THE UNPRECEDENTED UPSURGE OF OIL PRODUCTION CAPACITY AND WHAT IT MEANS FOR THE WORLD

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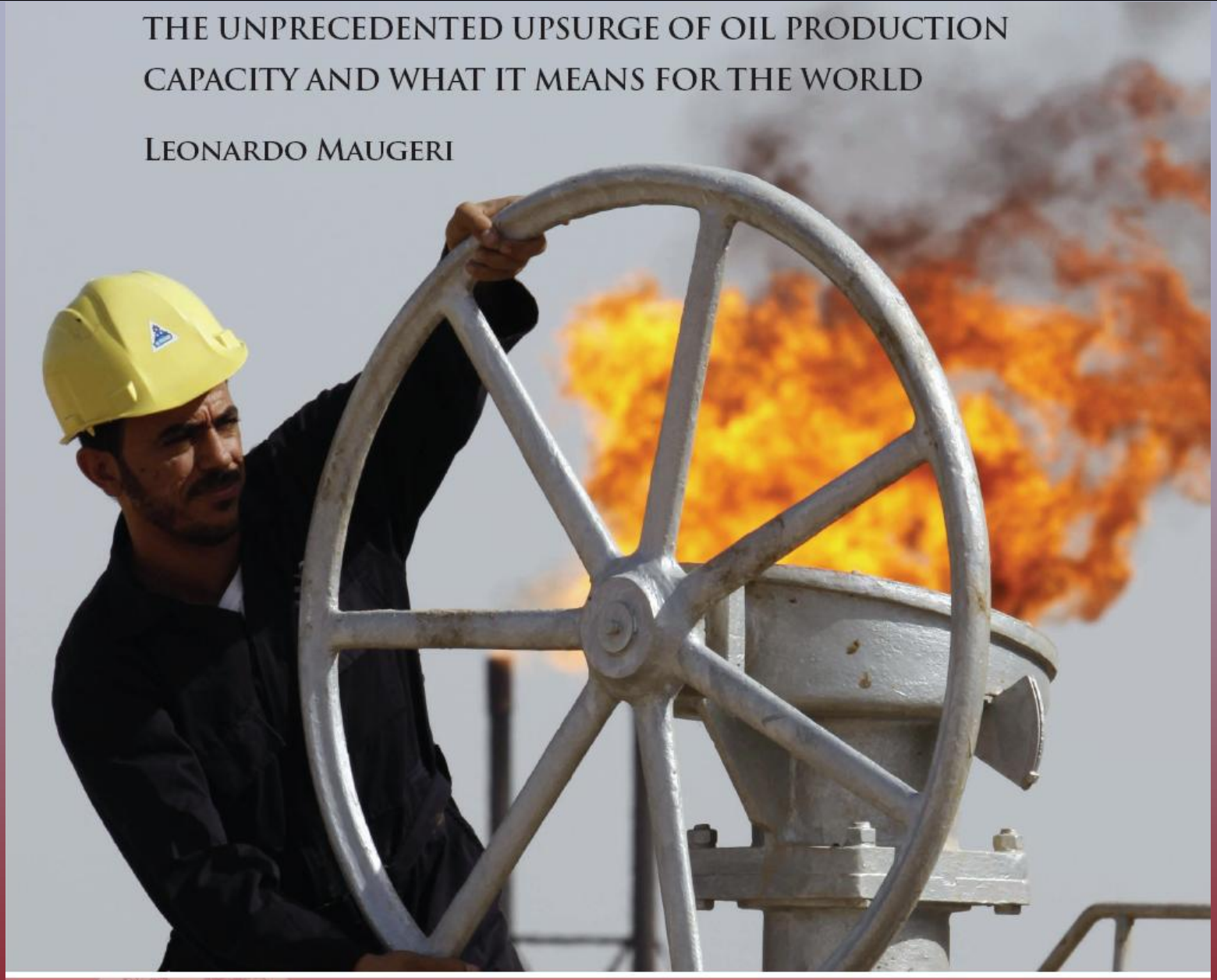


HARVARD Kennedy School
BELFER CENTER for Science and International Affairs

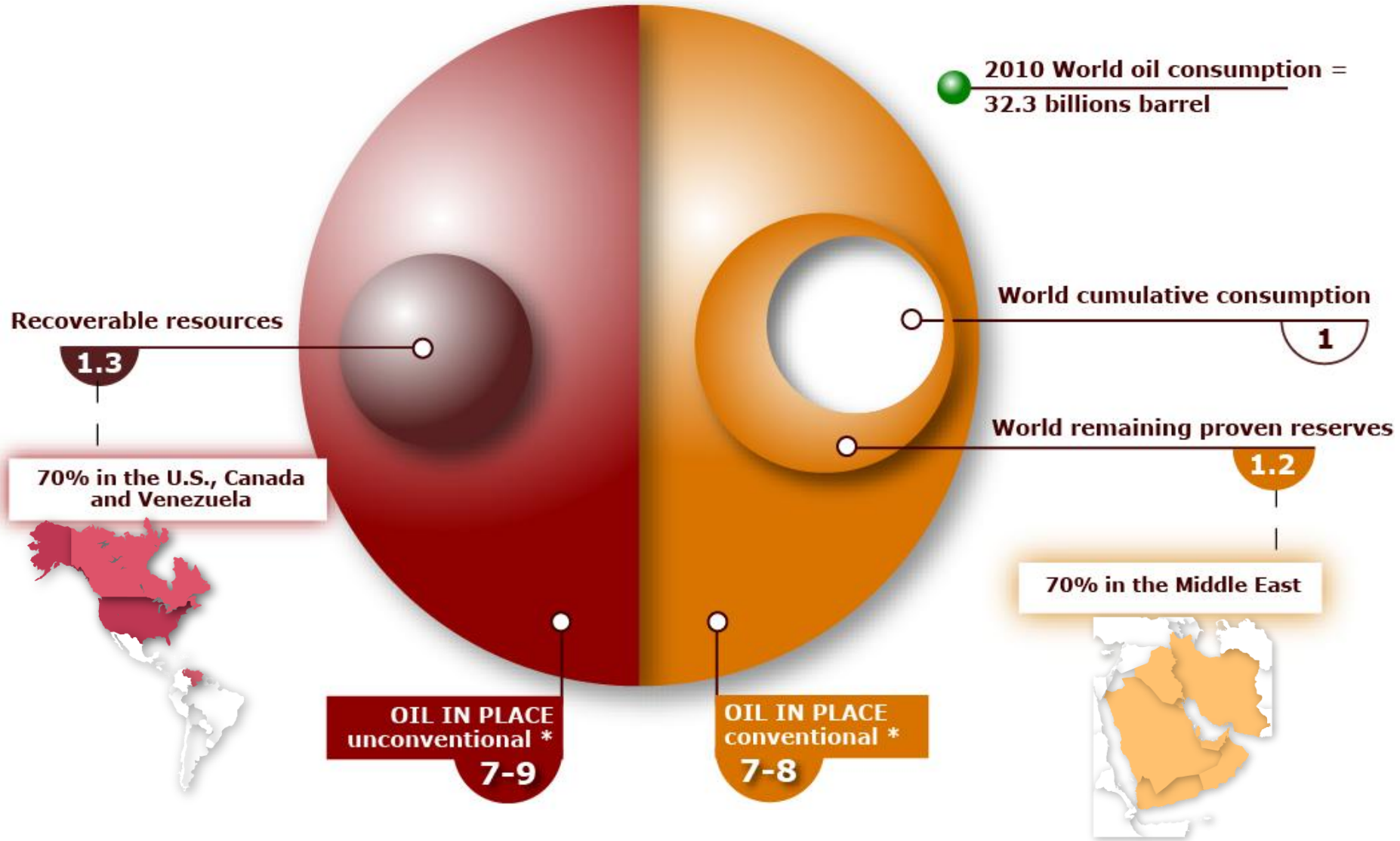
UNDERESTIMATION OF SUPPLY

- ★ "Peak-Oil" production mantra, in spite of ever-growing supply
- ★ Price, Technology, and Oil Industry Behaviour not considered
- ★ Supply still calculated as a function of demand, even if its investment-cycles are asynchronous with respect to demand
- ★ Few analyses based on bottom-up, field-by-field supply
- ★ General underestimation of huge unconventional oil potential: the case of U.S. shale/tight oil

The market is still convinced that oil supply capacity will remain structurally tight, but it now admits that short-term weakeness of demand may provoke a temporary decline of oil prices

IT'S NOT LIKE THIS

THERE'S PLENTY OF OIL UNDERGROUND
World known recoverable oil resources (Trillion barrels)

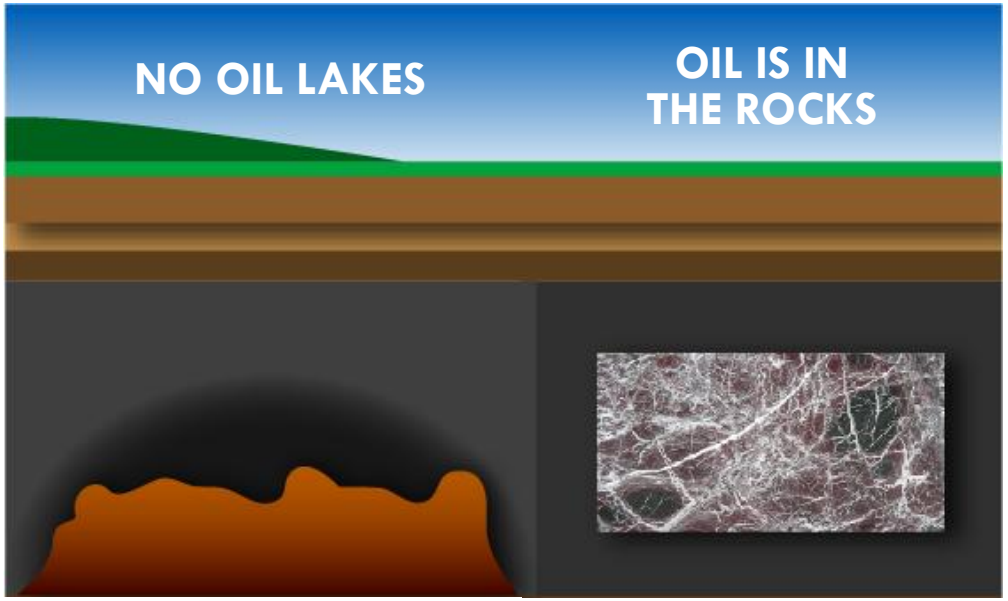


WHY IS IT SO DIFFICULT TO ASSESS OIL RESOURCES ?

Geology Hard Reality

No great underground oil lakes of caves, but only solid rocks.

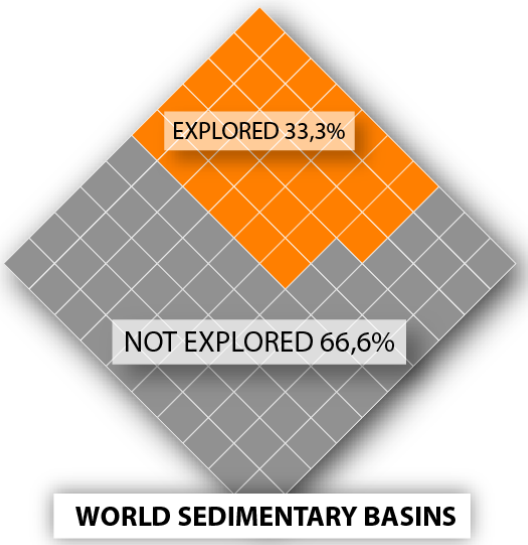
No current technology may ensure an exact answer to the question "how much oil lies beneath?" Drilling is always necessary to assess, and even drilling may be deceitful.



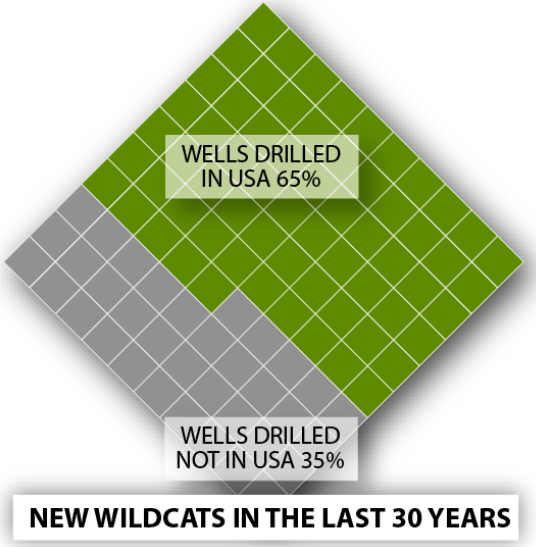
Limited Exploration

Only **1/3** of world's sedimentary basins has been **explored.**

65% of world's exploration wells (new wildcats) **drilled in the U.S.** alone in the last 30 years.



WORLD SEDIMENTARY BASINS



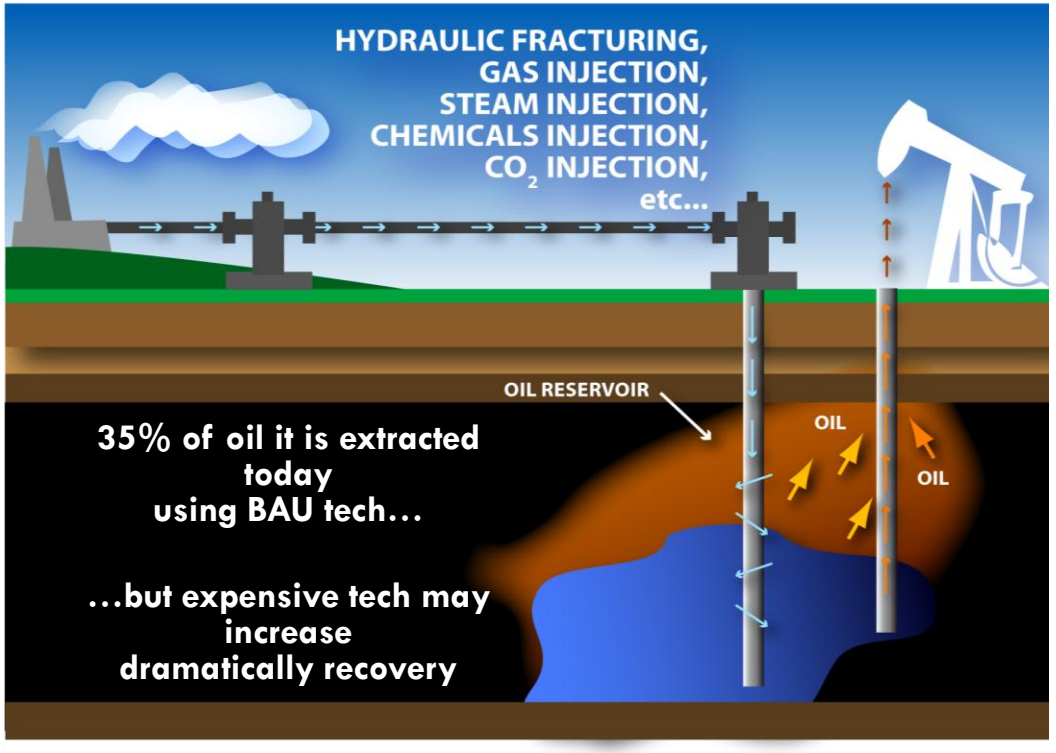
NEW WILDCATS IN THE LAST 30 YEARS

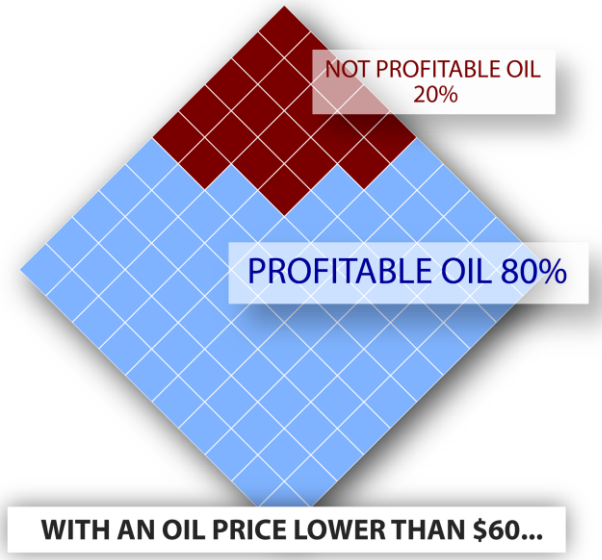
PRICE AND TECHNOLOGY ARE THE MOST CRITICAL FACTORS IN DETERMINING RESERVE AND PRODUCTION GROWTH

TECHNOLOGY

On average, less than **35%** of already known oil is extracted today using current business-as-usual technologies.

More expensive tech may dramatically increase oil recovery.





PRICE - COST

Oil companies make their investment decisions assuming a conservative (much lower) oil price in the long term (20 years).

Only **20% of** already recoverable resources are not profitable (double digit IRR) with an oil price (Brent) lower **than $ 70** per barrel (at current costs).

AN EXPLORATION&DEVELOPMENT BOOM IS UNDERWAY
A huge investment cycle started in 2003, and boomed from 2010 on

2010-2012 BOOM:
around **$1.5 trillions** invested for oil&gas E&P

EXPLORATION SPENDING RECORD
about **$90 billions** in 2011

EXPLORATION&DEVELOPMENT RECORD
more than **$550 billion** in 2011

2012: AN ALL-TIME RECORD?
Preliminary estimates shows that the pace of E&P investments is set to overcome **$600 billions**

The outcome of this boom - e.g. new production - will be asynchronous to demand

A Note on Methodology

Global field-by-field analysis=
Oil investments underway based on proprietary database

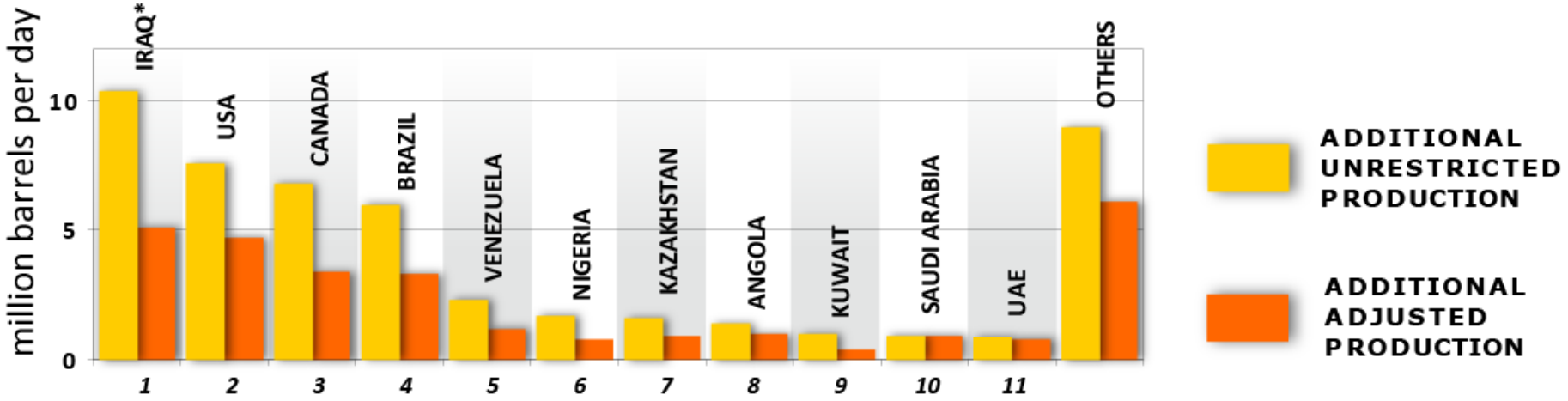
Additional unrestricted production =
targeted production of each investment, no risk-factor associated

Additional adjusted production =
actual possible production after cutting targeted production to take risk-factors into account

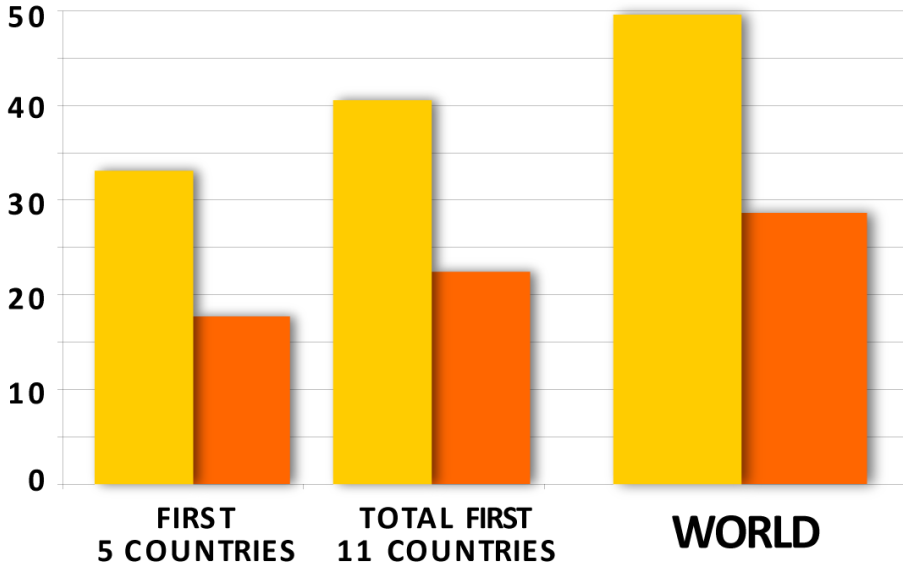
Risk-factors =
calculated on the basis of personal experience and assessment, and disclosed for each country

Depletion and Reserve Growth =
natural decline of already producing oilfields plus possible increase of their producible reserves, due to the discovery of new satellites or use of advanced technologies to recover more oil

WHERE WILL THE NEW PRODUCTION COME FROM? -1
(field-by-field estimates)



A "mosaic" of new oil production capacity is growing worldwide, implying an "unrestricted" (no risk-adjusted), additional output of a little less than 50 million barrels per day by 2020



* *Including the Kurdish Regional Government*

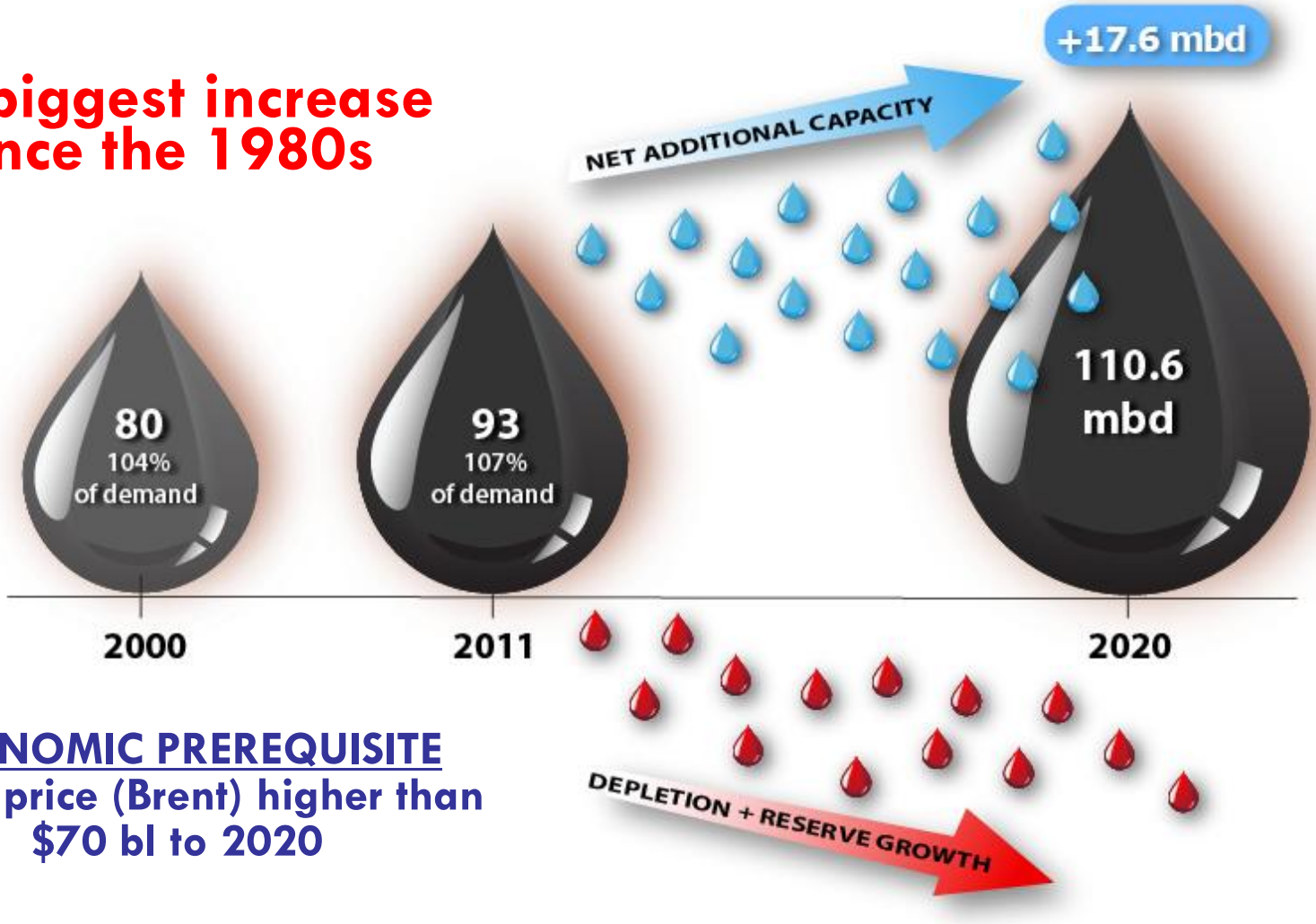
ADDING NEW PRODUCTION TO OLD ONE
(preliminary field-by-field estimates)

- ★ New oil production will integrate current world's production capacity
- ★ World's oilfields DEEPLETION rates appear to be overestimated, due to an underestimation of technological advance and RESERVE GROWTH
- ★ To 2020, the biggest oil producers tend to mantain a relatively stable production from older oilfields
- ★ Only four big producers (Norway, UK, Mexico, and Iran) may face a net decrease of their current production capacity

As a result, current world's oil capacity of about 93 mbd (end of 2011) will decline more slowly, probably at a 2-3 percent rate

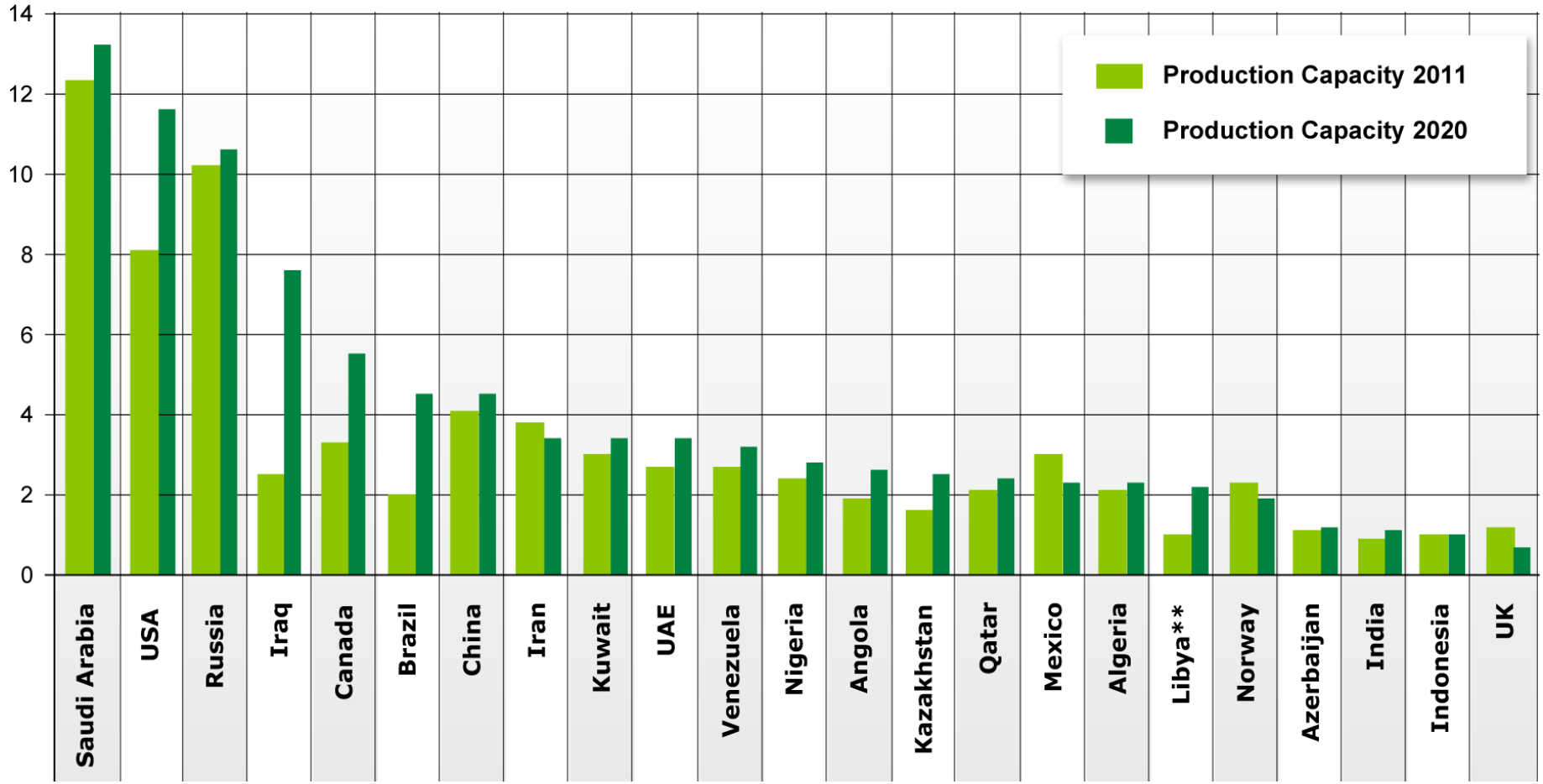
WHAT COULD THE OUTCOME BE?
World liquids production capacity excluding biofuels (Million b/d)

The biggest increase since the 1980s

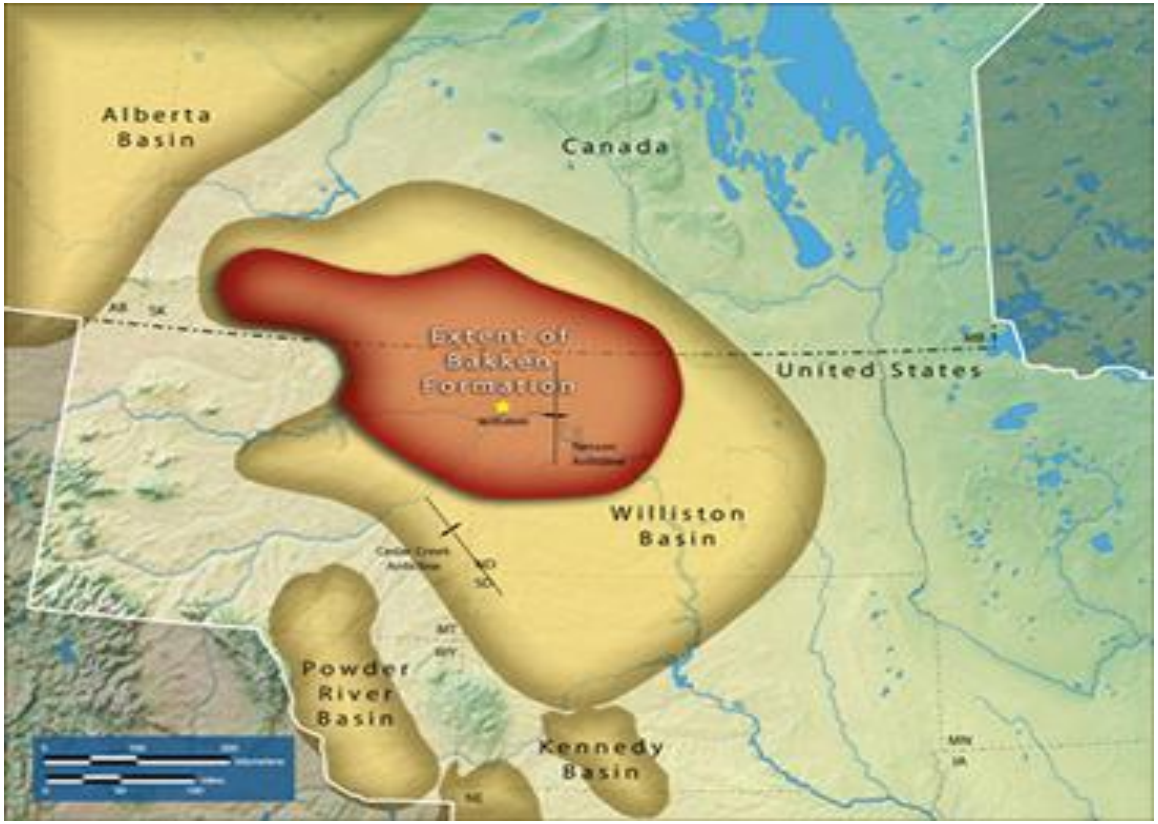


ECONOMIC PREREQUISITE
An oil price (Brent) higher than $70 bl to 2020

Country-by-country evolution of oil production capacity to 2020
(Million b/d)



U.S. SHALE-TIGHT OIL: A NEW PERSIAN GULF OR A HYPE?
1 - The case of Bakken Shale



PRICE (1999) BAKKEN'S POTENTIAL ASSESSMENT

271-503 billion barrels of original oil in place
Mean of 413 billion barrels
206 billion barrels of recoverable oil

U.S. SHALE-TIGHT OIL: A NEW PERSIAN GULF OR A HYPE?
2 - The case of Bakken Shale

2006

First combination of horizontal-drilling and fracking tested.

Production: 7,600 bd Bakken, 110,000 bd North Dakota

2006-2008

Average weekly drilling rigs: **25-30 (50 including Montana)**

2010

Production: **264,000 bd**

2011

Production **+530,000 boe/d in December, more than 80 percent light oil.**

Drilling rigs 183 (200 including Montana)

Preliminary evidence suggests that Price's analysis was right

U.S. SHALE-TIGHT OIL: A NEW PERSIAN GULF OR A HYPE?
3 – Bakken is not alone….

Additional production from U.S. shale/tight oil plays by 2020
(million barrels per day)

Shale Play	Additional unrestricted production	Additional adjusted production
Bakken/Three Forks	2.5	1.5
Eagle Ford	2.1	1.47
Permian	1	0.7
Utica	0.2	0.1
Niobrara/Codell	0.2	0.1
Others	0.6	0.3
Total	***6.6***	***4.17***

U.S. SHALE-TIGHT OIL: A NEW PERSIAN GULF OR A HYPE?
4 – Cons versus Pros

★The obstacles/1: the inadequate U.S. oil transportation system, and the structure of the refining complex

★The real obstacles/2: the fear of Hydraulic Fracturing

But…

★The U.S. shale revolution is the biggest oil revolution since decades

★It will allow the U.S. to produce 65 percent of the oil it consumes (or about 90 percent considering Canada's oil imports)

★It will likely represent the single, most important factor of economic growth and job creation in the next few years

OVERESTIMATION OF DEMAND ?

- ★ **Hype about China and Emerging Countries' oil "bulimia"**
- ★ **Underestimation of "Peak-demand" in OECD countries: it's not economy alone**
- ★ **Incapacity to assess the impact of ageing population, energy efficiency spurred by new legislations, technological innovation, consumers attitude**
- ★ **Long-term predictions of Emerging Countries demand extrapolated from past/present consumption trends**

UNLESS OIL DEMAND WERE TO GROWTH AT A SUSTAINED YEARLY RATE OF 1.6% TO 2020 (CURRENT RATE= LESS THAN 1%),

A COLLAPSE OF OIL PRICES IS ALWAYS POSSIBLE

MAJOR GEOPOLITICAL IMPLICATIONS

★The Western hemishpere could become virtually independent from the rest of the world, and the major source of oil production growth over the next decades

★However, the U.S. won't be insulated from the global oil market, and whatever happens in the Middle East will always influence the oil market

★Middle East's oil will be only one pillar - not the Center of Gravity - of the world's oil market

★Asia to become the key market for Middle Eastern Oil, and China a U.S. political competitor in the region, as well as in Africa

★China will try to extend its grip on Venezuela and Canada too (fields, pipelines, etc.)

★Opec strained by Iraqi oil resurgence and global production growth

Back-up

WORLD'S OIL PRODUCTION CAPACITY TO 2020 (MBD) - 1/2

	Production Capacity 2011 - end	Additional Unrestricted Production	Additional Adjusted Production	Net production additions or losses*	Production Capacity 2020
Saudi Arabia	**12.3**	0.9	0.9	0.9	**13.2**
United States	**8.1**	7.6	4.7	3.5	**11.6**
Russia	**10.2**	1.2	0.8	0.4	**10.6**
Iraq	**2.5**	10.4	5.1	5.1	**7.6**
Canada	**3.3**	6.8	3.4	2.2	**5.5**
Brazil	**2**	6	3.3	2.5	**4.5**
China	**4.1**	0.7	0.5	0.4	**4.5**
Iran	**3.8**	0.5	0.2	-0.4	**3.4**
Kuwait	**3**	1	0.4	0.4	**3.4**
UAE	**2.7**	0.86	0.8	0.7	**3.4**
Venezuela	**2.7**	2.3	1.2	0.5	**3.2**
Nigeria	**2.4**	1.7	0.8	0.4	**2.8**
Angola	**1.9**	1.38	1	0.7	**2.6**
Kazakhstan	**1.6**	1.6	0.9	0.9	**2.5**

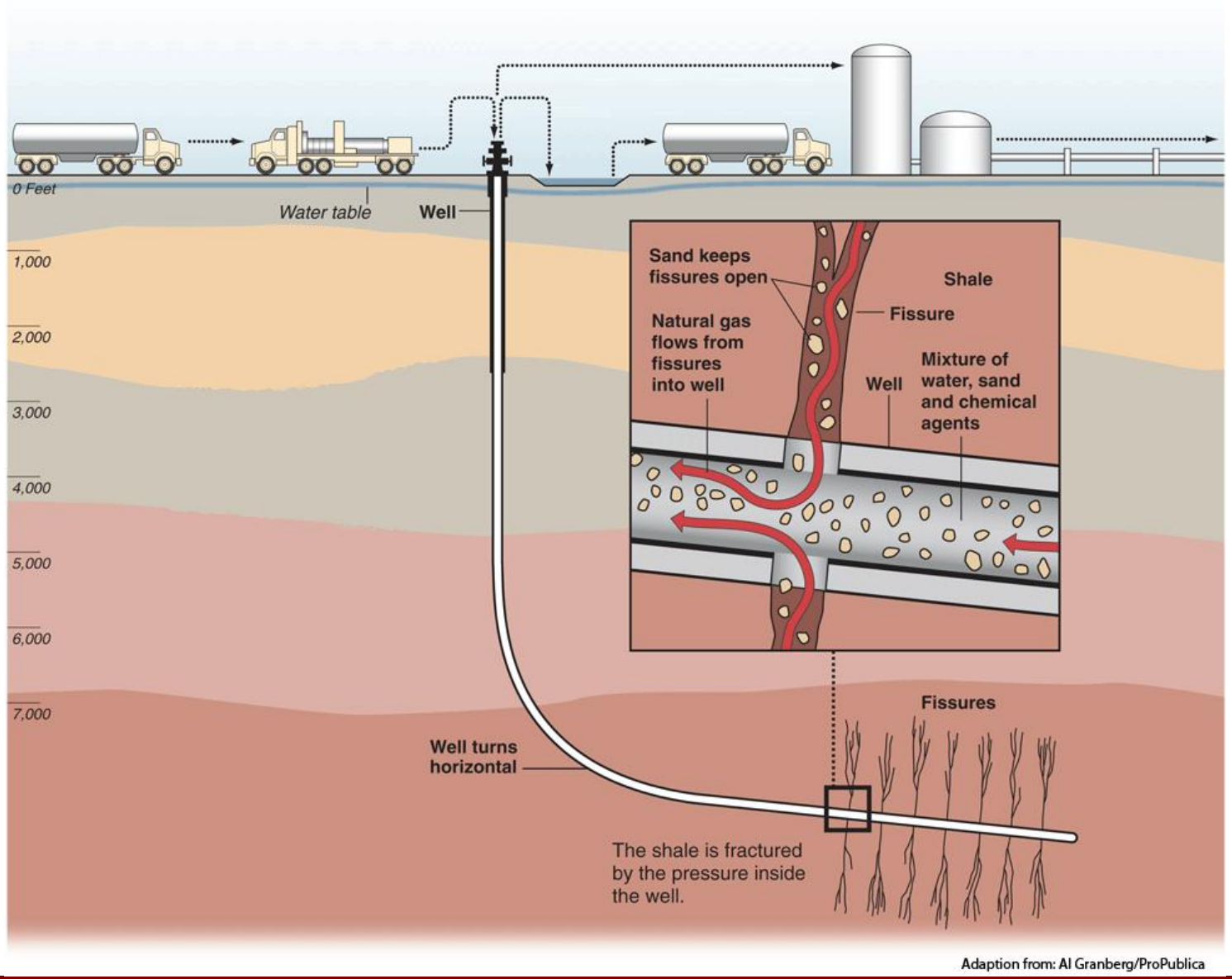
**** a disposizione per * dei losses***

WORLD'S OIL PRODUCTION CAPACITY TO 2020 (MBD) - 2/2

	Production Capacity 2011 - end	Additional Unrestricted Production	Additional Adjusted Production	Net production additions or losses*	Production Capacity 2020
Qatar	**2.1**	0.7	0.5	0.3	**2.4**
Mexico	**3**	0	0	-0.7	**2.3**
Algeria	**2.1**	0.7	0.5	0.2	**2.3**
Libya**	**1**	1.2	1.2	1.2	**2.2**
Norway	**2.3**	0.4	0.2	-0.4	**1.9**
Azerbaijan	**1.1**	0.4	0.3	0.1	**1.2**
India	**0.9**	0.6	0.3	0.2	**1.1**
Indonesia	**1**	0.4	0.3	0	**1**
UK	**1.2**	0.2	0.1	-0.5	**0.7**
Sub-Total	***75.3***	*47.54*	*27.4*	*18.6*	***93.9***
Others	**17.7**	2	1.2	-1	**16.7**
WORLD TOTAL	**93**	49.54	28.6	17.6	**110.6**
Of which:					
Crude Oil	**78**				**86**
NGLs	**15**				**24.6**

**** a disposizione per * dei losses***

How hydraulic fracturing works



US oil pipeline network