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Ecological Side of the Shale Gas Revolution

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Abstract: Shale gas has recently become a highly controversial multidimensional topic in many countries around the world. Although shale gas can make an important contribution to sustainable development, it can also cause significant damage to environment, including negative efforts to climate change. Therefore, the actual impact of shale gas will depend on how industry, governments, international agencies, non-governmental organizations (NGOs), and other institutions and organizations respond to sustainable development issues. An analysis of some of the ecological issues of the shale gas revolution is presented in this article.
Keywords: Shale gas, shale revolution, environmental impact

1. Introduction

The modern energy industry is inseparable from the use of natural resources. In addition, the use of any technology in the energy sector, whether coal-fired or gas-fired power plants, nuclear power plants, wind turbines, or biofuel for cars, have some negative impact on the environment. Today, mankind has to get used to the idea that there will always be negative impact on the environment and human healthin the energy sectorand we are discussing only about measures that to some extent minimize possible environmental risks. Among these measures, the key role is played by the legal regulation of environmental requirements established by countries in the energy sector. The experience of various countries shows that with a proper assessment of emerging environmental risks, and proportionality of measures taken, a balance is achieved between the desire to develop energy and the desire to minimize the harm to nature. Practice shows convincingly that if the assessment of risks for some reason turned out to be inadequate or initially the risks seemed insignificant, then the application of new technologies that turned out to be very "dirty" in fact can only be stopped before the full and complex reassessment of all environmental risks. This situation occurred with modern technologies for the extraction of shale gas.

This paper will address some environmental aspects of Shale Gas Production activities, including the characterization of new production technologies [1], environmental risks, and the reasons for applying such a strict form of legal regulation of environmental requirements as a total ban on Shale Gas Production in a number of countries. It is specific, but very eloquent example that allows us to make a logical conclusion that sometime the complete ban is really necessary and at times the only way to regulate environmental risks in the energy sector.

2. Shale Gas Production

The success of shale gas production in North America served as an occasion for stormy discussions about the future of shale gas not only in the US, but also in other regions of the world. However, amidst the enthusiasm for the so-called "shale revolution" and its role in changing the world energy market, it is noteworthy that the growth of protest sentiments related to the obvious ecological risks of shale gas production was somewhat unexpected.

First, there is a low profitability of shale gas production, due to the properties of the shale rock itself and the high cost of production process.Secondly, current technologies that are used for the production of oil shale, specifically horizontal drilling and hydraulic fracturing (hereinafter also - hydraulic fracturing), pose a serious threat to the environment and human health.

The history of the extraction of shale gas began a long time ago. For the first time, shale gas was obtained using fracturing technology in 1947. Questions about possibilities of production and the prospects for the use of shale gas on an industrial scale began to be discussed much later, in 2007. New technologies, in particular, hydraulic fracturing and horizontal drilling, contributed to the rapid increase in the production of shale gas in the United States, which made America completely independent of the supply of natural gas from abroad. Figure 1 below shows production of Natural Gas in US in 2010 (historical) and expected (projected) by 2030.

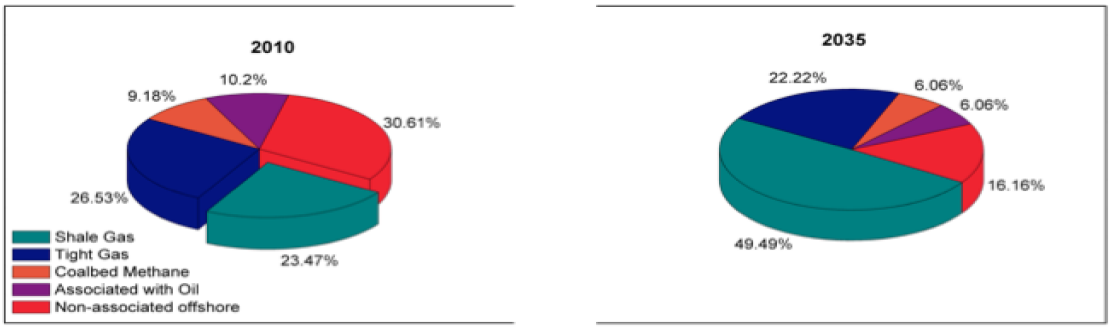

Figure 1: US Natural Gas production: Historical (2010) and Projected (2030).*Source: based on EIA data* [2]

According to the U.S. Energy Information Administration (EIA) statistics [2], the world's largest slate resources are located in Siberia, North America, Argentina, Brazil and Southeast China. Figures below shows estimated share of Shale Gas resources of World wide total (Figure 2) and information of the 10 countries with the mostShale Gas reserves (Figure 3), according to EIA (2013).

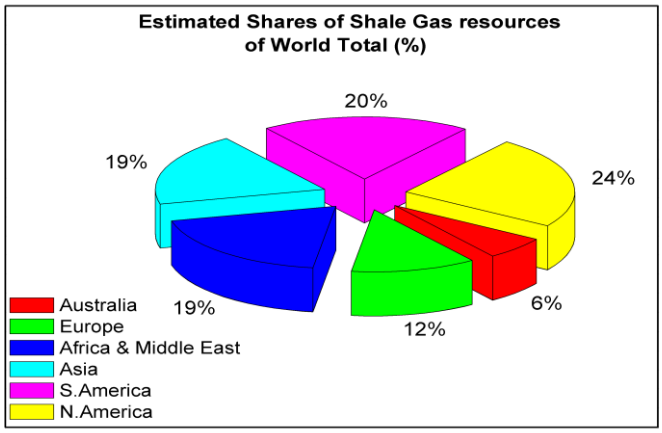

Figure 2: Estimated Shares of Shale Gas Technically Recoverable Resources (Percentage of World Total). Source: based on EIA data [2]

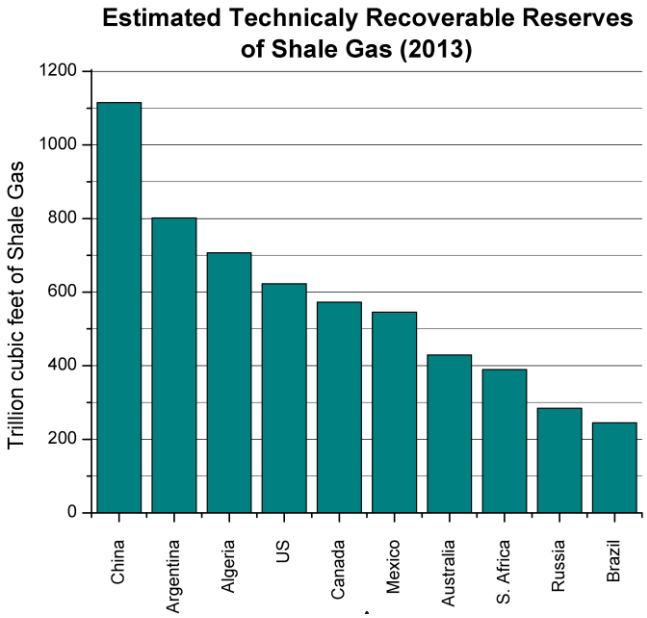

Figure 3: Estimated unproved technically recoverable reserves of Shale Gas by first 10 rating countries (2013) Source: based on EIA data [2]

However, except for the USA, shalegas was not produced for commercial purposes in other countries up to 2015.

The essence of the hydraulic fracturing technique (fracking) is the following: a well is pumped into the well under high pressure "tearing" liquid, which forms cracks in the shale rock. Developed in US special chemical solution, the composition of which - commercial secret, contributes to the increase of cracks, while preventing their closure.

Experts identify a number of factors that made a shale boom possible in the US: 1) private ownership of natural resources, including the right to develop minerals; 2) occurrence of shale rock in zones with low population density; 3) more comfortable geological structure of the formation for production; 4) rich experience in the development of shale deposits [3].

In comparison with the United States, in Europe the rights to develop natural resources are generally owned by the state where the production area is densely populated; The slate lies deep, which complicates the prey,and there are no mining experience and reliable mining technologies. In addition, legislation at the EU level only partially regulates the extraction of shale gas. Adopting uniform rules for the extraction of shale gas by the EU is not yet possible, since the positions of the states are radically different from each other. In many ways, the inability to reach agreement at the EU level is caused by different environmental standards existing at the national level of the EU member states, as well as different energy needs of European countries.

3. Environmental Impacts of Shale Gas Production Processes

To date, the growth of shale gas production in the US is accompanied by increased concerns about its negative impact on human health, the quality of drinking water and the environment as a whole.

In general, the critics of shale gas production from environmentalists boils down to this [1, 4, 6]:

- it is not safe;
- a huge amount of water is spent;
- chemicals, used in production, fall into the groundwater;
- associated gas and methane enter the atmosphere, which leads to environmental pollution.

Below, in more detail, the main environmental risks associated with shale energy will be considered.

3.1 Risks of changing the structure of subsoil.

The extraction of shale gas implies an impressive coverage of areas for drilling, while the drilling process itself means a significant violation of the integrity of the subsoil. Hence the environmental risks associated with the violation not only of the landscape of the drilling areas, but also the structure of the subsoil. Supporters of horizontal drilling argue that this method allows to minimize the scale of impact on the landscape and the environment, while they do not deny the likelihood of earthquakes and small shocks or vibrations, which, they say, do not pose a threat to humans and the environment. However, it must be recognized that this problem requires further research, since the technology of fracturingdestroys the structure of subsoil, as well as the ability of slate to easily split into individual slabs, can cause techno-genic catastrophes in the future.

3.2 Risks of groundwater pollution

One of the most critical risks associated with the extraction of shale gas may well be considered the threat of groundwater pollution which is directly related to the risk of contaminating drinking water in areas close to production [4]. As described above, the hydraulic fracturing technology assumes that a chemical solution is injected into the rock under high pressure to form micro-cracks from which the gas must flow. However, hardly anyone canto control and stop the formation of many other micro-cracks, through which methane and chemical fluids, used for hydraulic fracturing, migrated to overlying aquifers, thatintended for the collection of drinking water.

3.3 Risks of pollution of surface water and soil

The issues of transportation, storage and disposal of chemically hazardous wastes (mainly liquid) [5], remaining after drilling of shale wells, in order to avoid contamination of surface waters (lakes, reservoirs, rivers) and soil were very ecologically sensitive [6]. According to experts, the fluids used for fracturing operations are typically 95-98% water and chemicals [7].

3.4 Risks of emission of methane, carbon dioxide into the atmosphere

3.5 Other adverse effects of Shale Gas production

4. Prohibition of the Extraction of Shale Gas: Municipal, Regional, and National

The issue of shale fuel, especially its production and the associated environmental threats, is extremely controversial and is therefore widely discussed at the state and world level. In this discussion do not stand aside a various types of non-governmental organizations and interested groups(for example, GREEN MEPs, Friends of the Earth [8]),advocate for the environment and prohibiting the extraction of shale gas,.On the other hand, lobbyists putting pressure on the governmentand supporting mining companies that are ready to start extracting Shale Gas right now, no matter what.

However, the recognition of the obvious risks associated with the extraction of shale gas, led to the emergence of numerous prohibitions, under pressure of the local population, which today are quite effective ways to prevent irreparable environmental losses.

The first European countrywhich made an uncompromising step to protect the environment in the extraction of shale gas, was France. Law No. 2011-835 011gon the ban on the development and production of liquid andgaseous hydrocarbons by means of hydraulic fracturing technologies was adopted on June 30, 2011. The legislative ban is permanent and replaces the earlier decision to suspend drilling operationsin shale deposits. The ban also provides for the cancellation of all permits issued for such projects. The mining companies repeatedly tried to challenge this decision. In particular, Schuepbach Energy (an American mining company, Dallas),lost previously issued licenses for the extraction of shale gas, after the passing of the law, filed a complaint with the Constitutional Council of France, demanding that this ban be declared unconstitutional. The French Constitutional Council put an end to the dispute over the legislative ban on the extraction of shale gas, dismissing the complaint and recognizing the law as "constitutionally proportional" [9].

After France, the ban on the development of shale deposits was introduced by Spain. In April 2013 one of the shale-rich regions of Spain (northern Cantabria) announced a ban on the extraction of shale gas [10]. The ban was adopted unanimously, despite the fact that Spain imports about 76% of energy resources and suffers from unemployment.

Drilling of shale wells and shale gas production remains prohibited in Germany, and there will be no exceptions to such a ban for extractive companies as announced in November 2014 by the Minister of Ecology, Nature Conservation and Nuclear Safety.

In September 2013, the Italian Parliament approved a resolution of the Committee for Environmental Protection, which excludes all activities related to EMG in the national subsoil [11]. In the Czech Republic, 4 large regions were allocated for the potential production of oil, and a number of mining permits were issued. However, this caused a lot of protests among non-governmental organizations, as a result of which, at the national level, a coalition against mining with the use of hydraulic fracturing technologies was even created [12]. Prohibitions on the production of oil are active in a number of other countries, such as Austria, Switzerland (Canton Freiburg), Northern Ireland, Canada, some regions of Australia, Argentina.

An interesting example is the refusal to extract shale gas in favor of traditional hydrocarbons in Bulgaria. Realizing the risks not only for the agrarian policy, but also for the country's ecosystem, the National Assembly deputies in January 2012, banned US companies even exploration of deposits [13].

Among supporters of shale gas production, Poland and the United Kingdom still remain. Furthermore, the British government lifted their ban on drilling and hydraulic fracturing in May 2013, allowing mining companies to continue mining shale gas [14].

4.1 Bans of technology for hydraulic fracturing in the United States.

The moratorium on the technology of hydraulic fracturing in the state of New York was introduced in 2008. In June 2014, the Supreme Court of the State even issued a decision in which the hydraulic fracturing technology was allowed to be bannedat the local level. Paradoxically, in the state of Texas, where oil and gas production is one of the highest in the US, have too been banned from using horizontal drilling and fracturing technologies. In a small town in Denton in the north of Dallas, where about 275 wells are located, in a referendum, 59% of residents voted to prohibit drilling and mining within the boundaries of the city [15]. In many ways, this is due to the alarming results of ongoing research and observations in the conduct of gas production. Some regions of California, have returned to the idea of banning the production of shale oil using hydraulic fracturing technology.All this activity suggests that awareness of the risks to the environment and public health, and was quickly reflected in complete bans on the production of shale gas both at local and national levels.

5. Conclusions

The triumphantly proclaimed "slate revolution" turned out to be extremely dangerous for the environment and the population of entire regions.First, such mining requires a huge amount of clean water; Secondly, during extraction in large quantities, chemicals are used to keep the pores formed during the rupture open; Thirdly, drilling of shale wells costs 5-15 times more expensive than conventional ones with a low rate of recovery;Finally, there are high risks of environmental pollution, including poisoning of drinking water.

In thissituations, first of all, the municipal and regional authorities, who reacted with outrage of the population, began to take bans on any actions related to shale gas: whether it be exploration or development of shale deposits. In a number of countries, these restrictions were supported by courts of various levels.

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Author Profile

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