



Unconventional Gas: Opportunities and Challenges

SEAB Presentation

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CSIS

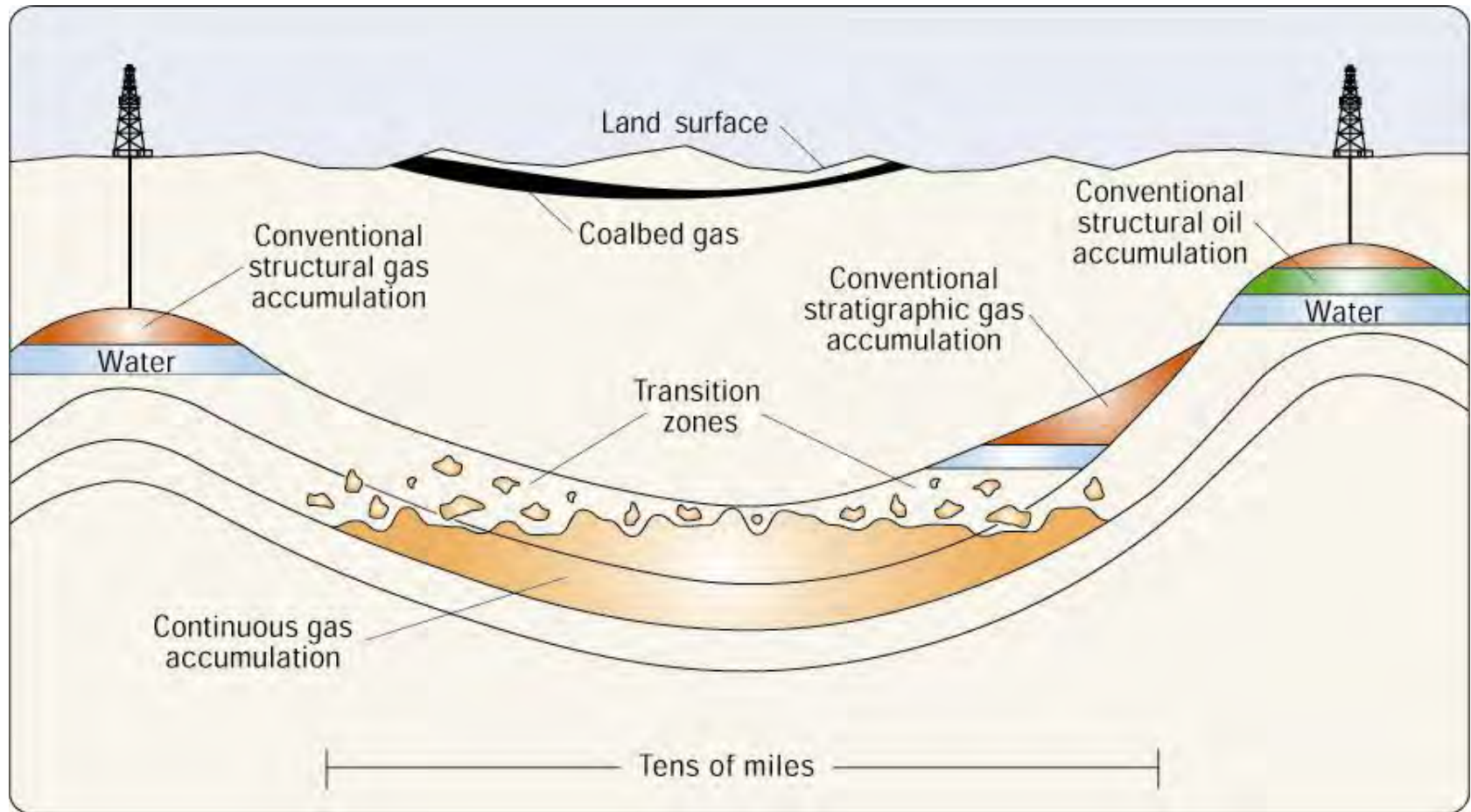
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Why is Natural Gas so Attractive?

- Readily available (US and globally) in significant quantities
- Transportable
- Storable/flexible (peak, base load, balancer)
- Multiple Uses
- Lowest Carbon footprint of major hydrocarbons
- Lower cost than other alternatives

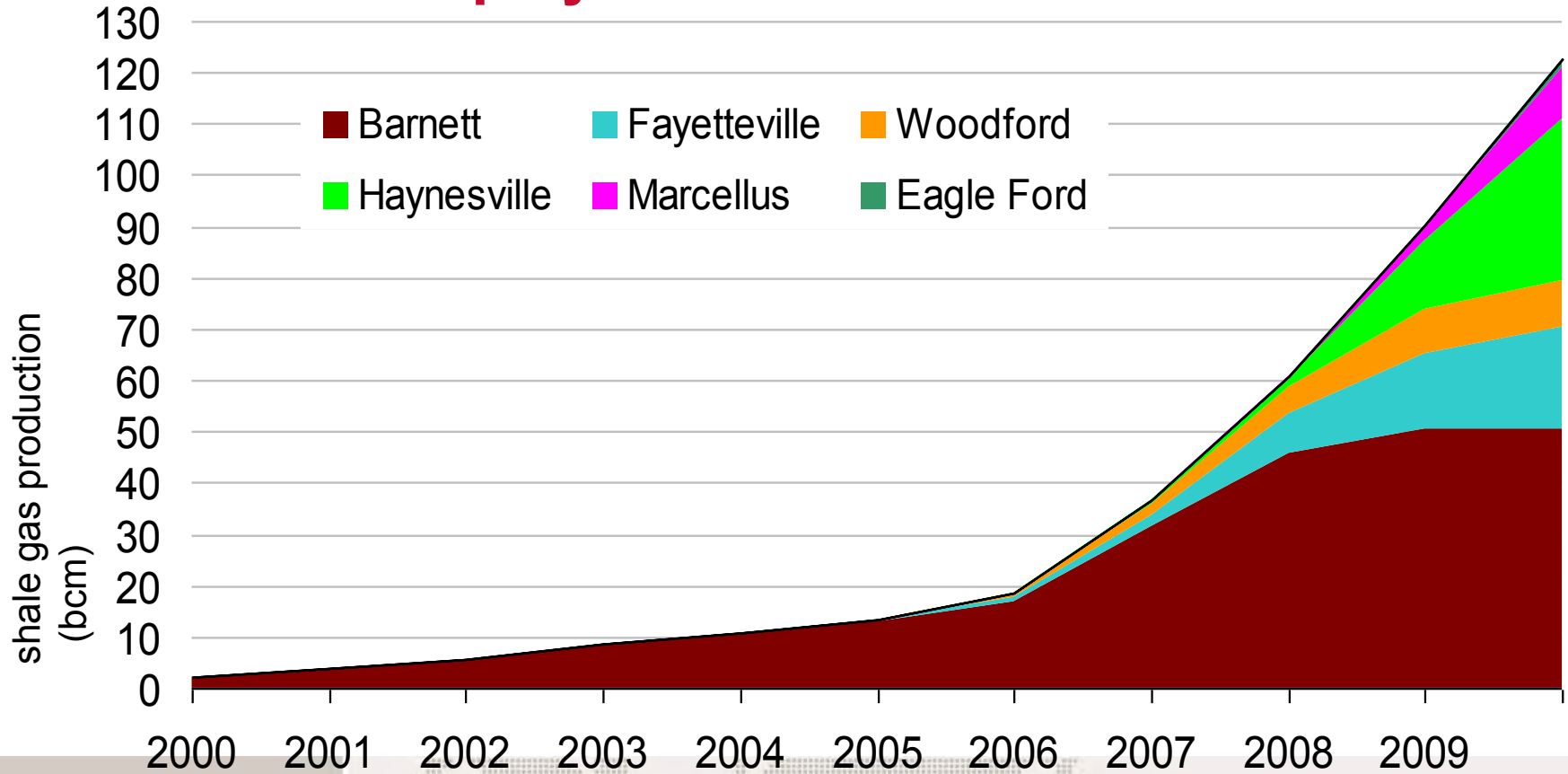
Conventional vs. Continuous (Source Rock) Resources



U.S. Shale Gas Resources



U.S. shale gas production from the major plays has increased 60-fold

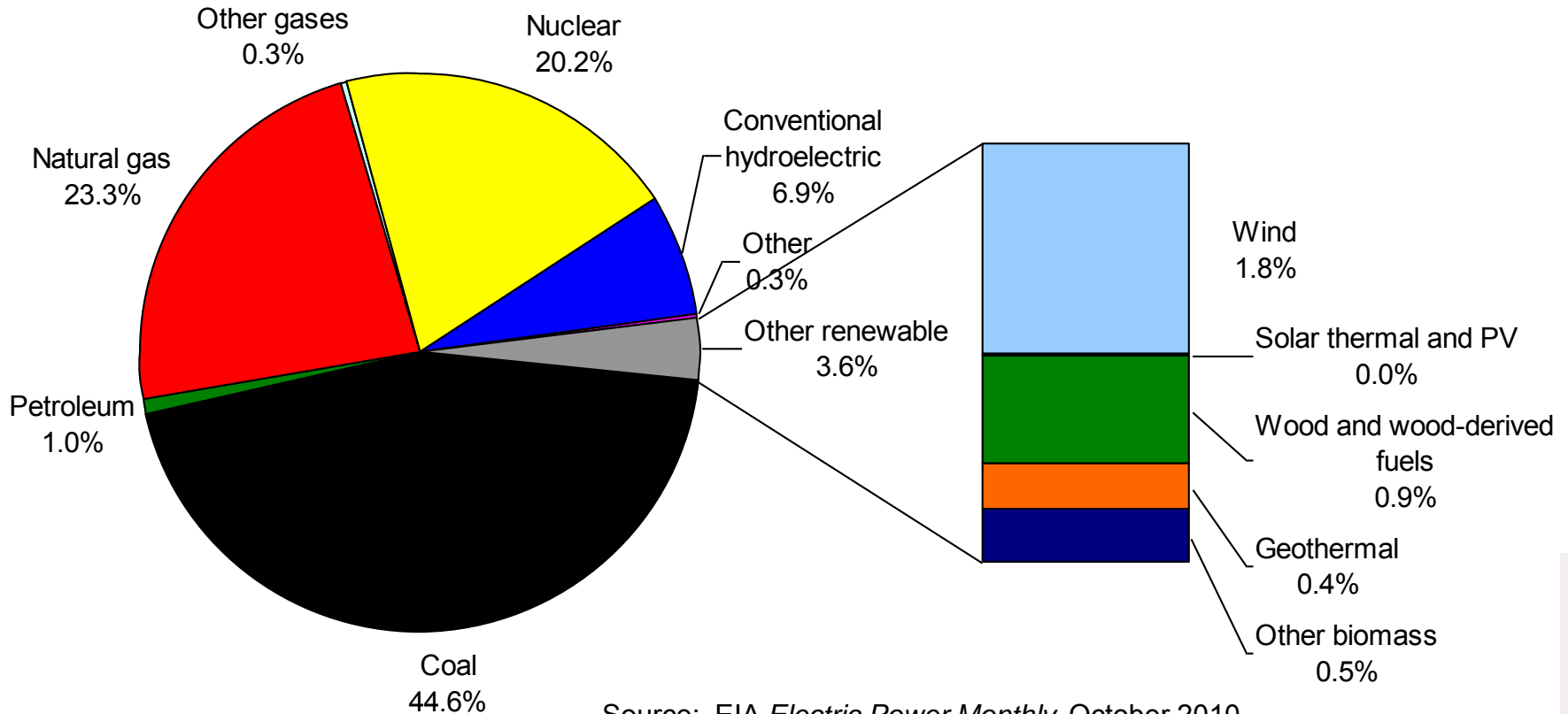


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Electricity Generation was 70% Fossil Fuels, 20% Nuclear, and 10% Renewables in 2009

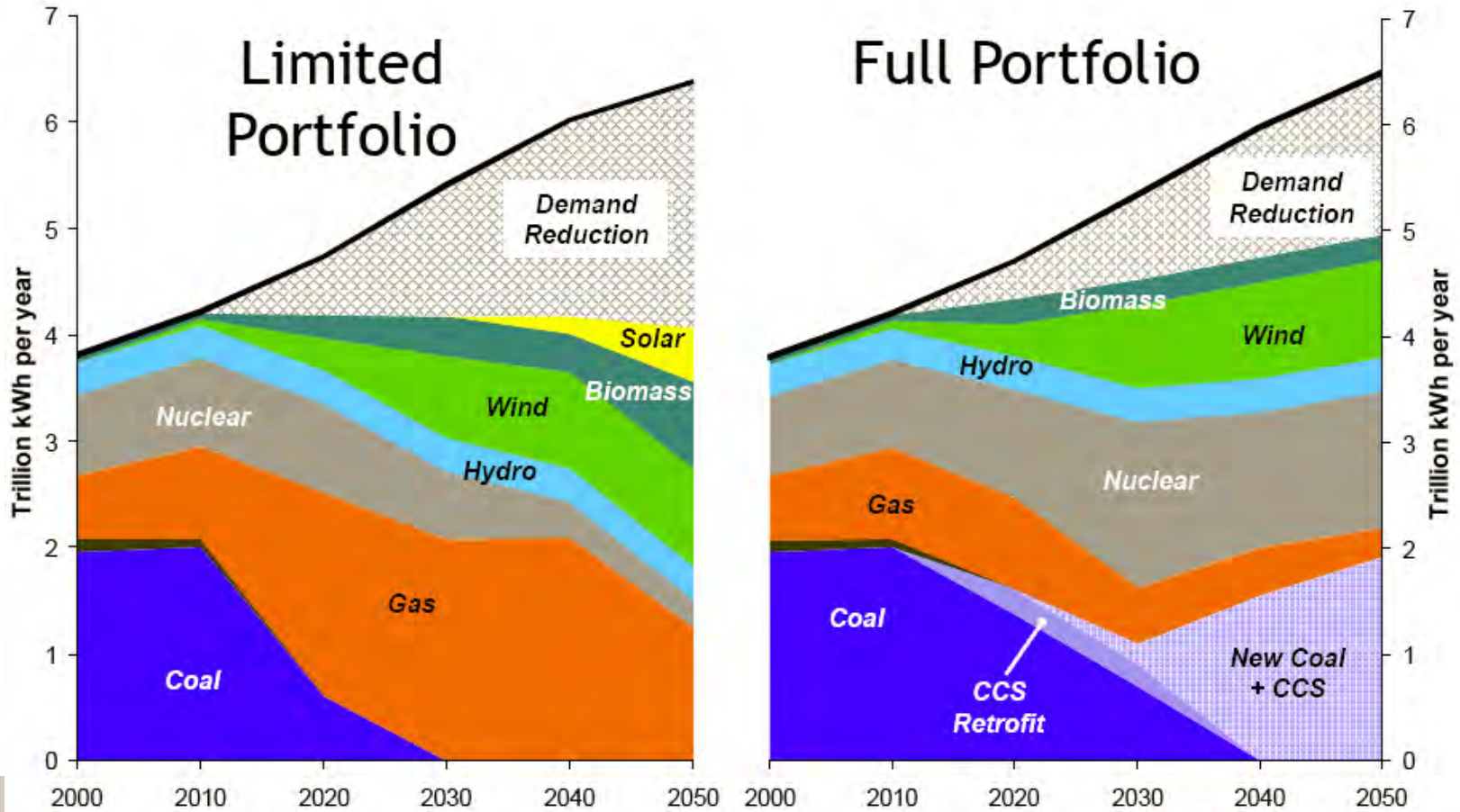
**2009 Total net generation:
3,953 billion kWh**

**2009 Non-hydro renewable net generation:
141 billion kWh**



Source: EIA *Electric Power Monthly*, October 2010

Roll for Gas in US Electric Generation Mix



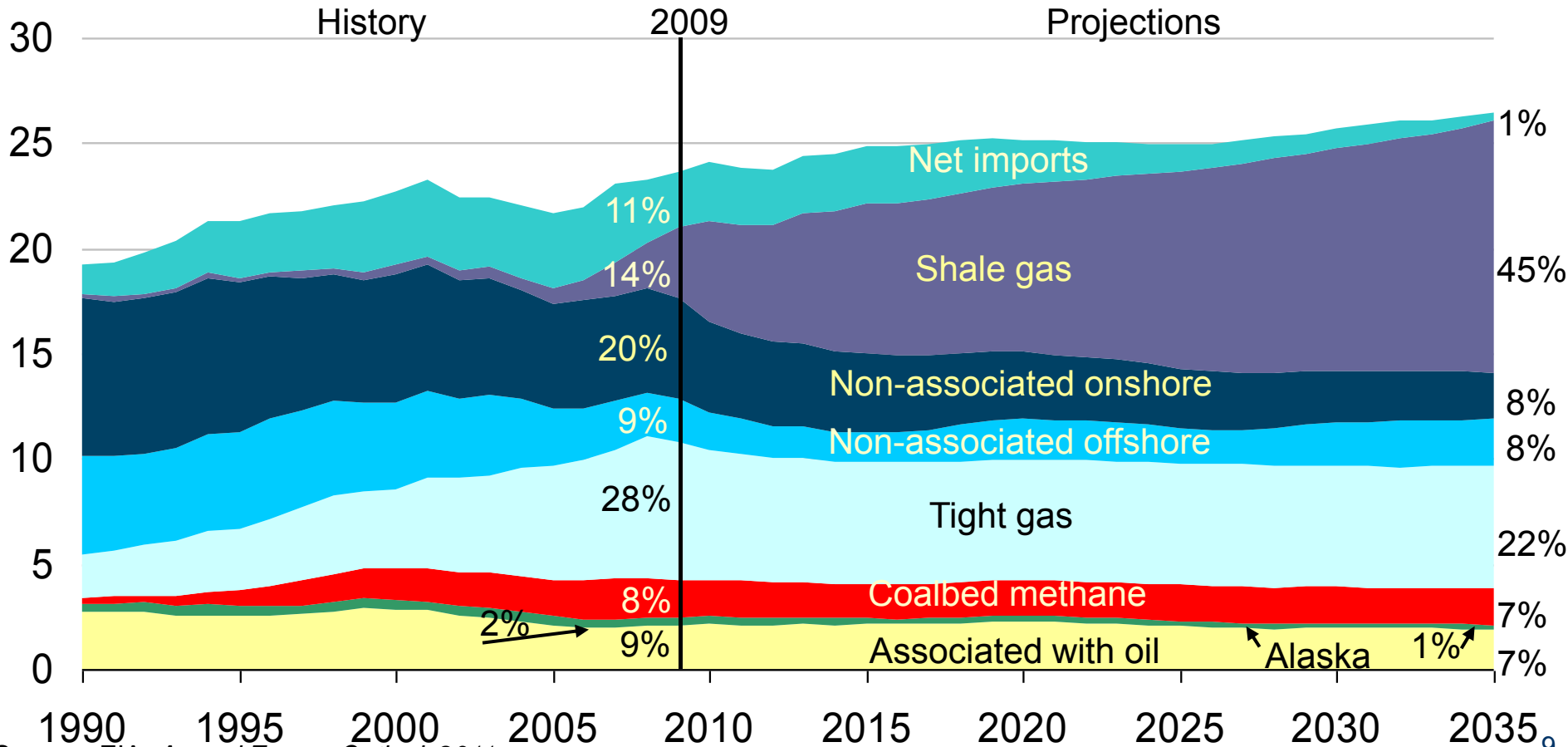
Implications of Global Shale Gas Development

- **Development of US shale formations would reduce US reliance on LNG and pipeline gas imports and free up LNG for use elsewhere**
- **Significant shale prospects likely in China, Turkey, Australia and Europe**
- **Development of indigenous gas sources, coupled with LNG, efficiency, renewables and interconnects could reduce EU reliance on Russian gas**
- **Increased gas use to displace coal reduces GHG emissions**
- **Global gas surplus could revamp price/contract structures**

Shale gas offsets declines in other U.S. supply to meet consumption growth and lower import needs

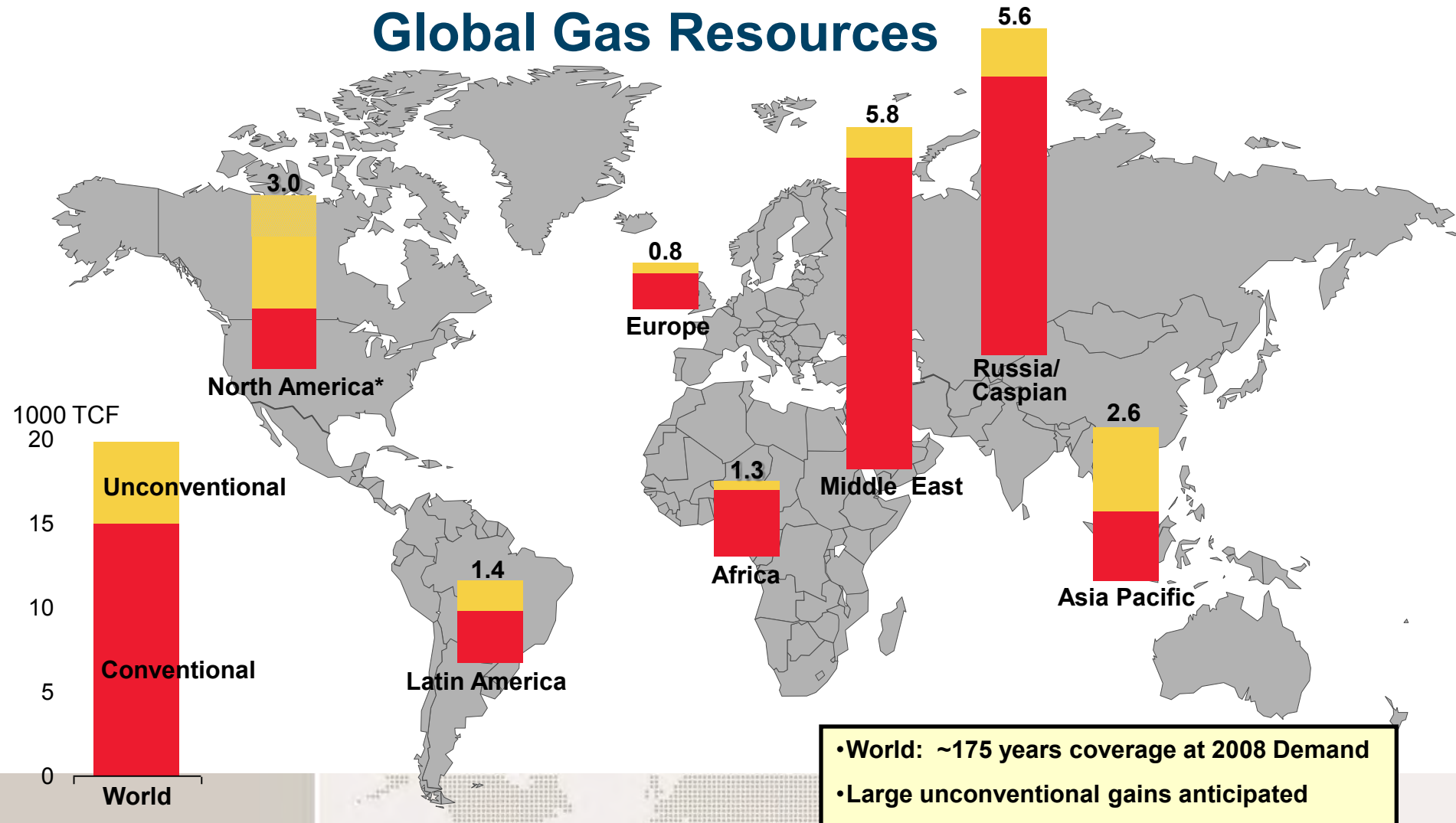
U.S. dry gas

trillion cubic feet per year



Source: EIA, Annual Energy Outlook 2011

Global Gas Resources

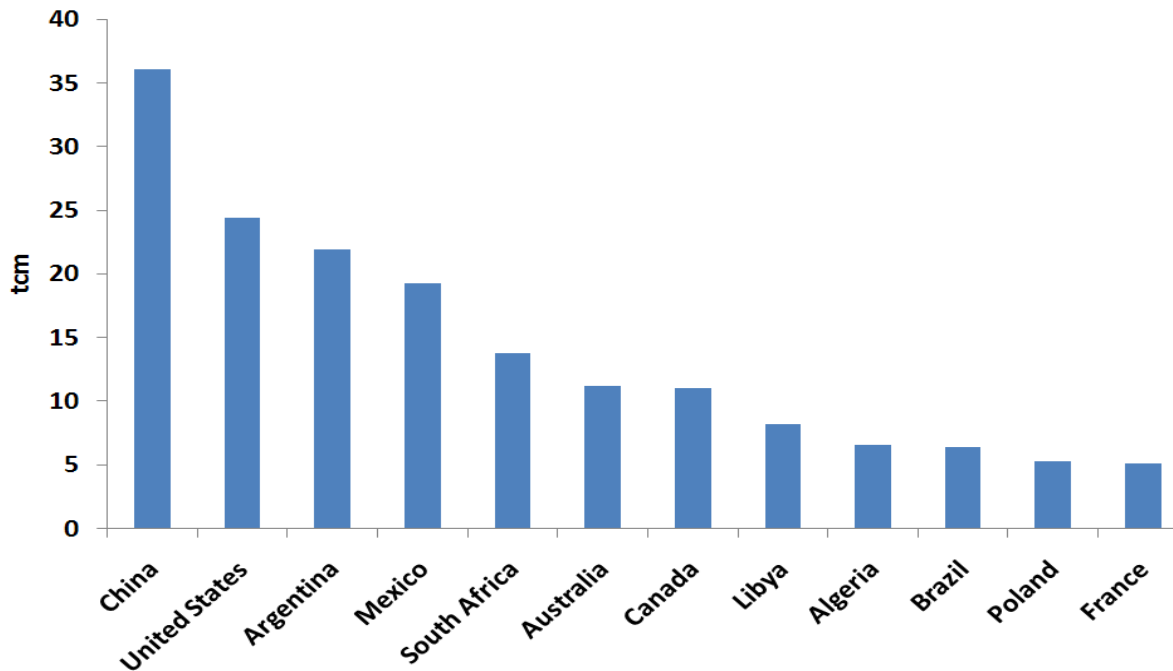


CERA's estimate for North America resource recently increased to 3000 TCF

Sources: EIA, USGS, NPC; Excludes volumes already produced

Unconventional gas will continue to affect markets

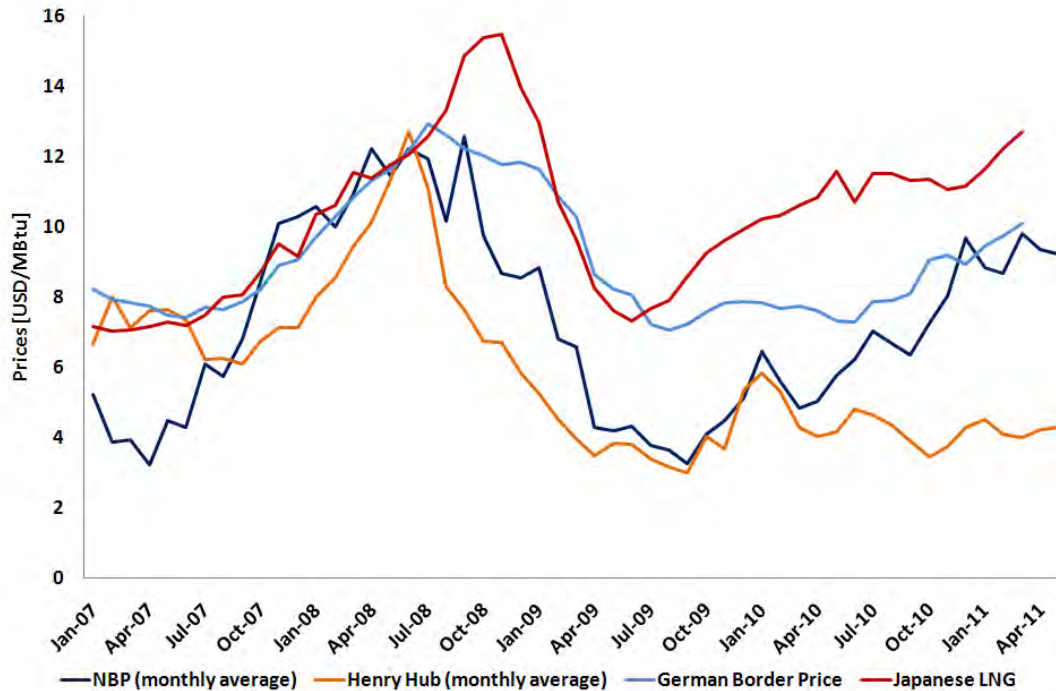
Estimated recoverable shale gas resources in selected countries



Source: EIA.

- *There are over 400 tcm of estimated recoverable unconventional gas resources, half of them are shale*
- *North American LNG imports at technical minimum, several LNG export projects under consideration*
- ***Repetition of the US success depends on geology, regulation, infrastructure and service background***

Wide Disparities between Regional Prices Reflect US Supply - Savings for Consumers



Most prices are on an upward trend, except in North America

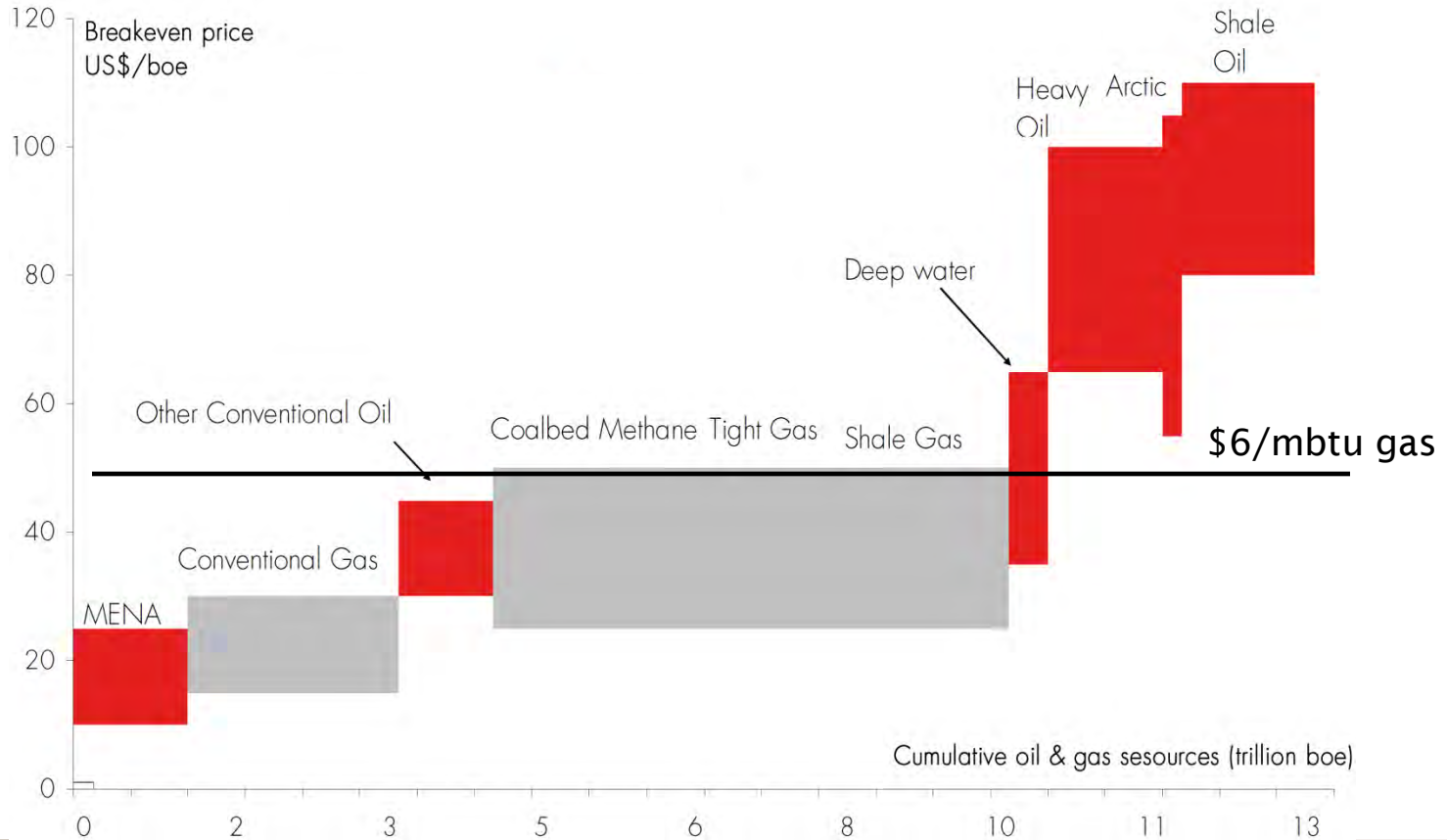
European contract and spot prices have been converging since mid 2010

Japanese prices still strongly follow oil prices

The US supply allows us to be disconnected from other markets, with significant consumer savings ...but that could change if development is reduced

Global hydrocarbons: a new economic order

Unconventional gas resources have become cost competitive



BUT ...realizing the full promise of shale resources is not a certainty and US domestic policy is important!

Technical/Economic Challenges

- All shales are not alike; application of drilling/reservoir fracturing technology & operational experience matters
- Steep decline rates require ongoing investment and drilling; and repeated fracturing
- Cost escalation and low commodity prices limit prospects

Environmental/Regulatory/Societal Challenges

- Well design and management of surface chemicals/materials are the best barriers to protecting water aquifers
- Disclosure of components of fracking fluids should/is happening
- Scale of water use, treatment & disposal are challenging
- Community Issues – infrastructure, land use, population density, noise, haze, road congestion and repair are “real” and need to be addressed
- Regulation and enforcement are essential