The Growth of Renewables and Gas-Fired Power Initiatives

Presentation to:
Platts 10th Annual Gas Storage Outlook
Houston, TX

January 17, 2012
By:
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This presentation is incomplete without reference to, and should be viewed solely in conjunction with the oral briefing provided by Mercator Energy.

Except for the historical information contained herein, the matters discussed in this presentation are forward-looking statements that are based upon current expectations. Important factors that could cause actual results to differ materially from those in the forward-looking statements include risks inherent in exploratory drilling activities, the timing and extent of changed in commodity prices, unforeseen engineering and mechanical or technological difficulties in drilling wells, availability of drilling rigs and other services, land issues, federal and state regulatory developments and other risks.
Mercator Energy

• Natural gas broker, energy service provider, producer and industrial end-user agent
• 19 year old company
• Headquartered in Denver, CO
• Clients in 12 states
• Have consulted in the U.S., Canada and China.
Projected Growth

- In the next 15 years, 105 gigawatts (GW) of renewable power generation are forecast to be constructed
- 88 GW could be new intermittent wind generation
- Approximately 33 GW of natural gas-fired generation needed to firm up wind generation generating approximately 45,500 gigawatt hours (GWh) of electricity

Enough Gas?

• Almost 5 billion cubic feet per day (Bcfd) of incremental delivery capability could be required over the next 15 years to provide the new gas-fired firming generation with firm natural gas supply

• Total annual gas use associated with firming intermittent generation could grow to about 440 Bcf by 2025

• Roughly 2 percent of current annual U.S. gas use

Southwestern Energy’s Anticipates Future Gains As Well

Fayetteville Shale

1st Quarter 2007
1st Quarter 2008
2nd Quarter 2010
Future Development Phase

Source: Southwestern Energy Financials

<table>
<thead>
<tr>
<th>Metric</th>
<th>1st Quarter 2007</th>
<th>1st Quarter 2008</th>
<th>2nd Quarter 2010</th>
<th>Future Development Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time To Drill (Days)</td>
<td>20</td>
<td>8</td>
<td>-60%</td>
<td></td>
</tr>
<tr>
<td>Wells Per Yr Per Rig</td>
<td>18</td>
<td>18</td>
<td>150%</td>
<td></td>
</tr>
<tr>
<td>Average Lateral (Feet)</td>
<td>2,104</td>
<td>2,104</td>
<td>138%</td>
<td></td>
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<tr>
<td>30 Day Ave. Prod Rate (Mcf/d)</td>
<td>1,006</td>
<td>1,006</td>
<td>248%</td>
<td></td>
</tr>
<tr>
<td>IP Additions Per Rig Per Yr (Mcf/d)</td>
<td>18,360</td>
<td>18,360</td>
<td>770%</td>
<td></td>
</tr>
<tr>
<td>Drill &amp; Complete Costs ($MM)</td>
<td>$2.6</td>
<td>$3.0</td>
<td>15%</td>
<td></td>
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</tbody>
</table>

Source: Southwestern Energy Financials
Historical NYMEX Prices

NYMEX – Average last 3 days of close as reported in Platts Gas Daily Report, A McGraw Hill Publication
Natural Gas to Wind’s Rescue
First off, First on
Cost Benefit?

• Total cost of natural gas infrastructure to support firming requirements: $2 billion to $15 billion

• This is equal to about 10 percent of the total investment in midstream pipeline infrastructure including gathering, transmission & storage*

• Such requirements can be significant, especially in terms of the natural gas transportation required to make such deliveries

• Incremental facilities may need to be constructed to guarantee reliable on-demand service to support firming power generators

*Reported in the NGAA Foundation’s 2009 report: Natural Gas Pipeline and Storage Infrastructure Projections Through 2030

A Cautionary Note

• Forecasts Count on Real-Business-Cycle (RBC) Theories

• RBC Theories/Models offer “no closed-form solution due to the interaction of linear and nonlinear elements”\(^1\)

• Solution clarity? Causality?

• RBC studies presume perfect information on data input

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\(^1\) Loglinear approximate solutions to RBC models: An Illustration and some observations, Sau-Him Paul Lau and Philip Hoi-Tak Ng, University of Hong Kong, January 2004
Linear Calculations in a Very Non-Linear World

\[ y = 1.518e^{0.259x} \]

\[ R^2 = 0.8644 \]
Intermittency is the Problem
Output is Not Correlated with Load

Typical 100 MW Wind Plant Generation vs. Hourly System Load

Source: Brett Oakleaf, Invenergy LLC
Two Examples

• Consider XCEL Energy
  – The largest single Wind Portfolio under one utility

• Consider Texas
  – The state with the largest total Wind Portfolio (10,800 MW)
Amount of Wind on the Public Service Company of Colorado System

Q. Is it true that Public Service, when compared to other electric utilities in the United States, has among the highest hourly penetration levels of wind in the entire nation?

A. To the best of my knowledge, yes that is true. We have experienced hours in which 30% of our customer load was being served by wind generation.

- Thomas A. Imbler

The Colorado Wind Reality

• 12.5% load factor (capacity credit) at peak hours*

(A nameplate 600MW facility is = to 75 MW at peak hours)

*Source: Colorado PUC in the matter of the application of Public Service Company of Colorado for approval of its 2007 Colorado Resource Plan, Direct Testimony and exhibits of James F. Hill - The effective load carrying capability (“ELCC”)
“…they [internal studies] seemed to have underestimated the fluctuation of wind generation, the speed with which total wind generation can change, restrictions on the ability of our owned and purchased units to keep up with wind generation variation, and the occasional need to curtail wind generation, among other things.”

Source: “2008 Wind Integration Report”, Xcel Energy; December 1, 2008
When Wind Blows At Night, Coal Gen Ramps Down

Xcel Defined Wind Event:
7/2/2008

Source: PSCo Training Manual
Independent Power Producer Demand Profile* (Instant-On Gas) at Fountain Valley Midway Simple Cycle Combustion Turbine (CT) Plant

*CIG Electronic Bulletin Board for Fountain Valley Midway – 6 Combustion Turbines
Texas Solution?

- Texas has 10,135 MW of installed wind capacity (3 times as much as any other state)
- That is 10% of Texas’s 103,000 MW of summer electric generation capacity
- On 8/28/2011, wind energy provided only 1.3% of total generation required.
- Texas has spent approximately $24 billion on wind turbines and related transmission.
- ERCOT considers 8.7% of the State’s installed wind generation capacity as “dependable capacity at peak”.

Source: Robert Bryce, National Review; August 29, 2011
Problems:
Operational and Regulatory
Operational

There is a lack of synchronization between electric scheduling and gas nominations.
# The 4 Cycles of Gas Nominations

<table>
<thead>
<tr>
<th>CYCLE 1: Timely Nomination Cycle on Nomination Day</th>
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<tbody>
<tr>
<td>Lock Down Nominations</td>
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<th>CYCLE 2: Evening Nomination Cycle</th>
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<td>Lock Down Nominations</td>
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<tr>
<th>CYCLE 3: Intraday Nomination 1 – Morning of Flow Day</th>
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<td>Lock Down Nominations</td>
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<tr>
<th>CYCLE 4: Intraday Nomination 2 – Afternoon and Evening of Flow Day</th>
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<td>Lock Down Nominations</td>
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</table>
Electric Day Scheduling

- Forecast uncertainty of wind generation makes day ahead scheduling on OASIS nearly impossible.
- OASIS day ahead scheduling begins at midnight.
- Gas nomination day begins at 8:00am.
Impact on Pipelines and Their Other Customers

Pipelines Get Nominated, Confirmed, and Scheduled to Fill the Pipe and Operate at Fairly Constant Rates through the Day

Source: 2011 Navigant Consulting, Inc.
Impact on Pipelines and Their Other Customers

If One Shipper Can Unexpectedly Swing Up, It Interrupts the Day’s Flow for the Other Shippers

Source: 2011 Navigant Consulting, Inc.
The Reality

It is economically difficult for a peaking electric generator to hold firm transportation on gas pipelines if their load factor is less than 60%.

- No cost recovery
- No equal footing
Regulatory Need

Electric power pricing should be structured in a way that ensures such costs can be recovered as a part of the price of electricity and in a manner that does not put gas-fired backup at a disadvantage with other firming options.
Three Practical Solutions?

• Interruptible Transportation
• Pipeline Line Pack
• Gas Storage
What’s Needed - Practical

- Automated High Ramp Rate Supply Response
- Wide Area Monitoring, Visualization, and Control
- Peak Electric Demand Management
- Predictive Load Modeling and Forecasting
- Real Time Inter-grid Communications (Gas/Electric)
- Automated/Dispatchable Market Area Storage
- Gas Supply Quality Monitoring and Management
- Automated Flow Control and Volume/Pressure Mgmt and Real-Time Load Balancing (Re-routing)
- Real-time Load Measurement and Management

Source: “Natural Gas in Smart Energy Future”; GTI/Navigant; January 2011
What’s Needed - Regulatory

• Modify market rules to facilitate and create procedures for direct communications between pipeline and electric grid operators to fully optimize the usage of energy.

• Promote real-time communications between the gas and electricity grids

• Consider regulatory pass through of costs related to specific firming of load volatility

Source: “Natural Gas in Smart Energy Future”; GTI/Navigant; January 2011
Conclusions

• Lingering issue of gas-electric interaction on the gas grid have to be resolved, and continuing industry and regulatory priority for that is important.

• The real question may be not how we firm renewables but why.

• In a low cost natural gas environment and with studies like Bentek and Civitas that show that wind power could actually produce more CO2 due to its intermittency, why build wind?
Citations for Report

All of the information utilized for this report is a compilation of information pulled from the following data sources:


Gas Technology Institute/Navigant, “Natural Gas in a Smart Energy Future”; January 2011

NREL, “Eastern Wind Integration and Transmission Study”; January 2010

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