International gas markets: recent developments and prospects

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International gas markets are changing rapidly

• The shale gas revolution in the US
• Gas ‘glut’ in Europe
  – Breakdown in ‘oil linked’ pricing in Europe
  – Will Asia follow?
• Russia/Asia
  – A swing producer? Or – missed the boat?
• East African potential
  – But at what price?
  – Constraints
The rationale for North American LNG exports: large price differentials leading to arbitrage opportunity

- The shale gas revolution in the US has seen gas imports drop sharply and LNG import facilities lie idle
- In contrast, gas imports to Asia have risen sharply thanks to Chinese demand growth and the impact of Fukushima
- A significant price gap has opened up, driven by the supply-demand imbalance and also by the continuance of oil-linked pricing – an arbitrage opportunity that is begging to be exploited
Figure 1.2  
Ratio of average natural gas and coal prices to crude oil prices in the New Policies Scenario

Note: Calculated on an energy-equivalent basis.
The opportunity is perhaps even more relevant for Canada than it is for the US

- Canada’s gas exports to the US have been falling thanks to increased shale gas production
- Production has declined in line with this fall, but Canada has significant conventional and unconventional reserves to exploit
- Exports to Asia are a commercial and a political goal, with a particular focus on assets on the West Coast
  - Gas prices in Canada would not support development of the country’s unconventional resources
16 new LNG export schemes are identified by the FERC, excluding Sabine Pass which has been approved.
North America could swamp the LNG market if all its projects came online (which is why that won’t happen)

• If all the US and Canadian projects came online 185mt of LNG could be exported by 2020 (compared to a global LNG market of 330mt in 2011)

• The key criteria for a new liquefaction plant are FERC approval for construction and DoE approval for non-FTA exports – only Sabine Pass (Cheniere) has these to date

• Political decision on US exports expected in 2013, with the impact on domestic prices and industry being the key uncertainty
Key question is about domestic gas price impacts.

- EIA survey looked at three key issues – the volume of exports, how fast they might be introduced and how shale gas production might respond
- Base case with no exports sees HH price rising to an average of $5.80 over period to 2035
- Exports cause early peak in prices but levelling out as production responds
- Key issue is the supply response of shale gas output – in worst case scenario HH price could average almost $10/mmbtu
- US policy very uncertain. Range of outcomes from ban on exports (crude oil exports are banned) to free for all
- Auction of permits? Export tax? (As in Russia). Fiscal terms
- Effects on competitiveness (hype) and on consumer incomes.
- Major uncertainties
Breakeven cost of shale gas production set to force an increase in Henry Hub price irrespective of exports

Cost curve for US shale output

- Consensus view is that current US shale gas production is not sustainable in the longer term at current price levels
- Liquids output and forward sales have mitigated low prices to date, but ultimately dry gas likely to be the marginal cost price setter
- Breakeven price likely to be in a $4-7/mmbtu range, with $5.50/mmbtu the mid point
Cost of US gas exports in Europe and Asia

Gas imports to the US and Asia

<table>
<thead>
<tr>
<th>Henry Hub Price</th>
<th>2.0</th>
<th>3.0</th>
<th>4.0</th>
<th>5.0</th>
<th>6.0</th>
<th>7.0</th>
<th>8.0</th>
<th>9.0</th>
<th>10.0</th>
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</thead>
<tbody>
<tr>
<td>Liquefaction</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
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<td>3.0</td>
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</tr>
<tr>
<td>Transport to Europe</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
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<tr>
<td>Transport to Asia</td>
<td>3.0</td>
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<td>3.0</td>
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</tr>
<tr>
<td>Regasification</td>
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<td>0.4</td>
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<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Full Cost Europe</td>
<td>6.6</td>
<td>7.6</td>
<td>8.6</td>
<td>9.6</td>
<td>10.6</td>
<td>11.6</td>
<td>12.6</td>
<td>13.6</td>
<td>14.6</td>
</tr>
<tr>
<td>Full Cost Asia</td>
<td>8.4</td>
<td>9.4</td>
<td>10.4</td>
<td>11.4</td>
<td>12.4</td>
<td>13.4</td>
<td>14.4</td>
<td>15.4</td>
<td>16.4</td>
</tr>
</tbody>
</table>

NB: does not assume 15% mark-up in Cheniere contracts

- Delivered cost to Europe or Asia includes upstream cost (or market cost), liquefaction, transport and regasification
  - Cheniere contracts include a 15% mark-up on Henry Hub price

- Delivered price to Asia assumes transport through a widened Panama Canal, where the tariff has yet to be confirmed

- At current HH price delivered cost to Europe would be .c$8/mmbtu and to Asia would be $10.mmbtu
Gas from US Gulf Coast would be competitive in Asia but would not cause a huge price shift

Breakeven delivered gas prices to Asia

- At a HH price of $5.50/mmbtu Sabine Pass LNG would sit in the middle of the cost curve to Asia

- Canadian LNG has a significant transport cost advantage but the initial capex for greenfield sites would be higher

- North American LNG would be unlikely to cause a large effect on prices, but is already changing the way in which price formation is being negotiated
In Europe US gas can again be competitive but is unlikely to cause a price crash

- US gas exports are likely to have a marginal impact in Europe

- A most likely delivered cost would be c.$10/mmbtu

- This would undercut current oil-linked contract prices, and would continue to do so unless the oil price falls back to c.$90-95 per barrel

- Price of US LNG imports to Europe can provide a benchmark for Gazprom if it seeks to be price competitive
Numerous Asian consumers are already involved in North American gas

- Supply contracts have already been signed with Cheniere Energy and with Kitimat in Canada

- Tolling agreements have been reached with a number of other potential liquefaction facilities

- Asian players have acquired significant gas assets across the US and Canada from which gas could be sourced for liquefaction

- Japanese and Chinese companies are most prevalent, but Korean and Indian companies are also taking upstream interests

- All these companies are likely to push for exports from North America, and can use their assets as negotiating tools with competing suppliers

- Would it be better to pay the price and invest elsewhere?
The political debate in Canada is still evolving and may limit future developments

• Canadian politicians have been very enthusiastic about increased economic inks with Asia, seeing energy as a key plank in this strategy

• However, this enthusiasm may be tempered by a number of concerns

• Nexen and Progress Energy deals highlight concerns over Asian influence in Canada

• Environmental lobbies against gas industry development are increasing their complaints
  – Development of shale gas
  – Pipeline routes
  – Shipping routes from Kitimat

• Some projects also remain fixated with oil-linked pricing (e.g. Kitimat) which would reduce competitiveness. (this is likely to change)
Likely outcome is total exports in the range 50-65mtpa by 2020

*Estimate of North American LNG exports*

- Application to FERC a key indicator of commitment to LNG exports
- Involvement of significant Asian partners may also catalyse developments
- 5 US projects and 3 Canadian projects seem most likely to move ahead by 2020
- Significant further development could push HH price to a level where exports become a less profitable option and could also cause political reaction
Prospect of North American gas exports already having an expectational impact on contracts and price formation

- The potential for North American LNG exports is undoubtedly large, and the current arbitrage opportunity is very tempting

- Political decisions will confirm or undermine the opportunity in 2013

- However, commercial considerations will play a greater role in limiting the overall size of export volumes

- North American exports are price competitive in Asia but sit in the middle of the cost curve

- In Europe US LNG exports are likely to act as a marginal price setter

- In both regions, though, the potential for HH-linked pricing has already caused a re-think of the price formation model
Price formation in Europe – and Asia

- Oil linked pricing breaking down
- The Groningen net back system
- Rise of European hubs – gas on gas competition
- Flexibility and renegotiation
- What accounts for the high prices in Asia?
- Competition policy and market structure
- Rusia and China
Gas Prices 2007 – October 2012

Sources: Argus, EIA, Platts, Own Analysis
European Gas Prices vs Coal
June 2009 – October 2012

Oil Indexed Contract estimate

BAFA

NBP

Gas Price Competitive with Coal in Power generation

Henry Hub

Source: Platts, BAFA, EIA, ICE, Argus, Own Analysis
What about East Africa?

- The potential
- Infrastructure and financing issues
- Costs and prices
- Managing the resource
Comparison Delivered Cost of LNG

<table>
<thead>
<tr>
<th></th>
<th>US Gulf Regas conversion</th>
<th>Australia Expansion</th>
<th>East Africa Greenfield</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freight</strong></td>
<td>3.5</td>
<td>1.2</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Liquefaction</strong></td>
<td>3.6</td>
<td>4.0</td>
<td>4.5</td>
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<td><strong>Gas Cost</strong></td>
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The graph shows the breakdown of costs for LNG delivery in US$, per MMBtu, with separate sections for Gas Cost, Liquefaction, and Freight for each location.
What about East Africa?

• The potential
• Infrastructure and financing issues
• Costs and prices
• Managing the resource
“Globalisation”: how quickly can international “basis” develop?

Sources: Argus, EIA, Platts, Own Analysis
US Oil and Gas Directed Drilling

Source: Baker Hughes, Arthur E Berman, Labyrinth Consulting Services
Impact of North American projects will also be mitigated by reaction of participants

<table>
<thead>
<tr>
<th>Participant</th>
<th>Pricing Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigenous owner of gas assets</td>
<td>Look for highest price available – HH or premium if offered by LNG exports</td>
</tr>
<tr>
<td>Owner of gas assets with LNG terminal</td>
<td>Aim for highest LNG price possible (currently oil-linked)</td>
</tr>
<tr>
<td>Consumer who owns gas assets</td>
<td>Transfer price at cost to domestic market</td>
</tr>
<tr>
<td>3\textsuperscript{rd} party LNG terminal owner</td>
<td>Offer HH price plus a margin, while also covering costs of liquefaction etc</td>
</tr>
<tr>
<td>Portfolio buyer of gas at HH prices</td>
<td>Relative price difference is key – aim for highest price possible in Asia/Europe</td>
</tr>
<tr>
<td>Consumer buying gas at HH prices</td>
<td>Looking for lowest price possible – would compare delivered HH-related cost with alternative supplies</td>
</tr>
</tbody>
</table>
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Gas price estimates in various LNG export scenarios

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- Reference case based on no exports sees HH price rising to an average of $5.80 over period to 2035
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