SLIDES: The Here and Now of U.S. Nat Gas

Michelle Michot Foss

Follow this and additional works at: https://scholar.law.colorado.edu/shale-plays-in-intermountain-west

Part of the Climate Commons, Energy and Utilities Law Commons, Energy Policy Commons, Environmental Health and Protection Commons, Environmental Law Commons, Environmental Policy Commons, Hydraulic Engineering Commons, Natural Resource Economics Commons, Natural Resources and Conservation Commons, Natural Resources Law Commons, Natural Resources Management and Policy Commons, Oil, Gas, and Energy Commons, Oil, Gas, and Mineral Law Commons, Science and Technology Law Commons, State and Local Government Law Commons, Sustainability Commons, Water Law Commons, and the Water Resource Management Commons

Citation Information
https://scholar.law.colorado.edu/shale-plays-in-intermountain-west/6

Reproduced with permission of the Getches-Wilkinson Center for Natural Resources, Energy, and the Environment (formerly the Natural Resources Law Center) at the University of Colorado Law School.
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
Dr. Michelle Michot Foss, CEE/BEG/JSG/UT

Natural Gas Resource Assessments

Technically recoverable assessments of the U.S. natural gas endowment 1970 to 2009 increased four to six times: 2,084 Tcf in 2009

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

©CEE-UT, 3

Major US shale basins

Niobrara
Green River
Bakken
New Albany
86–160 tcf
Marcellus
Huron
Antrim
35–76 tcf
Utica
Chattanooga
Floyd and Conasauga/Neal
Barnett and Woodford
Barnett 25–262 tcf
Pearsall
Haynesville/Bossier
Woodford
Caney and Woodford
Palo Duro
Barnett and Woodford
Hovenweep
Lewis and Mancos 97 tcf
Cane Creek
Monterey
McClure
Mancos
Baxter
Gammon
Excello/Mulky
Horton Bluff
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
- NETL Frac Technologies
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

![Graph showing cash operating costs and return over years 2007 to 2013](chart.png)

- 10% Return
- US 09 Cash Operating Costs ($/BCFE)
- US All Source F&D Costs 07-09 ($/BCFE)
- Nov '10 HH

Compiled by CEE based on company financial reports
Price Trends

• “Drill for oil, find gas? Drill for gas, hope it’s wet?”
• Overall, both drilling and marketed gas production are more responsive to oil price, but…….

Wellhead Price Eras

•…….customers pay and producers sell on gas price basis

CEE based on CME price data
©CEE-UT, 13

CEE based on U.S. EIA
©CEE-UT, 14
Price Level and Volatility Matter

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

Average price ($2005)

<table>
<thead>
<tr>
<th></th>
<th>Wellhead</th>
<th>City Gate</th>
<th>Res</th>
<th>Comm</th>
<th>Ind</th>
<th>Elec. Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 99:12</td>
<td>2.82 a</td>
<td>4.39 b</td>
<td>8.96 c</td>
<td>7.04 b</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:01-09:11</td>
<td>5.30</td>
<td>6.73</td>
<td>11.99</td>
<td>9.61</td>
<td>6.68 d</td>
<td>6.49 e</td>
</tr>
<tr>
<td>Change</td>
<td>88%</td>
<td>53%</td>
<td>34%</td>
<td>37%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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
### Price volatility ($2005)

<table>
<thead>
<tr>
<th></th>
<th>Wellhead</th>
<th>City Gate</th>
<th>Res</th>
<th>Com</th>
<th>Ind</th>
<th>Elec. Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 99:12</td>
<td>7.2%</td>
<td>6.0%</td>
<td>6.3%</td>
<td>2.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:01-09:11</td>
<td>12.2%</td>
<td>10.5%</td>
<td>7.7%</td>
<td>5.3%</td>
<td>11.4%</td>
<td>10.6%</td>
</tr>
<tr>
<td>Change</td>
<td>71%</td>
<td>74%</td>
<td>22%</td>
<td>110%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

* Std dev of change in price

---

### US Net Generation by Energy Source

- **1996 Total Net Generation = 3.4 Billion Megawatthours**
- **2009 Total Net Generation = 3.9 Billion Megawatthours**
- **Net Difference = 509 Million Megawatthours**

- **Natural Gas**
- **Nuclear**
- **Other renewables**
- **Other gases and other fuels**
- **Coal**
- **Petroleum**
- **Hydro**

Compiled by CEE; U.S. EIA
ERCOT Peak Day by Fuel Type

Does Renewable Energy Create Volatility?

April 26, 2009

MCPE ($/MWh)

Negative price intervals (15 min)

<table>
<thead>
<tr>
<th>Year</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>76</td>
</tr>
<tr>
<td>2007</td>
<td>338</td>
</tr>
<tr>
<td>2008</td>
<td>4,894</td>
</tr>
<tr>
<td>2009</td>
<td>3,069</td>
</tr>
<tr>
<td>2010</td>
<td>2,413</td>
</tr>
</tbody>
</table>
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”

Compiled by CEE based on industry data
Beyond Unconventional

The Endless Resource?

"100 ft of pay, 50% porosity, 90% gas saturation"

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?