

26th World Gas Conference

1 – 5 June 2015, Paris, France



TS PGCC2 Report

Implications of developing Unconventional Gas

Shigeki Sakamoto
The Institute of Applied Energy



Scope of the work (IGU work program)

- Identify the supply potential and characteristics for unconventional natural gas resources worldwide
- Analyse changes in government policies and energy mixes in countries with abundant unconventional gas resources
- Identify the issues and challenges in relation to developing unconventional natural gas
- Analyse the potential impact on the gas supply demand balances in both regional and global gas markets

Structure: basic research by 3 regional sub-groups

- Set up 3 regional sub-groups to conduct basic research



“Americas” led
by Mikhail Uchikin

“Asia Pacific” led
by Graeme Betune

“Europe” led by
Erik Houllberghs

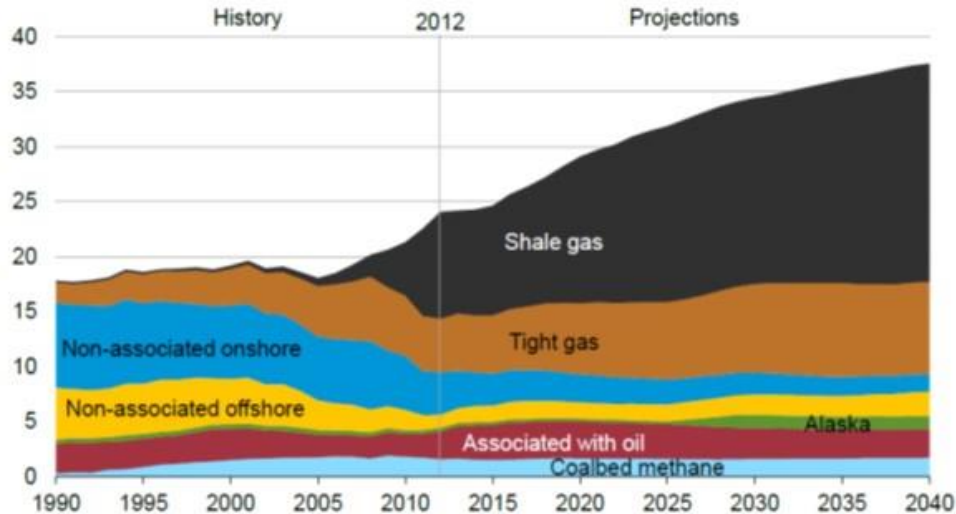
PGCC2 Report on “Implications on developing UNG”

- Success in commercial development of Unconventional Natural Gas (UNG) such as shale gas in the US.
- Implications of success in the US in developing UNG in Asia Pacific and to the world LNG markets, especially to East Asian markets.
- Prospects of developing shale gas in Europe

A. Americas: Increasing production of shale gas in the US

Shale gas leads U.S. production growth

U.S. dry natural gas production
trillion cubic feet

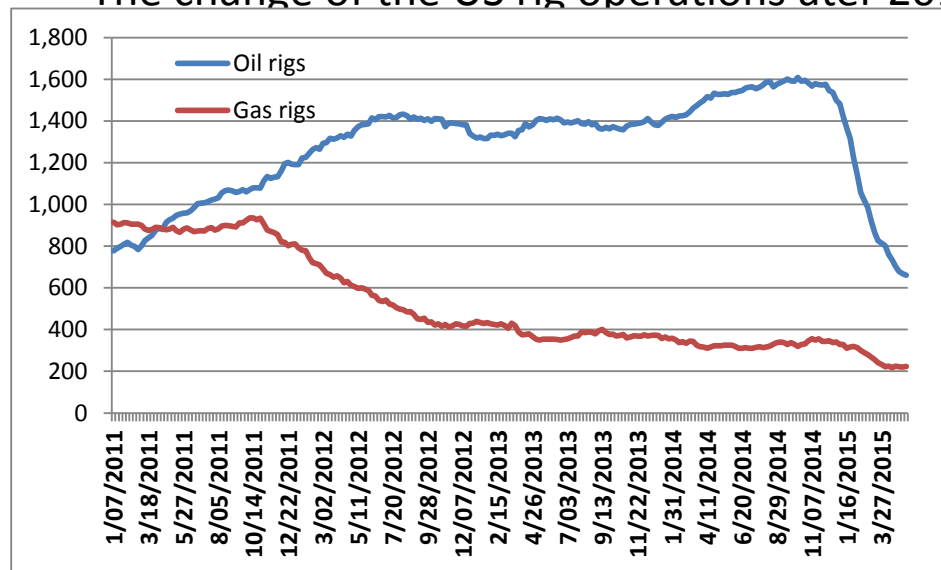


Sources: EIA
AEO 2014

Shale gas production has expanded in the US especially after 2007, reaching 40 % of the total gas production in 2014. EIA estimates shale gas production will be increasing further in the US.

The Change of Rig operations in the US by Baker Hughes

The change of the US rig operations after 2011

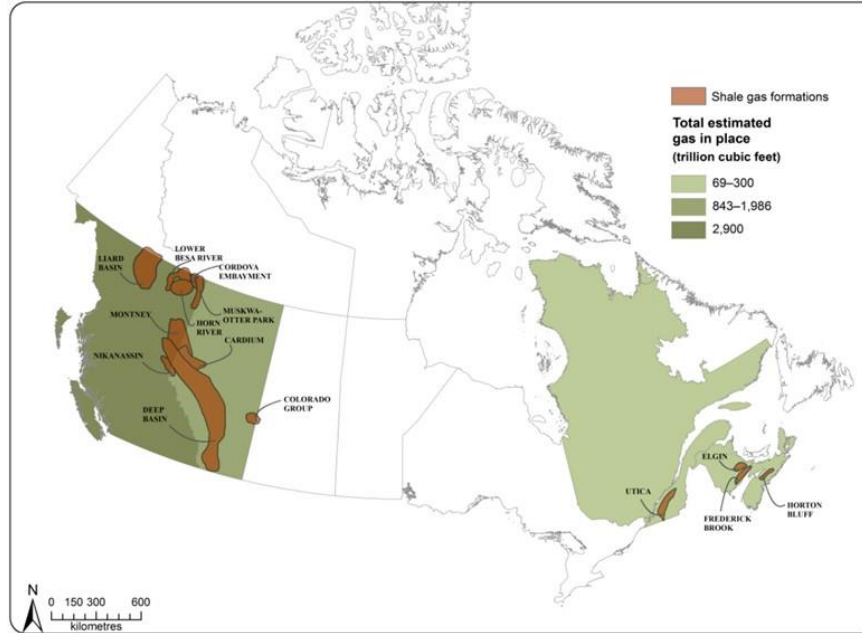


Sources:
Baker Hughes

The collapse of crude oil price from mid 2014 caused the significant decline of the US rig operations especially to oil rigs. However, operators improved efficiency of operations and reduced costs in order to minimize the damage on production. The gas production has not been much affected.

Prospects of shale gas & LNG developments in Canada

Shale plays in Canada



Sources:
Parliament of Canada

Development of shale gas & new LNG projects were also expected to be proceed with as well as those in the US. However, the collapse of crude oil price after mid-2014 made new projects with higher development costs more challenging. New projects in Canada by Petronas and Chevron have been postponed.

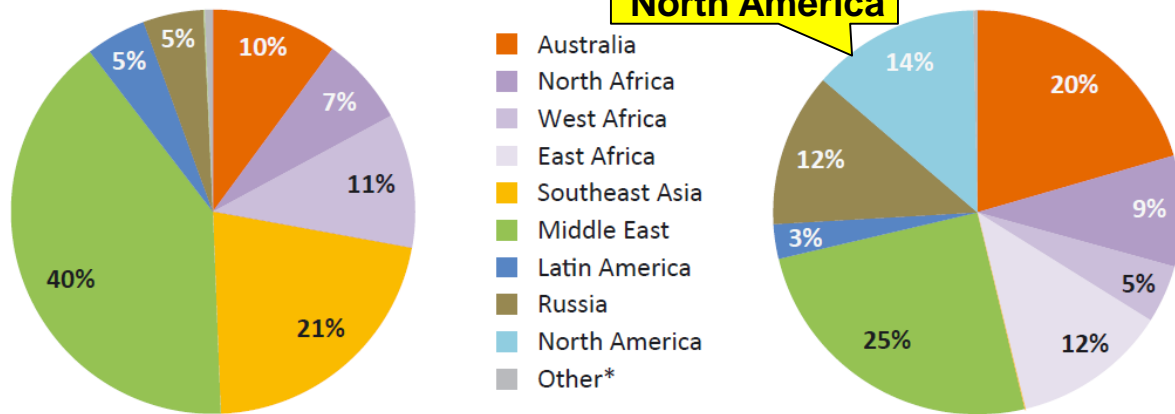
The impacts of UNG in the US on Asian Pacific

- The success of UNG developments in the US brought significant impacts in Asian Pacific:
 - 1) Success in UNG development, especially CBM production in Australia
 - 2) significant impacts of US LNG exports to East Asian LNG markets.

Change of LNG supplies in the global markets (2012 to 2040)

2012: 299 bcm

2040: 559 bcm

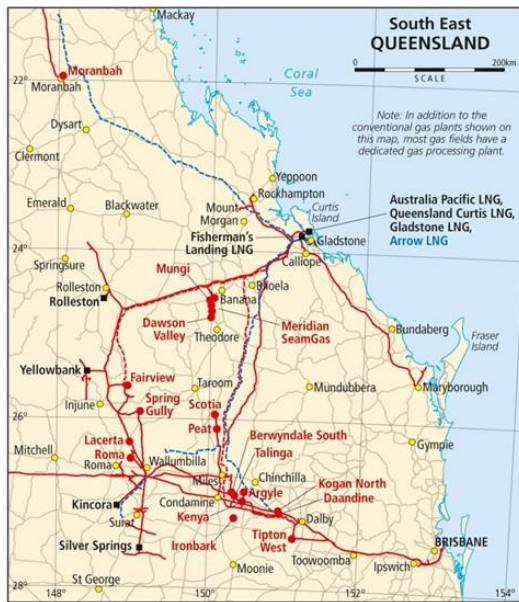


Increase of North American LNG market share (0%→14%)

Source: IEA WEO2014

B. Asia Pacific: Successful set up of 3 CBM-LNG, Australia

CBM-LNG projects in Queensland



Source: Energy Quest

loading of first QCLNG cargo, January 2015



Source: QGC

- **Following commercial success in the US, CBM was also developed in Queensland, Australia, which resulted in success of set-up of 3 CBM-LNG projects for export of 25 Mtpa (QCLNG, GLNG, APLNG).**
- **Shale gas is unlikely to have any major market impact before 2020..**

UCG development in Asian countries

- Commercial production of CBM has been conducted in major coal producing countries, such as China, India and Indonesia.

CBM Basins Within Indonesia



CBM Basin in Indonesia

Source:
Government of Indonesia

- Shale gas is unlikely to have major impacts due to commercial and technical challenges at least before 2020s'.

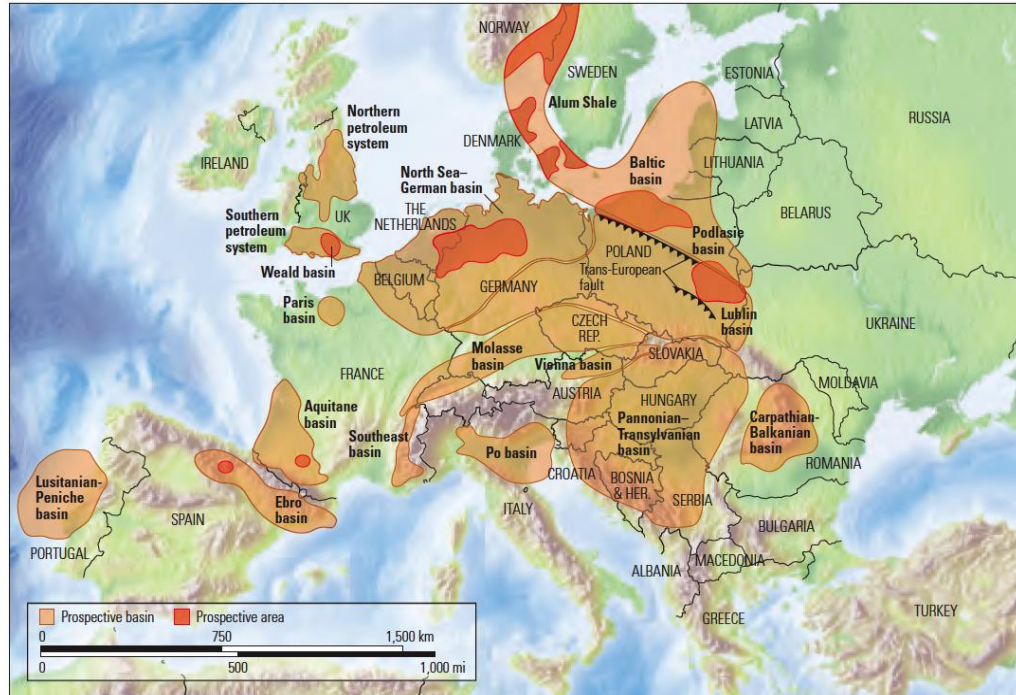
US LNG's impacts in LNG markets including East Asia

- The liquefaction capacity planned to be built in the US (more than 90 Mtpa), if fully completed, will have a significant impact on Asian LNG markets together with Qatar and Australia. US LNG Exports will be commenced around 2015-2016.
- Several East Asian LNG buyers have already executed contracts of LNG imports with the US LNG projects.
- Asian LNG buyers expect that US LNGs to be relatively cheaper than LNGs with the long-term contracts due to its pricing linked with gas-hub-price, and appreciate its term of destination-free.
- However, after decline of crude oil price from mid 2014, delivered price of US LNG to East Asian markets in 2016-2017 is likely to be the similar price level with those of long-term contract LNGs, which have linked with crude oil price.

C. Europe: Retreat of the prospects of shale gas

- It has been reported that there is also the potential of commercial shale gas production in Europe. Players expected to realize the similar kind of “shale gas revolution” in Europe.
- However, EP activities on shale gas so far revealed that it has not been favourable.
- Shale gas development in Europe has several challenges including geological difficulties, access to land use, comparatively high costs of operations and environmental concerns due to its dense population.
- Decline of crude oil price made major oil companies difficult to continue new investments in developing unconventional resources.

Potential of shale gas in Europe



▲ Europe shale basins. (Adapted from Kuuskraa et al, reference 6.)

Shale Basin in Europe

Source:
US EIA, Schlumberger

Several agencies including EIA forecasts that there are potential of shale gas in, Poland, France, UK etc. in Europe

Conclusion

- **The development of unconventional gas in North America is having a profound impact on gas markets globally.**
 - It changed the energy mix in the US,
 - reduced gas prices and stimulated economic development.
 - Outside the US, it has had direct impacts on other gas markets.
 - the growth of shale gas and oil in the US has led to lower oil prices worldwide, with implications for gas prices linked to oil.
- **However, the shale revolution in the US is unlikely to be replicated in other countries on a significant scale, at least not this decade.**
 - The circumstances in other countries differ materially from those in the US in terms of geology, community attitudes, regulation and costs.
 - The only significant exception at this stage is the growth of LNG based on Australian coal bed methane.