SLIDES: Industry Growth and Change

Stuart Ellsworth

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Industry Growth and Change

2014 Martz Summer Conference

University of Colorado Law School
Getches-Wilkinson Center for Natural Resources, Energy, and the Environment

June 5, 2014

Stuart Ellsworth, P.E.
Engineering Manager
Industry Growth and Change

What is different today?
What are some issues related to onshore development?
Why should we care?
What is Different Today?
What is Different Today?

Reservoirs
Development Plans (Drilling and Production)
Economics
Conventional vs. Unconventional Resources

Conventional oil and natural gas reservoirs are within geologic formations capable of flow and the internal fluid force allows for flow without other influences.

Unconventional oil and natural gas reservoirs are the exact opposite, meaning they cannot flow without other influences.
Oil and Gas Fields in Colorado

- Mancos
- Niobrara
- Niobrara
- Niobrara
- Tight Sands
- CBM
- CBM

Map showing locations of oil and gas fields in Colorado.
Conventional vs. Unconventional Resources

“Tight” Sands (Piceance Basin, Wattenberg Field)
Coal Bed Methane (CBM: San Juan and Raton Basins)
“Shale” plays (Niobrara and Mancos Formations)

These are self-sourced reservoirs

Drainage: Well spacing and pooling
Development Plans
Development Plans

- Unconventional Resources Plays
- Horizontal Hole & Lateral Length
- Hydraulic Fracturing
  - Multi stage stimulation completions
  - Geomechanic based designs
- Centralized Facilities
  - Multiple wells on a pad
Expert analysis of high-tier log measurements determined that a 10-ft interval, shown in yellow, in the Niobrara B, displayed in green, was the zone of greatest potential production.
GOHFER’s Complete Stress Equation

\[ P_c = \frac{\nu}{(1 - \nu)} \left[ P_{ob} - \alpha_v P_p \right] + \alpha_h P_p + \varepsilon_x E + \sigma_t \]

- \( P_c \) = closure pressure, psi
- \( \nu \) = Poisson’s Ratio
- \( P_{ob} \) = Overburden Pressure
- \( \alpha_v \) = vertical Biot’s poroelastic constant
- \( \alpha_h \) = horizontal Biot’s poroelastic constant
- \( P_p \) = Pore Pressure
- \( \varepsilon_x \) = regional horizontal strain, microstrains
- \( E \) = Young’s Modulus, million psi
- \( \sigma_t \) = regional horizontal tectonic stress

© 2009 Barbee & Associates
Poisson’s ratio, derived from simultaneous seismic inversion, was used in geological modeling to predict gas saturation and to map zones of higher reservoir quality.
Real-time interpretation of high-resolution resistivity images successfully maintained the wellbore within the 10-ft target zone for more than 3,000 ft.
## Colorado Oil and Gas Conservation Commission
### Horizontal Well Activity
#### January 7, 2014

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### 2013 and 2014 Permits and Spuds

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WELL BORE DIAGRAM
PLACE & CEMENT PRODUCTION CASING
Fluid inflow prevented by cement

Per COGCC Rules 317.i, j, & k and verified per Rule 308A
Cement Bond Logs to verify placement of cement

Per COGCC Rule 317.o requires cement bond logs for all wells.
Drilling and Production

Drilling and Completion times
Number of Active Rigs
Number of Drilling Permits
Number of New Drills
TOTAL DRILLING RIGS RUNNING IN COLORADO EVERY OTHER WEEK IN 2003-2014
(Based on Data in: through 4/30/03, PI/Dwights Drilling Wire -- after 4/30/03, Anderson Reports Weekly Rig Status Report)

Natural Gas
Henry Hub Natural Gas Spot Price

Oil
WTI Cushing Crude Oil Spot Price

Source: Bloomberg.
Number of Oil and Gas Well Permits For Wells Drilled Directionally & Horizontally From Common Well Pads in Colorado 01-07-14

Number of Applications For Permits To Drill

- Total APDS
- APDs For Directional Wells From Common Well Pads
- Horizontal


Permit Counts:
- 2000: 1529, 125, 1, 1529
- 2003: 2245, 560, 2245
- 2004: 2917, 890, 2917
- 2005: 4323, 1762, 4323
- 2006: 5904, 5904
- 2007: 6368, 2773, 6368
- 2008: 8027, 8027
- 2009: 5007, 3585, 5007
- 2010: 5159, 4194, 5159
- 2011: 4659, 462, 4659
- 2012: 2778, 878, 2778
- 2013: 3775, 2082, 3775

Legend:
- Blue bars represent Total APDS.
- Red bars represent APDs For Directional Wells From Common Well Pads.
- Green bars represent Horizontal.

Source: Colorado Department of Natural Resources
What are some issues related to onshore development?
What are some issues related to onshore development?

- Increased Regulations
- Public Concerns
- Renewed domestic drilling and production
- Multiple well pads and Centralized facilities
Regulatory Changes

Rule 318A GWA (1998)


Rule Making (2008)

Fracture Treatment Disclosure (2011)

Rule 318A Amendment (2011)

Groundwater Rule Making (2012)

Setback Rule Making (2012)

Spill Reporting Rule Making (2013)
Public Concerns

• Opportunities for mitigation
  ▪ Noise
  ▪ Air emissions
  ▪ Spill containment
  ▪ Traffic
  ▪ Construction Activity
  ▪ Disturbed Areas
Multi-Well Pads
Develop by Vertical or Horizontal Wells? 4 sq. mile area (2560 acres)

Vertical wells - 64 vertical wells on 2 acre pads uses 128 acres of land, about 26 miles of roads, 26 miles of pipelines, plus 4 to 8 facility pads to effectively capture the gas reserves.
Horizontal wells – 16 horiz. wells from 1 pad of 6 acres, with 2 miles of roads, 2 miles of pipeline and one facility on the same pad as the wells.

Horizontal well advantages:
• Less land used & placement choices,
• Fewer roads and pipelines,
• Less traffic,
• Less dust,
• Less urban & wildlife disturbance,
• Less air pollution.
• All wells penetrate the ground in the same area – can be easily monitored

Illustration retrieved from: Independent Oil and Gas Association of Pennsylvania’s Drilling & Developing the Marcellus Shale
Economics

- Budgets
  - DJ Basin Niobrara 2013 - $4 billion
- Production
  - Rose to a 50 year high for oil production
Gas: -3.6% (DJ Basin: +6.7%)
Oil: +18.9% (DJ Basin Oil: +26.3%)
Why Should We Care?
Why Should We Care?

• Natural gas has reduced emissions
  EPA Quad-O and CDPHE regulation of fugitive emission.
  Power plants and vehicle conversions to NG/CNG/LNG

• Manufacturing use of natural gas
  US Steel is converting steel plants to natural gas.
  Long term contracts for natural gas.

• Taxes
  Severance Tax -
  Ad Valorem Tax - County tax on production
    Weld County (8%) -
    Garfield County (7%) -
Exxon Bets Big on Gas With Deal For XTO
By RUSSELL GOLD
Updated Dec. 15, 2009 12:32 p.m. ET
Exxon Mobil Corp. placed a $31 billion bet that natural gas will play a critical role in the world’s future energy needs, saying it would purchase XTO Energy Inc. in an all-stock

Colorado land board OKs ConocoPhillips deal on Lowry Range
Xcel lays out natural-gas conversion plan for metro area
By Drew FitzGerald The Denver Post The Denver Post
Posted:

Xcel Energy plans to spend $1.3 billion over 12 years to convert Denver-area power plants from coal to natural gas to meet a state mandate to reduce pollution around the Front Range.

Shale-Gas Revolution Spurs Wave of New U.S. Steel Plants: Energy
By Sonja Elquist - Dec 31, 2012
The U.S. shale-gas revolution, which has revitalized chemicals companies and prompted talk of domestic energy self-sufficiency, is attracting a wave of investment that may revive profits in the steel industry.

Austrian steelmaker Voestalpine AG (VOE) said Dec. 19 it may construct steel plants using cheap gas. Nucor Corp. (NUE), the most valuable U.S. steelmaker, plans to build among at least five U.S. plants under consideration or being built that use natural gas to make steel.

Colorado gets $30M for more natural gas vehicles, fueling stations
Colorado's oil and gas boom could spill into construction sector
2012 Industry Economic and Fiscal Contributions in Colorado

Direct and Related Value from oil and gas activities: $13.7 Billion

Production Value $9.3 Billion on 29,300 direct jobs:
(average salary: $101,000)

Additional related jobs: $3.8 Billion on 51,200 (average salary: $74,800)

Private land owner (royalty and lease terms): $614 million

Public Revenues from oil and gas activities: $1.6 Billion

Severance Taxes, public leases/royalty: $1.0 Billion

From University of Colorado Boulder Leeds School of Business
Weld County Revenue

HOW OIL & GAS CONTRIBUTES TO WELD COUNTY REVENUE

2003
- Revenue: 82%
- Percentage of Revenue from Oil and Gas: 18%

2012
- Revenue: 66%
- Percentage of Revenue from Oil and Gas: 34%

4/30/13 Weld County Press Release
Breakdown of distribution from Anadarko tax payment:

- School Districts: 41%
- County: 23.77%
- Special Districts: 9.11%
- Fire Protection Districts: 8.51%
- Cities and Towns: 7.78%
- Junior Colleges: 7.47%
- Water Districts: 2.02%
- Water and Sanitation Districts: 0.18%
- Soil Districts: 0.16%
Industry Growth and Change

• What is different today?
  Unconventional Resources Plays

• What are some issues related to onshore development?
  Reducing and managing the impacts

• Why should we care?
  We can all benefit
Visit Us On the Web

colorado.gov/cogcc