CSCanada
Energy Science and Technology
Vol. 4, No. 1, 2012, pp. 68-74
DOI:10.3968/j.est.1923847920120401.178

ISSN 1923-8460[PRINT]
ISSN 1923-8479[ONLINE]
www.cscanada.net
www.cscanada.org

Unconventional Oil Potential Tends to Change the World Oil Market

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Received 12 May 2012; accepted 14 July 2012

Abstract

Falling unconventional oil production costs and a significant increase in its production (especially in the North America) can potentially impact the structure of the global oil trade. As a result, it will create additional risks for the producers of conventional oil, which production costs went up sharply in recent years.

The aim of this study is the analysis and forecast of the development of unconventional oil production, its potential impact on the international oil market and the traditional exporting countries. The forecast for the future state of the oil industry was carried out with the help of a modeling complex *SCANER*, developed at the Energy Research Institute of the Russian Academy of Sciences (ERI RAS). The estimates of the future situation in the oil market were based on the forecasts of the economic development of the world's main countries and regions, which then were compiled by the Russian Energy Agency in 2012.

The modeling results showed that unconventional oil had a great development potential. According to the ERI RAS forecast, its production by 2035 could increase by almost fivefold as compared to 2010 (i. e., from 2.3 mb/d to 11.4 mb/d), around 90% of oil from unconventional sources will be produced in the North America. Such an increase in production may also lead to the situation, when the North America will reduce its dependence on imported oil. In the future, this will lead to a redistribution of oil trade flows in the world and will impose a negative impact on the producers in Europe, the Commonwealth of Independent States (CIS), the Asian-Pacific region (APR) and, to a lesser extent, in the Middle East.

Key words: Unconventional oil; SCANER; World oil market

Grushevenko, E., & Grushevenko, D. (2012). Unconventional Oil Potential Tends to Change the World Oil Market. *Energy Science and Technology*, *4*(1), 68-74. Available from: URL: http://www.cscanada.net/index.php/est/article/view/10.3968/j.est.1923847920120401.178
DOI: http://dx.doi.org/10.3968/j.est.1923847920120401.178

INTRODUCTION

A significant dependence on the state budget of exporting countries on oil supply exported to the world market requires compiling personalized forecasts of the world energy market development in order to determine the potential oil demand in foreign markets. It should be noted that a large number of forecasts related to the world energy development is made now almost everywhere the world, including the world's leading energy agencies[3-4], and the oil industry forecast is most clearly reflected in the OPEC annual survey[5].

In Russia, such forecasts, which are based on the complex *SCANER*[1], are made every year by ERI RAS. Russia plays one of the key roles in the global energy industry, which makes the country an important player in the energy markets. Russian experts are often forced to "reactively" discuss a "foreign" vision of the industry future. The development of this forecast model was determined by the intention to ensure the continuity of the in-depth analysis of the world economy and energy trends for the long-term period, which would take into account the financial and technological factors[6], as well as identify possible risks for the Russian oil and gas industry.

The rapid development of technologies aimed at the production of non-traditional oil and lowering the breakeven price of projects in conjunction with the increase in the development costs of fields, which have conventional oil reserves, pose significant risks to the

world's traditional suppliers of oil and Russia[2]. Thus, ERI RAS, in its latest forecast of the world energy development, gave the considerable amount of attention to the potential of the development of unconventional oil sources.

1. METHODS SUMMARY

The module for global energy forecasts is an element of the SCANER complex, which has been actively developed for the past 5 years. The module represents a system for the simulation and optimization of economic and mathematical models of the global energy sector, data and knowledge bases linked to these models. The module enables to determine the positioning of the Russian energy sector within the global energy sector, evaluate the possibilities and risks of cooperation with foreign countries, develop custom forecasts of the situations in the global energy market and examine the forecasts produced by foreign analytical centers (Figure 1). In addition, it was tailored to measure the impact of the development of the global energy sector on the Russian energy sector and evaluate the capabilities of Russian companies related to the expansion of their activities on the external markets.

Global energy forecast is produced based on demographic forecasts, evaluations of the global energy sector development, dynamics of technological progress, energy and environmental policies in various countries.

A system monitoring the world energy markets has been developed within the structure of the module. It collects and analyses external statistical information, monitors the energy sector databases and the energy policies of different countries and uses the information on leading energy companies and top energy projects.

The module for global energy forecasts enables to determine the position of the Russian energy sector in the global energy sector, evaluate the possibilities and risks present in the external markets, and examine the forecasts produced by foreign expert organizations.

The system for collecting and processing the information within the module for global energy forecasts includes[7]:

(1) The module for the renewable energy sector includes detailed information on all national plans related to the development of the renewables, which is updated in accordance with the economic indicators of the "green" technologies.

(2) The entire global nuclear industry is represented on a module-by-module basis, including nuclear power units under construction, those planned for construction and potential projects. Changes in the energy policies of various countries are taken into consideration.

(3) Coal industry module enable to generate rational scenarios of industry development within the framework of a simulation procedure of coordinating demand for coking and thermal coal in Russia and abroad with potential development of the main basins and coal companies.

(4) The optimization model for the global gas market-it is the first instance when this model reviews pipeline and LNG markets of all the countries, which produce and consume gas. The model is equipped with the extensive database on foreign gas projects, fields, LNG plants, transport infrastructure and contracts. It also enables to take into account concurrently operation of the long term contract system and spot gas markets.

(5) Research technology considers non-economic limitations, which describe group collusion and market barriers. This makes it possible to analyze the impact of imperfect competition in the gas markets and consider geopolitical factors influencing the development of the gas markets (transit conflicts, armed conflicts, regulatory amendments, changes in the energy and environmental policies of the consuming and transit countries.

(6) Revision flexibility of the modeling module enabling to reflect the setting of the issue, changes in forecast horizons and the level of detail in the description of the research target (products/regions/countries etc.)

The module of the global oil market describes the resource base, cost of production, transportation and processing; operating and reserve capacities by field, groups of fields and sites. The oil model derives the information on the oil demand according to sectors and geographical localities used as the input data from the demand forecast module[6]. The demand forecast module determines the demand for oil based on the oil capacity indicators, similar to the computation of the energy demand. The general formula for the energy demand per sectors is as follows:

$$DEM_t = DEM_{(t-1)} * (DR)^E * (1+TR)$$

DEM_t – annual energy demand of a sector, t
DR – demand driver (GDP, population, etc…)
E – elasticity of the demand driver
TR – energy trend

At the first stage, the oil model translates the oil demand of the sectors and regions into the demand according to the types of petroleum products, which enables to make transport optimization related to the delivery of oil and oil products to the markets of the given geographical localities, comprising more than 2000 routes. The block of the oil market forecast contains the data related to more than 700 oil refineries, and gas processing plants (GPP), including the data on oil processing depth, capacities of the plants, and aggregate structure of produced oil products.

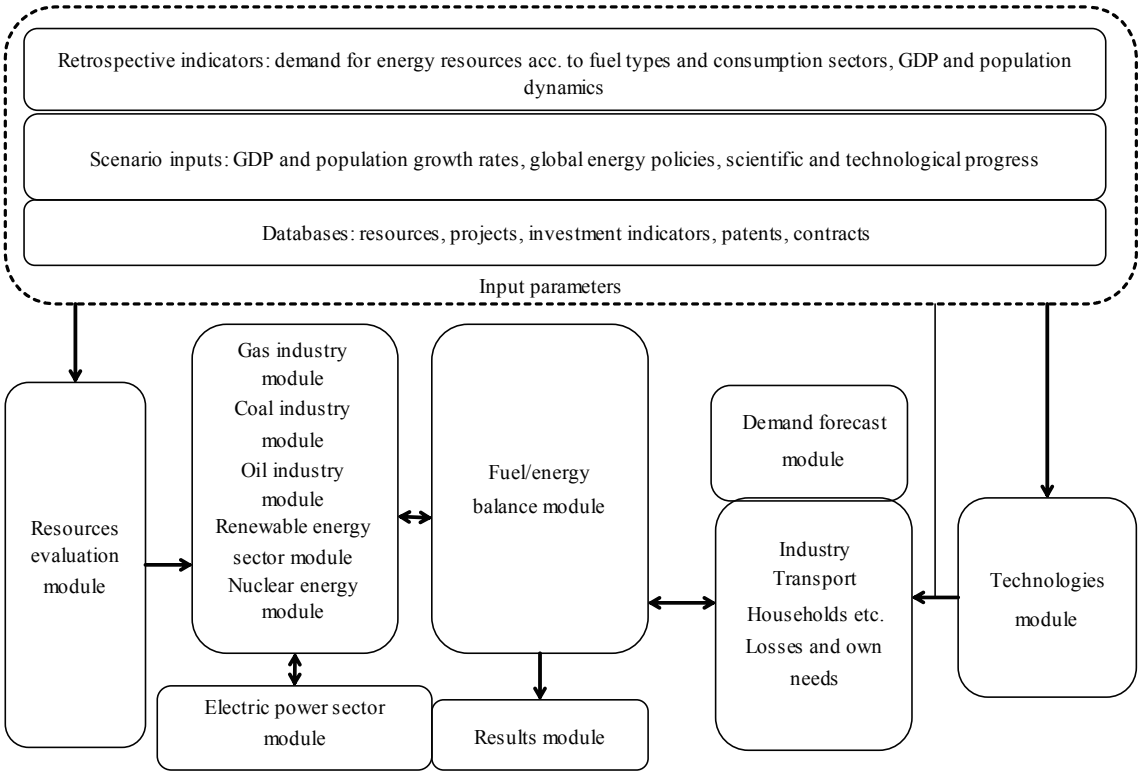

Figure 1
Structure of the Modeling Global Energy Forecasts

The forecast for the future production volumes of 450 largest oil fields, oil and gas provinces is based on the data on the reserves, costs and profiles of production. The dynamics of production profiles is simulated on the basis of the rates of oil production reported by operating companies. If the above information is not available, the Hubbert linearization curve is applied then[8]. The production forecast module also contains the data on the reserves of major oil and gas regions and potential oil recovery ratios, which enables to add to the forecast production growth rates from the undiscovered potential reserves and inactive fields. After the assessment of potential production profiles, the optimization of field commissioning/decommissioning is computed, which is based on current and estimated project costs, costs for transportation to a destination refinery and which is similar to the methods of forecasting used in the "Omo-oil" model[9] (Figure 2).

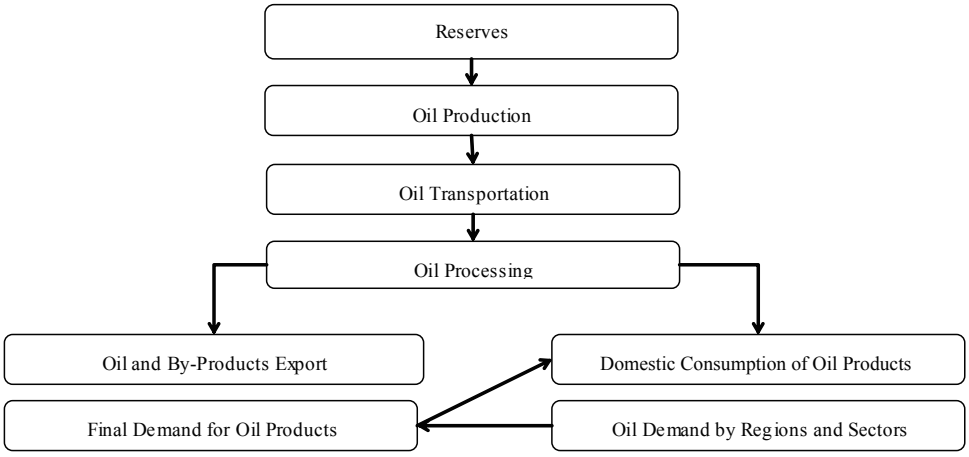

Figure 2
Structure of Modeling Oil Demand Forecast

2. RESULTS AND DISCUSSION

2.1 The Potential for Extracting Oil from Unconventional Sources According to 2012 ERI RAS Baseline Scenario

The baseline scenario of the ERI RAS forecast is based on the assumption that there would not be any significant upheavals in the oil market. The oil industry and energy sector would develop in the mode "business as usual", the price corridor used in the scenario ranges from $US 100/bbl to $US 145/bbl (2010) for the period from 2010 to 2035 (Figure 3).

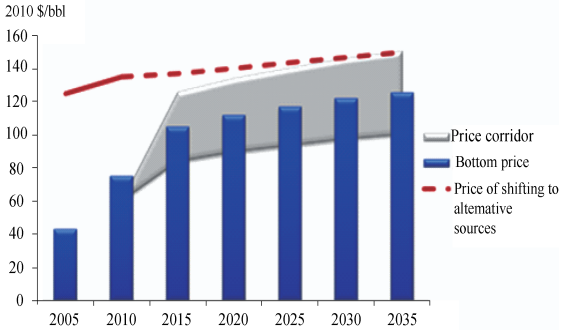

Figure 3
The Price Corridor of the Baseline Scenario
(Source: Global and Russian Energy Outlook until 2035, ERIRAS, REA, Moscow 2012. ISBN 978-5-91438-009-7)

The price corridor is not the forecast for oil prices - it is an economically substantiated range, within which, according to the scenario assumptions, the price of oil would fluctuate[10-11]. Nevertheless, due to the short-term impact of various factors, the price of oil, within certain periods of time, may go beyond the specified range.

The bottom price of the forecasted period is defined as the expenses for oil production in the most costly fields, which would have to be spent in order to meet the global demand for oil. The upper oil price of the forecast is defined as the price of shifting to alternative energy sources and, in particular, biofuel. Almost all oil production projects may operate within the above price range, including the North Sea offshore project, located in North-West Europe [12-13].

Modeling results show that global oil production, according to the baseline scenario, will continue to grow and it will reach 97.4 mbd/d by 2035. The demand for liquid fuels, which will not be covered by oil and which will amount to 4.41 mbd/d by 2035, will be met by biofuels and synthetic petroleum products, produced by utilizing gas to liquid (GTL) and coal to liquid (CTL) technologies. The leading role in the global oil production will be still retained by the regions located in the Middle East, the North America and the CIS. Noteworthy, that the increase in production for each of these regions will be characterized by a diversity of oil sources:

(1) In the North America, the production growth will be achieved mainly by increasing the number of projects aimed at oil shale and bituminous oil production;

(2) In the Middle East, the production growth will be achieved by the increase in the conventional oil production capacities of offshore and onshore oil and gas condensate fields;

(3) In the CIS countries, the main sources of oil production will be projects aimed at the development of the Caspian Sea shelf and the Russian Far East and Eastern Siberian fields (Figure 4).

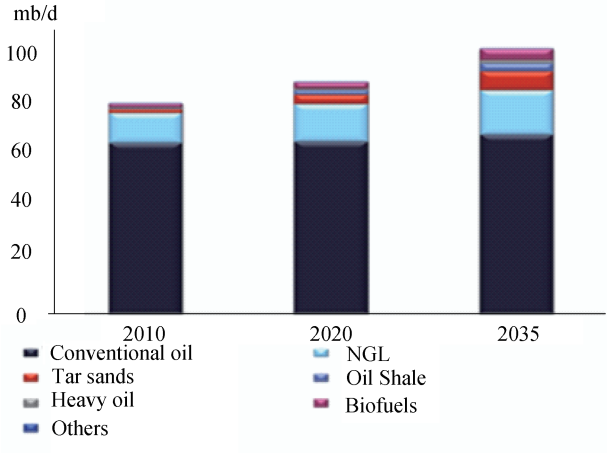

Figure 4
The Forecast for Global Liquid Fuel Production
(Source: Global and Russian Energy Outlook until 2035, ERI RAS, REA, Moscow 2012. ISBN 978-5-91438-009-7)

Globally, the significance of unconventional oil will continue to grow. Oil production from unconventional sources will reach 16.5% of the total oil production, while unconventional oil will be mostly produced in the United States and Canada, and it will reach 10.2 million bbl/day by 2035. The main issue still remaining in forecasting future production volumes is the determination of reserves.

2.2 Prospects for Extra Heavy Oil

Most of the estimated extra heavy oil reserves are located in the South America, and, particularly, in Venezuela, which, at the moment, is not only the heavy oil world leader, but the country also leads in heavy oil production. According to the estimates, the amount of Venezuela's reserves range from 296.5 to 652 billion barrels of recoverable oil[14,15]. By 2017, they plan to implement several new projects with total production capacity of more than 109.16 million tons of oil[3]. Most of the projects involve the construction of new plants – upgraders, which will produce synthetic oil obtained by mixing of extracted hydrocarbons and light hydrocarbon fractions.

The potential of other regions and countries, which also have large reserves of high viscosity oil, is still quite difficult to assess at the moment.

The mass media mentions very often the project for the development of the high viscosity oil deposit located in the neutral zone between Saudi Arabia and Kuwait. The Bahrain Minister of the Oil Department, delivering his speech on June 5, 2010, pointed out the significant potential of heavy oil for the future of the country's oil industry and which could be realized if oil prices grew above $80 per barrel[16].

To date, however, the talks on the Middle East's heavy oil still remain at the stage of the discussion on possible projects between governments and foreign oil majors, such as Total, Chevron, and Texaco. Significant reserves of easily accessible conventional oil, in terms of production costs, are much more attractive sources of income for the Middle East region.

Russia's potential reserves of high-viscosity oil, according to the IEA estimates, in 2010 could amount to 47.75 million tons[3]. It is obvious that the heavy oil reserves are located in the Eastern Siberia, but, at the moment, their commercial attractiveness is a big question, due to the poorly known geologic structure of the formations and the remoteness of potential fields from infrastructure facilities. In Tatarstan, pilot projects were launched by the Tatneft Company, but they did not reach to any level of industrial significance. In the Komi Republic, LUKOIL is implementing pilot projects in the Yarega oil field, which was discovered in 1932. Unattractiveness of Russian projects for investors is worsened by high costs associated with the severe conditions accompanying oil production and rigid laws regulating the oil industry[2].

Despite the optimistic estimates of the recognized world authorities, there are several factors that can hinder the rapid development of hydrocarbon production from unconventional sources.

(1) Due to the low oil price, the development of the most of heavy oil fields will become economically ineffective.
(2) The "closed" Venezuelan economy, its low investment rating and the lack of objective information on existing projects may bar the access to the capitals of major Western companies, which could be invested in the development of heavy oil fields, thus, substantially reducing the potential oil production in the region, which has the largest reserves of unconventional oil.
(3) For the countries of the Middle East (the second region with the largest reserves of heavy oil), it is unprofitable to produce heavy oil, since they have significant amounts of cheaper conventional oil.
(4) The development of heavy oil production in Russia remains doubtful, due to imperfections in the existing legislature related to regulating the share of rental payment between the state and the investor.

In any case, a significant increase in oil production from heavy and extra heavy oil reserves should not be expected within the coming decade. The process of bringing heavy oil to the world market is now totally dependent on the countries, which lack a favorable investment climate and flexible laws and which makes them unattractive to investors.

According to the baseline production scenario of the ERI RAS forecast, the production of extra heavy crude oil will exceed 2 million bbl/day.

2.3 Prospects for Oil Shale

According to the International Energy Agency (IEA) estimates, the total world resources of oil shale amount to 477 billion tons[3]. This figure does not reflect the entire amount of the reserves, as their major part still has not been explored yet, while the volumes of technically recoverable reserves are estimated very tentatively.

To date, the largest formation of oil shale is the Green River deposit located in the U.S. Its reserves are estimated at around 2000 billion barrels of oil. The Colorado reserves amount to 1000 billion barrels of oil. Other deposits of shale oil are found in Australia, Russia, Brazil, China, Estonia, Jordan and Morocco.

A significant breakthrough in the development of oil shale deposits was made almost simultaneously with the advances in sphere of shale gas production. Horizontal drilling and multistage fracturing, performed with the use of chemically active substances, reduced production costs, which resulted in the significant increase of the economic efficiency of shale oil production in the U.S. and encouraged the development of Eagle Ford, Backen Shale projects, and exploration of the Green River formation.

The total oil production from oil shale in the U.S. may exceed 2 million bbl/day by 2020 and total to about 3.01 million bbl/day by 2035, according to the ERI RAS forecast.

2.4 Prospects for Tar Sands

Significant reserves of tar sands are located in Canada, Russia, Africa, Asia and the USA. Canada is the leader in the tar sand reserves.

In Canada, a profound increase in oil reserves was made owing to the discovery of tar sands deposits. For example, the Canadian oil reserves amounted to 14.66 billion barrels in 1998, but already in 1999, when oil sands were discovered, the country's reserves were estimated at around 163.3 billion barrels of oil. At present, the aggregate amount of traditional and unconventional oil reserves in Canada total to 175.18 bln barrels[17].

The main potential of oil production from tar sands will come from the Canadian deposits due to its significant amounts of reserves, favorable investment climate and relatively low cost project planning.

Global production from oil sands may exceed 7.22 barrels million bbl/day of oil, according to ERIRAS.

2.5 Unconventional vs. Conventional Oil

The increase in oil supply from unconventional oil fields takes primarily primarily due to of the dynamics of the costs for the production of oil shale and sands. The breakeven price of these fields has changed in recent years, and during the period from 2006 to 2011, the costs of oil produced from shale dropped twofold – from $US 105/bbl to $US 48/bbl. During the same period, the breakeven price of oil sand deposits increased only by 20 % and amounted up to $US 73/bbl.

For the forecast period, the costs of shale oil production is expected to increase slightly and amount to $US 54/bbl in 2035, costs of oil sands production will be up to $US 98/bbl by 2035, costs of extra heavy oil production will rise to $US 99/bbl[6].

The growth of unconventional oil production in Canada and the United States, according to the forecast, will provide the overall production growth in the North America as well, which, by 2035, could result in more than 40% decrease in imports to one of the most energy-intensive import oil markets.

If the ERI RAS baseline scenario for 2012 proves true, the most attractive destination for oil exporters will become the Asian-Pacific and West European markets. It is noteworthy that it will be extremely difficult for Russia and the CIS countries, and, in particular, for Kazakhstan and Azerbaijan to compete in these markets with light oil from the Middle East and cheap oil African oil fields. For these producers, the target markets will remain in the West Europe and China, where oil will be delivered via the Eastern Siberia – Pacific Ocean and Atasu-Alashankou pipelines, which are already put into operation.

2.6 The "Shale Boom" Scenario: Threats and Risks for the CIS Countries

A significant increase in the production of shale oil in the U.S. as compared to the baseline scenario and further decline in the costs of production at such deposits is one of the most risky scenarios for conventional oil producers. In its forecast for the world energy, ERI RAS analyzed the "Shale boom in the United States" scenario taking into consideration the following assumptions:

(1) A further reduction in costs of shale oil production up to 2015.
(2) The U.S. will increase oil production from shale plays, despite the potential environmental threats, which may be incurred by production.
(3) The oil price drops under the impact of increasing capacity of cheap oil shale production, which will result in the fall in the production of the costly European and CIS deposits; the North America significantly increases its shale oil production.
(4) By the end of the forecast period, the U.S. almost completely abandons oil imports from all the countries, except for Canada.

The materialization of this scenario may lead to the drop in prices to $US 80/bbl, which may occur within the next five years (Figure 5), if the role of speculative activities on the oil prices excluded[10].

Such a scenario is especially dangerous for the countries with high oil production costs, and in particular, for the countries of the CIS, Asian Pacific, Western Europe and some Middle Eastern countries, which will be forced to switch to production of more expensive oil from deep-seated deposits. The modeling results show that the increase in the production of oil shale will reduce the U.S. imports up to 4 million tons by 2035, thus, decreasing the oil production in the CIS, Asia Pacific and Europe in total, more than 4.5 mb/d.

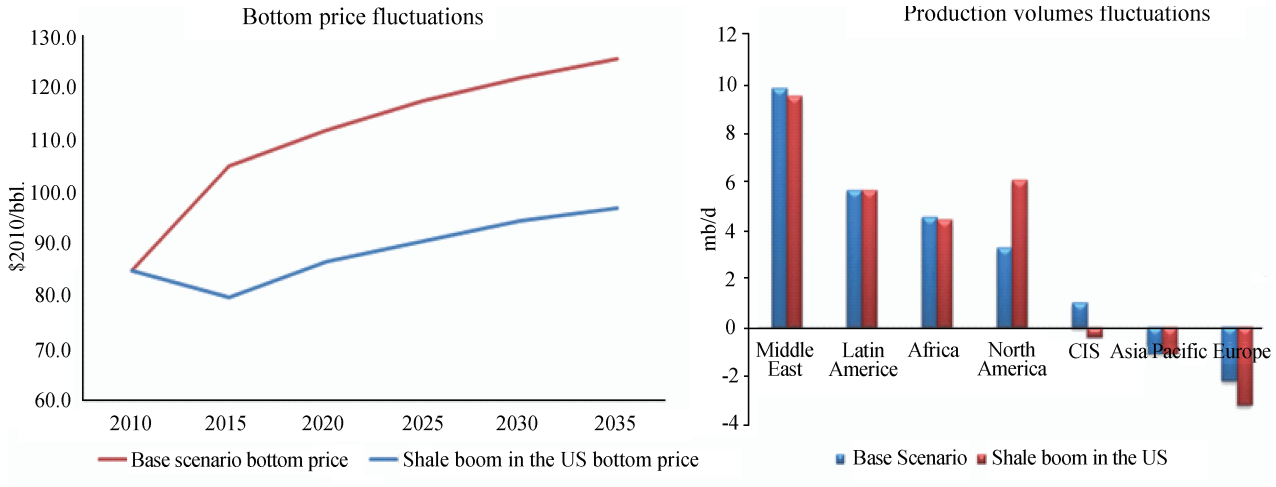

Figure 5
Fluctuations of Costs and Production Volumes acc. to the "Shale Boom in the US" Scenario Scenario
(Source: Global and Russian Energy Outlook until 2035, ERIRAS, REA, Moscow 2012. ISBN 978-5-91438-009-7)

CONCLUSION

The development of unconventional oil production technologies carries the objective risks for conventional oil producers. It is noteworthy that for the major exporting countries, the price of oil is the main factor of a deficit-free budget, which means a sustainable development of the country.

According to the Russian Energy Agency, the budget breakeven oil price for Saudi Arabia equals to $US 75/bbl and if the "Shale boom" scenario materializes and oil prices drop to $US 80/bbl, it would result in the slowdown of the biggest oil producer economy.

For Russia, the budget breakeven oil price, set forth by the Ministry of Finance of the Russian Federation, ranges from $US 100/bbl to $US 117/bbl for the next three years. Given the high breakeven price for Russian production projects, the decrease in oil prices will inevitably aggravate the economic situation in the country. A similar situation may occur in the Caspian countries - Kazakhstan, Azerbaijan and Turkmenistan, and some of the Middle East, such as Iran and Bahrain. The oil price decline will also affect oil production in Norway, which may become economically ineffective without the state subsidies.

The development of unconventional oil production significantly affects the global trade flows. Thus, the declining US demand for imports and the gradual stagnation of oil demand in Europe, due to the introduction of energy-saving technologies, will result in tighter competition among suppliers of the Asian-Pacific oil market. Such a "concentration" of the oil market in one region may lead to significant differences in spot oil prices in different regions of the world, yet creating even greater risks for oil producers and consumers.

REFERENCES

[1] Makarov, A. (2011). *SCANER, Super Complex for Active Navigation in Energy Research*. Moscow: ERI RAS.

[2] Grushevenko, E., & Grushevenko, D. (2012). Unconventional Oil: Potential and Prospects. *Energy Development Strategy, 14*(1), 56-62.

[3] IEA (International Energy Agency) (2010). *World Energy Outlook 2010*. OECD/IEA, Paris.

[4] U.S. Energy Information Administration (2010). *Annual Energy Outlook 2010*. Washington, DC: U.S. Department of Energy.

[5] OPEC (2011). World Oil Outlook 2011 [Online forum comment]. Retrieved from http://www.opec.org/opec_web/en/publications/340.htm

[6] ERI RAS, REA (2012). Global and Russian Energy Outlook until 2035 [Online forum comment]. Retrieved from http://www.eriras.ru/files/Outlook_2012_eng_light.pdf

[7] Mitrova, T., & Kulagin, V. (2011). Events in Japan, North Africa and the Middle East and Their Impact on the Prospects for Global Energy Markets. *Electric Power News, 52*(4), 24-33.

[8] Höök, M. (2009). *Depletion and Decline Curve Analysis in Crude Oil Production* (Licentiate thesis). Uppsala University.

[9] Coordination Council of the Institute of Economic Forecasting of the Russian Academy of Sciences (2010). *Guidelines for the Development of Forecasting Technological and Socio-Economic Development of Russia Until 2030* (pp. 423-430).

[10] Grushevenko, E. (2011). Analysis of Oil Prices, Determination of Effective Price. *SPE Oil & Gas Horizons conference, 14-15 November 2011, Moscow*.

[11] Grushevenko, D. (2011). Analysis of the Oil Pricing Mechanism, Calculating the Effective Costs. *Scientific and Practical Conference "Oil & Gas 2011", 11 April 2011, Moscow*.

[12] Goldman Sachs (2011). 330 Projects to Change the World [Online forum comment]. Retrieved from http://ebookbrowse.com/goldman-sachs-330-projects-to-change-the-world-pdf-d143547012

[13] Goldman Sachs (2012). 360 Projects to Change the World [Online forum comment]. Retrieved from http://www.docstoc.com/docs/119164686/Goldman-Sachs---360-projects-to-change-the-world

[14] OPEC (2011). 2010/2011 Annual Statistical Bulletin [Online forum comment]. Retrieved from http://www.opec.org/opec_web/static_files_project/media/downloads/publications/ASB2010_2011.pdf

[15] USGS (2009). *An Estimate of Recoverable Heavy Oil Resources of the Orinoco Oil Belt, Venezuela*. Fact Sheet 2009–3028. U.S. Department of the Interior, U.S. Geological Survey.

[16] Delamaide, B. (2010, June 5). Middle East Producers See More Heavy Oil in Their Future [Online forum comment]. Retrieved from http://oilprice.com/Energy/Crude-Oil/Middle-East-producers-see-more-heavy-oil-in-their-future.html

[17] BP (2011). Statistical Review of World Energy 2011 [Online forum comment]. Retrieved from http://www.bp.com/sectionbodycopy.do?categoryId=7500&contentId=7068481

[18] Grigoryev, L. (2010). As the World Recovers. *Oil of Russia*, *140*, 106-111.

[19] Kukol, E., & Treskov, V. (2011). Purse for Three Years. *Rossiyskaya Gazeta, 5649*.