

# **Fracking for Oil in the USA and its Impact on Angola's Economy**

**Presentation to the Angola Field Group  
at the Viking Club  
Luanda - Angola  
February 5, 2015**

**Tako Koning,  
Senior Petroleum Geologist**

My god, what was that???

I'm not sure, it fell so fast...  
but I think it might have been the oil price.



R.D.

# The presenter: Tako Koning

- Senior Petroleum Geologist
- Holland-born, Canada-raised
- B.Sc. in Geology from University of Alberta, B.A in Economics from University of Calgary
- 44 years of experience in the oil industry including 30 years with Texaco in Canada, Indonesia, Nigeria and Angola
- Has worked and lived in Angola for twenty years (1995 – 2015)

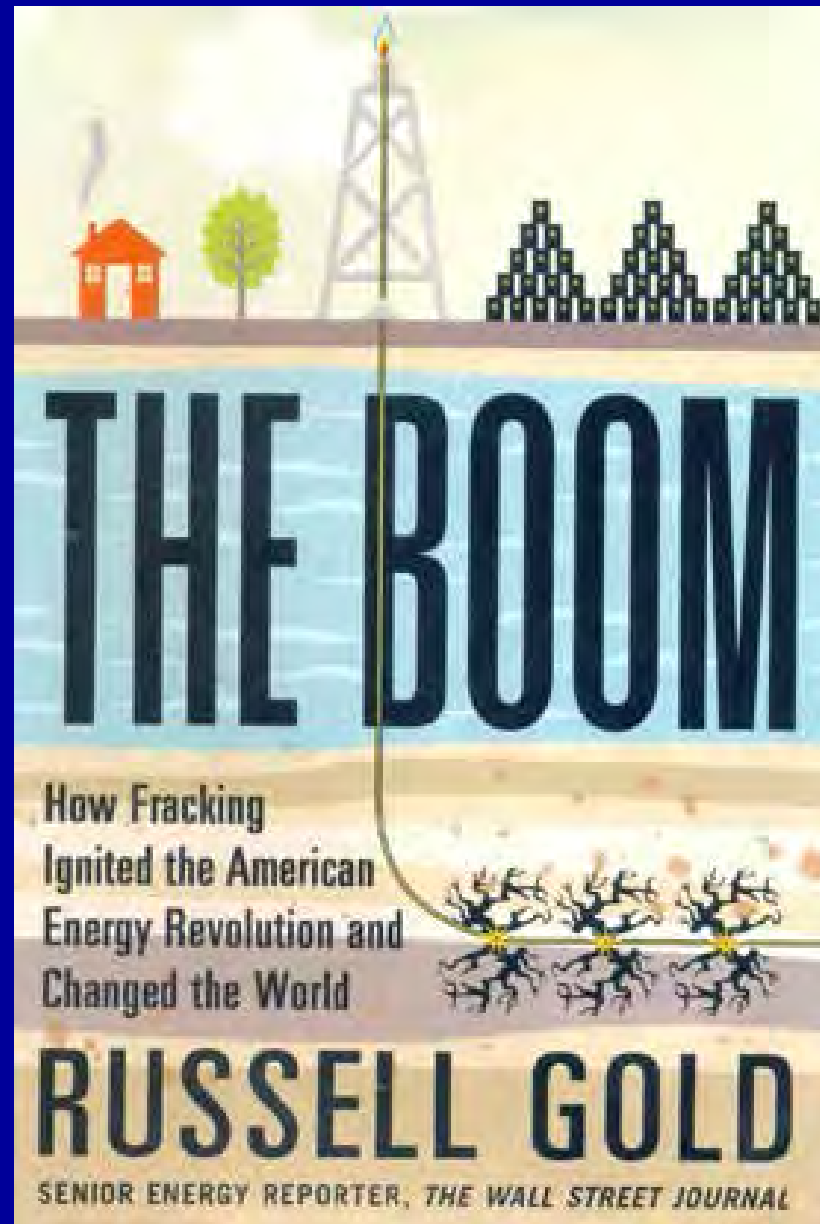
# **THIS PRESENTATION.....**

- This presentation is based entirely on non-confidential public domain information**
- Source of information is oil industry publications and websites**
- Anyone can have a copy of this presentation. I can email it to you**

# DISCLAIMER

- **This presentation represents my personal opinion and not any companies who I consult for**

# Recommended Reading



# Recent Headlines in the News Papers

- "Falling oil price a curse, not a tax cut for the British economy"
- "Falling oil price slide drives Russia's debt to "junk status"

# Recent Headlines in the News Papers

- "Canada faces a budget deficit due to plunging oil prices"
- "Canadian dollar drops 20% relative to USA dollar due to oil price crisis"



# Recent Headlines in the News Papers

- **"American Airlines expects to save \$5 billion from tumbling oil prices"**
- **"Caterpillar warns of sales hit in 2015 due to slow down of projects in oil producing countries"**

# Recent Headlines in the News Papers

- **January 23, 2015**  
**"Earthquake of 4.4 magnitude occurred near Fox Creek, Alberta, Canada and is blamed on fracking operations"**

# Recent Headlines in the News Papers

## Crude near 6-year lows



Over supply: US crude stocks rose to record highs this week

AP/Scanpix

# Recent Headlines in the News Papers

## Oil price collapse sparks 25% drop in rig count

Tally is now down more than 500 units since autumn — but EIA predicts a rebound later this year



Numbers plunge: the US rig count has plummeted  
Photo: AFP/SCAM/C

# Recent Headlines in the Papers

- February 3, 2015, Mr. Bob Dudley, CEO of BP stated "It will be a long time before we see \$100 oil again"

# Recent Headlines in the News Papers

## Obama lauds production but focuses on climate



President Barack Obama: Oil and gas gains are welcome but climate is concern

AFP/Scapto

Noah Brenner 21 January 2015 03:00 GMT

US president Barack Obama touted the country's tsunami of new oil and natural gas production in his yearly State of the Union address and reiterated his strong support of US efforts to curb climate change but he offered few specific initiatives in the energy sector.

# Recent Cartoon in a News Paper



# Recent Headlines in the News Papers

- Schlumberger is laying off 9,000 employees worldwide
- Baker Hughes is laying off 7,000 employees worldwide



# The Shale Revolution

- Quotation: "The ability to fracture shales and obtain oil and gas from them is the biggest *game changer* in my career as a petroleum geologist"
- By Tako Koning, petroleum geologist with 44 years experience in the oil industry

# Basic Petroleum Geology

- For a country to have oil or gas, it must have **sedimentary rocks** which occur in **sedimentary basins**
- If a country has no **sedimentary rocks**, then it has no oil & no gas
- For example, Botswana has only granites, accordingly no oil & no gas
- For example, Sweden has only granites , accordingly no oil & no gas

# Shale Outcrops in Alaska



# Shales - Mudstones

- **Shales** are hardened mud rocks, also called mudstones
- Thick layers of **shales** occur in sedimentary basins worldwide
- Not all **shales** will produce oil or gas when they are fracked

# Shales - Mudstones

- **Shales** have always been viewed as "tight", meaning impervious and incapable of flowing oil or gas
- However, in the mid 1990's George Mitchell, a Texas engineer experimented with fracturing the Burnet Shale in Texas to flow oil and gas

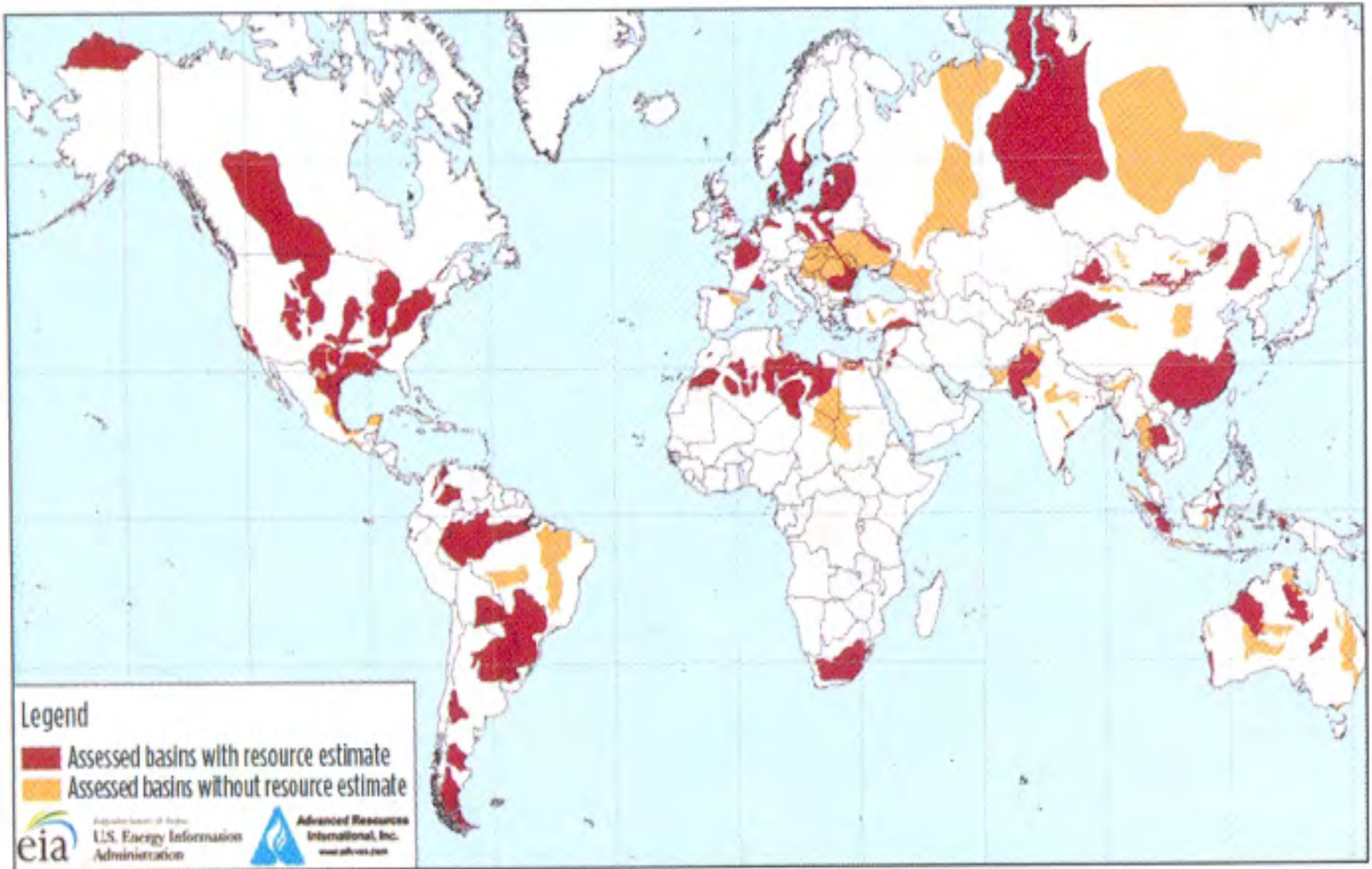
# George Mitchell, Petroleum Engineer

- George Mitchell is regarded as the father of hydraulic fracturing
- By 2008 big volumes of oil & *natural gas* was flowing from shales in the southern USA

# Shale Oil Production from Fracking

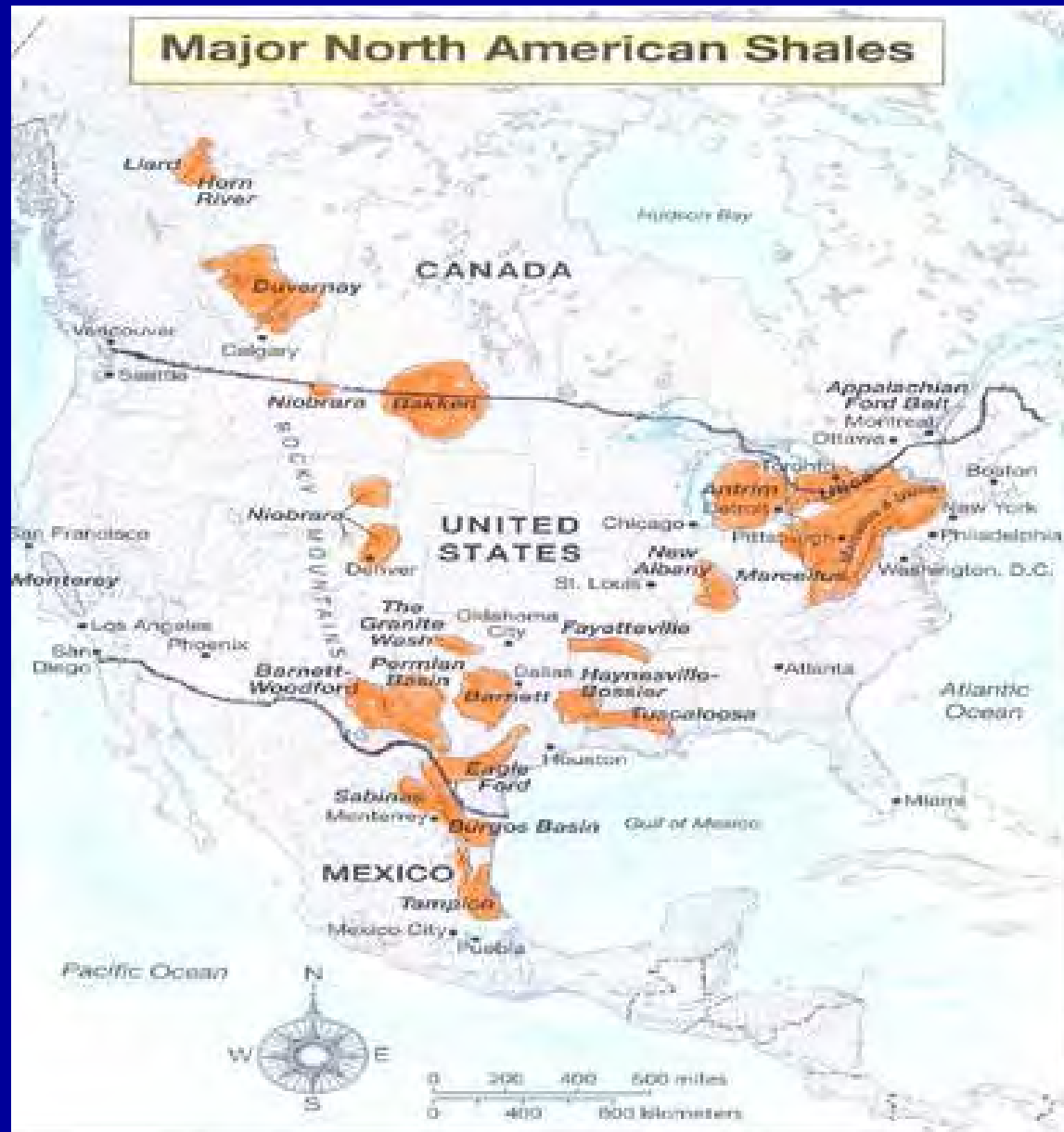
- Fracking of shales spread to Pennsylvania exploiting the Marcellus Shale for oil & *gas*
- Also to North Dakota where fracking of the Bakken shale now produces 1.2 million barrels of oil in the state of North Dakota!

# Shale basins worldwide





# Major North American shale basins



**Rate of oil production is commonly measured in barrels of oil per day**



# Global Oil Production – Top 20

<u>Country</u>	<u>Oil Production in barrels of oil per day (bo/d)</u>
1.) Russia	10,600,000 – will decline due to sanctions
2.) Saudi Arabia	9,500,000 – has 10%(?) excess production capacity
3.) USA	9,000,000 – now includes 4.0 mmbo/d due to fracking
4.) China	4,200,000 – oil production has peaked, plateaued
5.) Canada	3,400,000 – includes 2.1 mmbo/d from oil sands
6.) Iran	2,700,000 – reduced production due to sanctions
7.) Iraq	2,600,000 – increasing due to more oil from Kurdistan
8.) Kuwait	2,600,000 – steady, stable oil production
9.) Mexico	2,500,000 – low due to PEMEX monopoly
10.) U.A.E.	2,400,000 – steady, stable oil production
11.) Nigeria	2,200,000 – low due to security problems
12.) Brazil	2,200,000 – increasing due to pre-salt oil production

- continued onto next slide -

# Global Oil Production – Top 20

13.) Venezuela	2,100,000 – low production due to government policies
14.) Angola	1,800,000 – steady, stable oil production
15.) Norway	1,600,000 – will increase 15% in next 3 years
16.) Kazakhstan	1,600,000 – steady, stable oil production
17.) Algeria	1,200,000 – low due to security problems
18.) Qatar	1,200,000 – steady, stable oil production
19.) Colombia	1,000,000 – increasing due to new oil discoveries
20.) U.K.	1,000,000 – declining, mostly depleted old oil fields
<b>TOTAL TOP 20</b>	<b>64,450,000 bo/d</b>
<b>OTHER COUNTRIES</b>	<b>25,350,000 bo/d</b>
<b>TOTAL WORLD</b>	<b>90,800,000 bo/d</b>

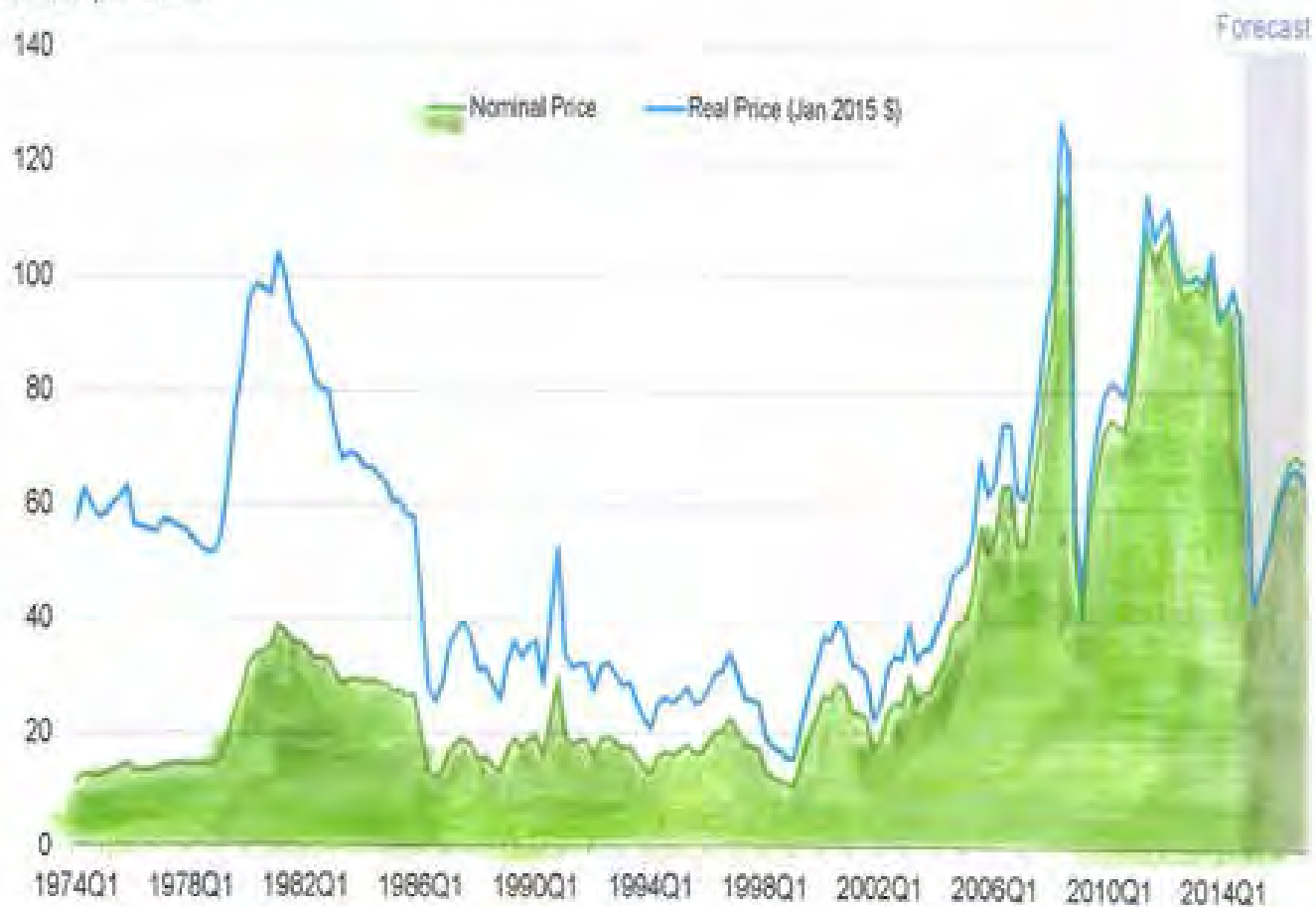
**NOTE:** OPEC produces about 30,000,000 bo/d which is 30% of the world's oil production. OPEC member Saudi Arabia produces 10% of the world's oil production. This data is effective to February 5, 2015. Sources of information is the Society of Petroleum Engineers' Journal of Petroleum Technology, USA EIA (Energy Information Administration), BP Annual Global Oil & Gas Review, and OPEC news releases. This data is for crude oil (black oil) and does not include NGL's (Natural Gas Liquids) and condensate. By Tako Koning, updated as new information becomes available.

# THE OIL & GAS BUSINESS – ECONOMICALLY VOLATILE!!

- *July 11, 2008*: oil prices peaked at \$147 per barrel and plummeted down to \$35 per barrel by December, 2008, then back to about \$110 per barrel
- Now about \$55 per barrel

# Oil Prices 1974 - 2014

Quarterly Imported Crude Oil Price  
dollars per barrel



# Oil Prices 2000 - 2014



# World Oil Production

- Current world oil production is **91 million barrels of oil per day**
- OPEC produces **30 million barrels of oil per day**, i.e. 30% of world's oil production
- Saudi Arabia produces **9.5 million barrels of oil per day**, i.e about 10% of world's oil production



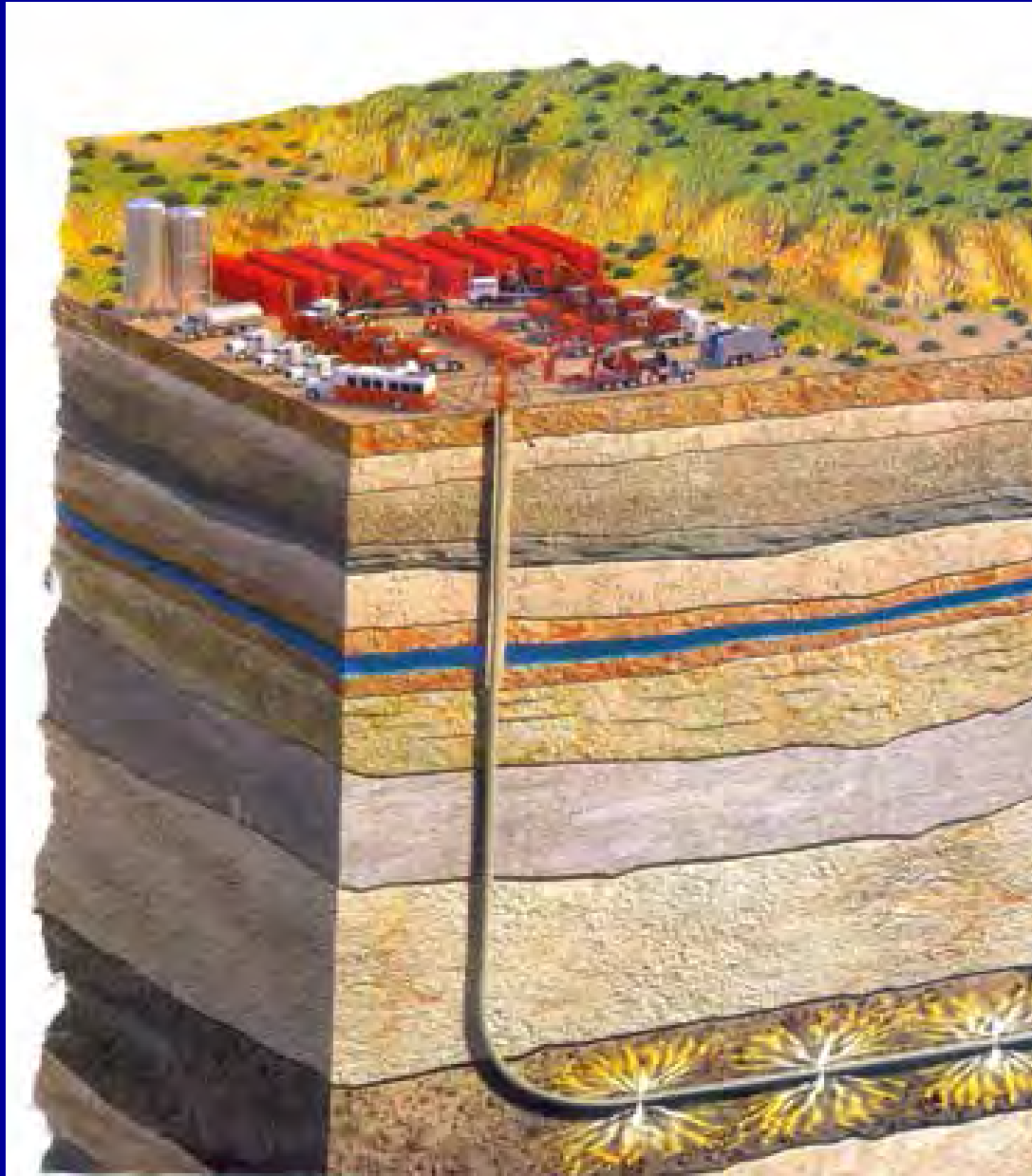
# Saudi Arabia

- Saudi Arabia has only two items in huge supply: sand and oil
- Oil is absolutely crucial to their economy

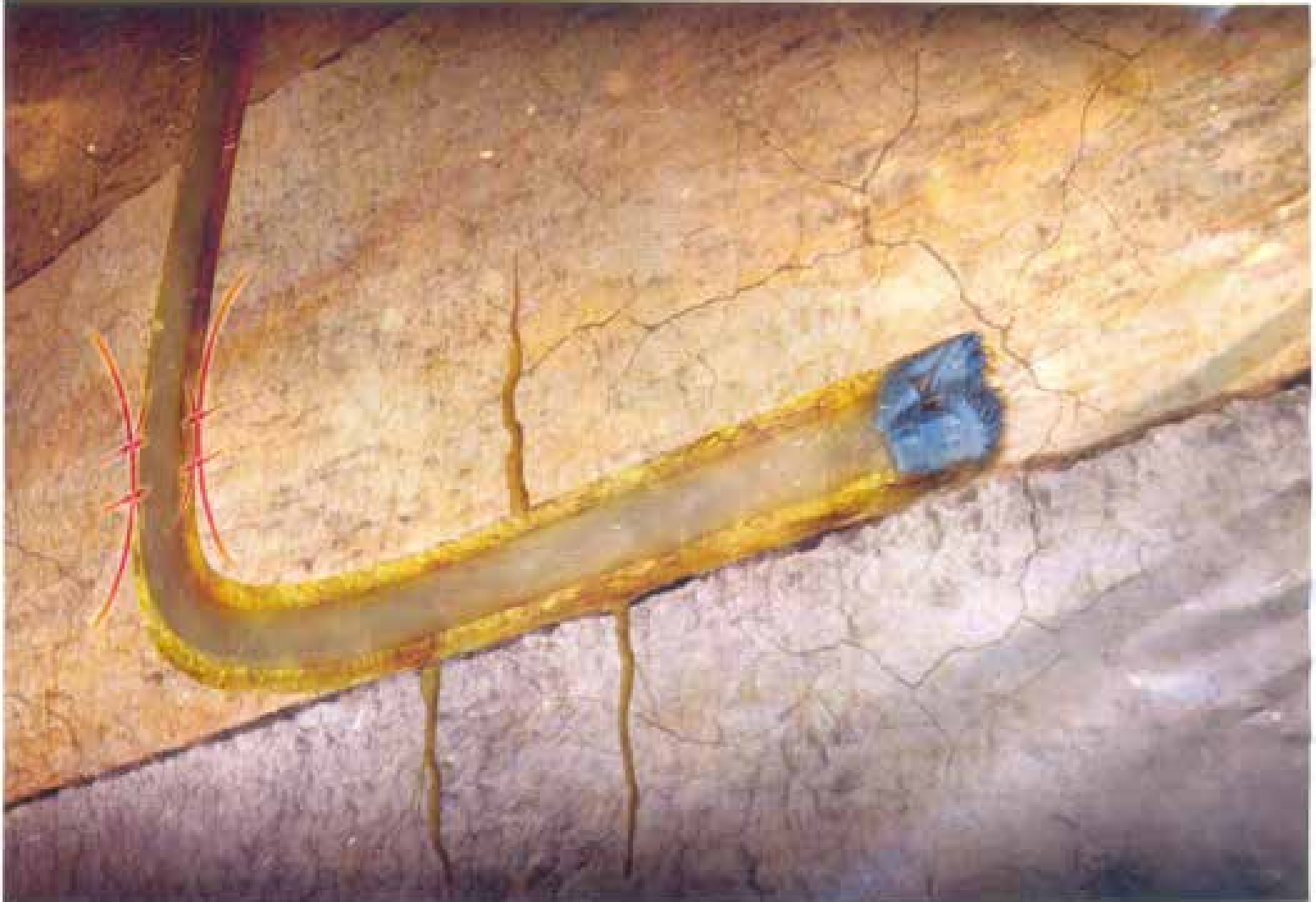
# Saudi Arabia

- Has not increased production in the past year, consistently producing **9.5 million barrels of oil per day**
- Will not reduce production since it is determined to keep its global market share which is **10% of world's oil production**

# Fracking Technology



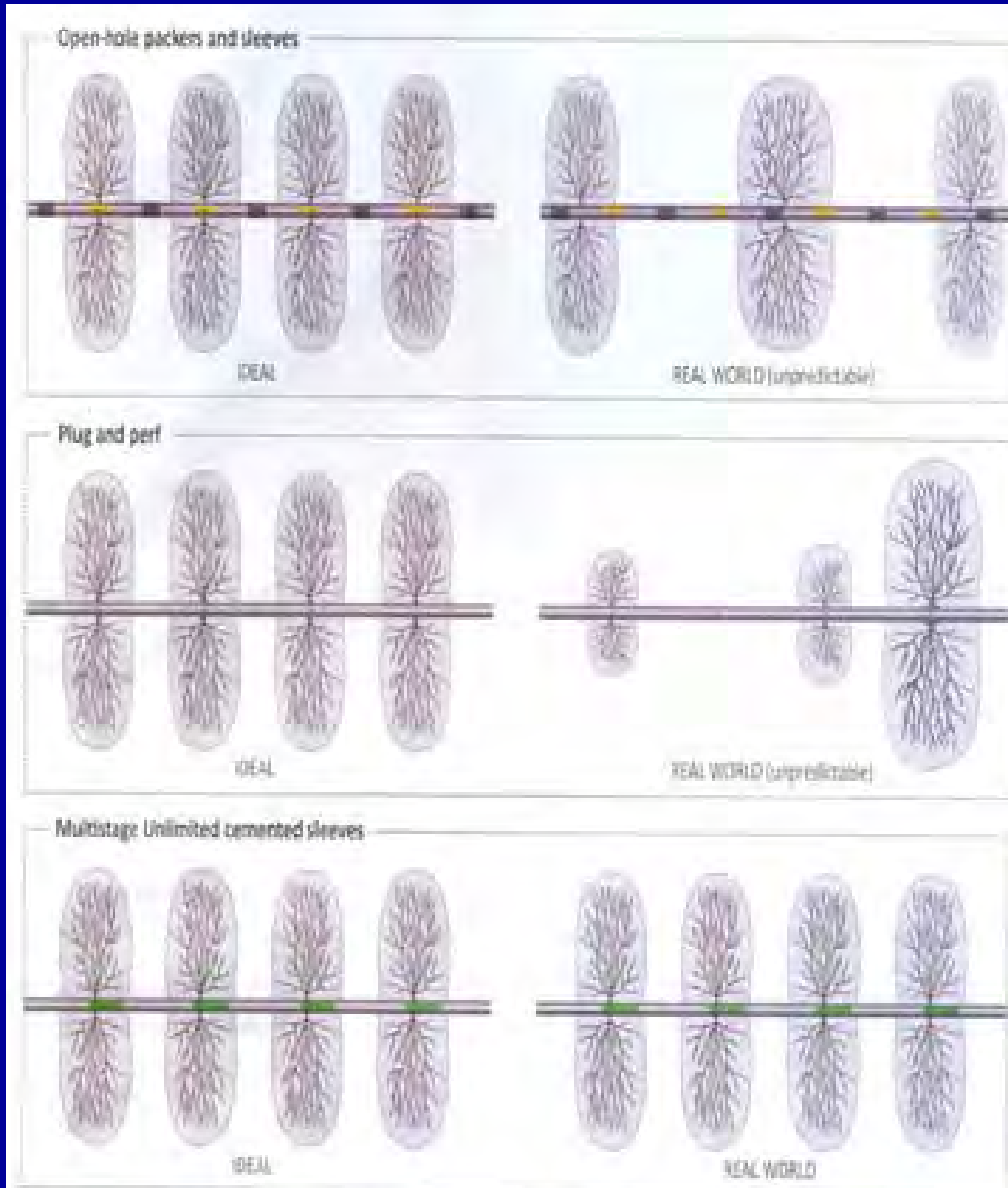
# Fracking Technology – Drilling a Horizontal Drain Hole



# Fracking Technology

- 1.) Drill down to 2,000 to 3,000 meters
- 2.) Turn well horizontally and drill a 1,000 to 3,000 meters (10,000 feet) drain hole
- 3.) Cement in steel casing
- 4.) Perforate through casing into zones of interest
- 5.) Do high pressure multi-frac operations
- 6.) Pump "propants" (small glass beads) into fractures to keep the fractures open and prevent fractures from closing
- 7.) Produce oil (or gas) from the well!

# Fracking Technology



# Fracking operation of Eagle Ford shale in south Texas



# Producing Oil from the Eagle Ford shale, south Texas





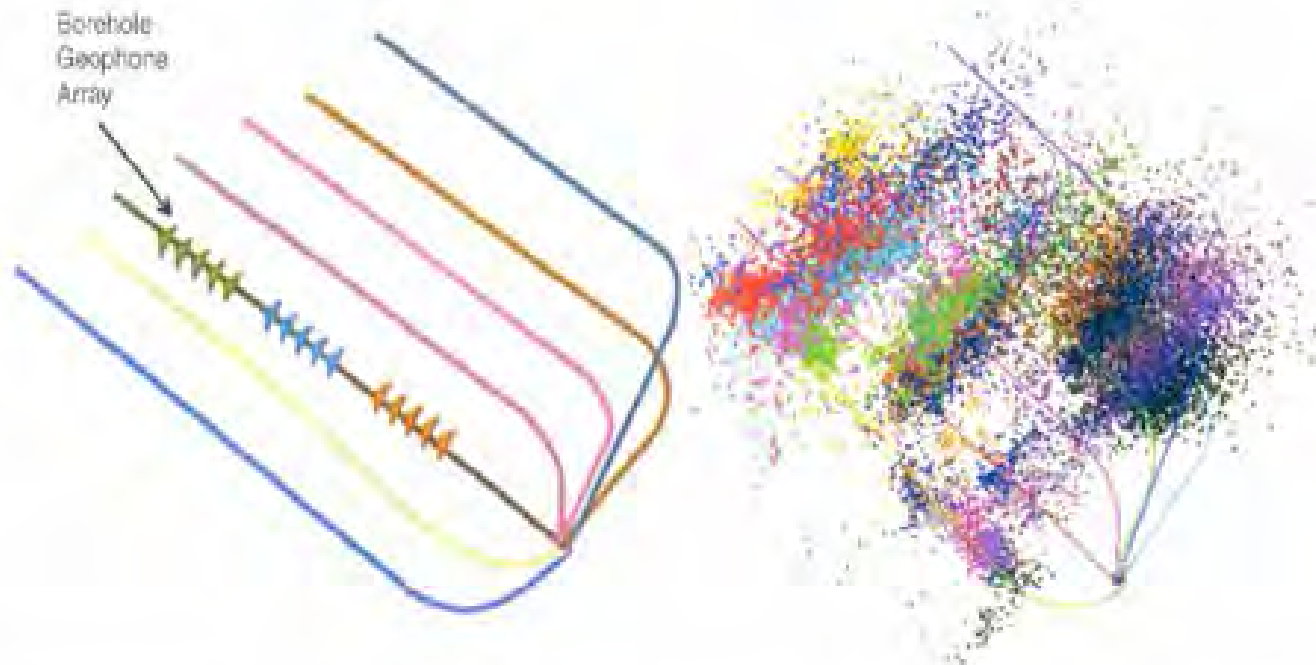
# Fracking operation in the desert of Oman, Middle East



# Fracking operation in New Brunswick, Canada



# Multiple bore holes – up to 15 from a single location



The image on the left shows the position of microseismic geophones and on the right are the microseismic events recorded during a zipper-fracturing sequence. *Image courtesy of Research Partnership to Secure Energy for America, and Gas Technology Institute.*

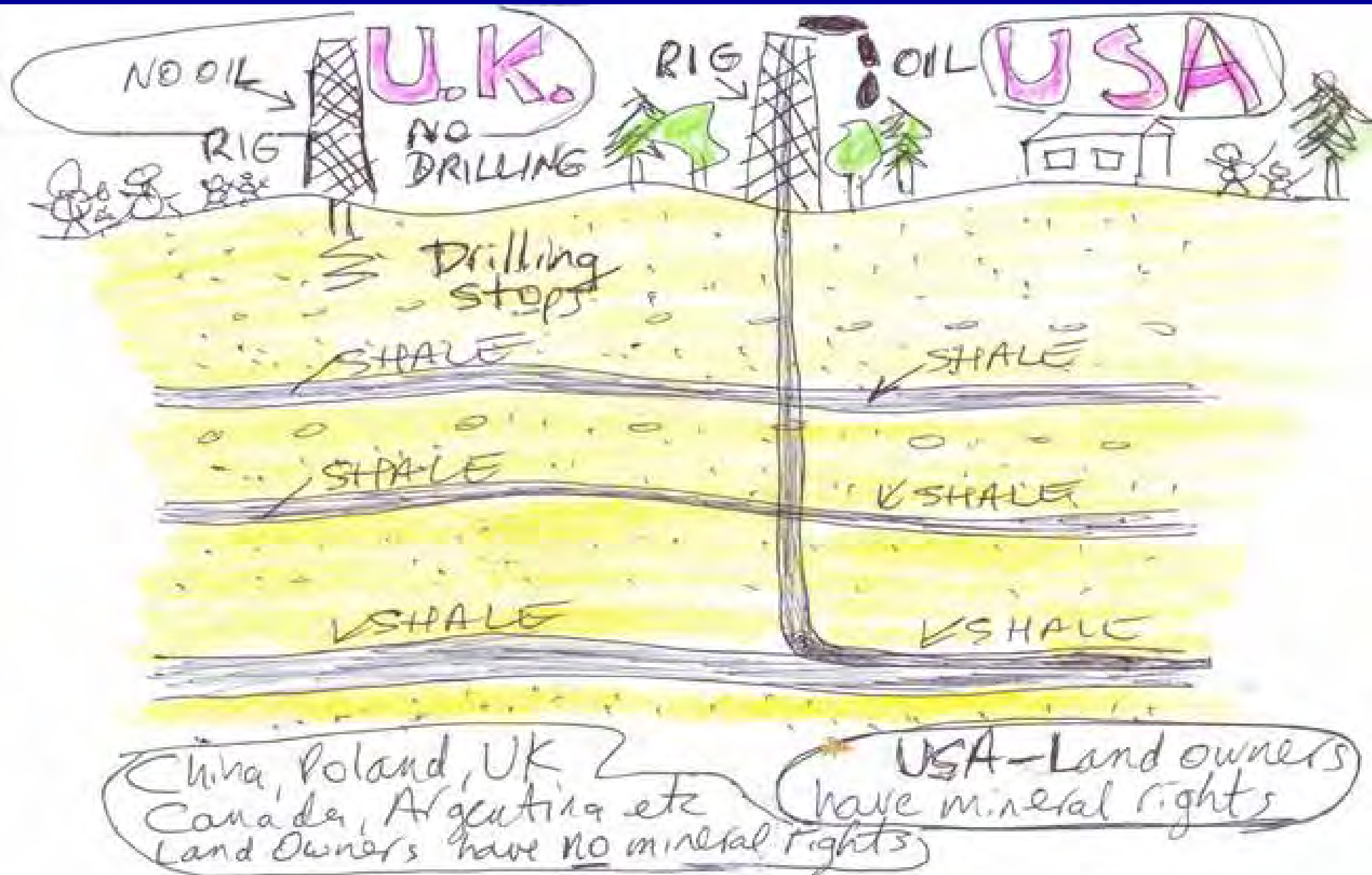
# Fracking – only onshore, *not* offshore

- Hydraulic fracking of shales is the same as fracking
- As you saw on previous photos, it takes a huge amount of equipment, trucks, pumps, etc so it can only be done onshore and not offshore, so with Angola all its oil is offshore so there will be no fracking happening in Angola

# Fracking – Costs Going Down

- According to IHS Energy, typical fracturing costs have fallen from \$70 to \$55/barrel in the past year
- The oil industry has learned to drill wells faster and cheaper and with better oil and gas flow rates

# Fracking—Outside USA & in USA



# Fracking – Incentives in USA

- The USA is the *only* country where landowners also own the underlying mineral rights, so they can greatly profit from oil or gas production on their lands
- Everywhere else, like U.K., Poland, China, Canada, Argentina, etc landowners do *not* own the mineral rights so they are inclined to oppose oil or gas production on their lands since they will not personally benefit from it

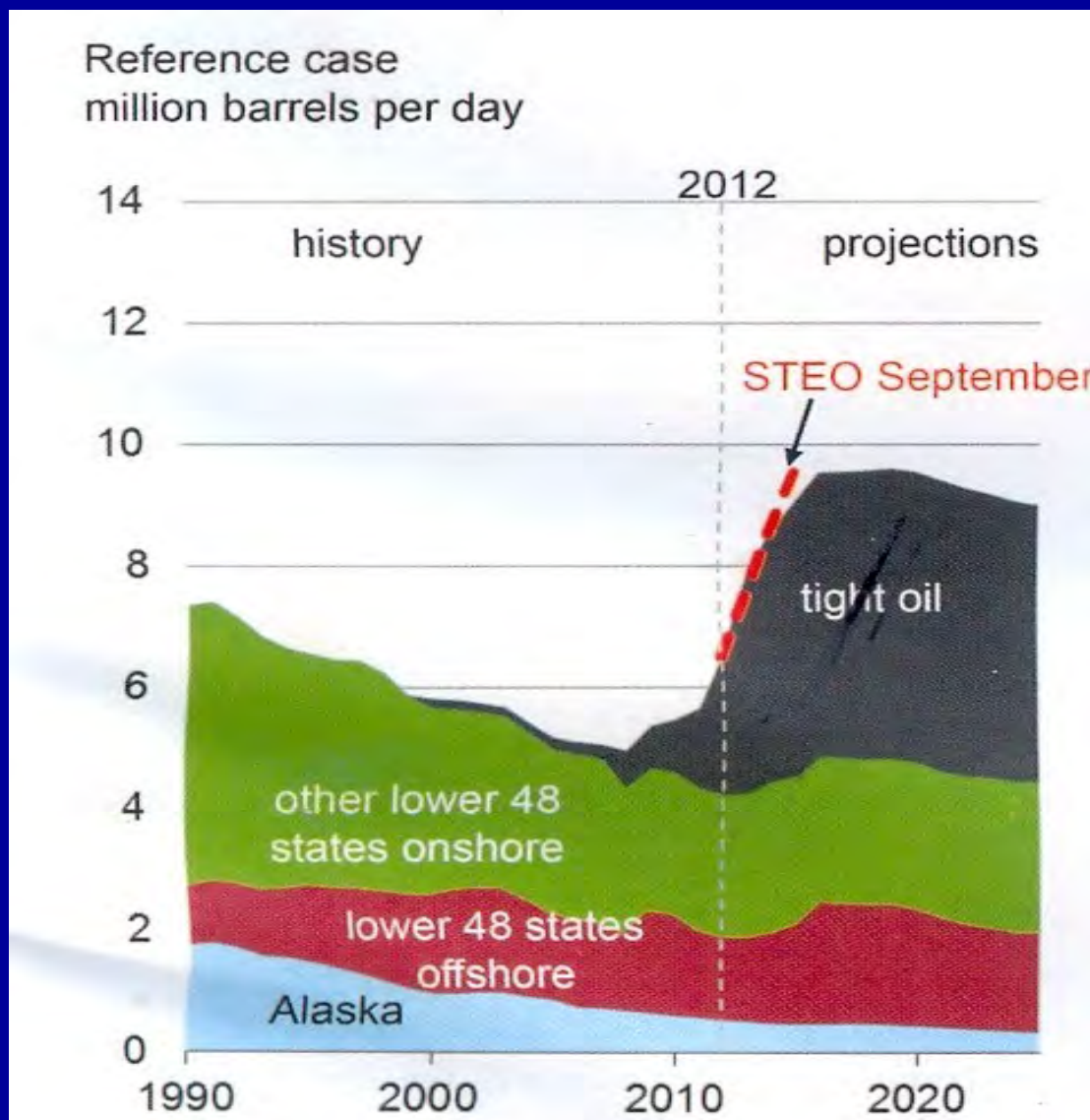
# Fracking – Definitions

- People sometimes talk about “hydraulic fracturing of shales” or they talk just about “fracking of shales”, please note they are the same
- In the next 2 slides by the USA EIA (United States government Energy Information Agency) it mentions “tight oil”, please note that is the same as oil being produced by fracking of shales



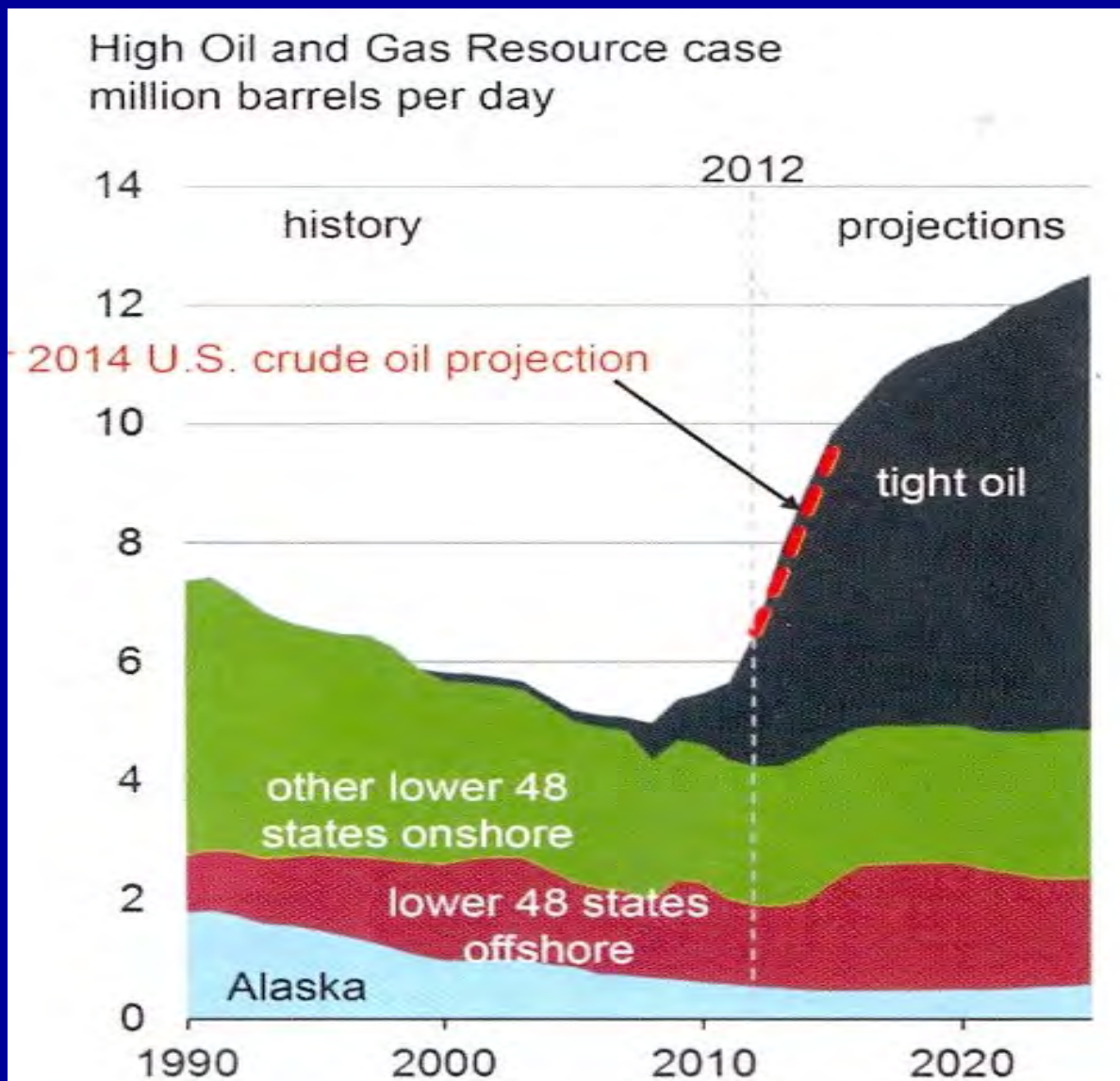
# USA Oil Production 1990 to Now

## Reference Case @ USA EIA

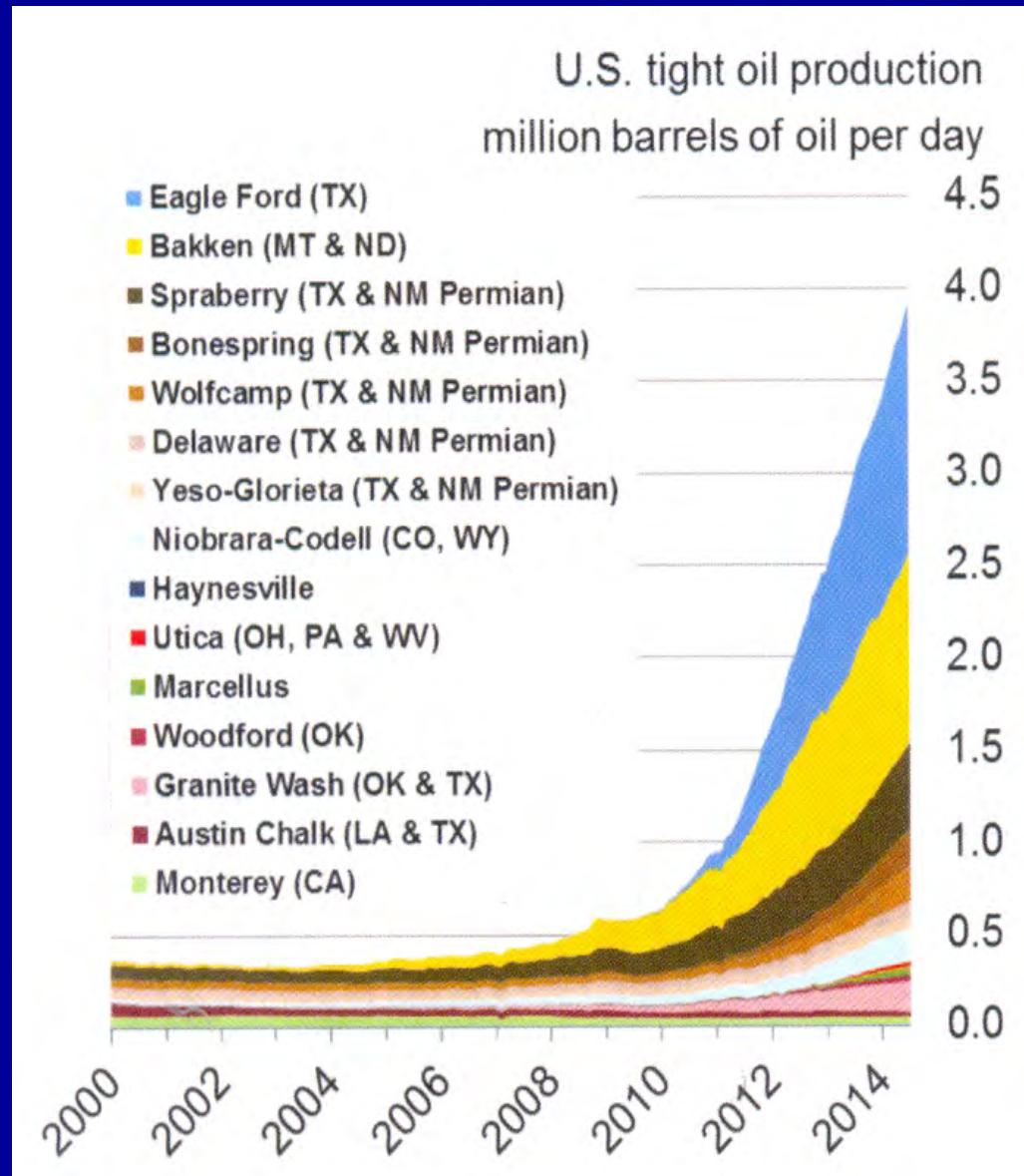


# USA Oil Production 1990 to Now

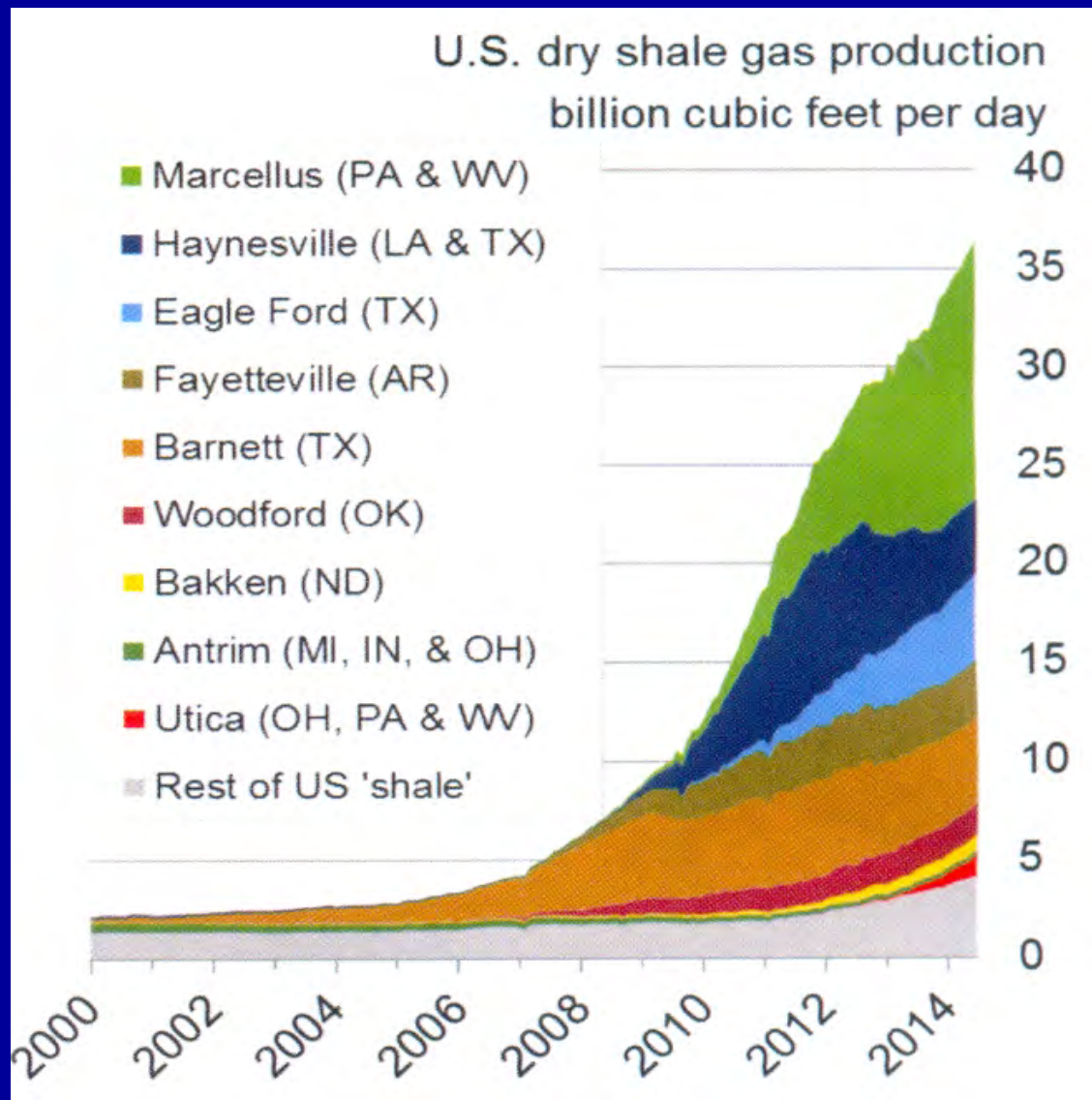
## High Case @ USA EIA



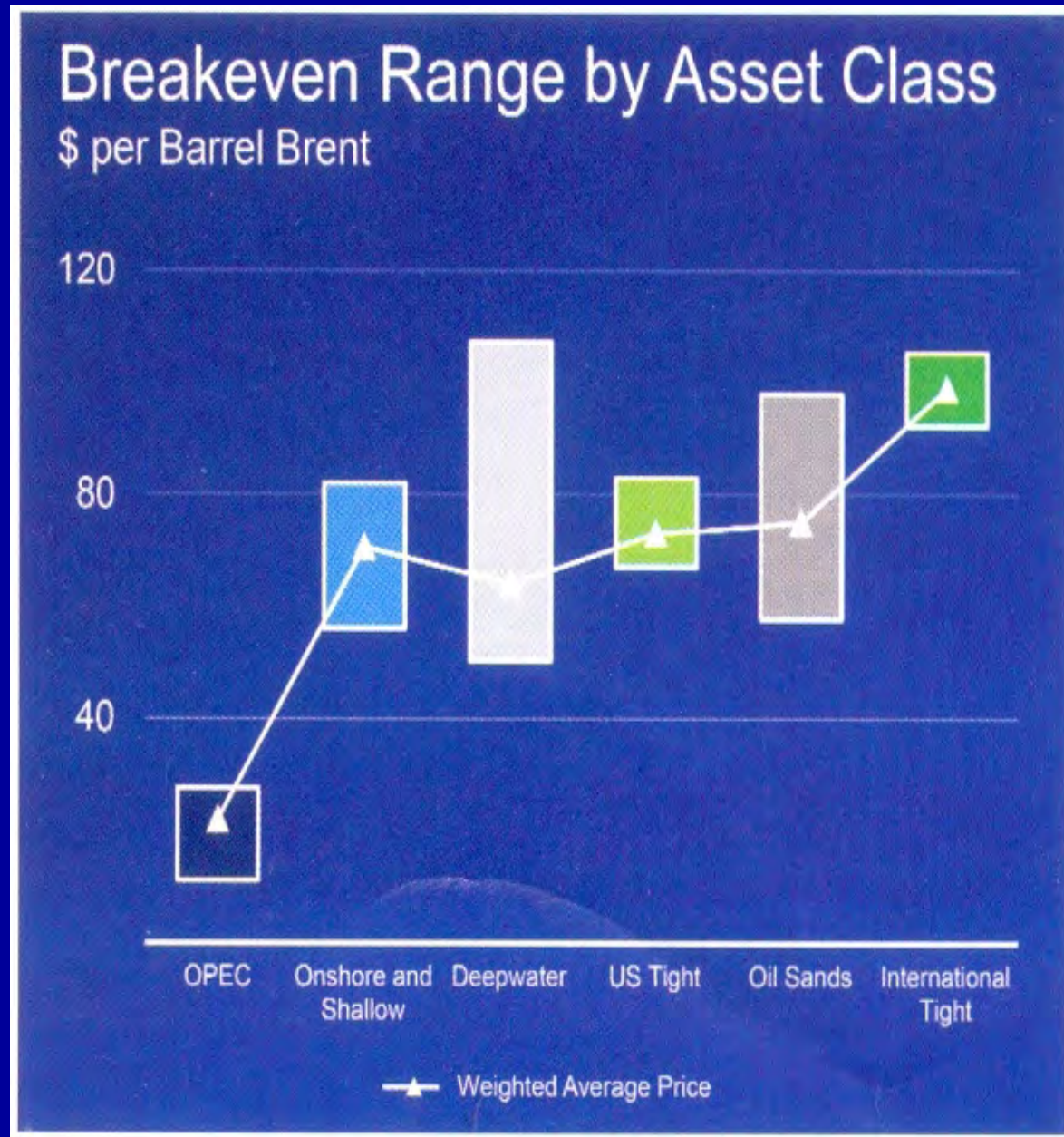
# USA Oil Production from Shales, 2000 – 2014 @ USA EIA



# USA Natural Gas Production from Shales, 2000 – 2014 @ USA EIA



# Breakeven Costs – Global Projects



# U.S.A.

- **The world uses 90 million barrels of oil per day.**
- **The USA currently uses 15.5 million barrels of oil per day which is equivalent to 17% of the world supply.**

# U.S.A.

- The USA now produces 9 million barrels oil per day
- The USA imports 6 million barrels of oil per day.
- QUESTION: Which country supplies USA with most of its imported crude?

# U.S.A.

## TOP FIVE COUNTRIES SUPPLYING OIL TO THE USA:

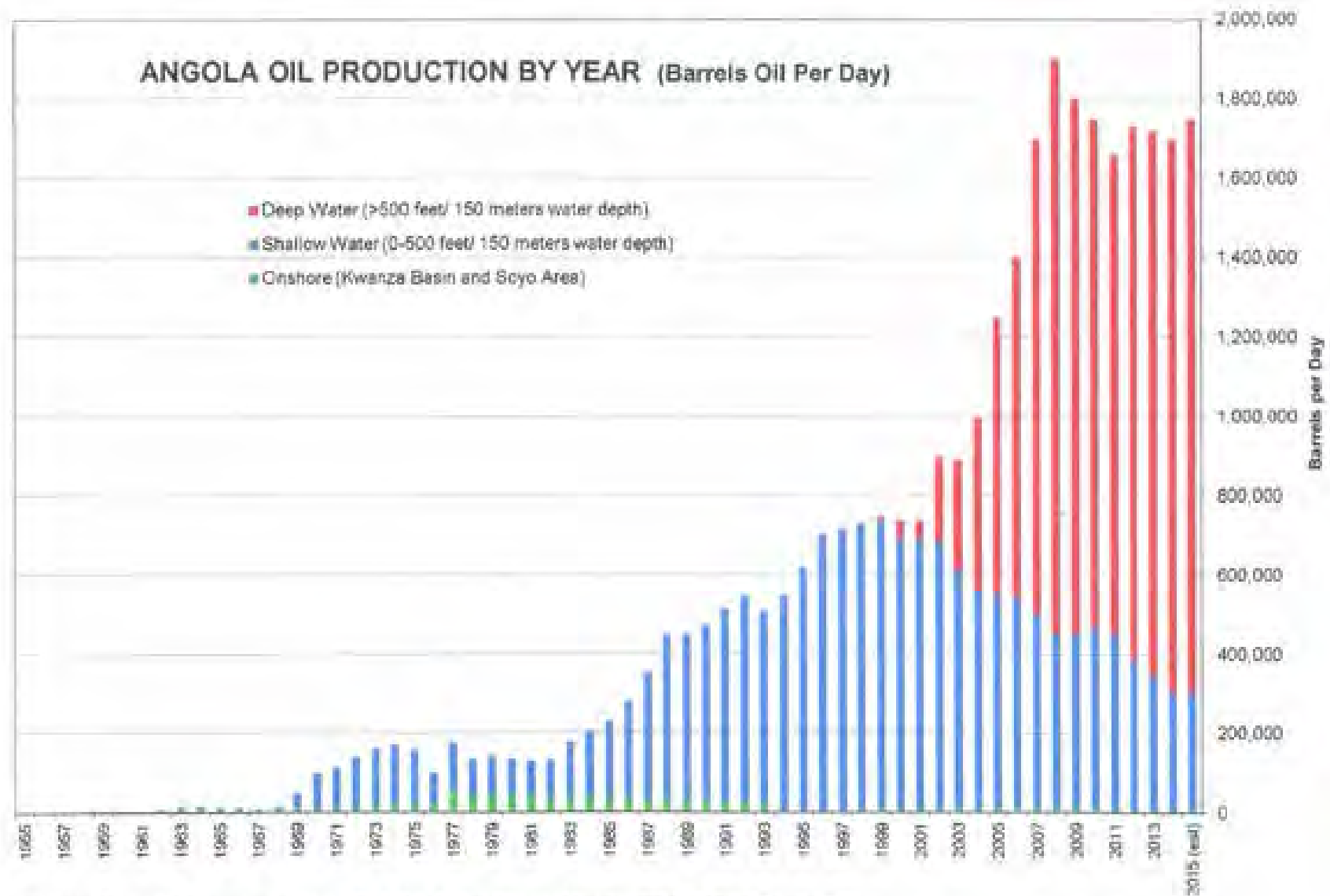
- **CANADA** 2.5 Million BOPD
- **SAUDI ARABIA** 1.6
- **MEXICO** 1.0
- **VENEZUELA** 0.8
- **KUWAIT** 0.4



# ANGOLA ECONOMY

- **A petro-economy**
- **Oil provides 45% of GDP and 95% of foreign exchange**

# Angola's Oil Production



Sources: Sonangol Universo magazines, Website - Angola Finance Ministry, 2014 BP World Energy Review

# Petro-Economies

## *Examples of Petro-Economies:*

- Saudi Arabia
- Qatar, Kuwait
- Russia
- Norway
- Nigeria
- Angola
- Texas, USA
- Alberta, Canada,
- Aberdeen, Scotland

# Petro-Economies

- When oil prices are high, it is PARTY TIME!!!!
- When oil prices are low, it is like being at a *funeral.....*

# A Petro-Economy - Calgary



# Benefits & Costs of Shale Oil

The next slide discusses the **Benefits of Shale Oil**, then another slide on **Costs of Shale Oil**

# Benefits of Shale Oil

- **Has added about 4 million barrels of oil per day onto world oil markets**
- **Reduces the world's dependence on politically volatile oil producing areas like Middle East**
- **Has lowered oil prices 50 - 60% so beneficial for consumers**

# Costs of Shale Oil

- **Has made oil markets extremely chaotic, especially difficult for petro-economies like Angola**
- **Reduces the incentive to develop renewable sources of energy**
- **Environmental issues (next slide)**



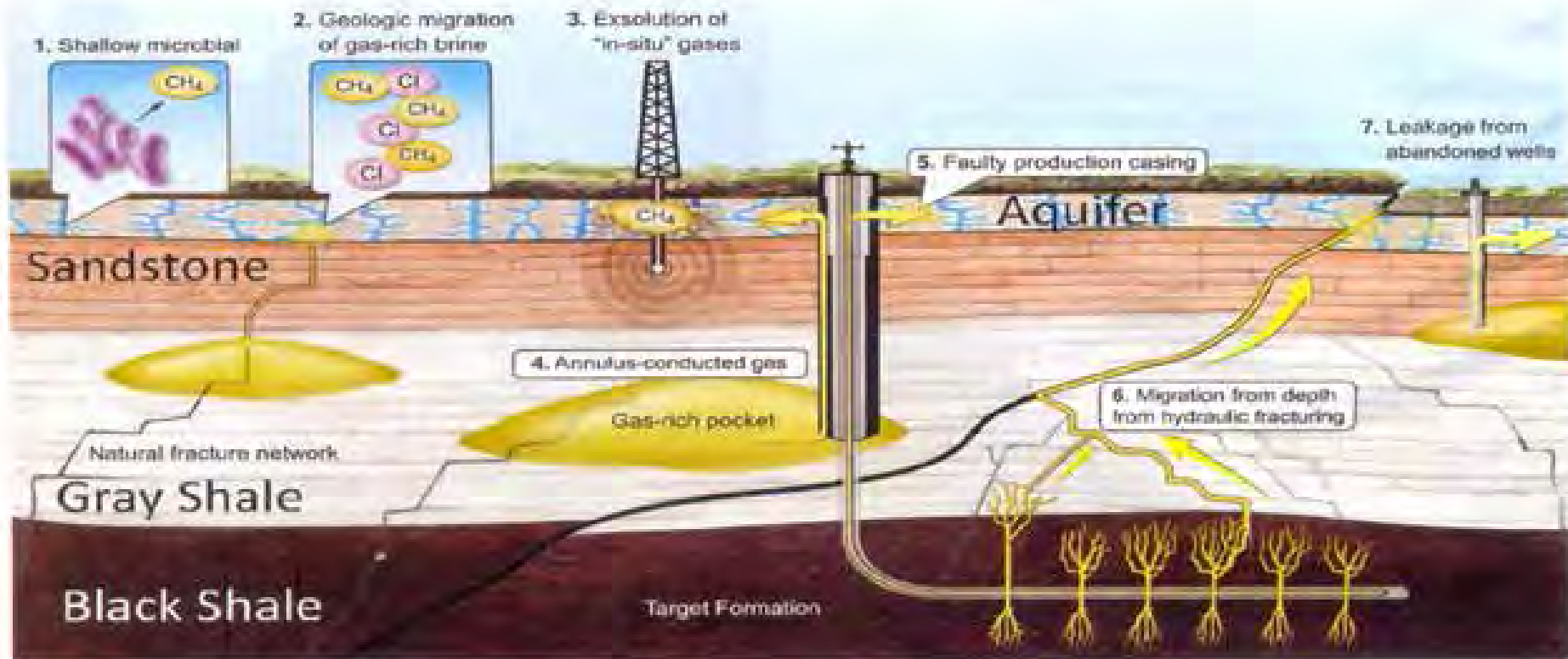
# **Costs of Shale Oil**

## **Environmental Costs**

- **Can locally effect ground water, not extensively but it is a definite issue**
- **Fracking requires a lot of water but now oil companies are recycling the frack fluids**
- **Fracking can cause local earthquakes**
- **Can have big effects on local areas – oil pump jacks, wellheads, pipelines, roads, flaring of gas, is causing the “nimby” effect (“not in my back yard”)**

# Oil & Gas Activity and Possible Effects on the Ground Water

## METHANE GAS



Numbered above, this diagram shows the seven possible sources of contamination researchers examined in their study of how groundwater methane contamination occurs, with the exception of coalbed methane and pipeline leaks. When high levels of methane were found in residential water wells near gas fields, the researchers said their data suggest the most likely causes were faulty production casing and insufficient cementing that allowed the gas to travel up a natural gas well's annulus. The researchers noted in their findings that the data appeared to rule out methane contamination as a result of horizontal drilling and hydraulic fracturing. *Graphic courtesy of Thomas Darrah and Ohio State University.*

# Closing Statement

For mankind, every source of energy has its benefits and costs:

- Oil & gas
- Nuclear
- Hydro
- Renewables – solar, wind, geothermal

I leave it up to you to decide what is best for you, your family and your community.

# Acknowledgements – Sources of Data and Photos

The main sources of information for this presentation was from the Journals of Petroleum Technology (JPT) of the Society of Petroleum Engineers (SPE) and various Upstream magazines.

- Slide 2, cartoon, from *Upstream*, by Rytis Daukantas, November 28, 2014
- Slide 6, book "*The Boom*" by Russell Gold, 2014
- Slide 11, photograph, *Upstream*, January 15, 2015
- Slide 12, photo of oil rig, from *Upstream*, January 30, 2015
- Slide 15, cartoon from *Upstream*, by Rytis Daukantas, December 12, 2014
- Slide 19, photo from *Explorer* magazine, February 2015, American Association of Petroleum Geologists (AAPG)
- Slide 26, photo of crude barrels, from *Upstream*, January 30, 2015
- Slide 35, photo of horizontal drilling & fracking, advertisement of TBC-Brinadd, JPT, October 2014
- Slide 36, photo of drilling horizontal drain hole from *SPE JPT*, November, 2014
- Slide 39, photo of fracking operation, south Texas, Halliburton photo, JPT, October 2014
- Slide 41, photo of fracking operation, Oman, photo by BP, Upstream Technology, June 2014
- Slide 42, photo of fracking operation in New Brunswick, Canada from *Energy Exchange*, a Pollution Probe publication, summer 2014 edition
- Slides 48 – 50, Oil & gas production graphs, by USA EIA, *EP* magazine, November, 2014
- Slide 52, chart of Breakeven Ranger by Asset Class, by Wood Mackenzie/Chevron, in *EP* magazine, August 2014
- Slide 57, Angola's oil production from 1956 – 2015, data from Sonangol *Universo* magazines, Angola Ministry of Finance website, BP's 2014 Global Energy Review
- Slide 65, diagram of ground water, from Thomas Darrah and Ohio State University, in *SPE Journal of Petroleum Technology*, December 2014

**Obrigado! Thank you!**

**Perguntas? Questions?**