Shale Gas as a Factor in the Economic Development of Northeast Asian Countries

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In this article I would like to express my viewpoints on some issues concerning the production and use of shale gas in the countries of Northeast Asia. These are discrete aspects and fragments, rather than the results of a dedicated study, and I do not claim this to be an exhaustive explanation of the issue.

Northeast Asia (NEA) is one of the largest regions on the planet. However, there is still no established definition of NEA. The borders of this region have not yet been determined from a geopolitical perspective, so the composition and size of Northeast Asia vary according to the context of analysis.

Most researchers include in this region the northeastern provinces of China, the eastern part of Russia from Baikal, Japan, and the two Koreas. However, many also attribute Mongolia, the whole of continental China, and even Taiwan, Hong Kong, and Macao to the region.

The discussion in this paper primarily focuses on Japan, China, the two Koreas, Mongolia, and Russia, especially its eastern part. However, in light of the subject matter and the significance of cooperation with the USA for each of the aforementioned countries, we cannot overlook the USA and shall conditionally include it in this region.

The NEA region is one of the world's key consumers of natural gas. This is likely to remain the case until 2030-2035. Only two countries in the region – the DPRK and Mongolia – do not use natural gas. Nevertheless, it is entirely conceivable that they too will be added to the ranks of the gas-consuming countries in due course.

Shale gas can play a key role in building up the demand for gas in the future and it is likely to have a variety of effects – both direct and indirect – on this process.

Shale Gas

The extensive coverage of issues relating to shale gas renders unnecessary a detailed examination of such questions as "what is shale gas," as well as the history of its development, technologies that have been introduced, and its impact on the environment.

Neither shall I touch upon such exclusively scientific problems as its origins, the principles behind its use, and the conditions and factors behind the formation and distribution of unconventional hydrocarbon resources. I shall note here only two points that are essential to a better understanding of the issue.

Firstly, shale gas resources. The fact that the shale beds distributed worldwide contain gas has been known for a long time. Expert appraisals suggest that there are huge shale gas deposits in the bowels of the earth. As Valery Yazev, President of the Russian Gas Society and Vice-Chairman of the State Duma, described it symbolically, "shale gas is everywhere – in some places more than others," as it is found in most sedimentary layers. However, there are no credible data about geological deposits and proven reserves worldwide, so the figures cited are subject to quite a few preconditions, as geological surveys and exploration of shale strata as a source of natural gas have, in effect, not been conducted anywhere other than the USA and Canada. Accordingly, none of the books and discourse on this subject are anything more than conjecture.

Secondly, the cost of extracting shale gas. At the moment, shale gas extraction takes place only in the USA and (albeit in small volumes) Canada. The experience of the USA, certainly, demonstrates the economic parameters for the development of this process, but at the same time, it is necessary to consider the specific features of the gas market of this country, which is characterized by a high level of deregulation and minimal intervention by the state in the activities of companies. The markets for shale gas formed in other countries will definitely have their own characteristic features.

According to a study by the Massachusetts Institute of Technology (USA), the break-even price of shale gas production is directly dependent on the initial productivity of wells (in this case, the initial productivity means the productivity of a well in its first 30 days of production). Table 1 shows the relationship between the break-even price (defined as net extraction costs plus a profit level of 10%) and the average initial productivity of wells for the five major shale gas basins in the USA, classifying them into three groups of wells:

- Group 1: Most productive 20% of wells
- Group 2: 50% of all wells
- Group 3: Most productive 80% of wells (i.e. all the wells except for the least productive 20% of wells)

As can be seen in Table 1, the break-even price for Group 1 ranges from $101.7 USD/thousand cubic meters on the Marcellus play up to $150.8 USD/thousand cubic meters on the Barnett play. The average break-even price for the five plays considered here is $131.4 USD/thousand cubic meters. For Group 2, the break-even price ranges from $142 USD/thousand cubic meters up to $230.6 USD/thousand cubic meters, with the average at $195 USD/thousand cubic meters. As for Group 3, which, as a matter of fact, can be said to define the conditions of extraction, the break-even price varies from $222.8 USD/thousand cubic meters up to $601.8 USD/thousand cubic meters, with the average at $403 USD/thousand cubic meters.

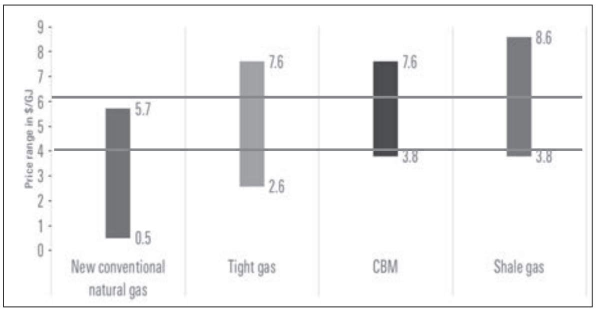
As shown in Figure 1, the production costs of both shale and other types of unconventional gas are, overall,

Table 1 Break-Even Prices of Shale Gas for the Major US Shale Plays

Shale Play	Indicator	Group by Productivity		
		20%	50%	80%
Barnett	Average Initial Production Rates tcm/day	*77*	*45*	*24*
	Break-Even Price USD/tcm	**150.8**	**230.6**	**404.7**
Fayetteville	Average Initial Production Rates tcm/day	*86.5*	*54.8*	*31.9*
	Break-Even Price USD/tcm	**136**	**195.3**	**313.2**
Haynesville	Average Initial Production Rates tcm/day	*353.6*	*216*	*72.8*
	Break-Even Price USD/tcm	**123.2**	**180.8**	**473.9**
Marcellus	Average Initial Production Rates tcm/day	*154*	*98*	*56*
	Break-Even Price USD/tcm	**101.7**	**142**	**222.8**
Woodford	Average Initial Production Rates tcm/day	*109.7*	*65.5*	*22*
	Break-Even Price USD/tcm	**145.5**	**223.9**	**601.8**

tcm: thousand cubic meters
Source: MIT Study on the Future of Natural Gas

Figure 1 Estimated Production Costs (Wellhead Price) of Conventional and Unconventional Gases (estimated ranges for 2010 in the USA)

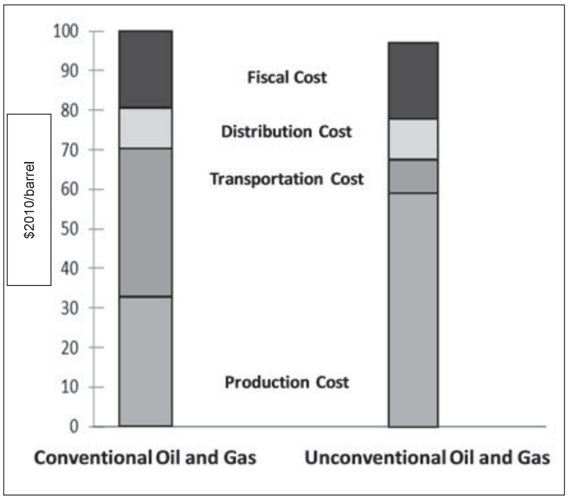


Note: The two lines added by the author indicate the price range within which competition for consumers among various types of gas is expected.
Source: "Central and Eastern European Shale Gas Outlook. KPMG", compiled from the May 2010 Technology Brief by IEA ETSAP

significantly higher than those of traditional forms of gas at present. In this respect, although unconventional hydrocarbons lose out in such a comparison in terms of the cost of production, they are ultimately winning because they are developed near areas of consumption, so transportation costs are minimal. In fact, the absence of such expenses makes unconventional resources competitive.

Figure 2 gives comparative estimates of the structure of world average consumer prices for traditional and unconventional hydrocarbons (in oil equivalent) as of 2010. Certainly, it is just an estimate, but an estimate which reflects the basic distinctions between the structures of the production costs of traditional and unconventional gases, as well as demonstrating the potential scope of this field. This estimate also, in our opinion, defines the main role of unconventional gas over the next 10-15 years; that is to say, while developing, securing or shaping each gas market, it is nonetheless likely to remain a local (regional) type of fuel.

Figure 2 Estimated Structure of World Average Consumer Prices of Conventional and Unconventional Oil and Gas (as of 2010)



Source: Author

Impact of Shale Gas on NEA Gas Markets

As already mentioned above, shale gas will have a variety of effects – both direct and indirect – on the formation of gas demand in the NEA countries.

Firstly, there is the production of shale gas itself, which may progress in the People's Republic of China. According to estimates by the Energy Information Administration (EIA) of the USA and the International Energy Agency (IEA), total technically recoverable resources of shale gas in China account for more than 36 trillion cubic meters, pushing the country into first place worldwide in terms of this indicator. Evaluations by Chinese experts themselves are more conservative, estimating the volume as being in the region of 26 trillion cubic meters. Shale gas is mainly concentrated in such areas as the Sichuan Basin and its vicinity, the districts around the upper and middle reaches of the Yangtze River, the Ordos, Qinshui and Songliao basins, and the Bohai Sea.

Shale gas development in China is in its infancy. At present, nationwide assessments of probable reserves and identification of promising areas are being carried out, while borehole drilling surveys are being conducted at a number of sites, along with appraisals of shale gas strata productivity. The first round of tenders for shale gas exploration and production licenses has already taken place. In 2010, the National Energy Administration of the People's Republic of China established the National Energy Shale Gas R&D (Experiment) Center and developed the Shale Gas Development Plan for the 12th Five-Year Plan (Guideline) period, which set a target of 6.5 billion cubic meters for annual production by the end of 2015. The Chinese government is prepared to subsidize these endeavors. For example, according to an announcement by the Chinese Ministry of Finance (November 2012), the state will pay production companies a subsidy of 400 yuan (about $64 USD) per thousand cubic meters of extracted shale gas. This is double the subsidy granted for extraction of coal bed methane. It is expected that shale gas production will grow to 50 billion cubic meters by 2020 and to 80 billion cubic meters by 2030.

According to IEA forecasts (the report entitled *Golden Rules for a Golden Age of Gas*) China will become one of the top three gas producers in the world by 2035, as well as becoming the absolute leader in terms of shale gas as a proportion of total natural gas production.

Tensions are emerging as a result of such forecasts. Is there any evidence to back them up? Are they attempts to distract attention from increases in gas imports, including from neighboring Russia?

The situation in regard to liquefied natural gas (LNG) leads us to a similar conclusion: until 2006, the IEA was forecasting that the world's largest importer of LNG would be North America, primarily the USA. For example, according to the *World Energy Outlook 2004 (WEO-2004)*, 45 new LNG receiving terminals were to be constructed in the region by 2030, including 33 in the USA. Meanwhile, the total volume of LNG imports to North America was expected to grow to 197 billion cubic meters by 2030. Based on such forecasts, Qatar and a number of other countries developed huge LNG supply capacity, with dozens of massive LNG tankers being ordered and constructed. In Russia, deliberations began regarding the Shtokman gas condensate deposit development project in the Barents Sea, primarily aimed at the American market.

Then, just three years later, *WEO-2009* admitted that "the unexpected boom in North American unconventional gas production, together with the current recession's impact on demand, is expected to contribute to an acute glut of gas supply in the next few years." Just think about this: despite the fact that tens of billions of dollars were invested in LNG production and transport projects, gas has ceased to be necessary!

Now, amid the same kind of pressures, it is predicted that China and India can almost completely meet their own demand for gas through the development of their own unconventional resources.

A clear signal is being given to national leaders and the business community: investment should be directed toward the development of shale gas, synthetic gas, and coal bed methane, instead of import pipelines or LNG projects.

But what if history repeats itself in terms of the "accuracy" of such forecasts? Where, then, will the economies of China or India be?

The second direct effect of shale gas on the economies of the NEA countries is the possible import of liquefied shale gas from the USA. Various options and conditions for the organization of such exports are being considered in the USA at present. I shall note just a few of them:

- According to assessments by the IEA, the profitability of supplying American liquefied shale gas to the markets of the NEA countries may be quite high;
- According to a July 31, 2012 announcement by Osaka Gas, it has - together with Chubu Electric Power - signed a contract with Freeport LNG (a US company based in Houston, Texas) for the supply of 2.2 million tons of liquefied shale gas per year (t/y) to each of them. The gas will be supplied from the first train of an LNG facility with a capacity of 13.2 million t/y (three trains of 4.4 million t/y each), which Freeport plans to construct on the site of an existing LNG receiving terminal, once it has received the appropriate permits from the US Department of Energy (for export of LNG to countries with which the USA does not have a free-trade agreement) and the Federal Energy Regulatory Commission (for construction). The LNG facility is expected to commence operations in 2017.

One would also like to note the active interest in gas production and LNG projects in the USA on the part of companies from China, the ROK, India, and Japan companies, many of which (CNOOC, PetroChina, Gail, Sinopec, and Kogas) are investing a significant amount in the development of shale assets, endeavoring not only to establish the foundations of a new type of business, but also to gain the necessary scientific and technical knowledge.

Regarding the indirect effects, it is again possible to identify two basic aspects. Firstly, there is the feasibility of supplying LNG from deposits in Alaska and Canada. Although Russia's mass media say practically nothing about it, it is common knowledge among experts that the "shale revolution" has "buried" a lot of the projects being undertaken by corporate giants (BP, ConocoPhillips, ExxonMobil, TransCanada), focused on the construction of gas trunk pipelines to the southern USA from Alaska and Canada, so there is a corresponding surplus of Alaskan and Canadian gas. Thus, in 2017-2020, this surplus gas could be exported in liquefied form to countries in the Asia-Pacific region, where gas prices are several times higher than those in the USA. Incidentally, one such project is currently the subject of a joint study by Rosneft and ExxonMobil. In my opinion, it is a very real threat to similar projects in other countries, aimed at NEA markets.

The second aspect is the significant psychological pressure brought to bear on the gas markets of NEA (as well as Europe) by low prices in the US domestic market since 2008, caused by a surplus of shale gas. The huge price disparities sustained over more than five years are undermining the structure of inter-regional price arbitration developed hitherto, driving even the most conservative countries, namely Japan and the ROK, to search for ways of reducing the price of imported gas. Along with the shift of the center of gravity of the gas trade within NEA to China, this creates adverse conditions for maintaining the characteristic premium prices seen in regional markets, by transforming the basic principles of the pricing system for gas exports worldwide.

Conclusions

In summary, there are two brief conclusions to be drawn:

Firstly, the shale revolution should, above all, spur the Russian gas industry to significantly reduce gas production and transport costs. Needless to say, without inexpensive gas (which provides fuel for power generation and is used as a raw material in the gas chemical industry), Russia will lose its competitive advantage and no magic spells invoking the "necessity of innovation" will be able to revive us. Top executives in the industry should understand this, as should the state, providing the relevant companies with a favorable investment climate and opportunities for steady development.

Secondly, the energy security of Russia is threatened not so much by the shale revolution itself, as by the country's general technological backwardness and lack of understanding of the latest generation of new technology development. As well as reducing the competitiveness of the Russian economy as a whole, this backwardness will heighten its vulnerability amid growing geopolitical rivalries. Coupled with the rapid ageing of its existing scientific and technical infrastructure, Russia's growing tendency to lag behind fundamental technological trends in the global energy sector will make it increasingly impossible for the country even to respond and adapt to new energy technologies and expansion into completely new fields of science and technology where others lead, let alone pioneer them itself.

[Translated by ERINA from the Russian text]