CEE CENTER FOR ENERGY ECONOMICS

Bureau of Economic Geology, The University of Texas at Austin

The Here and Now of U.S. Nat Gas

UC-NRLC, November 12, 2010

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High Altitude

- 1970s & 1990s "redux" with regard to perceptions about reliability, deliverability
  - Similar policy/regulatory disconnects
  - Risk that demand will be encouraged while supply and deliverability are constrained
- Even without GHG policy, gas "push" is inevitable
  - http://www.sierraclub.org/coal/
  - Strategic opposition to electric power transmission hinders both coal and renewables
- Drilling is essential
  - Environment, oil and gas tax policies

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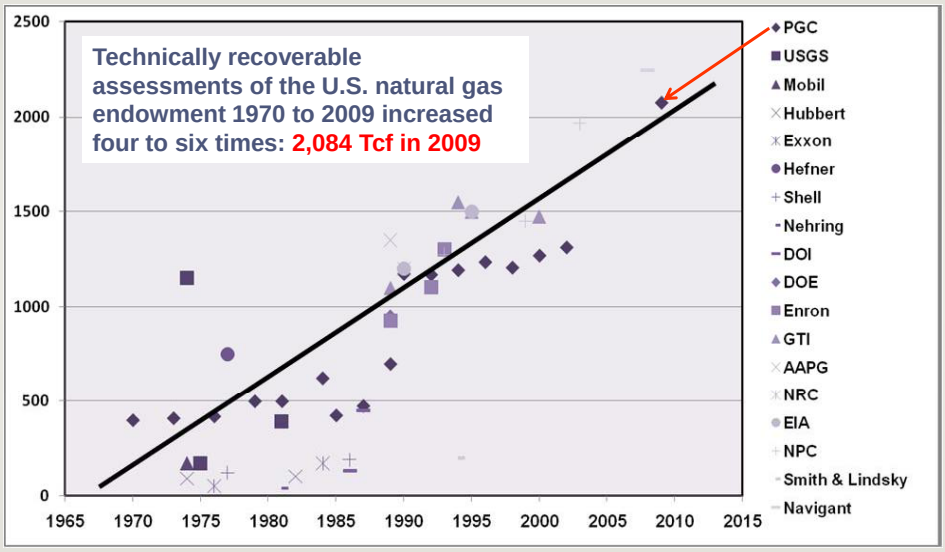
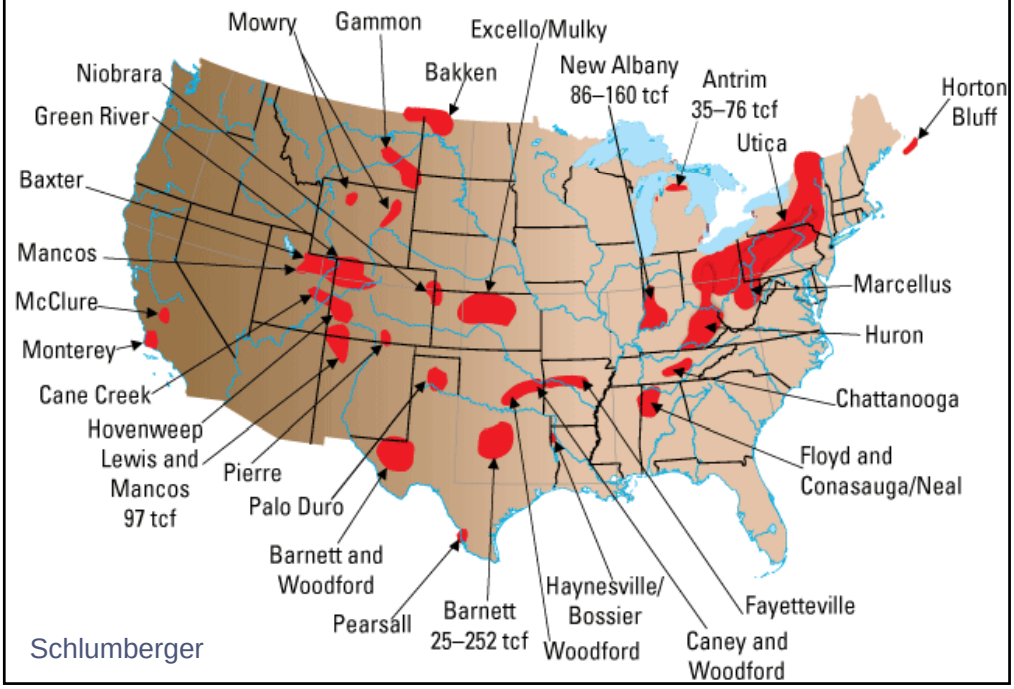
Natural Gas Resource Assessments



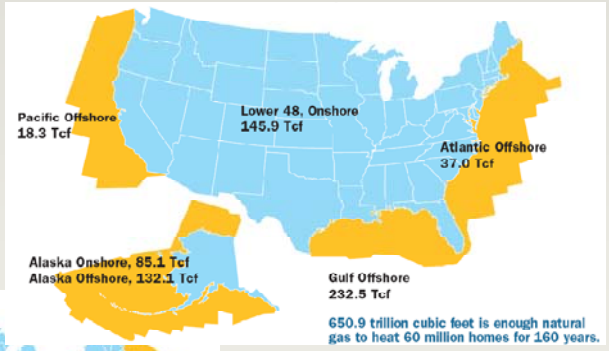
Source: Modified from Bill Fisher et. al., BEG-UT; GTI

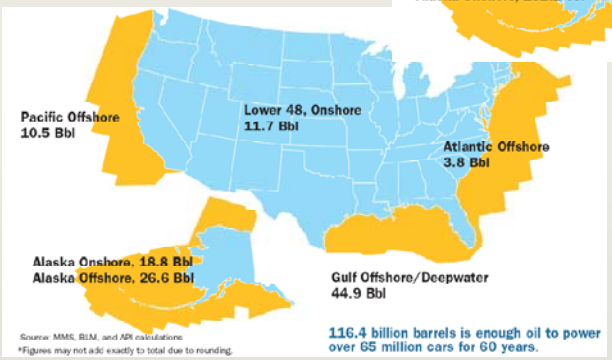
Major US shale basins.



Schlumberger

Shale Gas is A Hedge for Offshore





Technically recoverable resources; gold areas are moratoria; total 240.1 BBOE

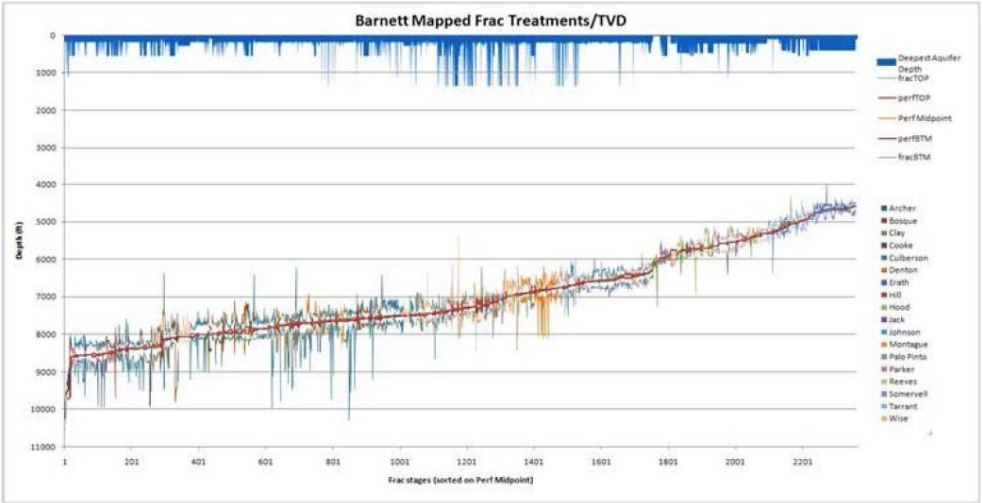
Barnett Shale Experience

- Water use for “frac’ing” and other Barnett Shale development is less than 1% of total water use in affected counties (BEG)
  - Water use will grow, but rate of use will be lower with technology improvement and recycling/re-use
  - Operators are actively testing recycling and reductions to manage water demand and produced water
- NETL Produced Water MIS

http://www.netl.doe.gov/technologies/PWMIS/

- NETL Frac Technologies

http://www.netl.doe.gov/technologies/oil-gas/EP_Technologies/ImprovedRecovery/AdvancedStimulation/Adv_Stimulation.html



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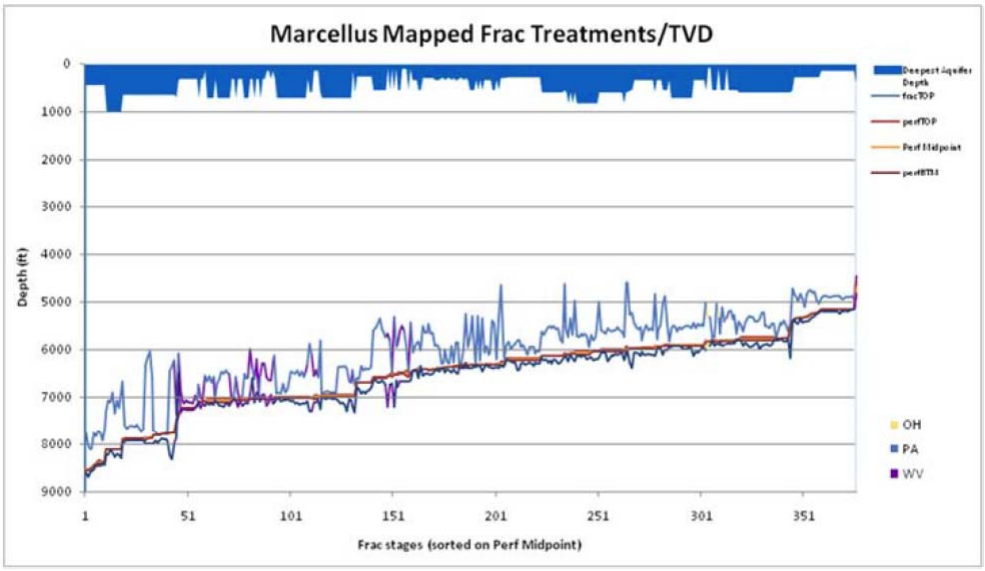
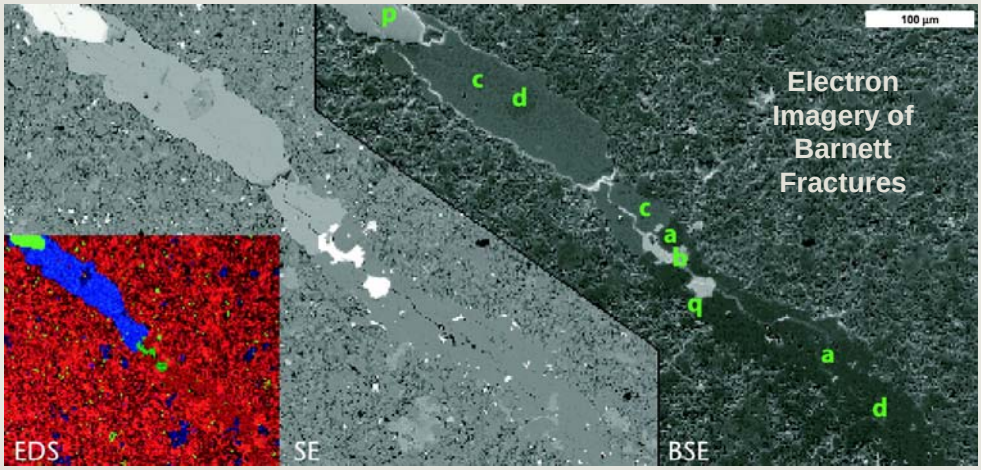
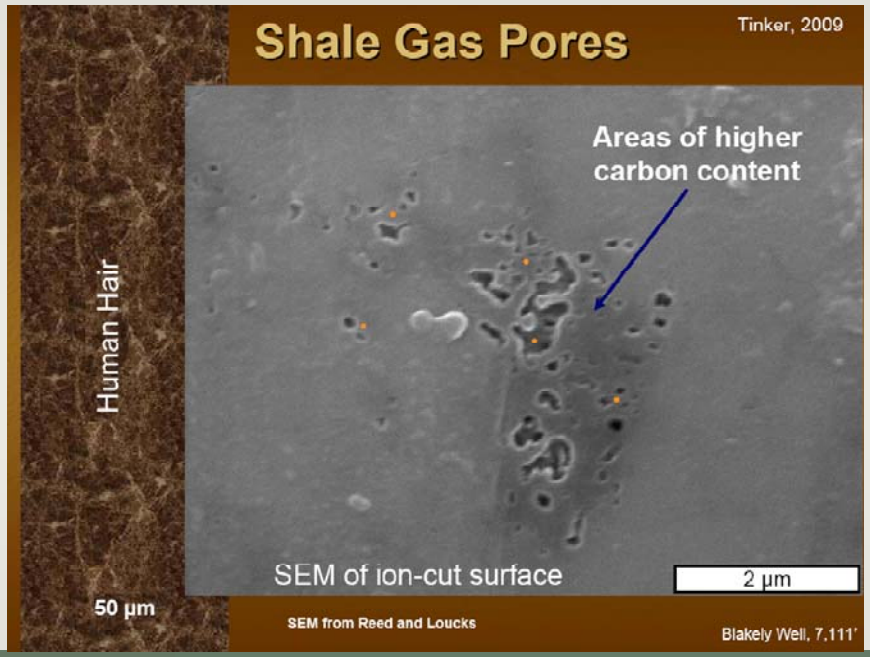


The Frontier



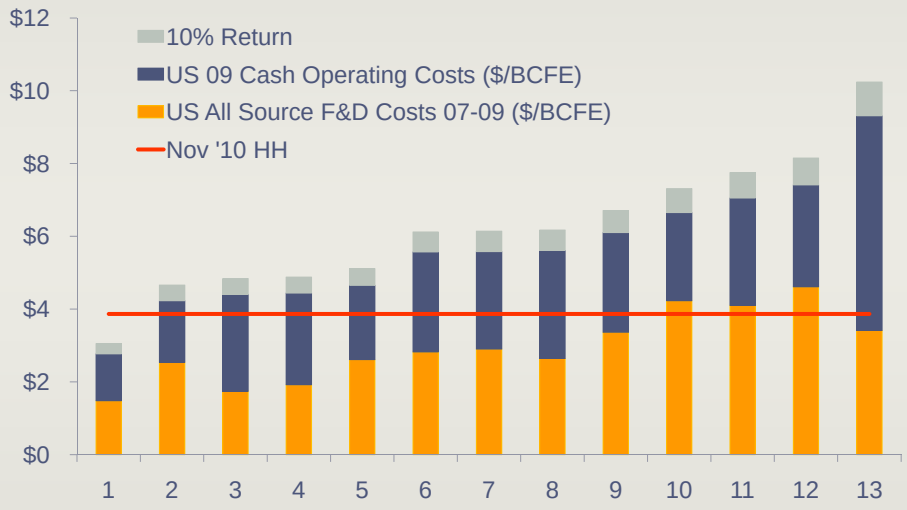
Gale, J. F. W., Reed, R. M., and Holder, Jon, 2007, Natural fractures in the Barnett Shale and their importance for hydraulic fracture treatments: AAPG Bulletin, v. 91, no. 4, p. 603–622.



The New "Nanodarcy" Universe of Technology

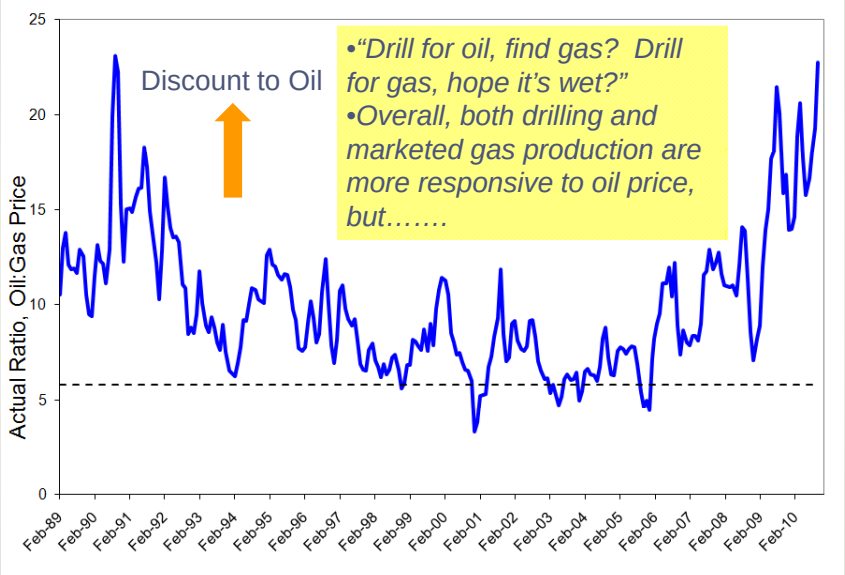
- Detection and advanced stimulation
  - Slow decline curves
  - Reduce drilling (fewer rigs, lower costs, smaller footprint)
  - Manage water disposal and other production issues
- Enhanced recovery
  - Extend field life

A Tough Business, Anyway



Compiled by CEE based on company financial reports

Price Trends



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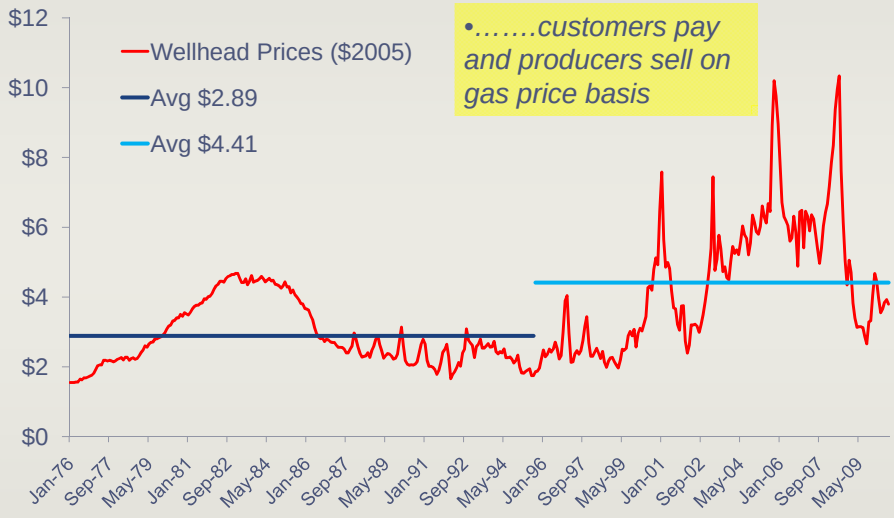
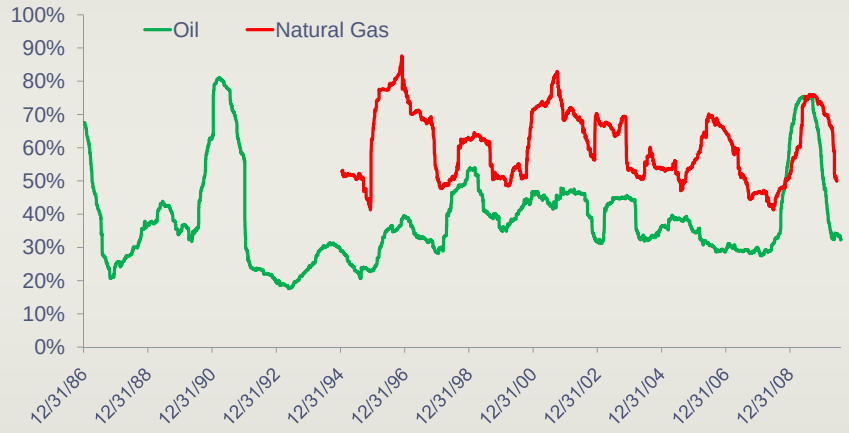
Wellhead Price Eras



Price Level and Volatility Matter



Compiled by CEE using CME (NYMEX) data; STDEV of LN daily,1-yr MA annualized

Average price ($2005)

	Wellhead	City Gate	Res	Comm	Ind	Elec. Power
Before 99:12	2.82 [a]	4.39 [b]	8.96 [c]	7.04 [b]		
00:01-09:11	5.30	6.73	11.99	9.61	6.68 [d]	6.49 [e]
Change	88%	53%	34%	37%		

[a] 76:01-99:12; [b] 83:10-99:12; [c] 81:01-99:12; [d] 01:01-09:12; [e] 02:01-09:12

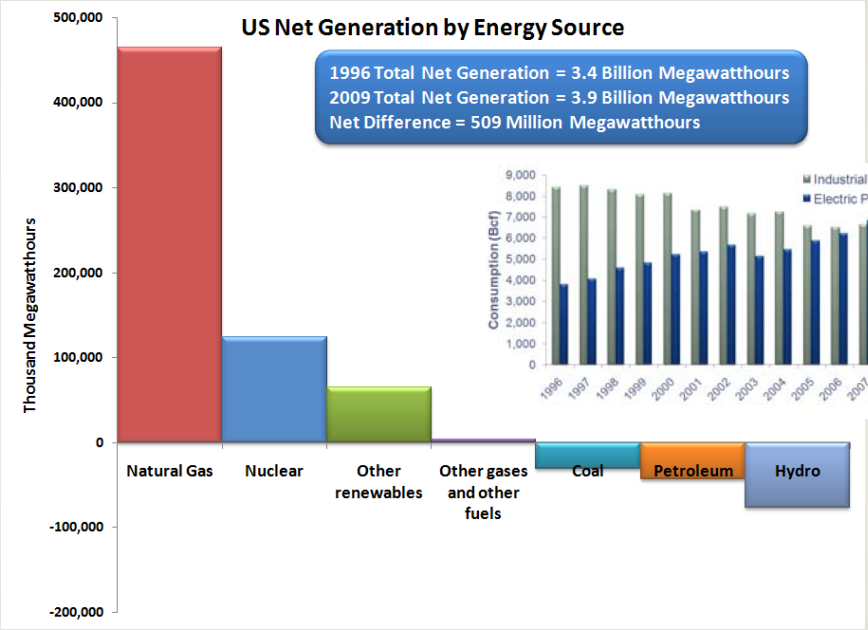
CEE-UT analysis

*Price volatility ($2005)

	Wellhead	City Gate	Res	Com	Ind	Elec. Power
Before 99:12	7.2% [a]	6.0% [b]	6.3% [c]	2.5% [b]		
00:01-09:11	12.2%	10.5%	7.7%	5.3%	11.4% [d]	10.6% [e]
Change	71%	74%	22%	110%		

[a] 76:01-99:12; [b] 83:10-99:12; [c] 81:01-99:12; [d] 01:01-09:12; [e] 02:01-09:12

* Std dev of change in price



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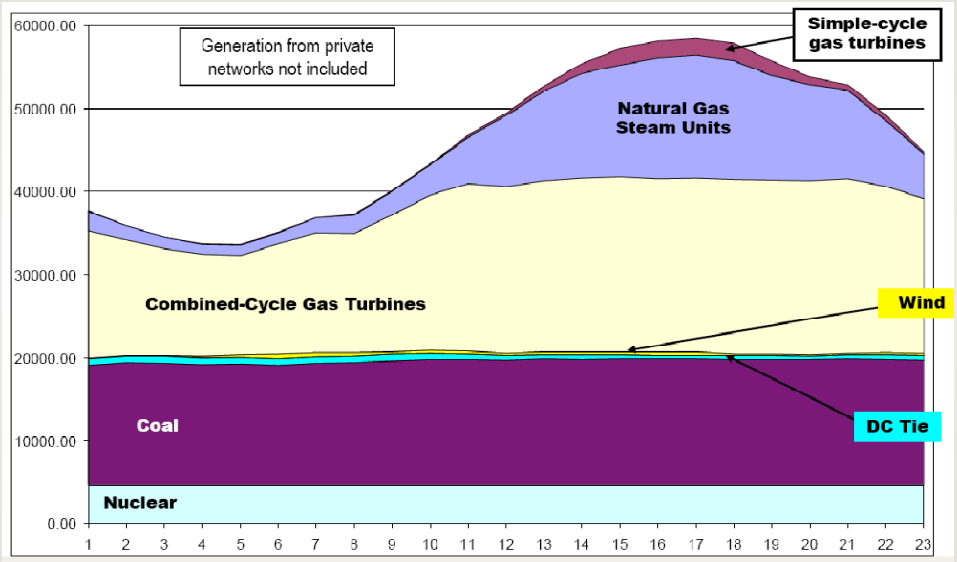
ERCOT Peak Day by Fuel Type



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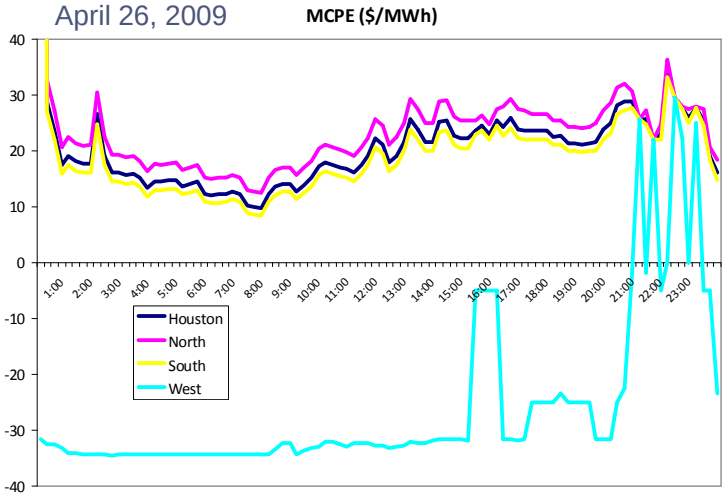
Does Renewable Energy Create Volatility?



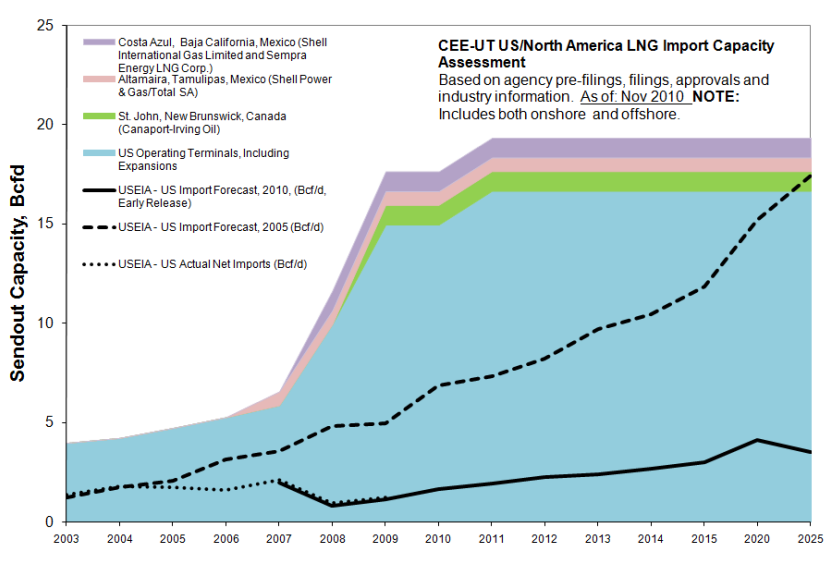
Negative price intervals (15 min)

2006	76
2007	338
2008	4,894
2009	3,069
2010	2,413 (5/31)

Price Observations

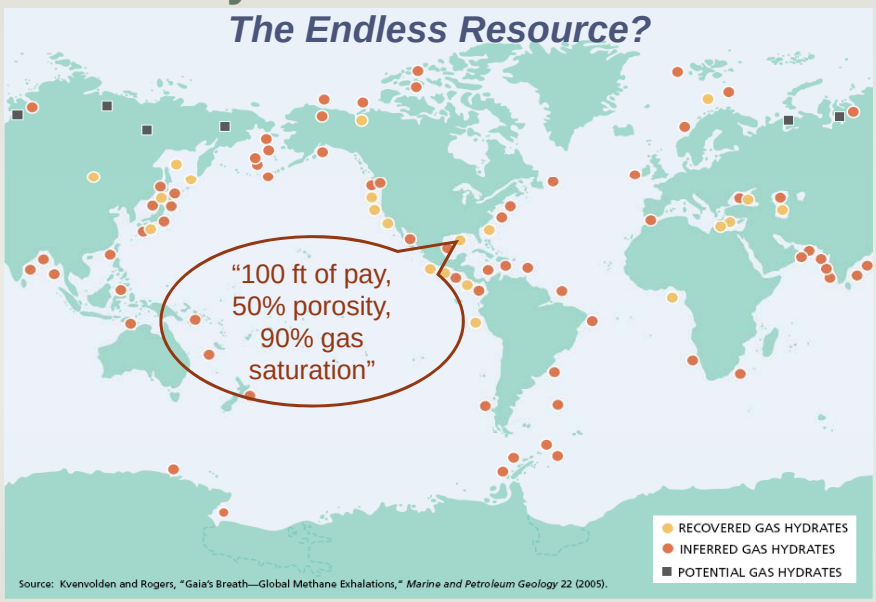
- **Volatility** is a sensitive issue for large users and regulated utilities; lack of data prevents analysis on changes over time
- Residential (and some commercial) customers are sheltered by regulators
- Wellhead price takers both suffer from and may contribute to volatility
- Electric power demand swings on marginal gas generators + impact of renewables may contribute to volatility

LNG "Optionality"



Beyond Unconventional

The Endless Resource?



Critical Role of Natural Gas in the U.S. Energy Mix

- Benefits of utilization – options for natural gas uses
  - For lower carbon electric power?
  - Industrial revitalization?
- Supply and price volatility
  - Frontiers, production management, frac and water issues
- Electric power dynamics – effective, optimal dispatch?