Risk and Uncertainty in US Gas

by

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U.S. Natural Gas Turmoil

Graph showing the trend in Gas Rigs and HH $/bbl from June 2006 to June 2016.
Despite the low natural gas prices, production continues to grow in many regions:

- **Technology**
- **Economies of Scale**
- **Decreased costs (partly thanks to low oil prices)**
**BEG: 3DRP Study**

Gas-In-Place 3300 Tcf
Recoverable 15-35%
Demand '16 27 Tcf
Demand '06 22 Tcf
- Total HZ wells drilled
  ~ 90,000
- Possible future drilling
  ~ 500,000
  + >1,000,000 in Permian
New Completion Strategies

- Established drilling patterns change with technological advances and new economic realm.
- New drilling and completion techniques affect the cost and recovery reshaping the supply capabilities and supply elasticities.

Ikonnikova et al., 2016
Change in Productivity and Profitability:

Change in well lateral length over time.
Focus on the Giant: over **2,000 Tcf** in-Place, about **45 Tcf** to be extracted by existing wells
~145,000 locations in PA & VW

Marcellus Shale - Drilled Area

Stratigraphy of Pennsylvania

Northwestern PA
- Rhinestreet Shale
- Cashqua Shale
- Tully Limestone
- Mahantango Shale
- Marcellus Shale
- Onondaga Limestone

Southwestern PA - Central PA
- Rhinestreet Shale
- Cashqua Shale
- Middlesex Shale
- Penn Yan Shale
- Burket Shale
- Tully Limestone
- Mahantango Shale
- Marcellus Shale
- Onondaga Limestone

Central PA - Northeast PA
- Cashqua Shale
- Penn Yan Shale
- Burket / Genesee Shale
- Tully Limestone
- Mahantango Shale
- Marcellus Shale
- Onondaga Limestone
Historical Maximums
Profitability and Supply Capability Change with Prices, Costs and Technology
Drilling and supply depend on:

- **Expected profitability of a well**
  - Energy prices (natural gas, gas liquids, and oil),
  - Drilling and Completion Cost (change with prices, technology, efficiency),
  - Regulation (fiscal, environmental) and Infrastructure,
  - Expected well production / resource recovery, which changes with technology,
  - **Uncertainty and Expectations**
3DRP Study: Projections for Different Prices

We need to look *beyond prices* and talk about ACTIONS, REACTIONS, INCENTIVES and ADJUSTMENTS

- **All plays $4/MMBtu**
- **Marcellus $3/MMBtu**
- **Hville $3/MMBtu**
- **Fville $3/MMBtu**
- **Barnett $3/MMBtu**
- **All plays EIA prices**
Summary

- The resource is there but geologic and reservoir characteristics vary dramatically: technology and economics help expand production capabilities.
- The U.S shale (oil and gas) plays will continue their development even in the low price environment: positive price signals can bring production to a new level if infrastructure is ready.
- The BEG production outlook model highlights the importance of resource, technology, prices, operator expectations, financial capacity, infrastructure, and other resources.