Practice and Challenges: Unconventional Natural Gas Development in China

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OUTLINE

I. Natural Gas Demand/Supply Outlook
II. Unconventional Gas Development: Status
III. Unconventional Gas Development: Accomplishments
IV. Unconventional Gas Development: Challenges
V. Looking to the Future
Natural Gas Demand/Supply Outlook in China

- Annual growth rate 2000-2010: 15.9%
- 8.5% > oil consumption, 5.5% > coal consumption
- Portion of China’s energy consumption: 2.4% in 2000, 4% in 2010
- Consumption: 2015 = 235 BCM, 2.2 × 2010

Natural gas consumption area:
- Surrounding areas of oil/gas fields → central and eastern China
- 2009: portion of gas consumption (Yangtze River Delta, Pan Bohai Bay and Southeast coastal area) > 40%
- End of 2009: 30 provinces, municipalities and autonomous regions
- 2020: gas demand (Yangtze River Delta, Bohai Bay, Pearl River Delta and MiddleSouth Area) > 70%
Natural Gas Demand/Supply Outlook in China

China's Gas Market Development Stages:

- **START-UP** (1949-2004)
  - Gas consumption: explosive growth
  - Consumer Structure: diversification
  - Demand area: surrounding gas field to east
  - Consuming mode: supply driven → demand driven

- **DEVELOPMENT** (2005-2030)
  - WEST TO EAST
  - Gasified Rate > 50%

- **MATURITY** (>2030)

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**Natural Gas Demand/Supply Outlook in China**

Gas supply:
- 2010: 100BCM  
- 2015: 160BCM

Gas output:
- 2020: 220BCM

Unconventional gas:
- 2020: 62BCM = 30% of total
Drivers for Unconventional Natural Gas Development

- Alleviate dependence on international sources
  Dependence on international gas sources:
  2015 ≈ 25%,
  2020 ≈ 30 - 40%

- Optimize energy structure

- Environmental protection
  Target of controlling CO₂ emissions 2005 - 2020:
  Reduce CO₂ emissions 40 - 45% per unit of GDP

Unconventional Gas Development: Status

Three major kinds of unconventional gas resources

- **Tight sandstone gas**: entered stage of scale, industrial & commercial development & utilization
- **CBM**: initial stage of exploration and development
- **Shale gas**: exploratory stage of development and utilization and has no reserves

- **Gas hydrate**: exploratory stage of investigation and evaluation and has no reserves
Distribution of Unconventional Gas in Main Onshore Basins

Tight sandstone gas:
- Distribution: Sichuan, Ordos, Songliao, Pan Bohai Bay, Tarim and Junggar
- Resource $\approx 12$ TCM (conservative data: 10 TCM)

CBM:
- Distribution: Shanxi, Shaanxi and Liaoning
- Proved geological reserves $\approx 290$ BCM
- Recoverable reserves $\approx 144$ BCM

Shale gas:
- Distribution: all basins
- Reserve: no data

Unconventional Gas Development:
Accomplishments

1. HISTORICAL FOREIGN COOPERATION AND EXCHANGES

CBM PROJECTS (CNPC):

<table>
<thead>
<tr>
<th>No.</th>
<th>Foreign Contractor</th>
<th>Contract Term (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chevron / BHP Billiton</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>Asia-Pacific Petroleum Ltd.</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Chevron/SINO Gas &amp; Energy</td>
<td>35</td>
</tr>
<tr>
<td>4</td>
<td>Orion Energy</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>Shell (China) Limited / Verona Development Corporation</td>
<td>30</td>
</tr>
<tr>
<td>6</td>
<td>REFLECTION Oil &amp; Gas Partners Ltd.</td>
<td>30</td>
</tr>
<tr>
<td>7</td>
<td>Longmen Huicheng Investment Ltd.</td>
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</tr>
<tr>
<td>8</td>
<td>Far East Energy Corporation</td>
<td>30</td>
</tr>
<tr>
<td>9</td>
<td>Asian American Gas, Inc.</td>
<td>30</td>
</tr>
<tr>
<td>11</td>
<td>TerraWest Energy Corp.</td>
<td>30</td>
</tr>
</tbody>
</table>
Unconventional Gas Development: Accomplishments

SHALE GAS PROJECTS:

2007: Joint studies between CNPC and Newfield Exploration Company.


2009-2010: CNPC, Sinopec and other Chinese companies signed agreements for cooperative development of shale gas in China with Shell, ConocoPhillips, ExxonMobil and other international companies.

2011: Ministry of Land and Resource held first license round. Second round by the end of the year.

2. RESERVOIR /GEOLOGY/TECHNOLOGY/EQUIPMENT

- Understand reservoirs and determine geological features
- Develop appropriate & special technologies
- Promote equipment logistics and reduce costs
3. PERSONNEL/MANAGEMENT

- Personnel training: develop natural gas talent base & engineering service team
- Project management: harmony management model

4. PLANNING /POLICY SUPPORT

The “12th Five-Year” Plan for clean energy:
- Intensify exploration and development of oil and gas resources
- Stabilize domestic oil output
- Promote fast growth of the output of natural gas
- Push on development and utilization of CBM, shale gas and other unconventional oil and gas resources
4. PLANNING/POLICY SUPPORT

The “12th Five-Year” Plan for shale gas reserves and output for 2015:

- Proved geological reserves = 600BCM
- Proved recoverable reserves = 200BCM
- Output = 6.5 BCM

Key points:
- Ascertain shale gas resource potential
- Increase efforts in scientific research and tackling of key technical problems
- Formulate policies for shale gas industry
- Clarify access threshold and standard of the industry
- Increase policy support

Goal of “12th Five-Year” Plan for CBM for 2015:

- Cumulative proved geological reserves = 500BCM
- Surface development will reach 10-15BCM
- Underground drainage = 10-15BCM
## Unconventional Gas Development: Accomplishments

### CBM POLICY SUPPORT

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax Preference</td>
<td>Ministry of Finance &amp; General Administration of Customs &amp; State Administration of Taxation, No.13 [2006]</td>
</tr>
<tr>
<td></td>
<td>Ministry of Finance &amp; State Administration of Taxation, No.16 [2007]</td>
</tr>
<tr>
<td>Development Subsidies</td>
<td>Department of Economic Construction of Ministry of Finance, No.114 [2007]</td>
</tr>
<tr>
<td>Resource Management</td>
<td>Ministry of Finance &amp; State Administration of Taxation, No.16 [2007]</td>
</tr>
</tbody>
</table>

### Unconventional Gas Development: Accomplishments

#### 5. RESPONSIBILITIES/OBLIGATIONS

**Natural Gas Production Forecast in 2010-2030**

- **Local company**: 988 BCM in 2010, 1725 BCM in 2015, 2380 BCM in 2020, 3100 BCM in 2030
- **CNODC**: 188 BCM in 2010, 325 BCM in 2015, 450 BCM in 2020, 310 BCM in 2030
- **Sinopec**: 180 BCM in 2010, 230 BCM in 2015, 315 BCM in 2020, 370 BCM in 2030
- **CNPC**: 725 BCM in 2010, 1185 BCM in 2015, 1510 BCM in 2020, 1980 BCM in 2030
### 1. TECHNOLOGY/EQUIPMENT

#### Comparison of CBM technology: China → Australia

<table>
<thead>
<tr>
<th>Content</th>
<th>China</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development time/year</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td>Exploration well/development well</td>
<td>3:1</td>
<td>1:1</td>
</tr>
<tr>
<td>Production per vertical well</td>
<td>2,000m³/day</td>
<td>5,000m³/day</td>
</tr>
<tr>
<td>2000m horizontal section of a horizontal well</td>
<td>5,000m³/day</td>
<td>12,000m³/day</td>
</tr>
<tr>
<td>Main completion type</td>
<td>Fracturing</td>
<td>Shaped well, cavity, sand packing, fracturing and gas injection</td>
</tr>
<tr>
<td></td>
<td>Multilateral well</td>
<td></td>
</tr>
</tbody>
</table>

### 2. RESOURCE/MARKET

- Resource in west / Market in coastal region
Unconventional Gas Development: Challenges

3. PRICE/POLICY/BEHAVIOR/REGULATIONS/STANDARD

- Market-oriented pricing
- Preferential policies

<table>
<thead>
<tr>
<th>Law</th>
<th>Mineral Resources Law</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulations</td>
<td>Measures for Area Registration Administration of Mineral Resources Exploration and Survey</td>
</tr>
<tr>
<td></td>
<td>Measures for Registration Administration of Mineral Resources Exploitation</td>
</tr>
<tr>
<td></td>
<td>Measures for Administration of Transfer of Mineral Exploration Rights and Mining Rights</td>
</tr>
<tr>
<td></td>
<td>Regulations on Exploitation of On-Shore Petroleum Resources Concerning the PRC and Foreign Countries</td>
</tr>
<tr>
<td>Rules</td>
<td>Interim Provisions for Exploratory Development and Management of Coal-Bed Gas</td>
</tr>
</tbody>
</table>

4. MANAGEMENT/SUPERVISION

- Management of shale gas ore lacks legal basis
- Relation with conventional gas needs clarification
- Approval & registration systems need to be specified
- Engineering service market is opening and greater opportunities for participation should be encouraged
- Supervision of exploration and development is still in its formative stage
Looking to the Future

- Unconventional gas will play an important role in: providing the energy supply, meeting demand, as well as solving the energy crisis.
- Natural gas consumption will have a larger proportion in China & greater market opportunities.
- In China, large-scale development of unconventional gas is imperative and inevitable.
- China is expected to become a pioneer in development of unconventional gas in Asia.
- Strengthening cooperation and sharing technology and experience is the only road to open unconventional gas development in the world.
- Embracing openness, China will strongly welcome foreign organizations, enterprises and other parties to carry out exchanges and cooperation, working together to promote gas development.

THANK YOU!