The Natural Gas Outlook for China

23\textsuperscript{rd} – 24\textsuperscript{th} February 2012

China Energy Issues in the 12\textsuperscript{th} Five Year Plan and Beyond

Conference

Traders Hotel

Singapore

Dr. Tilak K. Doshi
Principal Fellow & Head, Economics Division

Nguyen Linh & Nahim Zahur
Energy Analysts, Economics Division
Natural gas demand

- Since the turn of the century, China has been seeing double digit demand growth which overtook supply in 2006
- As of 2010, China consumed 110 bcm of natural gas and became the fourth largest natural gas consumer in the world after Russia, the US and Iran
- Gas only accounts for 4% in the energy mix as compared to around 20% in the US and EU, given its heavy dependence on coal
- Demand is unevenly distributed, concentrated in the industrial cities near the Eastern coast

Source: FGE database
Demand outlook

- Potential for even more rapid growth in the coming decades supported by strong macroeconomics and policy initiatives
- Strong implication on the increased use of natural gas in China's 12th Five Year Plan: target 8.3% of primary energy demand or 260 bcm annually by 2015 with an emphasis on the residential sector
- In a longer term, China is expected to be important in shaping the global natural gas outlook:
  - Projected to be the fastest growing natural gas market from 2009 to 2035, accounting for a quarter of global gas demand growth in IEA New Policies Scenario
  - Chinese demand is expected to increase from the level of Germany in 2010 to match the entire European Union in 2035 in the Golden Age of Gas scenario

Source: IEA World Energy Outlook 2011

[Bar chart showing natural gas demand growth from 2009 to 2035 for different regions.]
Natural gas supply

- Meeting double-digit demand growth will require a combination of supply-side factors:
  - Gradual shift towards market-based price from regulated price
  - Improvement in internal pipeline distribution network to bring locally produced gas to demand centers
  - Unconventional gas production potential in the long run
  - Step-up in import capacity both via pipeline and LNG
Gas pricing – government regulation and cost-based mechanism

- Historically, the government has kept gas prices low to promote the use of the resource as a substitute for low-cost coal
- Prices determined by production, transportation and distribution costs with some allowance for the return on investment
- China’s NDRC regulates the price at the wellhead (at $4.46/mmbtu) and the transport tariff
- The municipal governments determine the respective city-gate prices
- The current system imposes losses on wholesalers like PetroChina who pay $9/mmbtu for Turkmenistan gas and receive only half due to the price control set by the government.
Gas pricing – towards a market-based mechanism

- In December 2011, China unveiled its plan to liberalize price at the well-head for unconventional gas, a step to incentivize domestic production of coal-bed methane and shale gas
- A pilot reform of city-gate price was also launched in Guangdong and Guangxi
- These provinces were chosen as they lack land-based pipelines and thus rely heavily on imported gas
- Under the new mechanism, city-gate price is linked to market prices of imported fuel oil price and liquefied petroleum gas with a respective weighting of 60/40
Pipeline infrastructure

- China is building more cross-country pipelines to expand gas supply to the middle, southeastern coastal and southern parts of China.
- Third and fourth pipelines to be opened in 2013 with a capacity of 30 bcm bringing gas from Central Asia to Fujian.
Unconventional reserves – coal-bed methane

- China is the world’s third largest holder of coal-bed methane with estimated reserves of 36.8 Tcm, of which 10 Tcm is proven.
- Reserves are concentrated in 4 key basins, out of which Qinshui and Ordos account for 50% of the total resource.
Unconventional reserves – coal-bed methane

- China government envisages greater production and utilization of the resource in the coming years as part of the effort to reduce coal mine accidents and promote clean energy
  - Output as of 2011 is at 11.5 Bcm, expected to increase to 15.5 Bcm in 2012 to reach 30 Bcm by 2015 - the National Energy Administration
  - Plans to add 1 trillion cubic metres to its reserves over the next four years, with production bases in Qinshui Basin in Shanxi province and Ordos Basin in Inner Mongolian autonomous region
- Since 2011, the government has eliminated import tariffs on CBM exploratory equipment, parts and machinery till 2016
- A subsidy of Yuan 0.3 is also available per cubic meter of CBM produced, planned to increase to Yuan 0.4 – 0.5 per cubic meter
- Insufficient pipeline infrastructure to transport CBM, highly consolidated in the hands of state-owned companies
  - One existing pipeline to connect Qinshui basin to the second West-to-East pipeline operating since 2009
  - CBM from newly developed fields is mainly used in the vicinity
Unconventional reserve - shale gas

- According to recent EIA estimates, China holds the largest shale gas reserves in the world.
- Technically recoverable reserves are estimated at 1,275 Tcf (36 Tcm), considerably higher than the 482 Tcf held by the U.S.
- Government survey pegs a lower figure of 30 Tcm.
Shale gas – reserve distribution

- Sichuan and Tarim are the most prospective basins for initial stage of development.
- Other shale basins (the Ordos, the Junggar, the North China (Huabei), the Turpan-Hami, and the Songliao) are mainly non-marine, likely to be clay-rich, thermally immature and oil-prone, thus less prospective.

Source: DNV (2011)
Shale gas – recent developments

• In June 2011, China opened its first tender for four shale gas blocks in Sichuan and Tarim basins to domestic investors
• In December 2011, a PetroChina-Shell joint venture discovered shale gas at their Fushun-Yongchuan block in Sichuan
  – 20 wells were drilled each producing 10,000 cubic metres per day
• On 29 December 2011 CNOOC also started its exploration project in eastern Anhui province, with production expected to commence in 5 years
• China seeks to launch a second round of shale gas tender in early 2012
• State-owned CNPC targets annual shale gas production of 6.5 Bcm by 2015 and 80 Bcm by 2020
Shale gas – outlook

- Geological differences that make the technology difficult to duplicate in China
  - Shale gas plays in the US are typically found in the depth of between 2 – 4 km while in China, this number is between 4-6km, which significantly affects costs
  - While Texas and the US Midwest are largely on flat terrain, South Sichuan and Guangxi are generally hilly, which requires construction of new roads and bridges for large scale drilling and again add to costs
  - Limited pipeline infrastructure is in place for the uptake of shale production
- Water shortage in key basins, especially Tarim basin
  - Hydraulic fracking requires substantial amount of water
- No rules in place for treatment of waste water post production
- Reserves not open to foreign bidders and highly consolidated in the hands of three state-control oil companies
- Fracking technology is still in nascent stage
- Despite its efforts to acquire technological know-how, no shale play is alike, hence, China will have to develop its own solutions
Investments by Chinese companies in unconventional projects overseas

- Chinese companies have been active in acquiring coal bed methane and shale gas assets in North America where the technology to unlock unconventional gas has successfully transformed domestic markets.

<table>
<thead>
<tr>
<th>Date</th>
<th>Category</th>
<th>Investing country</th>
<th>Investing company</th>
<th>Recipient country</th>
<th>Project/ company</th>
<th>Valuation (in billion US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>May-05</td>
<td>Oil sands</td>
<td>China</td>
<td>Cnooc</td>
<td>Canada</td>
<td>MEG</td>
<td>0.2</td>
</tr>
<tr>
<td>Apr-10</td>
<td>Oil sands</td>
<td>China</td>
<td>Sinopec</td>
<td>Canada</td>
<td>Syncrude</td>
<td>4.6</td>
</tr>
<tr>
<td>Jan-11</td>
<td>Shale gas &amp; oil</td>
<td>China</td>
<td>Cnooc</td>
<td>USA</td>
<td>Chesapeake</td>
<td>0.6</td>
</tr>
<tr>
<td>Jan-11</td>
<td>Pipeline</td>
<td>China</td>
<td>Sinopec</td>
<td>Canada</td>
<td>Northern Gateway Pipeline</td>
<td>2.3</td>
</tr>
<tr>
<td>Feb-11</td>
<td>Shale gas</td>
<td>China</td>
<td>Petrochina</td>
<td>Canada</td>
<td>Encana</td>
<td>6.9</td>
</tr>
<tr>
<td>Jul-11</td>
<td>Oil sands</td>
<td>China</td>
<td>Cnooc</td>
<td>Canada</td>
<td>OPTI Canada</td>
<td>2.1</td>
</tr>
<tr>
<td>Oct-11</td>
<td>Oil &amp; shale gas</td>
<td>China</td>
<td>Sinopec</td>
<td>Canada</td>
<td>Daylight Energy</td>
<td>2.1</td>
</tr>
<tr>
<td>Jan-12</td>
<td>Oil sands</td>
<td>China</td>
<td>Petrochina</td>
<td>Canada</td>
<td>MacKay River Project</td>
<td>0.7</td>
</tr>
<tr>
<td>Jan-12</td>
<td>Shale gas &amp; oil</td>
<td>China</td>
<td>Sinopec</td>
<td>USA</td>
<td>Devon Energy</td>
<td>2.5</td>
</tr>
<tr>
<td>Feb-12</td>
<td>Shale gas</td>
<td>China</td>
<td>Petrochina</td>
<td>Canada</td>
<td>Groundbirch / Shell</td>
<td>~1.0</td>
</tr>
</tbody>
</table>
Pipeline imports

- Russian pipeline negotiations are unlikely to come through mainly due to pricing differences
  - Out of the two proposed routes, Altai is more likely to materialize but not expected to come online till 2020
- Central Asian pipelines offer the greatest flexibility for capacity ramp up
  - In 2011 Turkmenistan agreed to provide up to 65 bcm of gas to China
- Past negotiations with Central Asian partners have been progressed relatively faster
- Pipeline import capacity is expected to reach around 50 bcm in 2015

<table>
<thead>
<tr>
<th>Country of origin</th>
<th>Pipeline</th>
<th>Capacity (bcm)</th>
<th>Proposed start date</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkmenistan – Uzbekistan - Kazakhstan</td>
<td>Central Asia Gas Pipeline Phase I</td>
<td>15</td>
<td>2009</td>
<td>Existing</td>
</tr>
<tr>
<td>Russia Siberia</td>
<td>Altai</td>
<td>30</td>
<td>2011</td>
<td>Proposed</td>
</tr>
<tr>
<td>Turkmenistan – Uzbekistan - Kazakhstan</td>
<td>Central Asia Gas Pipeline Expansion</td>
<td>20 - 50</td>
<td>2011</td>
<td>Construction</td>
</tr>
<tr>
<td>Myanmar</td>
<td>Myanmar-China Pipeline</td>
<td>12</td>
<td>2015</td>
<td>Construction</td>
</tr>
<tr>
<td>Russia Far East</td>
<td>Eastern Route</td>
<td>38</td>
<td>2020</td>
<td>Proposed</td>
</tr>
</tbody>
</table>

Source: Nexant
LNG imports

- China started importing natural gas in 2006 when domestic demand surpassed supply and China became “self-insufficient”
- The first regasification terminal came online in Guangdong province which opened a window for imported LNG
- China’s gas imports have only been LNG until 2009 when the first Central Asian pipeline was completed
- Regas capacity has grown ten-folds from 1.3 bcm in 2006 to 13.8 bcm in 2010
- Currently 7 regas terminals under construction which are expected to be operational in between 2012 and 2014
- LNG import capacity is expected to be 55 bcm in 2015, possibly exceeding 85 bcm in 2035
LNG import prices

- Average price paid by China for imported LNG = $9.06/MMBtu in 2011 and $6.09/MMBtu in 2010
  - By comparison, average price for imported pipeline gas (from Turkmenistan) is $11.30/MMBtu in 2010
  - Lower than premium prices paid by Japan and S. Korea
  - Benefitted due to low-priced contracts (in $3-4/MMBtu range) signed with Australia and Indonesia, but recent contracts have been higher priced
  - Average price for LNG has increased 50% since 2010, in line with global upturn in LNG prices and greater proportion of LNG imported from higher-priced sources

![Graph showing LNG import prices from 2005 to 2010](source: Nexant)
Import outlook

- Assumptions for pipeline capacity ramp up:
  - 2011: Expansion of the Central Asian pipeline by 20 bcm
  - 2015: Myanmar – China pipeline, capacity 12 bcm
  - 2020: Russia Altai, capacity 30 bcm
- Future imports will have to be met by both pipeline gas and LNG
- Given the assumptions, there will be a significant supply shortage in around 2017
- Shortage could be met by:
  - An increased flow of Turkmenistan gas before 2017
  - An earlier commencement of the Altai pipeline before 2017

Source: Nexant
Conclusion

- In the near term, China gas supply will continue to lag behind demand; given the slow development of transport pipeline network and unconventional production, it is likely that most of the increase in demand will be met by imports.

- Domestic prices have been kept low in the past but there have been efforts to implement pricing reform.

- Hurdles remain for shale gas development in terms of fracking technology and water issue.

- CBM, on the other hand, is already in use but limited to areas in the vicinity due to a lack of pipeline infrastructure.

- In the past years, LNG has been the cheaper import option compared to pipeline gas, but China's imported LNG is expected to go up in price.

- An increase in Turkmenistan gas beyond the current 35 bcm and imports from Russia are among the solutions to bridge future supply shortage.