Changes and Considerations in the Natural Gas Marketplace*

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Abstract

The Potential Gas Committee has reported the natural gas resource base in the United States has grown to over 2000 TCF in their last report. Some estimate that number may grow to over 2600 TCF in their next report. The advent of an increasing role for unconventional natural gas is dominating the prospect generations, lease acquisition, drilling and the merger and acquisition activity worldwide. We are discovering that not all tight sands nor are all shales the same - the economic development threshold for each reservoir is different. The risk dollars for prospect identification, lease acquisition and drilling are borne by the industry, not through tax or production credits. We are an old economy pretty much on our own hook.

To be successful, both geologically and economically, we must understand our business from the concept to the point of consumption. We must understand the variables and constants that affect pricing for the seller and buyer, consumption, transportation and methods to stem volatility and risk. It is still fair, important and vital for our industry to make money.
CHANGES AND CONSIDERATIONS IN THE NATURAL GAS MARKETPLACE

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Rocky Mountain Section of the American Association of Petroleum Geologists

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GUEST SPEAKER:
David H. Hawk
Energy Analysis and Answers

If They Are Buying, You Shouldn’t Be Selling
• The results of The Potential Gas Committee’s latest biennial assessment of the nation’s natural gas resources, indicates that the United States possesses a total resource base of 1,898 trillion cubic feet (Tcf). This is the highest resource evaluation in the Committee’s 46-year history. Most of the increase from the previous assessment arose from reevaluation of shale-gas plays in the Mid-Continent, Gulf Coast, and Rocky Mountain areas.
Proved Reserves vs. Resources

- Known gas reservoirs
- Existing economic conditions
- Existing operating conditions

- Discovered
- Undiscovered
- Effects of technology
- Effects of economics
<table>
<thead>
<tr>
<th>Natural Gas Resource Assessment of the Potential Gas Committee, 2008 (mean values)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traditional Resources</strong></td>
</tr>
<tr>
<td><strong>Coalbed Gas Resources</strong></td>
</tr>
<tr>
<td><strong>Total U.S. Resources</strong></td>
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<tr>
<td><strong>Proved Reserves (EIA)</strong></td>
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<tr>
<td><strong>Future Gas Supply</strong></td>
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</tbody>
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* Value as of year-end 2009
PGC Resource Assessment 2008

Total Traditional Resources (mean values) by category

- Probable (existing fields) 441.4 Tcf
- Possible (new fields) 736.9 Tcf
- Speculative (frontier) 500.7 Tcf
- Total 1,673.4 Tcf

Data source: Potential Gas Committee (2009)
### PGC Resource Assessment 2008

**Total Coalbed Gas Resources (mean values) by category**

<table>
<thead>
<tr>
<th>Category</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probable (existing fields)</td>
<td>14.2 Tcf</td>
</tr>
<tr>
<td>Possible (new fields)</td>
<td>49.8 Tcf</td>
</tr>
<tr>
<td>Speculative (frontier)</td>
<td>98.9 Tcf</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>163.0 Tcf</strong></td>
</tr>
</tbody>
</table>

Data source: Potential Gas Committee (2009)
PGC Resource Assessments, 1990-2008

Total Potential Gas Resources (mean values)

Data source: Potential Gas Committee (2009)
Regional Resource Assessment

Traditional: 1,673.4 Tcf
Coalbed: 163.0 Tcf
Total U.S.: 1,836.4 Tcf

- Rocky Mountain: 374.4 Tcf, 51.9%
- Pacific: 51.3 Tcf, 2.6%
- North Central: 24.0 Tcf, 16.6%
- Atlantic: 353.5 Tcf, 17.3%
- Mid-Continent: 274.9 Tcf, 7.5%
- Gulf Coast: 455.2 Tcf, 3.4%
- Alaska: 193.8 Tcf, 57.0%

Data source: Potential Gas Committee (2009)
As Dr. Curtis observed, “Our knowledge of the geological endowment of technically recoverable gas continues to improve with each assessment. Furthermore, new and advance exploration, well drilling and completion technologies are allowing us increasingly better access to domestic gas resources – especially ‘unconventional’ gas – which, not all that long ago, were considered impractical or uneconomical to pursue.”

“Consequently, our present assessment demonstrates an exceptionally strong and optimistic gas supply picture for the nation.”

Report of the Potential Gas Committee, June 2009
Dr. John B. Curtis, Ph.D., Geology
The search for hydrocarbons usually began with the analysis of:

- A geologic basin where predominantly marine sediments were deposited.
- A source rock was present which had a high total organic carbon content.
- A reservoir rock with porosity and permeability was present.
- A cap rock that was very tight and would prohibit the hydrocarbons in the reservoir rock from escaping.
- A structural or stratigraphic trapping condition which allowed the hydrocarbons to migrate from the source rock into the reservoir rock and be trapped and stay there.
Coal bed methane, drilling and fracturing the coal seams to free the molecules of methane that were attached to the platelets of coal.

Shale gas, the source rock of the conventional search becomes the reservoir and source rock all in one. The low permeability allows the gas to be trapped in and around the shale size particle of the formation.

Tight sands gas, formations where the dominant lithology is silt and sand size particles. The rock has a low permeability and often low porosity. It is tight.
Price increases in commodity and new technology.

Technology has changed in the way unconventional wells are drilled, analyzed through seismic and advanced logging techniques, and are completed. The higher price received by the producer for the commodity has allowed very costly, massive, stimulation completions to be employed, freeing large amounts of gas trapped under very high pressures.

The ability to drill 15,000 feet vertically and then 30,000 feet horizontally and all combinations thereof have allowed large amounts of subsurface reservoirs to be exposed to the borehole from one surface location. Drilling large numbers of wells from a single drilling pad or drilling area has reduced environmental impacts and costs.
Natural Gas Supplies and Pricing

Mission:
- For a consumer, a stable supply of natural gas at the lowest possible price commensurate with the required degree of reliability and required time of delivery.
- For a producer, the highest price via a hedge or physical transaction as close to the wellhead as possible.

Estimated Consumption Profile
- Quality
- Volumes
- Time of Use
- Price Comparison with electric market options
  - When to generate/when to buy
Identify known constants and variables that act as price affecters short and long term. Using risk analysis, convert variables into constants.

**Constants**

- Real time market indicative pricing
- Price hedges in place
- Current demand
- Current drilling
- Current production
- Current source areas take away capacity
- Pipeline capacity firm
- Alberta/BC/Saskatchewan drilling/production reserves
- New geologic plays and impacts
  - Conventional
  - Unconventional
- Government taxes royalty rates
- Number of explorers
- Environmental issues
- Governmental rules and regulations
- War
- Regional consumption versus resources
- New storage
Pricing

Variables

- Market pricing short and long term (fluctuating)
- Drilling rates domestic
- Demand
- Production/deliverability
- Reserves addition
- National storage balance
- Canadian storage balance
- Winter weather

- Summer weather
- Hurricane season
- Market perceptions
- Oil demand U.S./Globally
- Oil reserves and deliverability and pricing
- LNG global liquification, regassification and markets and capacity
- Pipeline projects (take away effects)
Natural Gas Supply and Transportation Considerations

- **Creditworthiness**
  - Yours/their's

- **Taxes at the point of delivery**

- **Transportation**
  - Match pipeline space with consumption
  - Firm versus interruptible
    - Benefits
    - Risks
    - Cost
  - Firm with interruptible
  - Transportation management
    - Cost versus personnel and ability to manage
    - Lay off capacity
    - Acquire capacity
Natural Gas Supply and Transportation Considerations

- **Gas Supply and Transportation Management**
  - Benefits external – fees clearly defined and acceptable
  - Benefits internal
  - Diversified supply portfolio
  - Ability to manage around pipeline constraints in a least fashion
  - Potential to mitigate or eliminate effects of pipeline OFO’s

- **Cost Recovery**
  - For a utility, choices above should be analyzed, in part, on the ability to recover 100 percent of the commodity and transportation expenses incurred, acceptable and demonstrable, subject to a reasonableness audit, by customers and the PUC.
Emerging shale gas plays

**Horn River**
- Depth: 8,200 – 9,800 ft
- Gas in Place: 144-600 Tcf

**Montney**
- Depth: 5,500 – 13,000 ft
- Gas in Place: 80-700 Tcf

**Utica**
- Depth: 1,500 – 11,000 ft
- Gas in Place: >120 Tcf

**Antrim**
- Depth: 600 – 2,200 ft
- Gas in Place: 76 Tcf

**New Albany**
- Depth: 500 – 2,000 ft
- Gas in Place: 160 Tcf

**Marcellus**
- Area: 95,000 sq miles
- Depth: 4,000 – 8,500 ft
- Gas in Place: 1,500 Tcf

**Barnett**
- Area: 5,000 sq miles
- Depth: 6,500 – 8,500 ft
- Gas in Place: 327 Tcf

**Haynesville**
- Area: 9,000 sq miles
- Depth: 10,500 – 13,500 ft
- Gas in Place: 717 Tcf

Shale Production Forecast: Significant Growth Potential

Key risks include:
- Environmental impact (footprint, water)
- Operating challenges (costs, people)

Source: MIT Study on the Future of Natural Gas
Lower costs continue to drive shale growth

2011 Forward Strip: $4.65/MMbtu

Source: WoodMackenzie
World LNG Estimated August 2010 Landed Prices

- Altamira: $5.00
- Lake Charles: $4.54
- Cove Point: $4.80
- UK: $5.94
- Belgium: $5.90
- Spain: $6.84
- India: $7.00
- Korea: $8.20
- Japan: $8.20
Rockies Production Forecasts

The graph shows the production forecasts for Bcf/d (Billions of Cubic Feet per Day) from 2010 to 2020. The forecast includes high, low, and average projections. The graph indicates a steady increase in production over the years.