Centre for Alternative Technology

INFORSE-EUROPE

International Network for Sustainable Energy

Fossil Fuel Resources

by

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http://www.inforse.org/europe/seminar2010_CAT.htm

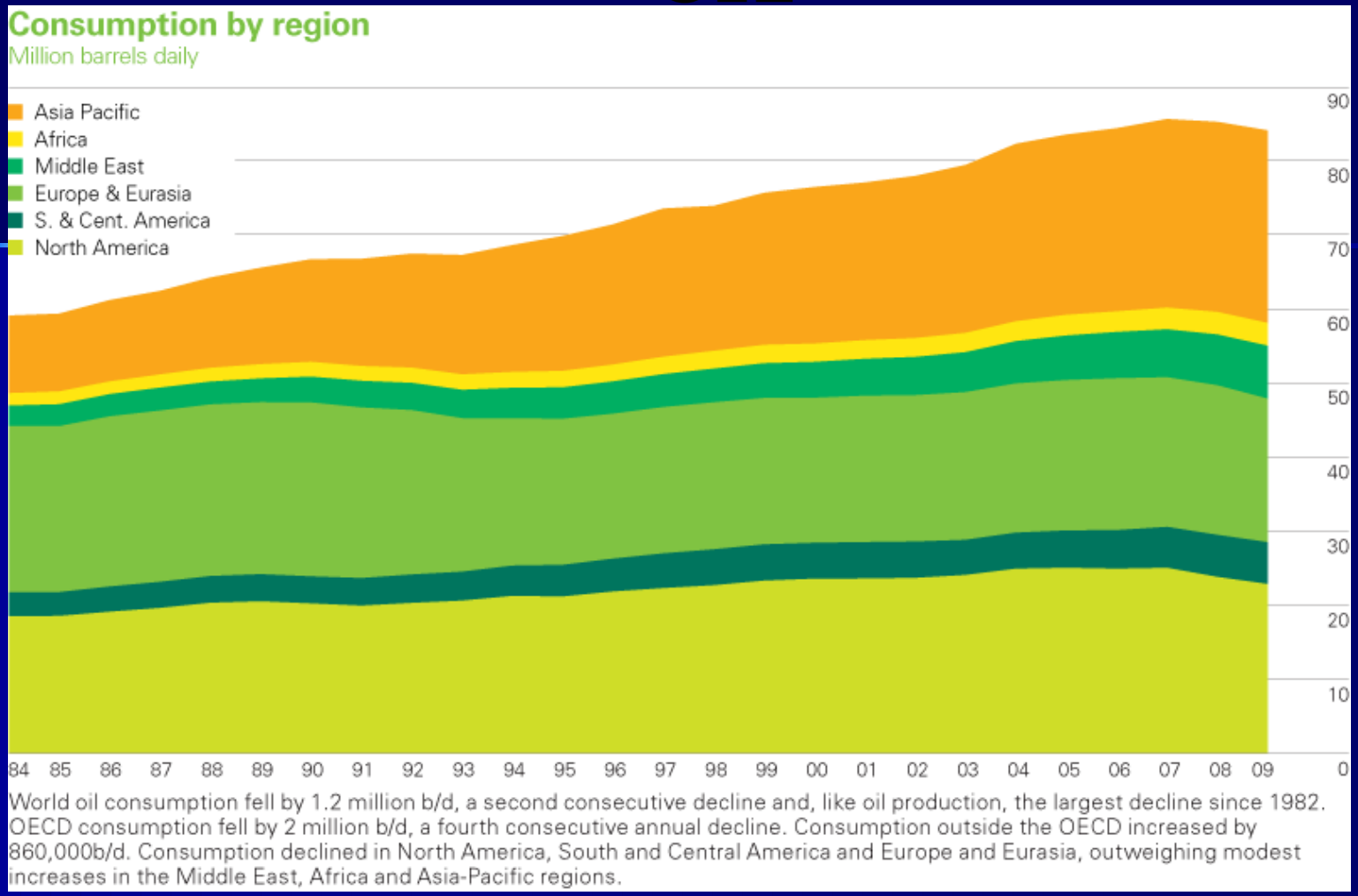
Fossil Fuel Resources

2010 Update

Emil Bedi

Machynlleth, Wales, UK
October, 2010

OIL



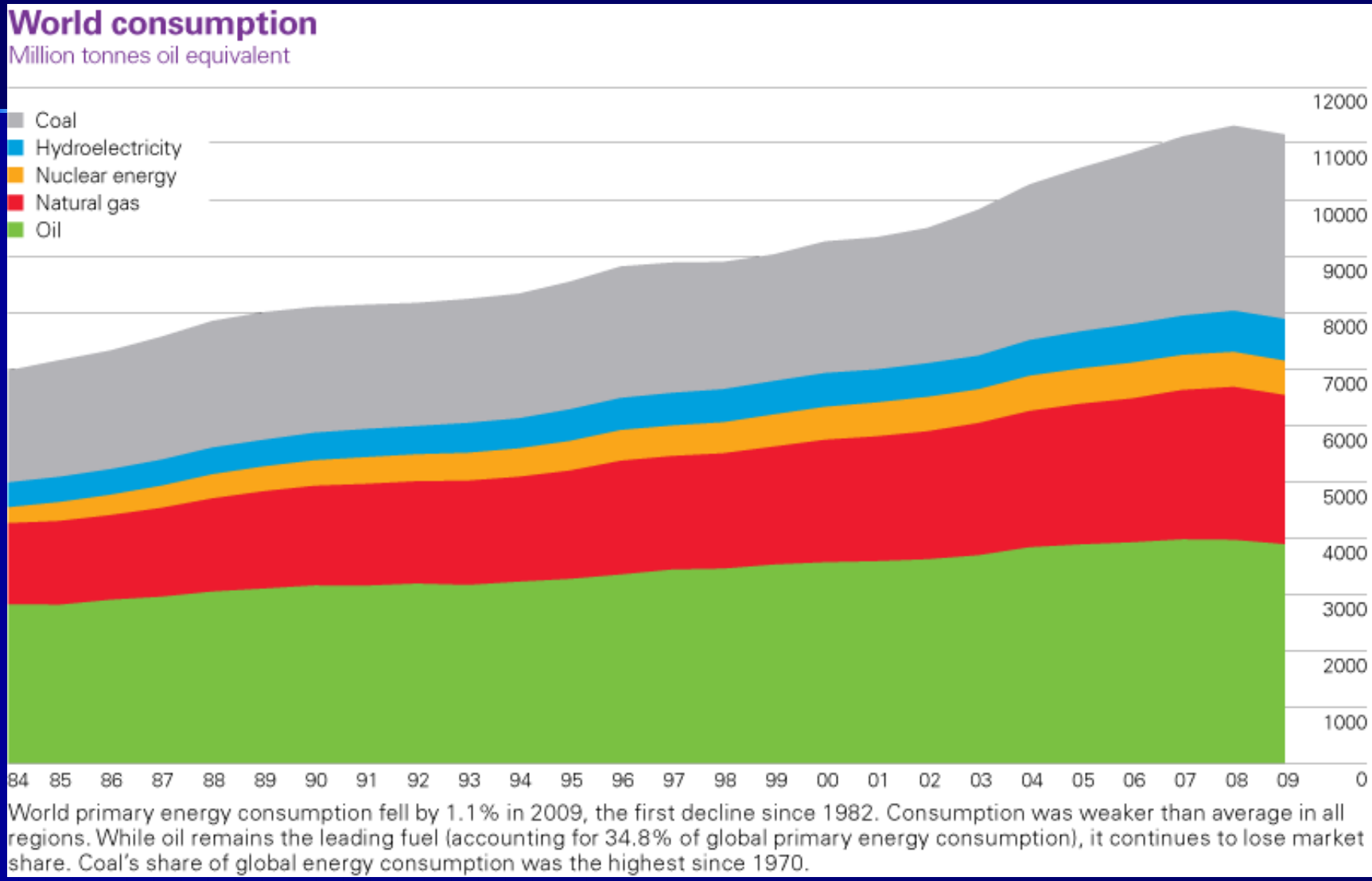
BP Statistical Review of World Energy 2010

Peak ? Not yet.

Economic decline.

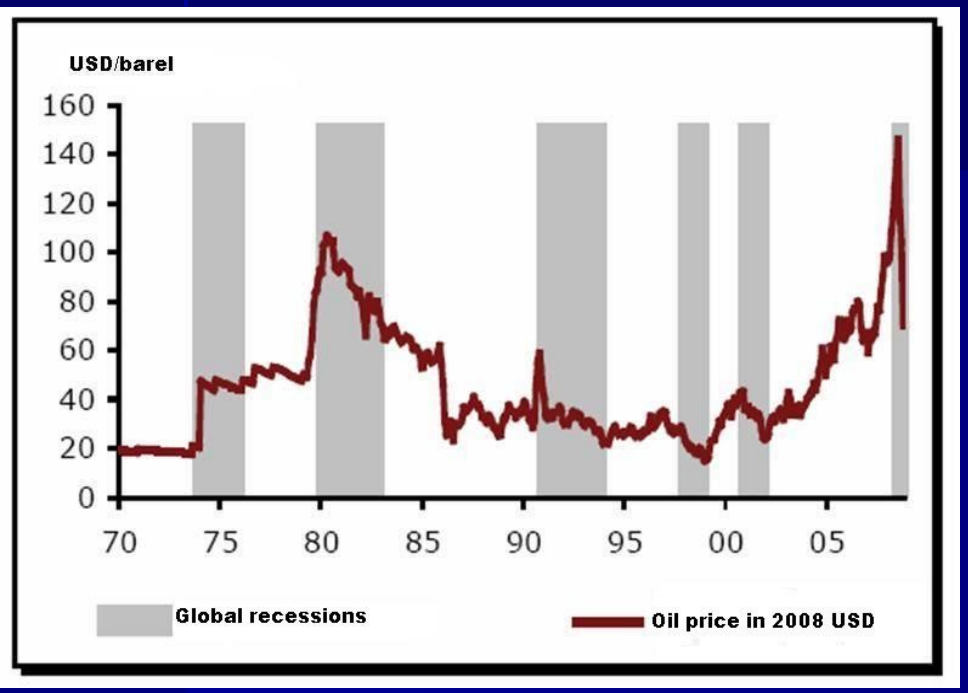
ENERGY Consumption

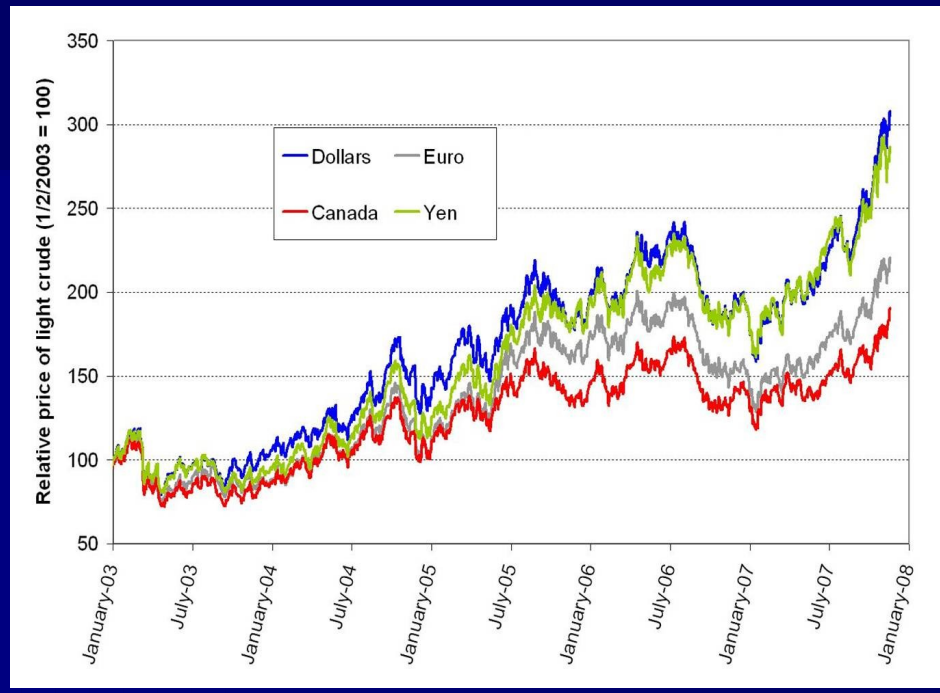
First decline since 1982.



BP Statistical Review of World Energy 2010

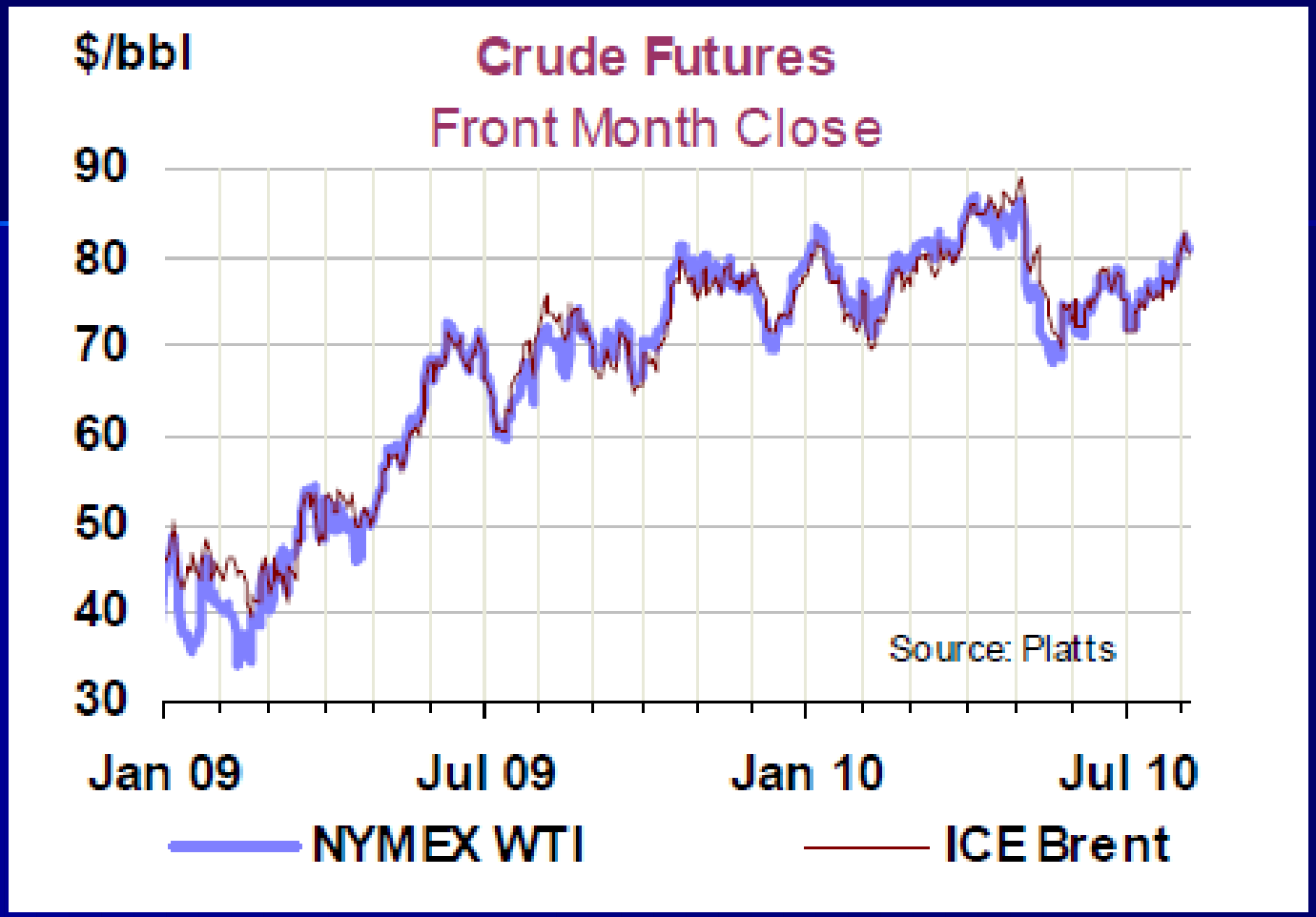
High oil price = economic decline





Future economy development depends on how much oil we will have.

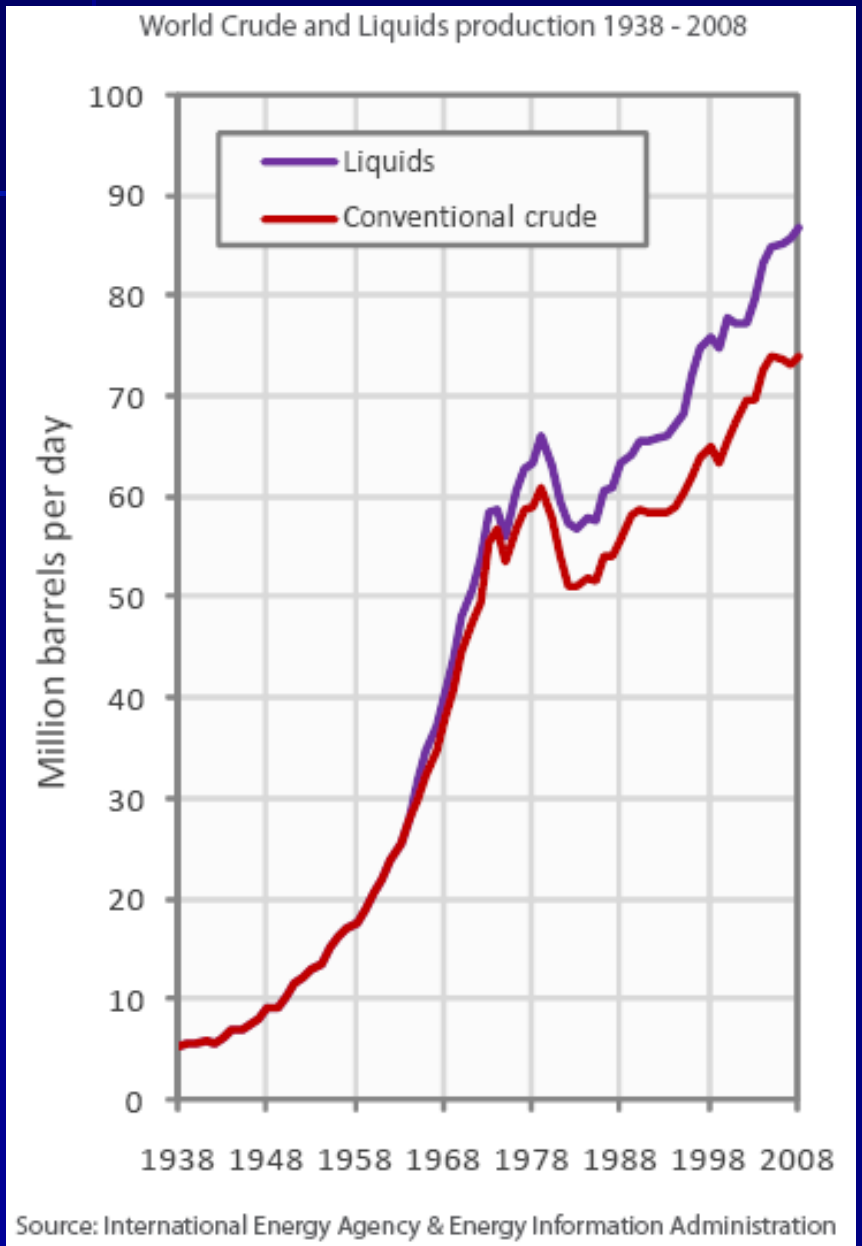
Recent Oil Prices

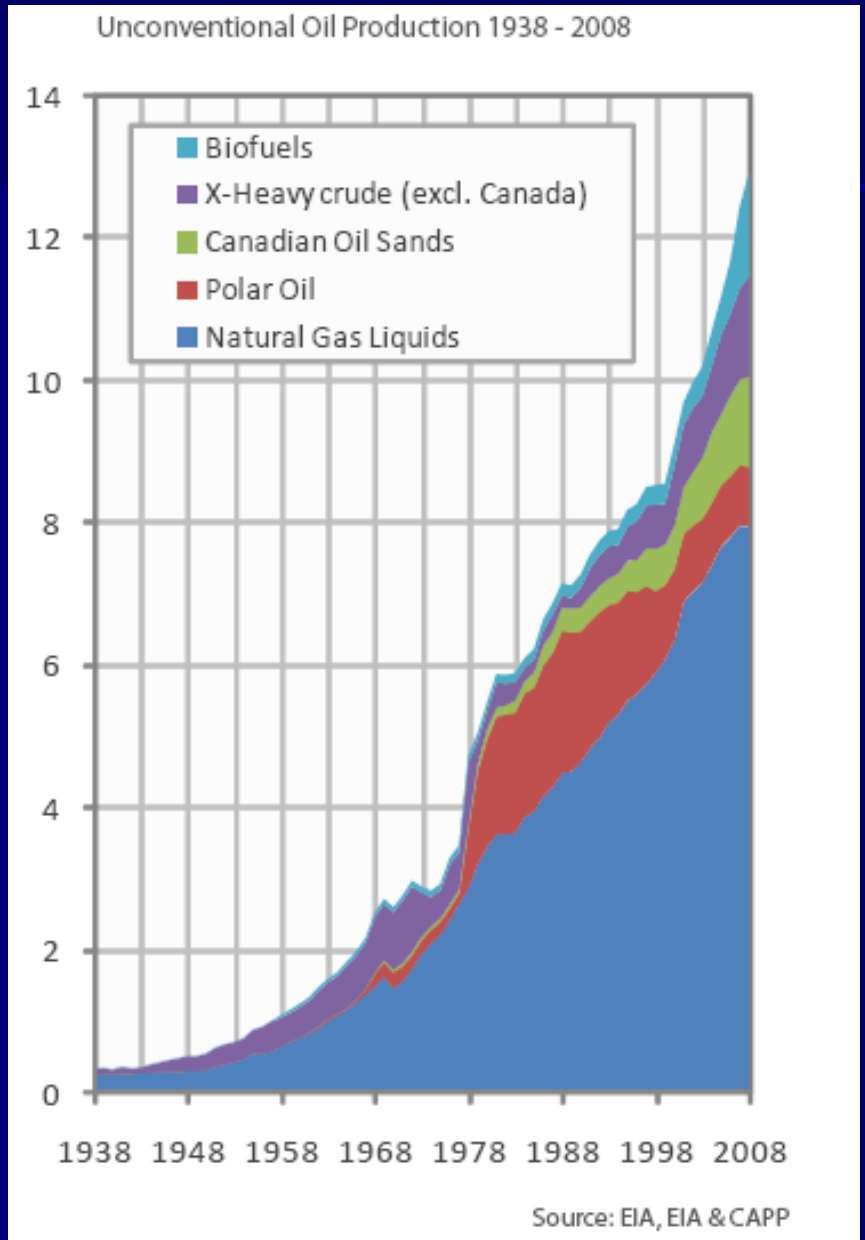


Oil exporting countries are happy.
Oil importing countries can live with this (?).

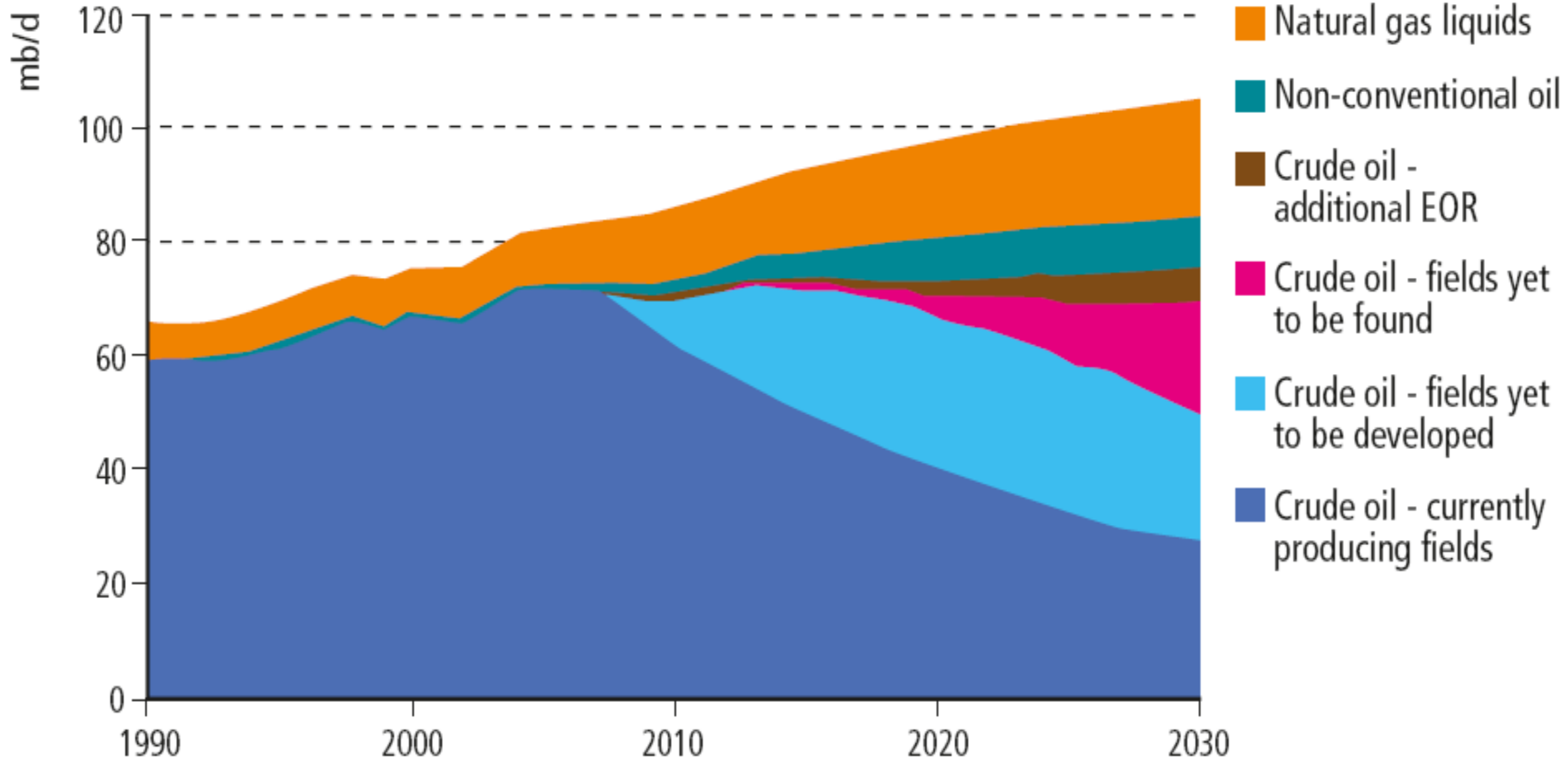
Big question: value of the US Dollar ?

Conventional Oil – Bad Outlook (Peak?)



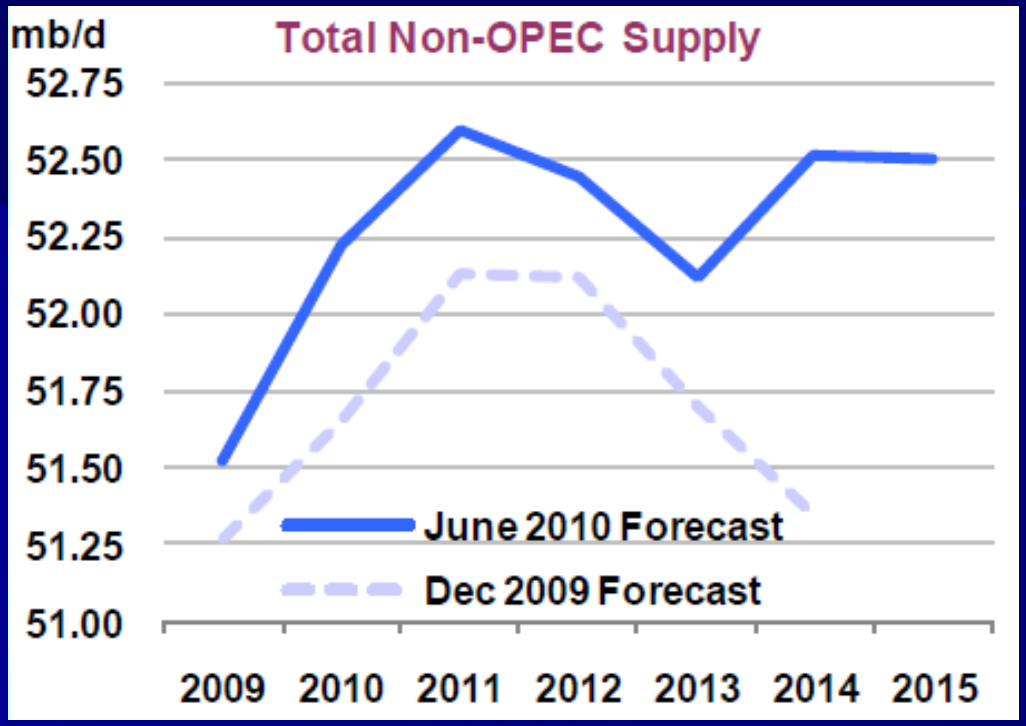


IEA 2008 Report – Peak oil of currently producing fields



Source: IEA (2008)

2011: Non-OPEC Oil Peak ?

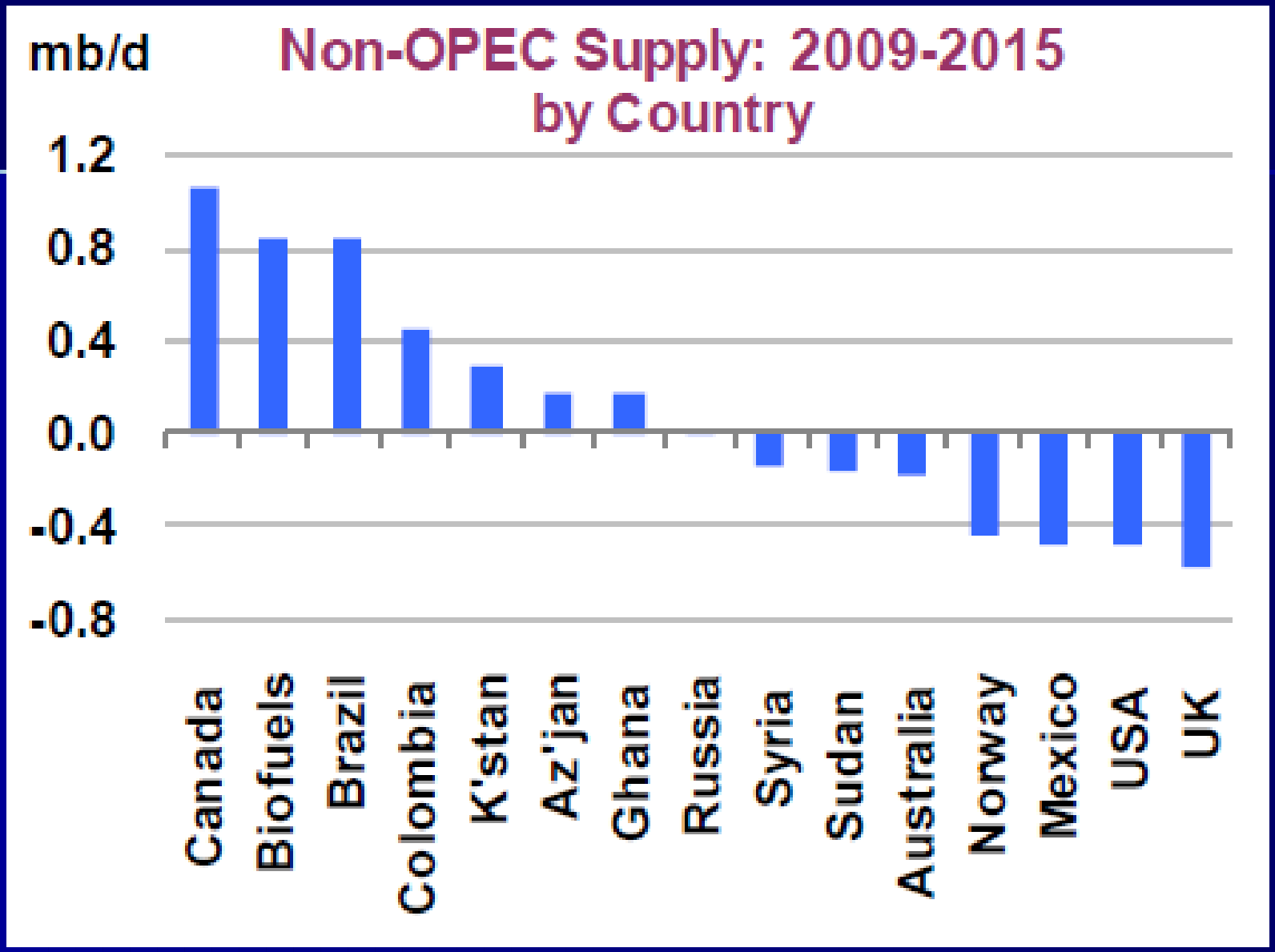


Source: IEA, 2010

Future growth comes from Canadian oil sands, biofuels, Brazil, Colombia and Caspian oil. **Biofuels +0.8 mb/d**, NGLs +0.7 mb/d, other unconventional oils.

Strong decline in North Sea, US, Mexico (-1.0 mb/d).

Non-OPEC supply, including non-conventionals, biofuels and NGLs, will likely peak by 2011 at around 52.6 million b/d.

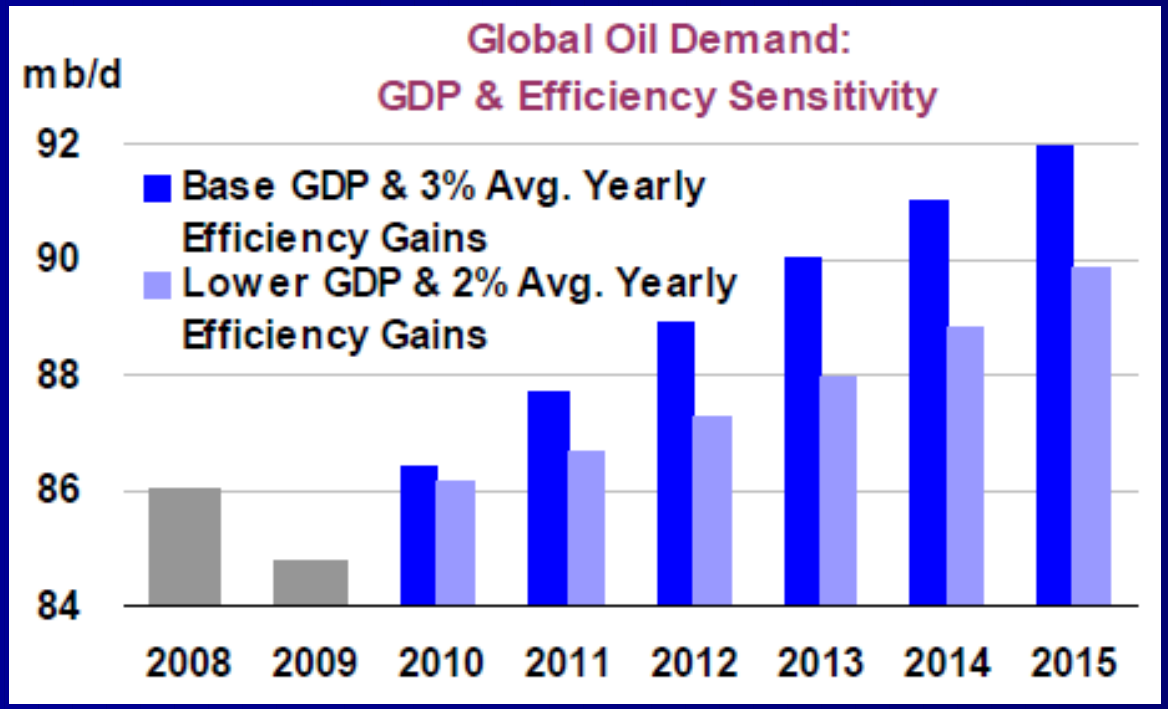

mb/d
Non-OPEC Supply: 2009-2015
by Country
1.2
0.8
0.4
0.0
-0.4
-0.8
Canada
Biofuels
Brazil
Colombia
K'stan
Az'jan
Ghana
Russia
Syria
Sudan
Australia
Norway
Mexico
USA
UK

Decline Rates are Increasing

- Non-OPEC decline rates have increased from 4.8% (2008) to 4.9% (2009). This is equal to 1 million b/d by 2015.
- 4% decline rates for fields developed prior to 1998 (which passed their peak).
- 18 % decline rates for peaked fields developed after 2002.
- Most barrels of incremental production face a steeper decline rate.

Oil Demand to Grow

- World oil demand is expected to increase by up to 6 mil. b/d in 2015.



Annual sales of cars in China will reach 10 million by 2010 and 20 million by 2020.

Cheap and Easy Oil is Gone

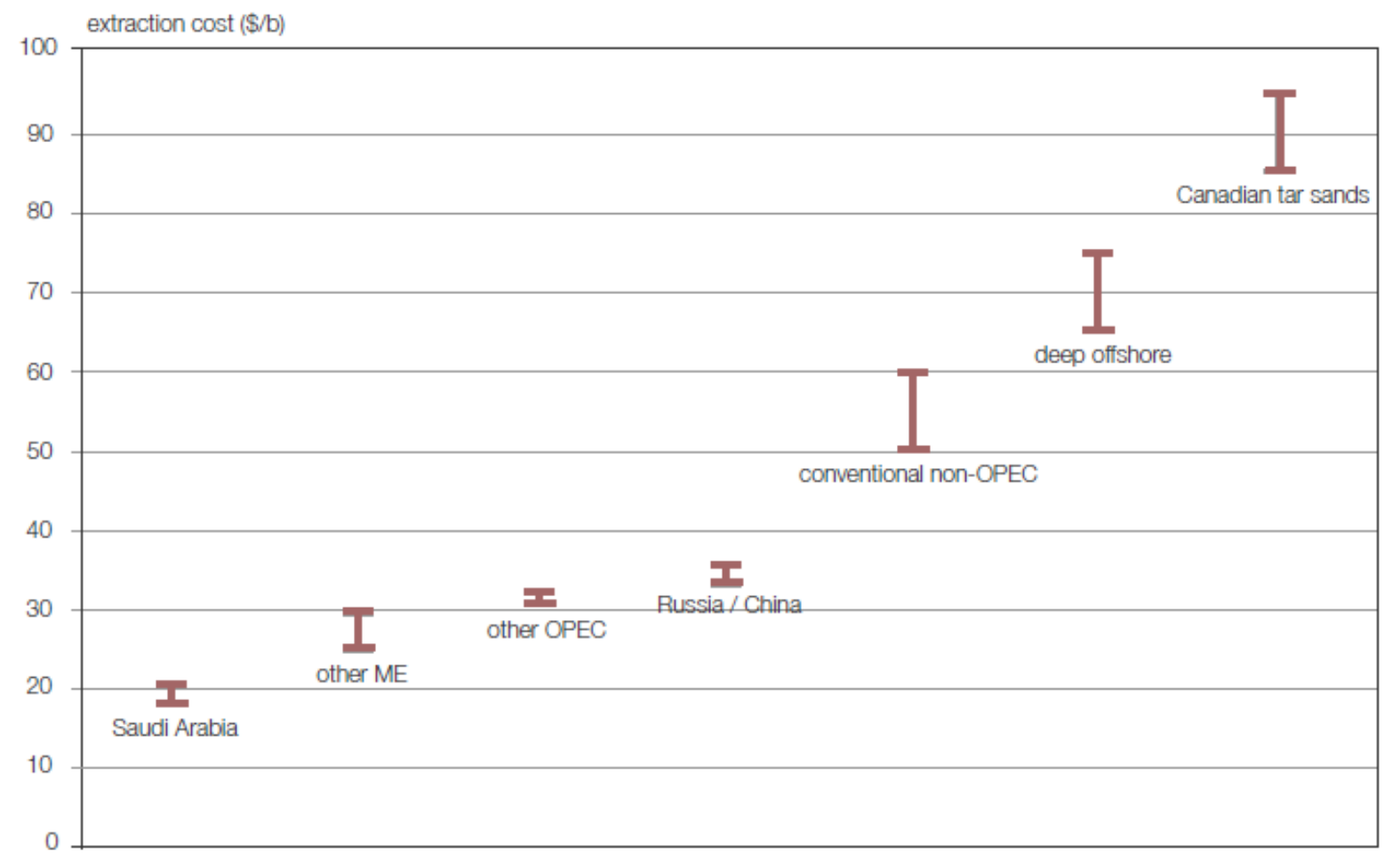
What's left are new fields which are:

- smaller
- harder to find
- of lesser quality
- in much more challenging places
- expensive
- risky
- dangerous
- often have a shorter life span

Destruction of the Horizon deepwater rig

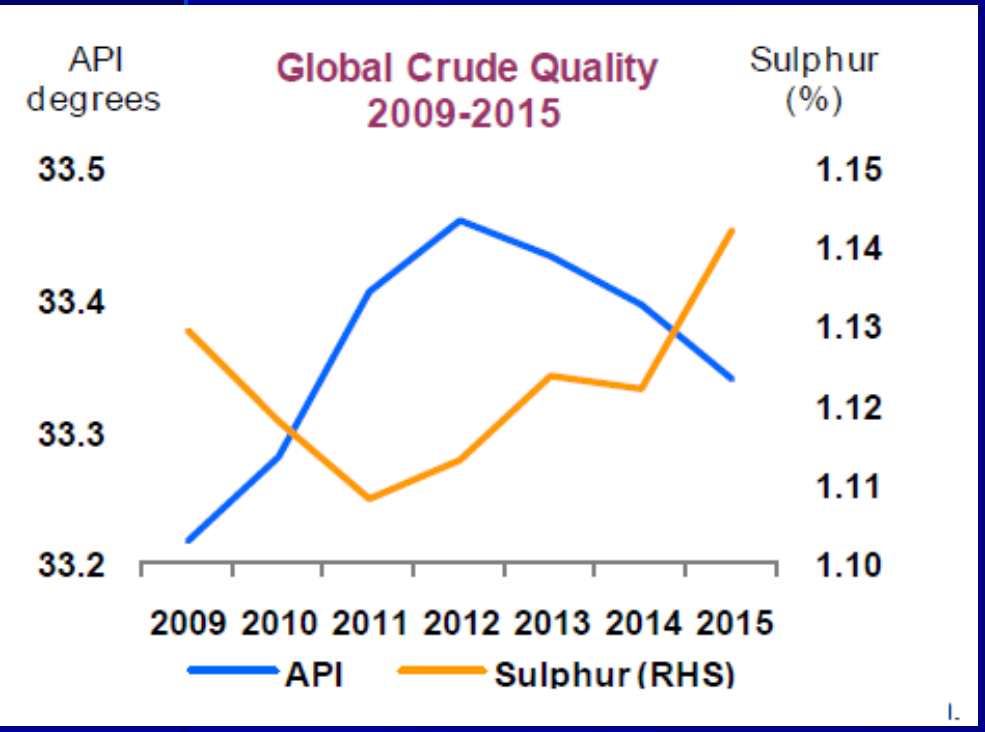
USA: Only offshore is it still possible to find a field which can deliver over 100,000 barrels per day.
Onshore resources are marginal. About 1,2 MBpd (over 20% of production), comes from **thousands** of small wells producing **less than 15 barrels per day.**

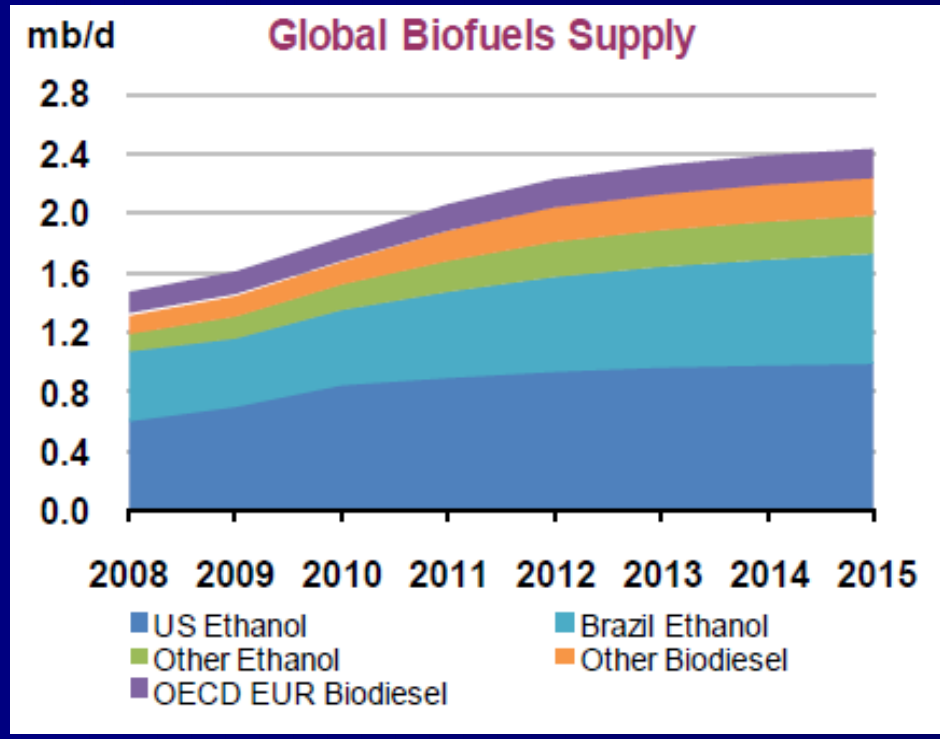
Rising costs of oil production



Source: Peak Oil Consulting

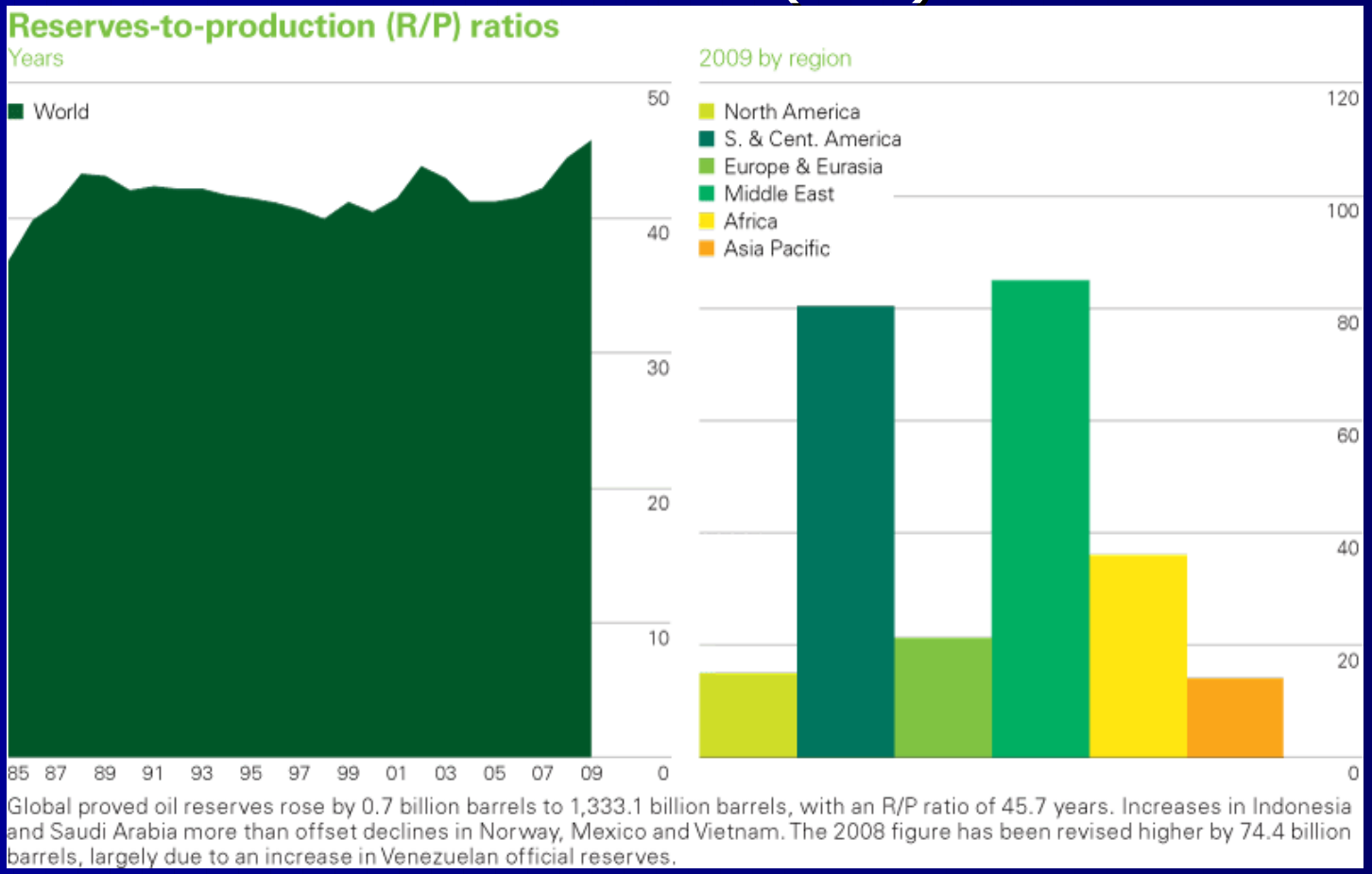
IEA (2010):
1. Dirty Oil on the Horizon
2. Bright future for Biofuels





Peak Oil Theory - Controversial Issue

Oil reserves are sufficient to meet demand until at least 2030 (IEA).



BP Statistical Review of World Energy 2010

Bundeswehr Concerns

Bundeswehr Transformation Center Study (2010):

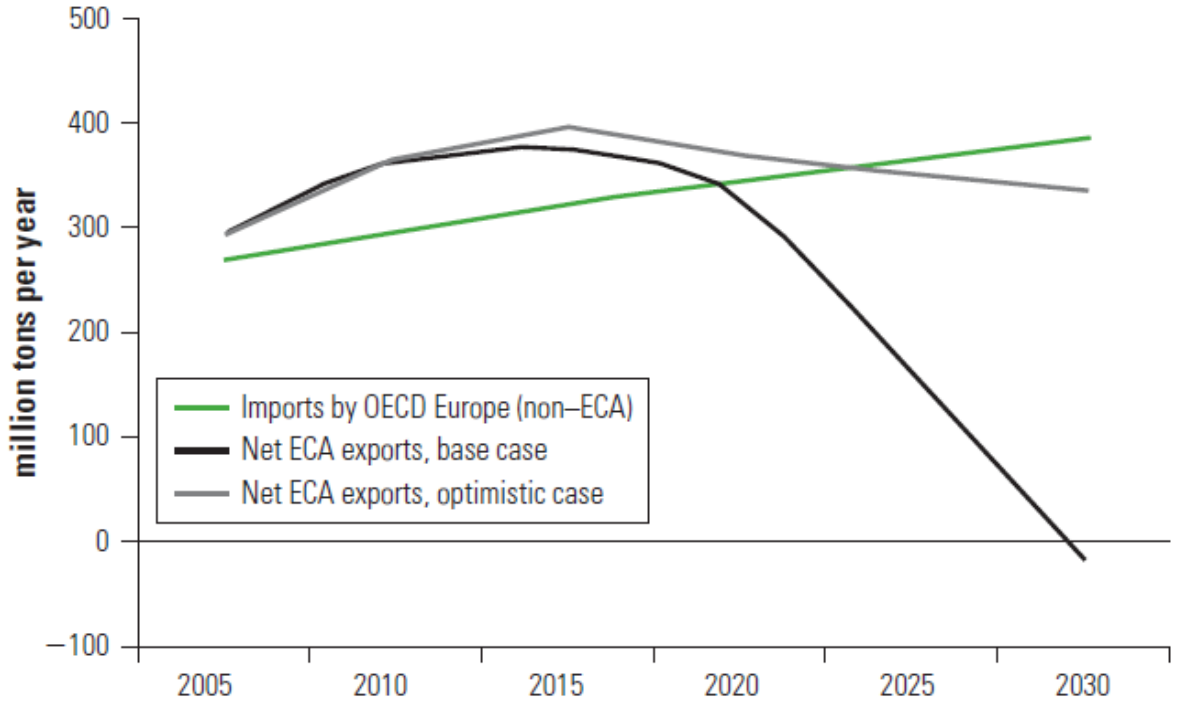
- There is "some probability that peak oil will occur around the year 2010 and that the impact on security is expected to be felt 15 to 30 years later."
- Price shocks due to higher transportation costs, and "shortages of vital goods could arise."
- "In the medium term the global economic system and every market-oriented national economy would collapse."

Source: Der Spiegel, September 2010.

Outlook for CEE

The World Bank 2010 Report „LIGHTS OUT?“

Actual and Projected Net Oil Exports by Europe and Central Asia, 2005–30



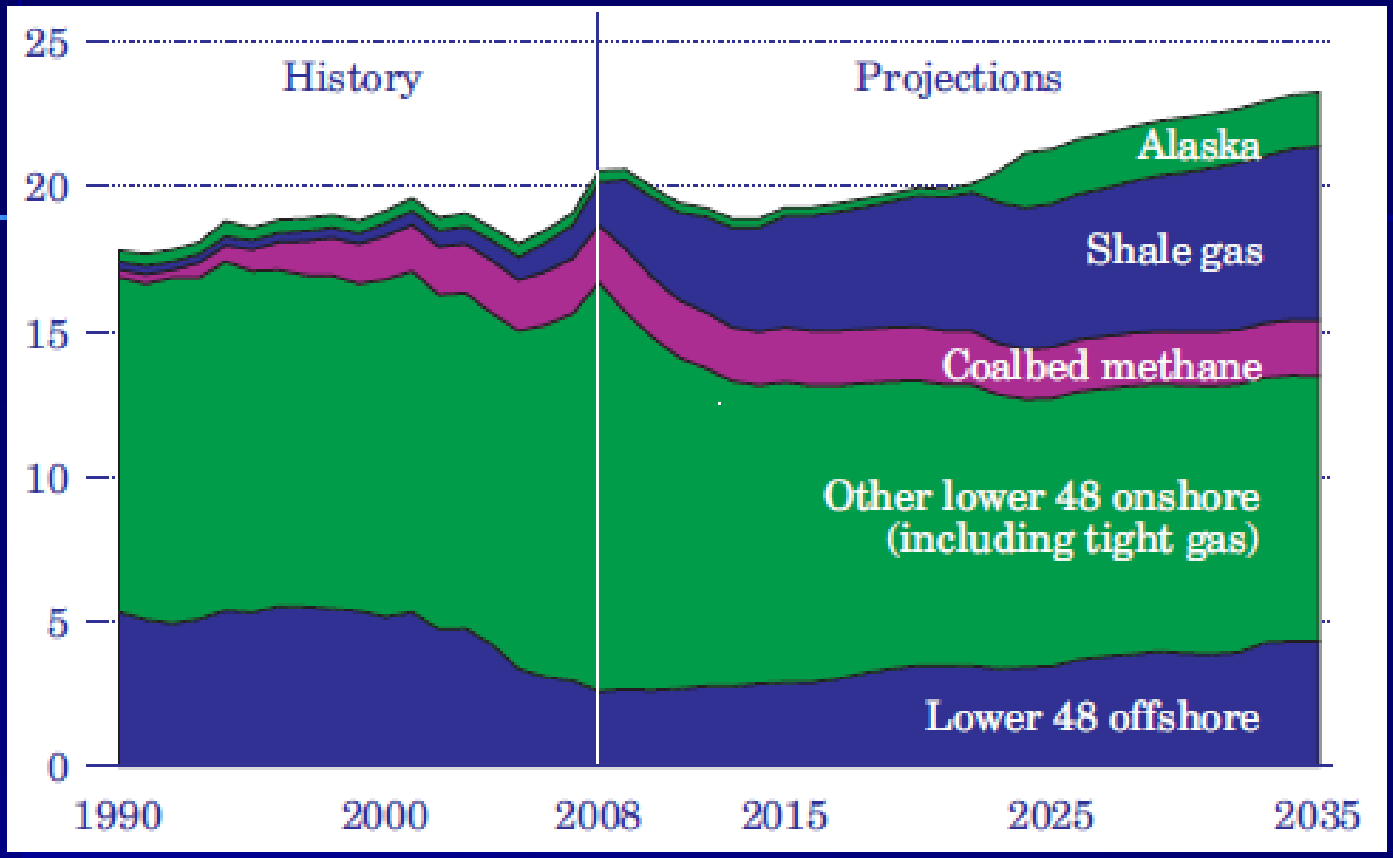
Source: Data for 2005 are from IEA; data for 2010–2030 are World Bank staff projections.

NATURAL GAS

Shale Gas :

- „Biggest energy bonanza in years“
- „Game Changer“
- „Quiet revolution“
- „Shift in Geopolitics“

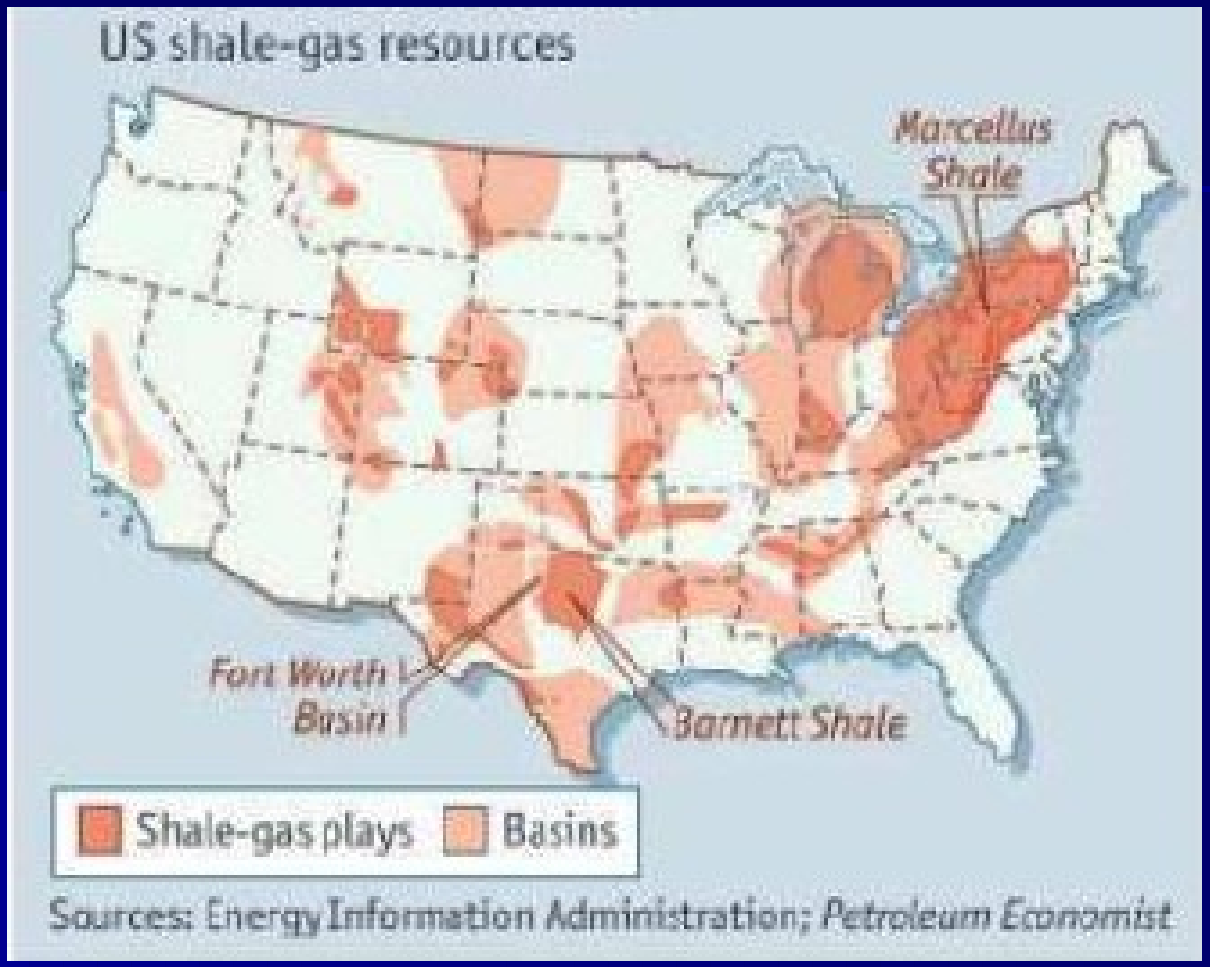
Shale gas in the U.S.



US Natural gas production (trillion cubic feet)

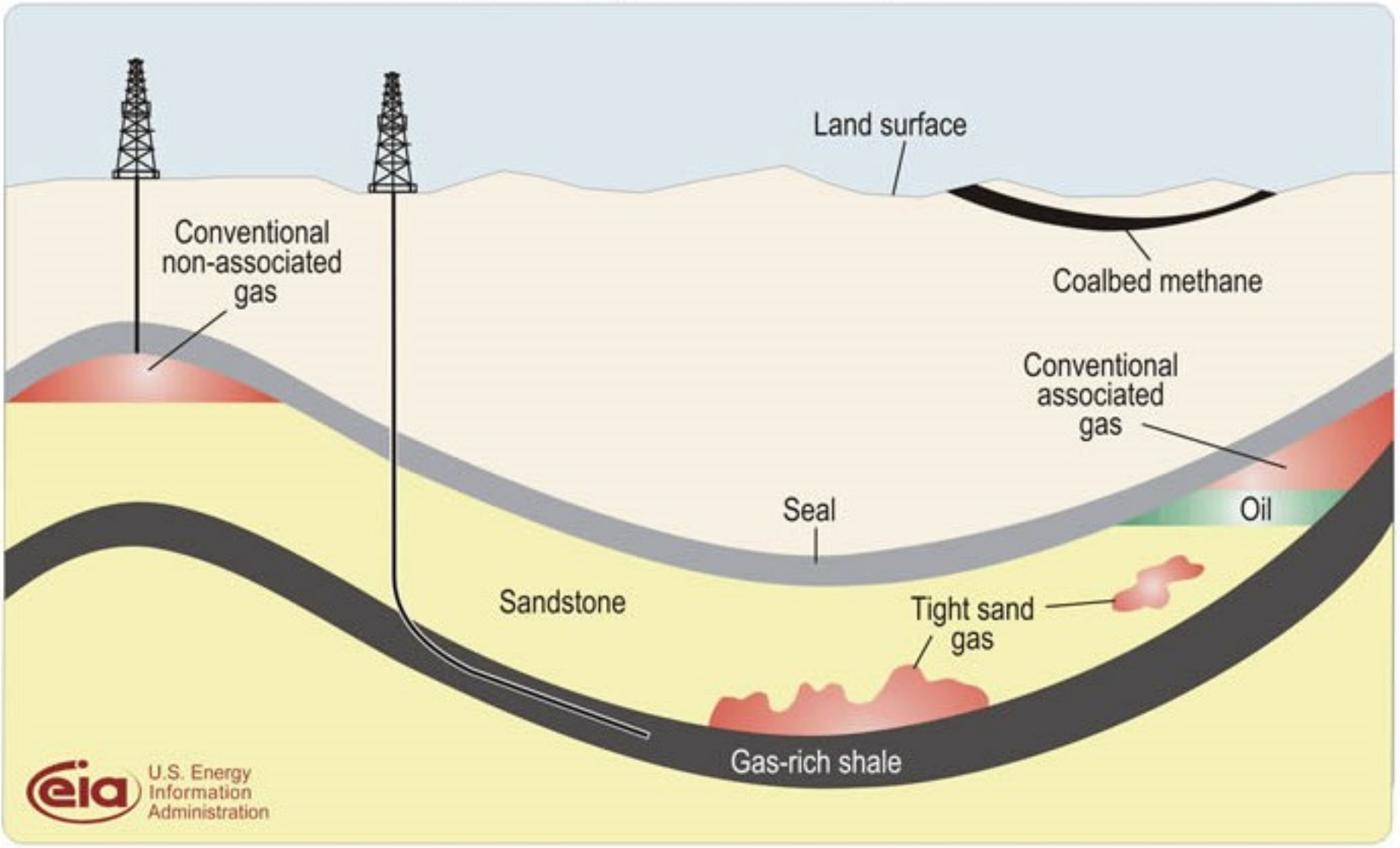
- Shale gas - now its 20% of U.S. production.
- Land-based source of hydrocarbons no off-shore problems.
- Large quantities and promising sources lie close to many big energy-intensive cities (New York etc.)
- Local farmers in USA are making thousands of dollars a day leasing out the right to drill on their land.

It´s almost everywhere



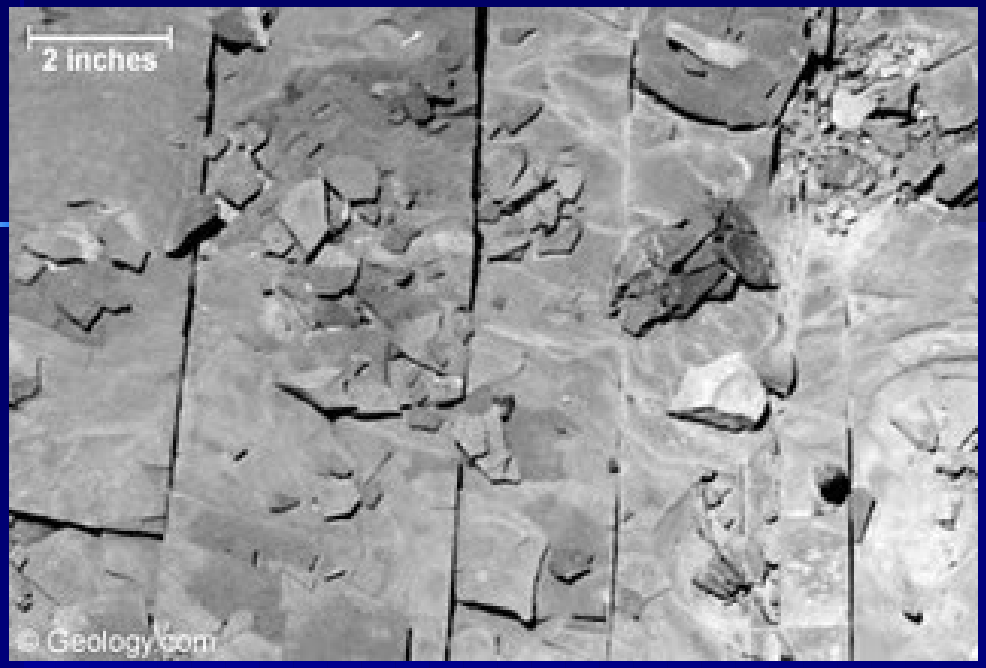
Marcellus shale could supply the entire USA with gas for a decade.

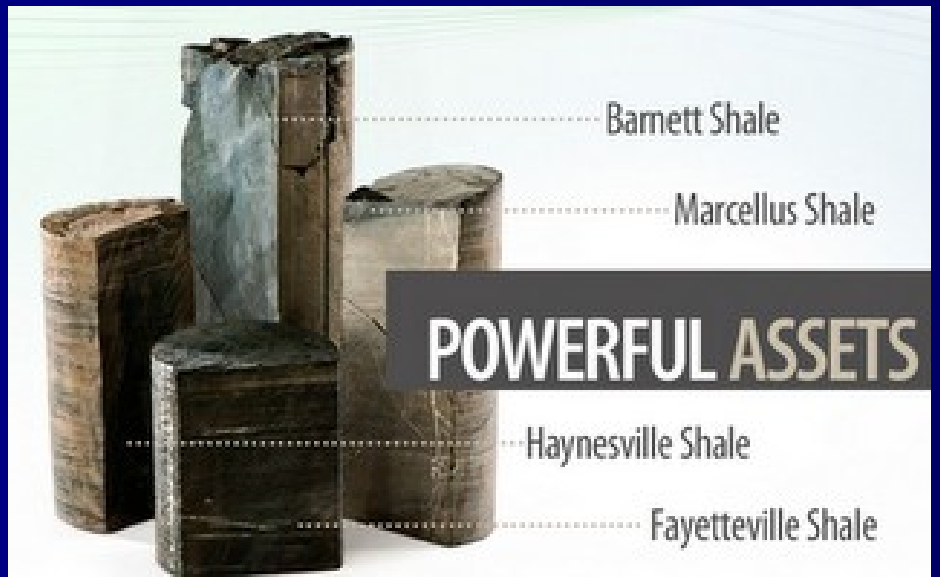
Schematic geology of natural gas resources

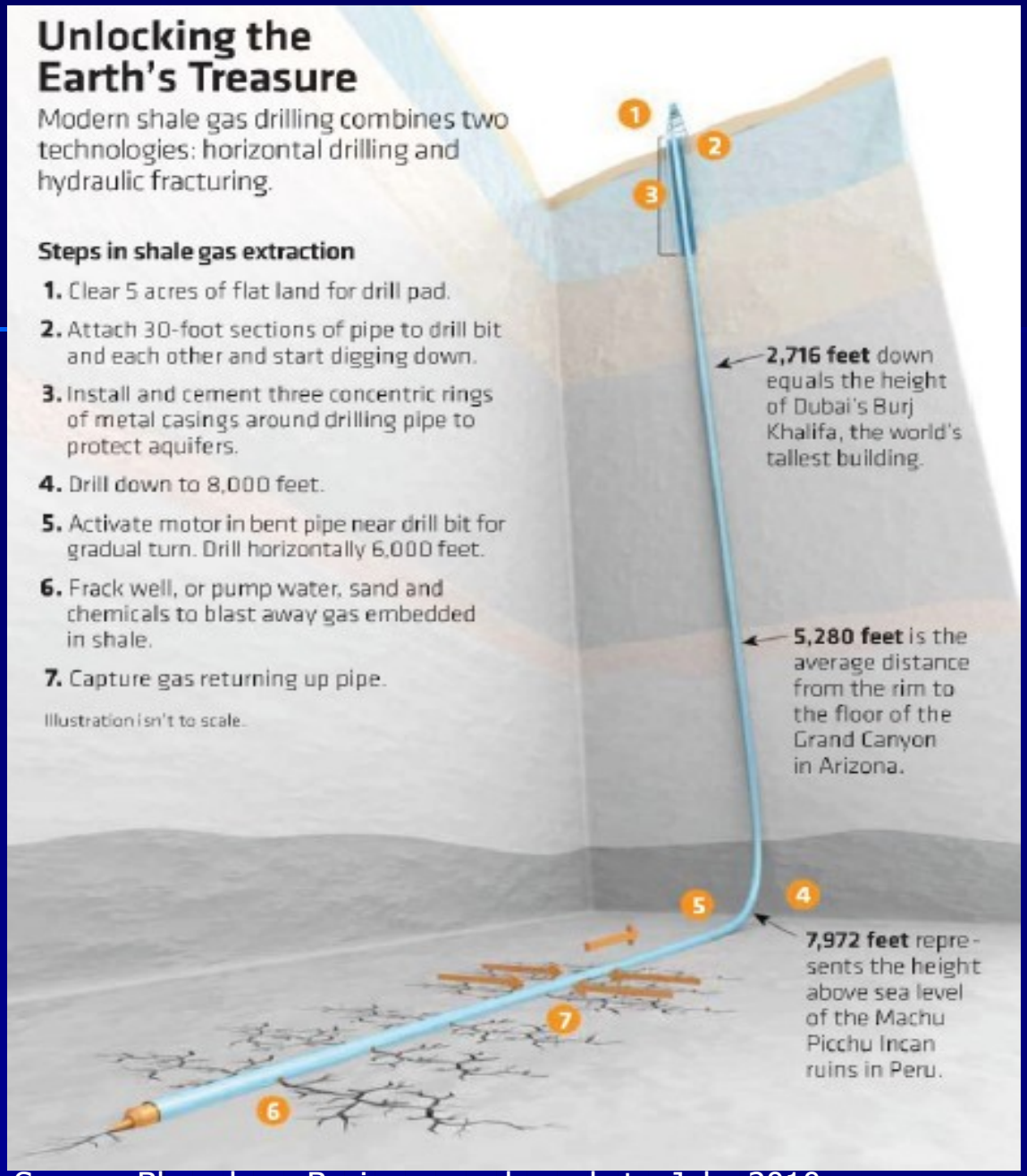


Gas is embedded in shale - the most common sedimentary rock, when ancient seabeds were covered and compressed by erosion.

Rock containing Shale Gas







Source: Bloomberg Business week markets, July, 2010

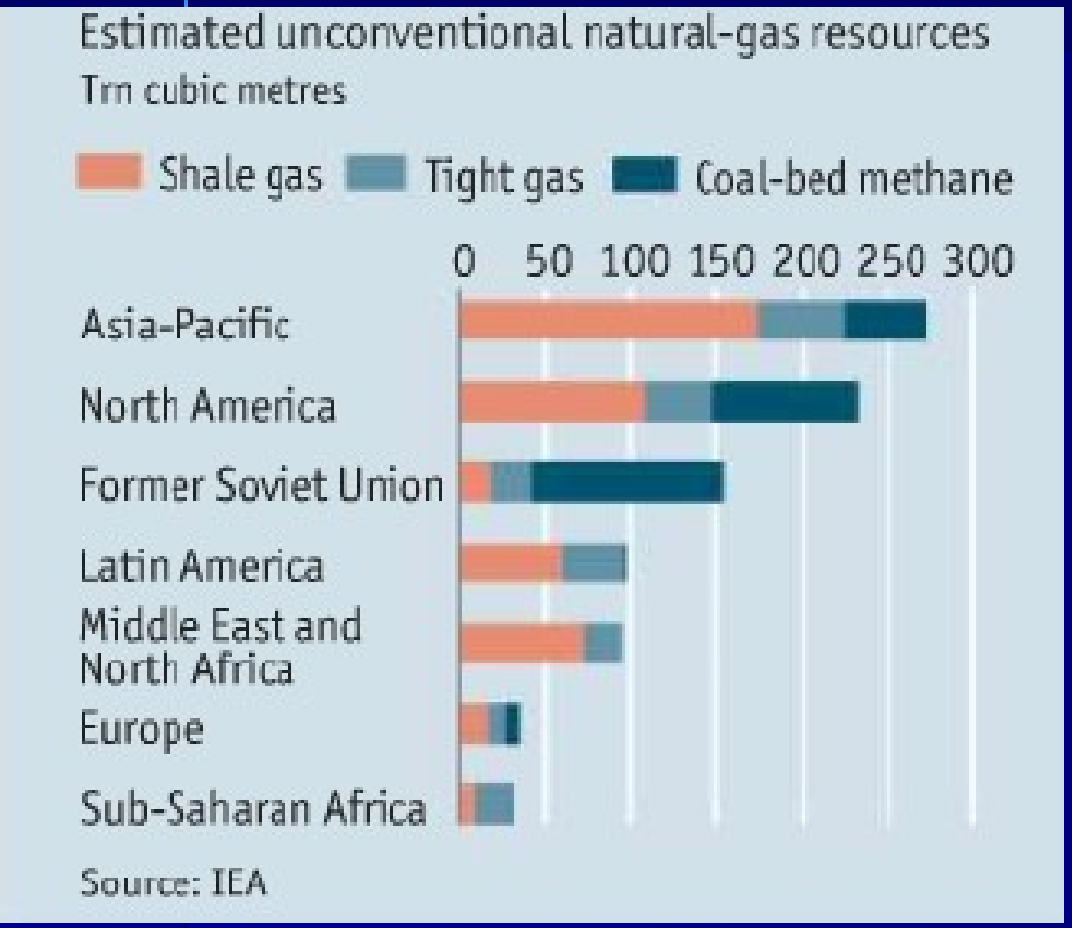
Hydro-fracturing has made accessible deposits previously considered unrecoverable.

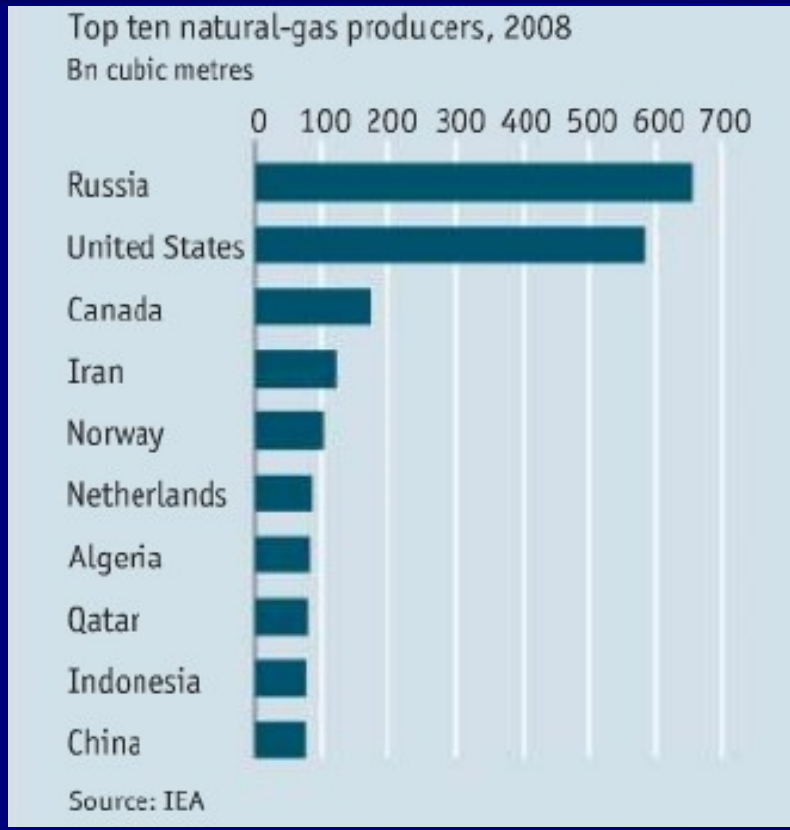
Fracking = blasting water into a well to shatter rock and unleash gas

New horizontal drilling techniques are making it easier to reach.

Video (6 min): http://marcelluscoalition.org/2009/01/drilling-process-video/

Potential resources are huge





Europe: Resources for almost 50 years if all conventional gas would be substituted by shale and other unconventional gas.

Shale gas in the World

- Canada (gas reserves and gas production have been in sustained decline): the discovery of the Horn River shale gas = Canada may be able to the repeat the US gas success.
- Potential shale gas reserves identified in Spain, Poland, France and Germany.
- Chevron Corp., Conoco a Exxon purchased drilling licenses in Poland.
- Exploration is going on in Austria (OMV in Vienna basin), Germany (Exxon), Hungary and other European countries.

Shale Gas and Europe

- Pilot wells in this year. Understanding of geology will be crucial.
- It will last at least 10 years when there will be a difference to conventional gas.
- Poland first result in this year. Recently joined the US in its Shale Gas Resource Initiative alongside China.
- Threat for Gazprom exports which relies on developing large and costly gasfields in inhospitable places.

Implications

- Coal power: setting price of carbon at 30 USD/ton = displacing coal power plants by nat. gas power plants.
- Oil companies (now in gas business) are lobbying for carbon price or carbon tax!
- Transport sector: gasification has the future.
- Shift in geopolitics of global energy supply.
- US offers international help with shale gas extraction.
- Dirty gas better than dirty coal.
- National security and climate change mitigation are key drivers.

Shale gas and RE

- Tandem Gas (flexibility in power production, infrastructure, cleaner than coal)+RE seems attractive for energy planners.
- 2010 gas market: low prices due to recession on oversupply of gas.
- Outlook for future: recession + efficiency and carbon reductions = less demand for gas = no big price shocks = new pipelins are questionable.
- U.S. DOE: Decades of relatively low gas prices.

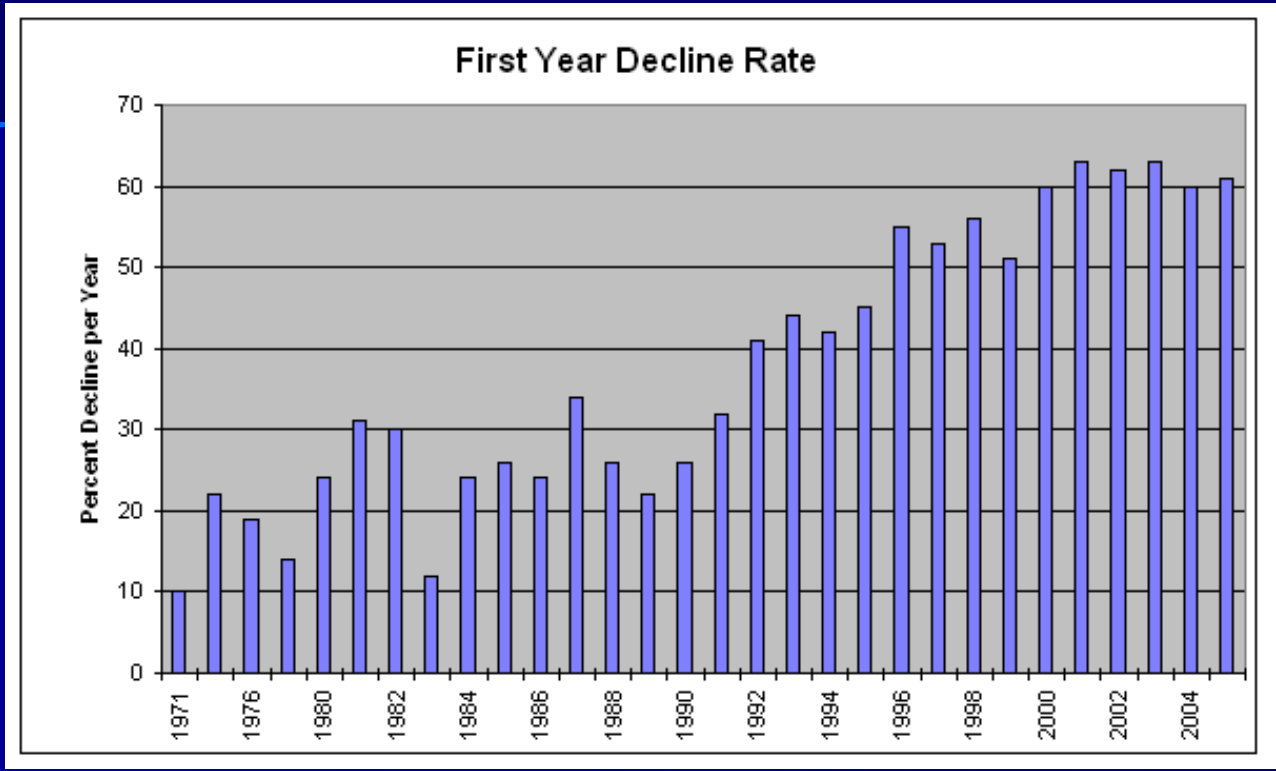
Shale Gas Business

- Better business than oil.
- Shale gas well costs - 4 mil. USD
- Oil well in Gulf of Mexico - 300 mil. USD
- Costs are higher than conventional gas or coal.
- Exploiting requires drilling lots of wells-harder in densely populated Europe than in America.
- Shale gas industry needs a natural gas price of 7,50 to 8,00 USD per thousand cubic feet to be competetive. The trading price in the U.S. is currently around 4 USD.

Environmental problems

- Drilling is very water-intensive. Pumping of 19 mil. liters of water (40% flows back) into well.
- Each well needs 82 tons of chemicals for inhibiting corrosion and kiling bacteria.
- Shale gas long term risk-contamination of groundwater. Texas Commision on Environment found benzene (10.700 times more than safe limit) near the gas well.
- Methane contamination found in some local water supplies. Well water becoming flammable **(http://www.youtube.com/watch?v=wwogQWLEqW8).**
- New York city Mayor (2010):"We firmly believe that drilling cannot be permitted in the city´s watershed."
- New York State: moratorium on new drilling.
- Environmental Protection Agency began an investigation.
- Proponents: „damage from coal mines is much worse."
- Opposition to drilling is rising.

Maybe it is not as promising as it looks



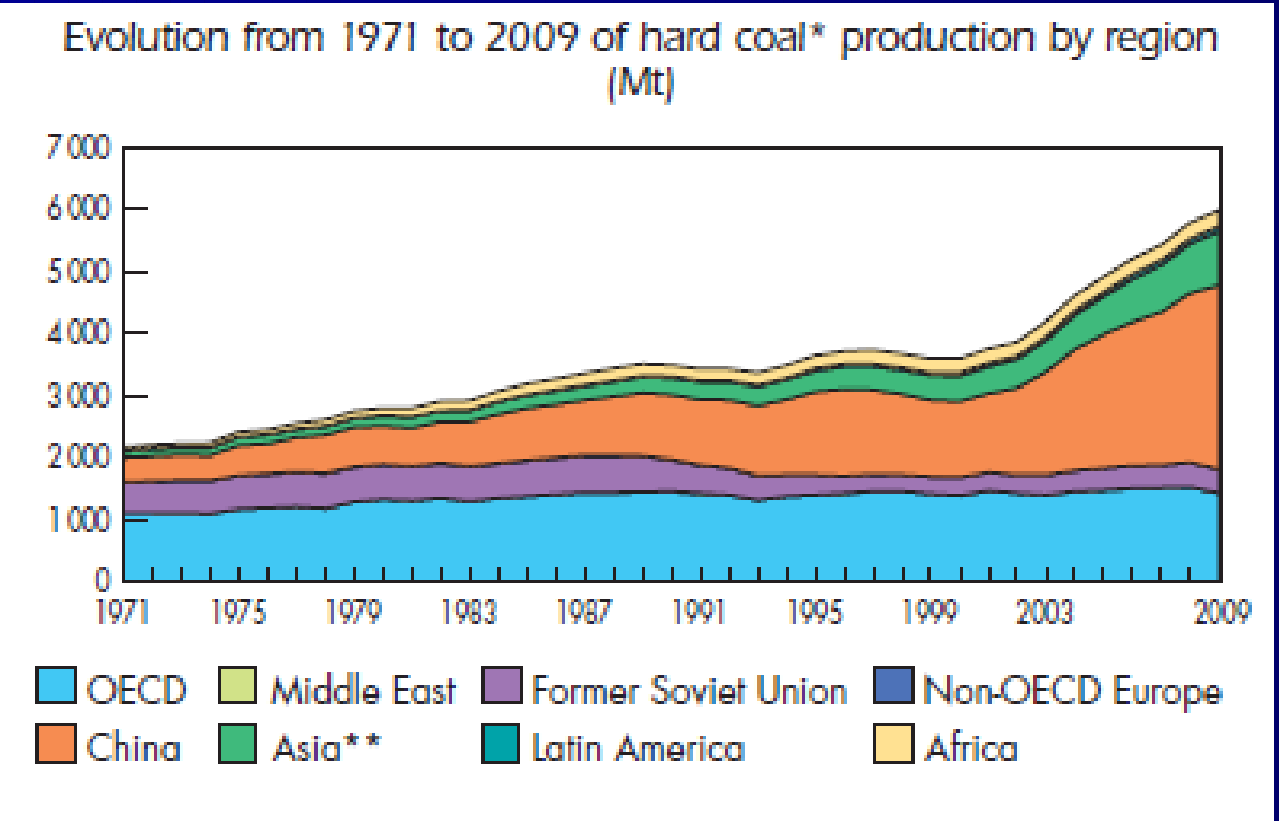
- Decline rates of some 67 wells in the Haynesville (USA) up to 25% a month. More than 60% decline of production in the first year.
- New wells have to be drilled at an ever increasing rate (as the fields get smaller) in order to maintain production.

COAL

Share of world energy consumption: 29.4% . The highest since 1970.

World’s leading electricity fuel (40% of the world's electricity).

Major contributor to climate change.



PREDICTIONS

- **U.S. Energy Information Administration (2010)** : „coal consumption for electricity will grow more than 50 percent by 2035 unless policies are put in place to stop the growth of greenhouse gas emissions.“
- **World Coal Institute (2010)**: "the use of coal will rise 60 percent over the next 20 years," ... "coal will last for at least 119 years."
- Most of the IPCC scenarios based on 200 years of coal supply, and the “eternal” (100 years plus) growth of carbon dioxide emissions.

Reserves – where they have gone?

Reserves/Production	Source
216 years	The BP Statistics, 2002
133 years	The BP Statistics, 2008
122 years	The BP Statistics, 2009
119 years	The BP Statistics, 2010

Coal Reserves

- Based upon methods and data that had not been reviewed since the early 1970s.

- Team at Newcastle University in Australia, David Rutledge at the California Institute of Technology, and a German Energy Watch Group: **coal production would most likely peak in the next couple of decades**.

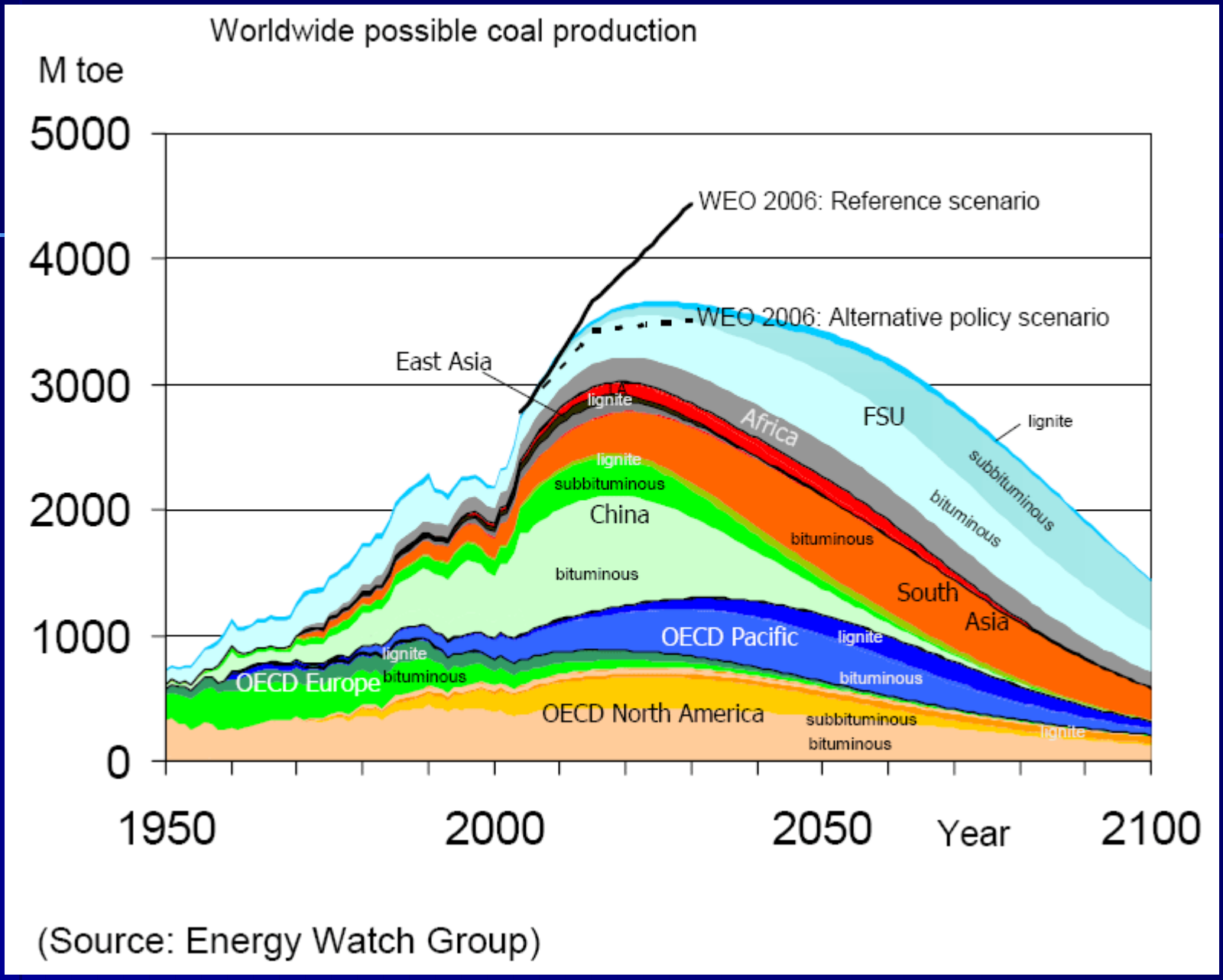
- Tad Patzek study (2010), chairman of the Department of Petroleum and Geosystems Engineering at the University of Texas at Austin:

  1. We are near or at the peak right now.
  2. By mid-century, the world's coal mining will supply only half as much energy as today.
  3. World will finish off the coal that is easy to reach and high-quality (large amount of energy per ton).
  4. What remains will often be of lower quality, harder to dig up and bring to where it is used.

- At the end it is not the R/P but Peak time what is important. The peak of production typically occurs long before the resource is exhausted. Strongly rising production in China will have a substantial influence on the peak of world coal.

U.S. Coal production

- ***The United States*** has already passed its peak of production for high-quality coal (from the Appalachian mountains and the Illinois basin) and has seen production of bituminous coal decline since 1990.
- Growing extraction of sub-bituminous coal in Wyoming has more than compensated for this.
- Taking reserves into account - growth in total volumes can continue for 10 to 15 years.
- In terms of energy content U.S. coal production peaked in 1998 at 598 million tons of oil equivalents (Mtoe); by 2005 this had fallen to 576 Mtoe.
- All of the reserves will probably not be converted into production volumes, as most of them are of low quality with high sulfur content or other restrictions."



(Source: Energy Watch Group)