

# Petroleum: History & Economics



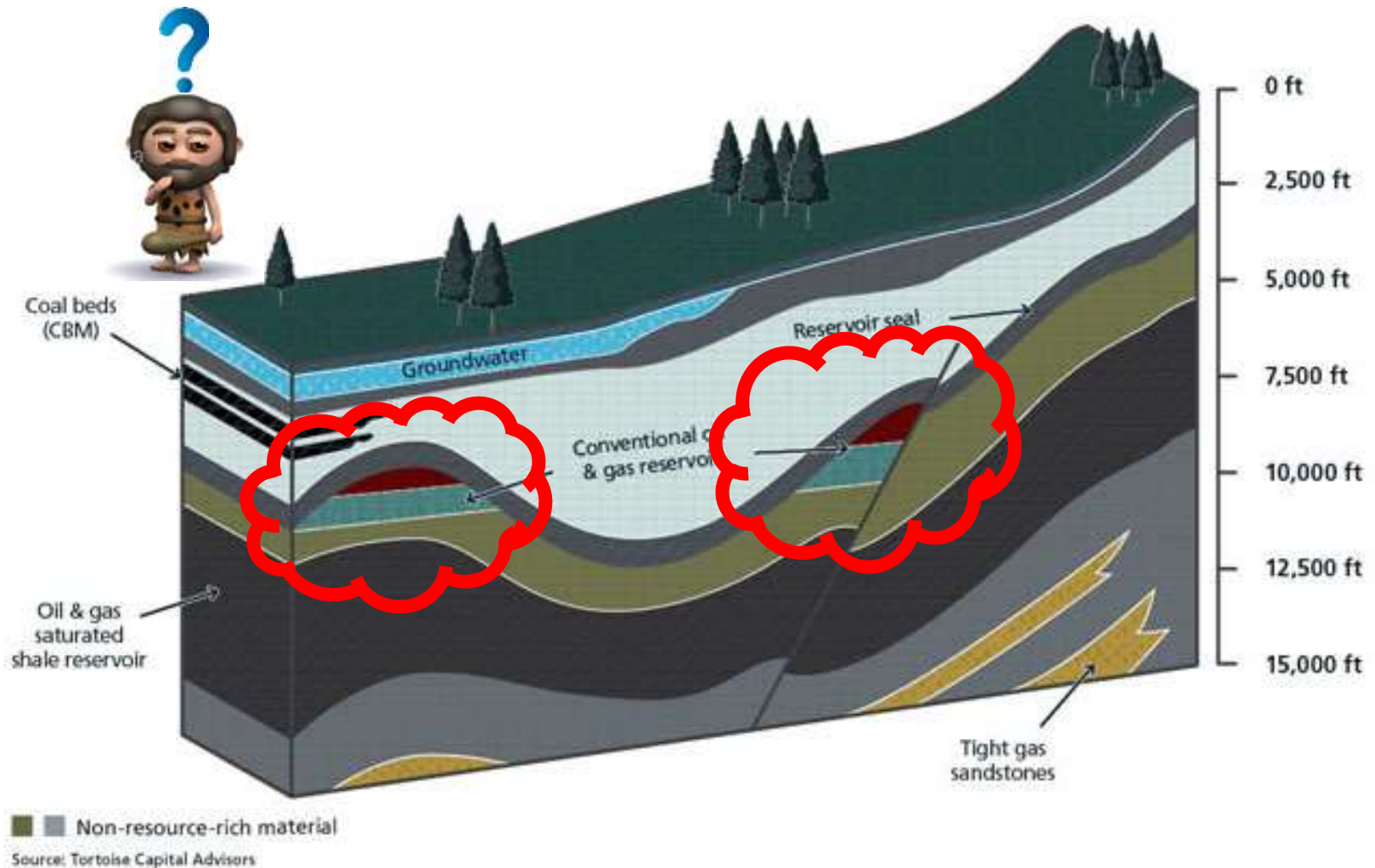
Musaed N. AlAwad

مسعود ناصر العواد

# **Presentation Outline**

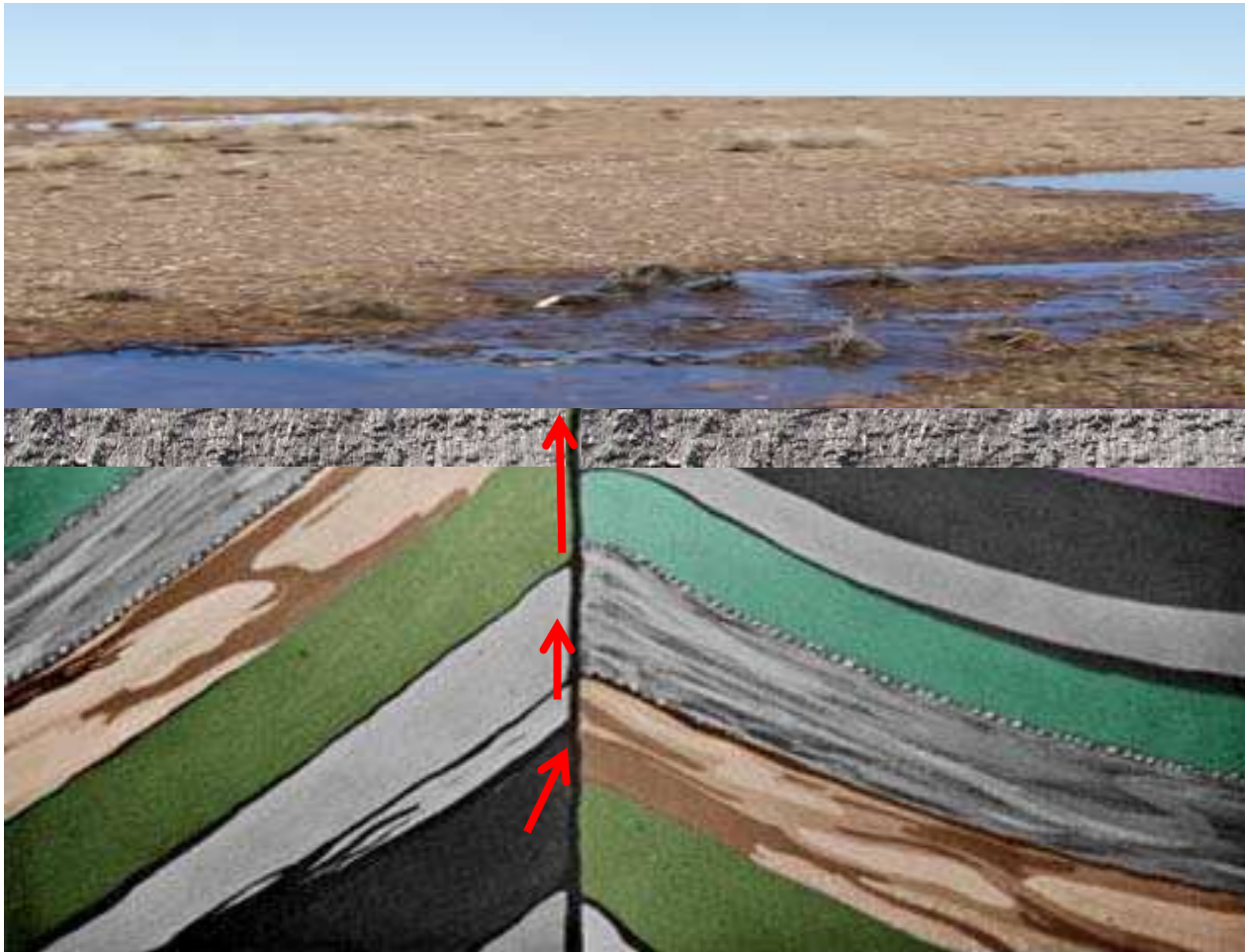
- 1. History of Worldwide Oil Discovery**
- 2. Oil in The Middle East**
- 3. Oil in Saudi Arabia**
- 4. Worldwide Oil Types and Reserves**
- 5. Oil Pricing Criterion**
- 6. Oil Price Fluctuation**
- 7. Alternative Energy Resources**
- 8. Conclusions**

# History of Worldwide Oil Discovery



Various Types of Petroleum Traps (Reservoirs)

# History of Worldwide Oil Discovery



Oil Seepage through Fractured Rocks



# History of Worldwide Oil Discovery



Oil Seepages in Several Parts of the World



# History of Worldwide Oil Discovery

Worldwide ancient people used petroleum seepage for:

1. Lighting.
2. Water proofing.
3. Building.
4. Medicine & Painting.



# History of Worldwide Oil Discovery

On August 28, 1859, Edwin L. Drake and Partners made the first successful use of a cable tool drilling rig on a well drilled especially to produce oil in Pennsylvania.

The drill reached its maximum depth of 69.5 feet (21.2 m) on August 27, 1859. Cable tool drilling techniques was used in drilling this well.

It took one and a half year to reach the above depth. In 1900, rotary drilling technique was developed.



Drake Oil Well

The Drake well is often referred to as the "first" commercial oil well, although that title is also claimed for wells in Ontario, West Virginia, Azerbaijan, and Poland, among others.

# History of Worldwide Oil Discovery



Wood-made Drilling Cable Tool Rig



# History of Worldwide Oil Discovery



Drilling Rigs Everywhere

# History of Worldwide Oil Discovery



**Drilling Rigs Everywhere**

# History of Worldwide Oil Discovery



Drilling Rigs Everywhere



# History of Worldwide Oil Discovery



Drilling Rigs Everywhere

# History of Worldwide Oil Discovery



Drilling Rigs Everywhere



# History of Worldwide Oil Discovery

**DRAKE WELL PARK**  
On this site "Col." Edwin Drake struck oil Aug. 27, 1859: the birth of the petroleum industry.  
Administered by the Pennsylvania Historical and Museum Commission.



Drake Oil Well Museum



# History of Worldwide Oil Discovery



blue barrel

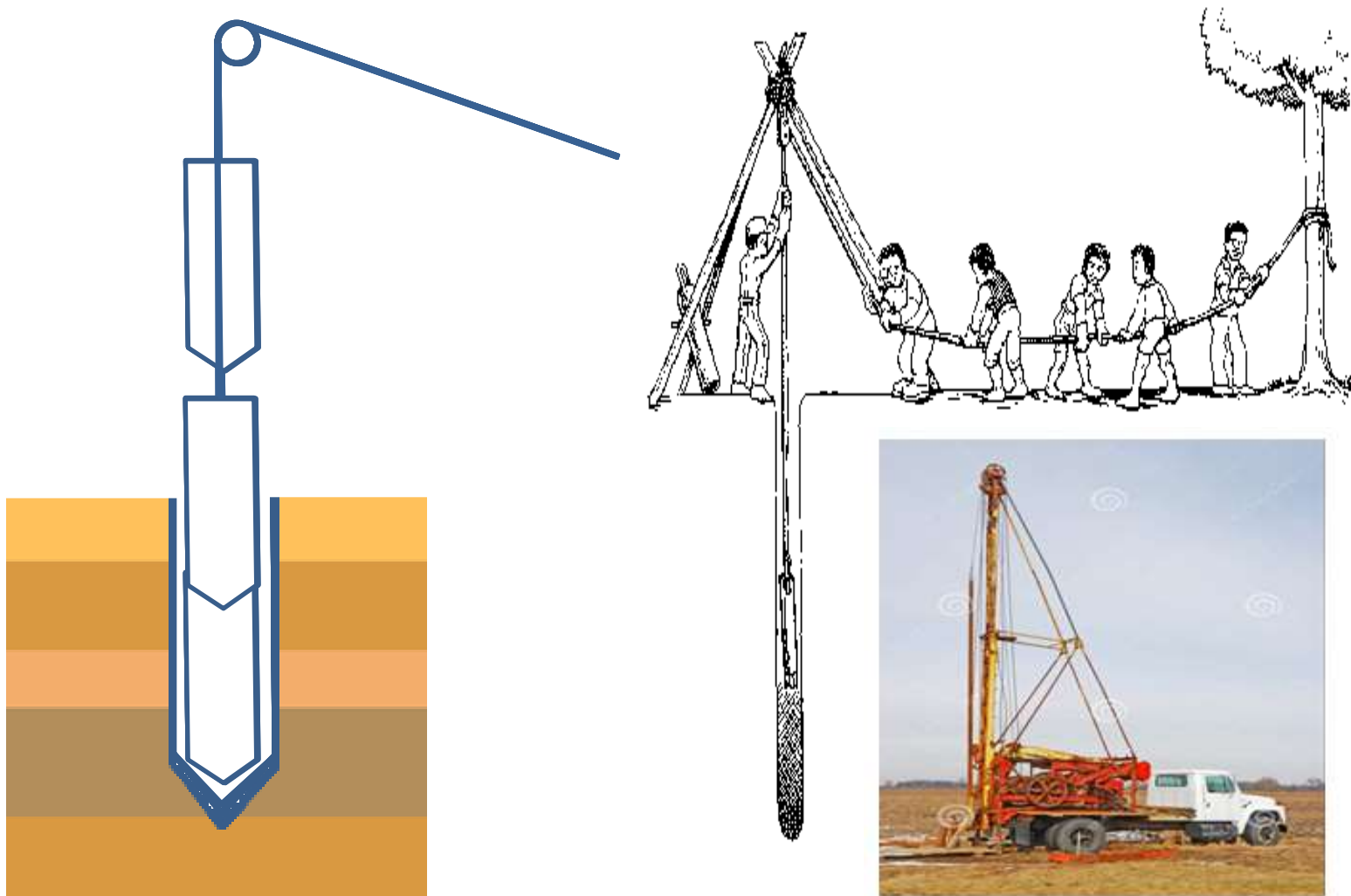


Barrel: bl? or brl? or bbl?



Transportation of Crude Oil Barrels

# History of Worldwide Oil Discovery



Cable Tool Drilling Rig

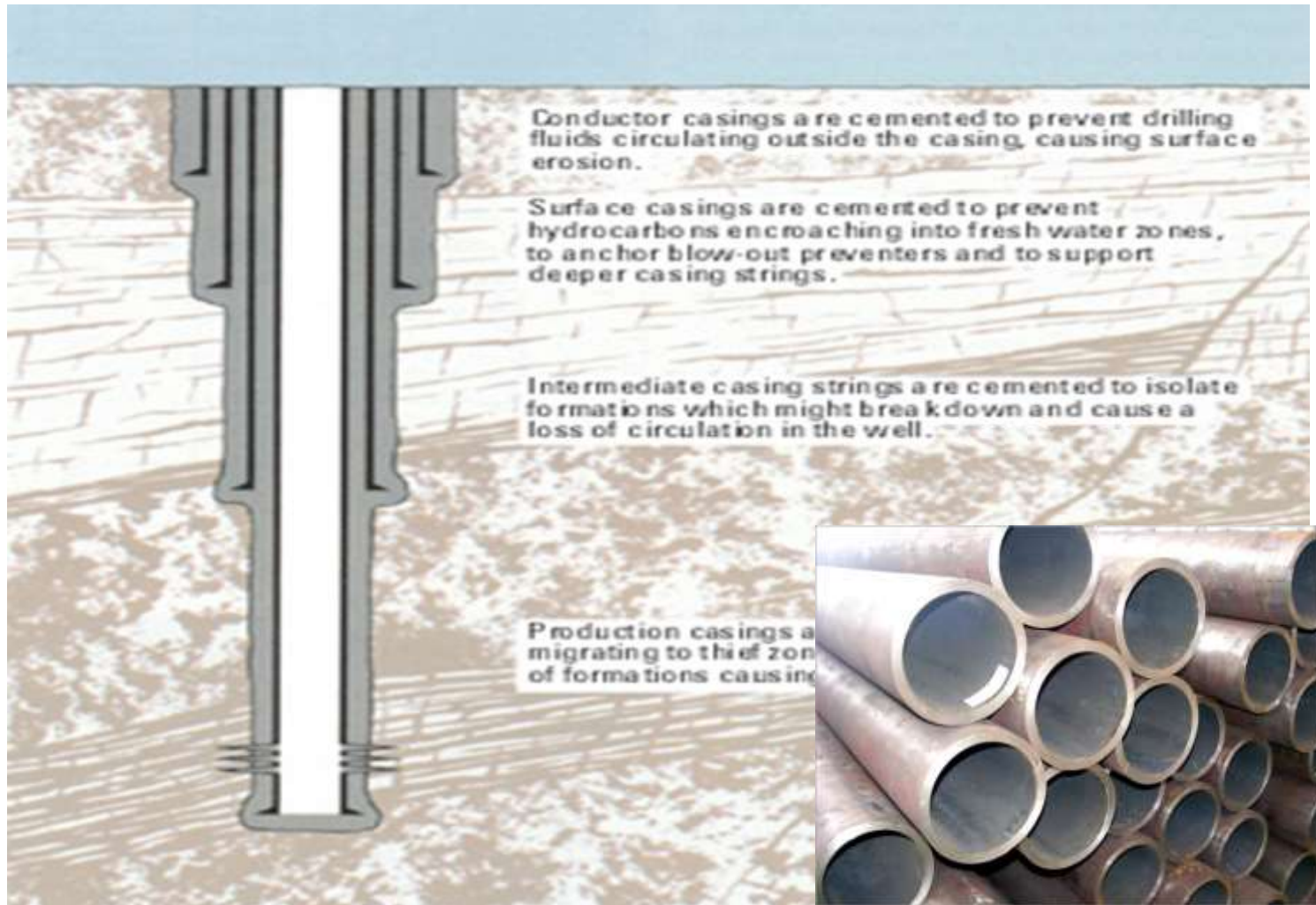
# History of Worldwide Oil Discovery



**Modern Rotary Drilling Rig - Onshore**



# History of Worldwide Oil Discovery



**Modern Oil Well Configuration**

# History of Worldwide Oil Discovery



**Modern Oil Well Configuration (Low Reservoir Pressure)**



# History of Worldwide Oil Discovery



**Modern Oil Well Configuration (High Reservoir Pressure)**



# History of Worldwide Oil Discovery



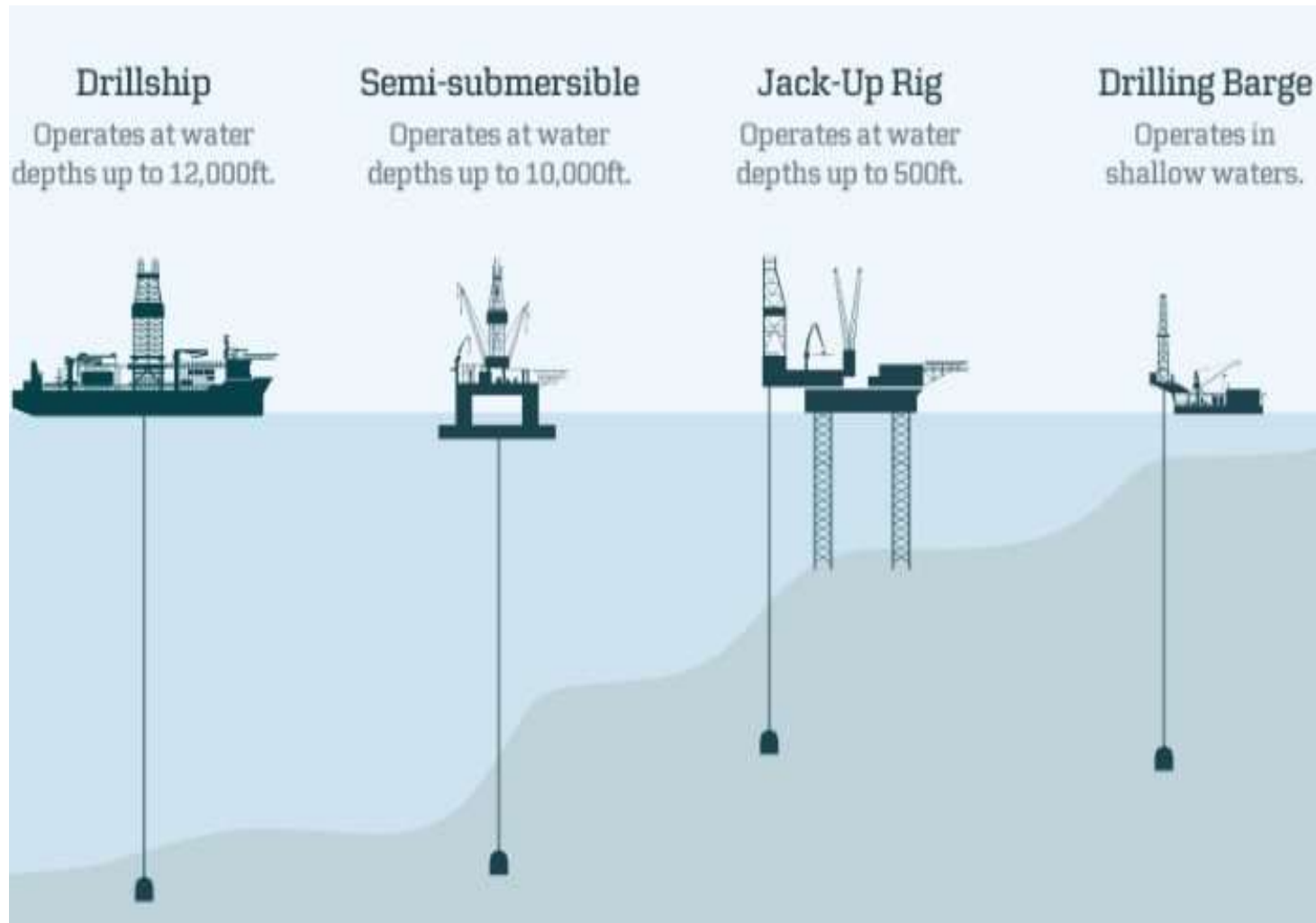
**Modern Oil Well Configuration (Wellhead Installation)**

# History of Worldwide Oil Discovery



**Modern Rotary Drilling Rig – Shallow Offshore**

# History of Worldwide Oil Discovery



**Modern Rotary Drilling Rig – Deep Offshore**

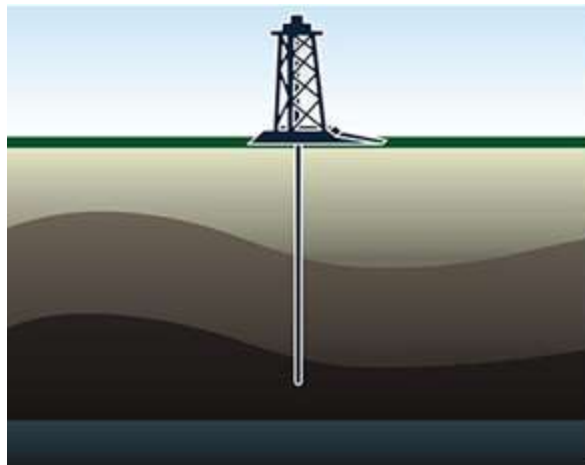


# History of Worldwide Oil Discovery

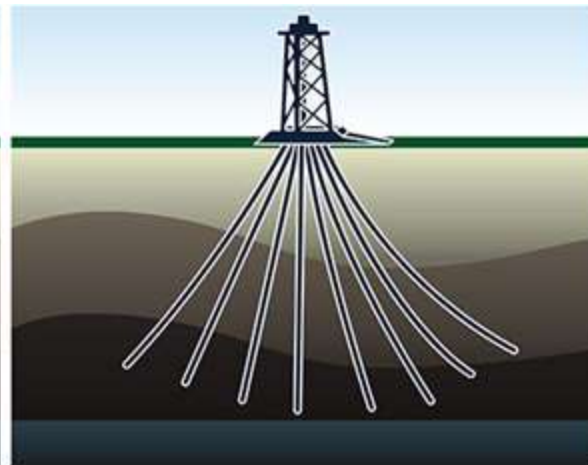
In 1859, 69.5 ft Drake vertical open hole well was drilled in one and a half year using cable tool drilling method.

Nowadays, 14000 ft well can be drilled in one month or less using rotary drilling method.

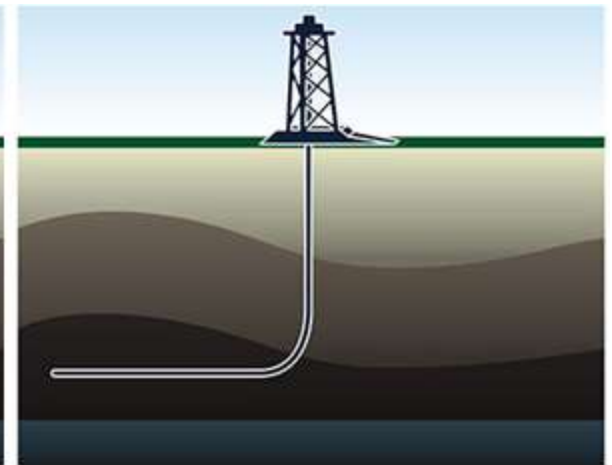
Petroleum wells could be Vertical, Directional, or Horizontal.



Vertical well

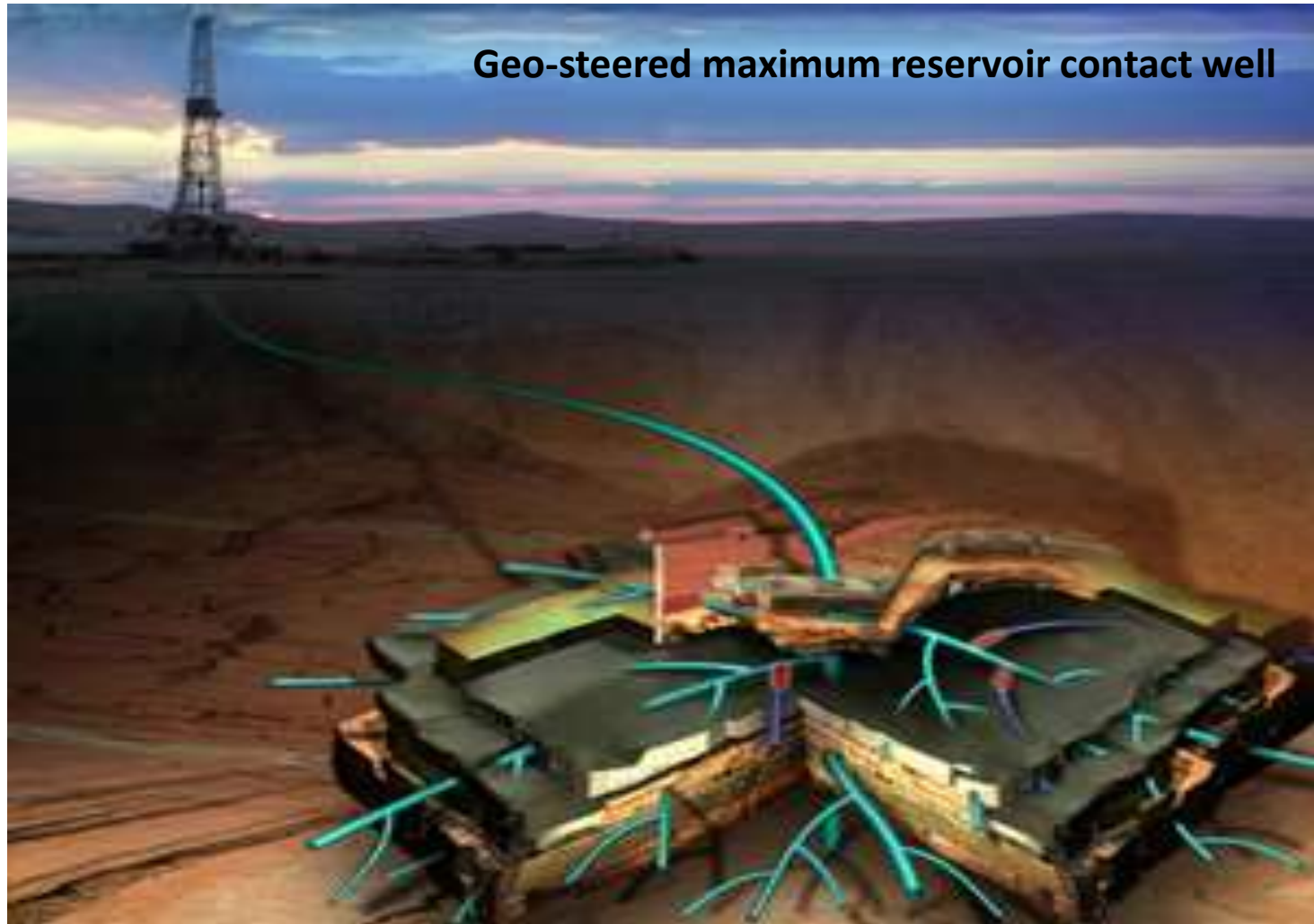


Directional well



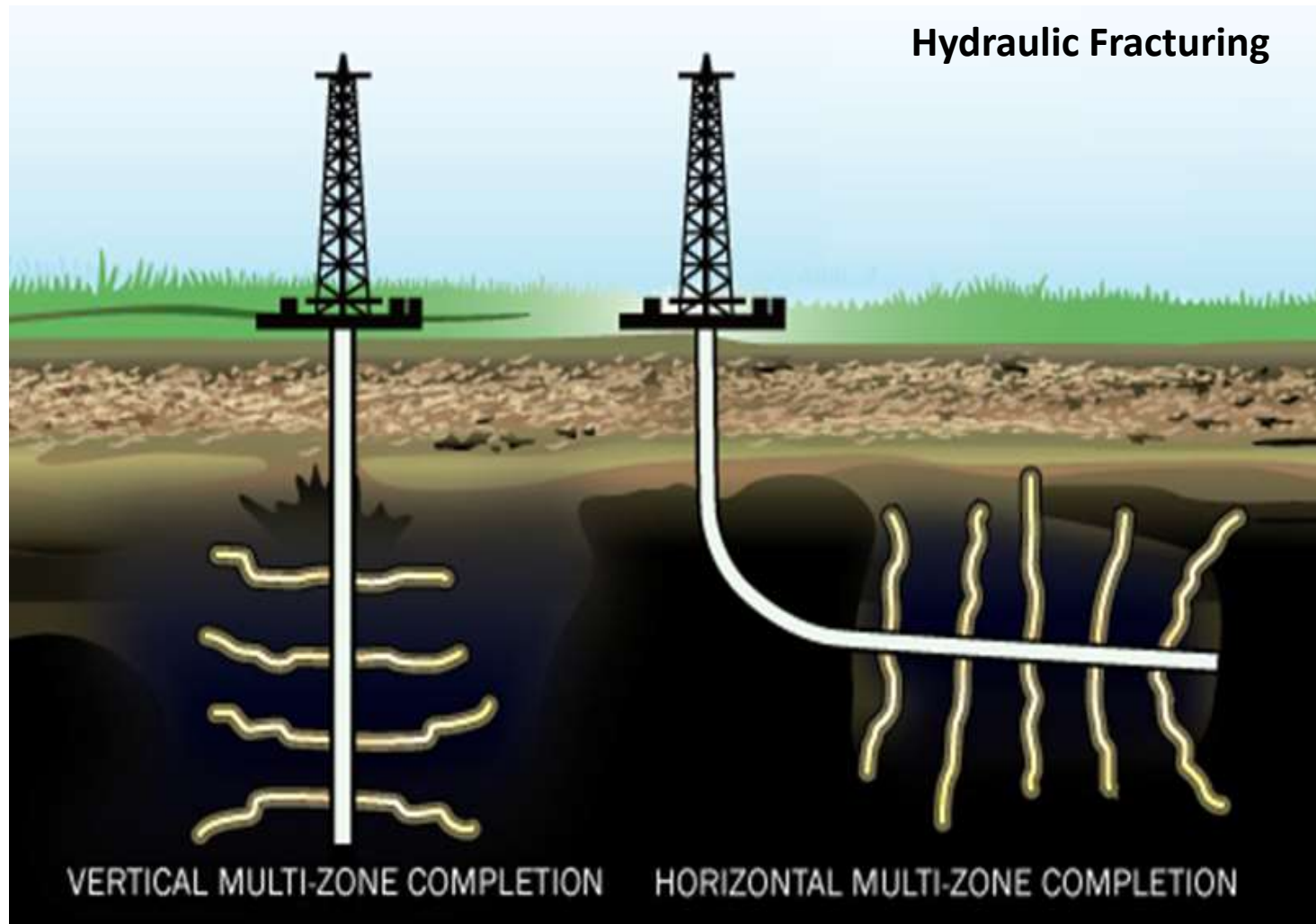
Horizontal well

# History of Worldwide Oil Discovery



Advancement in Drilling Technology

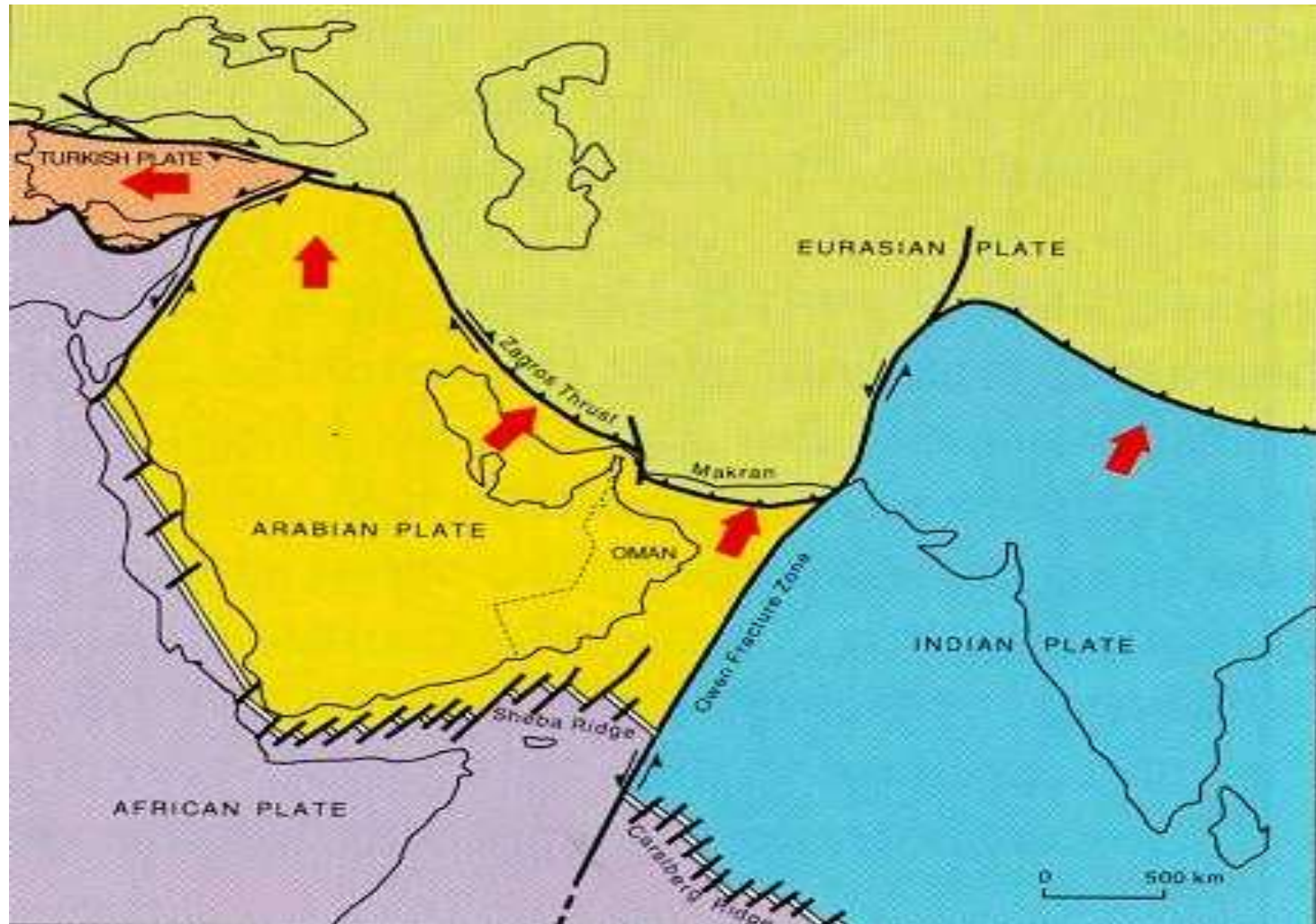
# History of Worldwide Oil Discovery



Advancement in Drilling Technology

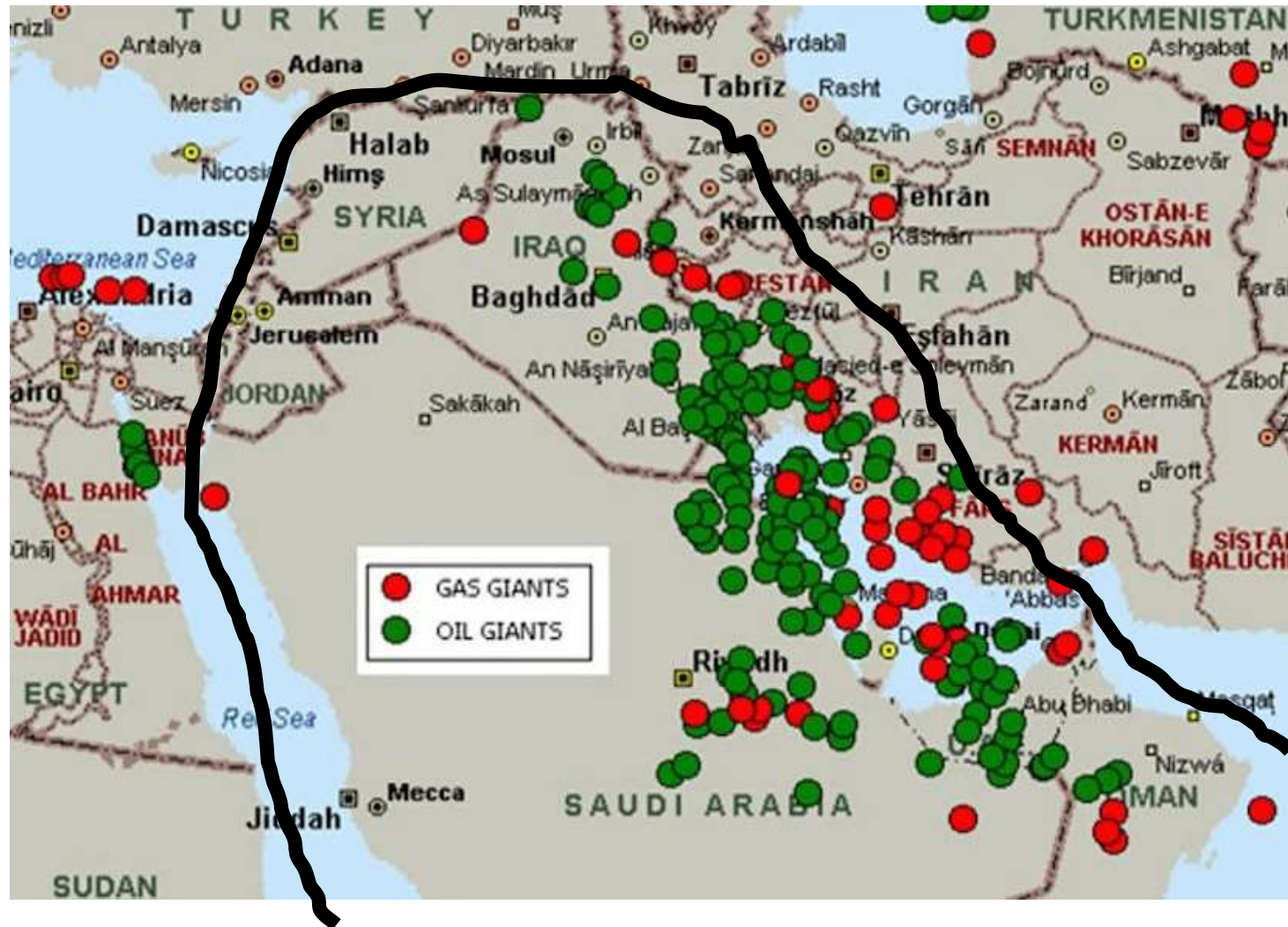


# History of Worldwide Oil Discovery



Advancement in Drilling Technology

# Middle East Oil and Gas



Arabian Plate  $\approx$  66% of the World's oil and gas reserves

# Middle East Oil and Gas

KSA - 12	UAE - 6	Kuwait - 5	Iraq - 6	Qatar - 1	Iran - 8
1 - Ghawar 3 - Safaniya 4 - Zuluf 5 - Manifa 6 - Khurais 9 - Abqaiq 10 - Berri 11 - Shaybah 13 - Marjan 19 - Qatif 22 - Abu Safa 28 -	7 - Zakum 18 - Murban – Bab 20 - Murban Bu Hasa 26 - Fateh 30 - Asab 31 - Um Shaif	2 - Burgan 23 - Raudhatain 29 - Sabriya 33 - Minagish 35 - Um Gudair	8 - Kirkuk 12 - Rumaila 16 - Majnoon 21- Rumaila North 24 - Zubair 27 - West Qurna	38 - Dukhan	14 - Gachsaran 15 - Ahwaz 17 - Marun 25 - Agha Jari 32 - Rag e Safid 34 - Bibi Hakimeh 36 - Azadegan 37 - Parsi
336 Billion	45.7 Billion	90.2 Billion	49.5 Billion	3.2 Billion	84.6 Billion

**Out of the 20 largest oil and gas reserves in the world:**

- 15 are in the Middle East (6 in Saudi Arabia, 4 in Iran, 3 in Iraq, 1 in Kuwait, 1 in Abu Dhabi),
- 2 in Russia,
- 1 in South America (Venezuela) and
- 2 in North America (1 in USA-Alaska, 1 in Mexico).



# Middle East Oil and Gas

Giant Filed Reserve:

Super Giant Field Reserve:

Mega Giant Field Reserve:

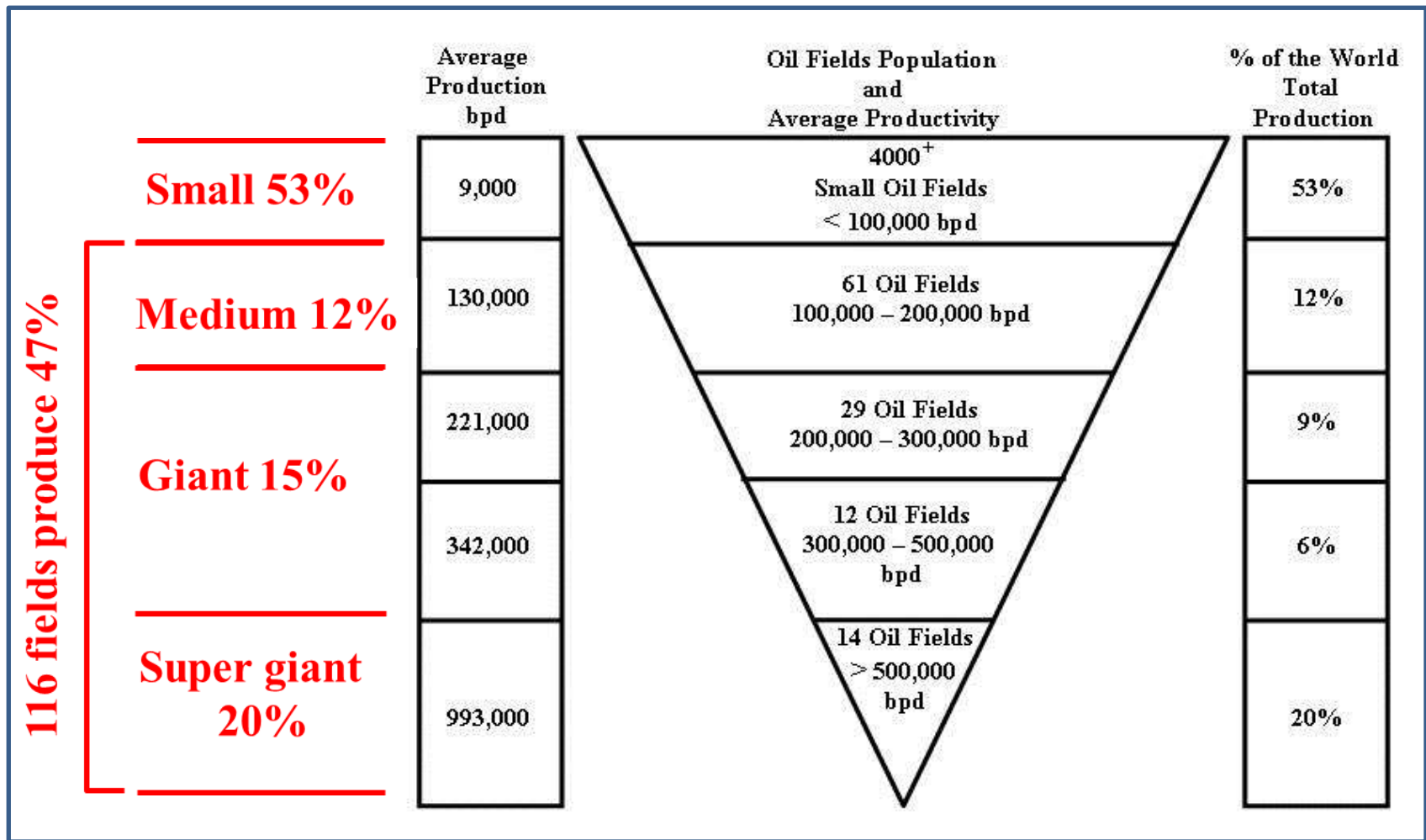
0.5 - 1.0 Billion bbls

>1.0 - <5.0 Billion bbls

>5.0 billion bbls

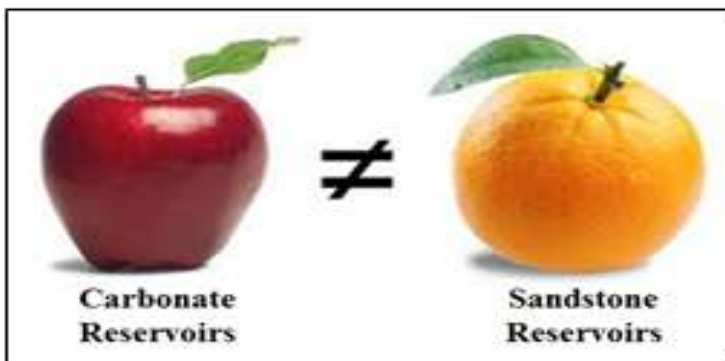
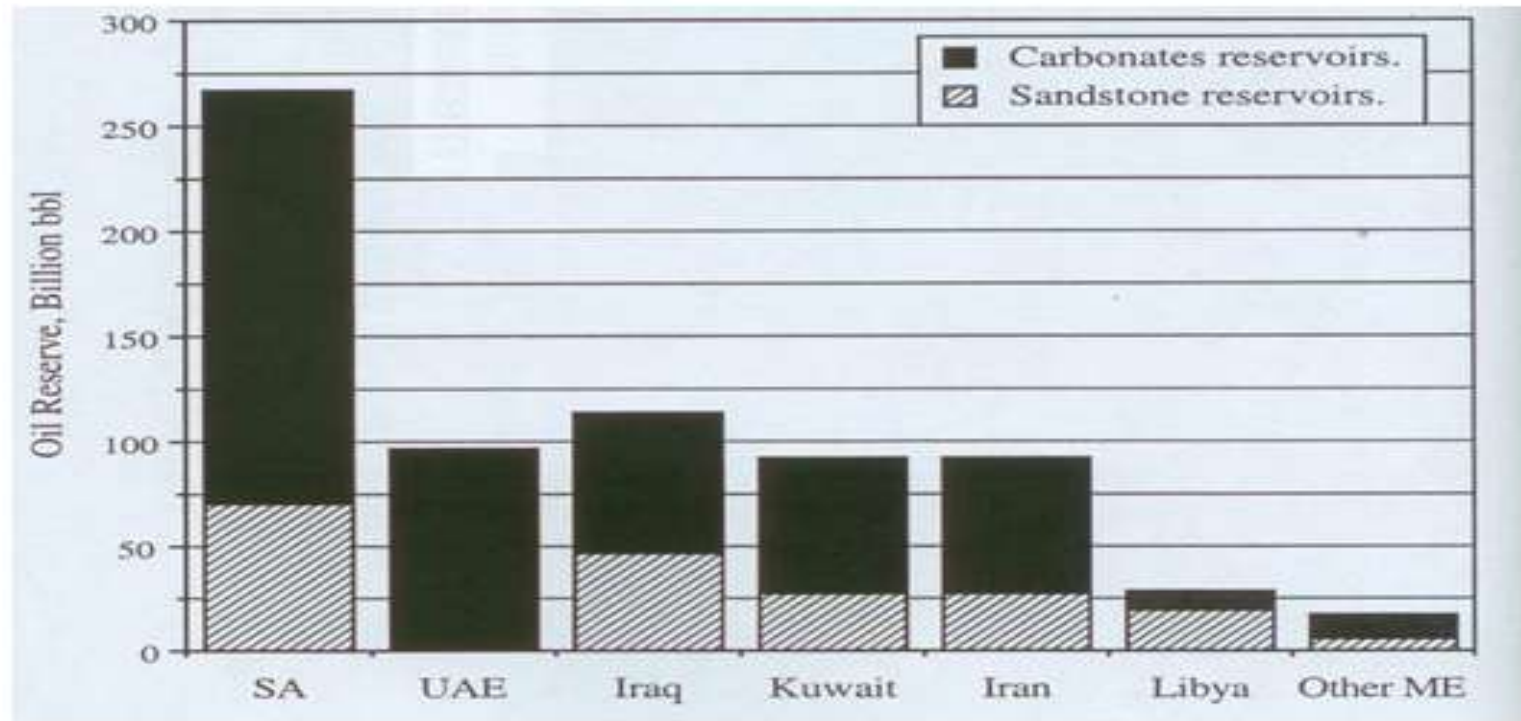
Field, Country		Reserve, 10 <sup>9</sup> bbl	Field, Country		Reserve, 10 <sup>9</sup> bbl
1	Ghawar, Saudi Arabia	79	2	Burgan, Kuwait	69
3	Cantarell, Mexico	35	4	Bolivar Coastal, Venezuela	31
5	Safaniya-Khafji, Saudi Arabia	30	6	Rumailia, Iraq	20
7	Tengiz, Kazakhstan	20	8	Ahwaz, Iran	17
9	Kirkuk, Iraq	16	10	Marun, Iran	16
11	Daqing, China	16	12	Gachsaran, Iran	15
13	Aghajari, Iran	14	14	Samotlor, Russia	15
15	Prudhoe Bay, Alaska, USA	13	16	Kashagan, Kazakhstan	13
17	Abqaiq, Saudi Arabia	12	18	Romashkino, Russia	12
19	Chicontepec, Mexico	12	20	Berri, Saudi Arabia	12
21	Zakum, Abu Dhabi, UAE	12	22	Manifa, Saudi Arabia	11
23	Marjan, Saudi Arabia/Iran	10	24	Marlim, Campos, Brazil	10

# Middle East Oil and Gas



World's Normal, Super, and Giant Oil Fields

# Middle East Oil and Gas



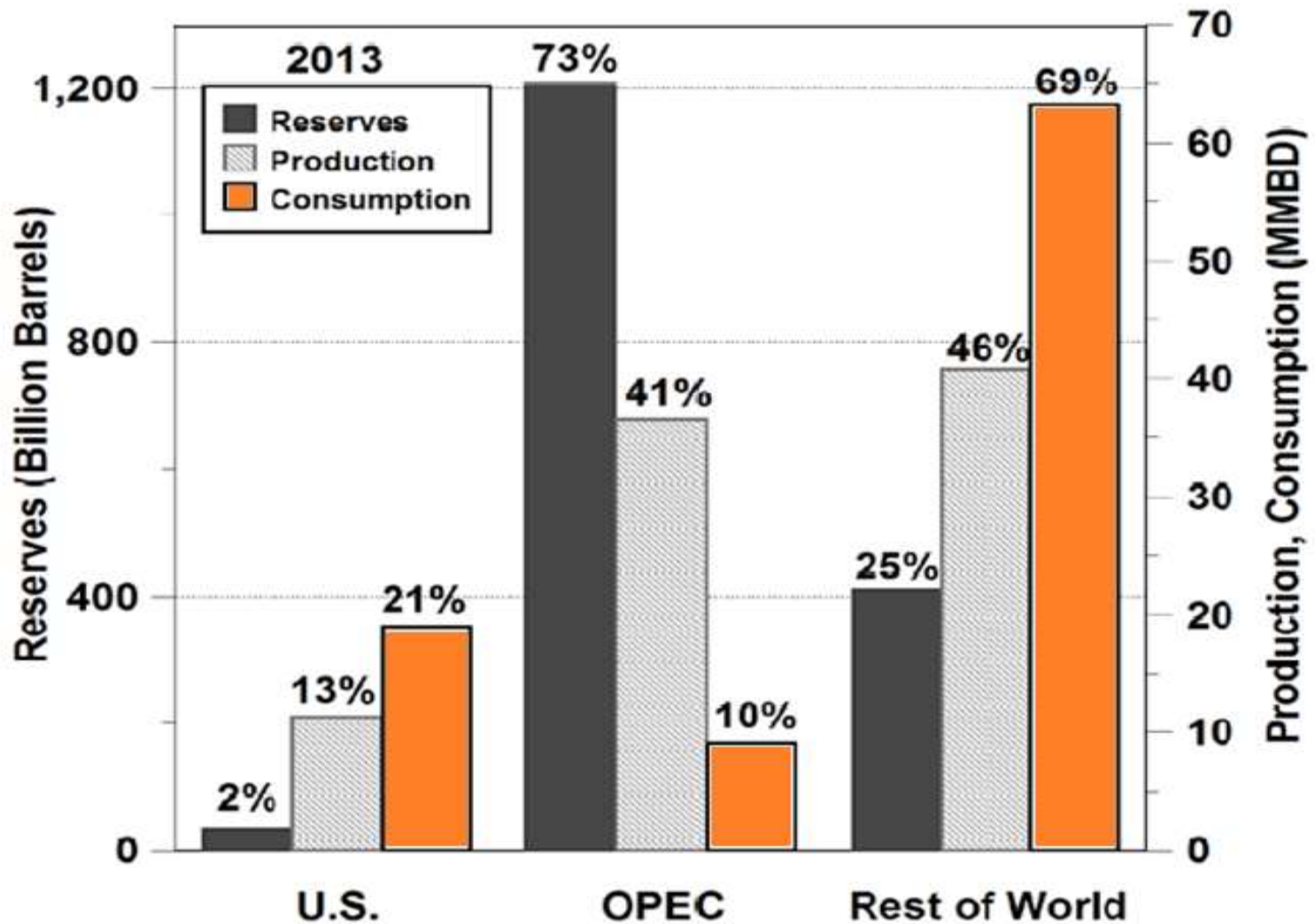


# Middle East Oil and Gas

## Worldwide Average Well Productivity

Country		Average Well Productivity, bbl/day	Country		Average Well Productivity, bbl/day
1	<b>Saudi Arabia</b>	<b>5623</b>	9	<b>Iraq</b>	<b>1252</b>
2	<b>Norway (North Sea)</b>	<b>5140</b>	10	<b>Libya</b>	<b>947</b>
3	<b>Iran</b>	<b>3221</b>	11	<b>Nigeria</b>	<b>940</b>
4	<b>Kuwait</b>	<b>2278</b>	12	<b>Mexico</b>	<b>875</b>
5	<b>U.K. (North Sea)</b>	<b>1728</b>	13	<b>Algeria</b>	<b>642</b>
6	<b>UAE (Abu Dhabi)</b>	<b>1595</b>	14	<b>Venezuela</b>	<b>200</b>
7	<b>Indonesia</b>	<b>1592</b>	15	<b>China</b>	<b>44</b>
8	<b>UAE (Dubai)</b>	<b>1578</b>	16	<b>USA</b>	<b>11</b>

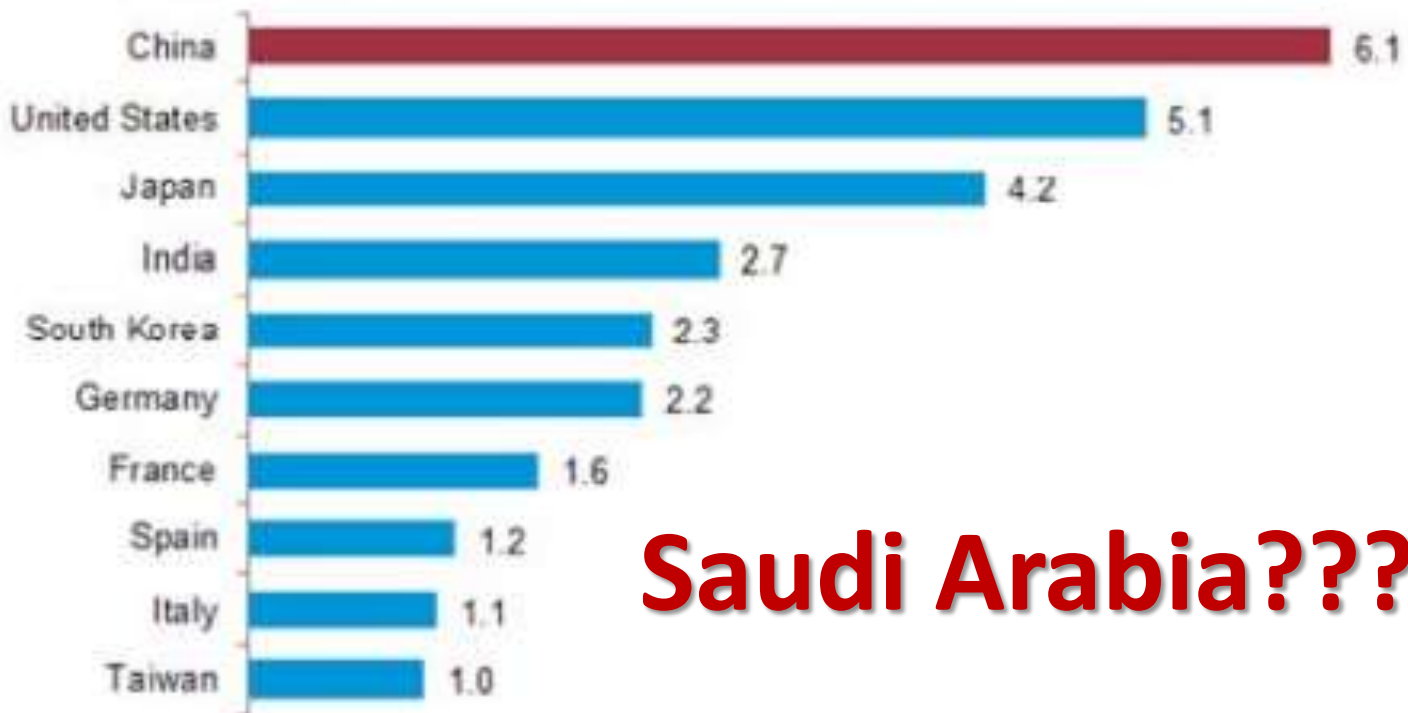
# Middle East Oil and Gas



# Middle East Oil and Gas

Top ten annual net oil importers, 2014

million barrels per day



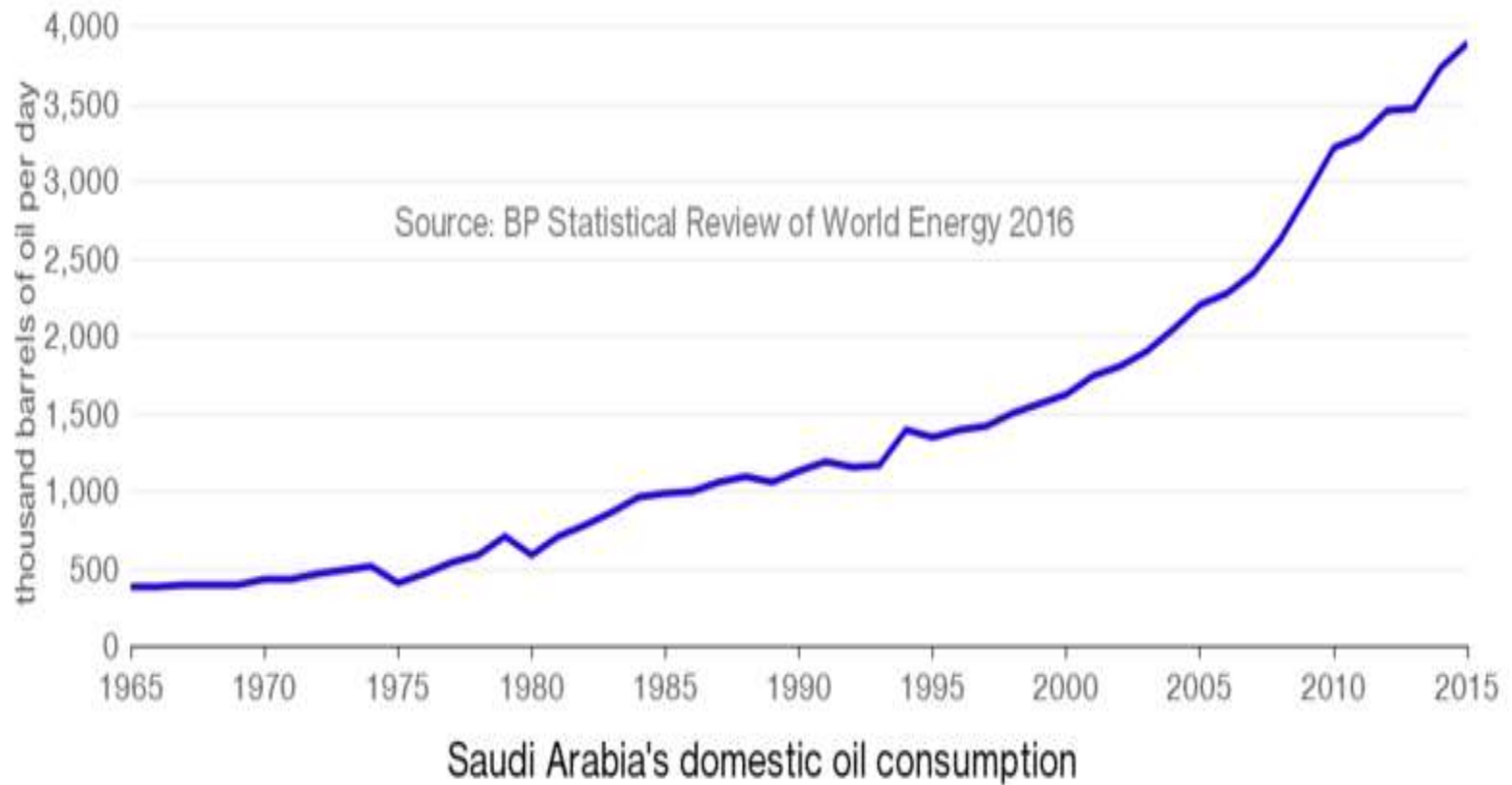
**Saudi Arabia???**



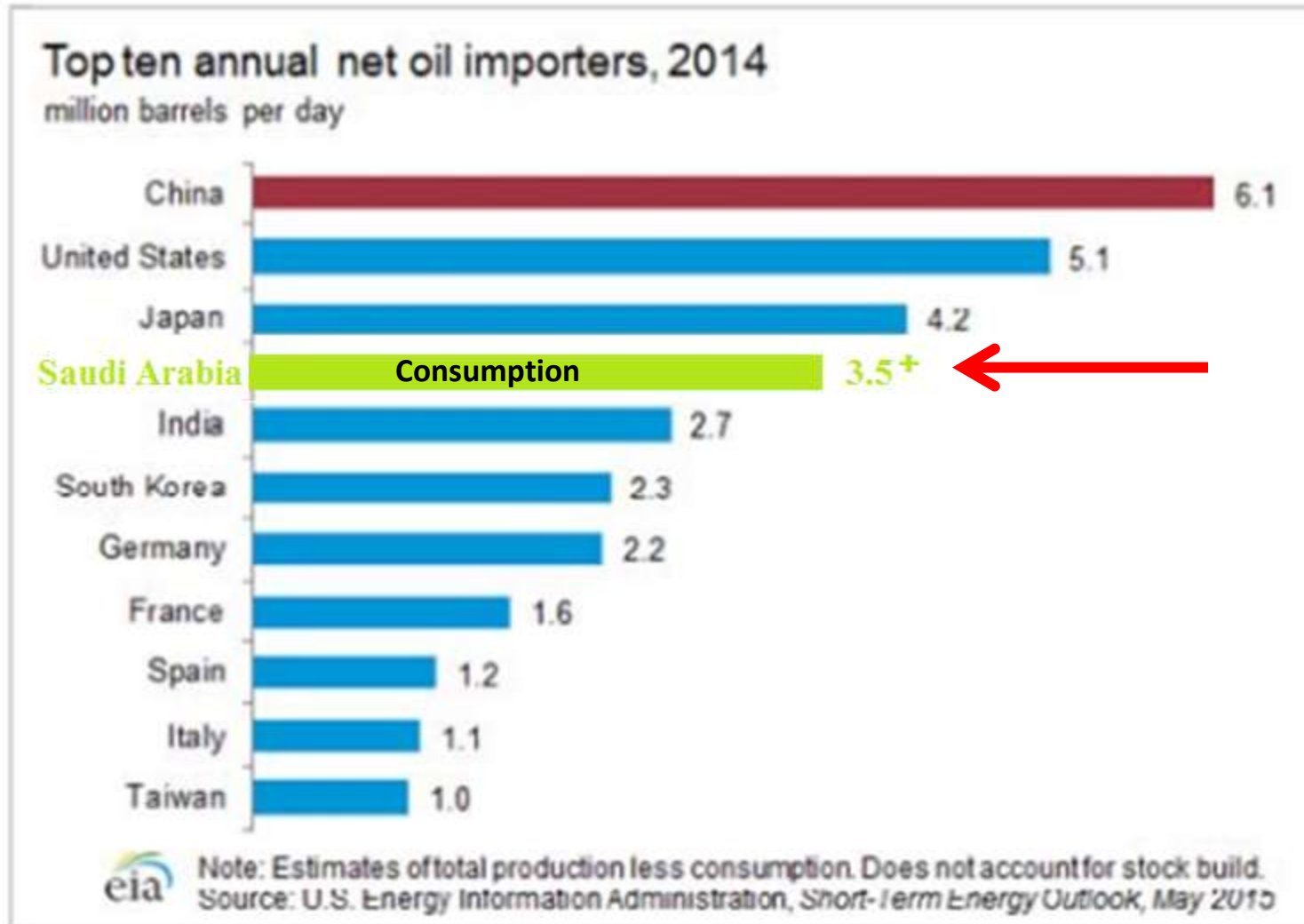
Note: Estimates of total production less consumption. Does not account for stock build.  
Source: U.S. Energy Information Administration, *Short-Term Energy Outlook*, May 2015



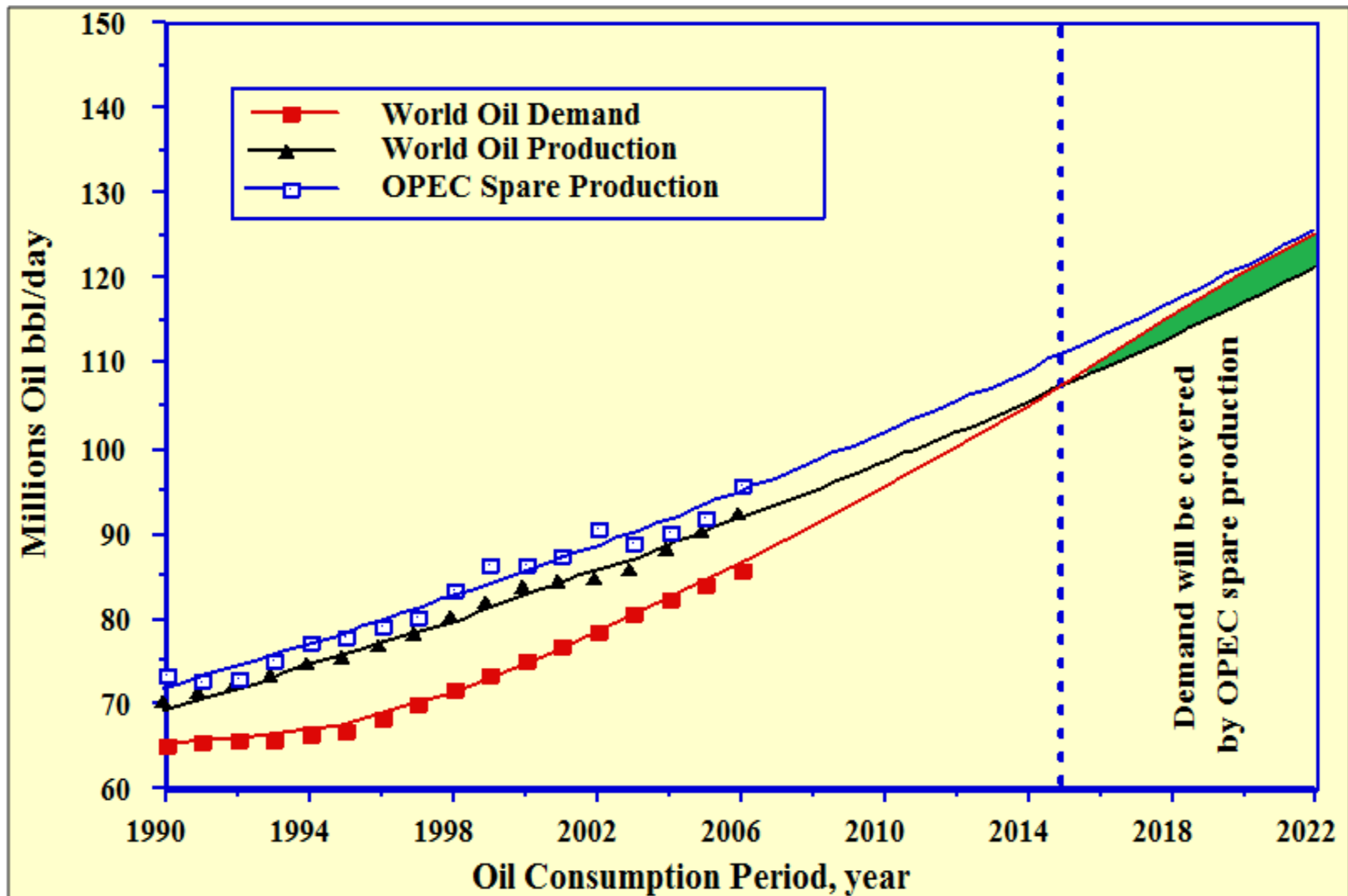
# Middle East Oil and Gas



# Middle East Oil and Gas

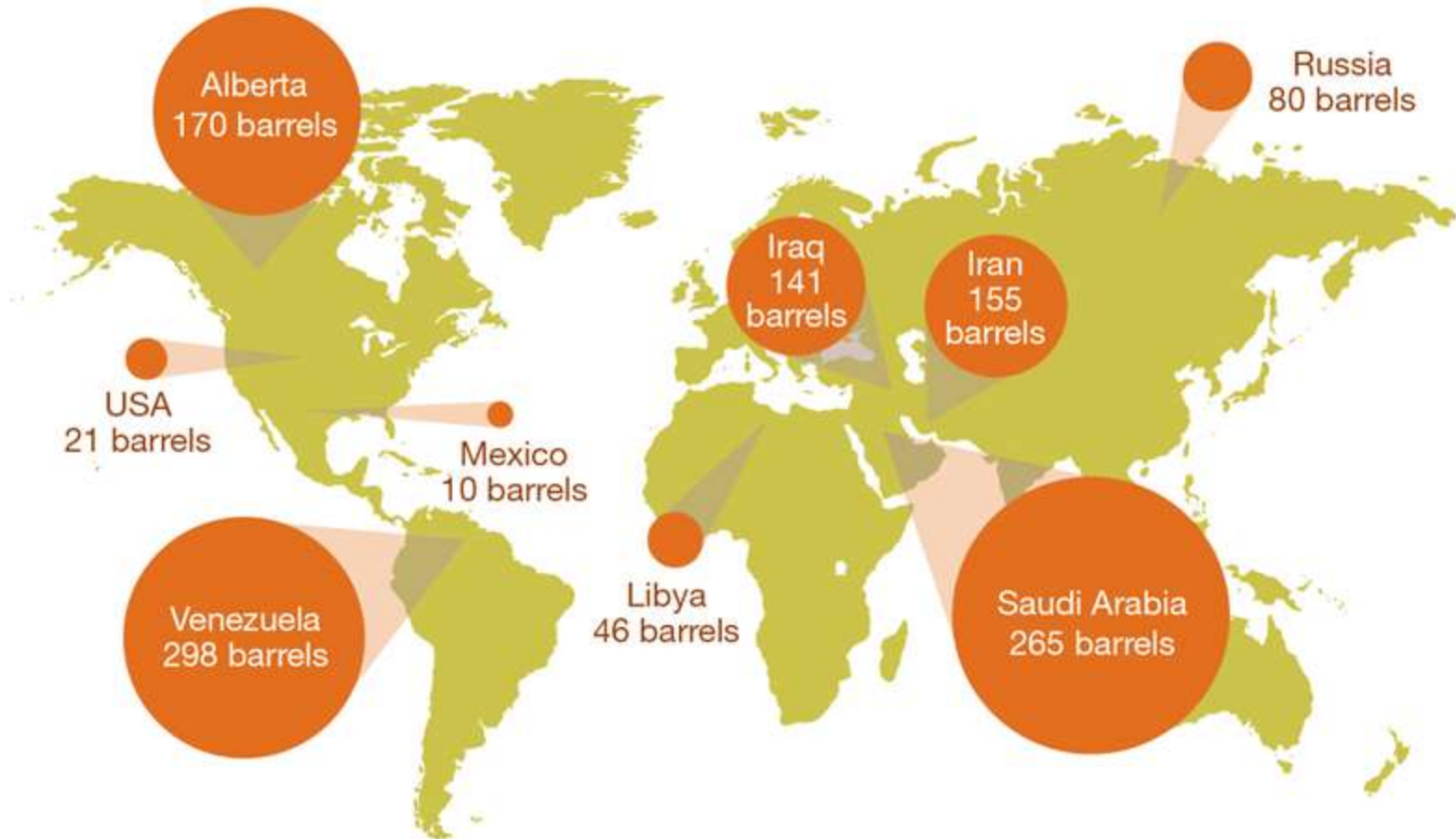


# Middle East Oil and Gas





# Middle East Oil and Gas



**Comparative Oil Reserves (billions of barrels)**

Source: Oil & Gas Journal, 2012

# Middle East Oil and Gas



Canada Oil Shale



Venezuela Heavy Oil

# Middle East Oil and Gas



Oil Shale



Heavy Oil

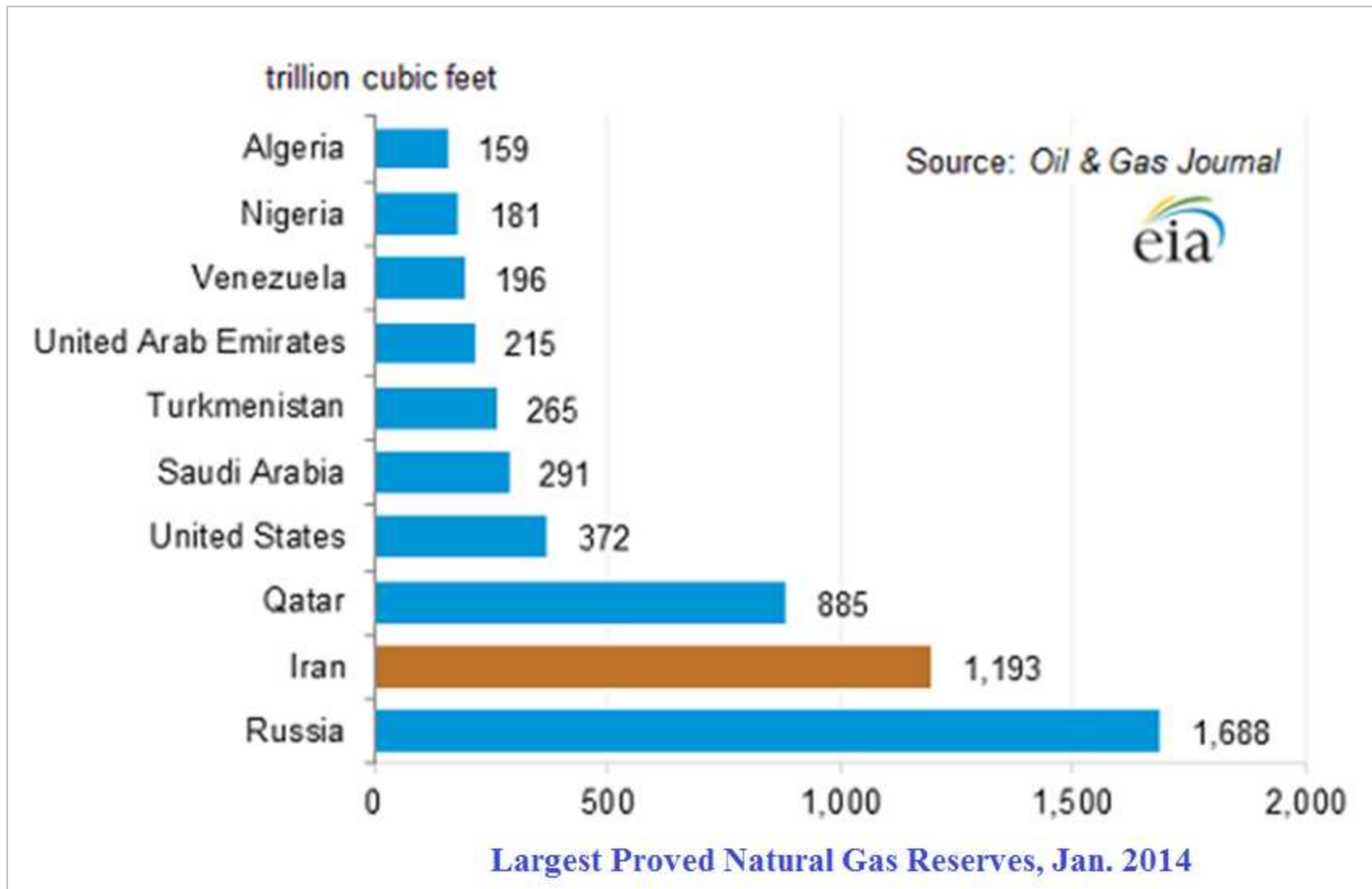


Conventional Oil

**Extraction &  
Treatment  
Cost ?**



# Middle East Oil and Gas

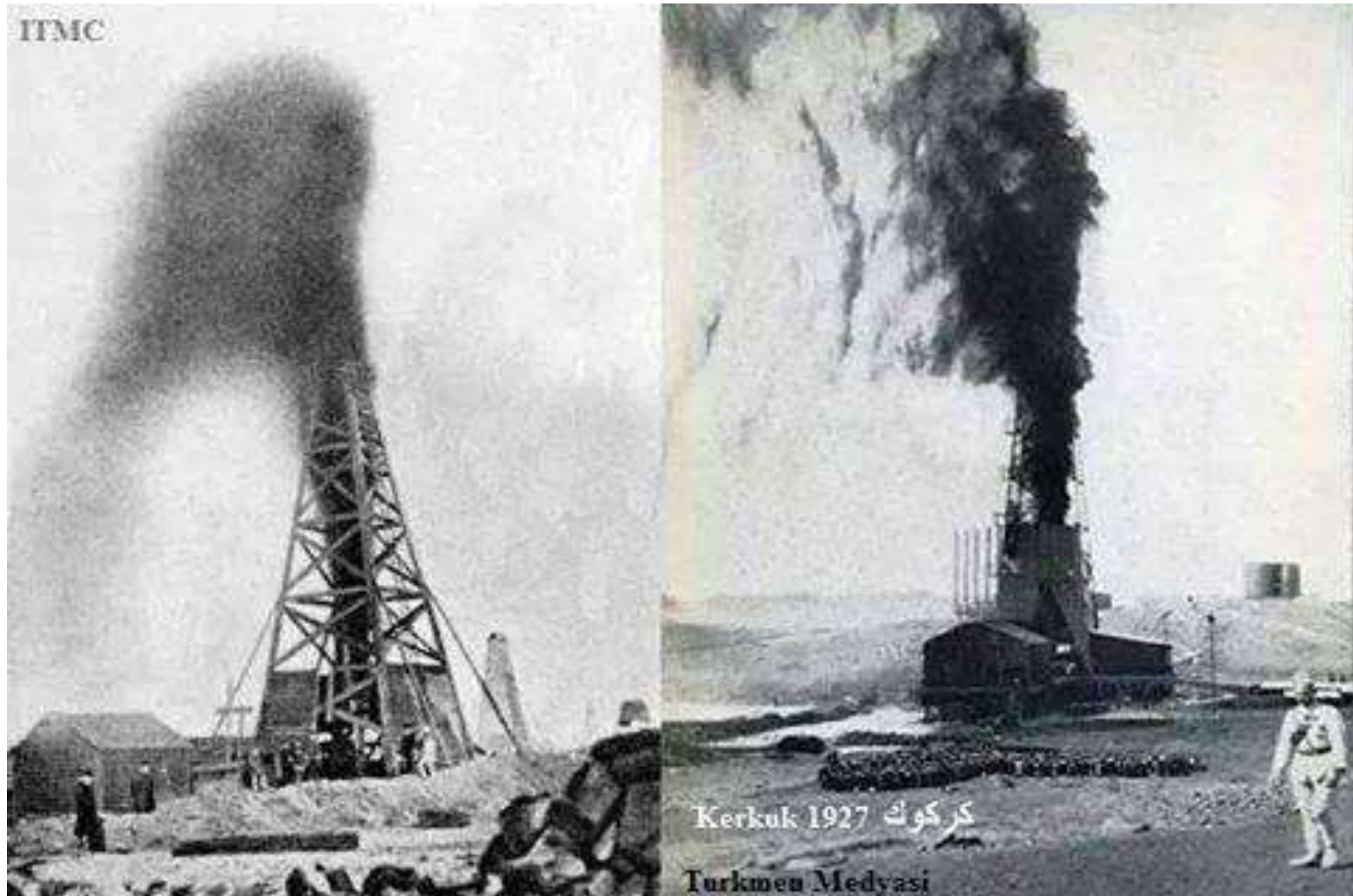


# Oil and Gas in Saudi Arabia



**The first oil well in Iran hit oil in Parsumash  
(MASJED SOLEIMAN) 26 - May - 1908**

# Oil and Gas in Saudi Arabia



**The First Well in Kirkuk Oil Field in Iraq, 1927**



# Oil and Gas in Saudi Arabia

## The First Exploration Concession

In 1910, Othman's empire started searching for oil in Farasan Islands without any success.

## The Second Exploration Concession

In 1926 the British Red Sea Petroleum Company started exploration for oil in the Farasan Islands without success.



# Oil and Gas in Saudi Arabia

## The Third Exploration Concession

In 1923, Holms started searching for oil in AlHassa area in the eastern province of Saudi Arabia. This concession was end with no discovery in 1928.



# Oil and Gas in Saudi Arabia

Oil was discovered in Bahrain island in 1932 in Jebel Dukhan area





# Oil and Gas in Saudi Arabia

Stimulated by the discovery of oil in Bahrain island (Jebel Dukhan) in 1932, attention naturally was directed to the prospects in Saudi Arabia.



# Oil and Gas in Saudi Arabia

## The Fourth Exploration Concession

In 1933, SOCAL started search for oil in Saudi Arabia. After drilling several oil wells to the same discovery depth in Bahrain no signs of oil appeared. In 1938 the company decided to drill deeper in well no.7 where oil was discovered in commercial quantities at 4717 ft below sea level.



Khamis ibn Rimthan AlAjmi



Well no. 7



Max Steineke

# Oil and Gas in Saudi Arabia



Starting Oil Production from Well no. 7



# Oil and Gas in Saudi Arabia



**With Determination and Insistence, Exploration Continues**

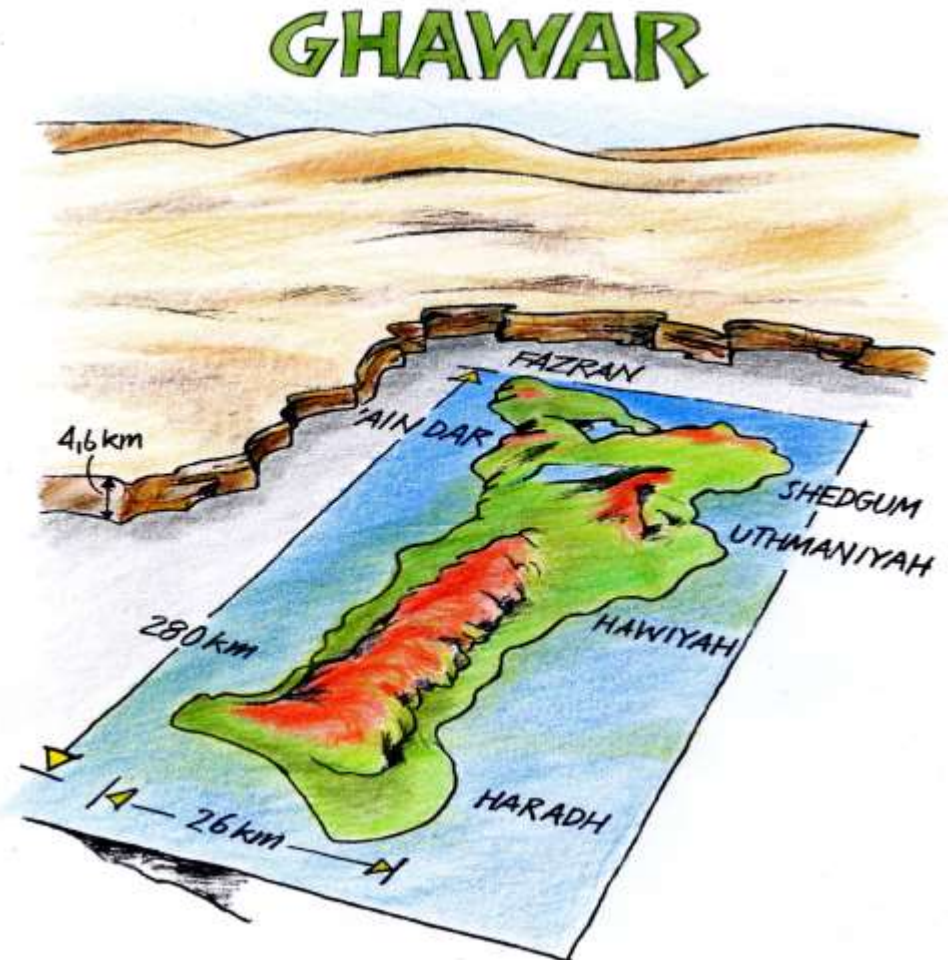
# Oil and Gas in Saudi Arabia



**With Determination and Insistence, Exploration Continues**

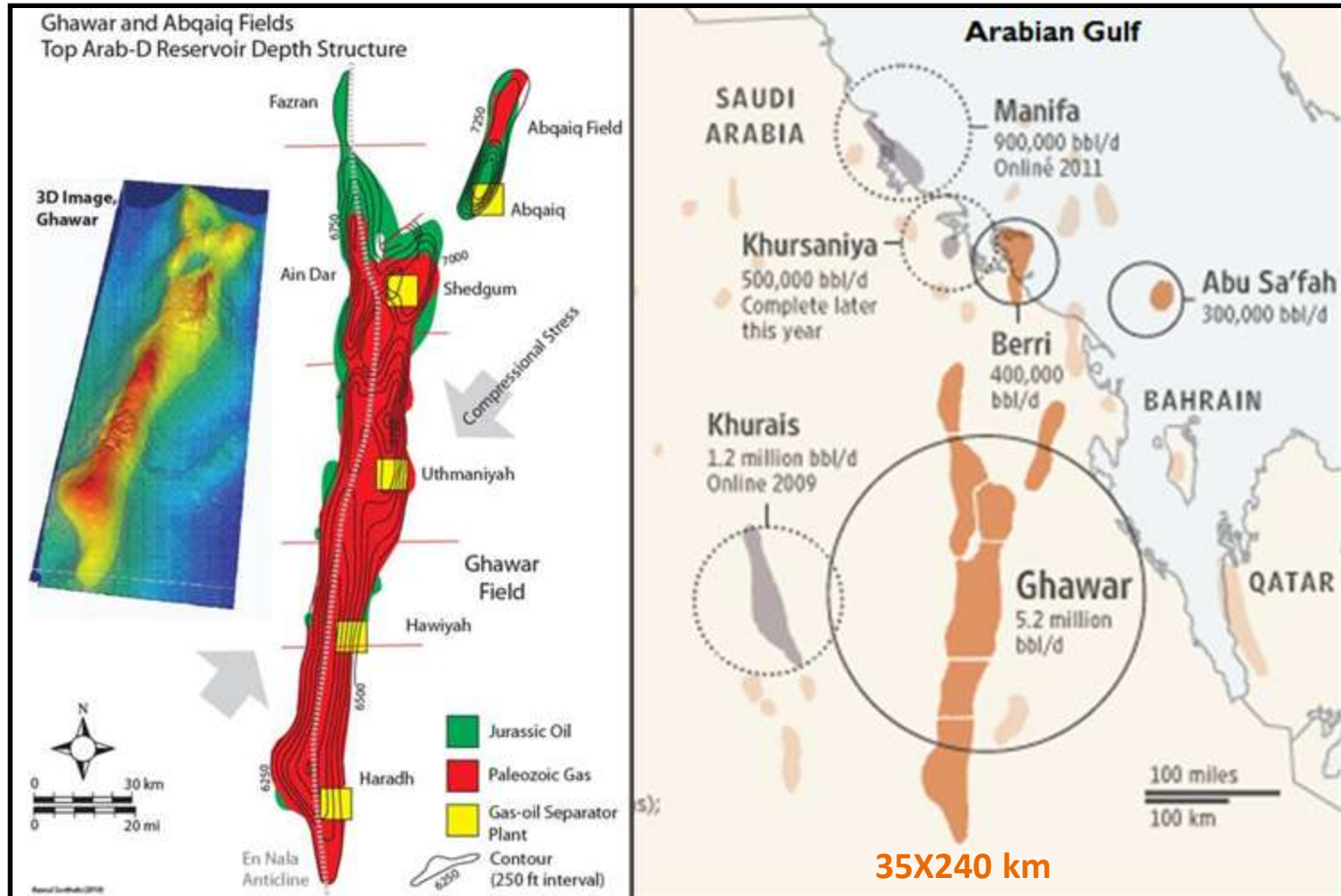
# Oil and Gas in Saudi Arabia

1. Ain Dar oil field, 1948
2. Haradh oil field, 1949
3. Uthmaniyah oil field, 1951
4. Shedgum oil field, 1952
5. Hawiyah oil field, 1953
6. Fazran oil field, 1957



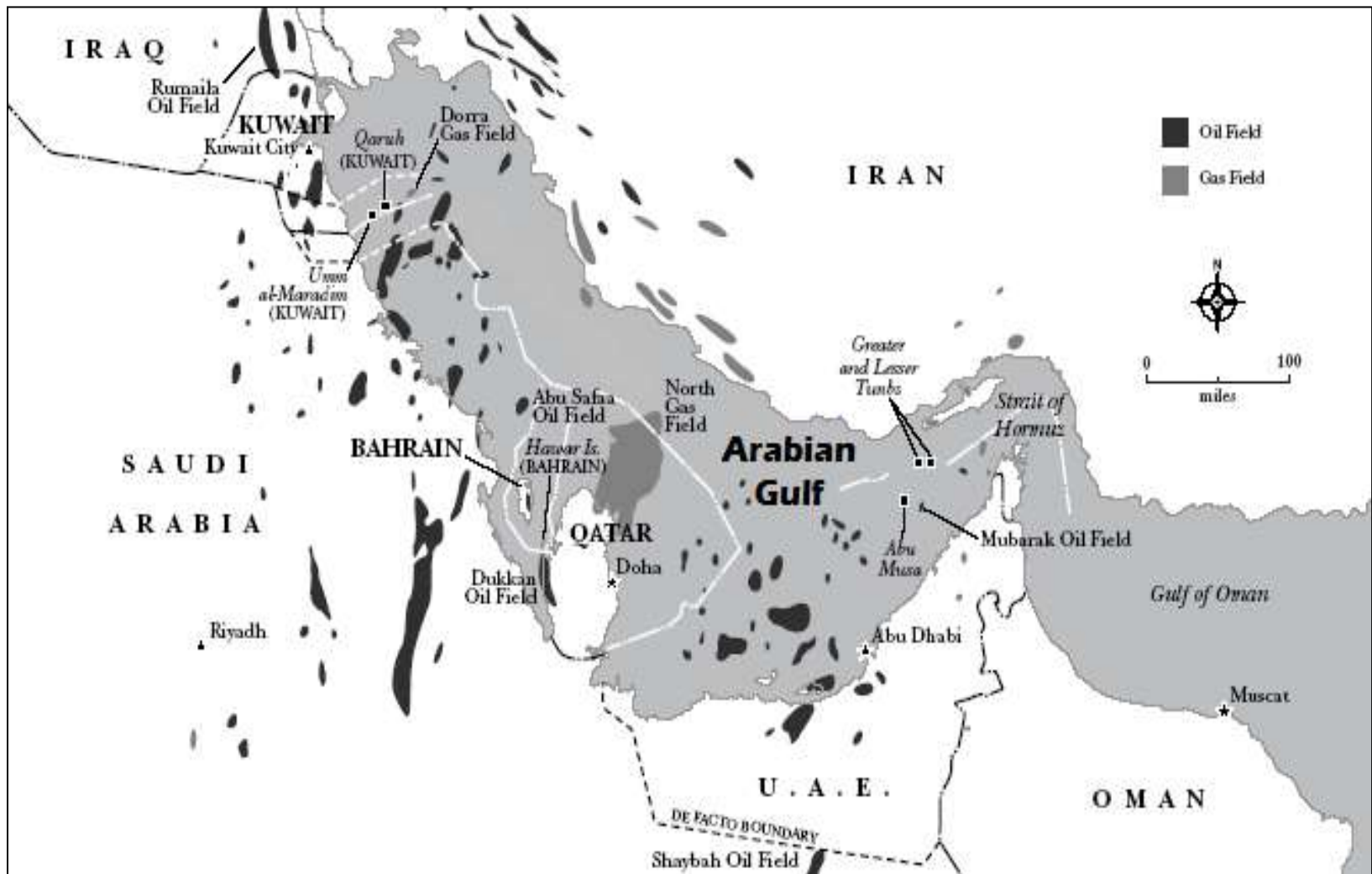


# Middle East Oil and Gas



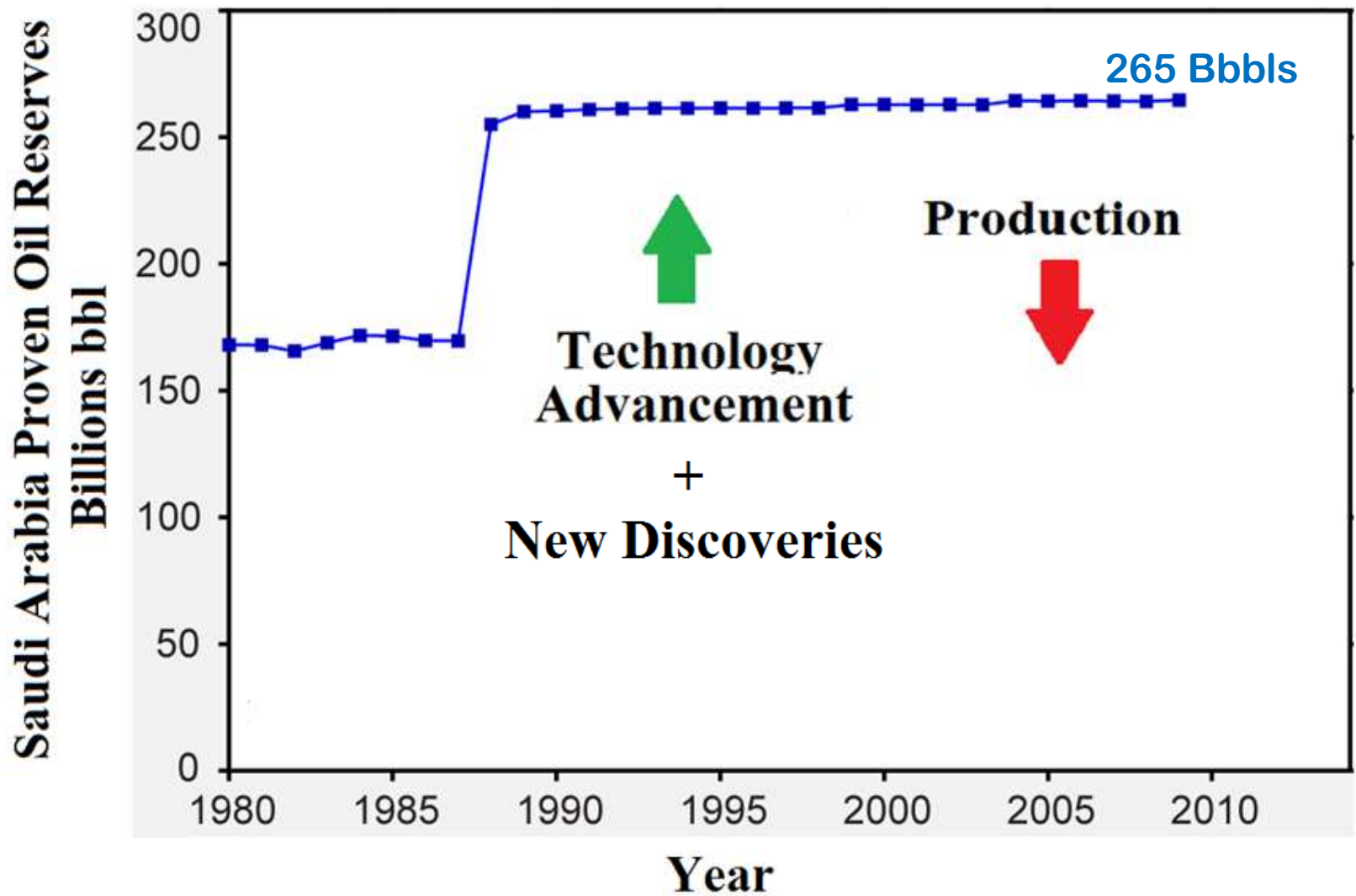
**Ghawwar, the World's Exceptional Super Giant Oil Fields**

# Oil and Gas in Saudi Arabia



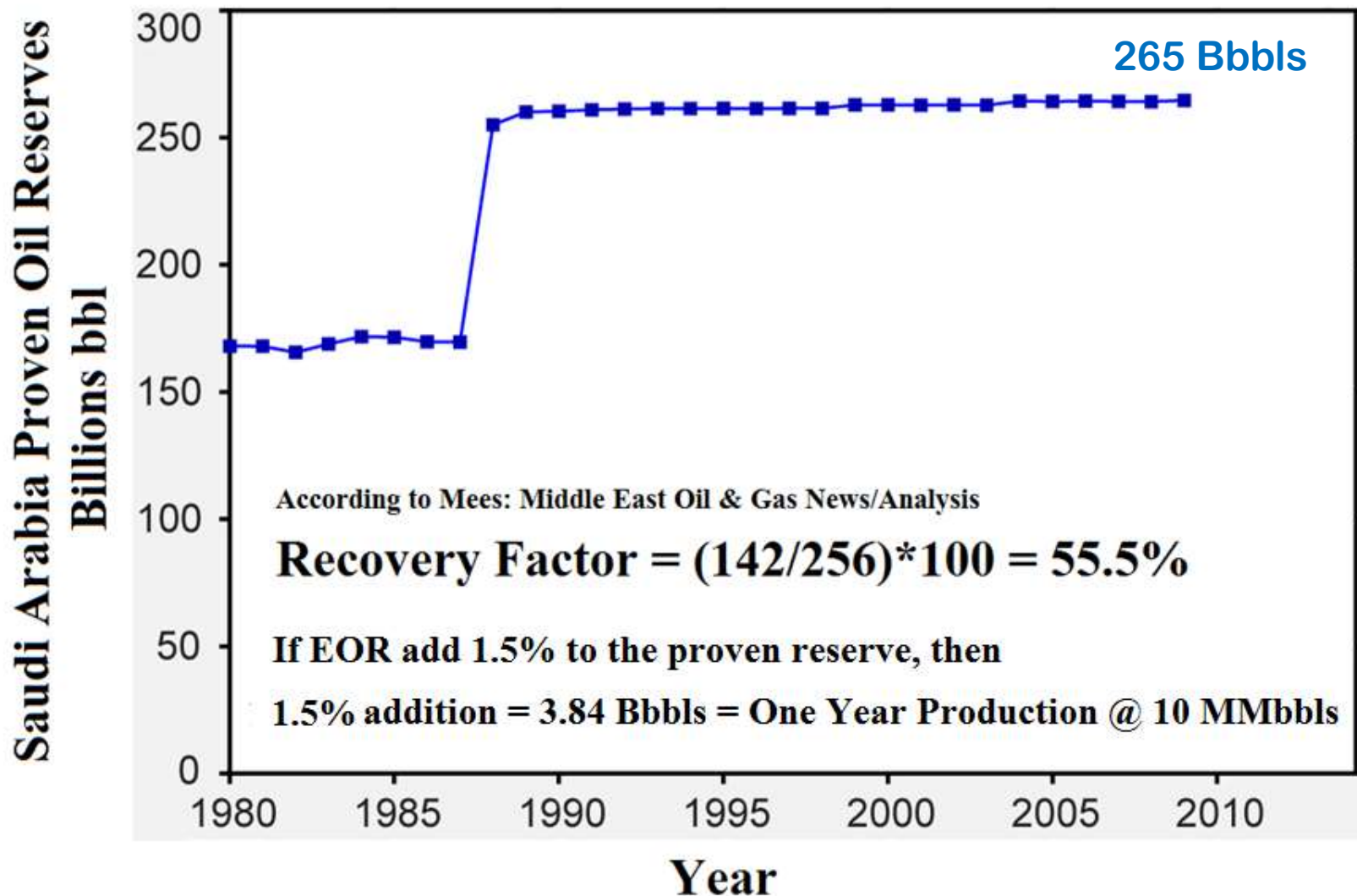
Saudi Oil Fields Map

# Oil and Gas in Saudi Arabia





# Oil and Gas in Saudi Arabia



# Oil and Gas in Saudi Arabia

40 to 49

31 to 39

22 to 30

11 to 21

6 to 10



Classification of Crude Oil Based on API Value

# Oil and Gas in Saudi Arabia

Light

Medium

Heavy

Extra Heavy

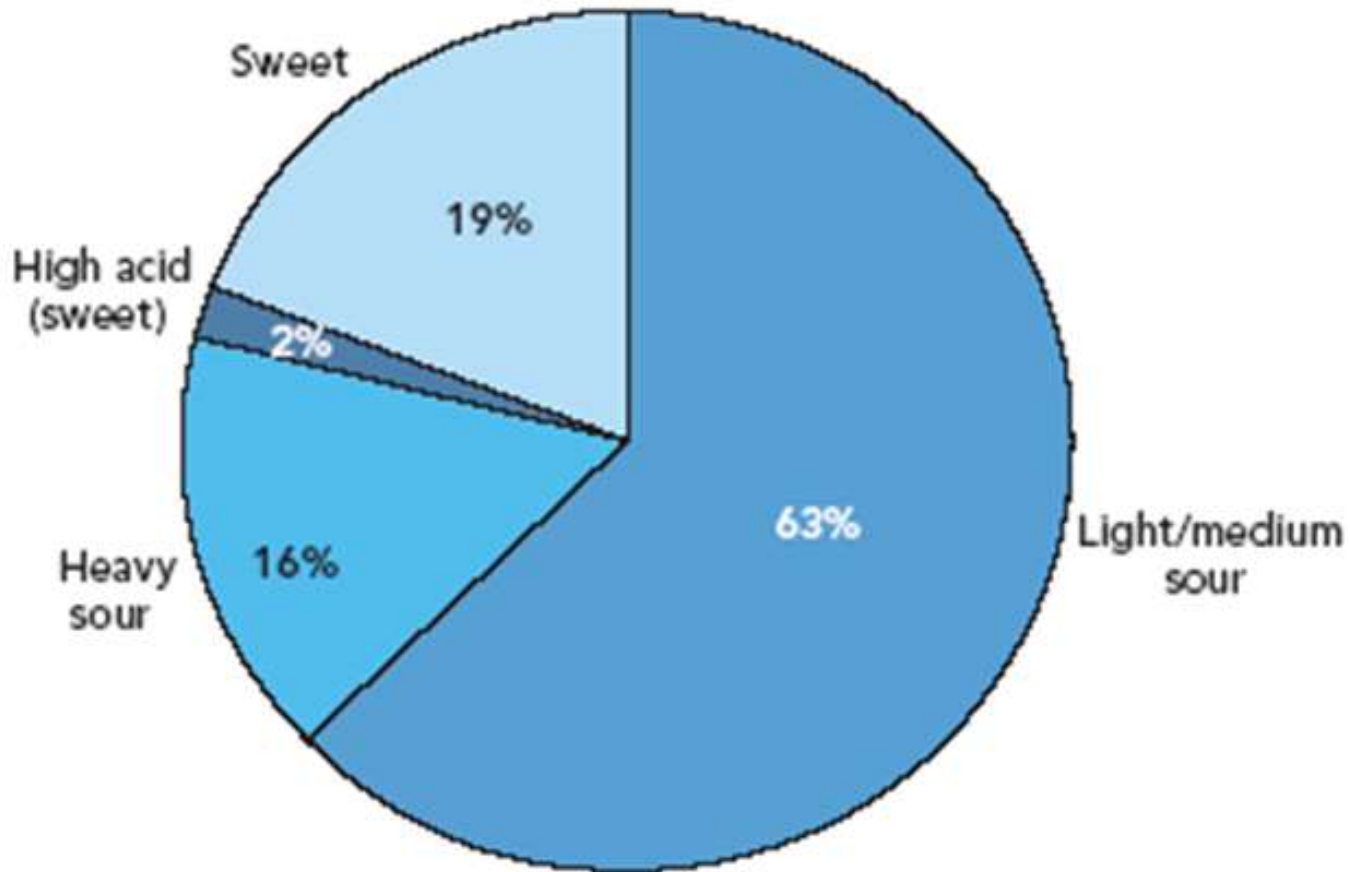
Asphaltene



**Classification of Crude Oil Based on API Value**

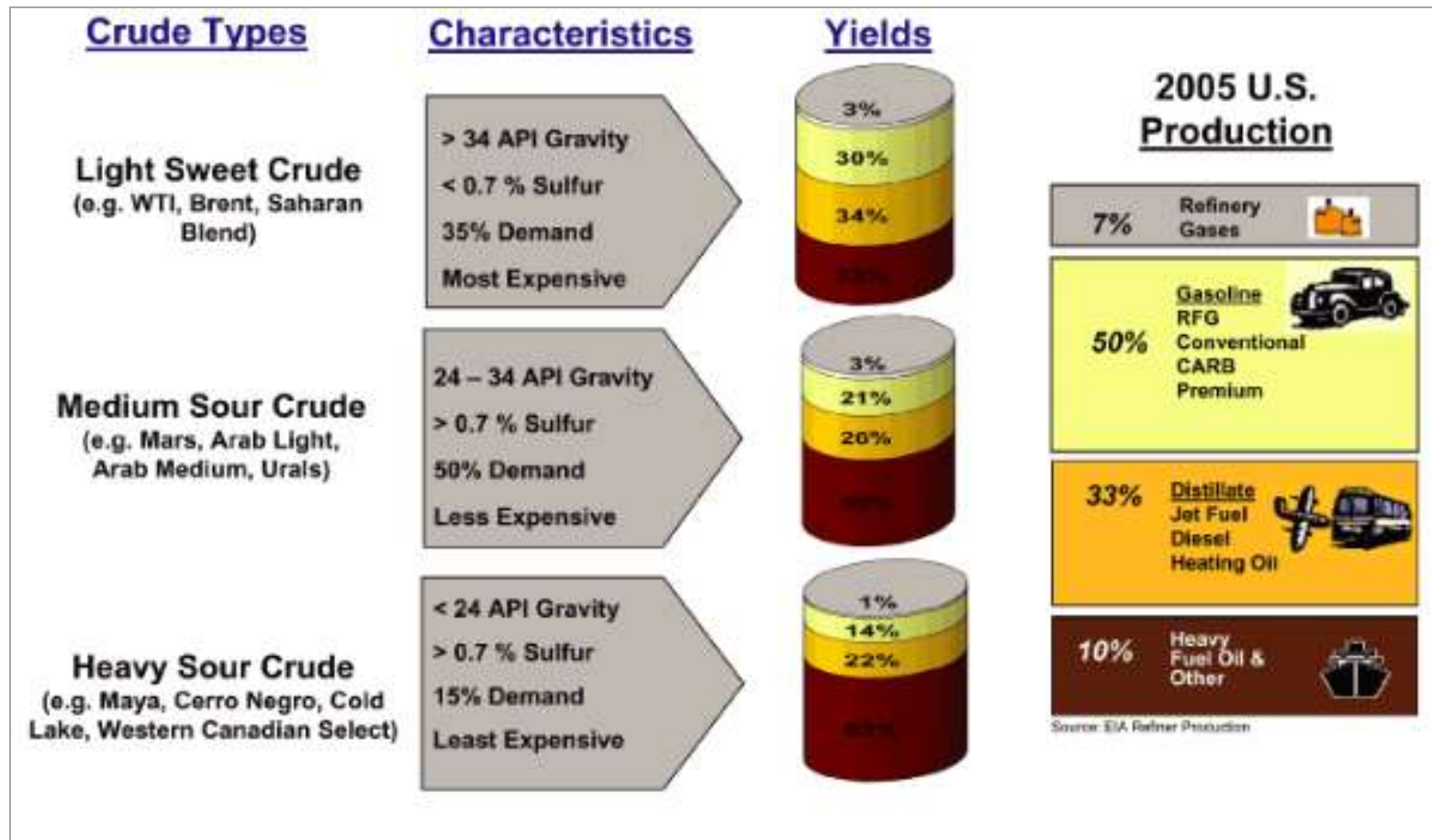


# Oil and Gas in Saudi Arabia



**Quality of Proven Oil Reserves Worldwide**

# Oil and Gas in Saudi Arabia



## Crude Oil Refining Products

# Oil Pricing Criteria

$$P_x = P_m \pm A_f$$

$P_x$  = Price of crude oil type X, \$/bbl.

$P_m$  = Price of Marker (benchmark) crude oil, \$/bbl.

$A_f$  = Adjustment factor, \$/bbl.

Geographic Location	Marker Crude Oil	Price Exchange Market
Europe and Africa	<b>Brent Blend</b> API = 38.3°. Sulfur content = 0.37 wt%.	1) London Petroleum Exchange (LPE).
Middle East and Asia	<b>Dubai-Oman-Arab light</b> API = 32°. Sulfur content = 2.13 wt%.	2) Singapore International Monetary Exchange (SIMEX).
America	<b>West Texas Intermediate (WTI)</b> API = 39.6°. Sulfur content = 0.24 wt%.	3) New York Mercantile Exchange (NYMEX).

Sometimes, total acid number (TAN) is considered as an important factor



# Middle East Oil and Gas

A BARREL OF OIL CHEAPER THAN  
A BUCKET OF CHICKEN

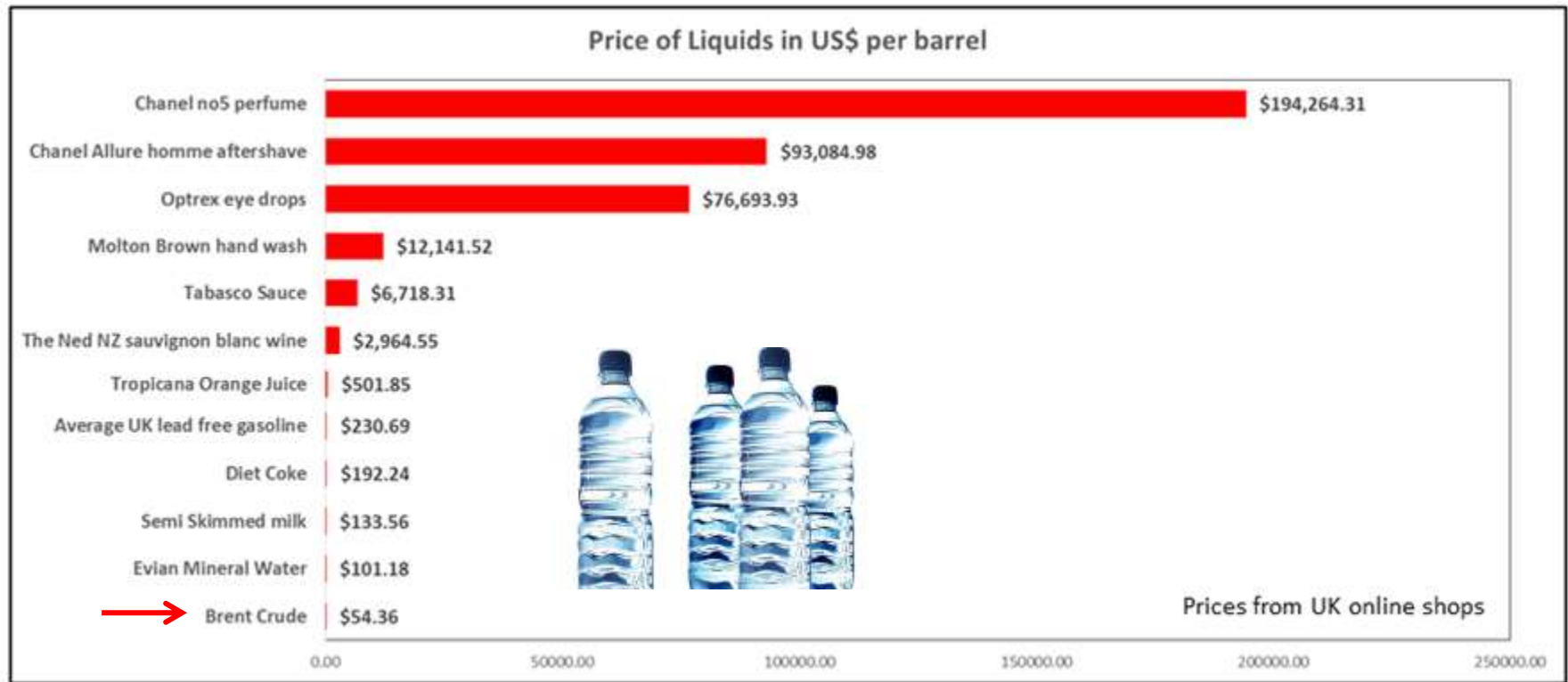
**\$28.75**



**\$27.51**



# Middle East Oil and Gas



Price of liquids December 2016 – Brent oil = \$54.36 / bbl , £1 = \$1.2728, 1 barrel = 158.987 litres

# Oil Price Fluctuations

- OPEC (The Organization of Petroleum Exporting Countries)
- Supply and Demand
- Restrictive Legislation
- Political Unrest
- Production Decline
- Financial Markets
- Weather
- World Oil Strategic Reserves



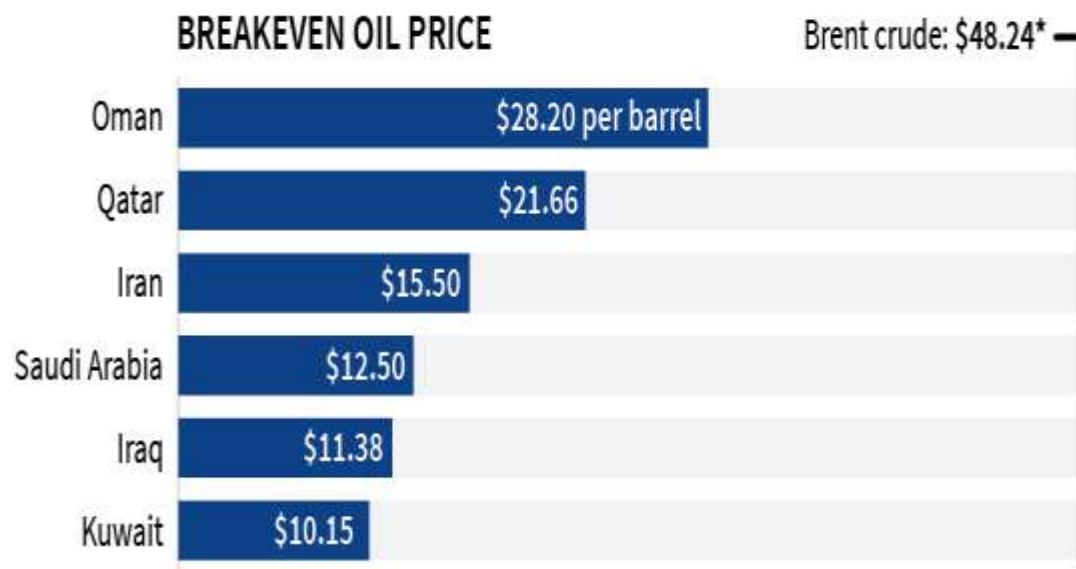
# Oil Price Fluctuations





# Middle East Oil and Gas

## Middle East oil field breakeven costs






\* As of closing Nov. 28, 2016

Sources: Rystad Energy UCube; Thomson Reuters Datastream

S. Culp, 29/11/2016

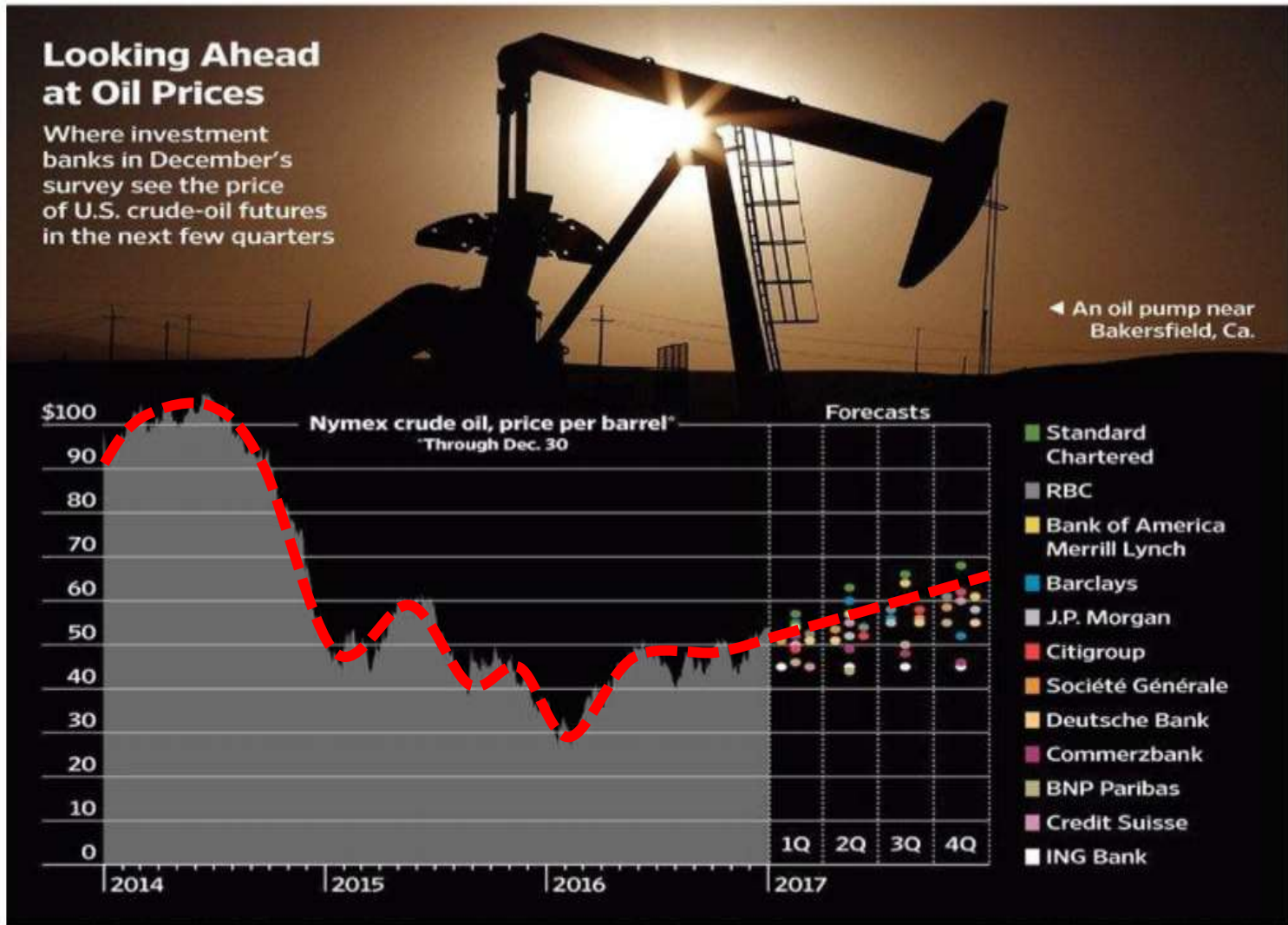


## Budget Breakeven Estimate

	Libya	\$184
	Iran	\$131
	Algeria	\$113
	Iraq	\$109
	Saudi Arabia	\$97
	UAE	\$74
--- <b>Brent crude oil</b>		<b>\$71.25</b>
	Qatar	\$71
	Kuwait	\$52

Information: IMF, Deutsche Bank

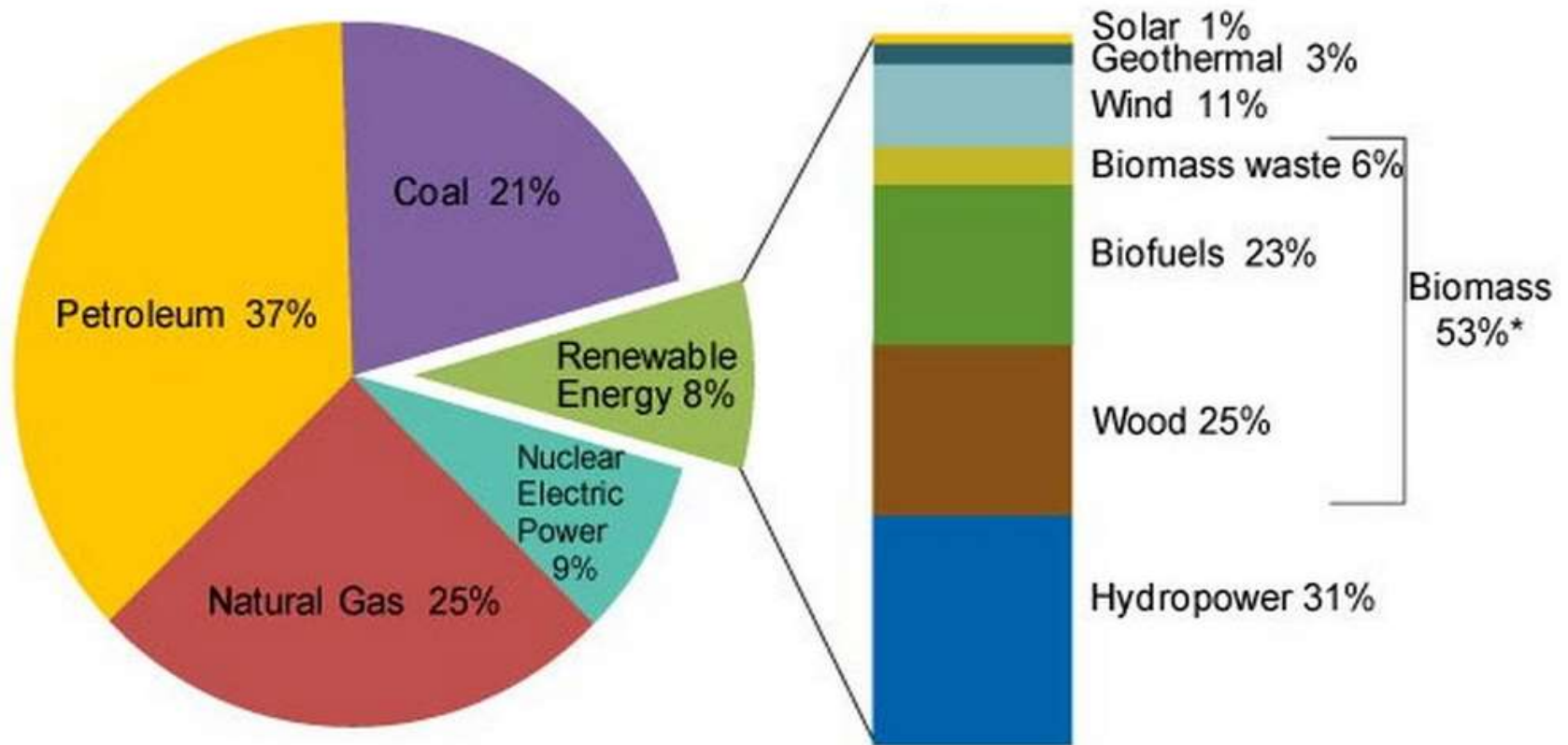
# Middle East Oil and Gas



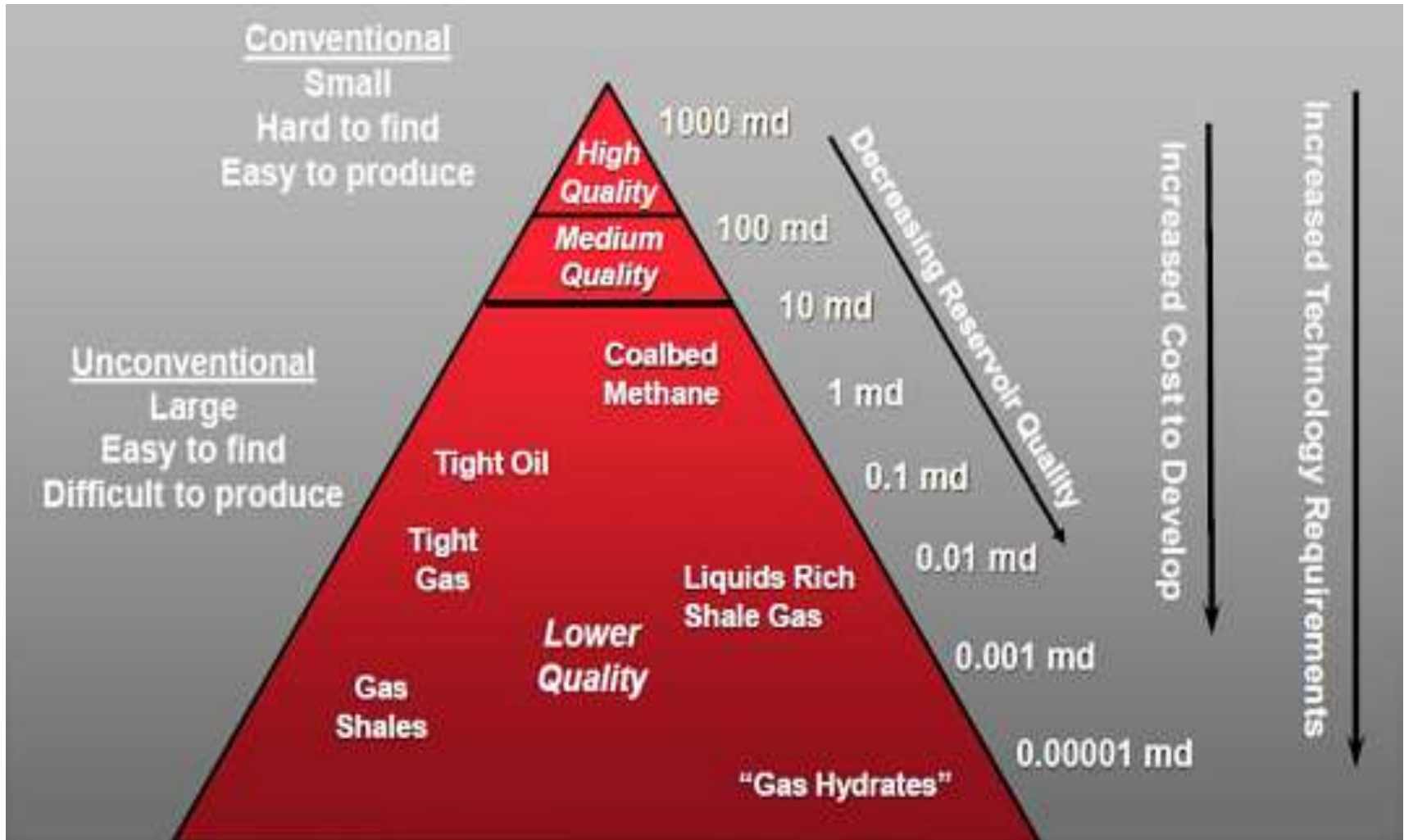
Sources: WSJ Market Data Group (oil price); the companies (forecasts); Reuters (photo)

THE WALL STREET JOURNAL.

# Alternative Energy Recourses

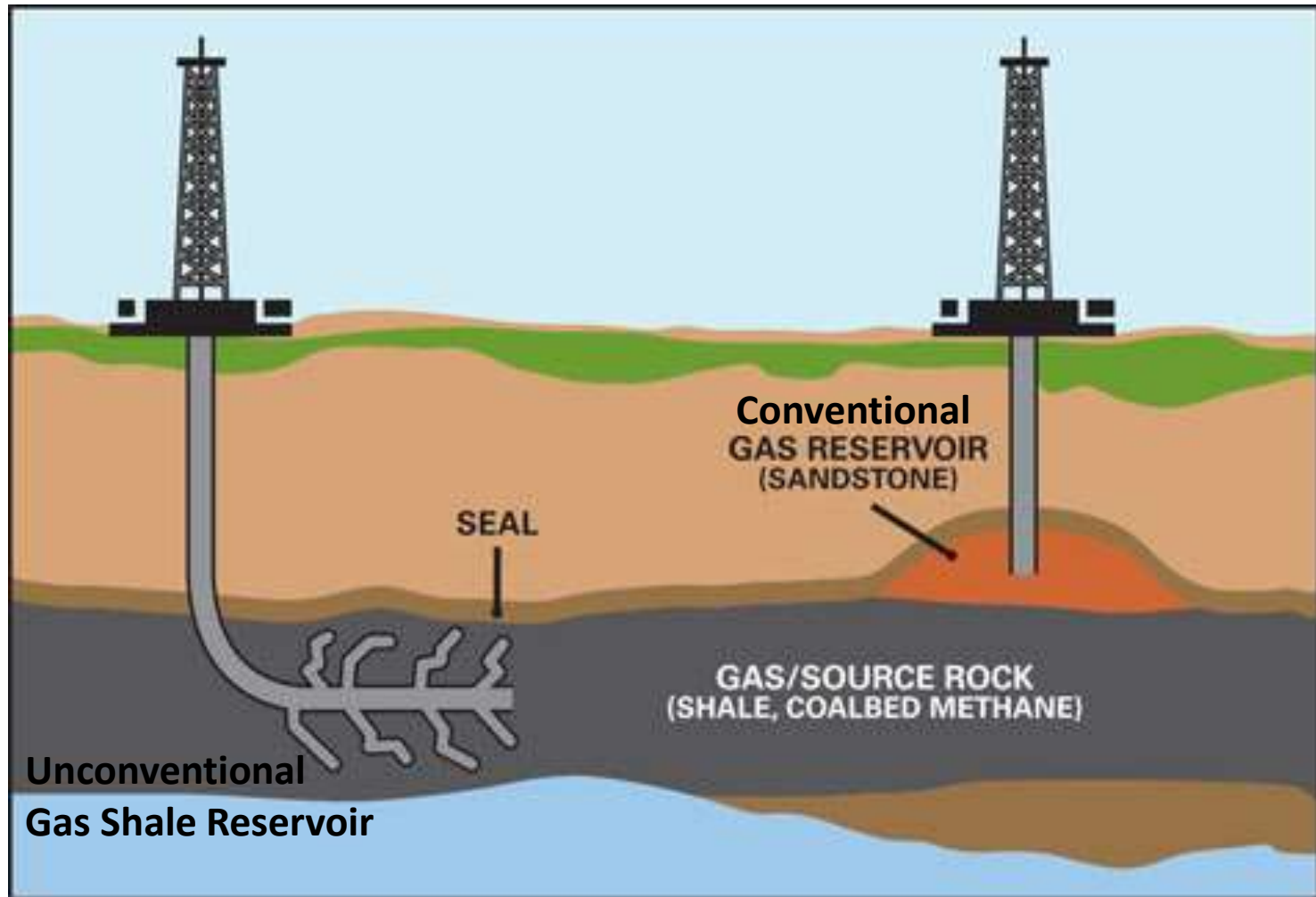


# Alternative Energy Recourses



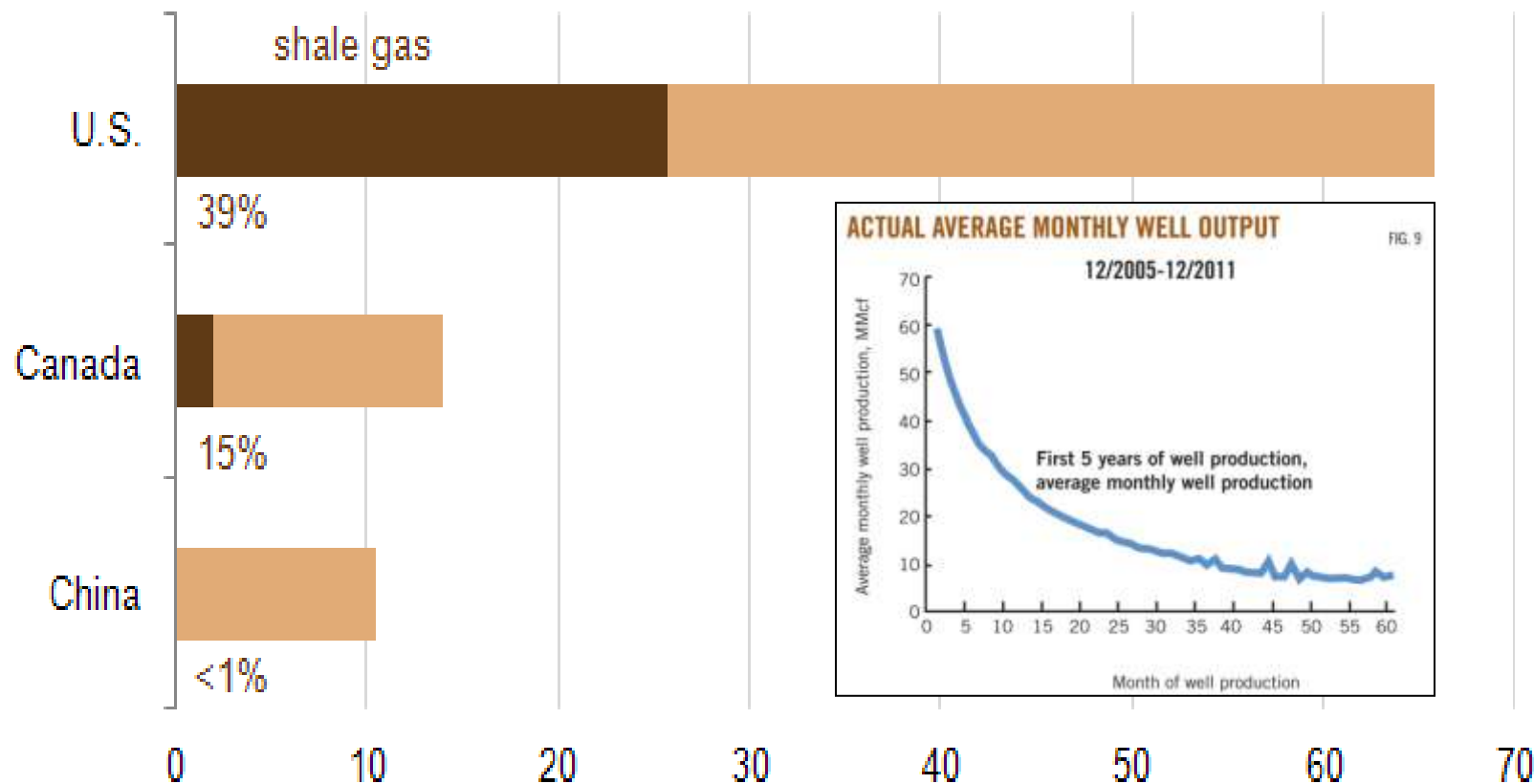


# Alternative Energy Recourses

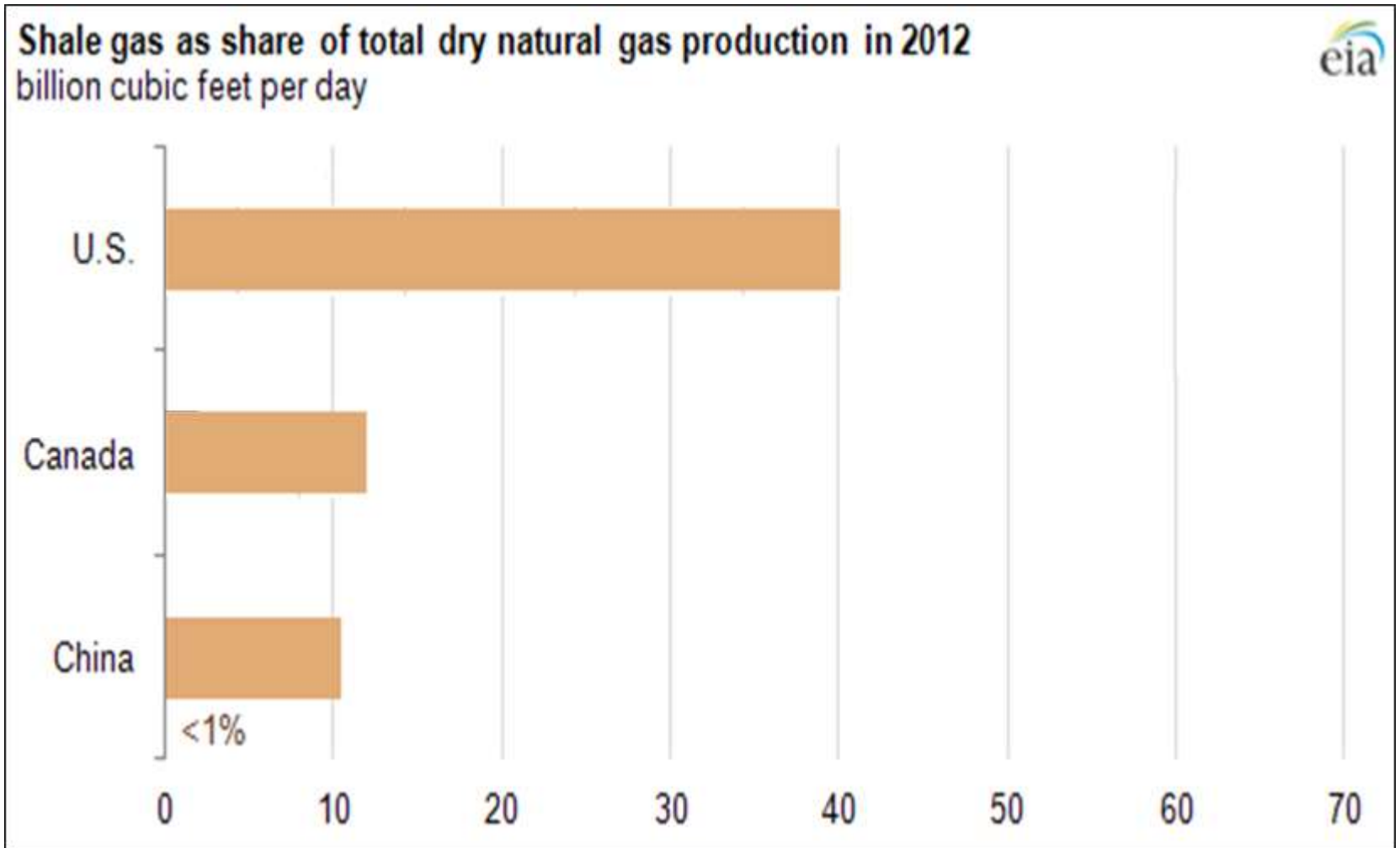


# Alternative Energy Recourses

Shale gas as share of total dry natural gas production in 2012  
billion cubic feet per day



# Alternative Energy Recourses



# Alternative Energy Recourses

The Stone Age didn't end for lack of stone,  
and the oil age will end long before  
the world runs out of oil.

*Sheik Ahmed Zaki Yamani*



## **Economic Depletion**

**A reduction in value, i.e. a better and cheaper alternative is found.**



# Alternative Energy Recourses

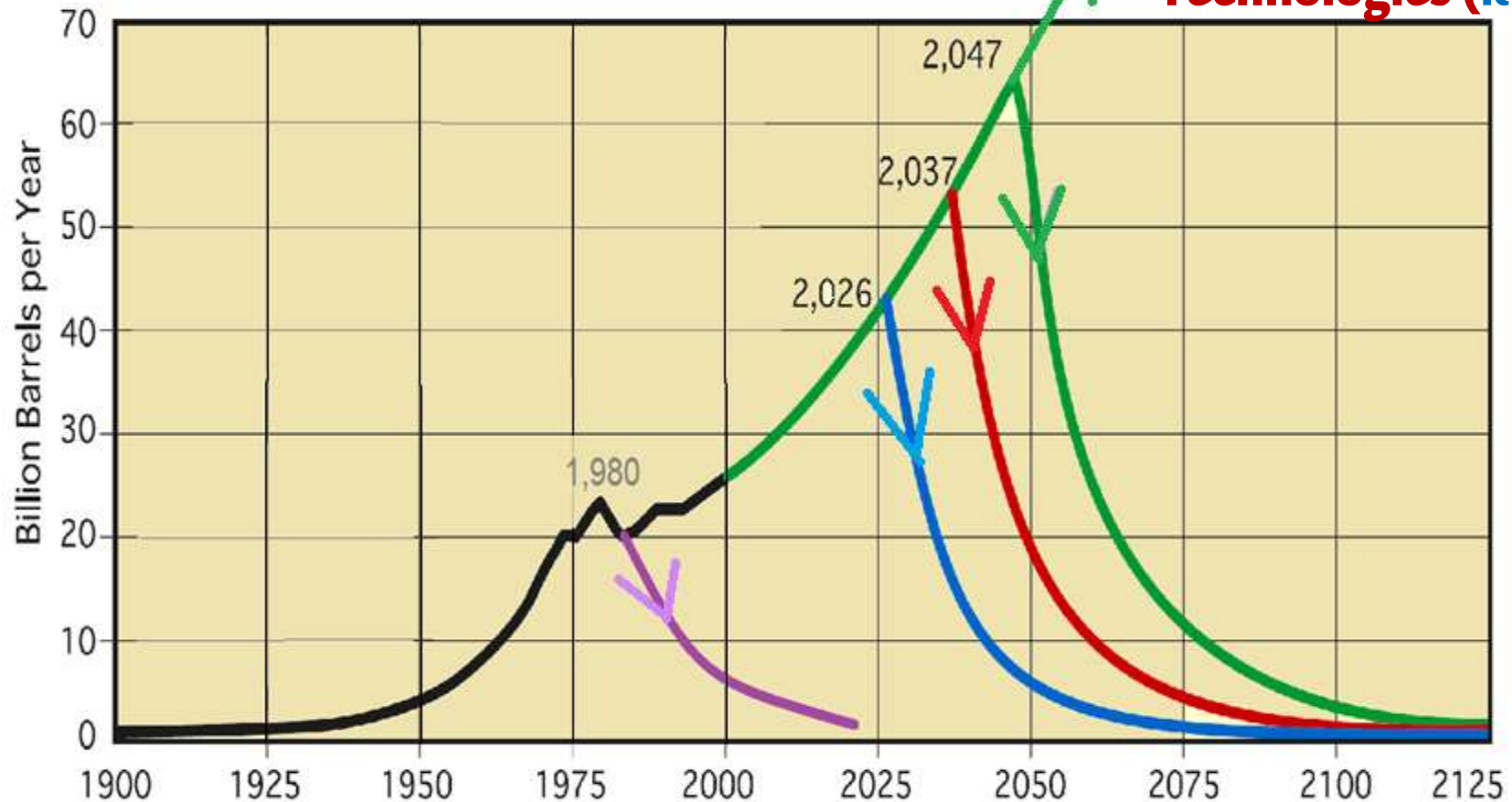


Figure 5: EIA Peak Oil Projections  
Source: Energy Information Administration

# ماذا استفادت المملكة من البترول؟



سابك  
SABK



لَا إِلَهَ إِلَّا اللَّهُ

[14:7] And when your Lord made it known: If you are grateful, I would certainly give to you more, and if you are ungrateful, My chastisement is truly severe.