Unconventional Oil and Gas

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Presentation Outline

• Unconventional oil and gas development activity in the US

• Trends and observations

• Potential and issues of major basins
Historical Rig Activity in the United States
Impact of Horizontal Drilling – Wells Drilled from 2000 to 2014

- Cumulative production for Pre-2015 oil wells: 4.8 billion barrels of oil (BBO), 9.0 trillion cubic feet (TCF) of gas
- Estimated ultimate recovery (EUR): ~9 BBO, ~15 TCF

- Cumulative production for these gas wells: 70 TCF, 0.7 BBO
- Estimated ultimate recovery: ~150 TCF, ~1.4 BBO
Well Performance Trends Normalized by Lateral Length

- **Proppant (Lb/ft)**
- **Completion Year**
- **Lateral Length (ft)**

**Geographical Areas**:
- Delaware
- Eagle Ford
- Midland
- Williston

**Regions**:
- Utica
- Marcellus
- D-J
- SCOOP/STACK
- Haynesville

**1st Year Cumulative Oil / Lateral Length (BO/ft)**
Well Spacing and Improving Completions

Excerpts from RSP Permian 2Q17 Investor Presentation

Excerpt from Goodrich 2017 Investor Presentation

Microseismic Case Study: Confirming Near-Wellbore Stimulation

Excerpts from RSP Permian 2Q17 Investor Presentation

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Well Spacing - Eagle Ford Well Density Map

1 section = 640 acres
(1 sq. mile)
Well Spacing - Bakken and Three Forks Well Density Maps

1 section = 640 acres (1 sq. mile)

June 2018
11,816 completed wells
34 rigs

June 2018
4,299 completed wells
16 rigs

6 wells/section (~880 ft. spacing between laterals)
Well Spacing - Haynesville Well Density Map

June 2018
3,849 completed wells
38 rigs

5 wells/section (~1,050 ft. spacing between laterals)

1 section = 640 acres (1 sq. mile)
Well Spacing – Midland Basin Well Density Maps

1,116 SPBY PDP
+586 PDP

1,617 WCA PDP
+727 PDP

2,761 WCB PDP
+860 PDP

Blue areas are developed at 4 or greater wells per section in landing zone mapped.

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Impact of Well Density on Performance

- Increased well density eventually results in interference and decreased well performance for subsequent wells.
- Performance for widely spaced initial wells may not be representative of future full-development performance.

1 section = 640 acres (1 sq. mile)
Unconventional Well Development Patterns

- Well spacing in map view is not the only spacing issue to consider
- Plays in US have multiple productive intervals and consideration should be given to the 3D aspects of the development patterns
Operators plan to optimize development economics

Economics dependent on price outlook, well spacing, interference and potential of loss opportunity is not downspaced early.
Summary

• Each play and horizon within each play has its own unique characteristics.

• Still improving completion techniques and drilling longer laterals, but...

• Still in early to mid-stages of development in most active basins.

• Many operators seeing necessity of changing completion designs to match with well spacing plans

• Development potential dependent on many variables, including:
  • Ultimate well spacing
  • Price Outlook
  • Economics
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