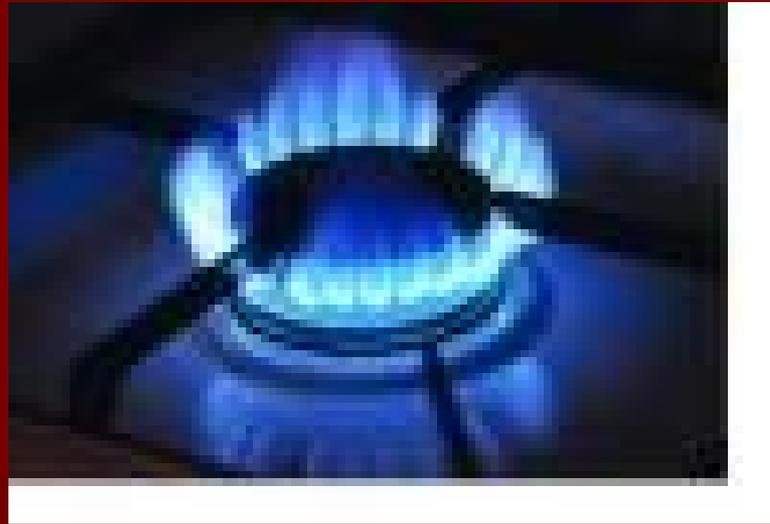


FOSSIL FUELS II

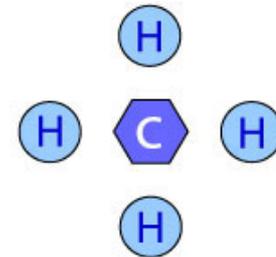
NATURAL GAS



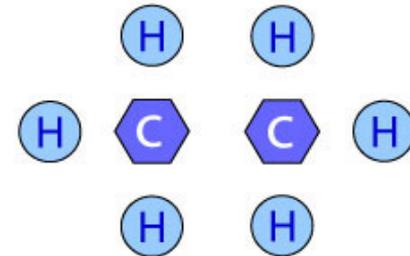
- Mixture of light hydrocarbons, mostly Methane, CH_4 .

[Audio Link](#)

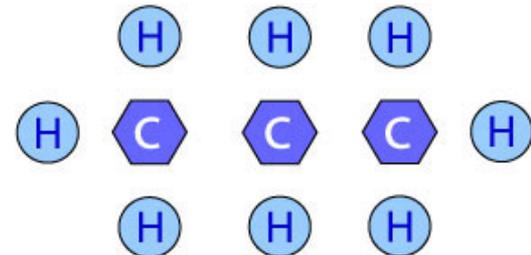
Methane (CH_4)



Ethane (C_2H_6)



Propane (C_3H_8)



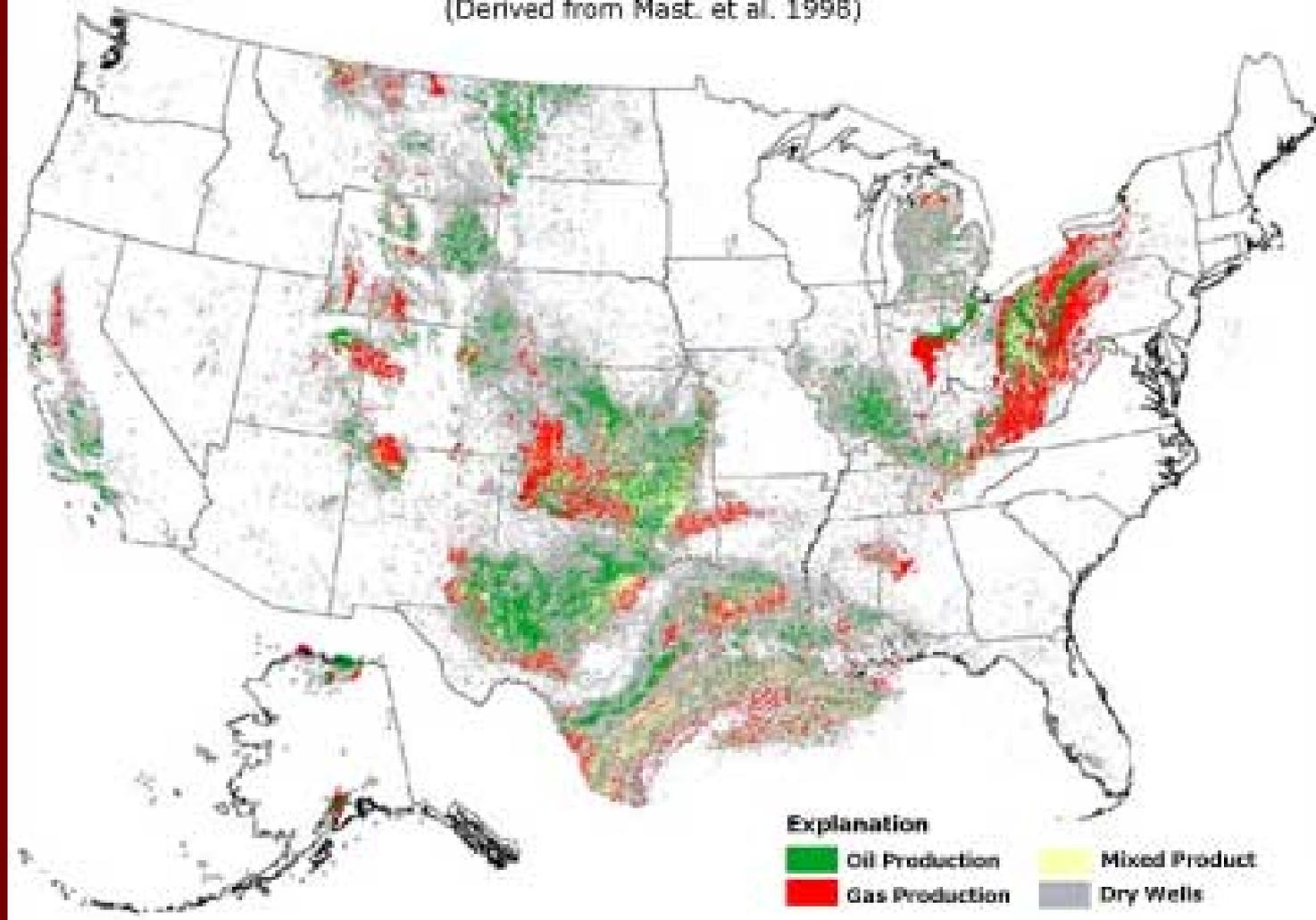
- In its natural state it has no color or odor.
- The odor comes from a chemical called mercaptan, which gives natural gas that funny sulfur-like or rotten egg odor.
- Much Cleaner burning than oil or coal.
- Far less CO₂ emissions than oil or coal.

- Formed by same basic processes as oil.
- Can be found alone in reservoirs (non-associated gas) or in the same reservoirs as crude oil (associated gas).
- Also can be found in coal beds. (more later)
- Much of what we know about finding reserves we learned from searching for oil.

US Oil & Gas Locations

Oil and Natural Gas Production in the United States

(Derived from Mast, et al. 1996)



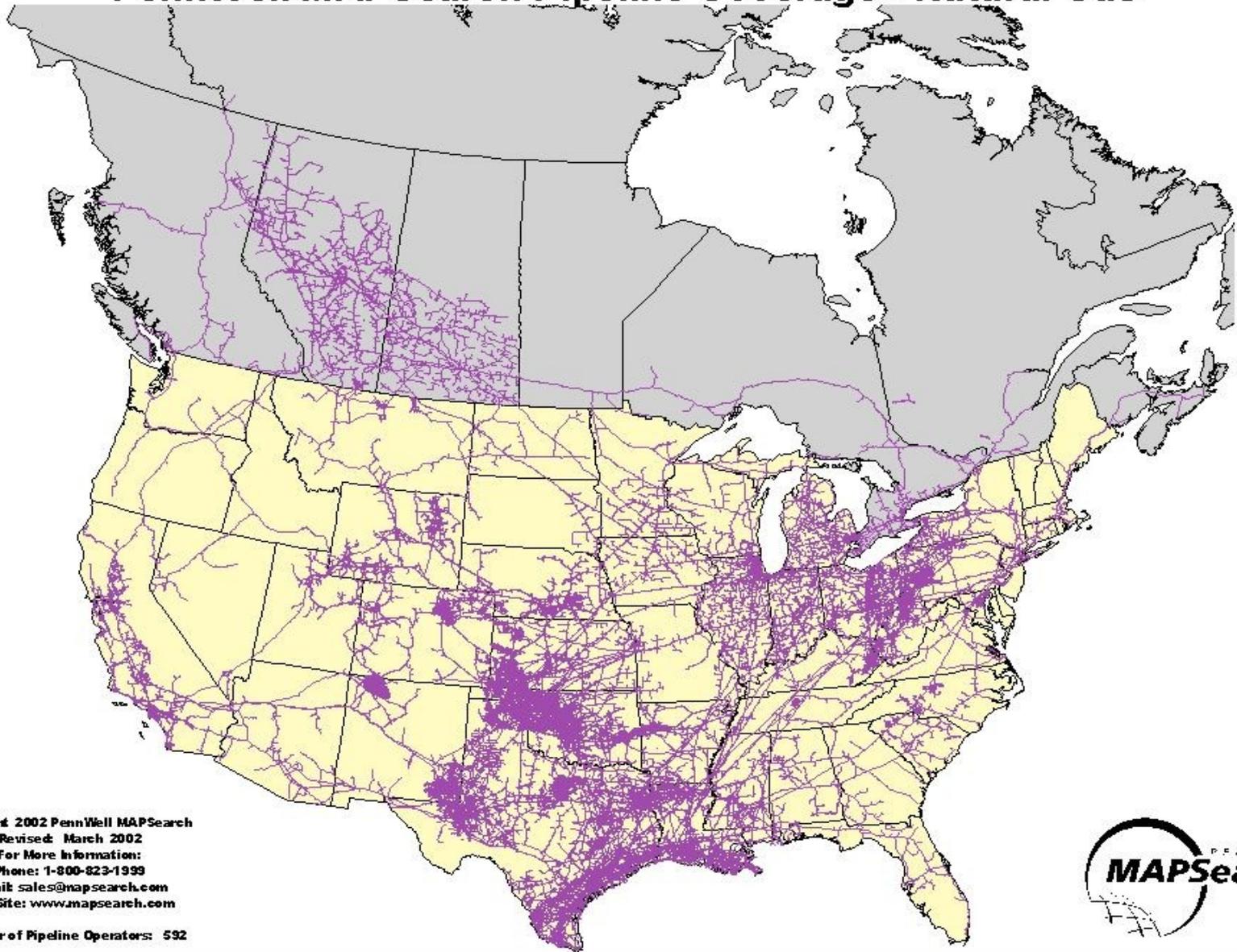
- The first well was drilled in 1821.
- Before the industry could expand, we had to build a pipeline system to deliver the gas to customers.
- After WWII, a high pressure pipeline networks was constructed to serve the entire US. (over 1,000,000 miles of pipe.)

Other Sources of Natural Gas



Argentine researchers discovered methane from cows accounts for more than 30 per cent of the country's total greenhouse emissions. For more on the role of agriculture in greenhouse gas releases see <http://epa.gov/climatechange/ghgemissions/gases/ch4.html>

PennWell MAPSearch Pipeline Coverage - Natural Gas



Copyright 2002 PennWell MAPSearch
Revised: March 2002
For More Information:
Phone: 1-800-823-1999
E-Mail: sales@mapsearch.com
Web Site: www.mapsearch.com

Number of Pipeline Operators: 532



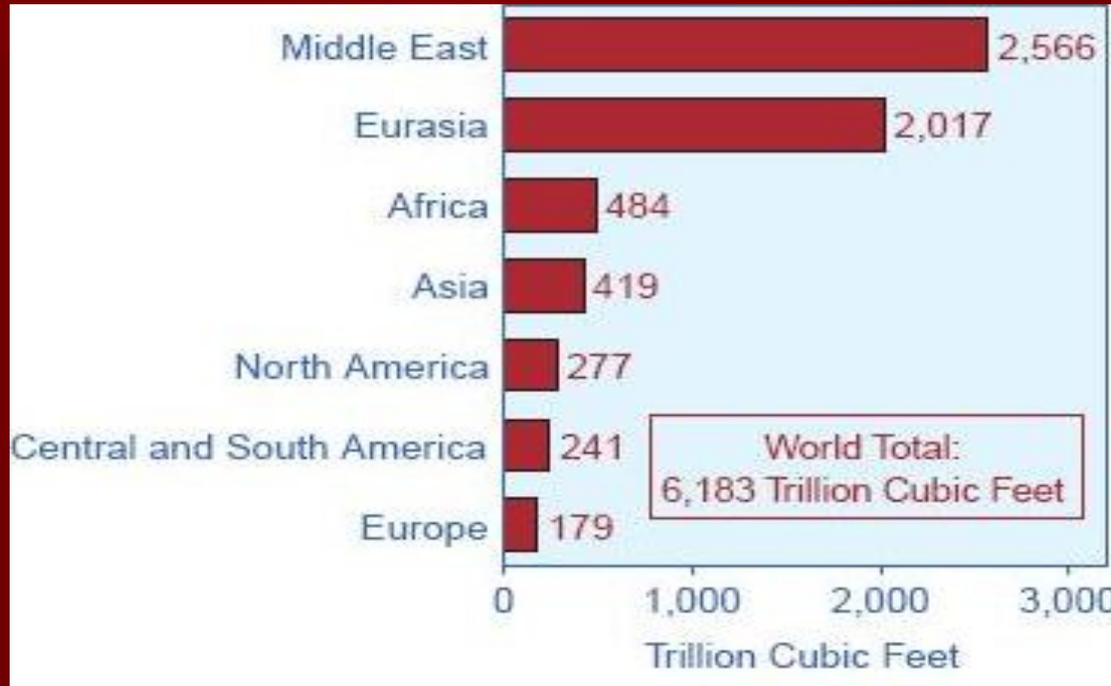


Gas pipeline in the UK

Exploration

- Much of what we know comes from searching for oil.
- Possible Deep earth mechanism for production. Could signify a large (but deep) supply.
- Potential to generate methane from biological processes.

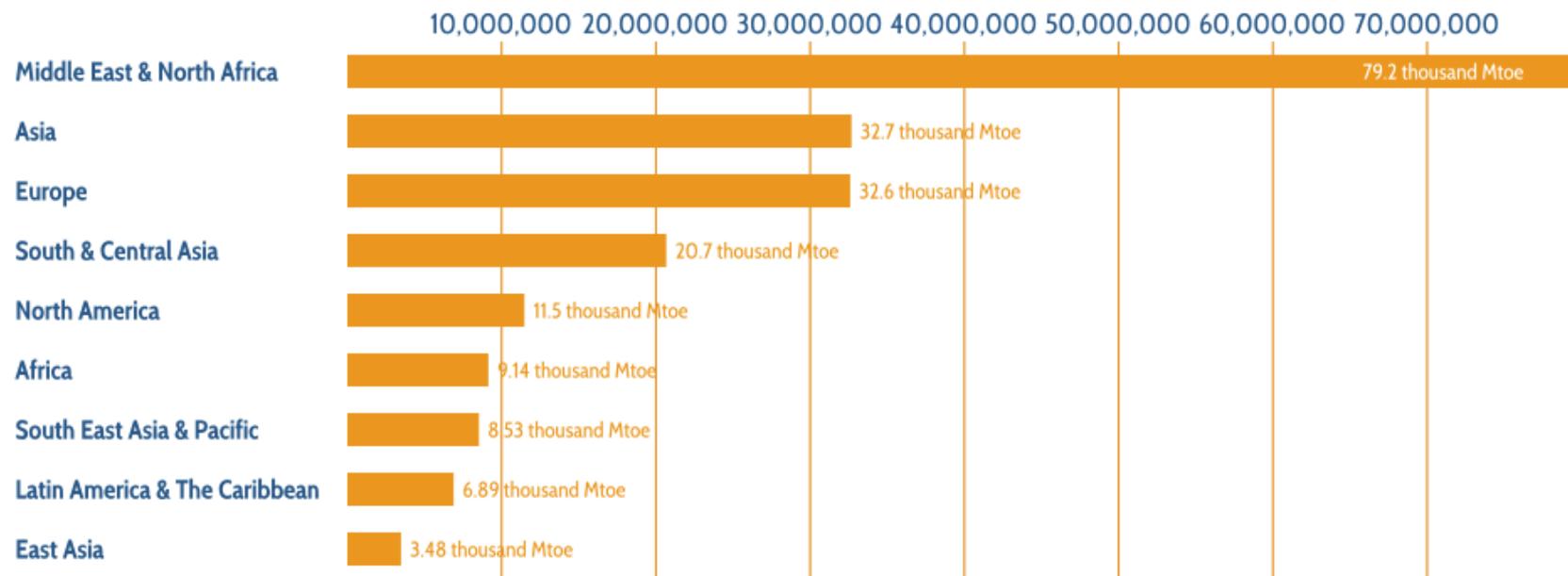
World Natural Gas Reserves 2008



Useful conversion factor: 35.3 ft^3
 $= 1 \text{ m}^3$

For more useful conversion factors, please see
<https://www.extension.iastate.edu/agdm/wholefarm/html/c6-89.html>

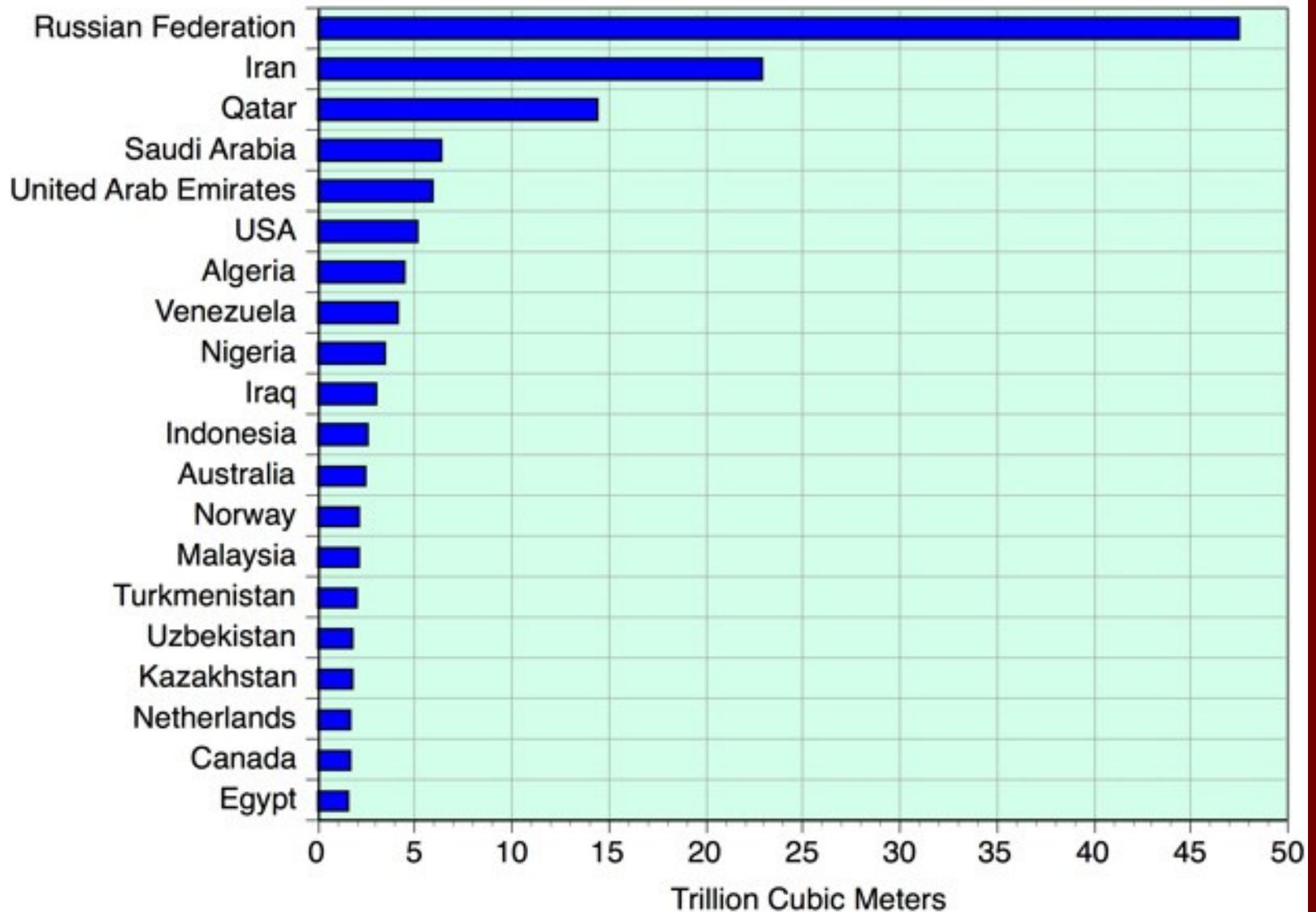
Gas Recoverable Reserves by region



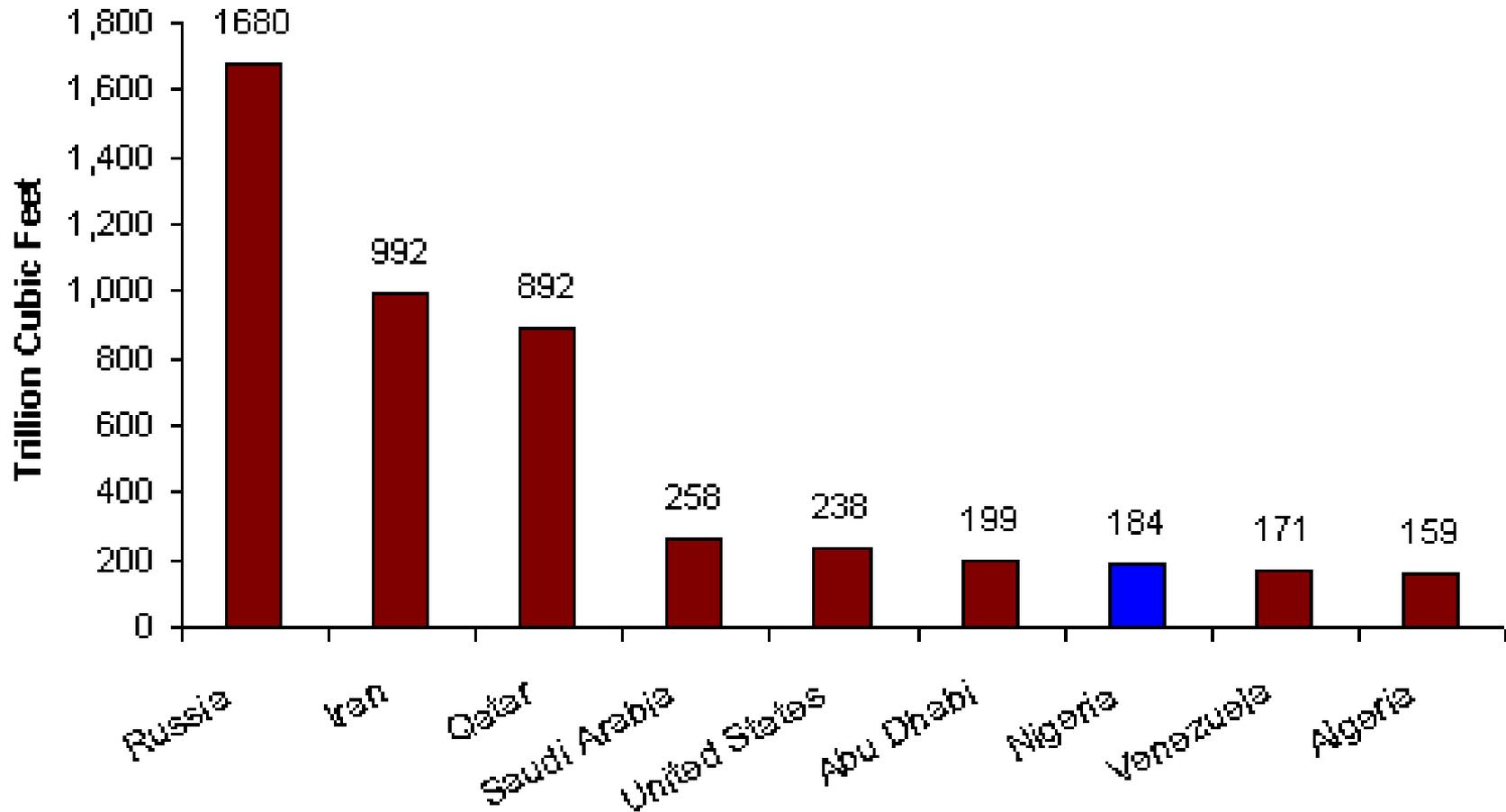
Copyright World Energy Council 2018

The data is presented differently from one source to the next. Useful conversion factor: 1 million metric tons LNG = 48.7 billion cubic feet NG
80000 Mtoe = 3,896,000 billion cubic ft NG = 3896 trillion cubic ft

Proved Natural Gas Reserves 2002 - Top 20 Countries



Top Proven Natural Gas Reserve Holders, 2009



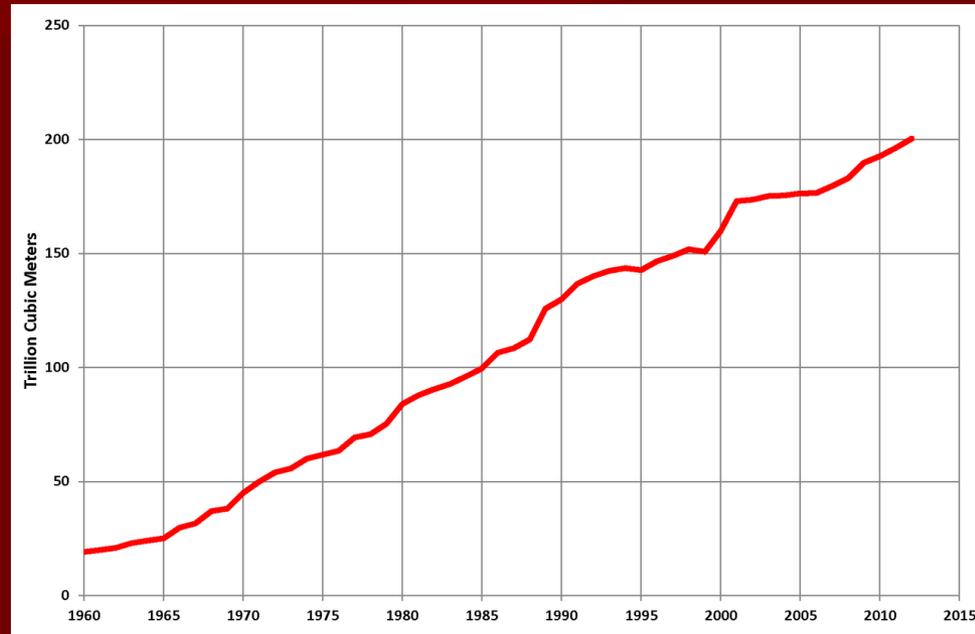
Source: *Oil and Gas Journal* 2009

Proven Reserves between January 2016 and December 2016 (from Wikipedia)

1	 Russia	47,800,000	1 January 2016 est.[5]
2	 Iran (see: Natural gas reserves in Iran)	34,020,000	1 January 2016 est.[7]
3	 Qatar	24,530,000	1 January 2016 est.[8]
4	 United States (see: Natural gas in the United States)	9,659,000	End of 2016[9]
5	 Saudi Arabia	8,489,000	1 January 2016 est.[8]
6	 Turkmenistan	7,504,000	1 January 2016 est.[8]
7	 United Arab Emirates	6,091,000	1 January 2016 est.
8	 Venezuela	5,617,000	1 January 2016 est.[10]
9	 Nigeria	5,111,000	1 January 2016 est.[8]
10	 Algeria	4,504,000	1 January 2016 est.

Proved and proven are interchangeable in this course. What has changed between 2016 and 2002? The units are million cubic meters. Compare this figure with the one from 2002.

World Natural Gas Reserves 1960-2012 (from Wikipedia)



Useful conversion factor: 35.3 ft^3
 $= 1 \text{ m}^3$
200 trillion cubic meters = 7000
trillion cubic ft

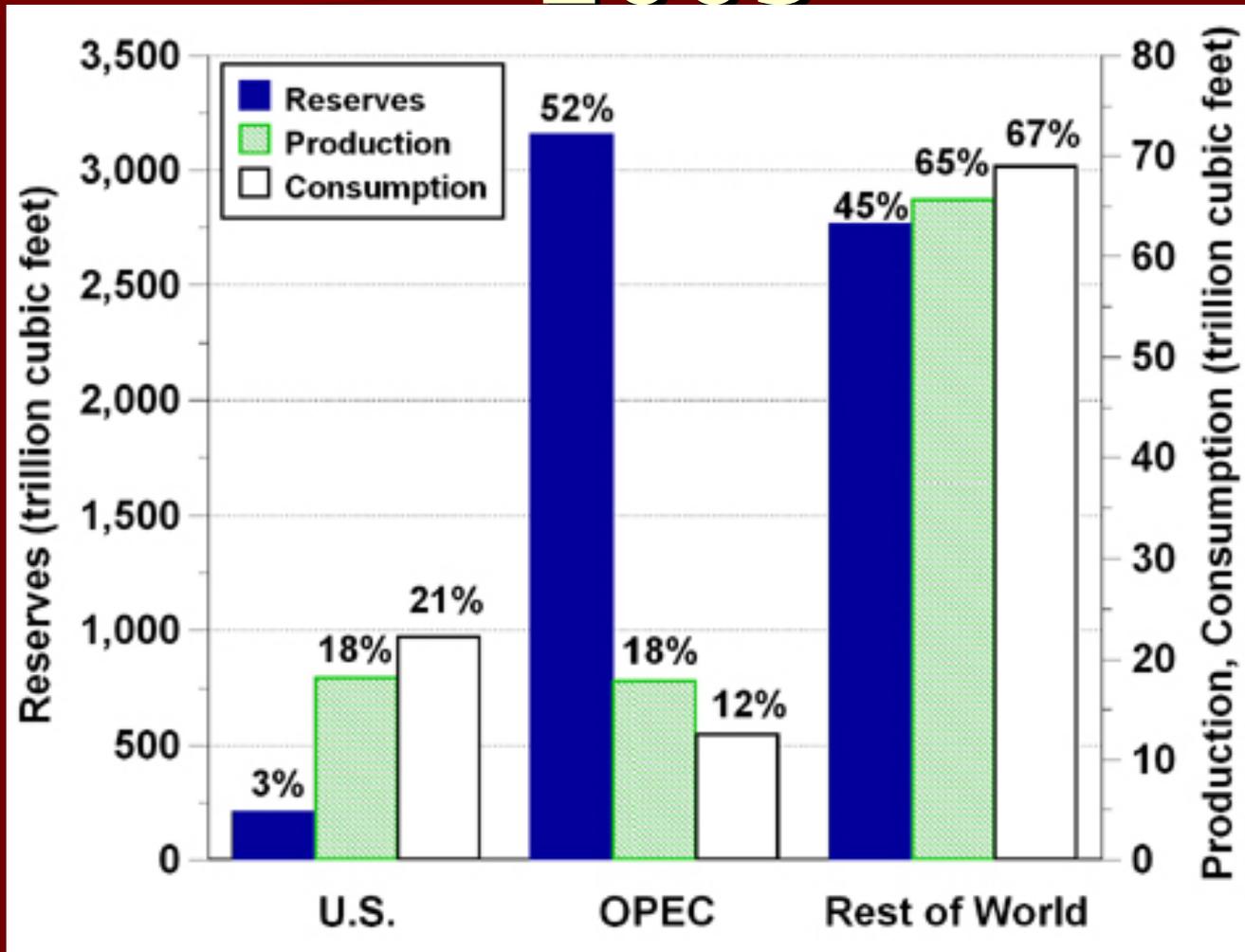
Top Gas producing countries



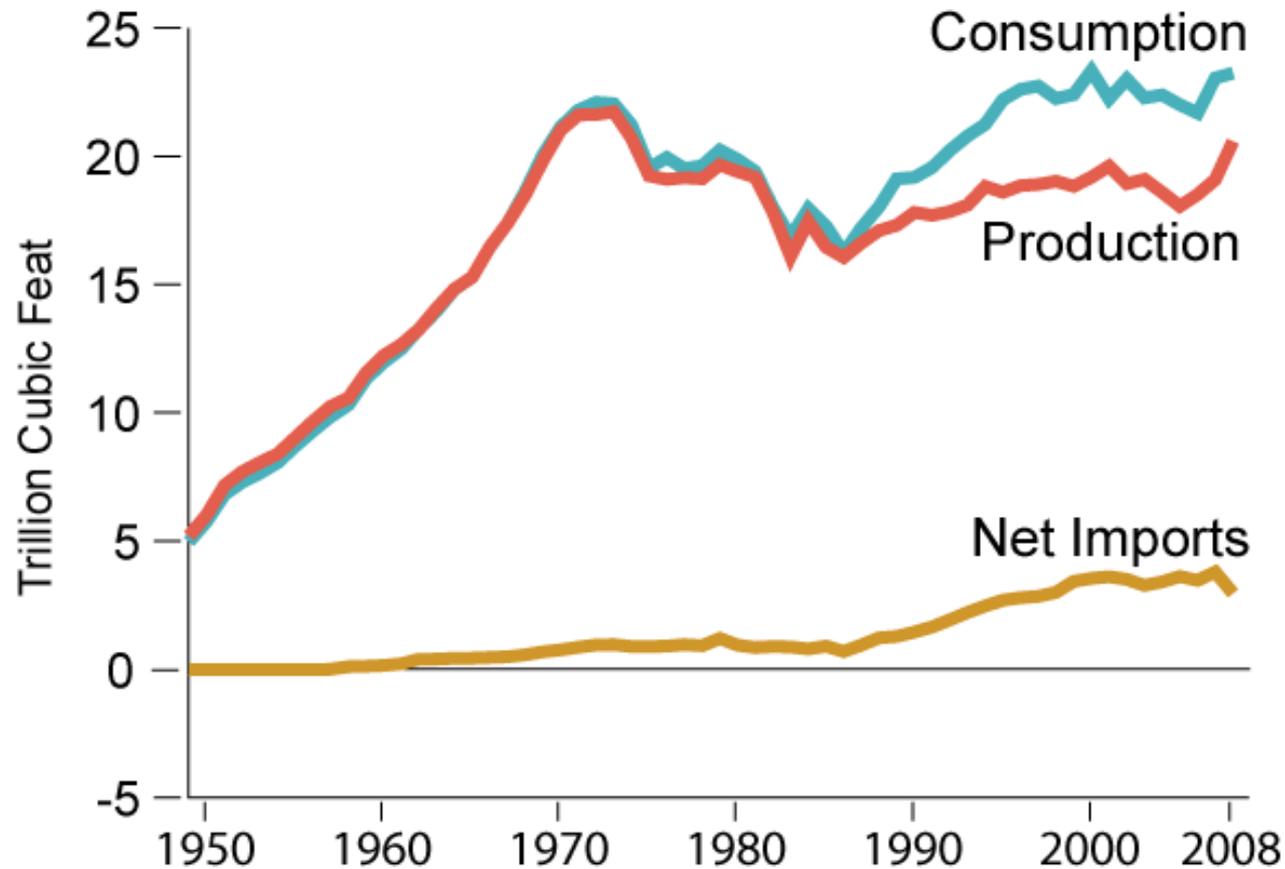
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The data is presented differently from one source to the next. Useful conversion factor: 1 million metric tons LNG = 48.7 billion cubic feet NG

US & World Gas Reserves and Production 2005



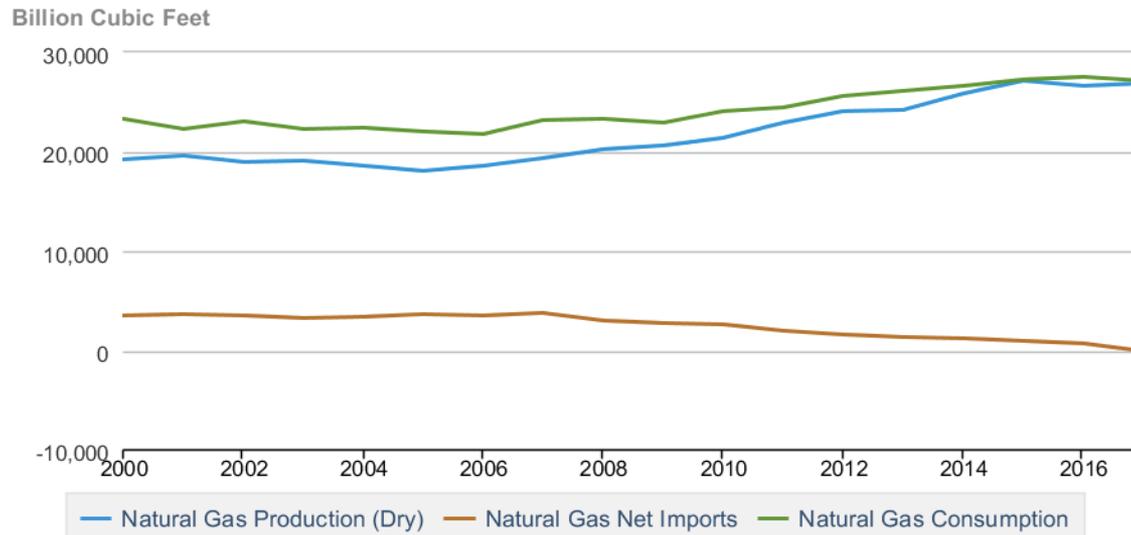
U.S. Natural Gas Consumption, Production, and Net Imports, 1949–2008



Source: Energy Information Administration, *Annual Energy Review 2008*, Table 6.1 (June 2009).

Updated U. S. Natural Gas Consumption, Production, and Net Imports

Table 4.1 Natural Gas Overview



 Source: U.S. Energy Information Administration

What has changed between 2008 and today?

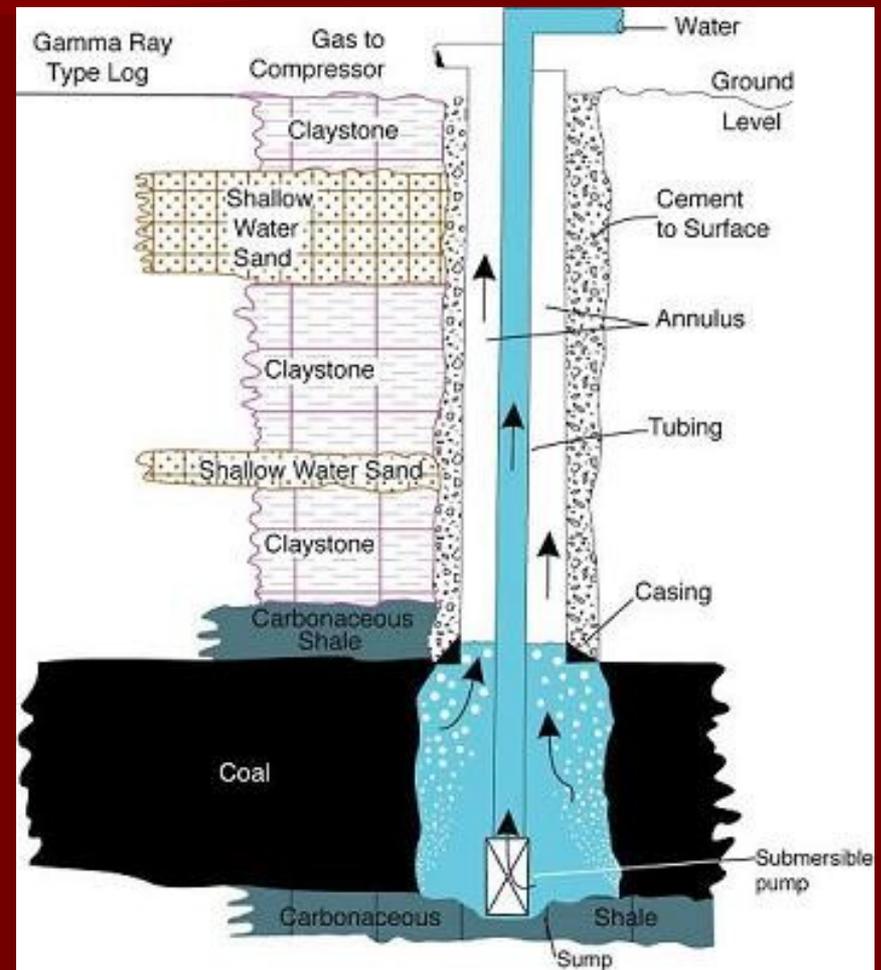
Other Sources of Natural Gas

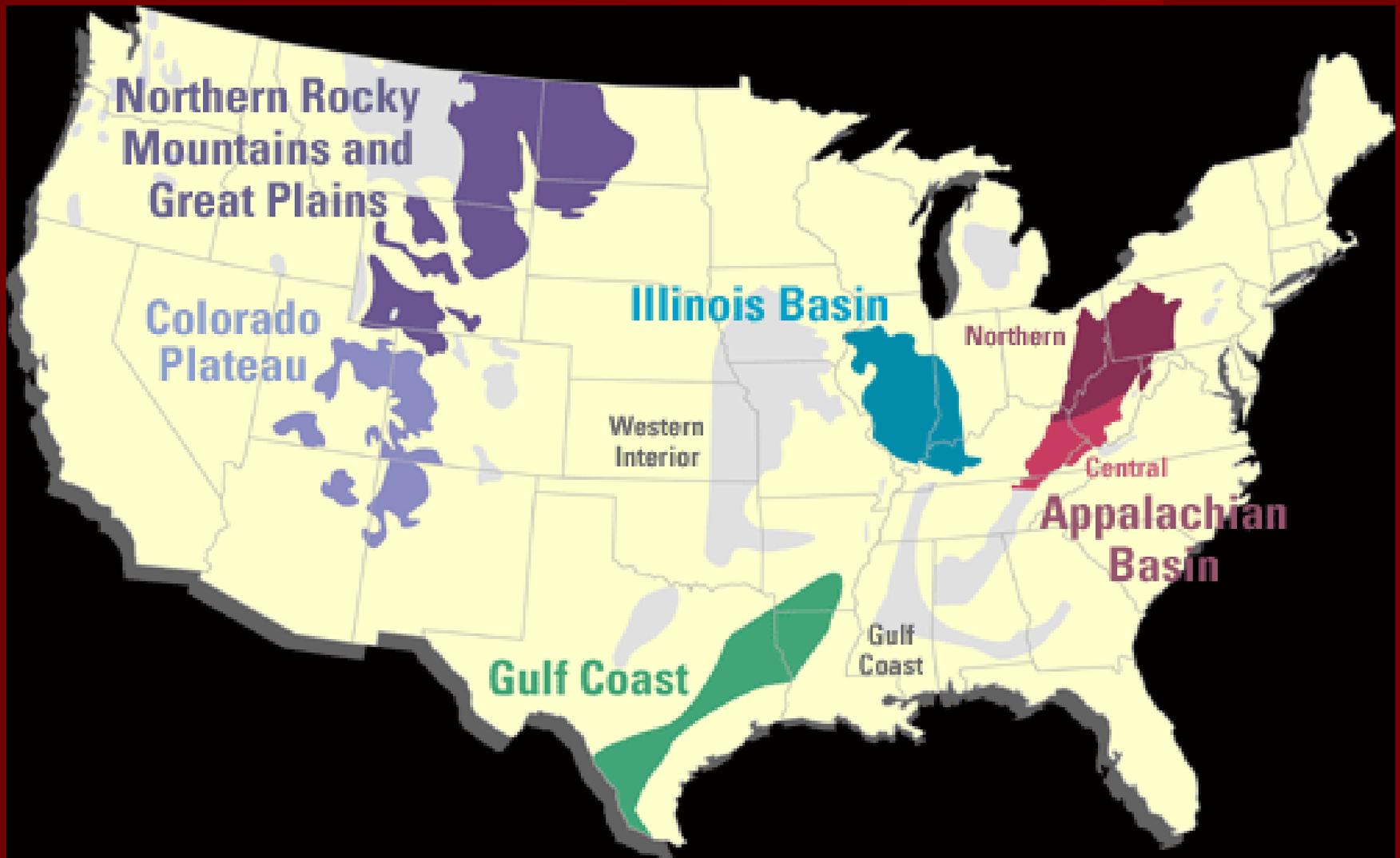


Argentine researchers discovered methane from cows accounts for more than 30 per cent of the country's total greenhouse emissions. For more on the role of agriculture in greenhouse gas releases see <http://epa.gov/climatechange/ghgemissions/gases/ch4.html>

Coal Bed Methane

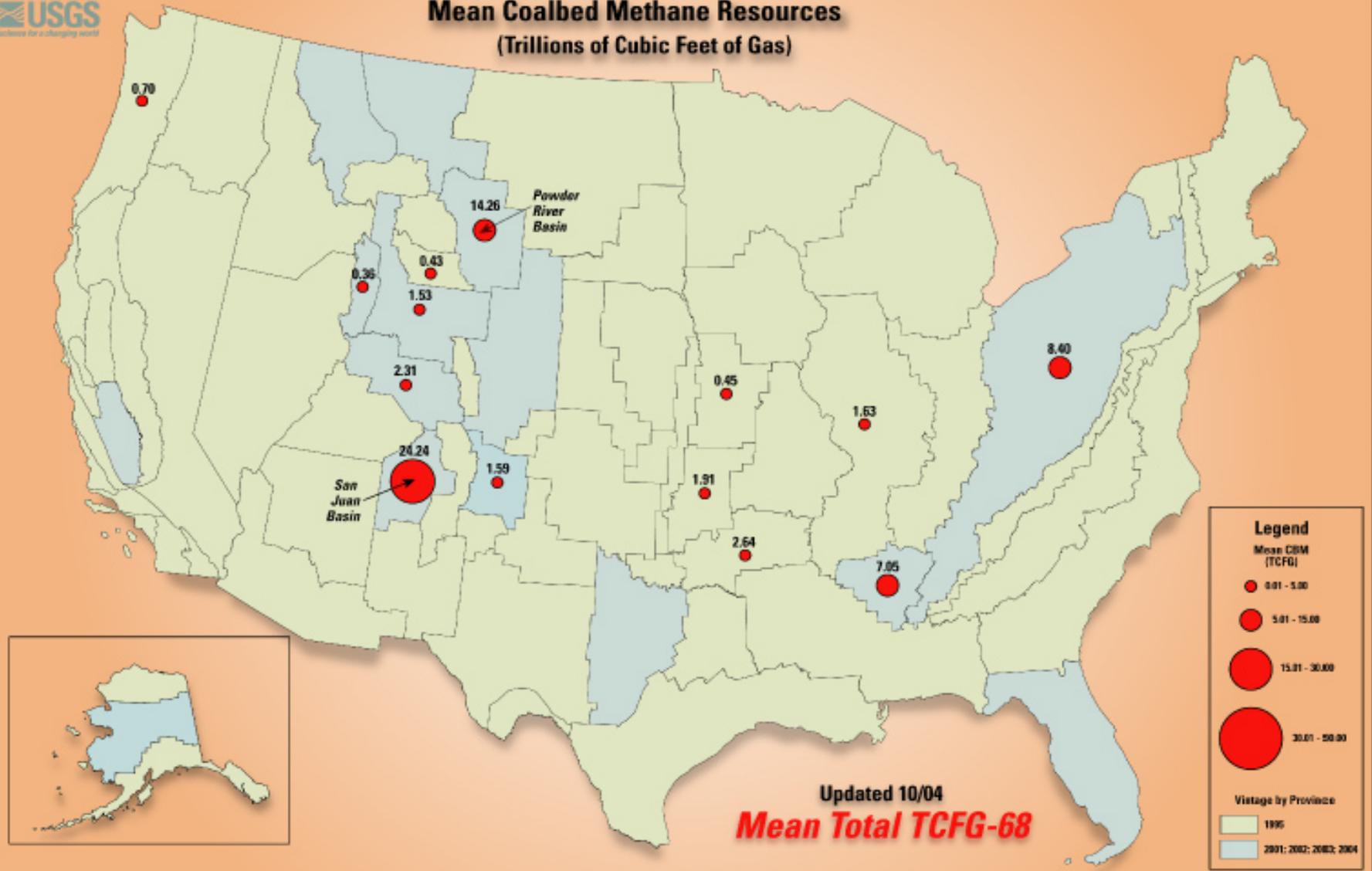
- CBM extraction involves pumping large volumes of water from coal seams in order to release water pressure that traps gas within the coal.
- Very inexpensive to develop.







Mean Coalbed Methane Resources (Trillions of Cubic Feet of Gas)



- CBM accounts for 10% of all domestic natural gas reserves and,
- In 2004, CBM accounted for nine percent of U.S. dry gas production.
- The Powder River Basin in northeast Wyoming has become a major supplier of coal bed methane.
- Since 2001, CBM production in the Basin has increased 200 percent to 332 billion cubic feet and now comprises almost 20 percent of U.S. annual CBM production.

Environmental Problems with CBM

- Discharge water at up to 100 gallon per minute per well. (15,000-20,000 wells)
- Discharge water is more “salty” than normal and can cause significant soil damage.
- New roads and power lines to get to the wells
- Large loud compressors.

CBM Discharge Pools



Should coal bed methane development be allowed on public land?

1. Yes
2. No

