Gas/Electric Integration (Electric Perspective)
Similarities

- Operate commodity transportation businesses, regulated by FERC with FERC-approved tariffs
- Operate interconnected transmission networks
- Sell firm and interruptible (non-firm) transportation service, but our non-LDC customers generally won’t buy firm service because of its cost
Differences

• Electric transmission is built in anticipation of demand growth (not firm service contracts)
• ISOs also run centralized energy markets, in addition to providing transmission service and have geographical exclusivity (same with non-market utilities)
• ISOs don’t own the transmission assets and are not responsible for maintenance (but individual utilities do)
SHALE GAS!

- Low commodity prices, translating to dramatically increased gas consumption for power generation—Marcellus is the cheapest gas in North America!
Increased Consumption for Power Generation

Winter 2012 vs. 2011
Gas consumption for power is up ~25%!

Source: EIA Gas Monthly June 2012
EPA Rules!

PJM expecting about 18,000 MW of coal plant retirements—10% of the generation fleet—and gas will be the replacement fuel.
We’re Not Your Ideal Customer!

Power generation gas use does not fit neatly into the gas contractual construct

- Electricity demand, like gas demand, fluctuates and is subject to steep ramps, especially in winter
- Increased wind and other intermittent resources don’t help
- Fastest starting generation resources, generally are gas-fired combustion turbines which can go to full output in about 10 minutes or less
How Does It Work?—Load Variability

Summer Load Shape

Slow, gradual increase in load throughout the day. Gas-fired units can be more carefully planned and sequentially brought into service.

Winter Load Shape

Very steep load pickup (5AM-8AM) in the morning, followed by an immediate stop and gradual decline during the day.
How Does It Work? -- Market Operations

Market selects the lowest set of offers from generators that can operate within the timeframe predicted by the load forecast.
Addressing the Issue

• Improved Communication and Data Exchange
  – Give Gas Control a fighting chance to anticipate what we are going to do!
Addressing the Issue

• The Market Will Provide Necessary Gas Infrastructure Additions
  – Shippers will need to effectively use the secondary capacity release market at times, if relying on interruptible service
  – Suppliers and generators may need to team up in open season processes to ensure delivery under peak conditions
Prevalence of Interruptible Delivery Service

New England Gas-fired Power Generation (>100 MW)
Addressing the Issue—Electric Side

- Placing limits on the use of quick starting generation
  - Recognition by the electric system operators that gas is a just-in-time fuel system that can only provide limited response in real time (how much for how long on each pipeline?)
  - Need for additional dual fuel capability
  - Use of hydro/pumped storage assets as other than economic energy providers (hydro assets are optimized to river use for run-of-river; pumped storage assets are optimized as energy providers)
Addressing the Issue—Gas Side

• Gas Demand Response
  – Are there gas consumers that would be willing to interrupt processes in the peak hours?
  – Ideal electric demand responder: Industrial gas producer—Large electricity consumer at a single site, can shut down quickly, and come back quickly with minimal impact to the process—are there equivalents in the gas business?
• Low gas prices are changing the basic dispatch of the system
  – Combined-cycle plants are running like base load plants (>80% capacity factor)
  – Low capacity factor units are still there and needed to handle the occasional high load or forced outage situation (<5% capacity factor)
• At high capacity factors, the costs of firm and interruptible delivery service start to converge

<table>
<thead>
<tr>
<th></th>
<th>Firm (FT-1)</th>
<th>Interruptible (IT-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservation ($10.91/dth/mo)</td>
<td>$3,257,402</td>
<td>$3,282,848</td>
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<tr>
<td>Usage (FT-$0.09/dth, IT-$0.45/dth)</td>
<td>$681,783</td>
<td>$3,282,848</td>
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<tr>
<td>TOTAL</td>
<td>$3,939,186</td>
<td>$3,282,848</td>
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<tr>
<td>or</td>
<td>$3.20/MWh</td>
<td>$2.67/MWh</td>
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</tbody>
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If electricity is $50/MWH, then gas transportation is

- 6.4% of energy offer
- 5.3% of energy offer

So, high capacity factor units can begin to “afford” firm service, but the low capacity factor units cannot!
The Real Issue

• To what degree can the gas pipeline system supply the occasional instantaneous start-up of electric generators to deal with high loads (somewhat predictable) and forced outage (completely random)?

• As a customer of the gas industry, the electric generator is analogous to wind generators or electric arc furnaces for the electric industry
  – Intermittent and minimally predictable
The Answer!

• Trust that the gas industry market forces will add capacity as needed, based on the existing paradigm
  – In areas where there is high reliance on gas, e.g. New England, require firm gas service or dual fuel capability for a substantial portion of the capacity (ISO-determined)

• Develop understanding on both sides of the limitations that exist
  – How much instantaneous capacity is available on each pipeline?
  – Share operational information to minimize surprises
Summary

• Power generation is a “double edged sword” for the gas business
  – Largest growth market
  – Potential to cause problems in operations

• Working together, we can minimize the operational problems
  – Awareness of the limitations on each side
  – Increased real time communications across the aisle
  – Use of the demand side resources on each side