Shale Gas Plays

Inevitable Updates

Bureau of Economic Geology
University of Texas at Austin
Acknowledgements and Disclosures

- Alfred P. Sloan Foundation
- IHS and DrillingInfo
- EIA
- BHP, ExxonMobil, Southwestern Energy, Devon, Range Resources, Cimarex, Carrizo for discussions

Potential conflicts of interest have been fully disclosed: see BEG website

Publications and Press:
- Several peer-reviewed journal articles – see BEG website
- Oil and Gas Journal Articles – Barnett and Fayetteville
- Mainstream Media including NPR, WSJ and many others
Interdisciplinary approach

**Geologic Analysis**
Results: geologic characteristics per mi2, incl. OGIP map

**Decline Analysis**
Results: Well declines, incl. expected recovery (EURs)

**Productivity Analysis**
Results: Productivity functions and expected productivity “tier” map, inventory of future wells.

**Well Economics**
Results by tier:
Breakeven prices and profitability index as a function of completion

**Production Outlook**
Results by tier: Pace of drilling with respect to economic, technical, policy assumptions
State-of-art

- BEG outlooks have done well so far
- But some of the observed changes in producer behavior are not covered by the models
- We get access to more data
- We keep learning from every new play
- => Need to enhance our approaches
Barnett Shale: Price sensitivity

Total: 44-47 Tcf

Tcf/ year

0
0.5
1
1.5
2
2.5

2005 2010 2015 2020 2025 2030 2035 2040 2045

$6 HH
$4 HH
$3 HH
EIA AEO14

Tcf/year
How to treat Resource composition that affects economics
Fayetteville: Price sensitivity

Total: 14-20 Tcf
Fayetteville Shale

How to account for
• Desorbed gas that matters for resource and future production
• Natural fractures and faults determining recoverable resource
Haynesville Shale: Most expensive

Total: 36-57 Tcf
How to capture

- Pressure gradient (extreme values lead to dynamic permeability)
- Clay effect
- Potential contributions from adjacent formations
Need for Updates

- Improved geologic knowledge
- Updates in decline analysis
- Revised analysis of productivity drivers (structural changes)
- Changes in well economics: cost structure and finances
- Production incentives w.r.t. new constraints
GEOLOGIC UPDATES:

1. Improved granularity (on characterization)
2. Better understanding (of data and features)
3. Knowledge expansion (reinterpretation of existing and usage of new data)
Marcellus Play Boundary

- ~46,000 square miles
- Minimum depth 2000’
- Minimum thickness 30’
- Outcrop +5 miles
- Maximum thermal maturity 3.5% Ro
Summary

- Heterogeneity across plays makes us learn more about shale geology
- New data and technological advances lead to continuous updates
- Expansion of drilling activity changes uncertainties
- Changes in economic environment translate into improved granularity
WELL PRODUCTIVITY, RECOVERY, TECHNOLOGY, AND STRATEGY:

1. Improved granularity (on characterization)
2. Better understanding (of data and features)
3. Knowledge expansion (reinterpretation of existing and usage of new data)
Decline Analysis

- Production decline is a function of geological rock properties;
- Expected production, however, is a function of completion design, geologic and company parameters.

=> Standard well approach, or well normalization, cannot be used

=> Technology and economics determine the productivity along with geology
OGIP vs. EUR Correlation

Need to understand production variability and reduce uncertainty
New Strategies

- Drilling and completion strategies determine number of future well locations
- Knowledge accumulation, resource exhaustion, and unfavorable economic result in diversity drilling and completion techniques

Infill drilling and cluster drilling can result in a substantial increase in future individual well and play recovery!
Completions and Experience matter

The diagram illustrates the average well EUR (Bcf) for a given region, comparing preferred completion against standardized wells. It shows a distribution across different economic regions, highlighting the importance of completions and experience in determining well performance.
WELL ECONOMICS AND PLAY OUTLOOK:

1. Models expand to account for new trends and practices
2. Outlooks improve when tested parameters are well defined and mutually consistent
Inventory w.r.t. Producers’ Decisions

- Number of locations & productivity depend on completions (HF water, spacing)
- Completion choice depends on the market environment and technology
Conclusion

- Changes in any aspect of play description leads to a review of all the parts of the analysis
- The outlooks results keep changing with:
  - Price (NG/NGL/WTI),
  - Basis differential/Infrastructure,
  - Costs & Technology improvement;
  - Regulatory framework.
- But resource in place may not be fully known yet.