Shale and tight gas in Poland—legal and environmental issues

Barbara Uliasz-Misiak, Andrzej Przybycin, Bogumila Winida

AGH University of Science and Technology, Faculty of Drilling, Oil and Gas, Mickiewicza 30 Ave., 30-059 Krakow, Poland
Polish Geological Institute—National Research Institute, Warsaw, Poland

HIGHLIGHTS

- Legal and environmental issues were analyzed regarding unconventional gas exploitation in Poland.
- Limited water resources and large areas of environmental protection might be critical for the unconventional gas production.
- Exploitation of unconventional gas was primarily regulated by the Geological and mining law and environmental act.
- Regulations presented in this paper, are aimed to encouraging investors to search for shale gas.

ABSTRACT

Exploitation of unconventional gas is limited by a number of economic, legal, environmental and social factors. When it comes to Poland, legal and environmental factors are of special importance, as they might significantly impact the exploitation of both tight gas and shale gas.

Exploitation of unconventional gas deposits, because of the technology needed for opening of these deposits, has relatively great impact on the balance sheet and the quality of water. Polish water resources are limited and depend on time and local circumstances. Therefore, obtaining adequate amounts of water needed to hydraulic fracturing of unconventional gas reservoirs may cause some problems. Another problem is return water management. Injection of contaminated water into the rockmass on a large scale seems to be impossible in Poland. Water discharge to surface waters, which seems to be the most probable solution, would result in deterioration of the purity of Polish rivers.

Around 32% of Poland is covered by different forms of protection, which might include limitations in exploitation of hydrocarbon deposits (depending on the type of area). Exploration, documentation and exploitation of unconventional gas in Poland is regulated mainly by the laws and regulations regulating geological and mining activities, environmental protection and waste management.

1. Introduction

Dropping production of conventional natural gas and the increasing demand for this raw material resulted in increased interest in unconventional natural gas while the development of technology has enabled the access to gas resources that were previously uneconomic to exploit.

In the U.S., the development of shale gas industry led to profound changes in the energy market. In 2000, shale gas accounted for only 1% of the gas supply in the U.S., while in 2012 its share is over 20% and growing. Models applied to analysis of the future of U.S. natural gas, shows that gas production will be rise by roughly 40–45% between 2005 and 2050. The shale gas will be a major contributor to the future of natural gas. Many experts believe that boom shale gas may be repeated in Poland having, according to some estimates, about 30% of European shale gas deposits. Polish government considers shale gas as an opportunity for economic development and the chance to increase national energy security (Gwiazdowicz et al., 2011; Paltsev et al., 2011).

The increase in shale gas production in the U.S. in the 2000s was the result of: high gas prices, governmental fiscal incentives, favorable regulations, reduced operating costs and increased production efficiency (Johnson and Boersma, 2013). In the 1980s of the twentieth century, U.S. Congress adopted the support program to producers of unconventional fuels (coal bed methane, tight gas and shale gas). A factor that largely contributed to the rapid development of shale gas in the United States is a decentralized control system that almost completely excludes hydraulic fracturing technology from federal supervision. Licensing of exploration and exploitation, as well as supervision of operations...
were granted to different state authorities, and therefore legal regulations in each state may significantly differ.

Specific market, legal and political conditions in the United States do not allow Poland to learn from the United States’ experience. The main problems associated with shale gas production in Poland include, in addition to the profitability of production, legal, environmental and social conditions, as the geological conditions are more difficult than in the U.S. Shale gas production on an industrial scale will require the availability of land for drilling, access to water and infrastructure and favorable regulations concerning the granting of concessions, environmental protection, water management and social acceptance.

2. Prospects for the occurrence of shale gas and tight gas deposits in Poland

The best prospects for the occurrence of shale gas in Poland are offered by the Lower Paleozoic shale formations age (mainly Upper Ordovician and Lower Silurian) occurring in sedimentary basins in Central Poland. The best prospects for the occurrence of tight gas in Poland are offered by numerous Rotliegend sandstones in the western part of Poland (Poprawa, 2010; Poprawa and Kiersnowski, 2008).

Estimates of shale gas resources in Poland made in recent years have shown a very wide range of results from 1000 billion m$^3$ (3 Legs Resources) to as much as 5300 billion m$^3$ (the report prepared for the Energy Information Administration by Advanced Resources International Inc.). In March 2012, the initial estimate of the resources of natural gas and oil in Lower Paleozoic shale formations in the Baltic–Podlasie–Lublin basin was presented by the PGI-PiB (Polish Geological Institute–National Research Institute). According to the study, shale gas resources can reach a maximum of 1920 billion m$^3$, while the estimated resources are most likely to be around 346–768 billion m$^3$. They are 2.5–5.5 times greater than the proved reserves of natural gas from conventional deposits (about 145 billion m$^3$) (Assessment of Shale Gas and Shale Oil Resources of the Lower Paleozoic Baltic–Podlasie–Lublin Basin in Poland, 2012).

Poland is currently considered as one of the most promising areas of occurrence of shale gas in Europe. This is evidenced by the interest of oil international companies including ExxonMobil, Chevron, Talisman and Marathon. This is reflected in the number of licenses for the exploration of unconventional gas. The first licenses for exploration and documentation of shale gas deposits were issued in 2007, while in February 2013, oil companies had 115 licenses for exploration and documentation of conventional and unconventional hydrocarbon deposits (including 16 concessions for unconventional deposits). The total area for all issued licenses for exploration or documentation of shale gas deposits is more than 91 thousand km$^2$, which accounts for about 29% of Polish territory. The highest number of licenses – 16 – belongs to PGNiG SA. Between 2010 and 2011, first exploratory drillings in the Baltic Basin (3 wells) and Lublin Basin (7 wells) have been drilled. The wells drilled in the Baltic Basin, including Lubocino-1 (PGNiG SA), Lebięś (Lane Energy Poland/ConocoPhillips) and Wylotowo S-1 (BNK Petroleum Inc.) allowed to extract gas from Lower Paleozoic shale. However, some exploration wells in the Lublin Basin produced negative results. This applies to the first exploration well, Markowola (PGNiG SA), as well as to the wells drilled by ExxonMobil.

According to data published by the Ministry of Environment, 40 exploration wells have been drilled in Poland until February 4, 2013. 309 exploration wells are planned by 2021 (128 wells accompanied by additional 181, depending on the capabilities and the results of work) (http://www.mos.gov.pl/artykul/3327_najczesciej_zadawane pytania_ odpowiedzi/12473_6_kiedy_i_gdzie_rozpoczeco_poszukiwania_shale_gas_w_polscie.html, 2013).

Most companies are currently at the stage of laboratory evaluation of rocks, accompanied by the interpretation of the research results and borehole measurements. Shale gas reserves are at an initial stage of exploration. To assess the size of unconventional gas resources, it is necessary to drill additional wells, while there is an urgent need for additional geological, physical, chemical and geochemical analysis.

3. Environmental conditions of exploration and exploitation of shale gas and tight gas in Poland

The work on exploration, documentation and exploitation of unconventional gas deposits may be related to the risk of changes in the natural environment. Aforementioned works can cause geomechanical transformation of the rock mass, quantitative and qualitative changes in surface water and groundwater, soils, as well as in the natural environment. What is more, these activities have an impact on the atmosphere (emission of pollutants and noise). Each of these transformations can be produced directly as a result of mining operations, but also as a result of changes to other environmental elements.

Exploration, documentation and exploitation of shale gas and tight gas has an impact on the atmosphere, soils just like in case of conventional gas exploration. This is due to the use of the same methods and technologies. On the basis of the current, short-term observations carried out by the Polish Geological Institute in cooperation with the University of Science and Technology in Krakow, it is suggested that the nature of these changes is not significant (Environmental Aspects of Hydraulic Fracturing, 2011).

3.1. Environmental impacts related to hydraulic fracturing

Hydraulic fracturing is related to high consumption of water and the need for disposal of large quantities of backflow fluids. A typical shale gas well requires an average of 10–20 thousand m$^3$ of water, and about 4000 t of proppant (Smith, 2010). With a dense grid of wells, the demand for water can be very large and have a negative impact on the resources of surface and groundwater in the close area.

Water resources include surface water and groundwater. Flowing water resources in Poland amount to an average of 62 billion m$^3$; in the dry years they may be less than the 40 billion m$^3$, while in very wet years—they can exceed 90 billion m$^3$ per year. Exploitable groundwater resources are around 1.7 million m$^3$/year (Diagnosis of the current condition of water management, 2010). Regional resources of fresh groundwater are estimated at the level of 38,022 thousand m$^3$/d. Available and perspective resources in the Vistula River basin (areas of potential occurrence of shale gas) amount to a total of 22.2 million m$^3$/d (Paczyński and Sadurski, 2007).

In the years 1995–2006, the total water consumption in Poland ranged from 10.9 to 12.1 billion m$^3$/year. The vat majority was surface water (about 83%), while only 15% was groundwater. Approximately 70% is used by the industry uses, while 20% is used by municipal services and 10% is used by agriculture. About 85% of water returns to the surface water as waste water with varying degrees of contamination (Diagnosis of the current condition of water management, 2010).

Polish water resources are limited and depend on time and local circumstances, similarly to the climate, characterized by variable weather patterns. The ¾ of Poland suffers from the periodic shortages of water (Fig. 1). It should be stressed, that the periodic shortages of water are the biggest threat to the Central and Eastern Poland. Taking into account climate change, the situation might get worse. Given the shortages water in some parts of Poland (which partially overlap prospective unconventional gas formations) and water demand of 10–20 thousand m$^3$ per well, obtaining adequate
amounts of water needed for the exploitation of shale gas and tight
gas may cause some problems (Diagnosis of the current condition of
water management, 2010).

Fresh groundwater in Poland is estimated to be 6000 million m$^3$, while it is unevenly distributed (Fig. 2). Fresh waters are
located at depths of up to about 1000–1200 m below the ground.
They are low-contaminated waters of the best available quality.
They are used mainly as drinking water and for the purposes of social and living conditions, as well as for the production of food and pharmaceutical products. Their use for hydraulic fracturing
treatments, especially in the areas with low groundwater
resources, is not impossible (Water law act). Mineralized waters
occur almost all over Polish territory. The vast majority of the
mineralized water located 500 m below ground level (Paczyński
and Sadurski, 2007). Hydraulic fracturing fluids may be prepared
on the basis of water with increased mineralization (up to 50 mg/
dm$^3$) (King, 2012). Therefore, the use of mineralized water for
hydraulic fracturing may be considered.

Despite the high demand for water during shale gas exploita-
tion, energy production from this gas is much more efficient in
terms of water consumption than in case of many other energy
sources (Scott et al., 2011). The production of 1 MJ of energy from
unconventional natural gas uses around 2.15–6.46 m$^3$ of water,
from conventional hydrocarbons 4.0–71.8 m$^3$ of water (Mantell,
2009).

Large amounts of contaminated water returning to the surface
after the fracturing process may be a potential threat to the aquatic
environment. The total amount of flowback fluid in case of tight
gas ranges from 30% up to 50%, while in case of shale gas it ranges
from about 5 to 70% (King, 2012; USEPA, 2010).

Injected fracturing fluid consists of water (98–99.5%) with the
addition of various chemicals (polymers and biocides) and prop-
pellant (sand quartz or special granulate) (Modern Shale, 2009).
Flowback fluid is characterized by its varied composition. Shortly
after the process, its composition is close to that of the fracturing
fluid, but the longer it stays in the well, the more it changes its
chemical composition (mixing with formation water, various
reactions with rocks and water) (Papso et al., 2010).

Spent fracturing fluids can be reused for hydraulic fracturing
(however, they must be cleaned of sludge solids, hydrocarbon
contaminants and may need desalination). They could be injected
into the rock mass or delivered to the wastewater treatment plants
(Rahm, 2011). This reduces water consumption and the environ-
mental impact of wastewater discharge. Currently in the U.S.,
about 6–10% of the total amount of water used in hydraulic
fracturing is recovered and re-used for hydraulic fracturing
(Mantell, 2011). However, this is an expensive solution because
of the need for desalination of flowback fluids and disposal of dry
residues containing heavy metals. What is more, utilization in
wastewater treatment plants requires the transport of large

![Fig. 1. Hydrological droughts in the period between 1951 and 2000 and the range of prospective unconventional gas formations (based on Diagnosis…2010).](image)
quantities of water, while injection of flowback fluids into the rock mass requires adequate injectivity and capacity.

In addition, exploration and exploitation of unconventional gas can lead to contamination of surface water, groundwater, and usable aquifers (Rahm and Riha, 2012). Typically, a fracturing fluid is injected at much greater depths than the average depths of the aquifers containing fresh water (usually not exceeding 300 m). Therefore, it can be assumed that any contact of fracturing fluid can take place only in case of accident or execution error.

3.2. Waste generated during drilling and exploitation of unconventional gas deposits

Exploration and exploitation of hydrocarbon deposits produces a number of waste products, which – according to the Polish law – are classified as mining waste. These wastes are usually classified as hazardous waste and non-hazardous waste.

When it comes to drilling wells, unconventional gas deposits are associated with greater amount of drilling fluid and drill cuttings than conventional gas deposits. In case of conventional gas deposits, every meter of well produces about 0.6 m³ of drilling waste, including around 60–80% of used drilling fluids (liquid waste), while the rest includes drill cuttings contaminated with drilling fluids and hydrated sludge removed from the well walls during their casing (solid waste). In case of unconventional gas deposits, drilling is creating more waste due to the dense drilling grid—the total amount of drill cuttings for the mining area of 100 km² is likely to be around 55 thousand m³ (Grzybek, 2011).

The exploitation of unconventional gas deposits is related to the problem of grounds degradation and soil surface. The area occupied by the mining equipment is relatively small, occupying about 1–2 ha. However, a large number of wells requiring appropriate management, such as access roads, may significantly increase the areas requiring land rehabilitation.

Another nuisance to people and the environment is the noise of drilling equipment and the increased volume of vehicles.

The impact of shale gas exploitation on the environment is not yet fully understood. Since 2011, Environmental Protection Agency (EPA) is assessing the impact of exploitation of shale gas on drinking water and groundwater; the full results of these studies will be known by the end of 2014. In Poland, the Minister of Environment ordered an examination of environmental aspects of hydraulic fracturing. The assessment of environmental impact of hydraulic fracturing was performed on the LE-2H well in August 2011 by the Lane Energy Poland company of the 3Legs Resources Group. All elements of the environment were analyzed, while particular attention was paid to surface water and groundwater. The study has shown that there was no change in the quality of
surface water or groundwater. (Environmental Aspects of Hydraulic Fracturing, 2011).

3.3. Exploitation of unconventional gas deposits and protected areas

Exploration, documentation and exploitation of shale gas and tight gas should be carried out without negative environmental impacts or minimizing these impacts, it is especially important in the areas of nature conservation. Approximately 32% of Poland is covered by various forms of protection, which represent a diverse set of measures to protect nature. Within the protected areas, restrictions on exploitation of hydrocarbon deposits – depending on the type of area – may occur (Table 1).

National parks, landscape parks and Natura 2000 sites may include unconventional natural gas deposits (Fig. 3). Potentially, such deposits can be found in two national parks and 33 landscape parks (Uliasz-Misiak and Winid, 2012), what can result in restrictions on exploration, documentation and exploitation. This situation

<table>
<thead>
<tr>
<th>Specification</th>
<th>Number of the objects</th>
<th>Area [thousand ha]</th>
<th>In % of total area of the country</th>
<th>Restrictions on hydrocarbon deposits exploitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>National parks</td>
<td>23</td>
<td>314.5</td>
<td>1.0</td>
<td>Exploitation of deposits is not possible</td>
</tr>
<tr>
<td>Nature reserves</td>
<td>1469</td>
<td>164.2</td>
<td>0.5</td>
<td>Exploitation of deposits is not possible</td>
</tr>
<tr>
<td>Landscape parks</td>
<td>121</td>
<td>2529.0</td>
<td>8.1</td>
<td>Exploitation is only possible after consultation with the park authorities, as such activity should be taken into account in management plans</td>
</tr>
<tr>
<td>Protected landscape areas</td>
<td>386</td>
<td>6992.5</td>
<td>22.4</td>
<td>Economic activity is only slightly limited</td>
</tr>
<tr>
<td>Natura 2000 areas—areas of special bird protection</td>
<td>144</td>
<td>557</td>
<td>17.6</td>
<td>Network does not introduce bans, protection system is flexible</td>
</tr>
<tr>
<td>Natura 2000 areas—areas of special habitat protection</td>
<td>823</td>
<td>3795</td>
<td>12.4</td>
<td>Network does not introduce bans, protection system is flexible</td>
</tr>
</tbody>
</table>

Fig. 3. Concessions for exploration and prospecting of unconventional gas (based on Ministry of Environment 2012) against the background of protected areas in Poland.
took place in case of 51 licenses issued between 2007 and 2010, which led to a ban on any geological and mining activities, seismic works and drilling within the Natura 2000 sites (Koziel, 2010).

4. Regulations on the exploration and exploitation of unconventional gas in Poland

Regulations used during the prospecting, exploration and production of unconventional gas, as well as administrative decisions and permissions that must be obtained are regulated by various laws. Exploration, documentation and exploitation of shale gas and tight gas is primarily regulated by the Geological and mining law and the regulations of the Minister of the Environment. Equally important are the legal regulations related to the protection of nature and environment. Application of the provisions in each case of exploration and extraction of unconventional gas depends on a number of factors, such as location, volume of production/production rate, the type and the amount of used raw materials and technologies.

Taking into account aforementioned information, the competent environmental protection authority is responsible for administrative decisions and permits, setting out the requirements that prevent the negative impact of exploration and production of shale gas on the environment.

4.1. The geological and mining law

4.1.1. Current state

The provisions regulating exploration, documentation and exploitation of hydrocarbons are regulated by the Geological and mining law dated 09 June 2011. According to the Geological and mining law recognition, exploration and exploitation of hydrocarbons requires a license granted by the Minister of the Environment. Moreover, adequate civil law agreement is needed for the establishment of the mining area.

The license is granted for a fixed period, not less than three years and not more than 50 years, unless the operator has applied for a license for a shorter time. The application for a license should specify the areas covered by the specific forms of protection, including wildlife protection. In case of important public or state interest, granting a license may depend on securing the claims that may arise as a result of licensed operations.

The transfer of the license to another party requires the knowledge and consent of the licensing authority. However, there is a condition of acquisition of all obligations and rights arising from the license (including geological information and ownership of the property). The licensing authority may refuse to grant the license if the proposed activity violates the requirements of environmental protection and prevents intended use of property, as determined in the local development plan. Therefore, municipal authorities cannot grant a license for exploration, documentation and production of natural gas if the local zoning plan or the study of conditions and directions of spatial development do not allocate certain areas for mining activities.

In case of violation of the regulations on environmental protection, rational management of mineral deposits, or non-compliance with license conditions (no activity or permanent cessation of operations), the licensing authority calls the license holder to immediately termination of infringements. If the license holder does not execute the instructions, the licensing authority may modify or withdraw the license without compensation. The license expires at the end of the period for which it was granted, if it became irrelevant, in case of death of the entrepreneur, business liquidation or in case of license waiver.

The license and agreement for the exploration and documentation are payable. The costs are calculated by multiplying the fees by the number of square kilometers of area, where the exploitation is carried out. Aforementioned fees are determined annually by regulations of the Ministry of Environment.

The concession for the extraction of natural gas needs to be agreed with the Minister of Economy, as well as with commune administrator, the mayor or the president of the city.

Hydrocarbon deposits are the part of the mining property owned by the State Treasury, which – within the limits set by law – can exclusively utilize them and has the right to establish mining usufruct. Priority for the granting of mining concession belongs to the entity that has explored and documented the deposit and prepared geological documentation required to obtain a license for extraction of the deposit owned by the State Treasury. As in the case of licenses for exploration and documentation, specific conditions may require the license holder to secure the claims that may arise as a result of licensed operations. Modification or revocation of license, refusal to grant a license and other limitations are based on the same principles as in case of concessions for exploration and documentation of minerals.

Hydrocarbons exploitation, as well as exploration, requires a license granted by the Minister of Environment, signing the agreement and the payment of exploitation fee. The fee is determined individually by the Minister of Environment depending on the type and amount of the extracted raw materials. Regulations introduce penalties for operating in flagrant violation of the conditions of the license or the approved geological work project (additional fee), or for conducting works without the required license or without an approved geological work project (increased fee).

In Poland, the State Treasury has the right to geological information (data on the results of drilling, geophysical, deposit and geological research). Entities which received the geological information as a result of their work are entitled to free use of this information. The exclusive right to use geological information for a period of 5 years since the expiration of rights (e.g. expiration of the license for exploration and documentation of the deposit) belongs to the company which performed the geological work in order to apply for a license.

4.1.2. Proposed changes

In order to encourage investors to search for oil and gas, including unconventional gas, it was decided to amend the Geological and mining law. The bill was submitted for public and inter-ministerial consultations in February 2013. The abolition of licenses for hydrocarbon exploration, simplification of investment procedures, especially in the field of environmental protection, and competitive tax system are aimed at stimulating the oil and gas sector in planning both exploration and extraction operations over a long period of time. The draft amendment modifies the distribution of incomes from exploitation fee. Due to the increase in fees, revenues of local governments of all levels should significantly increase.

The biggest changes in the proposed Act on concessions include, among others the introduction of combined concessions for both documentation and exploitation of hydrocarbons. The bill abolishes the requirement to obtain a license for hydrocarbon exploration, introducing the possibility of conducting geophysical research on the basis of geological work project. This provision ensures that the fulfillment of the obligations required to obtain the license already at the stage of documentation gives the exclusive right for extracting hydrocarbons. The concession for the documentation or exploitation will be granted for a period of not less than 10 years and not longer than 30 years. The bill takes into account licenses for hydrocarbon exploration and production. Aforementioned licenses should regulate the type of activity, its execution and operator’s responsibility to the licensing authority (in accordance with cooperation agreement). In addition, the
license shall specify the period of its duration (documentation stage should be no longer than five years; the same applies to extraction stage) and the obligation to report about the circumstances affecting the fulfillment of license conditions. The Act foresees the possibility of extending the extraction stage for the period necessary for exploitation of hydrocarbons from the reservoir. One-time extension of the license is possible only if the licensee has complied with the conditions specified in license. The proposed Act introduces limitations on obtaining concessions on the secondary market (allowed by the Geological and mining law of 9 June 2011 and potentially leading to the state’s loss of control over extraction process). The Act expands the conditions for modification and revocation of licenses, which may occur in case of non-compliance to the schedule set out in the geological work project or when the license holder is not providing data and geological samples in specified periods.


Proposed Act include important changes, as it reduces the time in which the entities that received a decision approving the geological documentation can take advantage of the right of priority for the acquisition of mining usufruct rights from five to two years; it also reduces the exclusive right to make use of geological information to two years.

The bill defines the requirement for an investment decision before the extraction of hydrocarbons, and upon documenting the deposit and approval of geo-technological documentation. Application for this decision will be supplemented by a decision on the environmental conditions, which is required before approval of mining site operation plan (so far only before receiving a license for exploration and documentation of hydrocarbon deposits).

Proposed Act finds that the information regarding the composition of fracturing fluid contained in the mining site operation plan is not a business confidentiality (Environmental protection law), which will provide free access to the complete information on the composition of fracturing fluid.

What is more, the bill changes the authority competent to issue decisions on the environmental conditions for exploration, documentation or production of hydrocarbons. According to the new Act, the decision depends on the regional director of environmental protection. Environmentally insignificant changes, such as changes in the depth of wells will not require additional changes or environmental decision.

The bill introduces a new division of revenues from exploitation fee. What is more, exploitation fees for the high methane natural gas are also raised—from 6.06 Polish zloty (zł) per thousand m³ to 24.00 zł/thousand m³. The same applies to remaining natural gas, as the rates are raised from 5.04 zł/thousand m³ up to 20 zł/thousand m³. The bill also introduces a new charge rate for exploration of hydrocarbon deposits, which will be 210 zł per square kilometer; provisions on the new rates will come into force on 1 January 2015.

The final form of the amendment to the Geological and mining law may differ from the presented proposals. The proposed amendment to the Geological and mining law would adapt the legal framework for the exploitation of hydrocarbons to the challenges and opportunities posed by the development of mining technologies and the economic situation in the world. The aim is to provide tools for the rational management of hydrocarbon deposits, increasing gas production from domestic sources, while ensuring adequate revenues for the state budget and local governments. At the same time the principles remain unchanged: to ensure the safety of exploitation, compliance with the requirements of environmental protection and the competitiveness of the investment in exploration of the deposits and hydrocarbons exploitation.

4.2. Environmental legislation


4.2.1. Environmental impact assessments

The granting of a license for the exploitation of hydrocarbon deposits may require to carry out an environmental impact assessment, which is a part of the procedure for issuing a decision on the environmental conditions. A decision on the environmental conditions occurs prior to obtaining concession for the exploitation. This decision determines the environmental conditions of the project. Environmental impact assessment carried out on its basis applies to planned projects which might – at least potentially – have a significant impact on the environment (Act on access to information on the environment and its protection and on environmental impact assessments). Exploration and documentation of mineral deposits using wells deeper than 1000 m in protection areas and 5000 m without protection areas and oil extraction of more than 500 t per day or natural gas production exceeding 500 thousand m³ per day are considered as likely to have a significant impact on the environment (Regulation of the Council of Ministers on investment projects which may significantly affect the environment dated 25 June 2013). If hydrocarbon deposit meets at least one of these criteria, receiving a decision on environmental conditions is necessary before obtaining a concession for prospecting and/or exploration.

When receiving a decision on environmental conditions is not necessary, but the prospecting and/or exploration of deposit will be conducted within the Natura 2000 sites or in the vicinity, it may be required to carry out the assessment for this area (not associated, however, with the need for receiving additional decision on environmental conditions).

The authority competent to issue a decision on environmental conditions for investments related to the exploration of gas deposits is the administrator of the municipality (mayor or president of the city), where the investment will be made.

4.2.2. Regulations on waste management

Wastewaters produced from shale gas extraction are considered mining waste. The act of 10 July 2008 on extractive waste is essential for the management of mining waste (this also applies to mining of crude oil and natural gas) (Mining waste act). Aforementioned waste should be recycled and if it is not possible because of technical or economic reasons, it should be disposed of according to the requirements of environmental protection or mining waste management program. It provides the rules for the management of extractive waste and unpolluted soil along with the procedures associated with obtaining permits related to waste management, policies for waste disposal facilities and procedures related to the prevention of major accidents in mining waste treatment facilities of category A waste (Mining waste act).
4.2.3. Regulations on water management

In Poland, water management is regulated by the Water law act. Water consumption is carried out on the basis of water permits, while it cannot violate the established rules, including: conditions for use of water from water regions and river basins, local spatial development plans, zoning approvals and requirements for the protection of human health, natural environment and cultural heritage sites listed in the Register of historic monuments, as defined in separate regulations. These permits establish the purpose and scope of water use, especially: the rate of flow, limitations arising from the need to preserve the flow and the method of water management (Water law act).

Another problem is the management of return waters after fracturing. These waters can be re-used in fracturing treatments, injected into the rockmass or discharged into surface waters. Water discharge to surface waters seems to be the most probable solution, thought the contaminated water should be previously subjected to return water treatment process. In the United States, flowback liquids that have not been re-used in fracturing treatments or subjected to return water treatment process are injected into the rockmass. In light of current legislation, such solution used on a large scale seems to be impossible in Poland. Therefore, water discharge to surface waters seems to be the most probable solution.

Water discharge to surface waters in Poland is regulated by relevant regulations, which specify the conditions to be met during the process. There are specified substances that are particularly harmful to the aquatic environment, and therefore discharging them into the sewage system requires a permit required by the Water law. It should be noted, that there are permissible amounts of substances that can be discharged in industrial wastewater (Regulation of the Minister of Environment dated 23 July 2008 on the criteria and method of evaluating the underground water condition; Regulation of the Minister of Environment dated 20 August 2008 on the method of classifying the condition of uniform parts of surface waters). It should be noted that sewage treatment plants deal with the treatment of wastewater containing more pollutants than flowback liquid from tanneries and galvanizing plants. Therefore, hydraulic fracturing wastewater treatment should not be a problem. Meanwhile, a serious problem can be the amount of the liquid.

4.3. The provisions on spatial planning and protection plans

One of the instruments in conducting effective environmental policy is an efficient planning system. Studies of land use conditions and directions should maintain the natural balance and rational management of the environment, involving, inter alia, exploration of deposits and determination of current and future demand for exploitation (Environmental protection law). Spatial development plans should take into account both the protected areas and the mineral deposits and must meet the requirements set by the Geological and mining law. Planning documents require consultations, as some of the decisions may have a negative impact on the environment (Nature conservation act).

Spatial development plans should ensure the integration of activities within the mining area, which include both implementation of the initiatives set out in the license and environmental protection. Aforementioned plans can specify protected objects or areas, while mining can be carried out only in a manner that protects these assets (Geological and mining law). Integration activities introduce two types of restrictions during the exploration and exploitation. Restrictions may apply to the rights of the owner of the property located within the mining area (involving a ban on development) and investor activity due to their impact on the environment (e.g. the need to conduct mining activities in a certain way (monitoring, etc.)).

New Geological and mining law increased the influence of the municipal authorities’ on prospecting, exploration and production of natural gas. According to the new regulations, the minister of the environment cannot grant license to aforementioned activities if they prevent intended use of property, as determined in the local development plan.

Security plans are the basic documents created for a national park, nature reserve or landscape park, valid for a period of 20 years. The plan includes a detailed description of the security measures, an indication of the tasks for which the protected area is established, and all the necessary procedures needed to implement protective measures. The plan identifies existing and potential internal and external threats, and identifies ways to eliminate or reduce them. These documents include guidelines for the study of conditions and directions of spatial development of municipalities, local and regional development plans for eliminating or reducing both internal and external risks (Environment protection law). Nature conservation act does not clearly specify whether the findings of the plan are binding for local plans of spatial development or, in particular, for zoning approvals. It is assumed that security plans are binding when the municipality is developing plans for areas within the parks. Security plans should primarily cover areas of planned investments.

5. The influence of environmental factors and legal regulations on shale gas development in Poland

The increasing use of natural gas and the accompanying depletion of conventional deposits have contributed to the growing interest in the unconventional deposits (shale gas, tight gas and coalbed methane). As shown in the studies, there is a possibility of finding deposits of shale gas and tight gas in Poland. However, determining the amount of shale gas resources in Poland will be possible in a few years.

Europe’s energy policy is based on three pillars: the internal energy market, climate package and the actions aimed at internal (infrastructure) and external (pipelines and international agreements) security of supply. The discovery of shale gas in Europe, including Poland, will inevitably affect European energy policy. Unconventional Gas gives the opportunity to move away from CO2 emitting power production (coal). Therefore, it contributes to the objectives of European energy policy aimed at reducing greenhouse gases emissions (especially CO2 emissions). The internal market of gas from unconventional sources can be an alternative to exports, allowing for security of supply and lower prices of imported raw material, thus increasing the competitiveness of EU industry. Appearance on the world market unconventional gas has far-reaching geopolitical consequences, that ultimately led to the fact that the price of Russian gas supplies to Europe are renegotiated and revised. Using gas as the main transition fuel to 2030 will reduce the costs of the transition to renewable energy sources, which will help to reduce CO2 emissions and help combat climate change.

Polish Energy Policy until 2030 foresees an increase in demand for energy. Primary energy demand is projected to increase from 97.8 Mtoe in 2006 to 118.5 Mtoe in 2030. The largest increase is projected for gas, which is expected to increase around 40%, whereas the share of coal and lignite will decrease by 16.5% and 23%, respectively. The Energy Policy of Poland until 2030 (2009) does not foresee the use of unconventional gas resources (Projection of Demand for Fuels and Energy until 2030, 2009). Currently, there are ongoing efforts on the new document “Polish Energy Policy until 2050”, which should be focused on innovation.
and efficiency of Polish power sector, taking into account the effects of decarbonization on Polish industry. For this purpose, the government should invest and support the efforts aimed at upgrading the infrastructure and installing new capacities. There is a need to gradually reduce the share of coal and to replace it with renewable energy sources and natural gas from unconventional sources in the next years. The need for research and preparation of the commercial exploitation of these deposits by 2020 is also emphasized (The position of the Polish Electricity Association, 2013).

Exploitation of unconventional gas, due to the technology of its production, presents new challenges. There are two groups of barriers which can be distinguished, the first includes regulations related to the extraction, transport and distribution of gas, which are decentralized and liberalized in North America, while centralized and controlled by the state in Europe and Poland. The second group includes broadly defined environmental and social aspects. Both groups increase the production costs and adversely affect the profitability of gas production. The less unnecessary costs, the greater the chance for economic success of shale gas production. On the other hand, the state treasury, as the owner of the deposits, should obtain fair remuneration for granting the license to exploitation of non-renewable resources, which should be carried out by private companies in a rational and sustainable way. The exploitation of natural resources should not affect the environment. Once the extraction is finished, the surrounding environment should be restored.

Effective legal regulations are the basis for the effective performance of each sector of the economy. Exploration, documentation and exploitation of shale gas and tight gas are primarily regulated by the Geological and mining law, the regulations of the Minister of Environment and other regulations relating to the protection of nature and environment. The Geological and mining law, which covers all issues related to exploration, documentation and exploitation of the deposits has the biggest impact on the development of shale sector in Poland. In 2011, a revised version of the law was introduced, though further amendments are required, especially when it comes to management of hydrocarbon deposits. Aforementioned changes are discussed in Chapter 3 of the article. However, neither the existing geological and mining law nor the proposed changes do not provide specific procedures for identifying and extracting gas from unconventional sources, which means that the rules are the same as for conventional deposits. Most of the conventional hydrocarbon deposits in Poland are ranging from several hundred million to 2 billion m³. Cost-effectiveness of their exploitation often depends on the distance from the existing transmission network. Therefore, the same legal requirements for conventional and unconventional deposits should not create obstacles for investor. The condition, which is of fundamental importance, is the discovery of significant resources of unconventional gas, exceeding several times conventional resources.

According to entrepreneurs, the changes proposed in the geological law does not reduce the risks of investing in the mining industry that involves the necessity to incur significant costs already at the stage of exploration activities, without any guarantee of success (this is particularly important in the case of shale gas resources, which are not yet investigated).

Despite the simplification of procedures in the proposed law – only one concession out of two is needed – the most often mentioned obstacles apply to licensing process. The position of the licensing authority has been significantly strengthened, which gives it an effective tool to enforce the obligations under the concession. The companies conducting mining activities are obliged to contact the National Energy Minerals Operator (NOKE), which will participate in the extraction process on behalf of the state treasury. Cooperation between the company and the NOKE will have a significant impact on the pace of investment. At the same time, NOKE will support entrepreneurs in obtaining all necessary permits and – to some extent – will bear the investment risk. On the other hand, the violation of work schedule (which is included in the license) may result in revocation of the license. What is more, the proposed shortening of the right of priority to apply for a license to extract minerals, aimed to mobilize the entrepreneurs, may prevent the company, which has invested in exploration, from receiving the concession; this is due to the excessive length of administrative proceedings in Poland and the need for consultation and numerous permits. Financial aspects are of particular interest, especially when it comes to the increase of mining fee, which, combined with new taxes on hydrocarbons, may cause small deposits unprofitable. Given the current gas prices in Europe and the decline in the dynamic development of the unconventional gas production, they are expected to stabilize at a level that allows entrepreneurs to meet public levy. The proximity of gas consumers is the preferred condition for lowering the operating costs.

An important element in the development of unconventional gas sector in Poland is very high social acceptance; 72% of the local communities from prospective mining areas, support the production of shale gas in Poland. At the same time, nearly 60% of respondents agree that the raw material should be mined at their place of residence, while only 7% indicated lack of acceptance (TNS OBOP survey, 2013). High social acceptance may result from the expectations to improve the social situation in the country due to the exploitation of hydrocarbons, as exemplified by Norway. Hence, it is difficult to expect the state treasury to resign from resource rent. At the same time, the charges should not exceed 40%, being rather low compared to the other countries extracting hydrocarbons.

Some of the changes proposed in the legislation are favorable for entrepreneurs. The introduction of combined concession for both documentation and exploitation of hydrocarbons is especially worth noting. Receiving environmental approval and preparation of environmental impact report would be necessary in case of mineral deposits using wells exceeding 5000 m in unprotected areas (previously 1000 m). What is more, environmental approval no longer depends on local government unit (commune administrator, mayor, mayor of the city) but on The Regional Directorate for Environmental, which should help to speed up procedures.

The regulations presented in this paper, especially proposed changes, are aimed to encourage investors to undertake exploration and future exploitation of unconventional natural gas. Currently, the government is working on regulations, while they need to be accepted by the Council of Ministers, the Sejm and the Senate. It can be assumed, that the proposed version of the so-called “Hydrocarbon Act” would be an important step to encourage investment in shale gas, thus affecting the energy market and policy of Poland.

Start of shale gas production on an industrial scale will require meeting the requirements of environmental protection, availability of land for drilling, access to water and infrastructure and community acceptance. This group of barriers may be essential to the future exploitation of unconventional gas in Poland.

Exploitation of unconventional gas resources requires drilling and the use of hydraulic fracturing treatments, which are associated with a high consumption of water. There are areas of significant deficit of both surface water and groundwater in Poland, while some of them overlap with areas of perspective occurrence of unconventional gas. Given the high demand for water (approximately 10–20 thousand m³ per well), it may not be possible to provide appropriate amount of water for shale and tight gas deposits. Meanwhile, large saline water resources can be used to produce fracturing fluids. Despite the high demand for
water during shale gas exploitation, energy production from this gas is much more efficient in terms of water consumption than in case of many other sources. Another problem is the management of return fluids after fracturing. These fluids can be re-used in fracturing treatments, injected into the rock mass or discharged into surface waters. However, injection of contaminated water into the rock mass on a large scale seems to be impossible in Poland. Water discharge to surface waters seems to be the most probable solution, thought the contaminated water should be previously subjected to return water treatment process or re-used in hydraulic fracturing.

Another problem associated with environmental considerations is the availability of land for future exploitation of shale gas. Poland has a large proportion (approximately 41%) of areas with different levels of environmental protection, which might significantly affect the production of unconventional gas. National parks and reserves cannot engage in any business activity. Areas covered by other forms of environmental protection, including the Natura 2000 network, include various limitations affecting the production.

The National Spatial Development Concept 2030, adopted by the Council of Ministers on 13th of December 2011, points out that new extraction areas and their related restrictions have to be included in national, regional and local spatial development plans because of shale gas exploitation. Local governments are taking actions to identify the determinants of shale gas extraction. Natural, tourist and recreational values of prospective areas of exploitation make it necessary to evaluate the possible investments. Limitations are also associated with high population density. This factor limits the possibilities of exploitation and increases the possibility of the opposition of local communities, especially in the areas with no tradition of oil and gas production. The availability of infrastructure (roads, pipelines) has a significant influence on potential shale gas extraction.

Natural gas production from unconventional sources creates a significant opportunity for Poland, both economically and geopolitically. It will have an impact on state and local government revenues (operating fees and taxes) and will increase the number of jobs in the areas of exploration of natural gas.

The development of shale sector in Poland will not only contribute to the diversification of gas sources, but also to the development of gas infrastructure in the country (internal security), and will increase the competitiveness of Polish industry.

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References

