Perspectives On the Unconventional Revolution in North American Natural Gas

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Unconventional Gas Considerations

• Game changer in North American natural gas resources & supplies

• Quadruple Whammy!
  • Surge in North American unconventional gas supplies
  • Surge in global LNG supplies
  • Worst recession since WWII: slump in global industrial gas demand
  • Clean energy mandates biased to renewables

• Energy security and clean energy implications

• Realign portfolios to new gas market factors
Market Factors

- U.S./Can GDP       - 3.5% 2009, +1.4% 2010
- World GDP          - 2.5% 2009, +1.8% 2010
- World energy demand - 2.0% 2009
- U.S. gas demand    - 3.3% (- 2.1 Bcfd) 2009
- U.S. gas rigs      - 56% (710 – 09/25/09)
- Canada gas rigs    - 85% (87 – 09/25/09)
- World LNG liquefaction + 29% (+ 6.8 Bcfd 2009-2010)
- U.S. LNG capacity  ~15.5 Bcfd (2010)
- U.S. LNG Imports   ~ 0.9 - 2.1 Bcfd (2009)
- U.S. gas price     $3.30 Mcf (HH Sep 2009)
US Natural Gas Spot Price
1989 – 2009 (April)

Record 3,800 Bcf October 2009?

US Gas Storage

Storage 09/18/09 = 3,525 Bcf
+ 16% vs 5-YR average

5-YR Hi-Lo Range

HH 2009~
U.S Vintaged Gas Production
2007: Transformation to the Shale Gas Era

2008 decline zero gas drilling = 16.2 Bcfd
Reversing the Trend
U.S. Average Annual Well Productivity

US Gas rigs down 878 - 56% 9/25/09
2007 - 2009
Wells IP < 500 Mcfd = - 6000 = (-1.1) Bcfd
Wells IP > 10,000 Mcfd = + 305 = + 4.7 Bcfd

-643 Mcf/d
+ 282 Mcf (43%)
U.S. Daily Gas Production by Type

<table>
<thead>
<tr>
<th>Type</th>
<th>2000</th>
<th>2008</th>
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<tbody>
<tr>
<td>Shale</td>
<td>889</td>
<td>5221</td>
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<tr>
<td>Chalk</td>
<td>594</td>
<td>304</td>
</tr>
<tr>
<td>Tight SS</td>
<td>6258</td>
<td>13699</td>
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<tr>
<td>CBM</td>
<td>4019</td>
<td>5133</td>
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20% 40%
Half the gas consumed was produced from wells drilled within the prior 40 months!

Gas Production by Vintage Year

50% of current production
Critical to capture borehole geometry, coring, testing and treatment operations.
Total (P-P-S) 1,836,423 Bcf (+ 515,473 Bcf +39% vs 2006!!!)

Other large resources include S. TX, Anadarko and Permian Basins, Piceance & Green River Basins in the Rockies.

Major increases associated with emerging shale plays: Led by Marcellus in Appalachian Basin and tight sands + Mancos shale in Uinta Basin.

The giant lower cost shale resources – Marcellus, Haynesville, Horn River in NE BC will dominate future developments

Squeeze out higher cost gas

Causing major shifts in investment and portfolios
Rebalance Supplies & Markets
Rockies East Flows and REX Pipeline

Displaced Mid-continent gas 2008
(Basis differential -$2.00!)
Displace Canada & Gulf gas 2009

2008-2009 Rockies basis
~ - $2.53 to - $1.15 Mcf

Capacity Expansion

East: REX    +  200 MMcfd 2009
Chicago Exp. + 1,200 MMcfd 2015
West: Ruby   + 1,300 MMcfd 2011
Southeast Ark La Tex

Haynesville Shale Recession Proof
Almost 100 rigs drilling
Lease protection
250 Tcf potential reserves

Chesapeake most active driller in the play with 29 rigs
Expect to produce 275 mmcfe net per day by end 2009.
Estimated average yield per well is 6.5 bcfe

Currently holds more than 510,000 net acres of leasehold in the play—largest leaseholder
Lease sale bonuses fall 95% from record

Recent PetroHawk IPs 9.6 to 16.3Mmcfd in LA and E TX
Questar’s 1st well Red River Parish IP 16MMcfd

PARTNER UP! Chesapeake leverages finding costs below $1.00/mcf through joint ventures with PXP
Gulf Coast

La Salle DeWitt Counties Eagle Ford Shale below Austin Chalk Edwards Reef Trend
Pioneer well 6.6 MMcf/d 194 bbls cond
Petrohawk 7.6MMcf/d, 250 bbls cond
100,000 net acres leased
Sharon Energy, Diaz Res, Anadarko, TXCO

Maverick Basin Pearsall Shale (Cret) complex geology--heavily faulted half graben
Anadarko with 12 tests
TXCO JV with Encana 27 tests
Initial production in the 1980s
Horizontal drilling/Staged fracs could turn Pearsall into predictable resource play across the basin but needs price support
SE New Mexico/West Texas

Percha Shale (Woodford Equivalent) being tested in Pedregosa Basin by Dan A. Hughes
Last drilling 20 years ago

EOG moving the Barnett Play to the northern Ft Worth Basin
250,000 net acres
Based on initial results and analysis of historical wells in the area---Net reserve potential of 225-460 Mboe

Barnett and Woodford being evaluated throughout the Permian Basin
Fayetteville Shale only “brand new” play in the Mid-continent in years—needs gathering system infrastructure

Southwestern Energy (SEECO) biggest leaseholder with 900,000 acres
Laterals over 3,000ft, multi-well pads,
IPs >5 MMcfd
Currently drilling with 8 rigs

SEECO asks for 183,000-acre Ozark Highlands Unit
Conway, Johnson, Pope and Van Buren counties
Entirely within Ozark National Forest

SEECO reported gross operated production from Fayetteville shale play area last fall exceeded 300 MMcfd, up from 84 MMcfd the year before

Chesapeake has 16 rigs drilling on its 420,000 acres at the play’s core
Others: XTO, PetroHawk
Newfield high volume producers in extended lateral drilling--one well at 12 MMcfed
Study of longer term production from nearly 100 horizontal Woodford wells est avg ultimate recovery per frac stage at 600 MMcf
Company’s net daily production >165MMcf/d
Newfield curtails some gas production until prices rebound

Continental Resources also active Hughes Cty
3 Woodford horizontal wells—two part of simultaneous frac pilot program
IPs 6.2 to 7.2 MMcf/d after frac
More two-well simultaneous fracs planned
Antero Resources Corp Arkoma Basin horizontal Woodford well Hughes Cty southeastern Oklahoma flowing 11.1 million cu ft of gas with 959 bbls of water per day

St Mary Land & Expl recent completions Coal County
IPs > 4Mmcfd Up to 15 stage frac jobs

Other players Oracle Res, Little Bear Res,
Woodford drilling in the Anadarko Basin plus Pennsylvanian, Cleveland and traditional targets
New Tonkawa sand play just developing
Woodford players: Devon, Cimarex and Chesapeake
Canadian, Blaine and Caddo counties
Depths 12,000 to 15,000ft w/4,000ft horizontal laterals
9-11 stage frac jobs  IPs 3-5Mmcfd
17 Devon-operated horizontal Woodford wells online Canadian County Nov 07 thru Mar 09
Combined production 6.2 Bcf  86,200 bbls of oil/cond
March production totaled 1.09 Bcf and 14,800 bbls of liquids
Texas Panhandle Western Oklahoma

Chesapeake Colony Granite Wash play wells flowing 5-10 MMcfg with cond
Proved reserves of 316 Bcfe  Average 5.7 Bcfe per well
Expects to drill 50 wells by end of 2010
Company says play is its highest rate of return thanks high oil and natural gas liquids content

Des Moines Granite Wash Horizontal Play
Depths from 10,000-15,000ft
Began in Buffalo Wallow Field, Hemphill county
3,000-4,000ft laterals

Wheeler County’s Stiles Ranch and Britt Ranch fields are in the “heart” of play

Newfield in Wheeler County
Recent Discovery 7H McCoy online flowing 25 MMcfg, 1,900 bbls cond
Other wells area flowing from 8-21 MMcfg with 300-1,200 bbls cond
Northeast

Marcellus Devonian Shale Play attracts Texas accents to western PA 600 miles or more in extent from WV to NY and continuous Depths around 8,000ft 120-250ft thick

Probable resource 150 Tcf to 500 Tcf Recovery factor ~10%
Cabot recent Teel H well IPs at 10.3 Mmcfd

Range reports highest rate in play of 24.5 Mmcfd
Expect Marcellus production to reach 100 Mmcfe by year end
Est 4.4 Bcf EUR per well for first 24 wells
Will complete 50 Marcellus wells by year end

Marcellus players include: Range Resources, Atlas Energy Resources, EXCO, Equitable, Chesapeake, Southwestern Energy, EOG, Cabot Oil & Gas, REX, Ultra Pet, Chief O&G, XTO and others

Huron Shale gas play
Cabot reports 1.0MMcfd w/o stimulation
Mason County well 6816ft TD 3530ft lateral
Range Huron Shale wells averaging 1.1Mmcfd

Appalachian Basin described as the most under explored, at deeper levels, mature basin—another “last frontier?”

Statoil buys into play through Chesapeake for $3.4 billion
What information is needed by the industry to continue the growth and development of unconventional resources?

- **Tight Gas Sands**
  - Pad drilling
  - Perf breakdowns, fracs and treatments, all stages, fluids, proppant, pressures, including fracture success/extent
  - Production tests before and after treatment stages
  - Permeability and porosity
  - Core description/analysis

- **Coalbed Methane**
  - Coal type
  - Water gauges/water disposal
  - Barefoot completions
  - Cavitation
  - Palm/pinnate lateral leg IDs
  - Coal Thickness, Grade and Gas Content

- **Shale Gas (and oil from Shale)**
  - Total Organic Content (TOC) and content percentage
  - Thermal maturity/vitrinite reflectance
  - Rock properties—e.g. brittleness, permeability/porosity, water saturation
  - Kerogen type
  - Gas sample analyses, (all from core analysis, any available geochem?)
  - Fracture matrices including orientation and density (microseismic mapping)
The Performance Puzzle
Putting it Together

- Well profitability
- Spacing vs EUR
- Horizontal vs Vertical
- Technical Enhancers
- Flow vs Operating Cost
- Pricing

Market

- Fractures - Joints - Cleats
- Rock Properties
- Depth
- Gas Content
- Permeability

Regulations

Fiscal Regimes
Take Aways
Revolution in Unconventional Gas

• Huge increase in shale gas resources & potential supplies transforms North American gas
• Shift from decade of tight supplies to era of under-demand.
  • Good news for energy security and consumers
  • Huge opportunity to facilitate transformation to clean energy
• Operators retool portfolios and operations
  • Focus: high productivity, low cost plays with markets (shales are king!)
  • Continuous process, technology & cost improvements
  • Alliances and partners (A&D)
• Market benefits of abundant, clean gas
  • Power generation – replace coal & complement renewables
  • Transportation fuel – CNG in fleets
Investment and Uncertainty
What is the Role of Natural Gas in the Energy Future?

90402-5
North American Gas Play Performance Analysis
Coming Soon!

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