

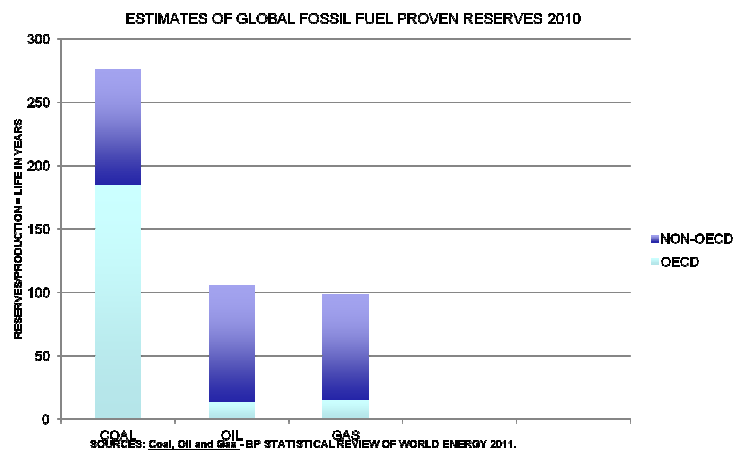


The availability of fossil fuels and the future role of shale gas

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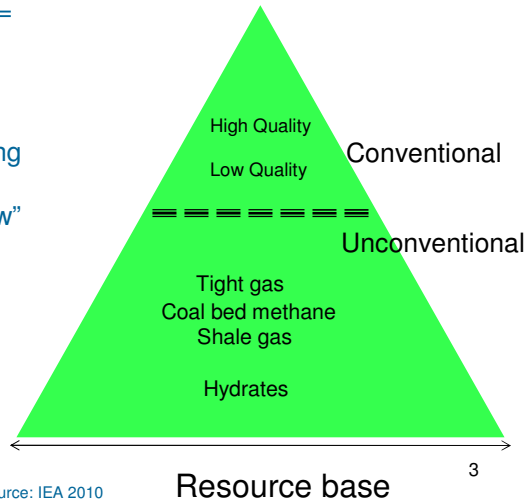
The Foundation for Science and Technology
The Royal Society 9th November 2011

Global Fossil Fuel Resources

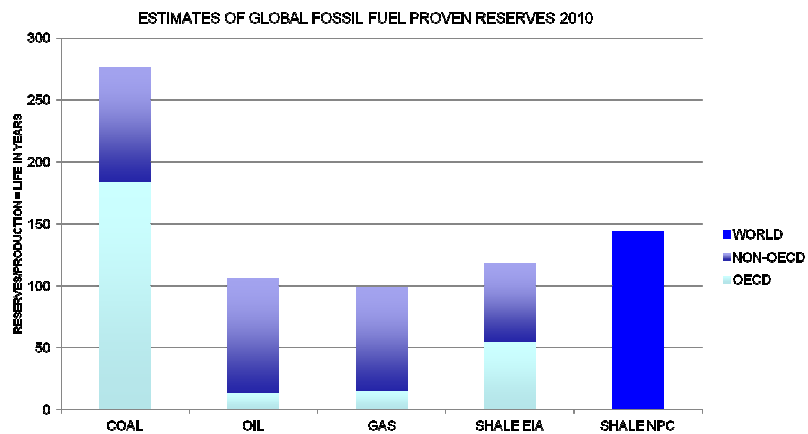


“What about shale gas?”

- Defining unconventional gas = drilling is not enough for a commercial flow
- Application of horizontal drilling and hydraulic fracturing for shale gas. These are not “new” technologies



Global Fossil Fuel Resources and shale gas

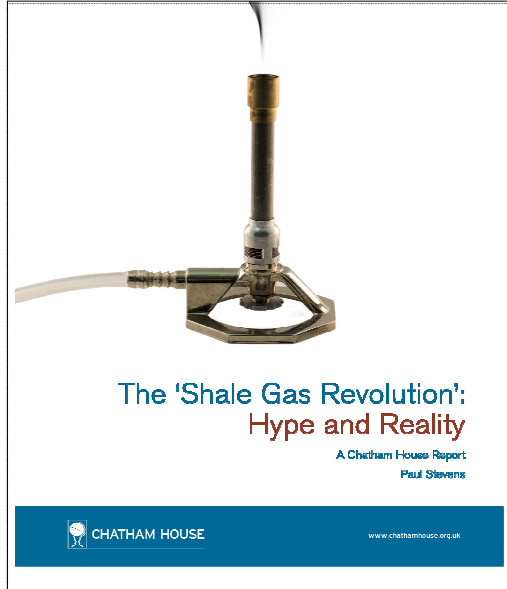


SOURCE: Coal, Oil and Gas - BP STATISTICAL REVIEW OF WORLD ENERGY 2011.
 EIA World Shale Gas Resources: An Initial Assessment 2011. Covers only 32 countries.
 SHALENPC, 'Unconventional Gas', Working Document of the NPC Global Oil and Gas Study, Topic Paper

How likely is it that the shale resources will be produced?

<http://www.chathamhouse.org.uk/research/eedp/papers/view/-/id/947/>

- Report published in September 2010



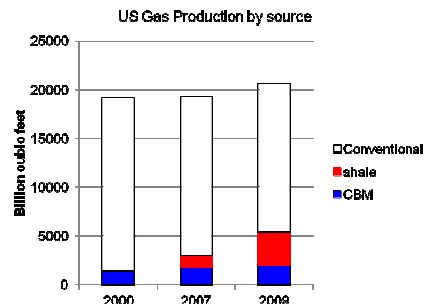
“The Shale Gas Revolution” What is it?

- Long time in coming!
- Public attention 2007/8 US Potential Gas Committee increased estimates of unproven US gas reserves by 45 %

Estimates put shale gas at 25% of U.S. production in 2010

Estimates suggest 50 percent by the 2030s

Medlock K B, Jaffe A M & Hartley PR (2011)
Shale Gas and U.S. National Security.
Baker Institute July

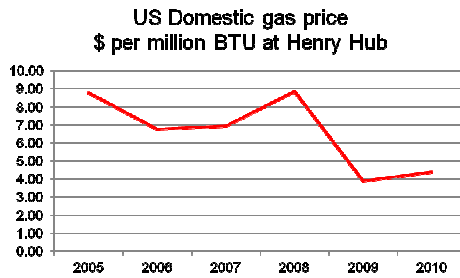


Source: EIA 2011

What consequences from the revolution so far?

- Gas Prices

- Fall in U.S. domestic prices but beware the recession ...
- In some markets, notably Europe, lower gas prices are straining the links between gas and oil prices.

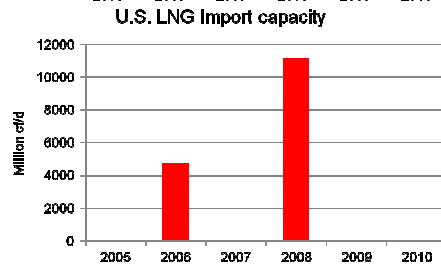
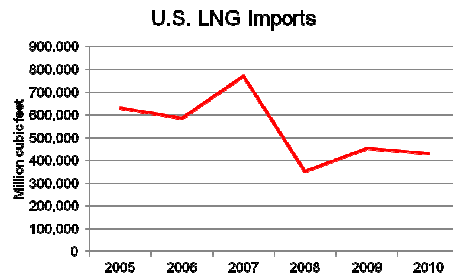


Source: BP 2011

What consequences from the revolution so far?

- U.S. Gas Trade

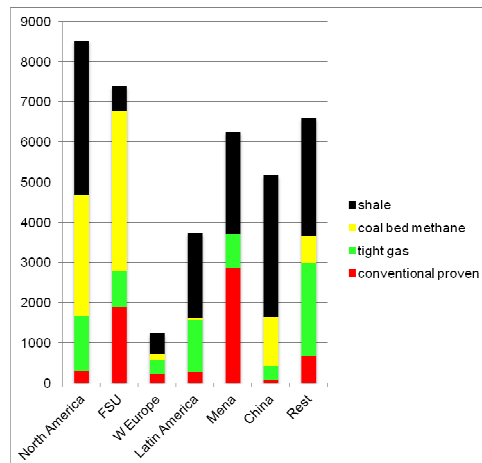
- Collapse in US imports of LNG
- Underutilization of LNG re-gasification capacity. 75% built between 2005-9. In 2011 some 90 percent is idle (EPRINC 2011)
- In 2011, U.S. Pipeline imports are the lowest since 1999 (EPRINC 2011)



Source: EIA 2011

“The Shale Gas Revolution” What are the questions?

- Can the “Shale Gas Revolution” continue in the United States?
- Can it be replicated elsewhere?



Conventional proven: BP Statistical Review of World Energy 2008
 Others: NPC Unconventional Gas Topic Paper 29 July 2007

Why is there uncertainty over the answers? Can it continue in the US?

- The economics of the projects look shaky under current gas prices
- There are concerns about the negative environmental consequences of hydraulic fracturing
 - The “Halliburton Loophole” (recent New York Times stories)
 - “Fracking Act” working through Congress
 - Drilling moratoria in a number of shale plays awaiting EIAs
 - New York State; Pennsylvania State forest lands; Delaware River Basin on the Marcellus; Maryland Marcellus; and many small towns e.g. Barnett

**Why is there uncertainty over the answers?
Can it continue in the US? Why not ...**

- The economics of the projects look shaky under current gas prices
 - Many smaller players hedged against lower gas prices
 - Large IOCs (with deep pockets) getting involved
 - Technology bringing costs down dramatically
- There are concerns about the negative environmental consequences of hydraulic fracturing
 - Problem increasingly seen as poor well completion not fracking
 - The use of horizontal drilling and fracking in increasing domestic oil production from “fallow” fields makes the technology ever more attractive.

HOWEVER AN NUMBER OF EIAs ARE CURENTLY UNDERWAY

Why is there uncertainty over the answers? Can it be replicated elsewhere? Europe

- Wrong rocks
 - Shale plays in Europe deeper, more fragmented, smaller, less material
 - Shale is clay rich and less suitable for hydraulic fracturing
 - Limited drill core data compared to USA
- Problems of regulatory framework
 - Unconventional gas not part of the regulatory framework
 - Traditionally small areas licensed but shale needs very large areas
 - Very strict local environmental regulations
 - No tax breaks or subsidies (except Hungary)
- Access to the pipeline network
 - Europe third party access- USA common carriage

Why is there uncertainty over the answers? Can it be replicated elsewhere? Europe

- Lack of service industry capability
 - Limited onshore service industry. Limited land rigs available. Peak of Barnett had 199 rigs. July 2010 34 land rigs in Western Europe
 - Access to water is key. Better methods = water requirements falling
- Environmental concerns
 - Ground water contamination
 - Radioactivity releases?
 - Earthquakes in Blackpool
 - Now France, Quebec, South Africa, even ExxonMobil in Germany have moratoria awaiting EIAs
 - “Carbon Footprint” has entered the debate
- Public acceptability in urbanized Europe with no property rights incentive and considerable disruption.
 - MAMBA Land and “NIMBYism”: England 383 people sq km, US 27

Finally ... Implications of these uncertainties

- Investor uncertainties will slow/inhibit investments
 - Unconventional/Conventional gas
 - LNG
- Gas demand will continue to increase, especially post-Fukushima. If the hype = reality fine. **But if not** there will be serious supply constraints five to ten years out given project lead times
- There must also be concerns about investment in renewables if there appears to be prospects for lots of cheap (allegedly relatively low carbon) gas



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