

"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





The U.S. Story: Lower 48 Unconventional Reservoirs



Source: Energy Information Administration based on data from various published studies. Updated: May 9, 2011



Then and Now: An Energy Revolution of Enormous Scale

Year 2000 Beliefs

- The U.S. is running out of natural gas
- U.S. oil production peaked in 1970, has fallen ever since, and will continue to do so
- Manufacturing going abroad
- Global resource scarcity

Year 2014 Realities

- The U.S. has over a 100-year supply of natural gas
- U.S. oil production growing rapidly, with no end to growth in sight
- Job creation and growth
- Global resource abundance



The Gas Side of the Revolution



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

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

Benefits From Unconventional Development





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





Completion Cost Efficiency²

²Comparison to 2010 average completion cost per unit of proppant.

Facilitating China's Unconventional Resource Development

"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



Regulatory: Overall Development Program (ODP)

- 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"





Regulatory: Optimizing the Development Program

- Critical development decisions include
 - Well length
 - Completion design
 - Well spacing (vertical <u>and</u> horizontal)
- Experiments can accelerate learning
- Learning from the experiences of other operators
 - Data in public domain
 - Data trades
- Quick decisions and implementation



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Regulatory: Production Sharing Contract Structure

非常规 Fei Chang Gui Unconventional 非常贵 Fei Chang Gui Very Expensive

- 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: 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 expertize and knowledge







Thank You!

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