countries



Infrastructure Development

1964

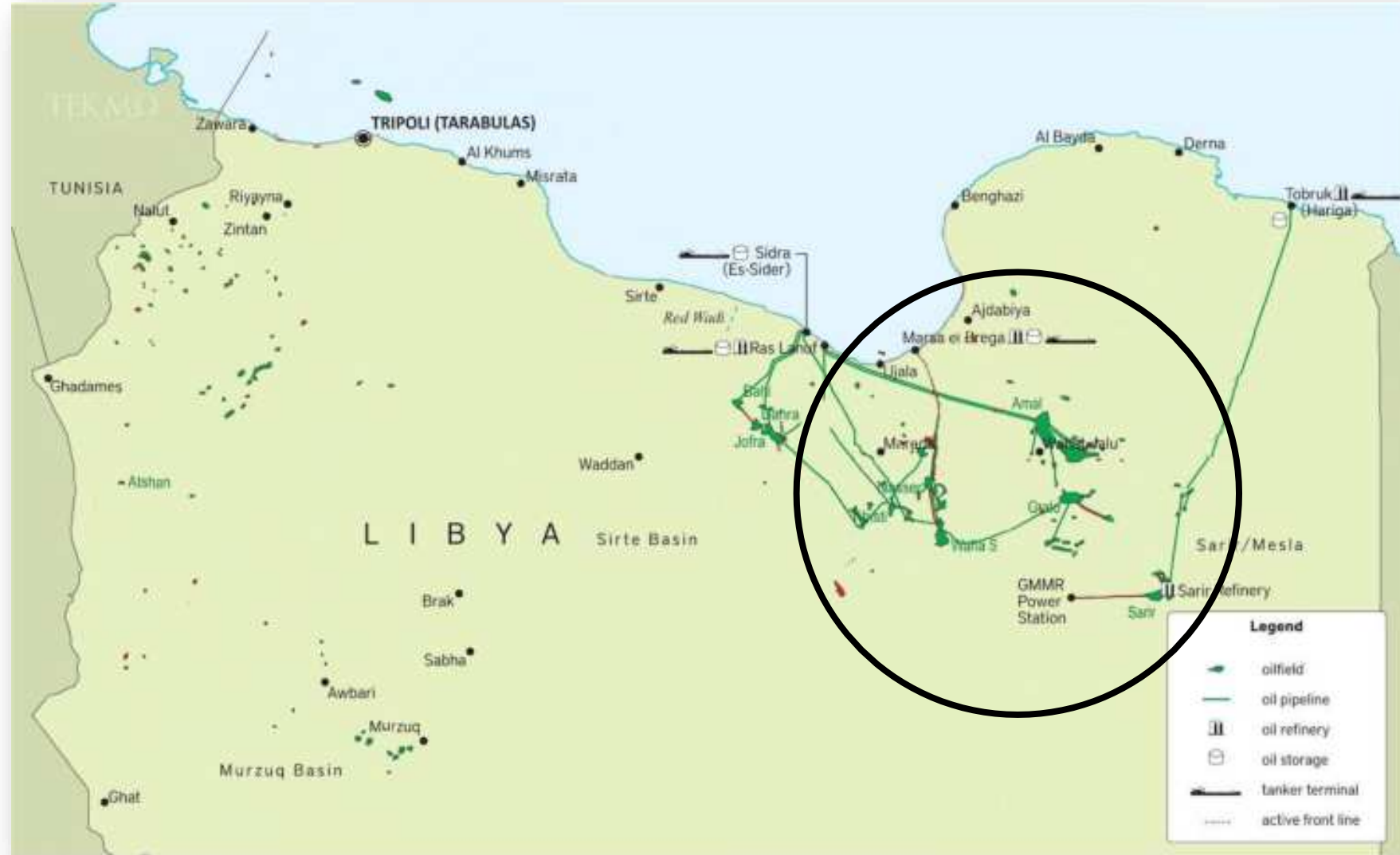
- El-Hofra Field was put on production by Mobil.



Infrastructure Development

1966

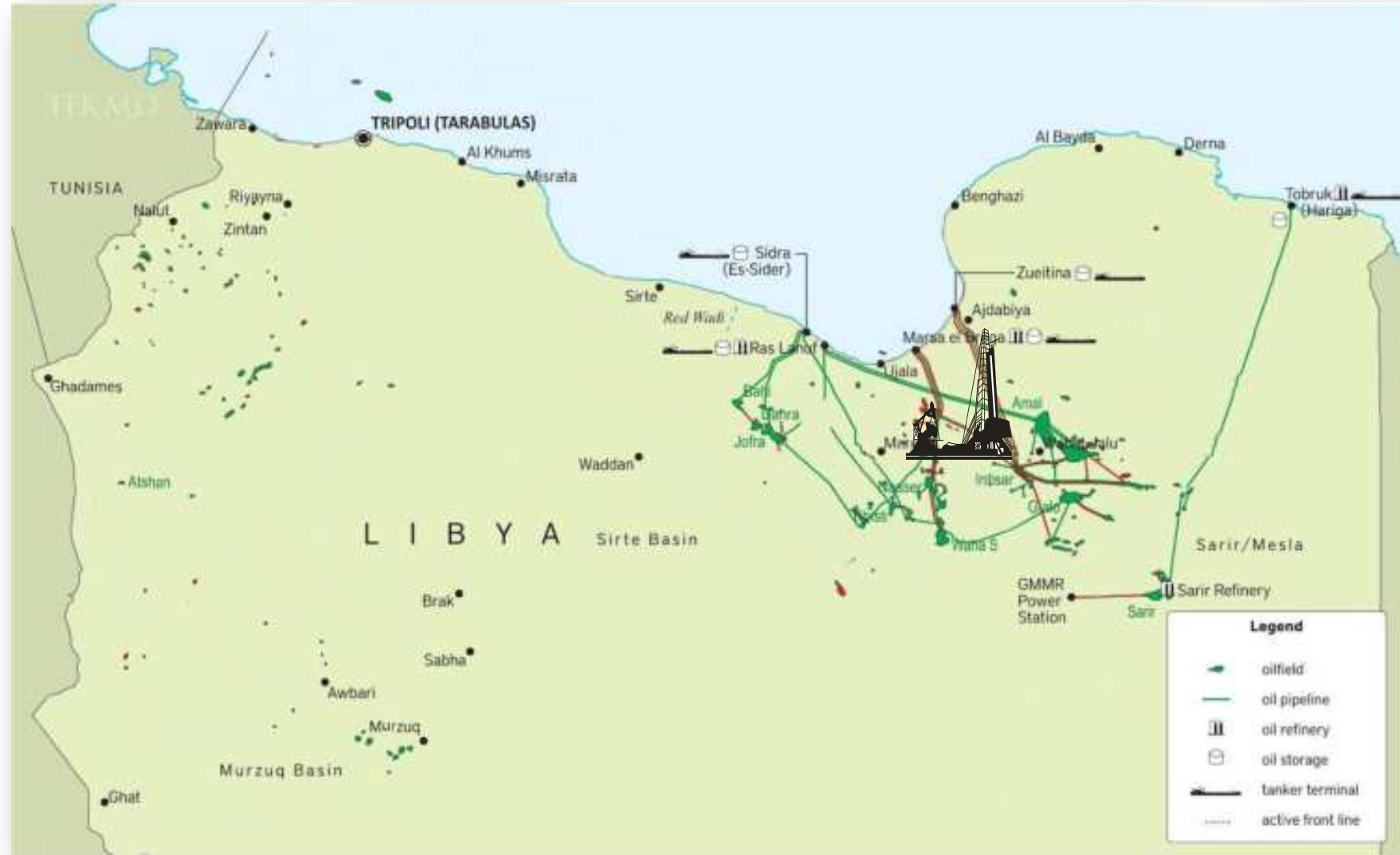
- Giant fields were put on production:
 - ❖ Sarir (BP)
 - ❖ Gialo (Oasis)
 - ❖ Waha (Oasis)
 - ❖ Nafoora (AMOSEAS)
 - ❖ Amal (Mobil)



Infrastructure Development

1967

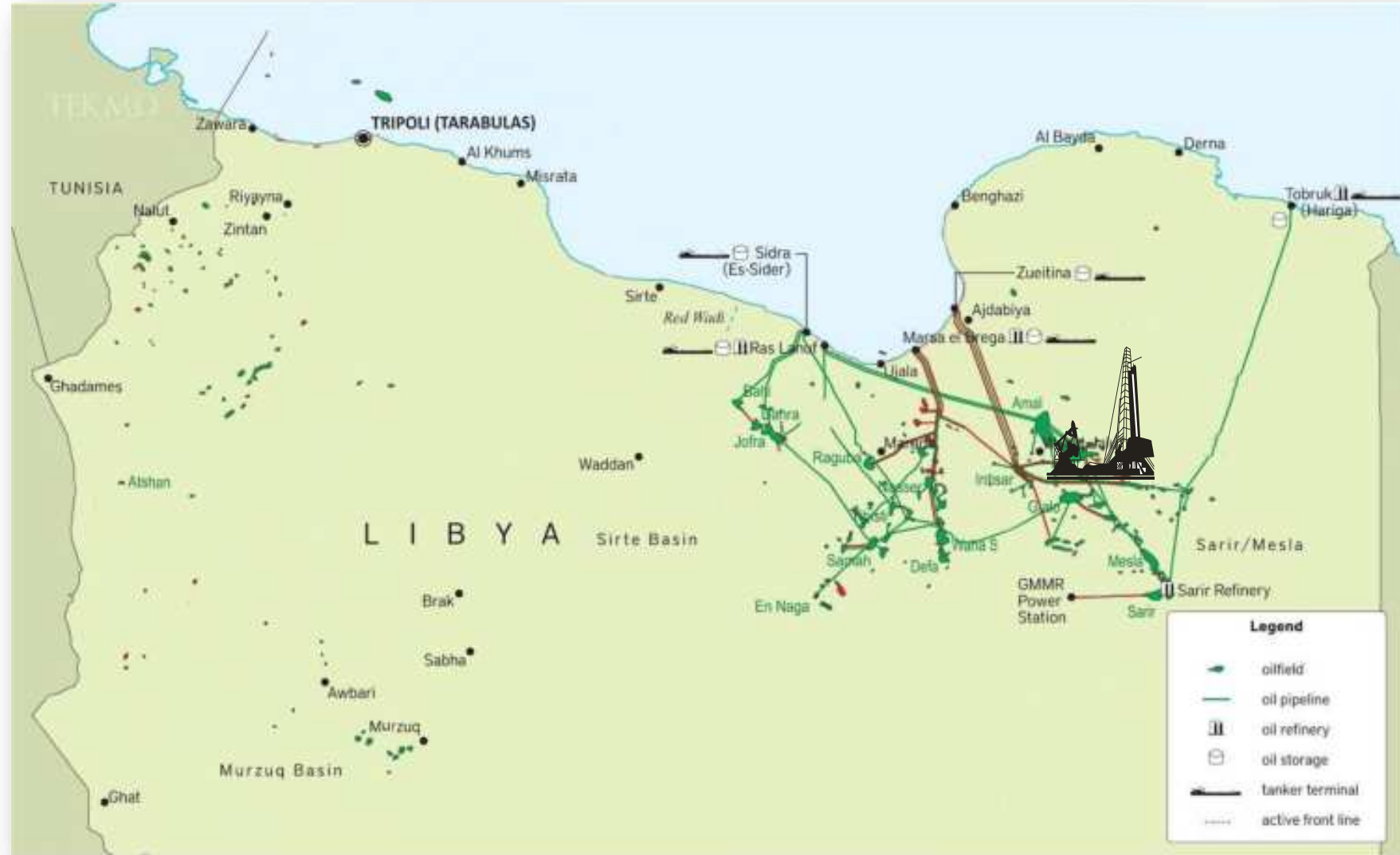
- Occidental's major discovery, Intisar field (conc. 103)
- Well D1 tested at:
 - ❖ 75.000 BOPD
 - ❖ 41 API



Infrastructure Development

1968

- Agip (Eni) discovered Abuattifel field



1968

- Shipment through Zueitina Oil Terminal (Occidental)



Infrastructure Development

1970

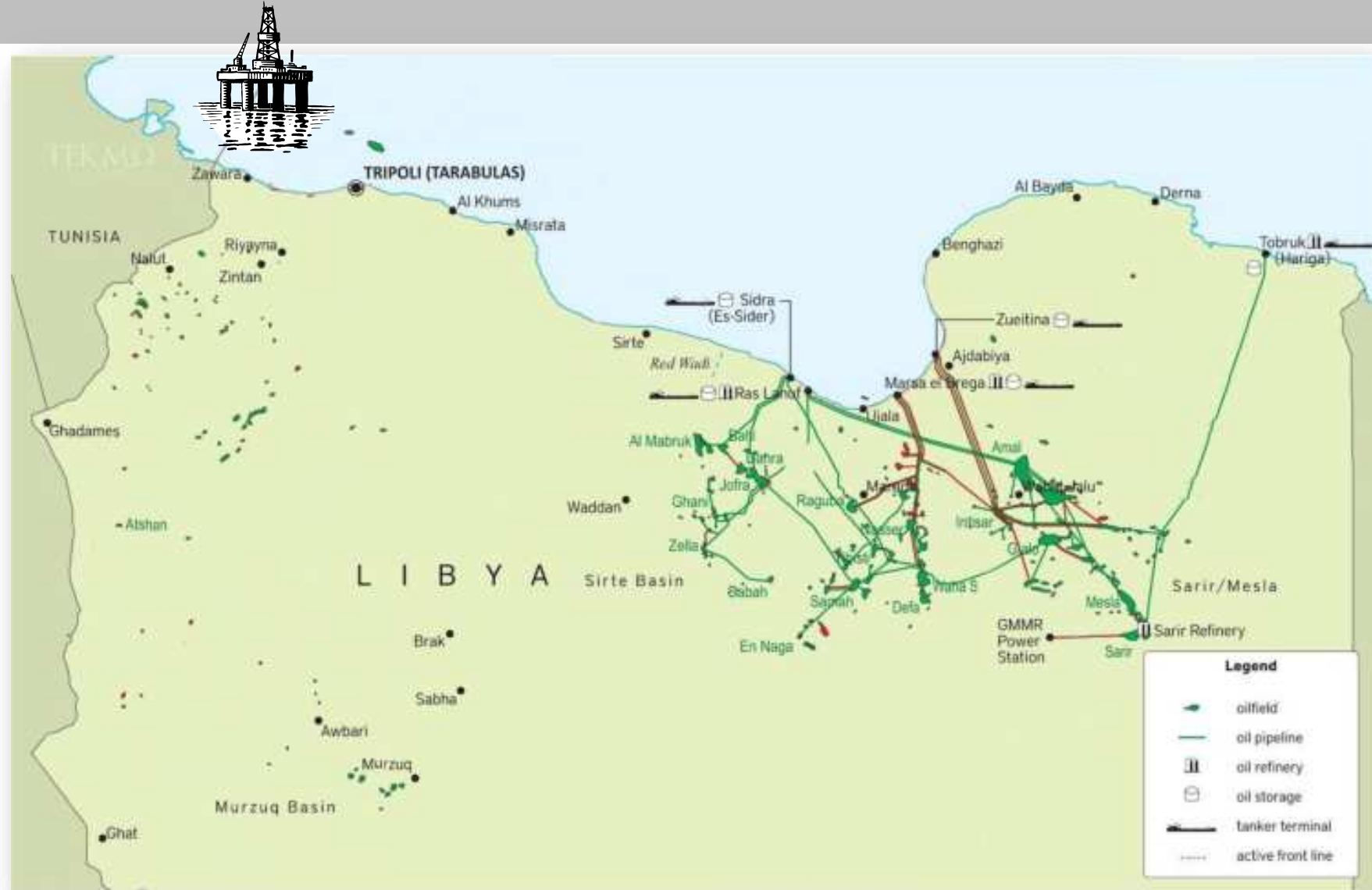
- Establishment of the National Oil Corporation (NOC)



Infrastructure Development

1971

- First offshore oil discovery by Elf Aquitaine (Al-Jurf)
- BP was nationalized and named AGECO (NOC 100%)



Infrastructure Development

1972 - 1973

- Participation agreements signed with major oil companies:
 - Oasis (Waha Oil Co.): NOC 60%, Conoco 16%, Marathon 16% & Amerada Hess 8%
 - ESSO Libya: NOC 51%, Exxon 49%
 - Agip Libya: NOC 50%, Agip (Eni) 50%
 - Mobil Oil Libya: NOC 51%, Mobil 49%
 - Oxy Libya: NOC 51%, Occidental 49%
- Texaco's concessions (C47 & C51) operated by Amoseas were nationalized (NOC 51%)

Infrastructure Development

1974

- Texaco & partners refused to accept nationalization and asked for international arbitration.
- Libyan government nationalized these concessions and established Umm Al-Jawabi Oil Company.



Infrastructure Development

1976

- First Wintershall oil production from Jakhira field



Infrastructure Development

1977



- First major offshore discovery of El-Bouri (Eni) field



Infrastructure Development

1979

- NOC's Direct Exploration Activities and Umm Al-Jawabi Oil Company were merged with AGECO to form AGOCO.



Infrastructure Development

1981

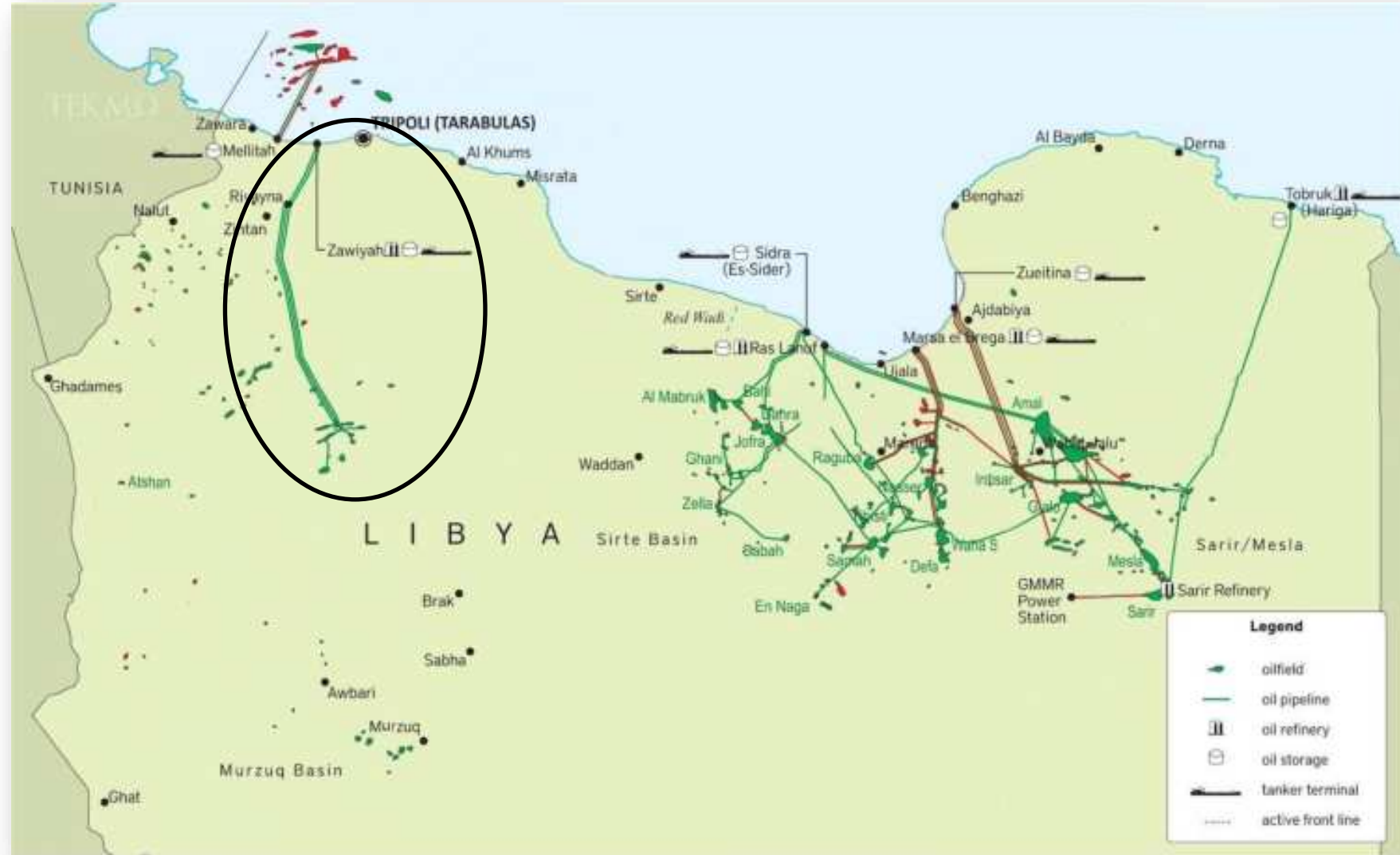
- Esso Oil Company (Exxon) exited Libya and Sirte Oil and Gas Company was established.



Infrastructure Development

1984

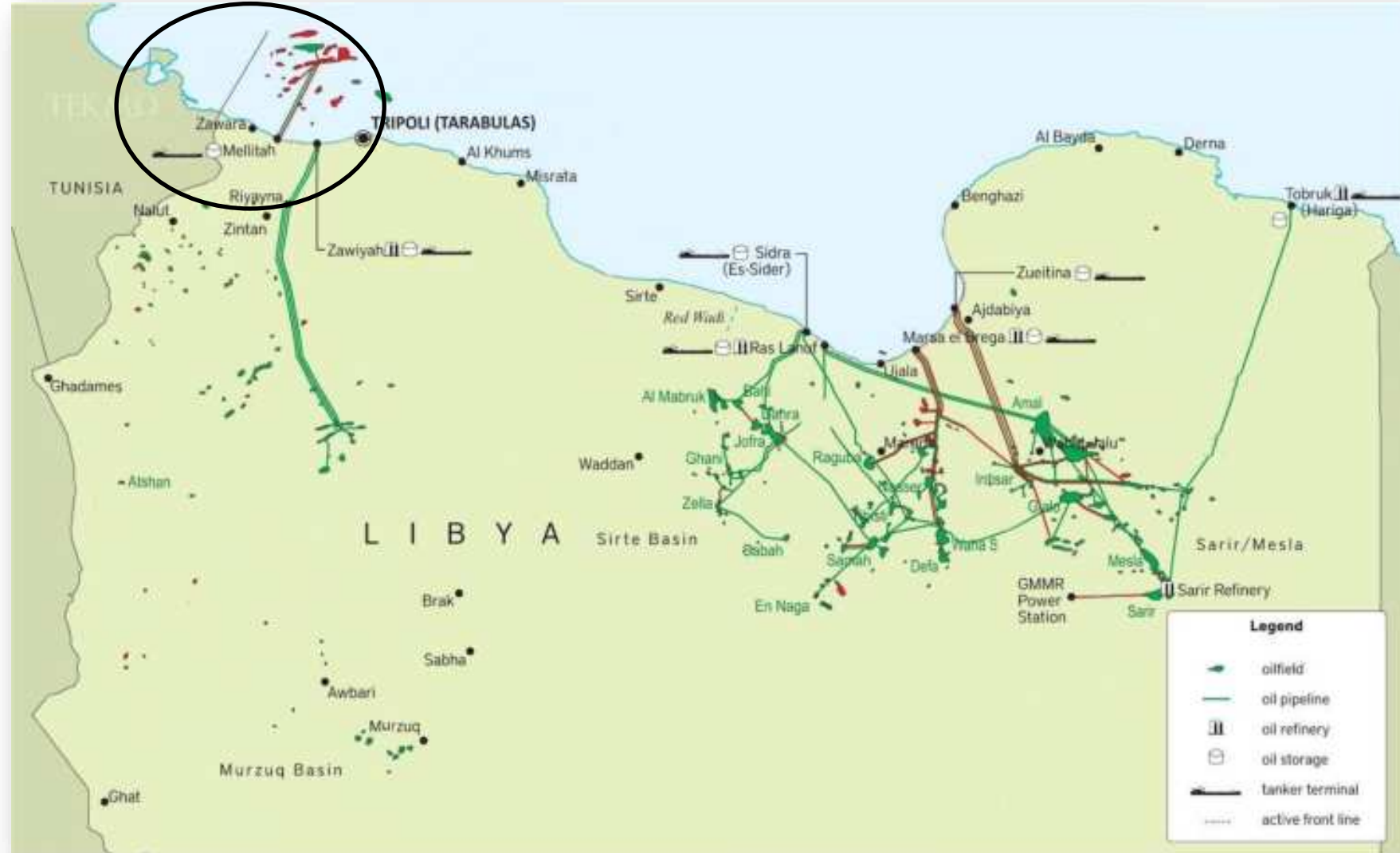
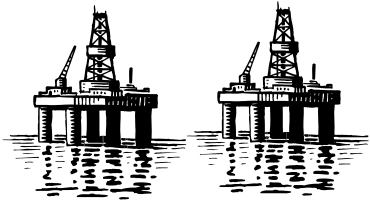
- Hamada oil field on production (AGOCO)



Infrastructure Development

1988

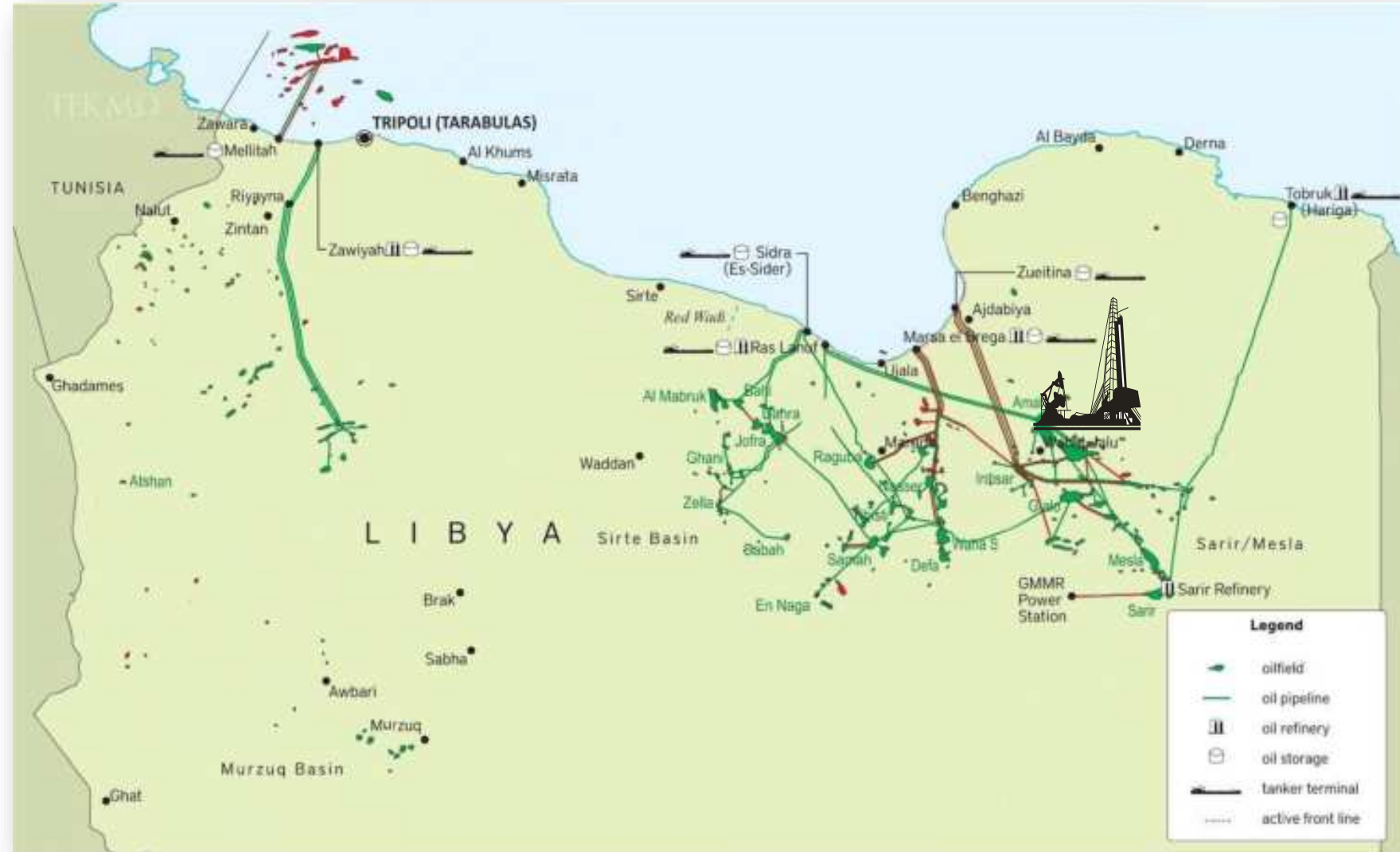
- El-Bouri offshore oil field (Eni) placed on production, using two platforms



Infrastructure Development

1989

- Wintershall's AsSarah oil field put on production



Infrastructure Development

1989

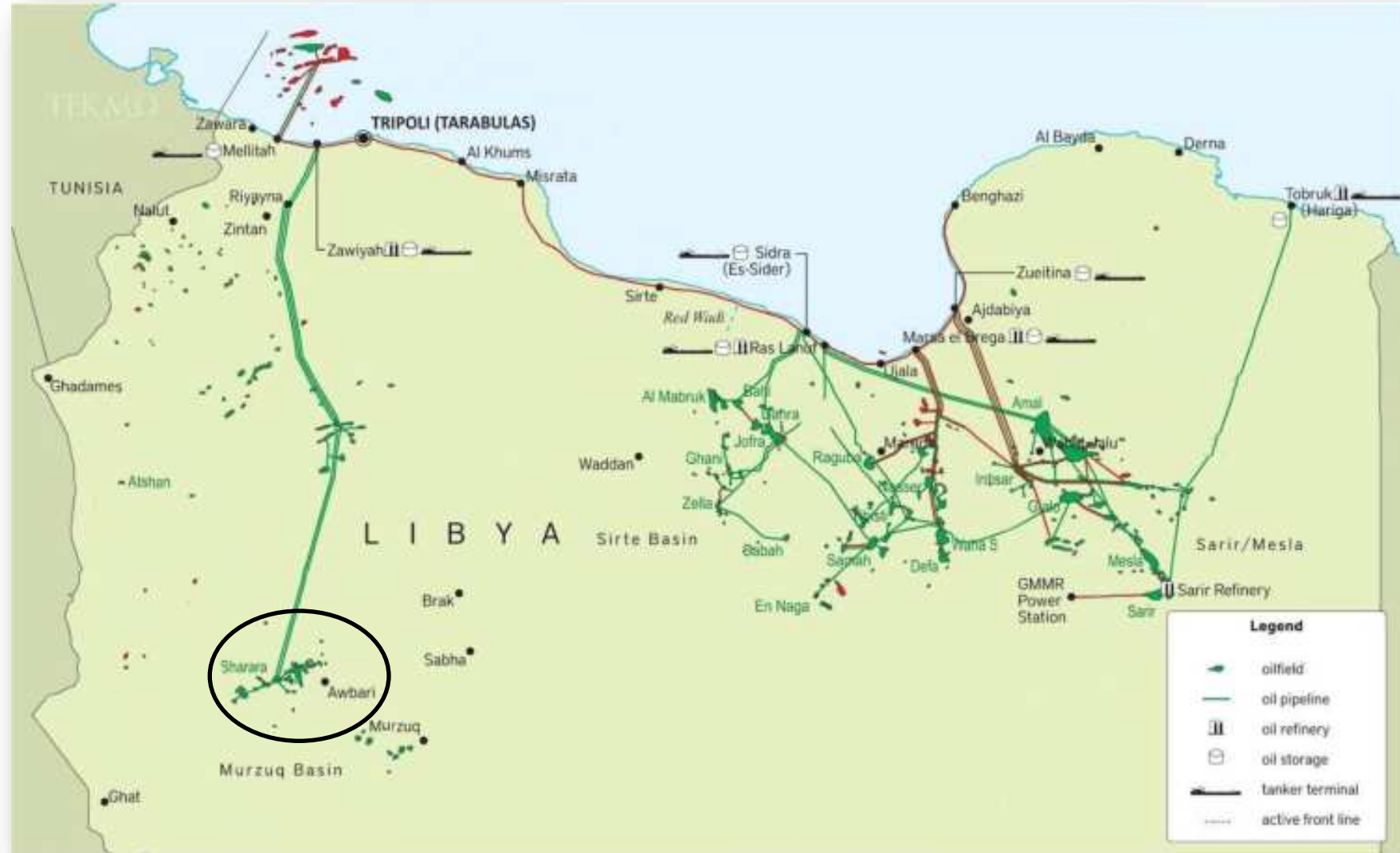
- Coastal Gas Pipeline



Infrastructure Development

1997

- Sharara field (Repsol) on stream



Infrastructure Development

2003

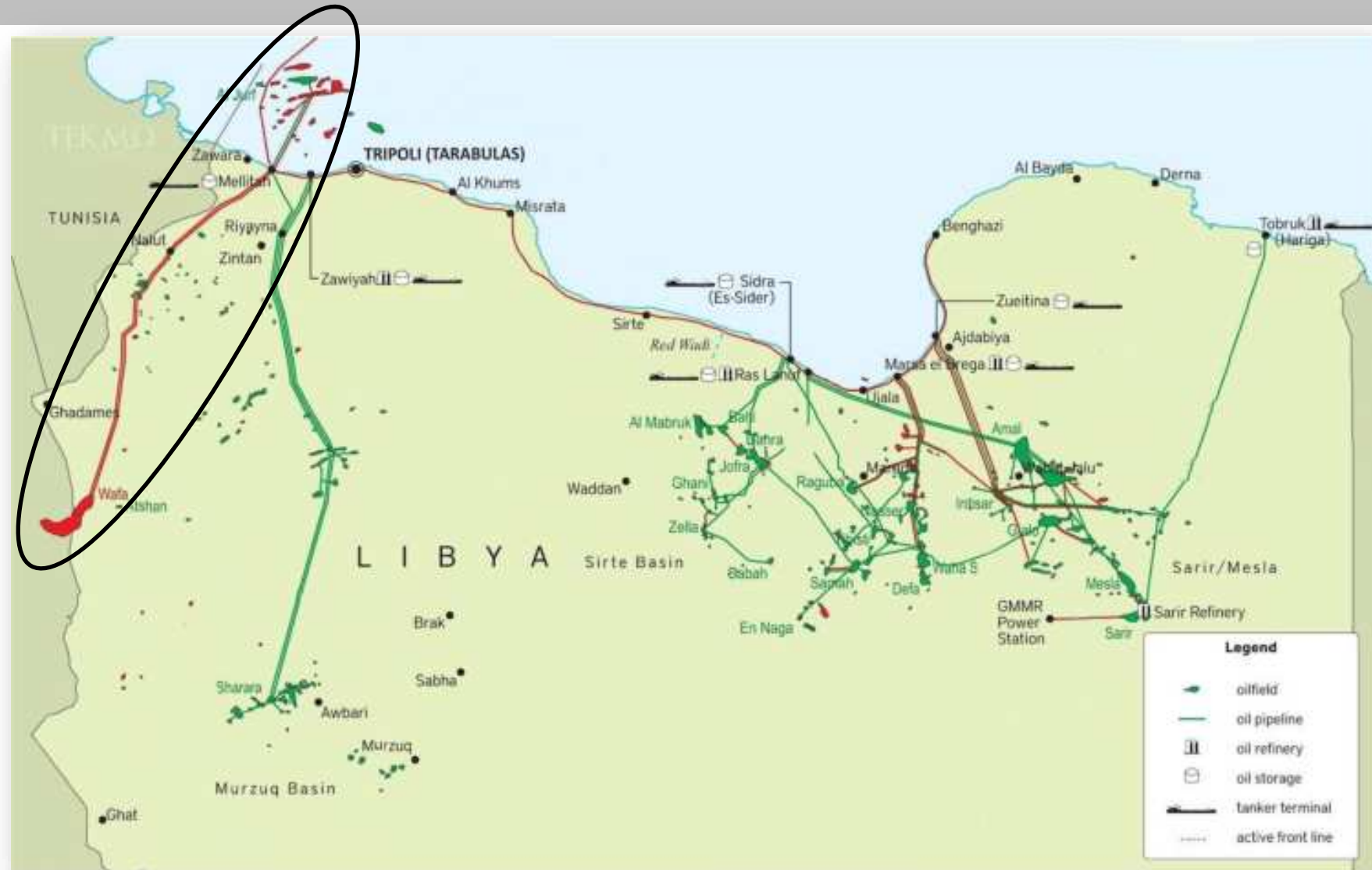
- Production started from Al-Jurf offshore oil field (MOO)



Infrastructure Development

2004

- Production started from Alwafa gas field
- Green stream gas pipeline to Italy carrying gas from Alwafa field and Bahr Alsalam



Infrastructure Development

2004

- LASMO discovery (Elfeel Field)



Infrastructure Development

2004

- Nafusa Oil Operations Company is a joint venture in partnership between NOC, LIA, and PT Medco Energi International.



Infrastructure Development

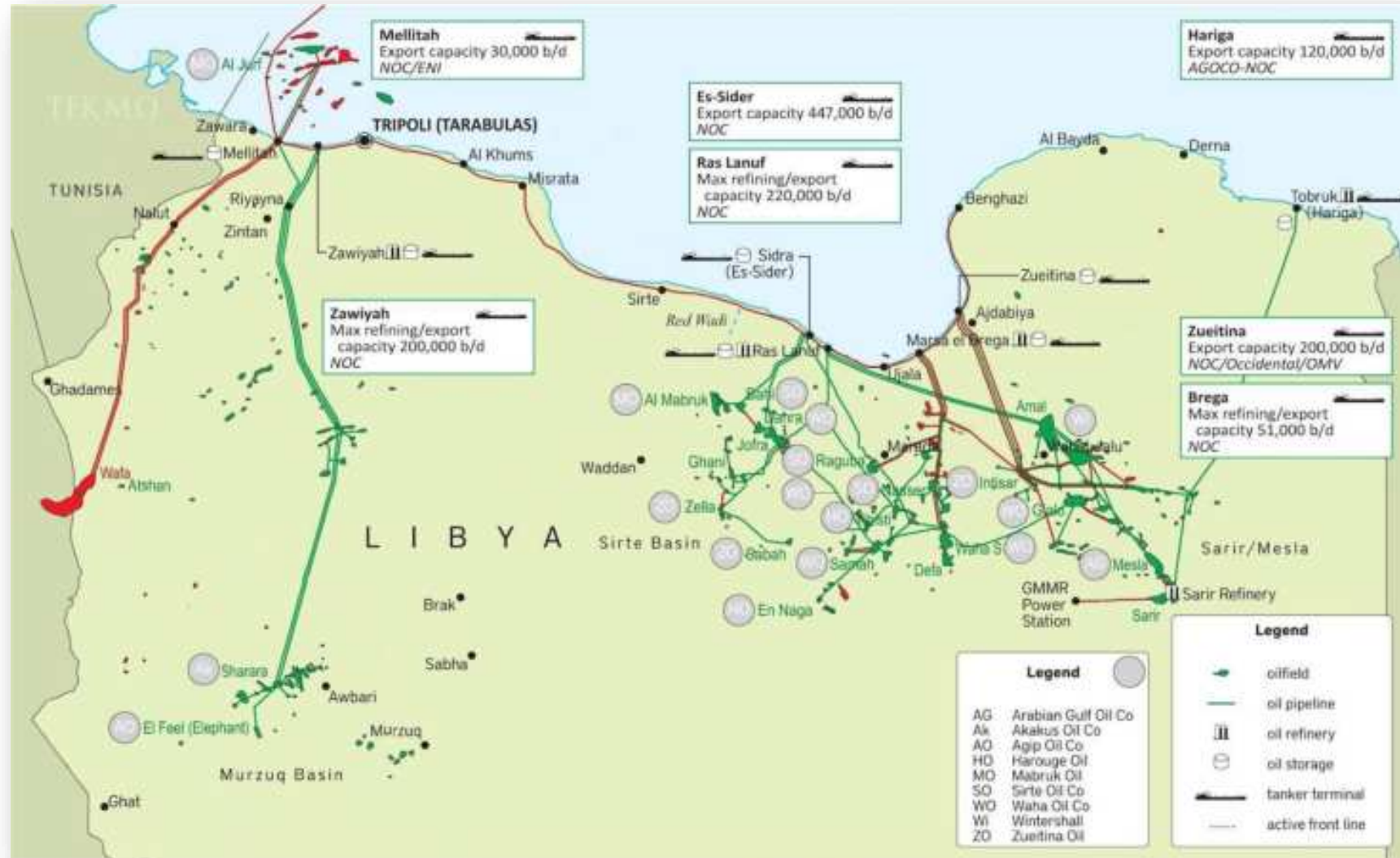
2017 - Zalaf Oil&Gas Exploration and Production Company

- NOC established Zalaf to develop certain “undeveloped” oilfields.



Infrastructure Development

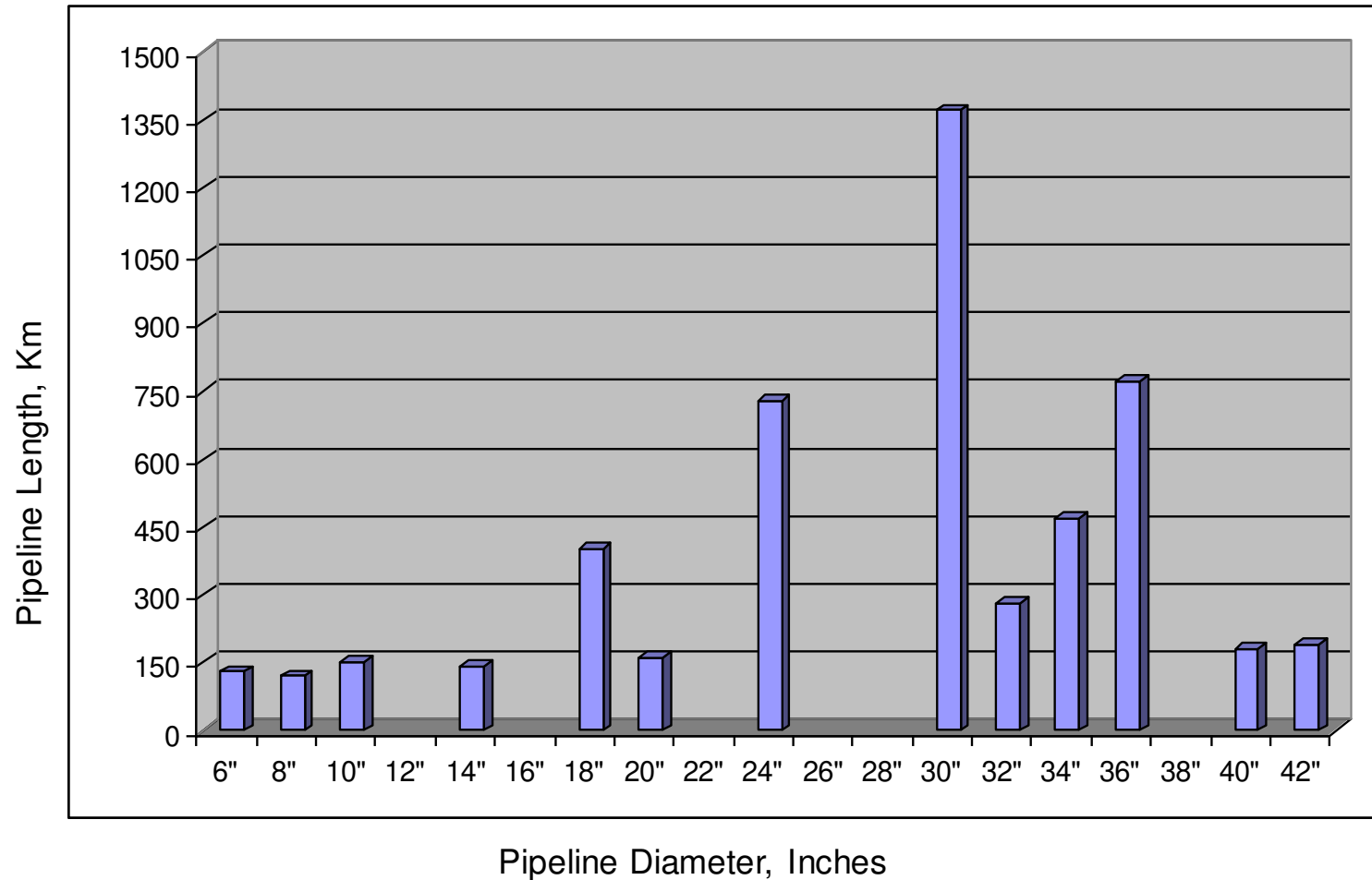
Oil Terminals and Capacities



Source: TEKMΩ

Infrastructure Development

Lengths & Diameters of Major Crude Oil Pipelines



- Total Pipelines Length ~ 5000 km
- The use of the pipeline network by different operators is governed by a special regulation and a tariff formula.

Infrastructure Development

Libyan Crude Types

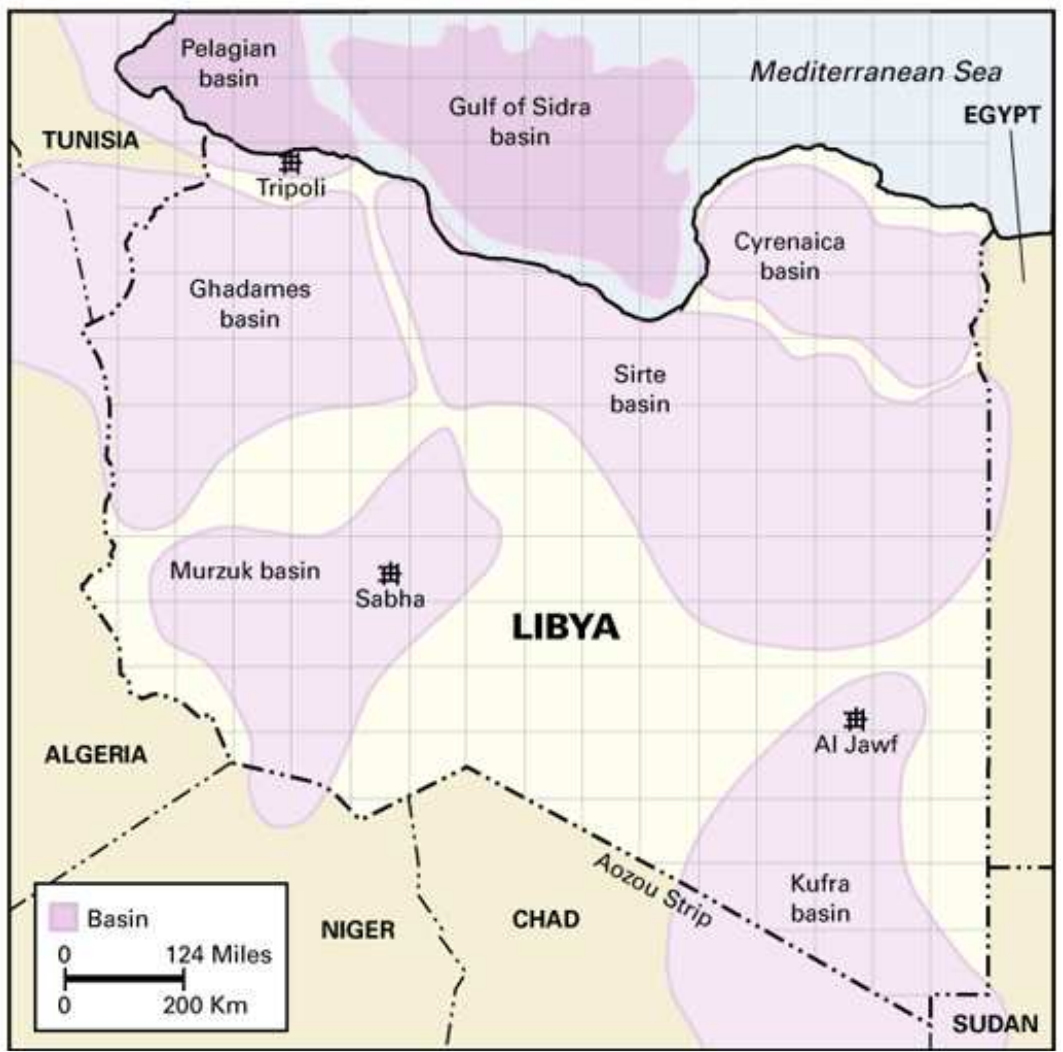
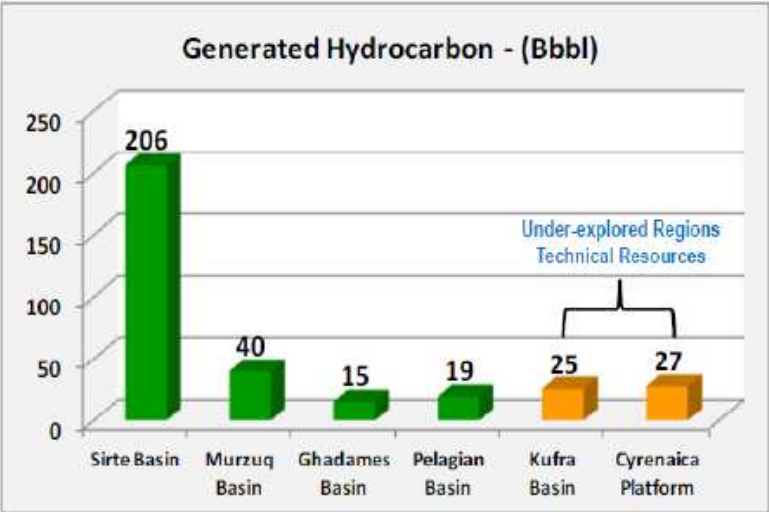
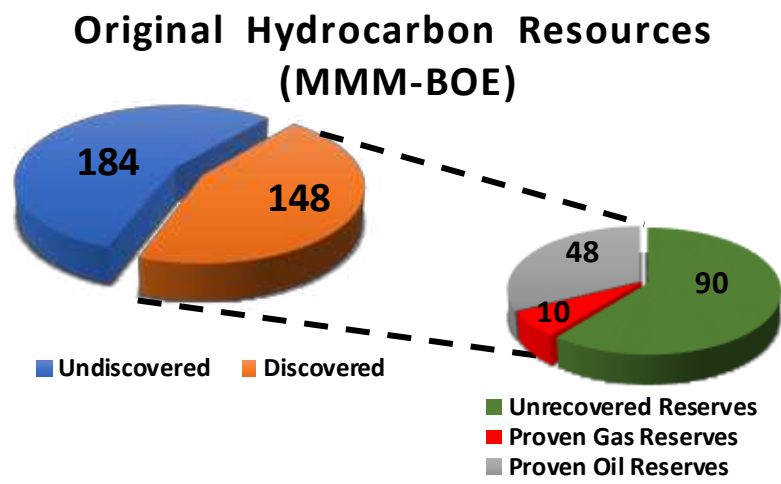
Terminal	API	Crude Oil Type
Hariga	38.6	Sarir
Zueitina	37.8	Intissar 103
Zueitina	41.1	Bu- Attifel
Ras Lanuf	38.5	Mesla
Ras Lanuf	38.1	Amna
Brega	41	Zelten/Raguba
Essider	37	Waha/Defa/Gialo/Dahra
Zawia	42.5	Sharara
Zawia	38.7	Elephant
Zawia	37	Hamada
Offshore	31	Jurf
Offshore	26.6	Bouri
Melita	56.7	Wafa

Libyan Oil Sector - Challenges and Prospects

Exploration Activities

Exploration Activities and Reserves Development

Sedimentary Basins and Hydrocarbon Resources



Source: Mohsen Khzam

Libyan Oil Sector - Challenges and Prospects

1957–1970 Giant Fields in 1st Phase of Exploration

- The following 15 giant oil discoveries placed Libya on the map of major oil producing countries:
 - Zelten (Nasser)
 - Raguba
 - Jabel
 - Bahi
 - Dahra/Hofra
 - Sarir
 - Messla
 - Gialo
 - Waha
 - Defa
 - Amal
 - Nafora
 - Intisar 103 D
 - Intisar 103 A
 - Abuattifel

Libyan Oil Sector - Challenges and Prospects

1974 EPSA I

- NOC introduced a new type of contracts namely; the Exploration and Production Sharing Agreement (EPSA) to stimulate and invigorate exploration activities in Libya under Libyan management:

**NOC 81%, IOC 19% free of tax
No A & B factors.**

- One significant oil discovery: Offshore Bouri field by Eni in 1977
- Several fields - which were already discovered - were developed
 - Zella
 - Sabah
 - Aswad



Libyan Oil Sector - Challenges and Prospects

1980 EPSA II

- EPSA II agreement was introduced by NOC:

**NOC 85%, IOC 15% free of tax
No A & B factors.**

- Rompetrol performed an intensive exploration program and should get credit for placing Murzuk Basin on the map of oil producing basins in Libya.
- Several discoveries were made including the Sharara oil field. However, Rompetrol was not able to provide the necessary financing and withdrew from Libya.
- Bulgarian oil company (BOCO) performed similar intensive exploration of Murzuk and Ghadames Basins and achieved two modest oil discoveries. However, fiscal terms of EPSA II did not enable BOCO to develop these discovered fields and it too exited Libya.



Libyan Oil Sector - Challenges and Prospects

1989 EPSA III

- NOC amended EPSA II in 1989 by introducing a more attractive sharing split throughout EPSA III:

**NOC 75%, IOC 25% free of tax
No A & B factors.**

- The Sharara oil field was developed by Repsol and partners.
- The offshore oil fields of Bouri and Al-Jurf were developed by Eni and Total respectively.
- El-Feel oil field was discovered by Lasmo and has since been developed and operated by Eni.
- BOCO's discovered oil fields were handed over to NOC, which have yet to be developed.



Libyan Oil Sector - Challenges and Prospects

2004 EPSA IV

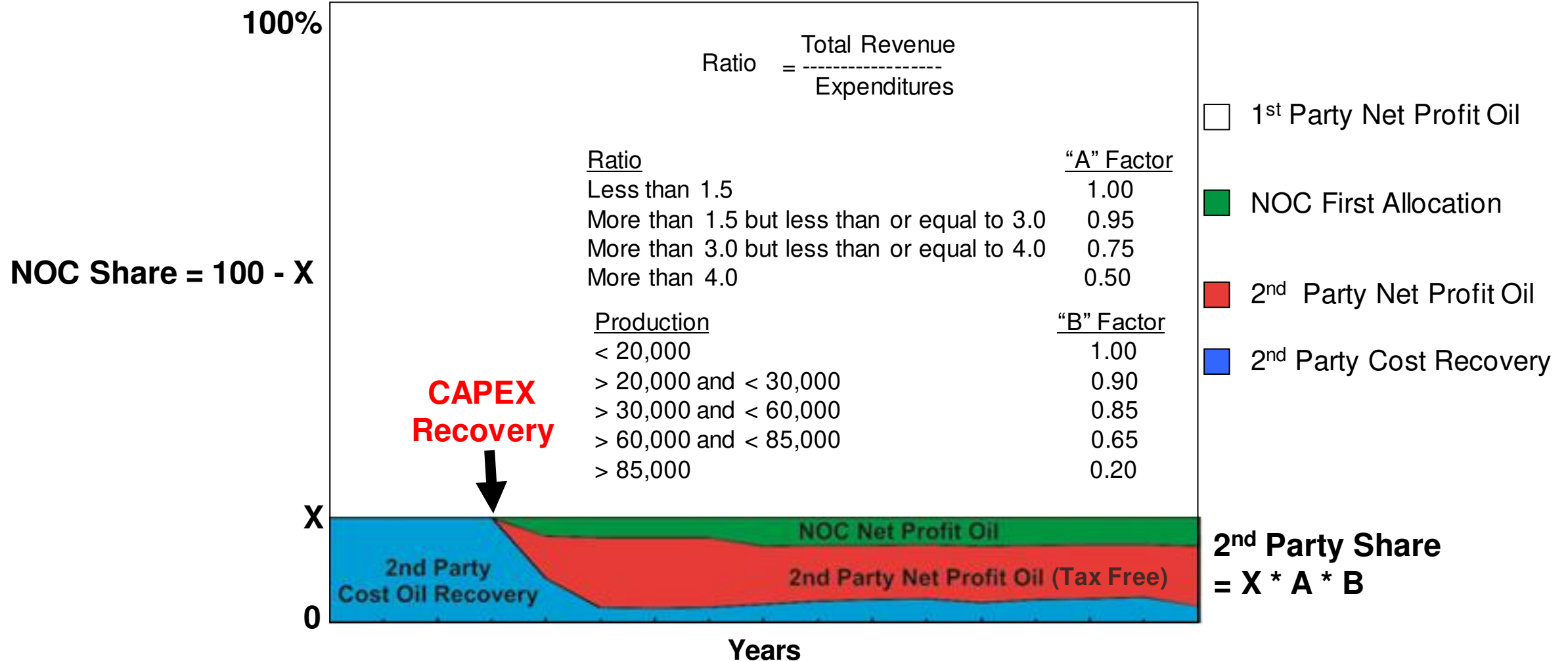
- In 2004, a new era of exploration started where four EPSA licensing rounds took place between 2005 and 2007; realizing several agreements but with varied and somewhat economically unrealistic production sharing splits.
- EPSA IV introduced a new contractual framework with A & B factors and a signature bonus.
- Modest oil discoveries in Ghadames Basin were achieved by Verenix and MEDCO. LIA has lately acquired Verenix share. These discoveries are being developed by NOC's Nafusa oil Company.
- Hess has also discovered a significant offshore gas field in Sirte basin, but it has not been developed yet due to stringent EPSA IV terms.



Libyan Oil Sector - Challenges and Prospects

2004 EPSA IV Fiscal Policy

Oil Revenue Distribution



Libyan Oil Sector - Challenges and Prospects

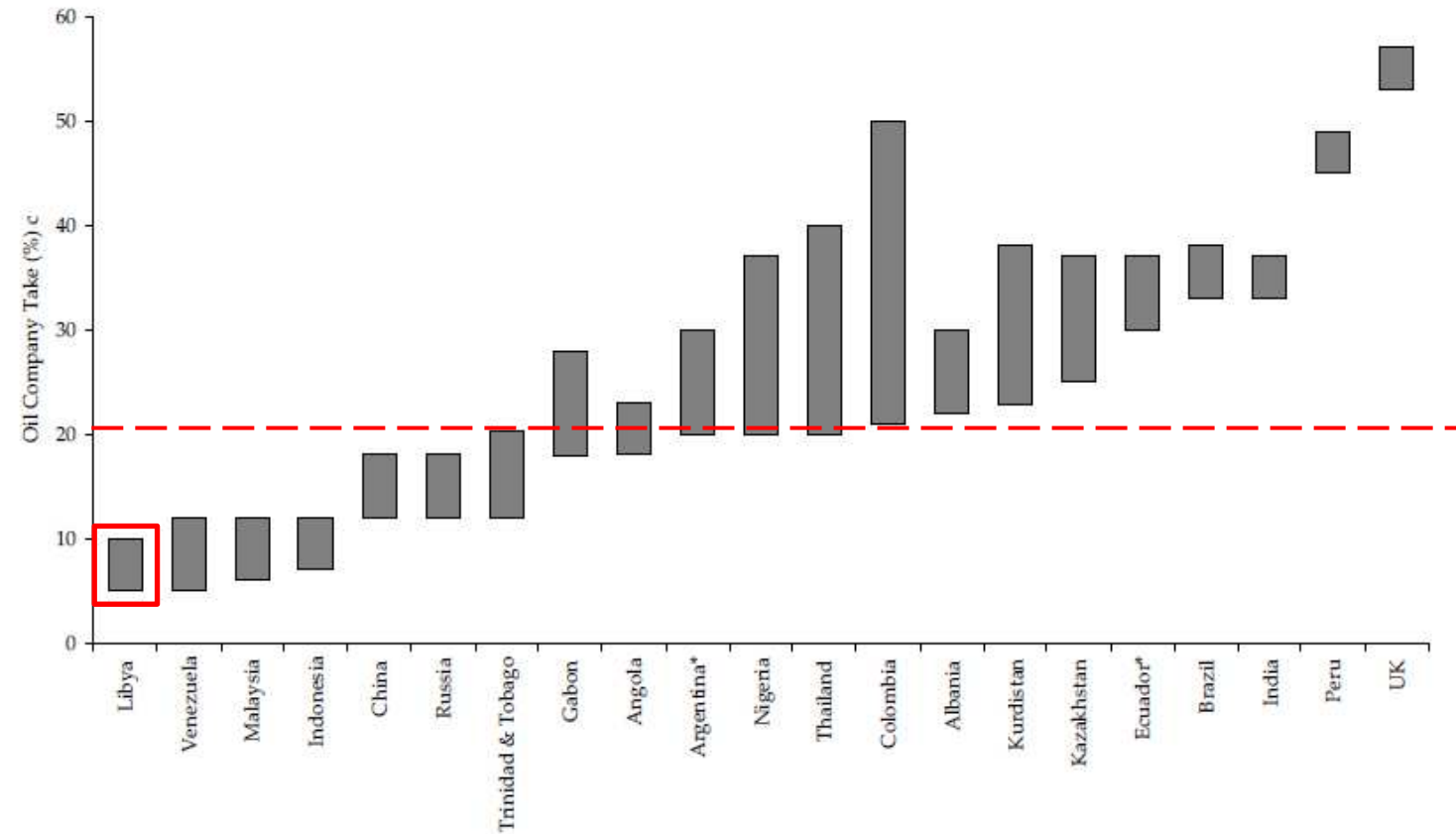
EPSA IV Exploration Results - I

- Since 2007, there have been 58 discoveries adding 3.2 billion barrels in place and 8.9 Tcf of gas.
- Unfortunately, EPSA IV has yet to achieve the prospected discoveries that would compensate depleting reserves or increase production capacity.
- Due to EPSA IV stringent fiscal terms, most international oil companies have shied away from making any further investments; deeming EPSA IV to be relatively unsuccessful!

Libyan Oil Sector - Challenges and Prospects

EPSA IV – Contractual Terms Comparison

- Libya's EPSA IV contractual terms are ranked as one of the harshest worldwide.



*excluding recent withholding taxes

Source: BP, Wood Mackenzie, Daniel Johnston, Raymond James Ltd.

Libyan Oil Sector - Challenges and Prospects

EPSA IV – Contractual Terms Comparison

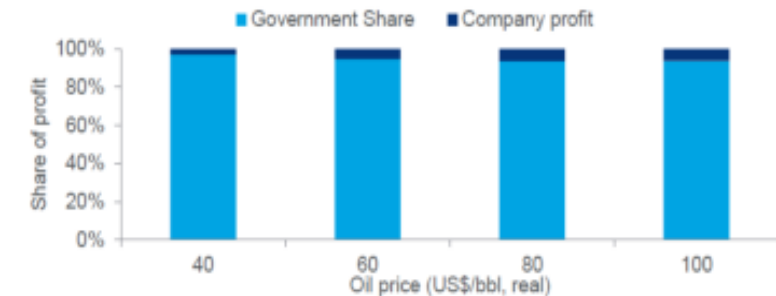
- Libya's fiscal terms page
- split of the bbls from woodmac report

Libya fiscal terms

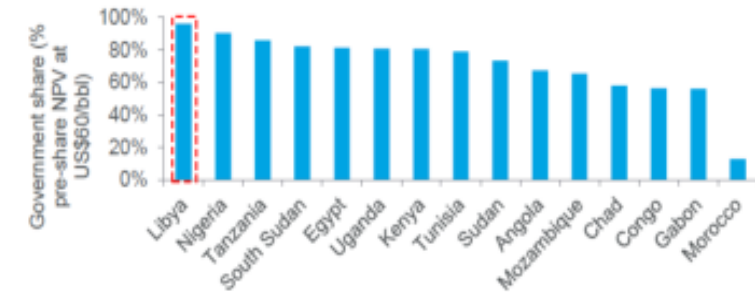
Libya's fiscal regime is harsh in which the government takes over 90% "off the top"

- Most contracts are Exploration and Production Sharing Agreements (EPSAs)
- In EPSA IV contracts (the most recent contract), contractors recover their share of costs from their net production allocation share, which is typically 10-20%
- Remaining crude is allocated between the contractor and the NOC according to biddable ratios
- Following the lifting of US sanctions in 2005, companies secured re-entry or extensions to existing contracts on very aggressive terms, accompanied by large signature bonuses and spending commitments
- Concessions 96 and 97 operated by Wintershall Dea were converted to EPSA IV agreements retrospectively from January 2008.

Libya's split of the barrel



Government share for a medium size oil project



Source: Wood Mackenzie Fiscal Benchmarking tool

Libyan Oil Sector - Challenges and Prospects

EPSA IV - Financial Status and Project Financing

- NOC funds 50% of all upstream capital expenditure:
 - It has historically struggled to access funds from Libya's government.
 - Thus, Its restricted budget allocations have slowed the pace of upstream investment.
- Hence, IOCs have shied away from their committed investments with respect to new contracts between 2006 and 2008:
 - Waha (ConocoPhillips, Marathon and Hess) planned to invest around **\$5 billion** over 7 years.
 - Suncor (previously Petro-Canada) pledged **\$3.5 billion**.
 - Occidental committed **\$2.5 billion**.
- The Oil Sector remains in dire need for continuous transfer of technology and significant foreign investments to further explore and develop oil fields.

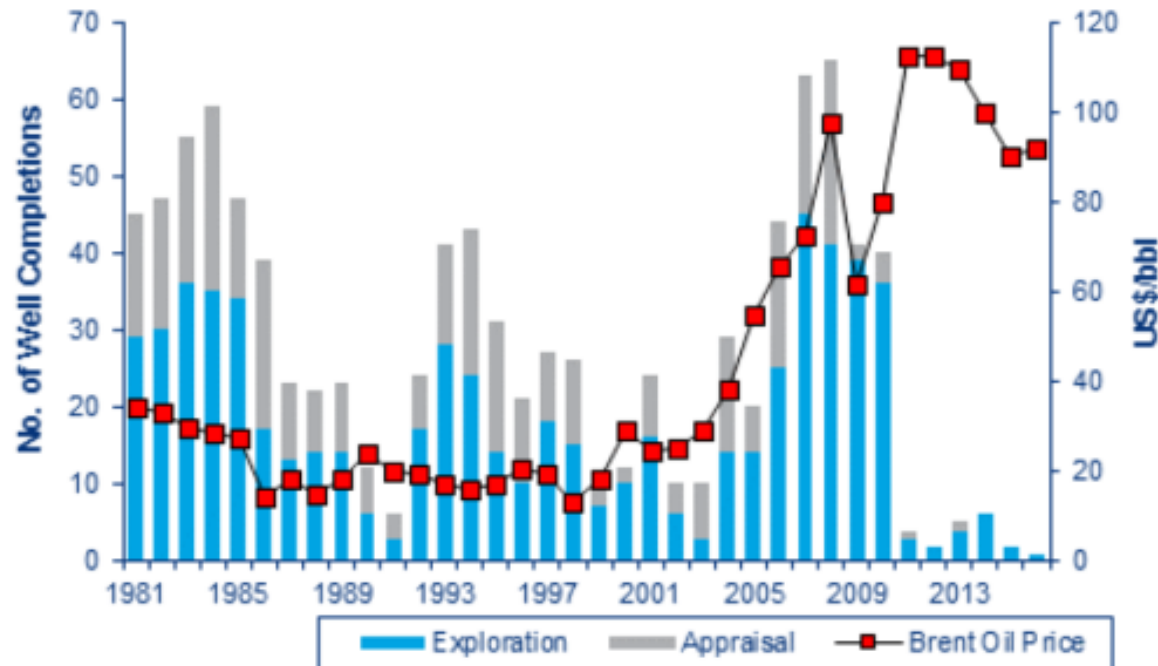
Libyan Oil Sector - Challenges and Prospects

EPSA IV Exploration Disappointing Results

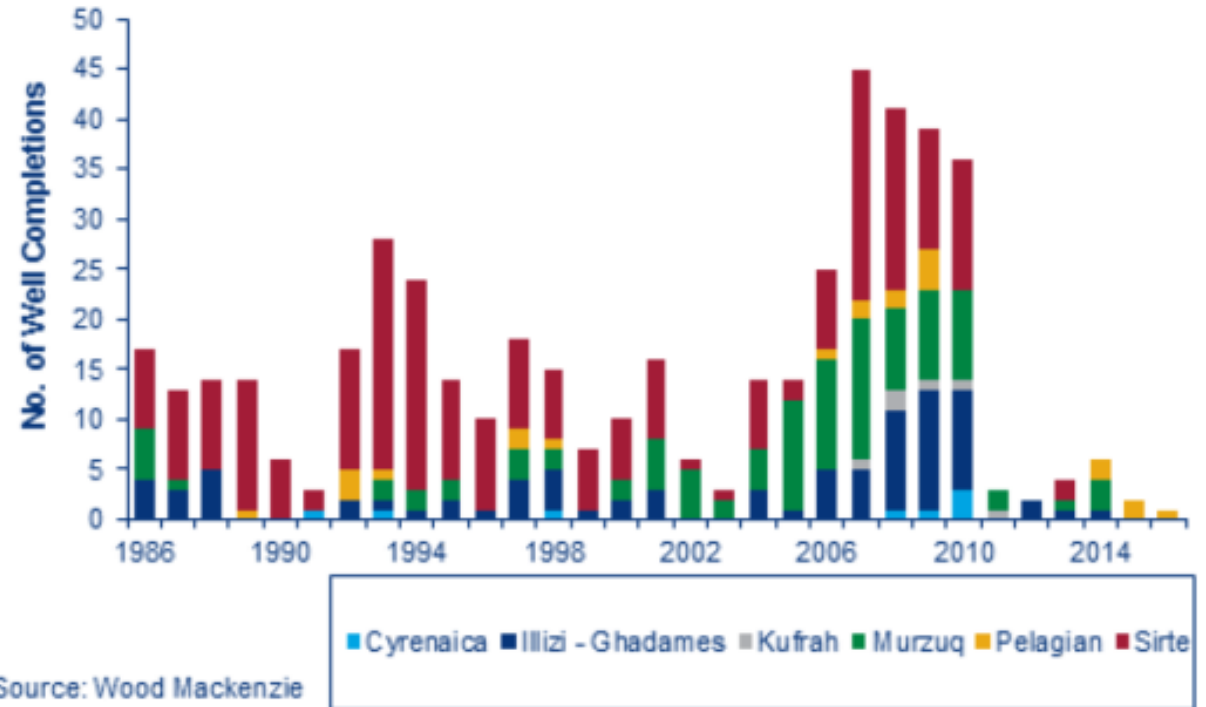
- Exploration companies which completed its exploration period with no drilling success and relinquished its exploration areas:
 - Occidental
 - Shell Exploration
 - Total Exploration & Production
 - Turkish Petr. Overseas
 - CNPC
 - Statoil
 - ExxonMobil
 - Tikoko Japan
 - Nippon Oil Exploration
 - Japex
 - Chevron
 - Pertamina
 - Eni North Africa
 - Woodside Energy
- Hess has relinquished its offshore exploration area with a significant gas find due to EPSA IV fiscal terms.

Libyan Oil Sector - Challenges and Prospects

1981 – 2016 Drilling Operations



Source: Wood Mackenzie



Source: Wood Mackenzie

- Drilling operations have not resumed seriously since 2011 due to security concerns and instability; except offshore drilling activities where Eni has resumed its activities.

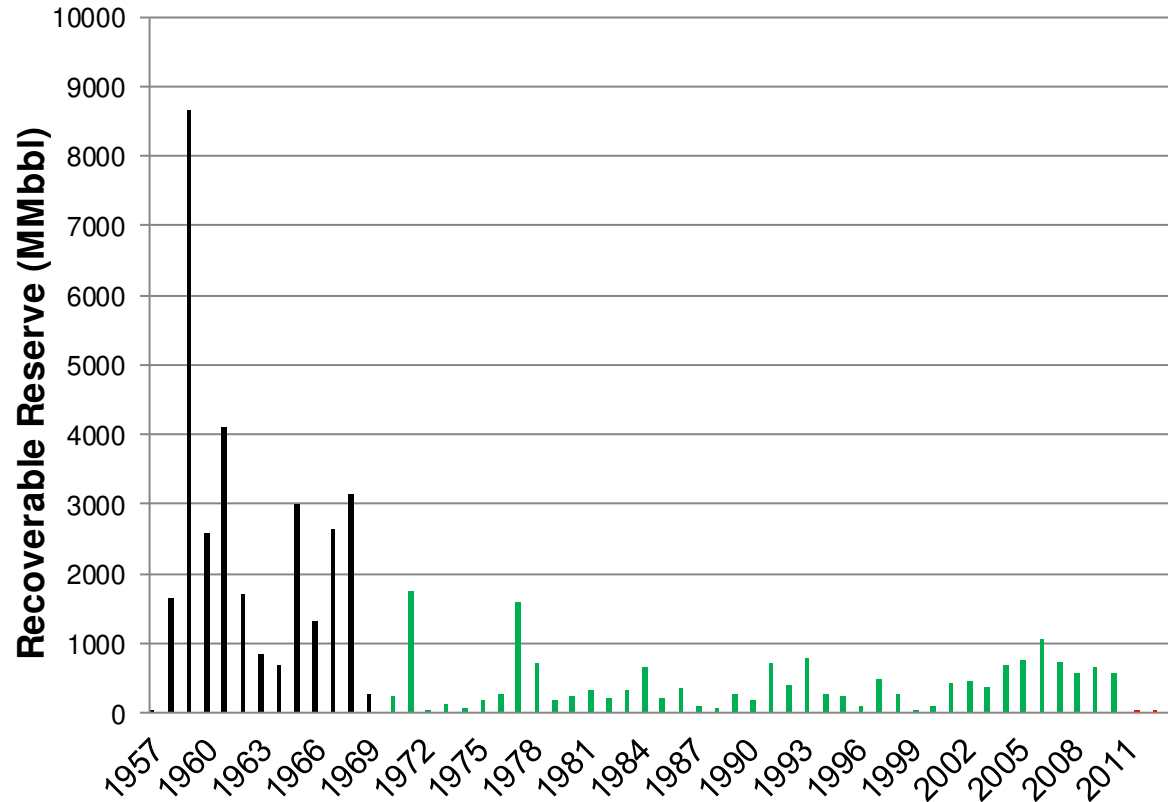
Libyan Oil Sector - Challenges and Prospects

Reserves

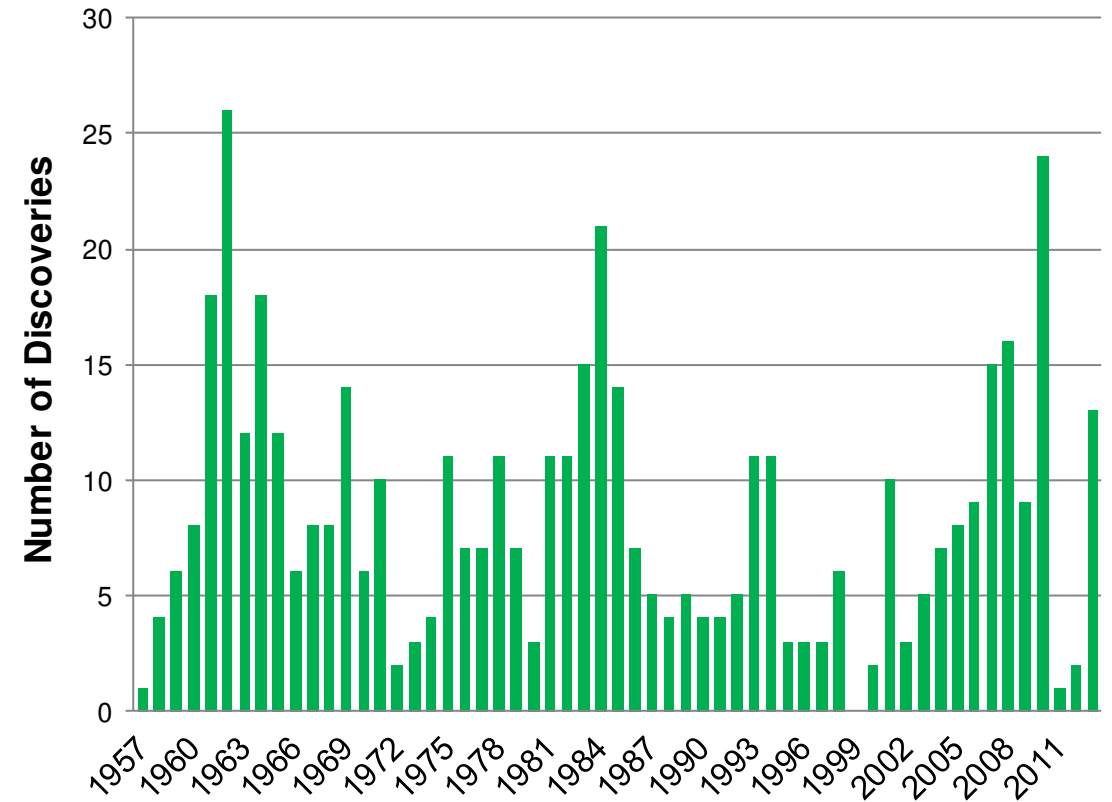
Libyan Oil Sector - Challenges and Prospects

1957 – 2013 Annual Discoveries and Added Oil Reserves

Added Oil Reserves per Year



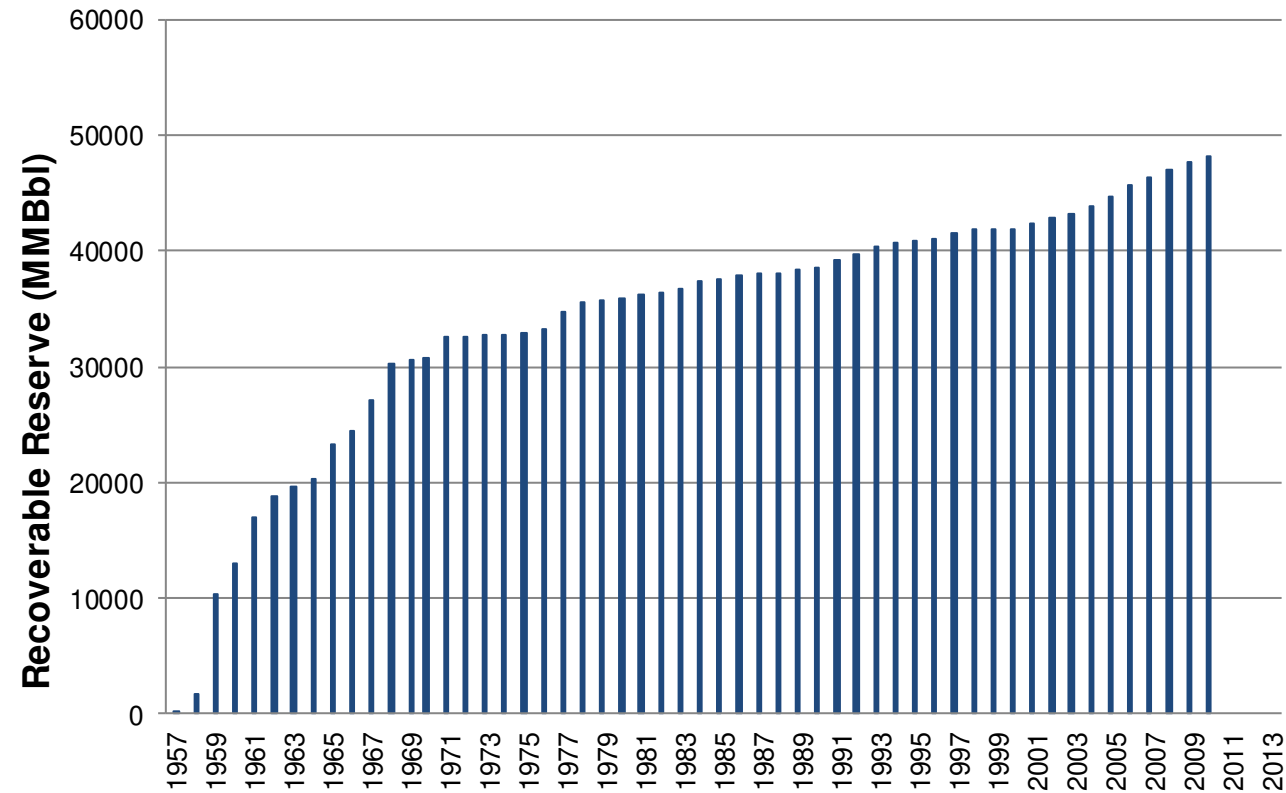
Discoveries



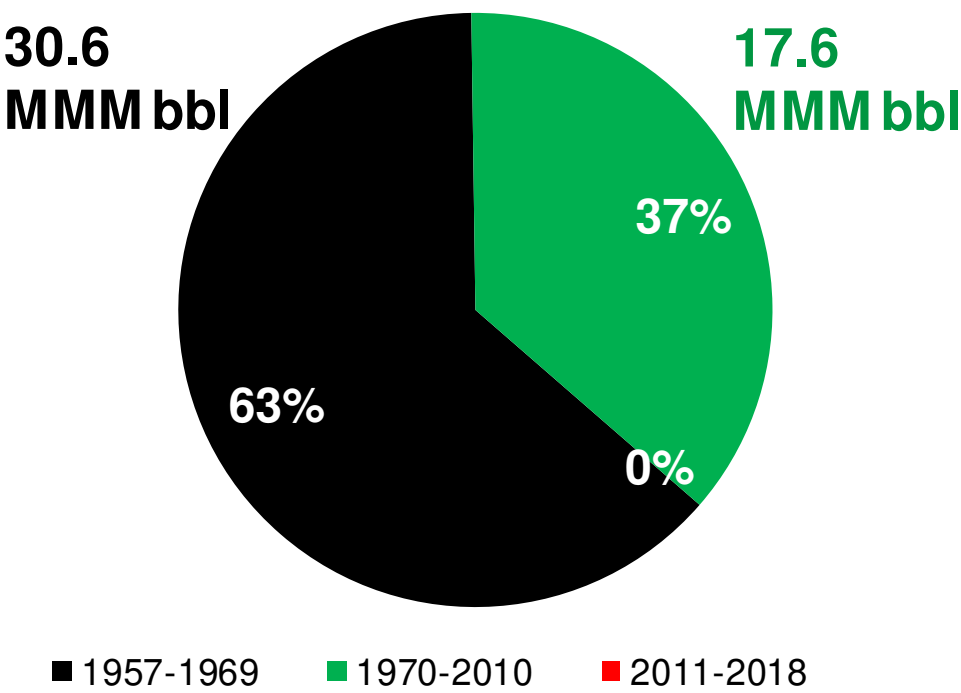
Libyan Oil Sector - Challenges and Prospects

1957 – 2018 Crude Oil Reserves

Cumulative Oil Reserves per Year



Proved Oil Reserves



Libyan Oil Sector - Challenges and Prospects

Remaining Reserves

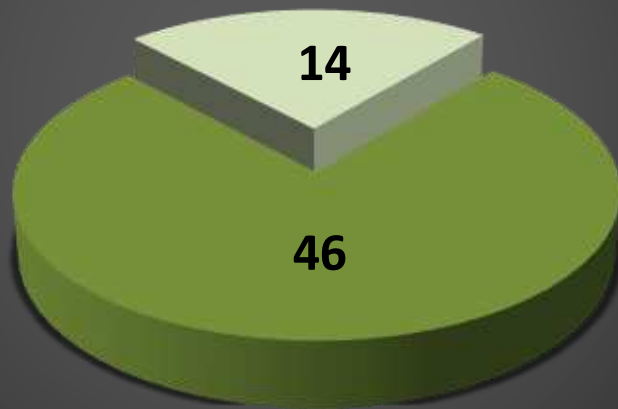
Key Facts

Liquid Reserves Remaining	10 billion STB	July 2022
Liquid Production	1.1 million b/d	
Liquid Reserves / Production	24.4 Years	
Gas Reserves Remaining	14 TCF	
Gas Production	1.2 bcf/d	
Gas Reserves / Production	33 Years	

Libyan Oil Sector - Challenges and Prospects

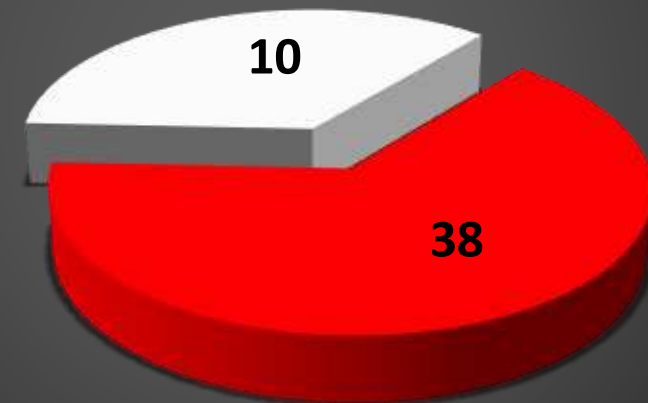
Remaining Reserves

**Remaining Proven Gas
Reserves
(TCF)**



■ Produced ■ Remaining

**Remaining Proven Oil
Reserves
(billion bbls)**



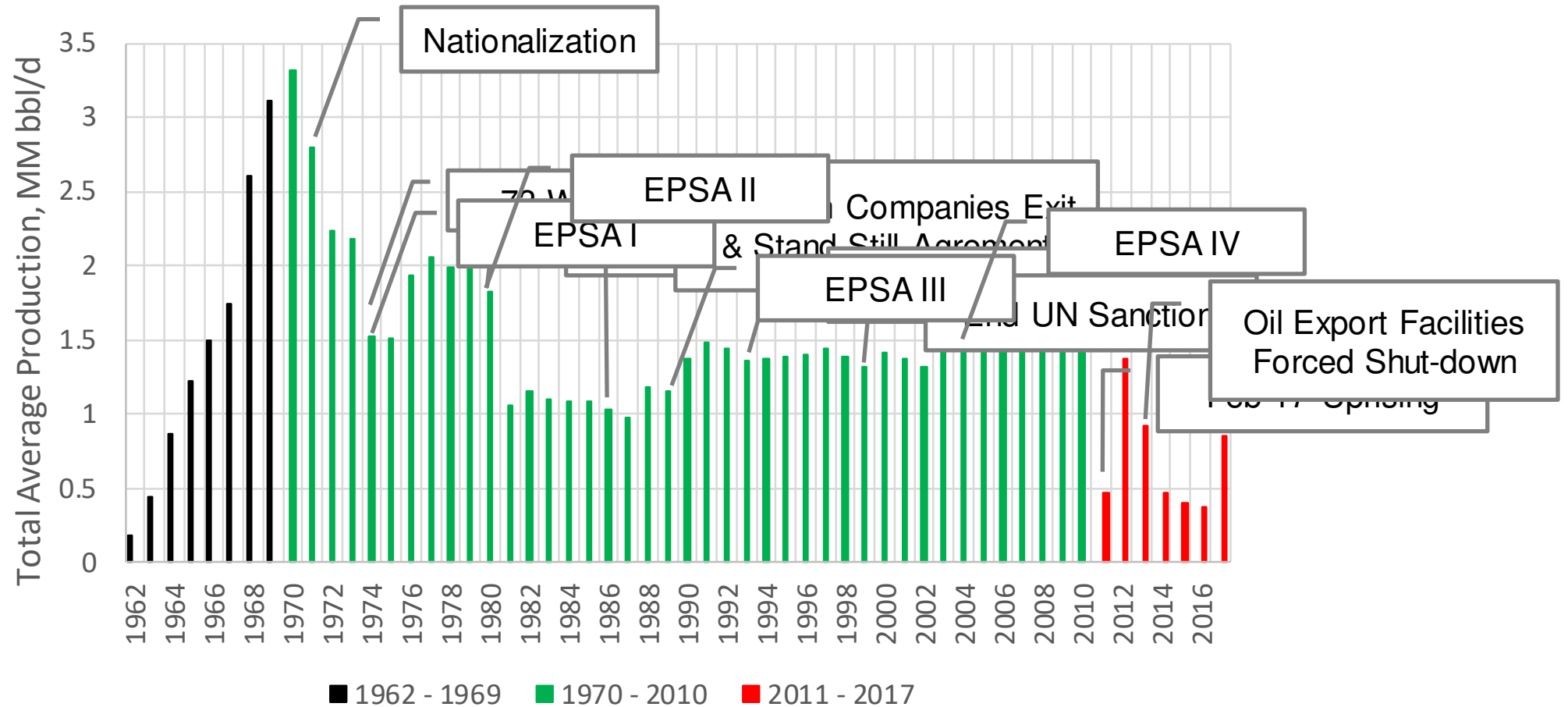
■ Produced ■ Remaining

Libyan Oil Sector - Challenges and Prospects

Production, Exports, and Revenues

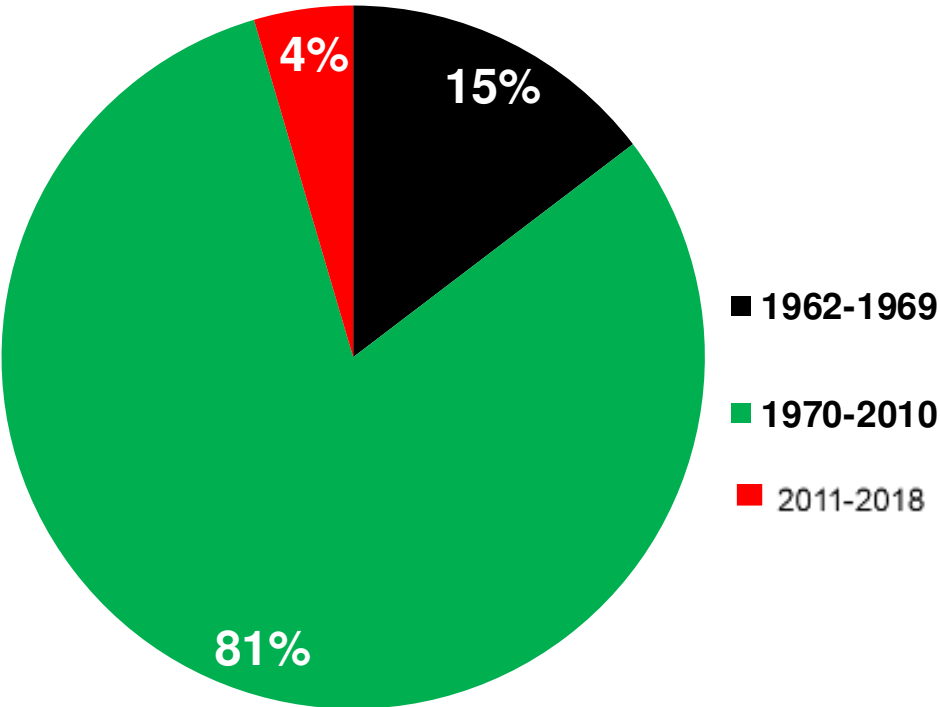
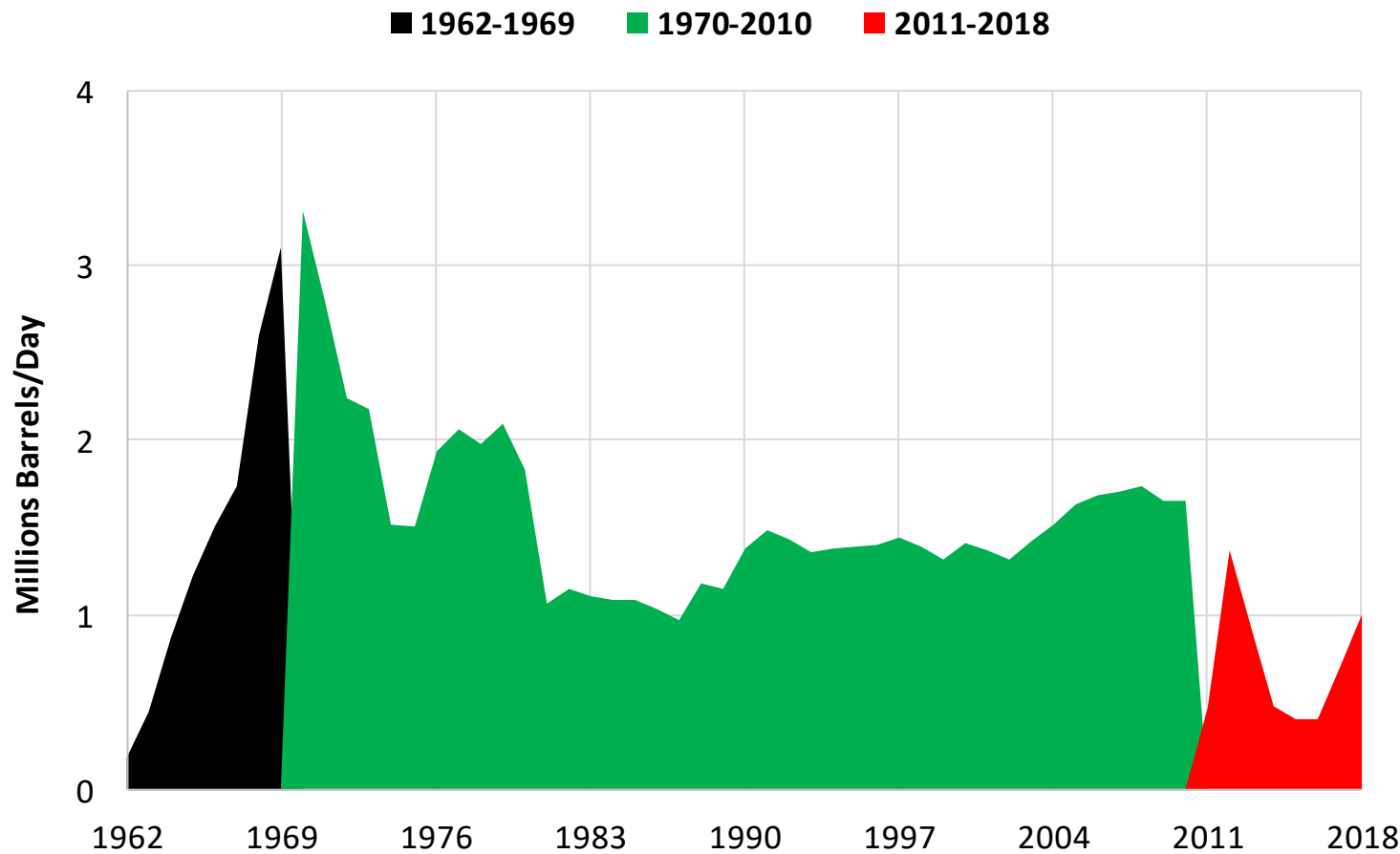
Libyan Oil Sector - Challenges and Prospects

Major Events Affecting Oil Production



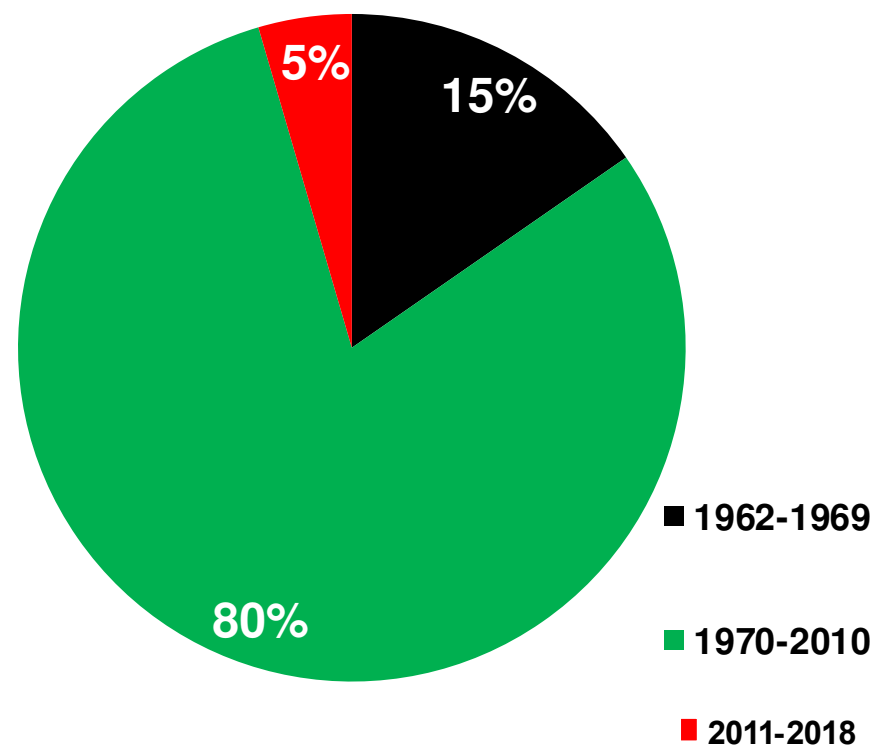
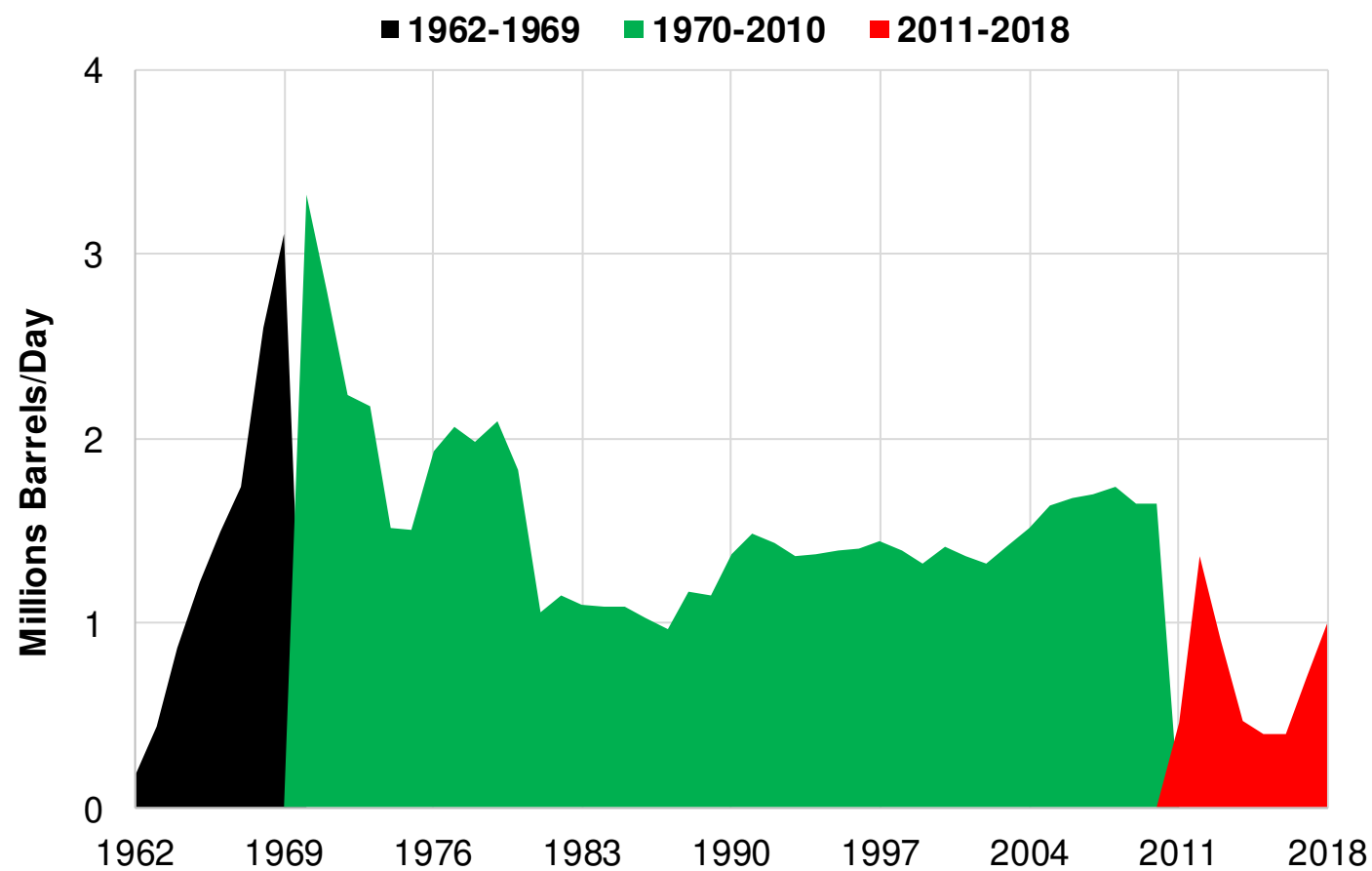
Libyan Oil Sector - Challenges and Prospects

Average Crude Production



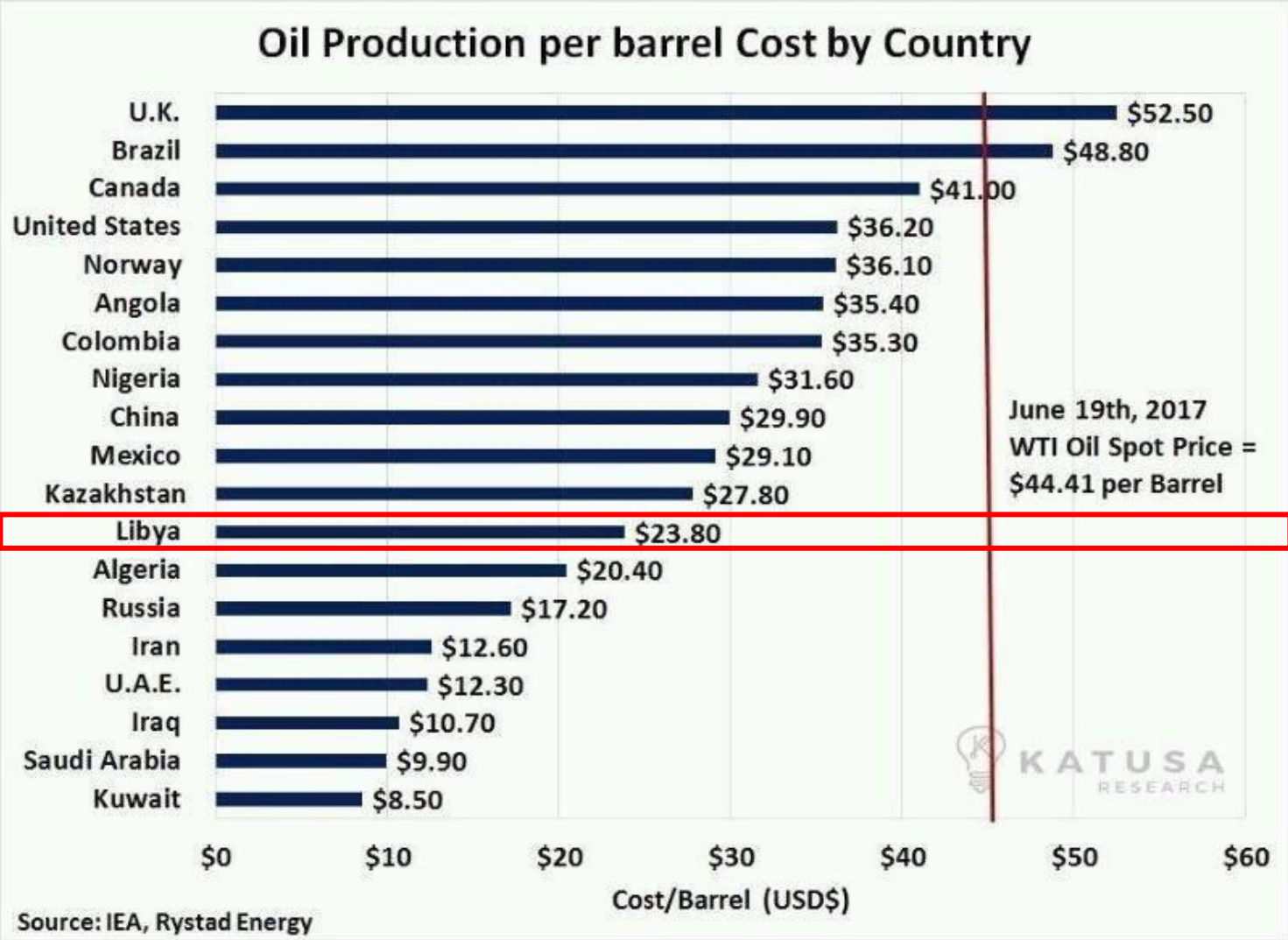
Libyan Oil Sector - Challenges and Prospects

Average Crude Export



Libyan Oil Sector - Challenges and Prospects

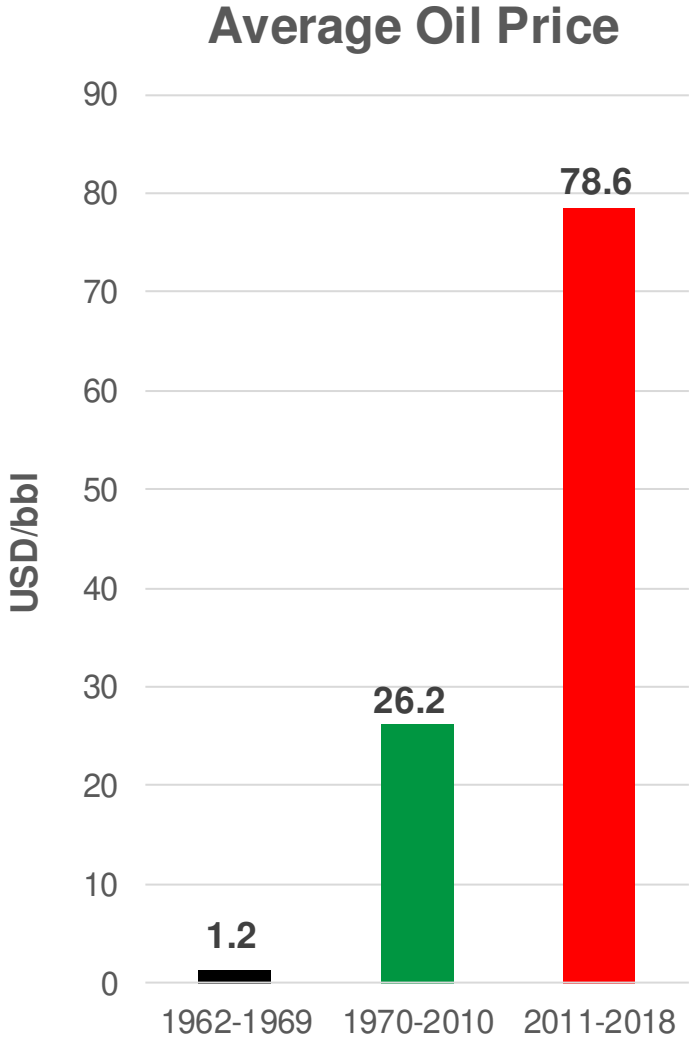
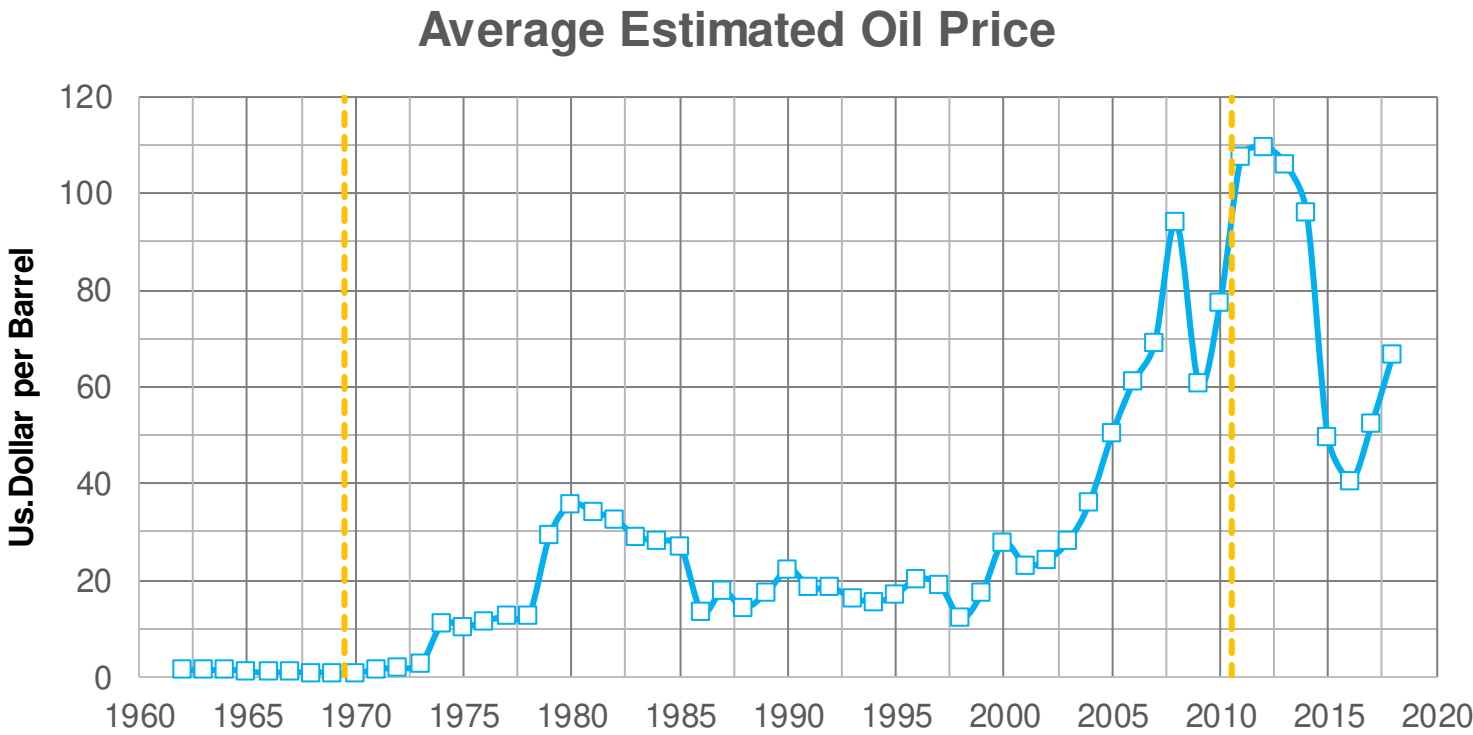
2017 Cost Per Barrel



The cost of oil barrel includes operating and capital costs, where operational cost in Libya is \$7.2 and capital cost is \$16.6.

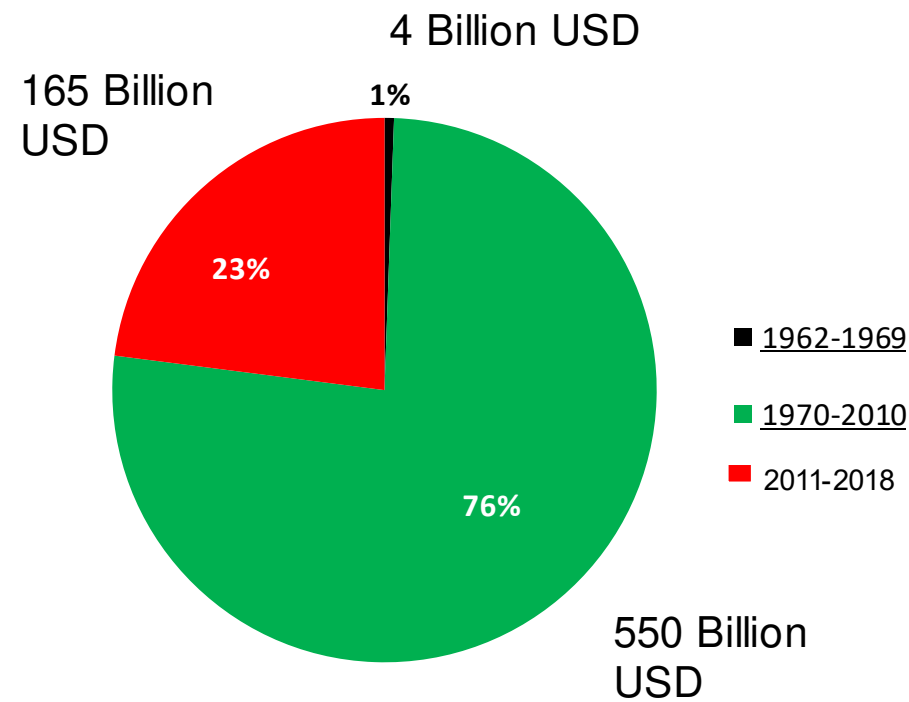
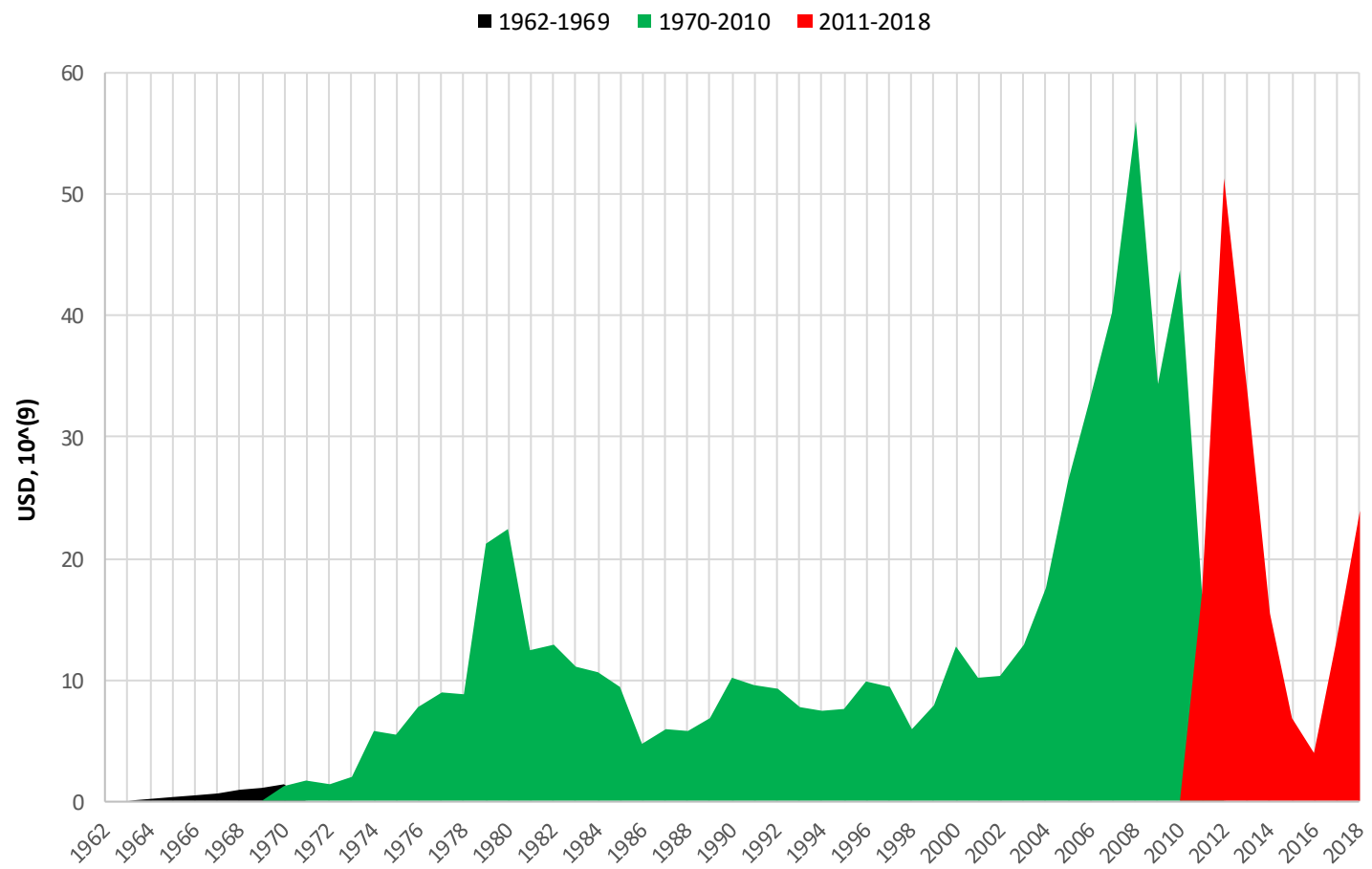
Libyan Oil Sector - Challenges and Prospects

Oil Price



Libyan Oil Sector - Challenges and Prospects

Revenues



Libyan Oil Sector - Challenges and Prospects

Future Potential

Libyan Oil Sector - Challenges and Prospects

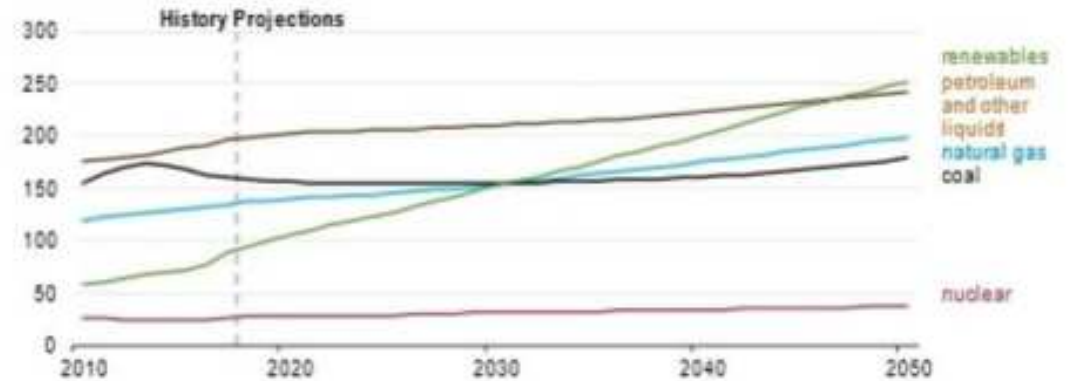
World's demand for energy 2010-2050

JPT JOURNAL OF
PETROLEUM
TECHNOLOGY

Fig. 2 shows the US Energy Information Administration's (EIA) 2020 predictions. Renewables are projected to be the most-used energy by 2050. However, by simply looking at the graph, one can see that renewables will produce 250 quadrillion BTU by 2050, and oil and natural gas combined will produce about 445 quadrillion BTU.

IEO2019 projects renewables the most used energy source by 2050

Primary energy consumption by fuel, world
quadrillion British thermal units



Note: 1 = includes biofuels

Source: U.S. Energy Information Administration, International Energy Outlook 2019



Dr. Linda Caputo, EIA
IEO2019, October 14, 2019

Libyan Oil Sector - Challenges and Prospects

Discovered-Undeveloped Reserves

- Several prospects have been discovered with significant reserves awaiting development:
 - Oil 4.1 billion STB
 - Gas 18 TCF

Libyan Oil Sector - Challenges and Prospects

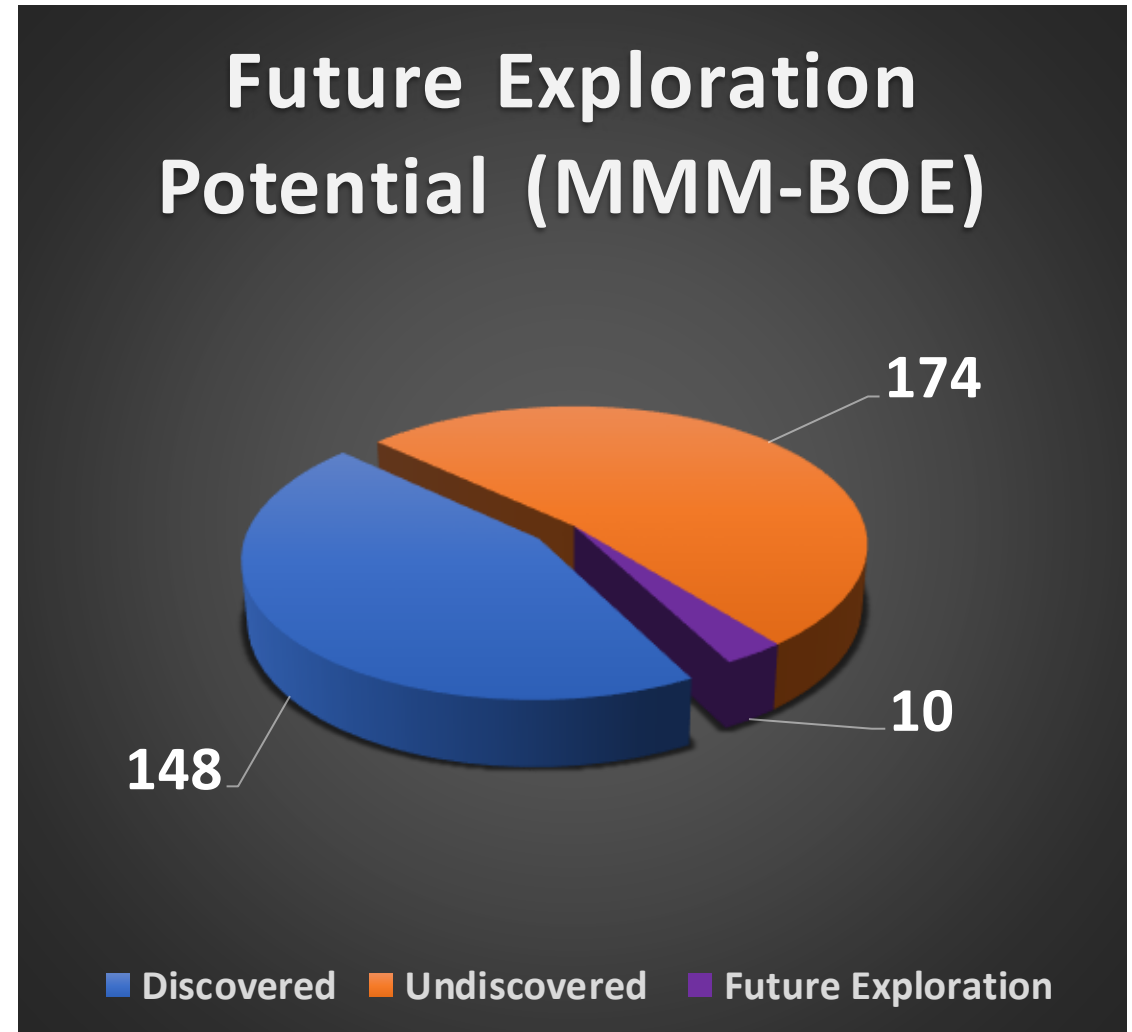
Marginal Oil Fields

- Available information indicates that in the last fifty years more than 300 discovered oil fields remain undeveloped; estimated reserves approximately one billion bbls!
- Development of these so-called Marginal oil Fields (1-3 wells per reservoir) are considered uneconomic by major IOCs as well as NOC's subsidiaries.
- It is imperative to explore ways and means to exploit these idle oil reserves.

Libyan Oil Sector - Challenges and Prospects

Exploration Reserves

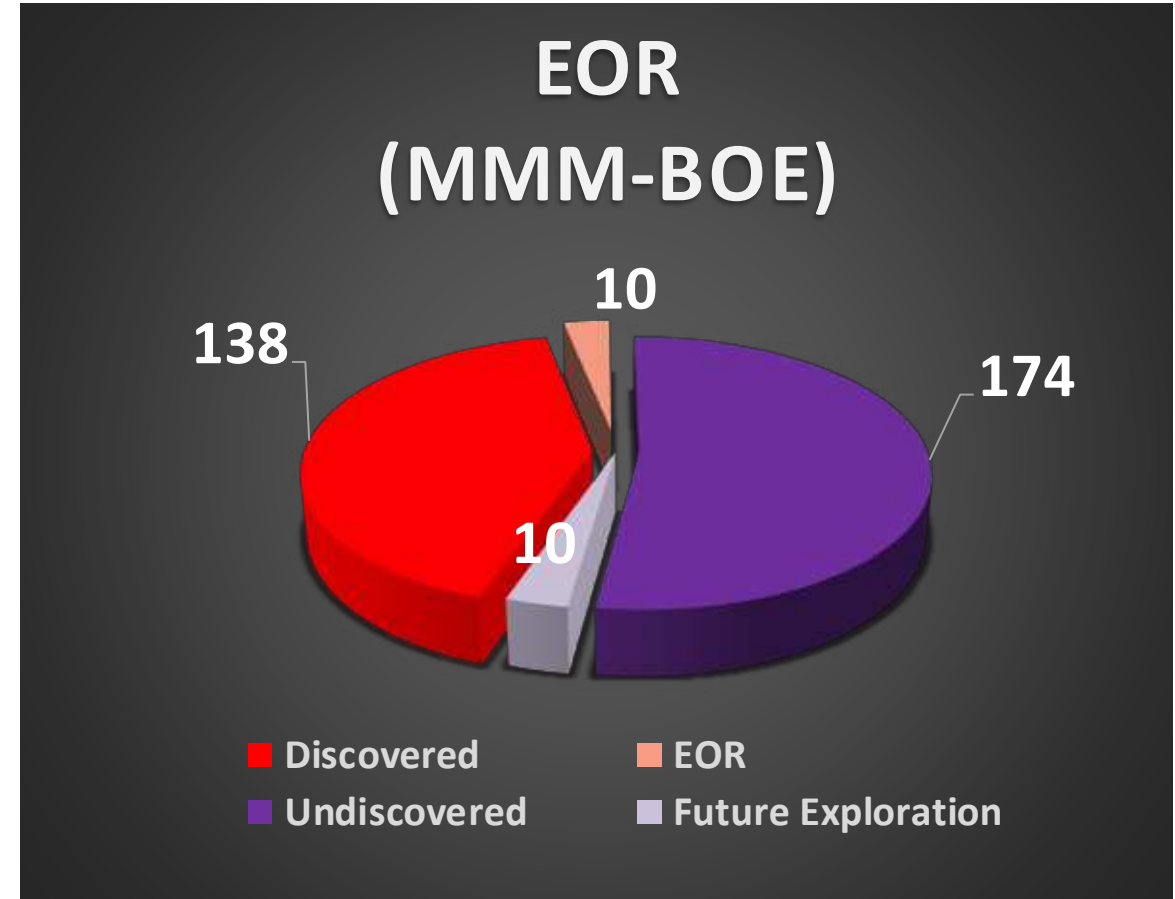
- Available studies and geological data indicate that:
 - The Libyan sedimentary basins require intensive exploration operations using latest technological methods in seismic surveys and drilling.
 - The volume of recoverable oil reserves of possible new discoveries is estimated to be approximately 10 billion-bbls with investments estimated at \$80 billion based on a cost of each discovered barrel between \$8 - 10.



Libyan Oil Sector - Challenges and Prospects

IOR / EOR

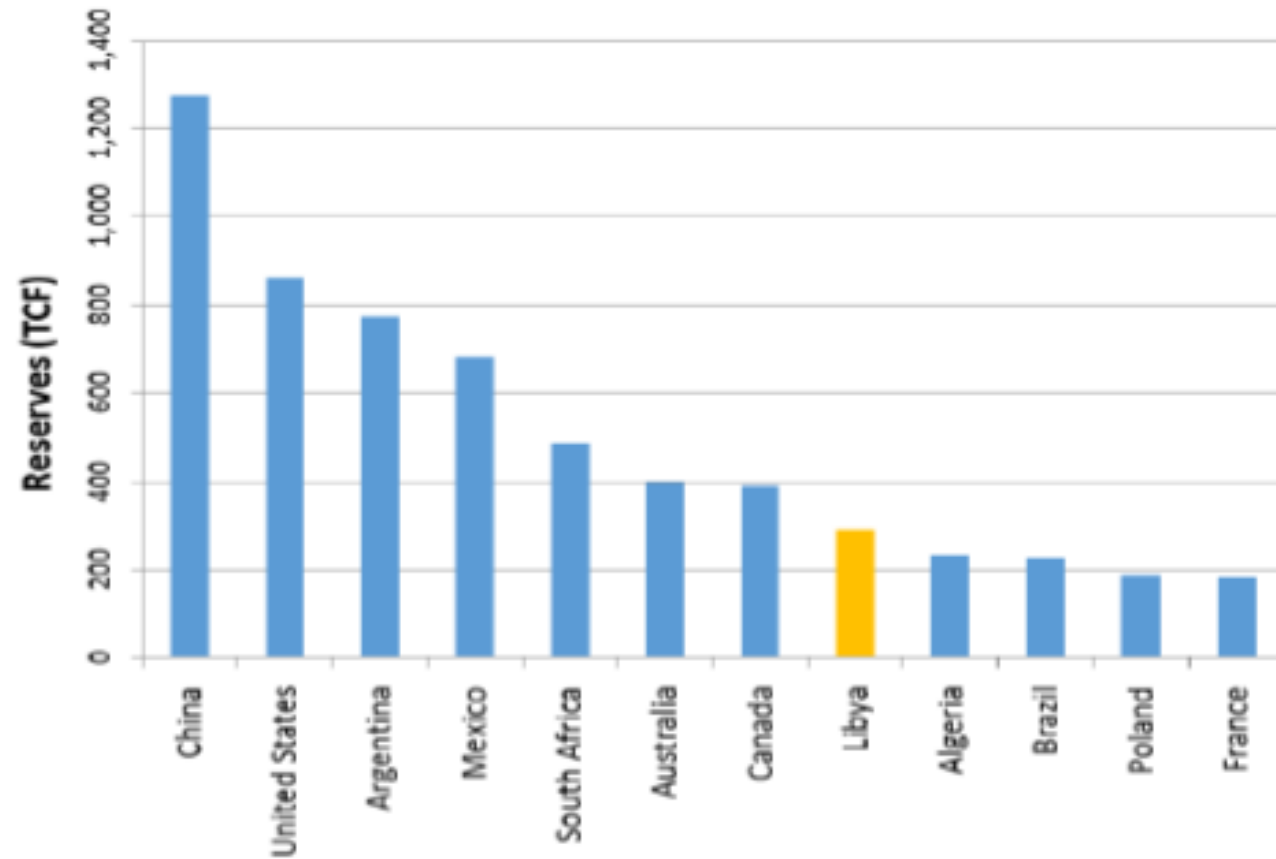
- Additional reserves of 10 billion barrels (+7% of OOIP) could be achieved by IOR (infill-drilling) / EOR; (miscible gas & CO2 injection).
- Approximately \$70 billion needs to be invested based on the estimated capital and operating cost per bbl CO2 injection \$7 and HC injection \$13 .



Libyan Oil Sector - Challenges and Prospects

Shale Oil and Gas Reserves

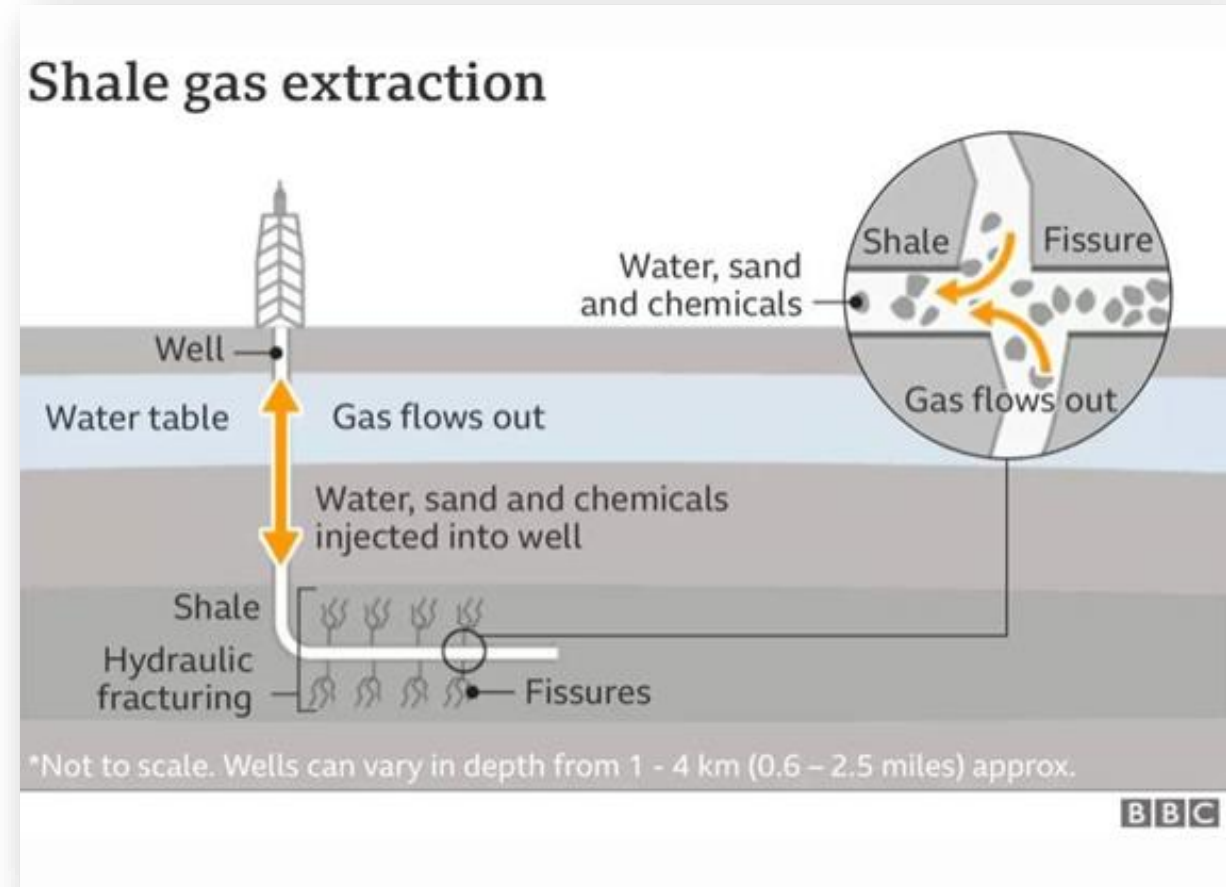
- Libya is home to the Silurian “hot Shale”, the most important Paleozoic hydrocarbon source in North Africa and Arab Peninsula.
- Libya is ranked eighth in the world for shale oil and gas reserves.
- It is estimated that the three geologic basins (Ghadames – Murzuk – Sirte) contain Technical Reserves of 122 trillion cubic feet of shale gas and 26 billion barrel of shale oil.
- These quantities require very advanced technology that has been recently developed in the USA. Shale oil & gas development require very significant capital investments.



Libyan Oil Sector - Challenges and Prospects

Problems Associated with Shale Oil and Gas

- The production of oil and gas from shales has a potentially serious impact on the environment.
- For specific areas of concern dominate discussion regarding development of the source:
 - Greenhouse gas output
 - Water consumption (4 millions gallons of water per well) and pollution
 - Surface disturbance (earth tremors)
 - Socioeconomic effects
 - Breakeven cost \$70



Libyan Oil Sector - Challenges and Prospects

Conclusions

- It must be highlighted that **80%** of discovered Libyan oil reserves have been produced since initial start of oil production in the early Sixties. Remaining proven reserves must be efficiently and optimally produced.
- Gas exploration has been relatively ignored historically. Therefore, in new exploration activities more focus must be on gas exploration
- Significant capital investments are required especially for giant oil fields. Maintenance and rehabilitation of damaged facilities of oil fields and export terminals require approximately **\$10-15 billion**.
- New exploration activities and implementation of IOR/EOR methods require approximately **\$150 billion**.

Libyan Oil Sector - Challenges and Prospects

Conclusions

- Common sense suggests that if financial resources and State-of-the-Art technology are readily and abundantly available, the Libyan Oil Sector is in no need for any foreign partners. However, it is the opposite as the Libyan Oil Sector remains in dire need for continuous transfer of technology and significant foreign investments to further explore and develop oil fields.
- It is necessary to attract and encourage foreign investments that would enable the Oil Sector to efficiently exploit Libya's oil wealth to the best interest of the public.

Libyan Oil Sector - Challenges and Prospects

Recommendations

- Security and stability of oil fields and terminals must be ensured, and oil production operations must not be disrupted or shut-down to safeguard constant flow of oil revenues.
- Petroleum Law No. 25 of 1955 needs to be revised and amended to cope with recent developments in the oil and gas industry.
- NOC should expedite review and re-evaluation of EPSA IV to introduce attractive fiscal terms to kick-start exploration and development activity.
- Resumption of drilling and exploration operations must be expedited in all exploration areas, without exception, should be made available for foreign investment.

Libyan Oil Sector - Challenges and Prospects

Recommendations

- Focus must be on redevelopment of the Giant oil fields that contain 80% of Libya's oil reserves by attracting significant foreign investments and applying modern technology to maximize reserves recovery.
- Expedite development of Discovered-Undeveloped and Marginals fields.
- Increasing capacity of oil production in Libya depends highly on increasing oil reserves which require implementing latest technology in exploration, modern drilling techniques, and EOR methods. It is imperative to expedite development of the marginal oil fields.

Libyan Oil Sector - Challenges and Prospects

Recommendations

- Exploitation of Shale oil & Gas reserves requires further studies. This initiative requires special oil legislation, advanced technologies, and significant financial investments.
- Libya must develop a new strategy to diversity sources of State income and not rely entirely on oil. Norway is an excellent example in exploiting its oil wealth by diversifying its economy and sources of income through investments in education, health, and sustainable development projects; ultimately preserving wealth for future generations.

Libyan Oil Sector - Challenges and Prospects

المهمة والإجتهاد – Diligence and Endeavour

بعزيمة صادقة

وتقوى لله خالصة

وهمة نبيلة عالية

و أخذاً بالأسباب المناسبة

تتحقق لنا الحياة الطيبة

و ما ذلك على الله بعزیز



أخيرا و ليس أخرا لابد من وضع
استراتيجية واضحة توقف الاعتماد الكلي
على النفط.
استراتيجية تعمل على استغلال هذه النعمة
و الثروة النفطية من خلال تنويع اقتصادنا
ومصادر دخلنا بالاستثمار في مشاريع
التعليم والصحة والتنمية المستدامة؛ و
ايجاد مصادر بديلة للطاقة أملا في الحفاظ
على ما تبقى من الثروة للأجيال القادمة.

Libyan Oil Sector - Challenges and Prospects

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