The 2nd IEA-IEF-OPEC Symposium on Gas and Coal Market Outlooks

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Natural Gas: Outlook and changing trends

Presented by:

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Main highlights

• There has been steady expansion of natural gas supply in the primary energy mix
• Gas demand is dominated by OECD, but growth in developing countries is fastest
• Significant uncertainty associated with natural gas as a fuel in the transportation sector
• In the US, shale gas expansion has resulted in augmented gas use for electric power and increased competitiveness for the petrochemical sector
• The global resource base is large, yet there are many potential barriers to its continued supply rise
• Although it is possible that increased inter-regional gas flows will establish more linkages among regional markets, this does not necessarily mean uniformity in pricing mechanisms nor a sharp convergence in prices
World supply of primary energy and natural gas share

- Expansion of natural gas supply in the primary energy mix both in absolute and percentage terms
- Natural gas increasingly important as a source of energy, particularly in DCs
Natural gas demand outlook

- Gas demand is dominated by OECD, but developing countries expected to see fastest demand growth
- US is world’s largest user of natural gas, averaging above 13 mboe/d in 2013
Natural gas use in transportation

• With abundance of natural gas across globe, use of natural gas in transportation could have significant implications
• Number of NGVs has been rising significantly in some markets such as China and the US
• Looking to the future, the penetration of NG vehicles is likely to accelerate
• Penetration of NV commercial vehicles in 2035 could reach 13% in China and 7% in OECD America
• In other modes of transportation, marine sector is currently adopting LNG as new bunker fuel
• Railways in some regions could be using LNG as replacement for diesel

Global penetration of Natural Gas vehicles (over vehicle parc)

Source: OPEC Road Transportation Model (RTM)
The US shale gas boom is having important consequences for its petrochemical industry.

- The availability of relatively cheap natural gas has provided the country with ethane at relatively low prices.
- Ethane is forecast to displace further volumes of naphtha as a cracker feedstock.
- However, the shift to lighter steam cracking feedstocks reduced the availability of co-product.
- In 2012, co-product propylene production from steam cracking was 2 million tonnes lower than the level of production in 2006.

Source: Nexant
US power generation: competition between gas and coal

- US electric power sector taking advantage of low natural gas price resulting from shale gas production
- Narrowing gas & coal price differential after 2008 led to reversal during 2011-2012
Natural gas supply

- Historically, natural gas supply dominated by OECD and Eurasia, but OPEC and Other Developing Countries have seen a rapid rise since 2000
- US (12.5 mboe/d) and Russia (nearly 11 mboe/d), top two producers account for almost 40% of global production
OPEC natural gas profile and global share (2013, in %)

- OPEC countries, with large reserves share (47%) in the world, possess significant potential for production and exports of natural gas.
- They constitute nearly half of the global LNG trade.

Source: OPEC Annual Statistical Bulletin, BP
Shale gas resources and constraints

Resources:
• Assessment commissioned by the US EIA, estimates global shale gas resource of around 1.3 trillion boe
• Of the total, China accounts for 15%, Argentina 11%, Algeria 10%, US 9%, Canada 8%, Mexico 7%, Australia 6%, South Africa 5% and Russia 4%

Constraints:
• Environmental impacts of hydraulic fracturing process with inherent risk of releasing toxic chemicals into groundwater
• Other environmental issues include possible surface spills of chemicals; disposal of waste water and excessive water use; rising traffic volumes
• Technical and commercial concerns involve high decline rates and future costs

Source: Advanced Resources International, Inc. 2013
Shale gas and prospects for US LNG

- Share of shale gas in total US natural gas on the rise due to improvements in horizontal drilling associated with hydraulic fracturing
- License to export granted to 8 projects so far
- Nearly all targeting Asian markets; 4 projects have already secured buyers

### LNG export projects approved by US Department of Energy, (mboe/d)

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<th>COMPANY</th>
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<tr>
<td>Sabine Pass Liquefaction, LLC (Louisiana)</td>
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<td>Freeport LNG Expansion, L.P. and FLNG Liquefaction, LLC (Texas)</td>
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<td>LNG Development Company, LLC (Oregon)</td>
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<td><strong>TOTAL</strong></td>
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Source: US Office of Fossil Energy

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Comparison of natural gas prices

- Natural gas market exhibited a trend towards price divergence between different regions as shale gas supply increased.
- While gas prices in US and Japan were at same level in mid 2008, they have gone apart by a factor of 4 or more in later years.

Source: IMF (US $/MMBtu)
Effect of US LNG on regional markets

• US shale gas boom and the resulting price differential between North American and European markets raises questions about prospects for LNG exports

• Extent to which US starts exporting LNG uncertain: exports may be hindered by transportation costs and domestic opposition due to potential economic losses

• How exports might impact European and Asian markets is still subject of much debate, in which LNG transportation costs and demand are key determinants
Key questions

- What are the prospects for shale gas supply expansion in the US and other regions?
- Can gas significantly penetrate the transportation sector?
- Will natural gas capture market share from coal in the electrical power sector, especially Asia?
- Over the next 20-30 years, is natural gas the main route to CO₂ emission reduction?
- To what extent will US LNG exports materialize, and when?
Thank you

Official launch of the OPEC World Oil Outlook
6th November, 2014 in Vienna