U.S. Natural Gas Infrastructure and Intermittent Power Resources

Anders Johnson
Director TGP Facility Planning and Gas Control
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Prepared for the Harvard Electricity Policy Group
Our Purpose

El Paso Corporation provides natural gas and related energy products in a safe, efficient, and dependable manner.
Vision and Values

the **place** to work

the **neighbor** to have

the **company** to own
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This presentation includes certain forward-looking statements and projections. The company has made every reasonable effort to ensure that the information and assumptions on which these statements and projections are based are current, reasonable, and complete. However, a variety of factors could cause actual results to differ materially from the projections, anticipated results or other expectations expressed in this presentation, including, without limitation, our ability to execute our strategy of selling assets to El Paso Pipeline Partners, L.P.; our ability to pay dividends declared; changes in unaudited and/or unreviewed financial information; volatility in, and access to, the capital markets; our ability to implement and achieve objectives in our 2011 plan and guidance, including achieving our earnings and cash flow targets; the effects of any changes in accounting rules and guidance; our ability to meet production volume targets in our Exploration and Production segment; the uncertainty of estimating proved reserves and unproved resources, the future level of service and capital costs, the availability and cost of financing to fund our future exploration and production operations; the success of our drilling programs with regard to proved undeveloped reserves and unproved resources; our ability to successfully identify new Midstream opportunities; our ability to comply with the covenants in our various financing documents; our ability to obtain necessary governmental approvals for proposed pipeline and E&P projects and our ability to successfully construct and operate such projects; the risks associated with recontracting of transportation commitments by our pipelines; regulatory uncertainties associated with pipeline rate cases; actions by the credit rating agencies; the successful close of our financing transactions; credit and performance risk of our lenders, trading counterparties, customers, vendors and suppliers; changes in commodity prices and basis differentials for oil, natural gas, and power; general economic and weather conditions in geographic regions or markets served by the company and its affiliates, or where operations of the company and its affiliates are located, including the risk of a global recession and negative impact on natural gas demand; the uncertainties associated with governmental regulation; political and currency risks associated with international operations of the company and its affiliates; competition; and other factors described in the company's (and its affiliates') Securities and Exchange Commission filings. While the company makes these statements and projections in good faith, neither the company nor its management can guarantee that anticipated future results will be achieved. Reference must be made to those filings for additional important factors that may affect actual results. The company assumes no obligation to publicly update or revise any forward-looking statements made herein or any other forward-looking statements made by the company, whether as a result of new information, future events, or otherwise.

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Agenda

- U.S. natural gas infrastructure
- El Paso pipeline background
- Pipeline ability to manage load variations
  - Examples from Tennessee Gas Pipeline
  - Linepack and gas fired generation
- Pipeline expansions
- Cost recovery thoughts
- Appendix overview
Transmission pipelines historically operated at a 60% load factor as many were designed to serve winter LDC loads, power demands have altered utilization.

Pipeline designs are typically based on firm contracted capacity (‘n’ design).

Linepack for major transmission lines is measured in Bcf, useable linepack is limited when a pipeline is fully utilized.

Shale gas supplies have dramatically altered the utilization and available linepack of many pipelines.

Major gas transmission lines are highly reliable delivering 99.99% of the primary firm scheduled gas.
Natural Gas Transmission Network
Pipeline Majors differentiated by color

300,000+ miles

EIA
Shale Gas – energy industry gas changer
Natural Gas Compressor Stations

Legend
- Interstate Pipeline
- Compressor Station
19% of total U.S. interstate pipeline mileage
28 Bcf/d capacity (13% of total U.S.)
17 Bcf/d throughput (26% of gas delivered to U.S. consumers)
Tennessee Gas Pipeline

13,800 miles
1,000 meters
12 Bcf Linepack (~1 Bcf useful)
90 Bcf Storage
72 Compressor Stations

TGP designed to deliver gas evenly-hourly over a 24 hour day

Several pipelines are designed to support uneven hourly demands
TGP System Power Plant Demand (Dec-Jan-Feb)

<table>
<thead>
<tr>
<th></th>
<th>Dec 2009</th>
<th>Jan 2009</th>
<th>Feb 2009</th>
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<tr>
<td>2011</td>
<td>1.24</td>
<td>1.05</td>
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Potential demand 5.1 Bcf/d
Firm Contracted demand 1.4 Bcf/d

4 of the 24 power plants account for ~60% of contracted volume
N.E. power plants are contracted for ~60% of their burn capacity. Higher contract levels improve pipeline response time, ability to provide flexibility when not fully utilized, and support new construction.
Examples of Winter Operations - Fully Loaded Pipeline Conditions
Managing hourly variability

Several of the following slides contain excerpts from Tennessee’s Winter update for power plants. More detailed information and assumptions available:

Power Plant Winter Operations Discussion Jan 19 2011
Pipelines offer hourly flexibility when it exists but must restrict flows (secondary and interruptible) to protect firm (primary) shipper rights when pressures fall.
Hourly demand, up to 1.5 Bcf/d daily rate, exceeds steady-state transport design of 1.04 Bcf/d

LDC hourly variation is typically <40% of the scheduled daily volume
Power plant hourly variation has exceeded 400% in extreme cases for brief periods
As demand exceeds physical capability linepack drops to minimum levels and pressures fall
Depending on the time-of-day, diameter, length of pipe, MAOP, and current pressure, millions of cubic feet may be taken from or added to linepack to meet the market.

Natural Gas Pipelines are a key component in meeting the U.S. intermittent power needs.

4 MMscf/h \approx 500 MWh

<table>
<thead>
<tr>
<th>Flow</th>
<th>Acc Vol</th>
<th>Sched</th>
<th>Pressure</th>
</tr>
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<tbody>
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2.4 Bcf/d leaving pipe
1.6 Bcf/d entering
Industry Discussion Topics

- Encourage use of proper transport agreements
  - Mechanism for PP to flow through transportation charges
  - Either require all plants bidding into the market to hold some nominal percentage of their peak burn as firm transportation, or
  - Require the system operators (ISOs/RTOs) to hold a similar amount of pipeline capacity on behalf of the market
- Develop new services (linepack, hourly); pipe tariffs vary
- Encourage new and needed infrastructure now
- Notification of a trip or excess power/gas – coordinated market overview entity
- Address disconnects between gas and electric day
Questions
Appendix
# Gas Supply Schedule

All Times are Central Clock Time (CCT)

<table>
<thead>
<tr>
<th></th>
<th>Chart Time</th>
<th>Evening Nomination</th>
<th>Intra-day Cycle-1</th>
<th>Intra-day Cycle-2</th>
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<td>11:30 AM</td>
<td>6:00 PM</td>
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<td>Initial Volumes Available</td>
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<tr>
<td>Scheduled Volumes Available</td>
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<tr>
<td>Effective Time</td>
<td>9:00 AM (next day)</td>
<td>9:00 AM (next day)</td>
<td>5:00 PM (current day)</td>
<td>9:00 PM (current day)</td>
</tr>
</tbody>
</table>

Hourly Nominations can be accommodated with a phone call
Depending on pipeline conditions and power plant location linepack on the TGP system can in theory support a 2,000+ MW power load swing for up to 12 hours.
Hourly ERCOT Generation by Fuel Type
(August 2010 average)
Renewable such as wind are attractive sources of energy but they need to be backed up. Gas fired generation is quick response, low initial cost, highly reliable, and commercially available in significant quantities.

ERCOT Wind Energy Generation Example

2009 Wind Hourly Output

Installed Wind Capacity

MW

Renewable Technology Working Group (RTWG)
H.Durrwachter, Report to TAC
February 4, 2010
### 10 Dec 2010 11:43 AM
Flow, Accumulated Volume, Scheduled, Pressure

<table>
<thead>
<tr>
<th>Flow</th>
<th>Acc Vol</th>
<th>Sched</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
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</table>

- Snapshot from TGP’s Powerplant SCADA screen
- Fully loaded pipeline being overpulled resulting in abnormally low pipeline delivery pressures
- Linepack is regional and may be lowest upstream of a compressor station
- Parties overtaking may adversely impact firm shippers
- Cost to control is $MM, who pays
TGP Ongoing Growth Projects

- **TGP 300 Line**
  - 340 MMcf/d
  - In-service: 2011

- **NSD Project**
  - 220 MMcf/d
  - In-service: 2012

- **Northeast Upgrade Project**
  - 620 MMcf/d
  - In-service: 2013

$1.2 billion investment

“Producer push”
Proposed New England Expansion

- In-Service Date: 2015/2016
- Incremental Volume: 500 MDth/d +
- Facilities: 110 mile + pipeline
- Markets: New England / Iroquois
## Winter Days Restriction Percentage

<table>
<thead>
<tr>
<th>Restriction Point</th>
<th>Percent Days Restricted (Nov – Mar)</th>
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<tbody>
<tr>
<td>MLV 223/STA 224</td>
<td>25.17%</td>
</tr>
<tr>
<td>Niagara Spur Backhaul</td>
<td>0.00%</td>
</tr>
<tr>
<td><strong>STA 245</strong></td>
<td><strong>43.05%</strong></td>
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<tr>
<td>STA 307</td>
<td>20.53%</td>
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<tr>
<td>STA 315 M/S</td>
<td>0.00%</td>
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<tr>
<td>STA 321</td>
<td>49.01%</td>
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<tr>
<td>STA 325</td>
<td>0.00%</td>
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<tr>
<td>MLV 355 M/S</td>
<td>7.28%</td>
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<tr>
<td>MLV 355 S/M</td>
<td>0.00%</td>
</tr>
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</table>

Pipeline segment utilization in some areas is nearing 100%, other segments have capacity available to offer flexibility to the marketplace.
Mainline TGP throughputs have dropped dramatically because of new Marcellus receipts.

Challenge is supporting infrastructure costs in a decontracting environment to maintain flexibility.
Gas Transportation Terms

- 1 Mcf = 1000 ft³ ≈ 1 Dth = 1,000,000 Btu (HHV)
- Gas Day begins 9 a.m. central time
- Linepack is the amount of gas in the pipeline (Mcf or Bcf)
- MAOP is maximum allowable operating pressure (psig)
- Tariff explains pipeline commercial rules


  - Service Priorities: Primary in Path (PIP), SIP, SOP, IT
  - Gas quality specifications
  - Operational Flow Order “OFO” is an order issued to alleviate conditions which threaten or could threaten the safe operations or system integrity, of the transportation service provider's system or to maintain operations required to provide efficient and reliable firm service