What Could Derail North American Natural Gas and Oil Development

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Topics

- Convergence of Technology Opens the Door to the Resource Play
  - Hydraulic Fracturing
  - Deep Horizontal Drilling
  - Multi-well Pad Sites

- Development Recommendations
  - National Petroleum Council (NPC) Report
  - Secretary of Energy Advisory Board (SEAB)
  - Industry Response thus Far

- Future State
Resource Play Opportunities

Lower 48 states shale plays

- Bakken
- Woodford
- Fayetteville
- Haynesville-Bossier
- Appalachian Basin
- Devonian Ohio Marcellus

Shale plays
- Current plays
- Prospective plays

Stacked plays
- Shallowest/youngest
- Intermediate depth/age
- Tight dolostone/carbonate

Basins
- Mixed shale & chalk play
- Mixed shale & limestone play
- Mixed shale & tight dolostone/carbonate

Miles

0 100 200 300 400
U.S. Onshore Drilling Activity

Onshore Rig Count

Source: Baker Hughes, Inc.
U.S. Onshore Drilling Activity

Onshore Footage Drilled & Well Count

Source: Spears and Associates, Inc.
## Comparison – 2010 vs 2013

<table>
<thead>
<tr>
<th>Category</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Oil Production</td>
<td>+40%</td>
</tr>
<tr>
<td>Natural Gas Production</td>
<td>+13%</td>
</tr>
<tr>
<td>Rig Count</td>
<td>+4%</td>
</tr>
<tr>
<td>Well Count</td>
<td>+20%</td>
</tr>
<tr>
<td>Footage per Well</td>
<td>+40%</td>
</tr>
</tbody>
</table>

Production Source: EIA
Rig Count Source: Baker Hughes
Anadarko Eagleford Quarterly Drilling Achievements

Last 3 years
- Drilling Days: -40%
- Footage/Day: +81%
- Wells Drilled/Qtr: +133%

Wells Drilled
Footage/Day
Average Drilling Days
Rig Count

[Graph showing drilling achievements over time with specific metrics and trends marked.]
The Major Issues

- Regulation – Enough too keep pace?
- Frac fluids – What’s in this stuff and why won’t you tell everyone?
- Water use – quantities, water quality, consumptive use, recycling.
- Aquifer contamination – disturbance of nearby water wells, gas migration, chemical flowback, leakage.
- Surface impacts – road wear and tear, trucks through neighborhoods, noise.
- Air emissions – GHG, HAPs (BTEX), Conventional Pollutants.
NPC Recommendation

NPC Prudent Development Report (September 15, 2011)
Recommendation:

Support Prudent Development

• Establish Regional Councils of Excellence to share effective environmental, health, and safety practices.

• Adopt policies for more effective regulation of natural gas and oil production and operations

• Commit to and carry out community engagement

• Measure and reduce methane emissions

• By supporting prudent development, provide access to resources
SEAB Recommendation

SEAB Report (August 11, 2011):

Organization for best operating practices:

A more systemic approach by the shale gas industry based on best practices—recognized as improvements to techniques and methods over time based on measurement and field experience—is an important way to achieve better operational and environmental outcomes, the report finds.

The report envisions the creation of a national organization, with external stakeholders, dedicated to continuous improvement of best practice through the development and diffusion of standards and the assessment of member compliance. The organization would likely work through regional subgroups.
Industry Response Thus Far

- **Appalachia**
  - Marcellus Shale Coalition (MSC) - adopted guidelines.
  - Appalachian Shale Recommended Practices Group (ASRPG)
  - Center for Sustainable Shale Gas Development (CSSD)

- **Colorado**
  - Responsible Operator Council (ROC) - Colorado

- **Eagleford Shale**
  - Eagle Ford Task Force
  - South Texas Energy and Economic Roundtable (STEER)

- **Bakken**
  - Bakken Production Optimization Program.
Industry Response Thus Far (Continued)

- Offshore
  - Center for Offshore Safety (COS)

- Oil Sands
  - Canadian Oil Sands Innovation Alliance
Sustainable Shale Gas Growth Zones

- Found in fact-sheet released as part of State of the Union Address
- Help regions with technical assistance and regional planning so they can withstand “boom-bust" cycles
- More details in the coming weeks or months
Attributes of a Successful Center of Excellence

- Identification of Best Practices
  - Update appropriately

- Engagement

- Dissemination of Best Practices
  - All regional producers
  - Community
  - Regulators
  - STRONGER
  - IOGCC

- Not an Advocacy Organization
“The nation can realize the benefits of the larger resources by ensuring they are developed and delivered in a safe, responsible, and environmentally acceptable manner in all circumstances”

- Prudent Development Report, 2011