The Good, the Bad and Predicting Quantum Shifts

This isn’t your grandfather’s natural gas market...

...or is it?
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The Best Cure For High Prices...is High Prices
Low gas prices are impacted by a variety of fundamental factors...
What Happened To Crude?
Will Supply Growth Continue?

• Portfolio management leads to declines in dry gas
• Political risk

• Increased drilling in “wet” and “oily” plays
• Additional power generation due to low prices

Source: Bentek and EIA
Natural Gas

Source: CME/NYMEX
Predicting the Future

✧ What Will Happen Next?

PREDICTION

Or

CORRELATION
By applying statistics we can wrangle blind spots into submission.
Statistics and Math Tell Us...

- The tip of a 1/3 inch long hour-hand on a wristwatch travels at 0.00000275 mph
- 1 out of 3 people eat at fast food restaurants every day.
- Tall people earn $789 per year per inch more than shorter people.
- The Moon can cause you to weigh less when it is directly overhead.
Constructing A Supply Forecast...That Tracks

Well Data
- Operator
- Location
- Permit Date
- Spud Date
- Completion Date
- First Producing Date
- Monthly Production
- Other (IP Rate, choke size, fracking fluid, well direction, etc.)

Type Curves
- Vintage by well spud year
- Differentiation of product (gas vs liquids)
- Assumption on WH condensate

Operating Trends
- Rig tracking
- Drilling efficiency
- Completions improvements

Production Forecast
- Forecast operating trends to reflect constraints (drilling, completions, infrastructure, etc)
- Anticipate behavior based on breakeven analysis

Pipeline Loading
- Evaluate current gas processing facility throughput and capacity (Bentek)
- Apply ‘typical’ pipeline sendout profile to new production

Economic Dispatch
- Look at how each market trades and operates
- Overlay any physical or operating constraints (interconnect capacity)
- Include basis incentive and variable cost

- Can integrate our internal intelligence and assumptions
- Insights into competitor business models and operating decisions
- Integrated systems (breakeven / production / power market / mapping) provides very transparent and integrated view
- Provides a visual timeline of play development
- Early identification of trend changes
Constructing A Supply Forecast...That Tracks

Well Data
- Event Dates
  - Permit Date
  - Spud Date
  - Completion Date
  - First Production Date

- Well Location
  - Latitude / Longitude
  - County / State

Production Data
- Monthly Production
- IP Rate, Decline

Operator
- ConocoPhillips

Rig Tracking Information
- Rig Number
- Rig Release Date

Physical Characteristics
- Lateral Length
- Number of Frac Stages
- Type of Frac Fluid
- Hole Direction
- Depth
- Choke Size
Constructing A Supply Forecast...That Tracks

Well Data
Type Curves

Aggregate well production by spud date

Production (mcf/d)

Month

2007
2009
2011
How many wells will be drilled?
How many rigs does that require?
When will the wells be completed?

- Permits issued
- Rig count
- Wells spud
- Uncompleted wells
- Rig efficiency
- Drilling efficiency
- Completions improvements
Constructing A Supply Forecast...That Tracks

Well Data

Type Curves

Operating Trends

Production Forecast

Portfoli0 Optimization

Well Capex

Completions

Rig Efficiency

Rig Count

Breakeven Economics

(EUR, operator, acreage location)

Wells Online (& Date)

= Production
Constructing A Supply Forecast...That Tracks

Well Data → Type Curves → Operating Trends → Production Forecast → Pipeline Loading

Pipeline A → Pipeline B → Pipeline C → Pipeline D → Pipeline E

Apply ‘typical’ pipeline sendout profile to new production
Constructing A Supply Forecast... That Tracks

- Well Data
- Type Curves
- Operating Trends
- Production Forecast
- Pipeline Loading
- Economic Dispatch

? Interconnect capacity from processing to pipeline

? Operational constraints

? Basis incentives

? End markets and existing contract obligations
Constructing A Supply Forecast...That Tracks Trading Strategies

Well Data
• Operator
• Location
• Permit Date
• Spud Date
• Completion Date
• First Producing Date
• Monthly Production
• Other (IP Rate, choke size, fracking fluid, well direction, etc.)

Type Curves
• Vintage by well spud year
• Differentiation of product (gas vs liquids)
• Assumption on WH condensate

Operating Trends
• Rig tracking
• Drilling efficiency
• Completions improvements

Production Forecast
• Forecast operating trends to reflect constraints (drilling, completions, infrastructure, etc.)
• Anticipate behavior based on breakeven analysis

Pipeline Loading
• Evaluate current gas processing facility throughput and capacity (Bentek)
• Apply ‘typical’ pipeline sendout profile to new production

Economic Dispatch
• Look at how each market trades and operates
• Overlay any physical or operating constraints (interconnect capacity)
• Include basis incentive and variable cost

✓ Can apply methodology on a lower level (sub-play, specific operator, etc.)

• Help articulate physical drivers behind basis swings - both intra/inter-regional
• Use supply forecast with power demand forecast to confirm longer-term trends for fundamental basis shifts
• Supply profile to enhance pipeline and storage utilization expectations
Rig Count Distribution

Shift to oil remains in strong uptrend

2011 Average Weekly Change: +8 Oil, -0.6 Gas

Source: Baker Hughes
But Shift to Oil Produces Associated Gas

- Gas production from ~ 3 oil wells equals one gas well
  - ...well pretty much...
- Gas rigs are slowly declining
- Gas equivalent rigs remain flat

Source: Baker Hughes and COP analysis
Production replacement ratio from gas to liquids shift

Based On:

One rig moved from the Marcellus to Eagle Ford (Oil) will produce 8 times less gas; the same rig moved from Haynesville (Dry) will produce 21 times less gas

Shift to liquids - gas production per rig highly variable

SOURCE: IHS Enerdeq database
Wells Spud (drilled) vs. Wells Completed

Divergence in number of completions and spuds.

Completion behavior rather than drilling activity will drive production in 2012

SOURCE: IHS Enerdeq database
Gas Rigs vs. Gas Wells Spud

......while number of wells spud continues to increase.
Uncompleted Wells – Significant backlog

Completion behavior rather than drilling activity will drive production in 2012

Haynesville and Marcellus outlooks critical to outlook
Producers Move to Liquids-Rich Plays
Gas Rigs vs. Gas Price

Gas rig count finally declining........
Shale Gas Production Forecast to Grow

Shale gas growth offsets other gas declines

Source: EIA Annual Energy Outlook 2012 Early Release
Significant deviation in 2012 gas production outlooks from consultants
The Middle of May...July Storage Levels

Natural Gas Storage

Date - Year

Bcf

2,606 Bcf
Global Gas Prices

As of 1/25/2012

LNG flows to U.S. remain at minimum rates

Altamira $2.93
Cove $2.71
Gul $2.96

Spain $5.19

Everet $9.11

UK $8.61

Korea $11.98
China $12.28
Japan $12.08

As of 1/25/2012
## LNG Exports in Play

<table>
<thead>
<tr>
<th>Location</th>
<th>Company</th>
<th>Timing</th>
<th>Bcfd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sabine, LA</td>
<td>BG / Cheniere</td>
<td>2015</td>
<td>2.6</td>
</tr>
<tr>
<td>Freeport, TX</td>
<td>Freeport LNG</td>
<td>2015</td>
<td>1.8</td>
</tr>
<tr>
<td>Corpus Christi, TX</td>
<td>Cheniere</td>
<td>?</td>
<td>1.8</td>
</tr>
<tr>
<td>Lake Charles, LA</td>
<td>BG / Southern Union</td>
<td>?</td>
<td>2.0</td>
</tr>
<tr>
<td>Cove Point, MD</td>
<td>Dominion</td>
<td>?</td>
<td>1.0</td>
</tr>
<tr>
<td>Coos Bay, OR</td>
<td>Jordan Cove Energy Project</td>
<td>?</td>
<td>1.2</td>
</tr>
<tr>
<td>Hackberry, LA</td>
<td>Sempra</td>
<td>?</td>
<td>1.7</td>
</tr>
</tbody>
</table>

**Total** 12.1

**Red** = Proposed to FERC  **Grey** = Potential site identified by project sponsor

Source: FERC as of January 10, 2012
Power Generation Demand Has Grown

Source: EIA
While Industrial Demand Has Declined

Source: EIA
Gas demand extremely sensitive to temperature

SOURCE: Bentek for gas demand, Temperature is daily high weighted by population of the 10 most populous US cities.
Winter HDDs – Lowest Since 2006

U.S. Population Weighted HDDs

<table>
<thead>
<tr>
<th></th>
<th>2011-2012</th>
<th>Last Year</th>
<th>10 Year Avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov</td>
<td>342</td>
<td>396</td>
<td>351</td>
</tr>
<tr>
<td>Dec</td>
<td>565</td>
<td>631</td>
<td>607</td>
</tr>
<tr>
<td>Jan</td>
<td>714</td>
<td>772</td>
<td>701</td>
</tr>
<tr>
<td>Totals</td>
<td>1882</td>
<td>1514</td>
<td>1682</td>
</tr>
</tbody>
</table>

-368 HDD => +556 Bcf surplus gas in storage
so 1 HDD ≅ 1.5 Bcf

Winter 20% warmer than last year and 10% warmer than 10 year avg

Source: COP Analysis
End October at Full Storage?

Even a hot summer likely results in test of full storage level (3.852 Tcf highest storage level to date)

Source: EIA, COP Estimates
Historical Rig Count

Growth driven by oil directed rigs
Completions growth relative to spuds is falling.

SOURCE: IHS Enerdeq database 1/20/12
Annual U.S. Natural Gas, Crude Oil, and NGL Field Production, 2000-2011 (billion boe)
NGL Supply Growth

Fractionation Capacity ~ 3.1 million bbl/d

Source: EIA
<table>
<thead>
<tr>
<th>Natural Gas Liquid</th>
<th>Chemical Formula</th>
<th>Applications</th>
<th>End Use Products</th>
<th>Primary Sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethane</td>
<td>C(_2)H(_6)</td>
<td>Ethylene for plastics production; petrochemical feedstock</td>
<td>Plastic bags; plastics; anti-freeze; detergent</td>
<td>Industrial</td>
</tr>
<tr>
<td>Propane</td>
<td>C(_3)H(_8)</td>
<td>Residential and commercial heating; cooking fuel; petrochemical feedstock</td>
<td>Home heating; small stoves and barbeques; LPG</td>
<td>Industrial, Residential, Commercial</td>
</tr>
<tr>
<td>Butane</td>
<td>C(_4)H(_10)</td>
<td>Petrochemical feedstock; blending with propane or gasoline</td>
<td>Synthetic rubber for tires; LPG; lighter fuel</td>
<td>Industrial, Transportation</td>
</tr>
<tr>
<td>Isobutane</td>
<td>C(_4)H(_10)</td>
<td>Refinery feedstock; petrochemical feedstock</td>
<td>Alkylate for gasoline; aerosols; refrigerant</td>
<td>Industrial</td>
</tr>
<tr>
<td>Pentane</td>
<td>C(_5)H(_12)</td>
<td>Natural gasoline; blowing agent for polystyrene foam</td>
<td>Gasoline; polystyrene; solvent</td>
<td>Transportation</td>
</tr>
<tr>
<td>Pentanes Plus*</td>
<td>Mix of C(_5)H(_12) and heavier</td>
<td>Blending with vehicle fuel; exported for bitumen production in oil sands</td>
<td>Gasoline; ethanol blends; oil sands production</td>
<td>Transportation</td>
</tr>
</tbody>
</table>

C indicates carbon, H indicates hydrogen; Ethane contains two carbon atoms and six hydrogen atoms

*Pentanes plus is also known as "natural gasoline." Contains pentane and heavier hydrocarbons.
Where is Demand?

- Industrial demand relatively strong
- Gas for power generation continues to increase
- CSAPR delay pushes back timing of larger demand increase from coal plant retirements
- LNG export projects starting to take shape but not likely before 2015
Industrial and Power Gen Demand Stable

**Industrial**

- 5 Yr Range
- 5 Yr Avg
- 2010
- 2011

**Power Generation**

- 5 Yr Range
- 5 Yr Avg
- 2010
- 2011

**Industrial demand below year-ago but above 5 year avg**

**Power burn above year ago levels as substitution for coal increasing with lower prices**

Source: EIA, COP Estimates
Potential Shifts in Demand

High Case

Low Case

+7 to +20 Bcfd Change by 2017
Demand Shifts to Be Slowly Driven by Economics

U.S. natgas remains the cheapest Btu in the energy stack

Source: NYMEX, ICE, COP Analysis
Factors Impacting Switching

Decrease

Grid Constraints
Coal Price
Coal Stockpiles
Plant Availability
Railroad Terms
Must Take Coal Contracts
Renewable Generation

Increase

Gas Price
Location
Nuclear Outages
Weather
EPA Regulations
Load Growth
Expiring coal contracts
Gas Demand and Temperature
(Model Output vs. Actual Data)

Significant switching has occurred, more upside may still be possible.

Is the market reaction lagging vs. potential?
Gas Demand by NERC Region

Gas Breakeven Price based on current delivered coal prices vary by region
Potential Sources of Demand

**Plant (NGCC)**
70 mmcf/d (~26 BCF/year)\(^1\)

**LNG Exports**
650-1,000 mmcf/d (~235-365 BCF/year)

**LNG Trucks**
0.002 mmcf/d per truck (~0.001 BCF/year)
30,000 trucks would equate to one NGCC plant

**Ethylene Plant**
60 mmcf/d (22 BCF/year)\(^2\)

**Ammonia Plant**
90 mmcf/d (33 BCF/year)

**CNG fleet vehicles**
0.001 mmcf/d per vehicle (~0.0005 BCF/year)
60,000 cars would equate to one NGCC plant

1. Assumes 7,000 btu/kwh heat rate for 500 MW NGCC plant running 85% of the year
2. Natural gas demand in the ethylene plant is for utilities; demand in ammonia plant is 75% for feedstock, the rest for utilities

Source: McKinsey, COP
Potential Signs of Tightening Supply/Demand

- Additional producer shut-in announcements
- Cash prices trading above monthly Index or futures
- Improving basis levels / increased transportation fees
- Storage surplus reductions
- CSAPR enforcement as of 2013
- Manufacturing plant restart or expansion announcements
Natural Gas Prompt Month Price

Source: NYMEX, DTN
## Natural Gas – Then and Now

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>(1 Month Ago) Today</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prompt Month Price, $/MMBtu</td>
<td>$3.53</td>
<td>($1.95) $2.62</td>
</tr>
<tr>
<td>5 Year Forward Price, $/MMBtu</td>
<td>$3.50</td>
<td>$4.16</td>
</tr>
<tr>
<td>Dry Gas Production, Bcfd</td>
<td>52</td>
<td>64</td>
</tr>
<tr>
<td>Total Demand, Bcfd</td>
<td>63</td>
<td>62</td>
</tr>
<tr>
<td>Power Generation Demand, Bcfd</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td>Industrial Demand, Bcfd</td>
<td>22</td>
<td>18</td>
</tr>
<tr>
<td>Storage Level, Bcf</td>
<td>1,575</td>
<td>2,606</td>
</tr>
</tbody>
</table>
Will 10 year low be tested?

How long will prompt price remain this low?

9 to 12 month bottom

Source: NYMEX, DTN
Conclusions

- Each gas rig is drilling more wells
- Value proposition of NGLs driving “uneconomic” production of Natural Gas
- Completion backlog is driving significant well inventories
- Rig count has become irrelevant to short term gas prices
- Key market factors are:
  - Weather related demand and storage levels
  - Completion decisions by market and work off of backlog
  - NGL productive capacity and logistic restrictions
  - Crude price and NGL price Correlation
  - Associated wet gas completions continue
  - Macroeconomic health and the demand for NGL products
  - There is a risk to the NGL market...that mirrors what has happened in the Natural Gas market over the past two years

Rig count will not drive 2012 gas pricing
Natural Gas Recap

Short-Term

- Potential for low price environment remains high especially if summer weather normal or cool
- High storage levels should continue to cap price advances and support volatility levels

Longer-Term

- Hedging opportunities for consumers may dissipate if supply curtailed or demand influenced by projects or legislative action
- Historically, U.S. natural gas price has not remained static for extended periods of time (post-deregulated market)

Be Prepared for the Price Shift