

Economic Mechanisms of Coal Bed Methane Development for Safe and Clean Energy

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The global energy market and local oil and gas systems as its components are in a state of continuous development. In the last decade, the most important changes were due to the continuing globalization of the market and, as a result, increased competition, stirred up by a significant increase in the role of gas – both from conventional sandstone reservoirs and unconventional sources.

Coal bed methane (CBM), just as shale gas, tight gas and gas hydrates, belongs to the group of unconventional gas resources. Before the start of active shale gas production, CBM accounted for 10% of the total national gas production in the U.S. However, with the start of the so-called Shale Gale, attention to that resource has dwindled.

At the same time, unlike shale gas, CBM production is considerably less complicated, geology- and technology-wise and is not linked to so many environmental risks and adverse effects.

However, improving safety of subsequent coal mining from less gas-saturated coal beds is a critical factor that largely determines high socioeconomic importance of CBM production. Early methane offtake also makes it possible to boost coal mining performance and efficiently utilize gas (e.g., for power generation) which otherwise would have been emitted into the atmosphere by mine degassing systems. Reduction of greenhouse gas emissions and increased use of gas, which is the most eco-friendly fossil fuel, are in keeping with the principles of sustainable and integrated subsoil exploitation and allows us to call the development of CBM resources a contribution to production of energy which is not merely clean but also safe.

Being an innovative company, in 2003 Gazprom pioneered the implementation of a ground-breaking project in Russia aimed at appraising opportunities for commercial CBM production in the Kuznetsk Basin, one of the world's largest coal fields, which is strategically important for the economies of West Siberia and the country at large. At the pilot and exploration work phases, Gazprom developed and tried a package of unique engineering solutions for CBM production, making it possible to deliver gas extracted from coal beds to Russian consumers for the first time in early 2010.

At the moment, trial and pilot production operation of exploration wells is underway in the Kuznetsk Basin. Its outcome will be used to make further decisions on directions in which the project will be pursued.

However, judging by experience, viable commercial development of CBM resources requires not only engineering innovations but also new approaches to statutory regulation, economic assessment of investment projects and interaction with coal companies. That work must be performed on a proactive basis, so that when the time comes for investment decision-making, taxation would have been made transparent and efficient, the potential organizational risks have been minimized.

Key economic tasks that appear sensible for the effective development of CBM resources in Russia, as well as any other country with an emerging CBM industry, require a systematic approach and can be represented as four interdependent blocks, as shown in Figure 1.



Figure 1. Key economic tasks for the effective development of CBM resources as an emerging industry

Russia's CBM resources (original gas in place, OGIP) are estimated at 83,7 trillion cubic meters (tcm), nearly 90 % of which are concentrated within the 4 largest coal basins – Kuznetsk, Tunguska, Lena and West Siberian.

From a strategic point of view, the main drivers for commercial CBM production in Russia are the following [1]:

- years of overseas CBM production experience, primarily in the U.S.;
- availability of effective technologies for CBM extraction in Russia;

- rich resource base (allocated differently from conventional resources);
- increasing costs of conventional gas production;
- increasing solvent demand for gas, both for domestic use and for export.

Long-term development plans for the CBM project in Kuznetsk Basin are to achieve commercial production volumes sufficient to provide a partial, and later, perhaps, a complete replacement of the existing pipeline gas supply to Kemerovo region with local unconventional resources. The economic output of such a substitution would include a reduction of profits from the pipeline gas supplies that are to be replaced with CBM. For some distant regions it may also result in cutting losses, in case the conventional gas supplies were unprofitable due to high transportation costs.

Two factors are associated with the need for enhanced approaches to assessment of cost-effectiveness of field development projects. First, the major discoveries of conventional natural gas fields have taken place in underdeveloped regions in the past few decades. Their development is performed within the framework of greenfield projects, unlike CBM production, which has the best prospects in industrially developed coal mining regions with minimized hauling distances, owing to their proximity to consumers (brownfield projects).

Second, potential CBM production volumes, even in unique coal basins in terms of their scale, such as Kuznetsk, can meet demands of one or several neighboring regions, but they will not become the starting point for mainline gas supplies on a par with the largest conventional fields. A formalized approach to calculation of extra cash flows has been developed for CBM production projects, addressing the regional importance of resources and the opportunity of transportation costs optimization due to production of gas from unconventional sources in the region of its consumption.

In order to take account of these factors, an original economic-mathematical mechanism that includes some “external” project cash flows has been developed to calculate the aggregate projected economic outcome of CBM production for Gazprom in general. It should be noted that the inclusion of the proposed external factors when assessing the cost-effectiveness of developing CBM fields requires prior calculation of the “inner” net cash flow of the project, that is, the net cash flow of solely production and sales of gas. For this reason, a comparison of the results of economic assessment for the subsidiary gas producer and Gazprom at large do not require any additional calculations and can be made.

The application of the economic-mathematical mechanism in addition to the accepted methodologies for assessing the economic efficiency of investment projects opens up opportunities for cost and logistics optimization due to the development of local unconventional resources in areas where it is most economically feasible. Depending on the specifics, the extent and profitability of the current economic activity in the project area, taking into account the external factors can radically alter the conclusions of the economic feasibility study of the project.

Comprehensive investment analysis, providing an objective consideration of the “external” factors would contribute to a more complete assessment of the expected cost-effectiveness of the project and, therefore, such mechanism should be used as the primary criterion for making strategic investment decisions.

One of the important factors affecting the economic efficiency of CBM production and the associated risks is the transparency and adequacy of taxation regime. Overseas experience has shown that the effective development of CBM resources in some countries has been largely stimulated by the introduction of the tax benefits that were subsequently abolished as the new industry built up production [2].

In 2011 Gazprom initiated legislative recognition of CBM as an independent mineral type. Thereupon, in 2013 it was excluded from the list of Mineral resources extraction tax (MRET) targets and favorable fiscal conditions were established, incentivizing development of the new sector at its generally most capital-intensive initial stage. In addition, since 2010 the Kemerovo region enacted targeted tax benefits for CBM production, reducing the tax burden payable to the regional budget.

The biggest challenge which requires involvement of government authorities and a joint resolution acceptable for various industries is the interaction procedure between gas producing and coal mining companies. An original organizational scheme of CBM production has been proposed to assure an acceptable return on investments for gas producers and for coal miners, minimization of costs on maintaining safe labor conditions during subsequent coal mining operations.

From the position of the coal industry, CBM production on the fields scheduled for future underground coal mining is generally similar to preliminary degassing, which will further significantly improve the safety and efficiency of underground works [3]. This concept opens up new prospects for mutually beneficial cooperation of Gazprom and the coal mining companies.

Preliminary degassing of coal seams is not only an effective technology for improving the safety of future coal mining, it also allows efficient use of the recovered gas (both separately and for the increase of methane concentration in the ventilation mixture from operational mines), which will result in reduced environmental footprint from greenhouse gas emissions. Together these benefits can make a significant contribution to improving the economic performance of subsequent coal mining in Kuznetsk Basin.

The possibility of rational planning of CBM production for the additional benefit of coal industry is provided by the planned renovation of the major coal producing assets in Russia, according to the Long-term program for the development of the coal industry until 2030. Given the recommended degassing period of 5-7 years (and up to 10-12 years, depending on the geology and requirements of methane content reduction), such degassing projects are advisable to be commenced these days.

Economic incentives for preliminary degassing of prospective coal mine areas for coal producers should lie in the reduction of future coal mining costs, which are expected to be achieved by [3]:

- enhanced performance of the permitted underground mining equipment;
- increased equipment utilization factor due to reduction of unplanned outages;
- reduced capital and operating costs associated with the ventilation system;
- reduced costs of eliminating the aftermath of methane burst and explosion accidents, including costs of restoring production, lost profits from coal sales for the restoration period, worker compensations and penalties;
- reduced costs of power lines and electricity due to its partial substitution by its generation from CBM, especially for the construction period;
- reduced payments for greenhouse gas (methane) emissions.

It should be noted that most of the investments made by the coal companies within the joint CBM production and degassing projects can be refunded in accordance with the Government Resolution “On approval of list of expenses related to the provision of safe working conditions and safety in coal mining, deductible from the amount of Mineral resources extraction tax” that introduced some changes in the Russian Tax Code.

A deduction from the amount of MRET payable for coal extraction is approved, in particular, for the following types of capital expenditures:

- costs of drilling degasification (CBM production) wells;
- costs of degassing stations and facilities;
- costs of drilling equipment;
- costs of gas collecting pipelines, shut-off and control valves, instrumentation;
- costs of methane treatment and utilization equipment.

The proposed mechanism allows coal companies to finance, using refundable within the following 3 years investments, all the necessary production facilities for CBM extraction, utilization and coal seams degassing. The gas company will incur only residual operational costs, offset by the sales of produced gas or electricity.

However, given the historic competitive nature of relationships between gas and coal on most developed energy markets, implementation of proposed organizational and economic concept will require some additional legislative initiatives and feasibility studies in order to build the foundation for a mutually beneficial interaction of gas and coal industries.

Thus, the further development of transparent and legislative authorized mechanism for joint CBM production and coal seams degassing projects, carried out with regard to the balance of economic interests of both coal and gas companies, is expected to enhance the conditions for sustainable and efficient long-term development of Russian fuel and energy complex.

The developed economic mechanisms can be adapted in order to increase the investment appeal of CBM exploration and production projects in other coal mining nations, becoming a further step towards clean, safe and efficient energy of the future.

References:

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