Shale gas development challenges and policy implications

Dr. Navinda De Silva
PDRA, IEPI
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UCL Australia

- UCL Australia, IEPI, Mullard space science laboratory
- The UCL team consists of multi disciplinary academics in Economics, Law, Engineering and social sciences
- At IEPI, we are conducting a study on the Australian potential to replicate the shale gas success in the US
- Mullard space science laboratory to initiate a pilot project on Hyper spectral remote sensing of hydrocarbons
- We have a specific cluster for research based on unconventional gas development, master and PhD students are also involved
- MSc and PhD students are mainly from the industry
- Our Academic strategy is to have a close association with the industry, governments and the community
### How shale gas revolution evolved in the US?

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>US</th>
<th>AUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Favourable geology</td>
<td>Yes</td>
<td>Yes?</td>
</tr>
<tr>
<td>Lots of drill core data to help identify “Sweet spots”</td>
<td>Yes</td>
<td>Depends on the basin</td>
</tr>
<tr>
<td>Weak environmental regulation for fracking</td>
<td>Yes</td>
<td>Depends on the state</td>
</tr>
<tr>
<td>Tax credits + Intangible drilling cost expensing</td>
<td>Yes</td>
<td>Yes?</td>
</tr>
<tr>
<td>Property rights to the landowner</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Pipeline access very easy – large network + common carriage</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dynamic and competitive service industry</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Population familiar with oil and gas operations</td>
<td>Yes</td>
<td>Depends on the state</td>
</tr>
<tr>
<td>Licensing large areas with vague work programs</td>
<td>Yes</td>
<td>Depends on the state</td>
</tr>
<tr>
<td>Significant government investment in basic R &amp; D</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Much of the shale gas has high liquids content</td>
<td>Yes</td>
<td>Depends on the basin</td>
</tr>
<tr>
<td>Higher gas prices and demand</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Investment on infrastructure</td>
<td>Yes</td>
<td>?</td>
</tr>
</tbody>
</table>
## Development costs

<table>
<thead>
<tr>
<th>US fiscal regime</th>
<th>Australian fiscal regime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Royalty (12.5% - 30%) – Private owner Based on value of petroleum</td>
<td>Royalty (10% - 12.5%) – State revenue May be credited against PRRT</td>
</tr>
<tr>
<td>Income tax EBIT *35% + EBIT *5%</td>
<td>Income tax Earnings before interest and tax *30%</td>
</tr>
<tr>
<td>Severance tax Up to 5% of revenue</td>
<td>Petroleum resource rent tax (PRRT) PRRT Taxable profit * 40%</td>
</tr>
<tr>
<td>Leasehold costs $5,000 per acre</td>
<td>Land lease costs (State) + Native lands Up to 1-2% of revenue</td>
</tr>
<tr>
<td>Depreciation Drilling and lease costs</td>
<td>Depreciation Diminishing value or Prime cost</td>
</tr>
<tr>
<td>Drilling and completion costs $3.5 to $7.0 M per well</td>
<td>Drilling and completion costs $12 -16 M per well</td>
</tr>
<tr>
<td>Operating costs $0.50 to $1.00/MMBtu</td>
<td>Operating costs $1.00/MMBtu</td>
</tr>
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</table>

In the Cooper basin, Shale gas development cost ranges from $6-10 per MMBtu
Pipeline / Infrastructure Access

Australia (25,000 km)  United States (350,000 km)

Common carriage / Contract carriage

- The pipeline network development is vital for the shale gas industry. However, in the Australian context, execution of common carriage will deter investment in pipelines
- Other infrastructure such as collector pipelines and processing plant access sharing will be important
Service industry

- Lack of skilled personnel
- Drilling capacity (Australia: 50 rigs US: 1681 rigs)
- Australian hydro fracturing capacity is less than 1%

The challenges of acquiring essential source materials

- Water (10 Mi – 20 Mi per well)
- Ceramic proppants (1,000- 10,000 T per well)
- Guar gum (9 T per well)
Regulatory systems

Environmental effects

Public disclosure of chemicals
US (www.fracfocus.org)
Europe (http://www.ngsfacts.org)

Environmental concerns can be minimized with responsible development practices (Royal Society, UK).

- Disparity of state regulations can also lead to escalate community concerns
- However, imposing excessive regulations will lead to deter investment
Community engagement

Social License to operate

Governance
- Regulations
- Public disclosure

Direct benefits
- Jobs
- Local development
- Sponsorships for education
- Sharing infrastructure

Corporate responsibility
- Respect community aspirations
- Environmental safety
- Early engagement
- Involvement of all stakeholders

Education and Training
- Public information days
- Presentations to local community groups
- Newsletters and mailings
- Website and contact points
Conclusions

• Uncertainties of shale gas development needs to be managed effectively to increase the investor confidence.
• Effective collaboration among communities, industry and governments is vital for long term success of an Australian shale gas industry.
• Collective learning and infrastructure sharing could also expedite the development progress.
• Dealing with community misconceptions and education should be given a high priority.