“Replicating North American Shale Success in China: Regulatory and Commercial Issues and Opportunities”

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The Unconventional Resource Story

- Current U.S. Story: Unconventional Resources
- Then And Now: An Energy Revolution
- Current Results and Benefits
- Facilitating the Shale Gas Revolution in China
- Basis for China Success: Regulatory, Data, and Commercial
- A Shared Vision
**Then and Now: An Energy Revolution of Enormous Scale**

<table>
<thead>
<tr>
<th>Year 2000 Beliefs</th>
<th>Year 2014 Realities</th>
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</thead>
<tbody>
<tr>
<td>The U.S. is running out of natural gas</td>
<td>The U.S. has over a 100-year supply of natural gas</td>
</tr>
<tr>
<td>U.S. oil production peaked in 1970, has fallen ever since, and will continue to do so</td>
<td>U.S. oil production growing rapidly, with no end to growth in sight</td>
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<tr>
<td>Manufacturing going abroad</td>
<td>Job creation and growth</td>
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<tr>
<td>Global resource scarcity</td>
<td>Global resource abundance</td>
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The Gas Side of the Revolution

U.S. Natural Gas Production (bcf per day)

Production Data Source: U.S. Department of Energy, Energy Information Administration (EIA)
The Shale Gas Revolution Has Spread to "Tight Oil"

U.S. Oil, Condensate and Natural Gas Liquids (NGL) Production

"Peak Oil"

NGLs

Alaska crude

Lower 48 crude

Source: U.S. Department of Energy, EIA, Annual Energy Review 2013, Table 5.1b
Benefits From Unconventional Development

**Economic**

**U.S. Jobs and GDP**
- Driving Growth

**Chemicals & Manufacturing**

**Energy Security**

**U.S. Net Energy Imports**

**Environmental**

**U.S. CO₂ Emissions (MTPA)**

Other Benefits of Natural Gas:
- Clean-burning
- Small water usage footprint
- No solid waste
- Enables wind & solar power

Source = U.S. EIA, From Total Energy
Summary From U.S. Experience

- Unconventionals have opened up an energy revolution in the U.S.
- Resulted in huge benefits to the American economy
- A very different exploration process was needed to make unconventional resources successful
- Large adjustments in policy and regulatory structures were needed to make it work
Adaptability: COP’s Eagle Ford Experience

- 37% reduction in drilling days
- 40% reduction in completion unit cost
- 75% of 2014 wells benefit from pad drilling
- Leveraging size to realize contract savings
- Testing new drilling/completion technologies

Drilling Cost Efficiency

<table>
<thead>
<tr>
<th>Year</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
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<tbody>
<tr>
<td>Cost</td>
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Completion Cost Efficiency

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</table>

1. Comparison to 2010 average days spud to spud.
2. Comparison to 2010 average completion cost per unit of proppant.
"It's not the strongest species that survive, nor the most intelligent, but the most responsive to change".

-Charles Darwin On the Origin of Species 1859

- Can the North American success be replicated in China?
- Regulatory commercial hurdles and possible solutions
- Potential benefits to China of a shale gas revolution
- Basis for success:
  - Regulatory: Flexible and adaptable
  - Data: Greater data availability
  - Markets: Market access
Overall Development Program

- Designed for fully appraised, conventional fields
- Identifies development plan, facility design, technology, well spacing, cost estimates, etc
- Compliance document

Other documents require modification

- Environmental Impact Assessment
- Shale Gas Resource Assessment

Needed: Aligned government approval documents and processes with adaptive approach to unconventional resources
- The “Rolling ODP”
Critical development decisions include
- Well length
- Completion design
- Well spacing (vertical and horizontal)

Experiments can accelerate learning

Learning from the experiences of other operators
- Data in public domain
- Data trades

Quick decisions and implementation
Regulatory: Production Sharing Contract Structure

- Chinese PSC has been a successful model for over 30 years
- Assuring the PSC structure aligns with the realities of shale
  - Assuring key definitions are aligned with government statements
  - Governance, decision-making and adaptability
  - Relinquishment aligned with unconventional resource development
  - Government incentives flow to all investors
- Current Chinese PSC clauses exist to address many of these issues
Data access in China

- Access to existing data critical to North America’s Shale Gas Revolution
  - Investors could place educated bets
  - Most states require submittal of certain data to the public domain

- Chinese data currently held tightly by NOCs or as state secrets
  - Obtaining approvals for release of data has been time consuming
  - Transferring data from China to use at global centers is challenging

- Liberalizing access and usage of data will accelerate learning and application of technology
Markets: Gas Commercialization Principles

- Pricing reform and access to transparent pricing
  - Central Government Incremental City Gate Pricing now being published
  - Level playing field for gas producers

- Transportation access at fair and reasonable tariff structures
  - Restructuring pipeline ownership rules
  - Establishment of access rights for third parties
  - Establishment of a pipeline regulator

- Building similar market access issues for gas producers in China as experienced by Chinese investors in North America
Shale Gas in China: A Shared Vision

- Abundant supplies of clean energy to China
  - Accelerating the advent of the shale gas revolution in China
  - Increasing gas supplies while lowering costs

- Benefits to the Chinese People
  - **Economic**: More tax revenues and jobs
  - **Energy Security**: Home grown energy supplies and infrastructure
  - **Environmental** "Clean energy for crowded places":

- A shared vision of adaptation and evolution
  - Continuously apply global technology and operational breakthroughs
  - Cooperation for a more adaptive and effective regulatory system
  - Sharing existing expertise and knowledge
Thank You!

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