Добыча сланцевого газа в странах постсоветского пространства: первые результаты и проблемы

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Аннотация: рассматриваются подходы и возможности разведки и использования сланцевого газа в странах, которые ранее входили в состав СССР. Многие из них проявили интерес к итогам «сланцевой революции» в США, которые открыли новую страницу в добыче газа. Ряд стран постсоветского пространства рассчитывают за счет использования сланцевого газа снизить зависимость от внешних поставок и добиться энергетической независимости.

Обобщены данные о запасах сланцевого газа в странах постсоветского пространства, представлены предварительные итоги их энергетической политики в сфере разработки месторождений данного углеводородного ресурса, проанализированы первые результаты деятельности нефтегазовых компаний.

Из всех стран постсоветского пространства наиболее активную политику проводила Украина, заявив о своем первенстве по запасам сланцевого газа. Украинская сторона привлекла зарубежные нефтегазовые компании, которые проявили интерес к сланцевым месторождениям. Между тем, проблема добычи сланцевого газа на Украине, оказалась политизирована, затруднив объективную оценку стартовых условий и возможных последствий для общества и экологии, возникающих при добыче этого углеводородного сырья. Сланцевый газ также оказался в центре внимания властей Казахстана и Молдавии, которые рассматривали этот углеводородный ресурс в качестве значимого фактора в реализации политики диверсификации источников сырья и обеспечения независимости от российского газа. «Сланцевая революция» не осталась без внимания в России, которая вынуждена учитывать фактор сланцевого газа в мировой энергетике, корректируя свою ценовую политику. США пытались внедрить сланцевые контракты в России, обеспечив себе доступ на российский газовый рынок. С одной стороны, Россия осталась равнодушна к сланцевому буму, продолжая реализовывать трубопроводные проекты, с другой – нет абсолютного отрицания потенциальных возможностей этого вида углеводородного сырья.
В целом, страны постсоветского пространства, несмотря на отсутствие законодательной базы, технологий и нерешенные экологические проблемы, проявляют определенный интерес к добыче сланцевого газа.

Ключевые слова: сланцевый газ, углеводородные ресурсы, запасы, производство, энергетическая политика, Россия, Украина, Молдавия, Казахстан, экология


Shale Gas Production in the Post-Soviet Countries: First Results and Problems

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Abstract: This chapter considers the approaches and possibilities of exploration and use of shale gas in the countries of the former USSR. Many of them became interested in the results of the US “shale revolution” which opened the new stage in gas production. Some post-Soviet countries are eager by using shale gas to reduce their dependence on external deliveries, thus, attaining energy independence.

The data on shale gas reserves in the post-Soviet countries are taken together; the preliminary results of energy policy in these countries concerning development of the shale gas deposits are presented; the first results of oil and gas company activities are analyzed.

Of all post-Soviet countries, Ukraine was most active in this respect having declared about possessing the greatest shale gas reserves. Ukraine invited foreign oil and gas companies which showed interest in the shale deposits. But the shale gas production in Ukraine acquired political dimensions impeding the objective assessment of startup conditions and likely consequences of shale gas extraction for the people and natural environment. Shale gas was in the focus of attention of the authorities in Kazakhstan and Moldavia which considered this hydrocarbon resource as the significant factor for diversification of hydrocarbon supply and ensuring independence of the Russian gas. “Shale revolution” was not neglected in Russia which had to take into account the shale gas factor in the world energy balance adjusting its policy respectively. USA made attempt to push its shale contracts in Russia, thus, ensuring access to the Russian gas market. On the one hand, Russia remained indifferent to the shale boom and went on implementation of
its pipeline projects, but, on the other hand, it does not waive off absolutely the potential of this hydrocarbon resource.

In general, the post-Soviet countries regardless of the lack of a legislative base, technologies and unresolved environmental issues have shown certain interest in shale gas production.

**Keywords:** Shale gas, Hydrocarbon resources, Reserves, Production, Energy policy, Russia, Ukraine, Moldova, Kazakhstan, Ecology


**INTRODUCTION**

The US success achieved in shale gas production in the early 21st century has attracted attention of many post-Soviet countries that appeared in the territory of the former USSR after its disintegration in 1991. The experience of the American companies that were quickly expanding the shale gas extraction, the so-called “shale revolution,” seemed very attractive, primarily, for those post-Soviet states which had no oil and natural gas deposits of their own and, consequently, depended on external sources of these hydrocarbons. Among such states there are Armenia, Belarus, Georgia, Moldavia and Ukraine. They took different ways to obtain alternative sources of hydrocarbons. For the past two decades they did everything to weaken their dependence on external gas supply, first of all, from Russia [1].

At the same time, the hydrocarbon exporting countries also showed interest to shale gas deposits and their development, such as Russia and Kazakhstan. In the recent decade they have been discussing the impact of the US “shale revolution” and possibilities to implement shale gas projects. Until recently the interest to the shale gas issue in Russia was limited to discussions at the expert level and inclusion of this problem in some official documents and declarations of politicians. No endeavor to attain the commercial shale gas production may be attributed to the lack of accurate data on the shale gas reserves available in Russia, high cost of production, high environmental risks and lack of required technologies. Similar situation is observed in other post-Soviet countries which undertake only assessments of shale gas reserves, except Ukraine that in 2017 initiated the commercial shale gas extraction considering it as the alternative for Russian gas.

**HISTORY OF SHALE GAS EXTRACTION IN THE USSR**

The interest to shale deposits in Russia like in the USA was noted in the 19th century. Initially, the shale oil was in the focus of attention. Its extraction was started in the mid-19th century, although in small quantities. Shale oil was mostly used as fuel and in ichthyol production. In 1919 the commercial scale production was started. Shale oil was extracted in the Samara region.

In the USSR oil shales were extracted in the territory of Estonia that was part of the Soviet Union, in the Leningrad region and near Syzran in the Samara region [2]. Shale oil extraction did not reach commercial scales as oil deposits in Azerbaijan (Caspian Sea) and later in Siberia were developed.

For experimental purposes the shale gas had been produced in the USSR for several decades. Shale gas is natural gas that is found...
trapped within shale formations in sedimentary rocks abounding in organic matter required for oil and gas formation. Gas deposits are usually confined to sands, while shales are the more dense rocks featuring low porosity and composed of smaller size and hard particles.

Shale gas is referred to the so-called unconventional natural gas. This term means natural gas found in clay schist rocks, in coal seams, in tight sandstones, occurring at great depths in geozones under small pressure. At the same time, shale gas is extracted from solid rocks which are more difficult to drill and its reserves in such shale plays are much smaller.

Shale gas is extracted applying such technologies as directional drilling, hydraulic fracturing (fracking), when hard rocks are crashed with water and special chemical reagents, and seismic 3D GEO modeling. Similar technology is used for extraction of coalbed methane. Hydraulic fracturing (HF) is aimed to stimulate operation of oil and gas wells by creating fractures in a formation to increase inflow of fluids (gas, water, condensate, oil or their mix) to a wellbore. HF technology is accomplished through pumping of fracturing fluids composed of a blend of chemical reagents, sand, water and acids fretting fracture walls in a formation into a well under pressure higher than the fracturing pressure for oil and gas formations. Then water is pumped out, while sand fills the extended fractures and let gas freely flow into a well via which it goes up to the surface. The world’s first hydraulic fracturing was conducted by company Halliburton in 1949.

The respective technologies have been designed in the former USSR from the early 1950s. The theory of shale gas extraction technology had been developed by academician Sergey Christianovich at the Oil Institute of the USSR Academy of Sciences. It envisaged injection of fluid into a well for fracturing geological formations and increasing their oil yield. Based on such theory, the hydraulic fracturing of a coalbed was conducted in 1954 in one of Donbass mines [3]. The approaches to shale gas extraction suggested by Soviet scientists were successfully applied in the 1970s-1980s in the territory of the USSR. However, this technology was not widespread. It was applied mostly in developing not large oil and gas deposits [4].

**SHALE GAS RESERVES**

Opening of large shale plays in the USA and application of new modern technologies of shale gas extraction were the basis for a breakthrough in development of this kind of hydrocarbon resource. They also gave rise to discussions of this issue in the post-Soviet countries which allegedly possess great shale deposits although there are no accurate data on shale gas reserves in any of them. The matter is that in the USSR no fundamental researches of shale gas reserves had been conducted and no theoretical and practical studies of the problems and opportunities of shale gas extraction were carried out. As a result, these countries have only approximate data obtained still in the time of the Soviet Union. For this reason, after the US “shale revolution” the post-Soviet countries can present only rough data on shale gas deposits with some reservation on the need to conduct additional investigations. Consequently, the state balance of mineral deposits did not include oil shales.

The figures for shale gas reserves in Russia differ greatly, too. According to Gennady Shmal, President of the Union of Oil and Gas Industry of Russia, the shale gas reserves are roughly estimated at 25 trillion cu. m3 [5]. The State Report «On the State and Use of Mineral Resources in the Russian Federation of 2010» said that «no shale gas plays were found in Russia» [6].

Unlike Russian experts, the Energy Information Agency (EIA) in 2013 published its data having evaluated the shale gas reserves in...
Russia at 8 trillion m³, or 20% of the current reserve base [7].

One of the countries being most interested in shale gas production was Ukraine. The insignificant oil and natural gas deposits made it dependent on hydrocarbon supply from Russia. In 1991 Ukraine formulated the task to reduce dependence on the Russian gas and, if possible, even to refuse from its deliveries. However, due to the lack of own large fields and finance the task has not been fulfilled.

Having widened cooperation with the US companies engaged in shale gas production the Ukrainian authorities and experts returned again to discussing the prospects of energy independence. The first issue to be addressed in this regard is assessment of the resource base that can be a benchmark for initiating shale gas projects in Ukraine. However, the estimates of the shale gas reserves in Ukraine differed greatly varying from 2 to 30 trillion m³. Such data scattering only proves the fact that information on shale gas reserves in Ukraine is not accurate and can be accepted only conditionally.

In Kazakhstan the total shale reserves are evaluated at 5-6 billion tons. These fields were discovered still in the mid-20th century. The shale plays have not been studied adequately, so Kazakhstan has no accurate information about available shale gas reserves. In 2012 Kazakhstan authorities demanded to conduct additional geological-prospecting surveys for identification of the situation with shale gas in the territory of the country.

Other Central Asian country – Uzbekistan started in 2013 extraction of hydrocarbons from shale formations. Company «Uzbekneftegaz» initiated the project costing 600 million USD with no results whatsoever.

Some other post-Soviet countries show interest in shale gas issue. Thus, in 2011 the Ministry of Energy and Natural Resources of Armenian and the International Mineral & Mines Ltd. (registered on the Isle of Man) signed the memorandum identifying the directions of prospecting and development of shale plays in Armenia. In 2013 the representatives of the United States Geological Survey visited this country to investigate the shale gas deposits [8].

Similar situation was in Moldavia that tries to get more accurate data on the shale gas reserves of the country. Shales were found at a depth of 1700 meters in Iargara (Leova District), in Rezeni (Ialoveni District) of Moldavia. In the latter area two wells were drilled and at a depth of 1100 meters shales were found. Drilling works were also conducted in Neslavcea (Ocnita District) and shales were found at a depth of 1200 meters. Shale gas may be discovered at 3500 meters, but its extraction will be extremely labor intensive. According to surveys of the British Company «Canyon Oil and Gas Ltd.» conducted near village Valeni (Cahul District), shale plays may occur at a depth of 2500 meters.

**DISCUSSIONS ABOUT SHALE GAS PRODUCTION IN RUSSIA**

As the scale of shale gas production in USA was growing speedily, many post-Soviet countries, including Russia, started discussing this issue. For several years the attitude to shale gas has changed perceptibly: from complete negation to interest to this hydrocarbon production.

Taking into account that Russia has ample natural gas deposits which development is not costly many come to a conclusion that so far the development of shale gas plays is not cost effective. And the more so as the prospects of shale gas production in Russia still have many questions and, first of all, lack of geological study of shales. Accordingly, there are no even rough estimates of shale gas reserves.

Russian experts in this field believe that in the nearest decades no cardinal changes in the oil and gas market will be observed and the increase of the shale gas production will not
change the situation in the gas market of Europe as such increase was supported by governmental subsidies [9]. Nevertheless, Russia has started assessing the situation with shale gas extraction in USA more attentively and follows more closely the European countries’ policy in this field. In the recent years Russia held special conferences on the results of the «shale revolution» attended by many scientists, politicians, ecologists and experts. Thus, in March 2010 the Lower Chamber of the RF Parliament organized the round-table conference on the theme «Prospects of Shale Gas Development» that took together the representatives of the leading research institutions, including Russian Academy of Sciences (RAS), and oil and gas companies [10]. At this conference it was noted that Russia had sufficient reserves of natural gas amounting to 34.6 trillion cu. m as of 2016 estimates. However, their development requires substantial investments. In addition, it was stressed that shale gas development is sensible near consumers, in the regions with developed infrastructure and with no centralized gas supply. Then in April of the same year Yury Trutnev, that time Minister of Natural Resources and Ecology of Russia said that growth of the shale gas production was a serious problem for the Russia’s major gas company «Gazprom» [11]. This was the first time that a governmental authority came out with such declaration.

Regardless of cautious assessments of shale gas production prospects the Russian oil and gas companies, some experts and governmental authorities have shown some alterations in their position towards this hydrocarbon. In late 2010, Dmitry Medvedev, that time RF President, ordered to prepare the state program on hydrocarbon extraction from unconventional sources, including shale gas. However, the oil and gas companies were not in a hurry to get down to its extraction emphasizing the specific features of shale gas production: relatively low yields of wells and sharp drop of yields already in the first years of extraction, great volume of development drilling, the need of permanent movement to new areas, high capital intensity of shale projects. All these factors permit to identify its role as a local resource.

In 2011 the Energy Committee of the Lower Chamber of the RF Parliament recommended to the government to assess the shale gas potential of Russia, to study the advanced technologies of shale gas production, to evaluate the possibility and prospects of their application in Russia [12]. Moreover, these recommendations emphasized the need of detailed study of the effect of shale gas production in USA and its likely development in European countries and China on the current and future gas deliveries from Russia [13].

Beginning from 2012 with the soaring shale gas extraction in USA, the discussions concerning the prospects of shale play development went on. The significance of shale gas was stressed by Russian President V. Putin, who, in April 2012, said that the country should be ready for remodeling of the hydrocarbon market due to development of the shale gas technologies. In addition, the Russian President noted that the new wave of technological changes is coming and that in the recent years USA was actively developing the shale gas technologies [14]. «Gazprom» was assigned to investigate the consequences of the «shale revolution» while developing the gas export strategy.

At the same time, the RF Ministry of Economic Development presented scenarios of long-term forecasts of the socioeconomic development of the Russian Federation until 2030 [15]. This document outlined the ranges of likely shale gas production in Russia that by 2030 could grow from 60 to 128 billion cu. m. But at this time Russia did not conduct geological surveys, had no data about shale gas reserves, no respective equipment, technologies
and specialists. At the same time, RF Ministry of Economic Development warned about potential threat to the country if USA continues expansion of the shale gas output.

In late 2012 the RF Ministry of Energy came up to the government with the proposal to start shale oil and gas extraction having noted that the shale gas technologies should be worked out in Russia on special test grounds and small plays [16]. However, such proposal did not find support of oil and gas companies. As a result, in 2013 the discussions in Russia concerning shale gas production went on.

The shale gas issues were included into some documents adopted by the RF Government. Thus, RF Government Decree No. 436-p of March 2013 “Natural Resources Restoration and Management” outlined the need to conduct assessments of resources and reserves of shale gas, gas hydrates and coalbed methane, first of all, in the regions not sufficiently provided with oil and gas. Attention to this issue was dictated by the growing significance of the «shale» factor in the world gas production, which invariably resulted in the drop of prices of Russian gas. In this respect the expert community in Russia launched the opinion that Russian company «Gazprom» had «slept out» the shale boom.

However, in April of the same year V. Putin said that «Gazprom» should not be accused of overlooking the «shale revolution» and underlined that the prime cost of shale gas was much higher than of the traditional gas. In addition, Russia has ample fields where natural gas is extracted by traditional methods. V. Putin also noted that shale gas and shale oil production involved serious damage to the natural environment. The Russian President also stressed that Russia did not waive completely the shale gas extraction [17]. A year later, in 2014, Russian President underlined once more that shale gas extraction was very costly and many shale projects could be unprofitable [18].

In 2014-2015 the shale gas issues were discussed many times at the expert level and in Russian governmental institutions. The key idea of these discussions and publications was the need to develop own technologies for shale hydrocarbon production and to work out measures capable to mitigate the likely impacts of the «shale revolution». One of the constraints of shale gas production in Russia was the lack of the technologies of directional drilling and hydraulic fracturing that could be applied in shale play development [19].

Neglect of application of the new technologies for shale gas extraction enhanced the risks of negative impact on Russia of the «shale revolution» the results of which would influence greatly the formation of the Russian gas policy [20]. Russia put more emphasis on gas cooperation with EU accounting for up to 30% of all supplies of Russian gas [21]. As a result, Russia and its gas industry are threatened not so by the «shale revolution» proper, but by technological backwardness, immunity to producing new technologies of the last generation [22].

In 2014 after imposing the Western sanctions on Russia the scale of cooperation in the oil and gas area was cut sharply and the more so as these sanctions affected, primarily, the activity of Western companies which could transfer technologies of shale play development. As a result, the progressing interaction of the Russian companies with the leading foreign oil and gas companies was stopped [23].

Such position was based on the forecasts of shale gas production in Europe. It assumed that Russian gas would remain for long one of the principal hydrocarbon sources for European countries. The key issue will be the price at which European countries will buy Russian gas. According to estimates of the RAS Energy Research Institute, if the «shale revolution» goes on, then by 2040 the Russian export will be cut down by 70 billion cu. m, which will
result in the reduced share of Russia in the European market [24].

In the foreseeable future the «Gazprom» positions in the gas market will be affected by numerous factors, including among others the growing supplies of liquefied natural gas, introduction of energy saving technologies in European countries. In addition, in the recent decade Russia faces the problem of technological backwardness that creates barriers for implementation of projects on hydrocarbon extraction in difficult areas. This refers, in particular, to Arctic with its very complicated geological and climatic conditions that require application of utterly new technological solutions [25].

UKRAINE JOINED THE SHALE RUSH

For Ukraine the key issue in attaining energy independence is the search for alternative energy sources. One of such sources may be shale gas which production is in the focus of attention in Ukraine.

Shale formations taking origin in Poland go through four western areas of Ukraine – Lvovsky, Ivano-Frankovsky, Zakarpatsky, Chernovitsky and reach its central part – Dnieper-Donets Depression. Apart from this, shale plays are found in the Odessa Region and in southeastern regions. Thus, potential shale plays were discovered in several areas of the Dnieper-Donets Depression. In total there have been found 11 perspective areas in Western Ukraine and 7 in the territory of the Dnieper-Donets Depression, i.e. in Poltava and Kharkov regions where traditional gas is actively extracted.

Lack of accurate data on shale gas reserves, technologies, equipment and finance do not make Ukraine less optimistic and regardless of these constraints it evolves the ambitious plans how shale gas can reduce the volume of gas import, primarily, from Russia. According to the published estimates, it will save much budget finance and enhance the energy independence of Ukraine. It is believed that by 2030 the share of shale gas in the gas balance of Ukraine can reach 15-20% which should lead to reduction of gas volumes purchased from Russia. Ukraine planned that during ten years (till 2021) it would be able to double gas production, including shale gas, bringing it to 40 billion cu. m per year.

In fact, there have been no reasonable grounds in Ukraine for such forecasts due to the lack of reliable information about shale gas reserves, lack of technologies, lack of feasibility and geological surveys to confirm practicality of its extraction.

In the recent years the Ukrainian authorities did their best to keep abreast the new tendencies in hydrocarbon production. They passed some decisions aimed to verify the actual shale gas reserves. In 2010 Ukraine launched development of the state purposeful economic program for extraction and use of coalbed methane and shale gas. It envisaged mostly the regulatory measures. The program was designed for the period from 2010 to 2014. After its implementation Ukraine should be able to substitute 1 billion cu. m of imported gas, largely, by coalbed methane. The total cost of this program that had not been realized was evaluated at 500 million USD.

In 2010-2012 Ukraine was endeavoring to attract Western oil and gas corporations to development of shale plays and extraction of coalbed methane. Negotiations were conducted with such companies as ExxonMobil, Halliburton, ConocoPhillips, Shell and others that responded to the Ukrainian proposal. One of the first foreign companies that started its activities in Ukraine was EuroGas Inc. It explored gas fields in Western Ukraine, in the east of the country having accumulated some information required for shale gas production.

ENI and Total also showed interest to develop fields having complicated conditions. Still
in 2010 one of the Total units even signed an agreement with Polish EuroGas Polska taking part, in particular, in the projects on extraction of coalbed methane in Western Ukraine (Lvov-Volyn basin). If the required finance is invested, the gas production may be as high as 15-20 billion cu. m per year.

In early 2011, in Davos, there was the first meeting of Ukrainian President V. Yanukovich with Director of Company Shell P. Vozzer at which they arranged about further cooperation. Shell undertook to organize shale gas extraction in the Kharkov and Donetsk regions. The Treaty on Cooperation in the Oil and Gas Industry was signed by Shell and “Ukrzazdobycha” still in June 2006.

Ukraine connected great expectations concerning shale gas production with US assistance. In February 2011 there was the third meeting of the Ukrainian-US Commission on Strategic Partnership that was the main coordinating mechanism of bilateral cooperation for all issues being of mutual interest for Ukraine and USA. As a result of negotiations the joint declaration was adopted confirming the relevance of provisions contained in the Ukraine – USA Charter on Strategic Partnership signed in December 2008. In addition, the governments of Ukraine and USA signed the memorandum of mutual understanding in respect of unconventional gas resources, including shale gas. The purpose of this memorandum was to create conditions for exchange of knowledge and expert research results between these two countries on assessment and qualification of shale gas resources in Ukraine. In addition, it also referred to further development of mutually beneficial cooperation of the companies in analysis of potential reserves of coalbed methane, shale gas, tight gas in dense rocks and other unconventional hydrocarbons in different areas of Ukraine. And, finally, this document asserted that governments of USA and Ukraine were endeavoring to promote and to develop further the direct contacts and cooperation among governmental authorities, universities, research centers, institutions, exploration and production companies. This memorandum was called to create, on a governmental level, the incentives and to give warranties of promoting projects on shale gas exploration and extraction.

In December 2011, the Ukrainian government issued the decree in which it approved the tender conditions for Product Sharing Agreement (PSA) for Yuzovsky (Donetsk and Kharkov regions) (reserves of 4 trillion cu. m) and Olessky (Lvov and Ivano-Frankovsky regions) (reserves of 2.98 trillion cu. m) shale gas plays.

Ukraine extended its cooperation with major oil and gas companies having experience in shale gas extraction. In 2012 Ukraine organized a tender for product sharing transactions in respect of perspective areas of probable shale gas extraction: Yuzovsky and Olessky. The Yuzovsky site (Donetsk and Kharkov regions) was taken by British-Dutch Shell that in January 2013 signed PSA with the Ukrainian government for 50 years and planned to extract shale gas. In the first phase of geological surveys it was expected to obtain 2D and 3D seismic data and to conduct drilling of 15 wells in the Yuzovsky site. Geological surveys should have been financed by foreign investors within 3 to 5 years. By rough estimates, their cost should have been from 200 to 400 USD. If the surveys and prospective drilling provided positive results the company could start drilling and completion of production wells. The volume of investments was expected to be some 3.5 billion USD. Simultaneously, the construction of the pools of water to be used in fracking was started.

For the second site — Olessky (Lvov and Ivano-Frankovsky regions) the tender was awarded to US Chevron (the contract was signed in 2013). In December the Ukrainian
government made changes in the tender for hydrocarbon sharing agreement to be extracted within the Olessky site.

Rather successful progress in attracting foreign oil and gas companies to shale play development in Ukraine was stopped by political events in this country. In late 2013 the actions of the opposition resulted in aggravation of the political situation that in February 2014 led to change of government. Later, in April of the same year the military actions began in Lugansk and Donetsk regions that affected seriously the possibilities to develop shale plays. As some part of shale plays located in the zone of military actions, the foreign oil and gas companies had to postpone their activities in these regions. In late 2014 US Chevron refused from geological and prospecting surveys in Ukraine due to growing risks. In August 2015 Shell withdrew from the joint project with Ukrainian company «Nadra Yuzovskaya». Western investors had to take such steps because of instability of the social and political situation in Donbass which was an obstacle for shale play development.

Lowered interest of foreign companies to shale play development in western regions of Ukraine was also noted. The main reason for such change of their attitude was connected with the general instability of the political situation in Ukraine. As a result, at the turn of 2014-2015 the development of shale plays in Ukraine had never started. Military actions in the eastern regions of Ukraine which intensity had declined in March 2015 enhanced the uncertainty as to when foreign oil and gas companies could start shale play development.

But Ukraine did not abandon the idea of shale play development. In March 2015 National Joint Stock Company «Nadra Ukrainy» allotted 15 sites for drilling prospecting wells for gas trapping from shale formations. For accomplishment of the perspective plan of development that will give a growth of 220 million tons of fuel equivalent this company, in the conditions of limited budgetary funding, is expecting to obtain 300 million USD under state guarantee from international financial institutions and, accordingly, it makes active efforts to attract international oil companies to participation in joint projects.

The task of diversification of hydrocarbon sources was included into the document “Energy Strategy of Ukraine: Security, Energy Efficiency, Competition” prepared in August 2015. It stated the need to reform the energy complex of Ukraine in the period till 2020 and to fix strategic benchmarks for the long-term perspective till 2035. According to this strategy, the share of unconventional energy should be about 20%, including shale gas.

Already in 2016 Ukrainian authorities returned once more to the idea of shale gas extraction in the Yuzovsky site that had been earlier abandoned by British-Dutch Shell. The rights to shale gas development in Donbass and in the Kharkov Region (Ukraine) were awarded to Dutch Company Yuzgaz B.V. In 2017 the company started preparatory works for shale gas production.

**BUILD-IN INTO SHALE FLOW**

In some post-Soviet countries the shale gas production is considered as an opportunity to alleviate in the future the dependence on external supplies of natural gas. Russia is the sole source of natural gas for Moldavia and Ukraine via which territory the Russian gas is delivered. Moldavia covers 100% of its gas needs by Russian gas and has no other alternative sources. Accordingly, Moldavia, being dependent on hydrocarbon import, is endeavoring to diversify the hydrocarbon sources. Shale gas plays found in Romania and Ukraine may change cardinally the energy security for Moldova. The representatives of this country have stressed more than once
that they are interested in energy sources diversification.

According to the Draft National Plan of Action in Renewable Energy Sources for 2013–2020, Moldavia expects by 2020 to provide 20% of energy consumption from the use of renewable energy sources (RES) and shale gas production. However, there are some obstacles for accomplishment of these plans, and the key one is that the state has no finance [26]. In addition, great wear-out of gas pipeline networks is also a negative factor for energy security of the country. According to the data contained in the Energy Strategy of Moldavia that was updated in 2013, by 2030 approximately 70-75% of the equipment used in the energy sector will become deteriorated.

In June 2014 the Moldavian government decided to establish the state enterprise «Vestmoldtransgaz» with the authorized capital of 0.57 million USD that would manage gas pipeline Yassy-Ungeny and provide services on natural gas transit via this line from Romania to Moldova. This enterprise will be a part of actions of the Moldavian government for obtaining «alternative sources of natural gas supplies in the context of energy security improvement».

In 2015 Moldavia started natural gas deliveries from Romania via pipeline Yassy-Уngenя, but in small quantities – less than 1 billion cu. m with the carrying capacity of this line being 1.5 billion cu. m. It should be noted here that Romania proper cannot cover its gas needs from its own sources and imports from Russia 22-42% of gas to meet its domestic needs. According to Bucharest, in case of stopping gas supplies from Russia the internal reserves of the country will be sufficient only for not more than 6 months.

Moldavia invited British Company Canyon Oil and Gas Ltd. that applied hydraulic fracturing technology (HFT) in prospecting shale gas and oil plays in the hope of future commercial scale extraction. The company invested 1 million USD into drilling of two oil wells in the Valena Region in Moldova. Exploitation of one well began in September 2013 and of the second well in the second half of 2014. But the yields of both wells were insignificant.

The company also possesses several sites for gas extraction in Viktorovka and Baimaklia (Cahul Region) located quite near the state border with Romania. The company invested its own money into exploration of these sites and expected to get 80% of revenues from gas output. The remaining share was with Oil and Gas Company «Velixchimp Ltd». Company Canyon Oil and Gas Ltd. expected to double the yields in Valena by installing additional advanced drilling equipment.

**SHALE GAS REQUIRES FURTHER STUDY**

In the recent years the post-Soviet countries have not achieved the unified understanding of the state and prospects of shale gas extraction. Scientists had noted that investigations were conducted in the 1940а-1950s on small territories.

The “shale revolution” quickly developing in the USA and having engulfed the post-Soviet countries has not produced the expected effect as yet. In view of the negative environmental consequences the post-Soviet countries are not in a hurry to push extraction of this kind of hydrocarbons.

In Russia the interest to shale gas is reduced to discussions at the expert level as availability of ample traditional gas reserves makes shale gas not so attractive [27]. And the more so as the prime cost of traditional gas is much lower than the expected cost of shale gas [28].

Great wish of Ukraine to start shale gas production and shale gas potential reserves in Moldova raise the issue of the need to coordinate efforts of these two countries in implementation of energy projects. Ukraine has discovered considerable shale gas resources
in the area adjoining the territory of Moldova and proposed to start their production jointly. In addition, Moldova was presented the results of researches and expertise of this energy source. There is also a possibility that shale gas plays may be found not far from Chernovtsy (Ukraine) that is close to the territory of Moldova.

Kazakh government also focuses much attention on shale gas, thus, the Program on Alternative Energy Development in Kazakhstan for the Period of 2012-2030 was prepared. The main targets defined in this program include development and management of alternative energy in Kazakhstan. Astana is not going to neglect alternative energy sources, including shale gas.

In 2014 Kazakhstan planned to launch development of shale gas plays. However these works were postponed due to probable negative consequences for Kazakhstan.

CONCLUSION

Shale gas may change the alignment of forces in the global gas market which may influence foreign and domestic policy of many countries. This applies in full measure to the post-Soviet countries which start looking more closely on this kind of hydrocarbons. It is worth noting that until recently the shale gas was not taken into consideration while developing oil and gas fields [29].

Shale gas production makes alterations in the policy of many world countries provoking the new lines of rivalry and changing cardinaly the alignment of forces in the world and regional energy markets. The technologies of shale gas extraction which reserves are available in many world countries, including those which have not been in the group of gas producers, may lead to radical change of the situation. And the more so as many world countries, first of all, major producers and consumers of hydrocarbons, are involved, directly or indirectly, in shale gas extraction.

The «shale revolution» bears certain challenges for Russia being at the same time the occasion to underline the importance of further development of pipeline projects. Russia is doing its best to assert the idea on the need of their implementation stressing the role of operating and potential projects in improving the energy security of Europe. In their turn, the opponents emphasize the growing role of shale gas which should reduce significantly the need of construction of new pipelines for Russian gas.

The main problem for Gazprom is depletion of gas fields and acute need in large investments into development of new sites: gas fields in Western Siberia have been worked out for more than 50%, while the share of difficult reserves exceeds 60% and goes on growing.

For many post-Soviet countries the shale gas production seems the sole alternative of Russian gas deliveries. In particular, Moldavia feels rather vulnerable in natural gas supplies as Russia is the only source of natural gas. Diversification of energy sources may create prerequisites for lowering the gas prices and developing rivalry to Russian gas. However, such scenario may be realized in the far perspective. Moldavia also takes into consideration the negative environmental impacts of shale gas production and do not force these projects.

Ukraine, for which the attainment of energy independence is a priority issue, tries to address the similar tasks. One of the directions of this policy is development of new hydrocarbon fields, in particular, production of unconventional gas resources (shale gas, coalbed methane, tight gas, etc.). However, the first attempts of Ukraine to develop shale gas plays, including with the assistance of the leading oil and gas companies, have failed. The political risks, lack of accurate data about shale gas reserves
and also lack of the required infrastructure played their role in this failure.

The issues of shale gas production in Kazakhstan are also rather acute. But insufficient geological study of potential plays, lack of explicit legislative regulation of development process, high environmental threats due to imperfection of extraction technologies and high investment risks of shale projects are obstacles for full-scale implementation of the shale development strategy in Kazakhstan. But this does not mean that the country will not take efforts to organize shale gas production. In the nearest decades Kazakhstan is going to take particular steps for development of shale plays available in the country [30].

Shale gas production in the post-Soviet countries may be rather perspective in terms of diversification of gas sources. At the same time, it will be possible to speak about particular plans on shale gas development only after obtaining answers to such questions as prime cost of extraction, possibilities to observe ecological norms. Among main environmental issues of shale gas production there are seismic risks, groundwater pollution, releases into atmosphere, pollution of surface waters and soils.

For increasing the volume of extracted shale gas and improving the energy security the post-Soviet countries should increase capital investments into exploration and development of oil and gas fields. This will ensure growth of their own hydrocarbon reserves and permit to renovate and update the drilling and oil and gas extraction equipment, to commission new capacities and to intensify production in the existing fields.

Quite burning for the post-Soviet countries is also the issue of technologies which they have not possess so far. One more key issues that is a constraint for shale gas production in Russia is hydraulic fracturing without which commercial scale production of shales is impossible [31]. To obtain certain progress in this sphere the post-Soviet countries should increase considerably the quantity of operating drilling rigs and pumping plants for hydraulic fracturing of formations [32]. It is not accidental that about 2.5 million of HF operations are performed in the world and about 1 million in the USA.

Therefore, for development of unconventional gas reserves on a commercial level it is necessary to conduct geological surveys for their assessment and to verify the prime cost and cost effectiveness of their extraction; to develop modern technologies and engineering facilities for gas extraction and processing; to envisage privileged taxation for geological survey and production companies.

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