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The authors provide significant insight into the political challenges of oil and gas development in the Caspian Sea. Development of these assets is of importance to the littoral states, none more so than Azerbaijan.

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Diversification of the Upper Nitra Region With a Focus on Activities Using Current Resources

Zuzana Beňová

Introduction

Economic and climatic reasons are most often given in the context of the phasing out coal mining within the European Union. While environmental activists primarily argue that producing electricity from coal is the worst option for the environment, economists are observing the unprofitable nature of this industry in the European Union. However, from another point of view, it should be noted that coal mining is supported by governments, mainly to maintain a stable employment rate in regions, which have focused on this industry. If the cession of coal mining were abrupt, it would automatically create significant socio-economic consequences. Given this, it is important to use a prudent approach to this topic.

The following article deals with the issue of transformation of the Upper Nitra region, where brown coal is extracted and burned. This region lies in the central part of the Slovak Republic, and the importance of the coal industry for this region can be seen in different areas. The study begins with a comparison of different approaches to the diversification of regions, which are now focusing on coal mining, but in the future will face phasing out this industry.

A description of the current situation follows this part with an emphasis on the economic indicators of the largest and only mining company in the region of the Upper Nitra. The final part describes in more detail one of the projects, through which the mining company tries to use already existing sources to diversify the region.

In my work, I used several scientific methods. First of all, I would like to thank hydrogeology RNDr. Jozef Halmo and scientist RNDr. Juraj Masár for providing an interview that served as a basis for subsequent analysis. I also appreciate the company Hornonitrianske bane Prievidza a.s. for providing information about the current situation in the Upper Nitra. This work also used materials of the Government of the Slovak Republic, the European Commission and the Organization for Economic Co-operation and Development.

Different Approaches to Phasing out the Coal Industry

Opinions regarding the transformation of coal regions across the whole European Union usually strongly depend on personal conviction. In general, there remains a belief that the production of electricity from coal is in decline and will be replaced by new sources of electricity in the future. In addition to changing the energy mix in individual countries, this transition will also cause structural changes in regions that are currently inherently dependent on coal mining.

Two authors Monika Oczkowska and Thomas Pellerin-Carlin state, that the transformation of coal regions in the European Union is a necessary solution, which reflects the current situation in the international economy. According to their research, there are different reasons, which at the end of the day prove that stopping coal mining is in the public interest. First of all, they claim, that member states of the European Union are not able to compete with cheap coal imports coming from developing countries, such as India or China. Besides these two countries, they also mention imports from the United States of America, but for objectivity, it is important to add that the coal industry in the United States of America is also in decline. From an economic point of view, coal mining in the European Union is not economically advantageous, especially because it is subsidized in most member states of the European Union.

The authors declare that another, but no less important aspect related to coal mining and its subsequent combustion is the emergence of externalities that negatively affect the environment and public health. Oczkowska and Pellerin-Carlin are convinced that the combustion of coal in the European Union is directly responsible for approximately 400,000 premature deaths. Coal combustion also causes greenhouse gas emissions, based on their study, and it can be argued that the combustion of coal is responsible for 1/4 of the greenhouse gases. The results of the study are that there should be no more discussion on whether coal mines should be closed or not, but how to transform coal regions across the European Union and at the same time, to minimize the negative aspects of transformation.¹

Josef Auer states that in the case of Germany, accelerated discontinuation of lignite mining is likely to have serious consequences. At the moment, the country would not be able to compensate for the

amount of electricity produced from coal by other sources of electricity. This is particularly the case when the country is not even in favour of nuclear power generation, which currently accounts for 11.8 percent of total domestic energy production. The author points out that if the resulting deficit were to be compensated by the production of electricity from renewable sources, it would probably mean the transfer of workers to other areas in the country; these are workers who have been employed in coal mines. The economically less developed regions of East Germany are therefore likely to face higher unemployment rates. Auer also adds that it is necessary for the public to be aware of the consequences of the transformation and to be informed that after the end of mining, it is unlikely that the regions will be able to ensure the same standard of living as they currently have.²

The Coal Industry in the Slovak Republic

Coal mining has a long history in the Slovak Republic. Historically, it has been associated with many regions in this territory, but the extraction of brown coal is mainly connected with the region of Upper Nitra, located in the central part of the Slovak Republic. The downward trend in coal-fired power generation has also affected this region, and the question arises, how the region should be transformed to eliminate the negative aspects of the transformation.

First, I would like to describe the existing coal industry in the region of Upper Nitra and its importance for the Slovak economy and energy security. The Organization for Economic Cooperation and Development states that the production of electricity produced from coal has decreased in Slovakia since the year 2000 by more than 50 percent.³ Brown coal is currently mined in Slovakia just in one region, already mentioned above and mining is operated by one private company, called Hornonitrianske bane Prievidza a.s. (HBP JSC.). Underground mining is used for extraction of coal in three coal deposits, namely Mine Nováky, Mine Handlová and Mine Čáry.

The entire production of coal is intended for consumption in the domestic market. The strategic customer of this coal, produced by HBP JSC. is a power plant, located in a village, called Zemiaske Kostofany, which uses coal for electricity and heat production. The location of the power plant can be described as a strategic intention, as it is situated just a few kilometres from the Mine Nováky. The Ministry of the Economy states that the share of electricity production from domestic coal has been decreasing since the year 2011. The current share on the energy mix in the Slovak Republic was according to the HBP JSC. 4.78 percent in the year 2017.⁴ The importance of the coal industry in the Upper Nitra could also be demonstrated through a comparison of the biggest employers in this region. The following table shows the top ten biggest employers in the district of Prievidza (the largest city in the region of Upper Nitra).

As we can analyze from the table above, employment is a critical consideration of the company HBP JSC. Besides this total number, HBP JSC estimates that in the whole region, there are approximately 11,000 working places, which are connected with coal production and its combustion.⁵ Sudden and uncontrolled cessation of mining activities would, in this case, have significant consequences for unemployment in this region. In this context, I would like to remind the reader, that currently, the Central Office of Labour, Social Affairs and Family registers just 1,565 vacancies in the mentioned region.⁶

Table 1: The Biggest Employers in the Region of Upper Nitra

Name of the company	Estimated number of employees
Hornonitrianske bane Prievidza JSC.	2000-2999
GeWiS Slovakia Ltd.	1000-1999
SaarGummi Slovakia Ltd.	1000-1999
UNIPHARMA JCS.	500-999
ContiTech Vibration Control Slovakia Ltd.	500-999
Hospital with Health Centre Prievidza with headquartered in Bojnice	500-999
COOP Jednota, consumer cooperative	500-999
SLOVAKTUAL, Ltd.	500-999
Nestlé Slovakia, Ltd.	500-999
FORTISCHEM JSC.	500-999

Source: Finstat.sk, Author's processing

The Government of the Slovak Republic has declared that the general economic interest aimed at promoting domestic coal-based electricity will be phased out in the year 2023. However, the ending of the subsidy for mining does not automatically mean that the mines will be closed, if the company finds coal buyers and, at the same time, adheres to strict environmental rules, mining can continue. According to data, which was provided by the HBP JSC, current extractable reserves of brown coal in three deposits represent exactly 41,766,284 tonnes, with an annual production volume of 1.6 to 1.7 million tonnes per year.⁷ Here I would like to emphasize that it is indeed more efficient from an economic point of view to mine reserves in coal deposits. To demonstrate this claim, we can use the fact that mines, which were closed for example, in 1992, in the Czech Republic, still have funds invested, mainly focused on their maintenance and drainage.

The phase-out of the coal industry in the region of Upper Nitra depends on many factors and divides society, mostly living in the influenced region. Since the state subsidizes the production of electricity from domestic coal, it has become criticized. The total amount of support provided by the state differs, for example, last year, a tariff based on the calculations of the Regulatory Office for Network Industries was 115,712,382 EUR, which has represented an increase in comparison with the previous year.⁸ Support for domestic coal is paid by customers in the price of electricity in the so-called tariff for operating the system. This system and questioning of its effectiveness was also mentioned in the Country Report of the Slovak Republic, prepared and published by the European Commission.⁹

Many politicians in the Slovak Republic argue that the amount of provided help should be used in a more effective way than we can observe nowadays. Although the subsidiary is many times criticized, it is fully consistent with the European Law. One of the founding treaties of the European Union, namely the Treaty on the Functioning of the European Union in Article 106, allows Member States to define enterprises separately with a so-called general economic interest.¹⁰ It is important to note that, even if Member States do so, the Commission monitors the situation and seeks to prevent aid to undertakings of general economic interest from distorting competition.

The European Commission decided in May this year (2019) that the subsidies granted to the Zemiarske Kostolany power plant do not violate the competition rules within the European Union. The support that will be terminated in 2023 is important for the security and regularity of the electricity supply in Upper Nitra. According to a report, without the power, as mentioned above, it would not be possible to secure the supply of energy in Upper Nitra as it is nowadays.¹¹ Politicians, who criticize the assistance offer different solutions where that money can be used more effectively.

For instance, Pavol Zajac from a non-parliamentary political party states that funds should be used for the construction of the expressway R2, which would connect Prievidza and Žiar nad Hronom and would directly lead to R1, heading for Bratislava or Banská Bystrica (industry and business centres in Slovakia).¹² Although construction of expressway R2 will increase the interest of foreign investors in the region, arguing that the amount of funds intended to promote brown coal electricity could be used for these purposes is misleading, whereas, under European Union law, these funds can only be used for so-called general economic interest.

The region of the Upper Nitra is not the only one in the European Union, which is facing the same issue connected with phasing out the coal industry and its further transformation. Although it is speaking a lot about phasing out the coal industry and it being replaced by new ones, from my point of view, this transformation has already started through different types of agro activities. HBP JSC is actively pursuing these activities, which underline their importance for the region and the whole society and economy.

Projects Aimed at Diversifying Region of Upper Nitra

According to representatives of HBP JSC and the Government of the Slovak Republic, the transformation of the Upper Nitra should not be based only on waiting for new investors but also exploiting the existing potential, which the mine has brought to the society during its existence. This position is also directly endorsed in the Action plan drawn up in the first half of 2019. It refers to the province of Limburg, which lies in the Netherlands and Belgium. In the Netherlands, the former mine company was transformed into a modern food and chemical conglomerate. Mine areal in Belgium has changed into a museum of modern art and scientific centre of development of green energy.¹³

One option I detail as an example is the daughter company AGRO FISH FARM Ltd., which uses the potential of water flowing from coal deposits in Handlová. Since the beginning of extraction, this water had no use and was discharged into surface streams. A team of hydrogeologists came up with the ground-breaking idea of utilizing this water at a temperature of approximately 15-20 degrees Celsius. The thermal potential of water can be used for various purposes, such as heating greenhouses or buildings. The company first started to exploit the potential of this water to heat the greenhouses for growing tomatoes. Greenhouses are situated close to the currently non-working coal deposit Koš. The annual production of tomatoes is approximately 1.5 tonnes.¹⁴ The project, which was built in areal of the Mine Handlová, can be considered as more ambitious than the project of greenhouses.

The farm is focused on African catfish breeding. It is kept in clean and safe water that flows out of the Handlová coal deposit in a capacity of approximately 120 litres per second. Heat pumps heat the water to 50 degrees, which is subsequently used for heating greenhouses situated in the same area as the premises intended for fish farming and processing. The annual capacity of production is 1 000 tones of fish and is the biggest operation of its type in the European Union, focusing on breeding and processing African catfish.

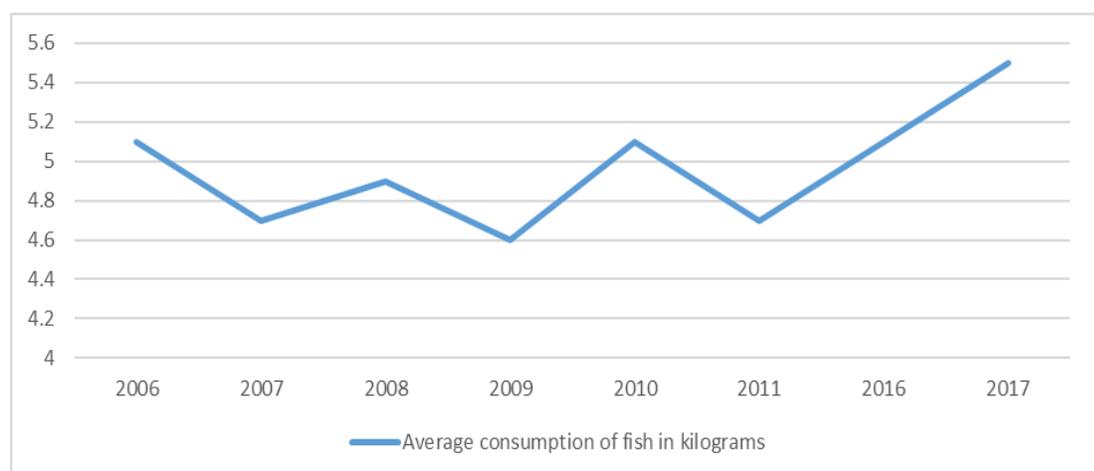
Within the area, we can talk about the so-called circular energy system, since biological fish waste is subsequently used in biogas stations, which are utilized in the greenhouses. The whole area of the mentioned company consists of a breeding and processing area and two greenhouses. In this context, it should be emphasized that the farm is extremely productive, which is reflected in annual production to the area ratio. Based on the building plan, it can be stated that the main breeding hall has dimensions of 80 x 30 m. This means that the built-up area is 0.24 ha. Taking into account that in such an area, 1000 tons of live fish are bred annually, in the conditions of the Slovak Republic, we are talking about a unique project. According to the data provided by scientist RNDr. Masár, the average fish production in a pond in Slovakia, is about 500 kg per hectare. If we compare this figure to the production currently achieved by the farm, we are talking about an enormous efficiency improvement. While another average fish producer in Slovakia needs one-hectare pond to produce 1,000 tonnes of fish per year, the AGRO FISH FARM Ltd. will achieve this production in an area of less than a quarter of a hectare.¹⁵ This high figure is mainly due to the energy potential of mining water in combination with its quantity.

Evaluation of the Project and Possibilities of its Development

The project of AGRO FISH FARM Ltd. can be considered as ground-breaking and, at the same time, as an ambitious one. The most important lessons learnt from the project can be used as an appropriate example for other regions across the European Union, which are also phasing out the coal industry and facing its necessary transformation.

In my opinion, the advantages of the project include health benefits. Although the Ministry of Health Care tries to promote the consumption of fish, the average annual consumption of Slovaks still lags significantly behind the world average. Consumption of fish and trends of its development are illustrated in the following graph.

Figure 1: Average Consumption of Fish Per Inhabitant in the Slovak Republic



Source: Ministry of Agriculture and Rural Development of the Slovak Republic. (2017) “Podporíme chov sladkovodných rýb na Slovensku.” and Ministry of Agriculture and Rural Development of the Slovak Republic. “Analýza sektora rybného hospodárstva.”, Author’s processing.

For fish consumption in Slovakia, two main trends can be currently observed. One of them is that this figure is rising and at the same time, the Slovak Republic is not able to meet the demand for domestic production and is dependent on imports. According to the information mentioned before, we can evaluate that the decision to breed and process fish has a huge economic potential and can replace imports. Currently, the import of freshwater and marine fish represents 15,400 tonnes per year.¹⁶ In the case that the domestic production of fish will increase, we can observe a decrease in imports.

A decrease in fish imports represents a reduction in costs and, at the same time, an increase in Slovakia's food self-sufficiency. Given the fact that the farm was opened in August 2015 and most of the production goes to the domestic market, it can be assumed that the growth that we see in the graph is due to the company's activity on the market. This trend must be viewed positively because eating fish meat is beneficial for several reasons. The meat of African catfish can be classified as a health food. It is characterized by low-fat content (7 percent) and high protein content (17.9 percent). It also has a high proportion of omega 3 fatty acids.¹⁷ Consumers may also be interested in the fact that meat from African catfish does not have a classic fishy smell, which may discourage consumers from consuming. Given the above, there is no doubt that, from a health and economic point of view, the creation of AGRO FISH FARM Ltd. was undoubtedly a decision in favour of the common good.

The company was established as one of the possibilities of diversification of the region of Upper Nitra. As it was mentioned above, HBP JSC. is currently playing a key role in terms of employment in the Upper Nitra. Based on forecasts and the latest information, it is not expected that any employer will be heading to the region to provide a comparable number of jobs in the near future. With this in mind, any employer who can provide jobs with a forward-looking perspective is welcome. AGRO FISH FARM Ltd. may be considered as such an employer, and it has provided 80 working places for employees with different qualifications. Although this number does not reach the rate of employment, which is currently provided by HBP JSC., there is a presumption that the company will continue to create similar projects, which automatically means creating new jobs. Similarly, given the nature of the projects, such a large number of employees are not required to retrain. I consider the increase in the unemployment rate after mining to be the greatest threat to the region.

The advantage of the project is the fact that although it is tied to the existence of the coal deposit in mine Handlová, it does not mean that the farm will reach the same fate if mining is terminated in a couple of years. Based on geological surveys, it is proved that water will continue to flow out of the deposit, even after the coal deposit will be closed. The only threat is that there will be a slight reduction in the volume of water flowing out of the mine, but it will not completely stop.

This project can serve as a model for other regions, which, after the decline or even the complete closure of coal mining, will face the necessary transformations of the region. The project mentioned above works on the principle of a combination of current and future sources. Although this project may serve as a model for other regions, it is important to draw attention to the obstacles it may encounter.

The whole project is based on exploiting the potential of mining waters. In the case of Handlová, a huge advantage is the depth of the bearing, which is about 200 m deep. Although it is deep mining, the advantage is that water is drained only from the depth mentioned above, which automatically reduces costs and simplifies the pumping process itself. In the case that a similar project was implemented, for example, in mines located in the region of Moravia in the Czech Republic, a problem related to deep mines could arise. Coal mining in this region occurs at a much greater depth, about 800 m below the surface. It follows that the costs that would have to be spent on pumping and subsequent use of water would be much higher. In these cases, it is more likely that a reverse procedure will be introduced and, instead of pumping out water and exploiting its potential, the deposits will be deliberately flooded after extraction.

Conclusion

Currently, in Slovakia, mining and coal-based electricity generation do not have a huge future. Given this, it is necessary to transform the region of Upper Nitra, for which the industries mentioned above are crucial. The views on how change should occur are different. Mostly opposition politicians argue that the end of mining should occur in the shortest time possible. However, in my view, this statement can not be fully accepted, as the security of electricity supply in the Upper Nitra region would be seriously jeopardized if mining was terminated.

From the climatic point of view, neither the import of coal from abroad and its combustion in Slovakia, nor directly the import of electricity produced from coal abroad will not solve a current situation. The transformation of the region should go hand in hand with the gradual decline in mining. In the future, the region would be helped by the construction of an expressway linking it to other industrial centres in the area. In addition to the arrival of new investors, the region can also benefit from resources that have arisen as externalities during a long period of coal mining. HBP JCS. has already started to develop various agro activities that exploit the potential of mining waters. The energy potential of water can have different uses and in no way can it be claimed that it is limited to heating greenhouses or thermophilic breeding of fish.

The AGRO FISH FARM Ltd. needs to be evaluated very positively, for several reasons. First of all, it is a company whose activity is tied to mining activity but can continue to operate even after mining will be terminated. The drawback we are aware of is the possible decrease in the volume of flowing water. The fact that the company focuses on the production of African catfish, whose indicators include health-beneficial foods, must also be viewed positively. Based on my analysis, there has been an increase in fish meat consumption since the company was established and started operating on the market. In addition to the beneficial impact on human health, it should be emphasized that the farm's activity increases Slovakia's food self-sufficiency. Within the framework of this problem, it is important to state that in the conditions of Slovakia, it is a relatively unknown type of fish, which represents a marketing obstacle for the company.

Furthermore, the company is using water which is pumped from a depth of approximately 200 m. This significantly saves costs and simplifies companies' operations. I see huge potential in similar projects in the future. By its nature, society can exploit the energy potential of water to grow any crop that can be grown in greenhouses that are heated by mine water.

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My name is Zuzana Beňová, and currently, I am working on my Ph.D. degree at the Faculty of International Relations at the University of Economics in Bratislava. I am adding my e-mail address; zuzana.benova@euba.sk.

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Green Energy In Central Asia on the Example of the Republic of Uzbekistan

Andrianna Baleha

Introduction

Energy systems are basic factors of the economic and, therefore, geopolitical, social stability and security of the country. The Central Asian region, as one of the world leaders in the extraction and export of oil, gas, coal and other energy resources, demonstrates this.¹ Energy assets and the possibility of their transportation completely determine the course of development of the economies of the Central Asian countries and is one of the main priorities of government strategies for the future.

The new dynamics and development trends on the global energy scene, the modern needs of the sales market, legal regulation and control of ecology and climate changes in the world, as well as the attitude of the world society and its active participation in environmental protection, are changing the context in which the countries of Central Asia will operate. In connection with these realities, in this article, we will focus on renewable energy in the Central Asian region, especially in the Republic of Uzbekistan. We want to show that in spite of the leading and profitable role of fossil fuels like oil, natural gas and coal in this region, “green energy“ should become part of the progressive, modern and economically viable strategy of the Central Asian states.

The Role of Renewable Energy in Central Asia

The rapid pace of development and the economic outlook for renewable energy technologies constitute significant competition for the fossil fuel-based energy system. “*Over the past four years, the total renewable energy installed worldwide has outpaced that provided by fossil fuels, with higher investments in developing countries than in developed countries.*”² Today, the share of renewable energy generated globally is one-third of global installed electricity generation capacity and continues

to grow every year.³ Also, do not forget that renewable or regenerative energy, the source of which is the sun, water, wind, tides and geothermal heat, in contrast to fossil fuels, is inexhaustible and safe for humans and the environment. World practice and numerous studies confirm not only the relevance of this topic but its economic and geopolitical importance and prospects for many regions of the world and not least for Central Asia.

The dependence of the state budgets of Kazakhstan, Uzbekistan and Turkmenistan on the extraction and export of hydrocarbon raw materials, world prices and quotas for these resources, on economic stability and preferences of importing countries, as well as generous subsidies to the hydrocarbon sector pose significant economic risks for the region.

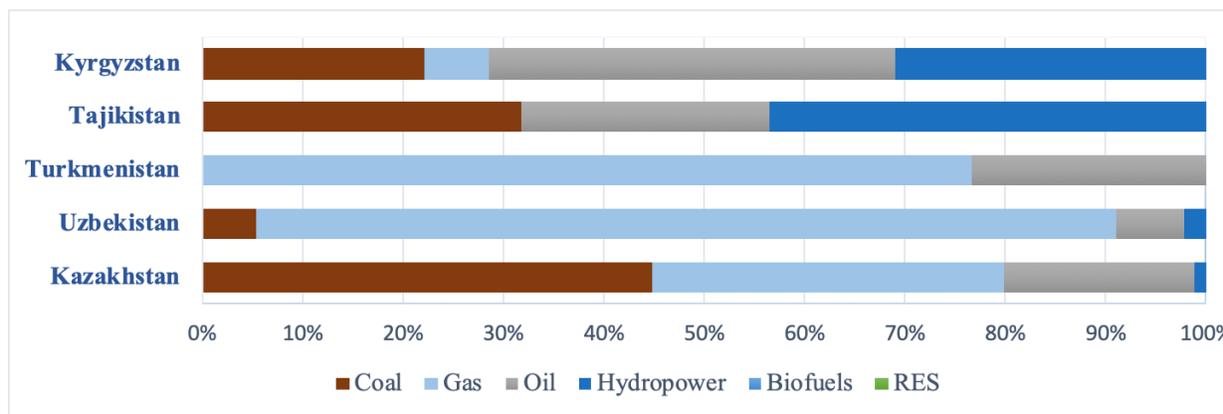
An equally important part of the country's energy security is the population's access to clean and safe fuels that would not harm the health of citizens. Despite providing more than 90% of the Central Asian population with electricity, about 6 million people (mostly the rural population) are forced to risk their health by using traditional fuels such as wood, dung and charcoal for cooking.⁴

Also, a big problem is the low quality of atmospheric air, which a significant part of the population of the region faces. In Tajikistan, Turkmenistan and Uzbekistan, the level of exposure to pollutants critically exceeds WHO standards for air quality and is at a red level – more than 35 PM2.5 µg/ m3.⁵ These critical indicators lead to the premature death of people due to cardiovascular, respiratory and oncological diseases.⁶

These are several important, but not the only facts facing governments when they consider including the use of renewable energy sources in the state's energy strategy and strive to increase its energy capacity and accessibility to the population.

Of course, the Central Asian region is rich in natural resources such as oil, coal, natural gas, which are the main sources of energy. As the latest data from the International Energy Agency in Tajikistan and Kyrgyzstan show, a large percentage of energy is provided through hydropower. In 2017, biofuels, waste, renewable sources of energy were not represented at all in the region's energy sector, but at the moment, the share of renewable energy sources in Central Asia, not including the energy generated by hydroelectric power stations, varies from 1% to 3%.

Figure 1: Energy Production in Central Asia in 2017



Source: <https://www.iea.org/statistics/?country=KAZ&isISO=true>

Despite such a low rate of renewable energy use, according to the United Nations Development Program (UNDP), the potential for “green energy” in Central Asia is very high. Wind and solar photovoltaic energy in Kazakhstan, solar and biogas in Uzbekistan, hydro and solar energy in Tajikistan, Kyrgyzstan and Turkmenistan can be a good alternative for providing energy to remote rural areas with limited access to the grid and traditional energy sources.

At the moment, there are many economic and technological difficulties in the large scale adoption of “green energy” in Central Asia. These are low electricity prices in connection with the established system of production and transportation of hydrocarbon fuel and its active subsidization by the state, which makes the

competitiveness of renewable energy difficult. The high initial investment required to start energy production from renewable sources and the poor financial support of the banking sector are economic barriers to this energy sector. According to investors who are already in the market with “green energy” in Central Asia, the big problem is the binding of fixed tariffs to the national currency, which complicates the payback of projects and increases currency risk. Also, for the established work, there is insufficient technology suppliers and specialists in this field, which, on the other hand, presents many opportunities for young people in this region.

Despite the difficulties and barriers presented for introducing renewable energy into the region’s energy sector, the government of the Central Asian countries, Kazakhstan and Uzbekistan in particular, take a rather active position on this issue and set specific and ambitious goals. During the government of the President of Kazakhstan Nursultan Nazarbayev in 2013, a concept was developed for the transition of the Republic of Kazakhstan to a “green economy” by 2050. As experts in this concept suggest, Kazakhstan will reach the maximum level of oil production and export between 2030 and 2040, given this development trend, the country's government is prudently planning to increase the share of alternative energy sources (solar, wind, hydro and nuclear energy) by 30% by 2030 and by 50% by 2050 compared with the level of 2008.⁷

The President of the Republic of Uzbekistan Shavkat Mirziyoyev also issued a Decree in 2013 “On Measures for the Further Development of Alternative Energy Sources” and a Program of Measures for the further development of renewable energy, improving energy efficiency in the economic and social spheres for 2017 – 2021. On April 16, 2019, the Legislative Chamber of the Republic of Uzbekistan adopted a law on the Use of Renewable Energy Sources, “which provides tax, customs and other benefits and preferences in the field of renewable energy use.”⁸

In addition to state support for this industry, private businesses, both local and foreign, also take active positions through various conferences, forums, projects, and closely and systematically collaborate with students and young professionals. This cooperation demonstrates the relevance, importance and prospects of promoting renewable energy in this region. It is also a good indicator that “green energy” has every chance for development and implementation in the energy complex of Central Asia, thereby realizing the achievement of the ambitious goals set out in the strategies states.

Green Energy in the Republic of Uzbekistan—First Steps

The main source of energy in the Republic of Uzbekistan is currently gas – about 86%. “Green energy” in the country is at an immature level and represents only about 3%.⁹ According to an analysis by Emblem of the United Nations, the gross potential of renewable energy is about 51 billion toe and technical 179 million toe. At the moment, only 0.6 million toe (0.3%) is utilized of the technical potential through the use of hydropower of natural and artificial reservoirs.¹⁰

With the active support of the government, directly the Ministry of Economics, the Ministry of Agriculture and Water Resources, as well as the Academy of Sciences of the Republic of Uzbekistan, JSC Uzbekenergo and JSC Uzbekhydroenergo, a study was made of the potential of renewable energy of the Republic of Uzbekistan, namely per the Roadmap “Development and Use solar energy in Uzbekistan” developed by the Scientific and Production Association “Physics of the sun. “ Also, concerning the study of wind energy, an “Assessment of the potential for developing renewable energy sources” was conducted with an assessment of the wind energy potential of the Republic of Uzbekistan. Based on the studies, the country's government plans to increase the share of renewable energy sources in the production of electric energy by 30% by 2030.

According to the Ministry of Energy, in September 2019, an “agreement with the French company Total Eren on the construction of a 100 MW solar power station in the Samarkand region on PPP terms was signed in order to begin moving toward the goal, and in October, the results of a tender for the construction of a 100 MW solar power plant were summed in the Navoi region, according to the results of which the Emirati company Masdar was declared the winner with a tariff of 2.679 cents / kWh. “^{11,12} Also, according to the Ministry, in 2020, it plans to conduct a competitive selection of projects for solar and wind power plants with a total capacity of more than 700 MW. The financing of these projects will be provided exclusively using direct investment from abroad.¹³

The use of modern solar water heating systems is already being used in several motor transport enterprises, medical institutions, at the facilities of the Ministry of Defense of the Republic of

Uzbekistan, Uztransgaz, Uzbekistan Railways, Almalyk and Navoi mining and metallurgical plants, other enterprises and organizations.¹⁴

Uzbekistan has 650 rivers, 500 lakes and many reservoirs.¹⁵ This gives the country great potential for the development of hydroelectric power plants, as another important source of electricity production and to increase significantly beyond the market share of 2% (Table 1). According to JSC Uzbekhydroenergo, which is mainly responsible for the development of hydropower in the country, such new hydroelectric power plants are under development including the Zaminskaya micro-hydroelectric power station, the Tuyabugizskaya small hydroelectric power station. A cascade of small hydroelectric power stations on the Great Fergana Canal, and the modernization of the commissioned HPS-1 (hydroelectric power station), which is part of the Shakhrikhan cascade of hydropower plants. More than 20 new hydroelectric power stations are under construction and existing ones are being modernized.¹⁶

Wind is also a potentially important source of energy in the Republic of Uzbekistan, which is confirmed by studies conducted in 2015 by the unitary enterprise Talimarjan TPP, JSC Uzbekenergo and a consortium of German companies Inec-GOPA and GEONET with the support of the World Bank.¹⁷ These studies showed that the technical potential of wind energy is 520 GW of installed capacity, and the main wind zones were in the Navoi, Bukhara, Samarkand regions and in the south of the Republic of Karakalpakstan. As a result, the Arabian company Abu Dhabi Future Energy Company PJSC (also known as Masdar) has signed an agreement with the Ministry of Investment and Foreign Trade of the Republic of Uzbekistan and JSC Uzbekenergo on the construction of a wind power plant with a total capacity of 500 MW.

The government of the Republic of Uzbekistan, in accordance with the proposed concept, plans to build three solar photovoltaic stations in Samarkand, Navoi and Surkhandarya regions and one wind power station in Navoi region with a total capacity of 402 MW and annual electricity production of up to 830 million kWh by 2021.¹⁸

Our analysis indicates that the government of the Republic of Uzbekistan is taking confident steps towards diversification of the country's fuel and energy systems. It is creating a favourable investment climate, developing a wide system of legal guarantees and benefits for foreign investors, as well as taking a holistic system of measures to stimulate activity enterprises with foreign investment in this field to achieve their goals in a specified time.

Conclusion

Each state government faces an important task to provide reliable and safe electricity to the population of their country. They also need to promote the development of all sectors of the economy, as well as to ensure the energy independence of the state and its economic stability. For some, this task is a big challenge and a zone of conflict of interest. An unequivocal solution to the problem should be the diversification of fuel by increasing the share of other energy carriers. Renewables can be just such a rational and strategic decision.

To include the energy sector using renewable energy sources in our national goals, in our opinion, means to join the so-called "elite club" of states that support the values of a progressive and responsible world community and recognize the importance of sustainable economic growth without harming their citizens and the environment.

The economic and political privilege of using renewable energy is also obvious to the governments of Central Asian countries. In the course of our analysis of this topic, we were able to verify this. There can be no quick and radical transition from traditional fuels to renewable energy in this region since countries occupy leading positions in the extraction of oil, gas, coal and uranium and have an established system for their extraction and transportation. But the gradual introduction of "green energy" into the region's common energy complex and the increase in its use are the real and necessary goals of the countries of Central Asia.

In our article, we also emphasized that the territorial location and climatic conditions of the Central Asian region demonstrate the huge potential for using the energy of the sun, wind, water, thermal waters and biomass. Much work has been done to study renewable sources of energy and create so-called maps of their best use. Legislative, economic and political support of the state, international organizations, financial institutions, private investors and specialists in this field will be able to overcome all the obstacles to the introduction of "green energy" in the energy complex of Central Asia.

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Analysis of Geopolitical Factors During Development of Oil and Gas Shelf of the Caspian Sea by Azerbaijan

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Introduction

The article concerns the essence of unfavourable and favourable factors that determine the situation with the development of Azerbaijan's oil and gas shelf of the Caspian Sea at the present stage with the emphasis on the role of geopolitical factors. Geopolitical factors have a very significant effect on this situation. The Caspian shelf or the bottom of the Caspian Sea belongs to five states - Azerbaijan, Kazakhstan, Iran, Russia, and Turkmenistan. Among these countries, the Caspian shelf is of significance for Azerbaijan's economy, for providing the country's energy security at the national level, and for ensuring the export of hydrocarbons [1, 2]. Moreover, today there is no document agreed by all the Caspian states on the division of the bottom of the Caspian Sea, which would allow all these countries, including Azerbaijan, to conduct oil and gas production without conflict. The absence of such a document is the most important factor in geopolitics that impedes the development of the mentioned shelf by Azerbaijan.

On the other hand, today, there are factors of geopolitics that contribute to the development of this shelf. This is an extremely open policy of the Government of Azerbaijan regarding the creation of favourable conditions for external investors and the ability of this Government to make compromises in solving the problems of transit through third countries of its exported hydrocarbons. The oil production and

transportation infrastructure created in previous years cooperation with international companies in oil production and transportation, as well as the legal framework based on the “Contract of the Century” [3], signed in 1994, play important roles.

Issues devoted to the geopolitical problems of the Caspian region are discussed at various sites. In particular, in [4, 5], potential hydrocarbon accumulation sites in the Black Sea-Caspian region are identified. It is shown that the Georgian part of the Middle Kura depression smoothly passes into the Azerbaijani territory of the Middle Kura depression, where terrigenous-carbonate and volcanogenic Mesozoic deposits were discovered. Small accumulations of oil in thin sandy Eocene reservoirs have also been identified. Based on the analysis of data on gas manifestations, it can be concluded that the upper part of the South Caspian section is highly enriched in gas, and the intensity of gas manifestations in the lower part is the highest. The studies showed the prospects for the development of oil and gas regions within Western Azerbaijan.

The discovery of large deposits of oil and natural gas in the Caspian Sea raised not only the question of determining its international status but also the question of how to divide Caspian natural resources. Previous Russian-Persian (and then Soviet-Iranian) treaties dealt only with the regulation of shipping and fishing and did not address the issues of exploration, production and transportation of crude oil and natural gas by laying pipelines on the bottom of the Caspian Sea. Having no historical obligations, the new littoral countries - Azerbaijan, Kazakhstan, and Turkmenistan - began to pursue a unilateral policy in which their national interests prevailed. Within the framework of the five-sided format of negotiations, the countries of the region continue negotiations, planning to sign the Convention on the international legal status of the Caspian Sea [6].

In [7], an overview of the interests of countries located in the Caspian region is presented. The alignment of forces and their political and economic interests. The article emphasizes that the region lacks a unified energy policy and cooperation strategy as a whole, i.e. not only in the fuel and energy sector but also across the entire spectrum of socioeconomic and geopolitical issues. In this regard, it is advisable to determine the tactics and development strategy jointly: determine the attitude to the environment, develop common stereotypes, and form a vector of goals.

The Situation Around the Oil and Gas Caspian Shelf of Azerbaijan in Retrospect (until 2018)

The authors considered it possible to consider the boundary of the current stage of 2020 as the final year of the current decade. The proximity of this year to today allows us to speak fairly confidently about the quantitative values of the main indicators of the situation with oil and gas production in Azerbaijan on the shelf of the Caspian Sea. It is necessary to analyze the situation around this shelf in retrospect to reach quantitative indicators of the development and functioning of the oil and gas complex of Azerbaijan in 2020 while emphasizing the role of the Caspian shelf.

On that part of the shelf of the Caspian Sea, where Azerbaijan today produces oil and gas, more than 90% of all hydrocarbon reserves for the country (authors estimate - taking into account the data [8, 9]). Reserves on land are depleted and continuously reduced (oil has been extracted here for more than 150 years). At the same time, about 95% of domestic needs [8] are covered by the oil and gas complex of Azerbaijan. Oil and gas also represent about 85% of export products by volume [10].

For the other four countries above, the importance of their oil and gas complexes are also of importance. However, unlike Azerbaijan, the main reserves of their hydrocarbons are not located on the shelf of the Caspian Sea, but in the mainland of these countries. Judging by the data in Table 1, Azerbaijan, like no other Caspian state, needs the mentioned document on the division of the bottom of the Caspian Sea. And although the Convention on the Legal Status of the Caspian Sea was adopted at the last meeting of the heads of the five Caspian littoral states in August 2018 [11], the issues of dividing the bottom are not mentioned here.

Table 1: The situation with the oil and gas of the Caspian countries with the allocation of the role of the Caspian shelf in terms of their reserves and production volumes (2018)

Indicators	Russia		Azerbaijan		Turkmenistan		Kazakhstan		Iran	
	Oil, million tons	Gas, billion m ³	Oil, million tons	Gas, billion m ³	Oil, million tons	Gas, billion m ³	Oil, million tons	Gas, billion m ³	Oil, million tons	Gas, billion m ³
Proved reserves: total,	14,600	38,900	1000	2100	100	19,500	4300	1000	22,600	3400
including on the shelf of the Caspian Sea	350	700	900	1900	20	n/a	2000	250	1600	1400
share of shelf reserves to total reserves	2.4%	1.9%	90%	90%	20%	n/a	47%	25%	7%	4.1%
Production volume: total,	563.3	669.5	39.2	18.8	10.6	61.5	91.2	22.4	220.4	239.5
including on the shelf of the Caspian Sea	6.9	0.0	36.0	18.8	1.5	0.0	13.0	9.0	0.0	0.0
share of offshore production and total production	1.2%	0%	92%	100%	14%	0%	14.2%	40%	0%	0%
Domestic consumption	360.1*	454.5	4.6*	10.8	7.1*	28.4	16.4*	19.4	86.2*	225.6
Export	203.2	215.0	34.6	8.0	3.5	33.1	74.8	3.0	134.2	13.9

* Crude oil refining volumes within the country to produce petroleum products used domestically and exported. Sources – [9, 10, 12].

Since 1994, thanks to the creation of appropriate conditions by the Government of Azerbaijan to external investors [3], intensive development of the oil and gas shelf in the part of the Caspian Sea that has been recognized by all the Caspian states as Azerbaijan has begun. This part contains a rather large number of oil and gas fields with total proven reserves (for 2018) of liquid hydrocarbons of 900 million tons [9], and gas - in 1900 billion m³ [9]. Official forecast reserves are more than 1,500 million tons of oil and more than 2,300 billion m³ of gas.

Basically, through the development of these reserves, Azerbaijan successfully fulfilled all the basic requirements for ensuring its energy security, both in terms of supplying its domestic consumers with energy resources and in fulfilling all obligations for the export of hydrocarbons. Exploration at the Caspian Sea's oil and gas shelf has increased. New hydrocarbon deposits have been developed here, and annual production and gas levels have grown.

Since 2010, the situation with the development of the country's oil and gas complex has begun to change for the worse. This year there is a peak in oil production (50.8 million tons). Its production level began to decline and, in 2018, reached 39.8 million tons. That is, over eight years, oil production decreased by 22.8%. Since 2016, the level of gas production began to decline slightly. In 2015 its production amounted to 34.3 billion m³ (natural gas - 18.8 billion m³ and 11.6 billion m³ - associated gas), then in 2018 - 30.4 billion m³. This decrease in gas production levels occurred mainly due to a reduction in associated gas production while lowering oil production levels.

Natural gas production has remained at the same level over the past 3-4 years. One of the main reasons for the decline in oil production by Azerbaijan after 2010 should be considered the beginning of the fac-

tor, which is associated with difficulties in delimiting the Caspian Sea shelf between Azerbaijan and Turkmenistan, as well as between Azerbaijan and Iran. In this case, the effect of the factor was expressed in Turkmenistan's disagreement regarding the further eastward expansion of those areas of the Caspian Sea to which various oil companies have prospected for oil and gas, and also produced these hydrocarbons for Azerbaijan. There is a more specific reason for Turkmenistan's claims - the controversial issue of Azerbaijan's right to the Sardar-Kapaz oil field.

Iran also opposed the expansion of the Azerbaijani shelf (but already to the south), challenging Azerbaijan's right to develop the Alov-Araz-Sharg gas field. Disagreements with Iran over the disputed gas field have little effect on the overall situation with the development of its offshore gas fields by Azerbaijan.

In addition to the disputed fields mentioned above, Azerbaijan has many other "indisputable" gas fields. These include the Shahdeniz with projected gas reserves of 1.2 trillion m³ and the Absheron, Umid, Ashrafi and others - with projected total reserves of more than 2.5 trillion m³. The disagreement between Azerbaijan and Turkmenistan over the very delimitation of the Caspian shelf between them turned out to be very serious. The fact is that today three-quarters of all oil of Azerbaijan is produced in the deep-sea shelf area of the Caspian Sea of the powerful oil-bearing area of Azeri-Chirag-Guneshli (ACG). To complicate matters, the above-mentioned "controversial" Sardar-Kapaz field is a continuation of the block of ACG fields.

The geological exploration for oil in the ACG area continuously increases with the extension of its borders farther east, towards Turkmenistan. Until a certain point in time, not a single Caspian country made claims against Azerbaijan to advance ACG borders eastward, considering such a move to be completely legal. New oil deposits were discovered at ACG sites, and intensive development is underway.

A favourable investment climate, high world oil prices, and most importantly, the dynamics of increasing its reserves in ACG, made this complex of fields very attractive for external investors. Suffice it to say that in the development of ACG, ten world oil companies took part (including BP, Statoil, SOCAP, etc.).

The situation changed after Turkmenistan expressed its disagreement with the further advancement of the borders of the ACG field complex to the east. The progress of these borders has ceased, the discovery of new oil deposits has stopped, and the flow rates of wells at ACG fields have begun to fall. The annual oil production here, having reached a peak in 2010, began to decline.

The main reason for the manifestation of the difficulty in resolving "shelf" disagreements, as already mentioned, is the lack of a clear agreement among the Caspian states on the division of the bottom of the Caspian Sea between them. Azerbaijan has only a bilateral agreement with Russia on the demarcation of the border of its shelf zone, and there are no such agreements with Turkmenistan and Iran.

There was a decline in annual oil production in Azerbaijan from 2010 to 2017. It was not only because of the "shelf" disagreements. The decline was also influenced by a sharp decline in world prices for oil in the second half of 2013, an increase in the cost of oil production at its fields, and an increase in the cost of ensuring industrial safety on platforms for offshore oil and gas production.

"Offshore" disagreements and a decrease in oil production, together with the above factors, turned out to reduce the attractiveness of the Caspian oil and gas shelf among investors. This mainly affected the oil industry, when foreign investments began to decline in the oil sector of Azerbaijan (in 2014, these investments were at \$ 6.7 billion, and only \$ 4.9 billion in 2016).

The reduction in hydrocarbon production with a virtually unchanged level of primary energy consumption has accordingly affected the export volumes of Azerbaijani hydrocarbons balanced with ensuring the country's energy security. For example, the need to fulfill its obligations to export gas and the need to provide gas to domestic consumers made Azerbaijan (by agreement with the Russian side) refuse to supply gas to Russia.

Back in 2010, 1.5 billion m³ of Azerbaijani gas was sent to Russian Dagestan via the Baku-Makhachkala gas pipeline, and by 2015 this export had ceased. Moreover, Gazprom undertook to supply up to 4 billion m³ / year to Azerbaijan [9, 13] (2 billion m³ by agreement with the state-owned company SOCAR and 2 billion m³ by agreement with the Azerbaijan methane company). State revenues from hydrocarbon exports began to fall, its investment opportunities decreased.

Since 2017, the Azerbaijani economy has been stabilizing due to a slight increase in world prices for hydrocarbons, as well as the rather successful solution by the Government of the country of the problem of diversification of the GDP structure due to the rapid development of non-oil sectors and a sharp increase in export of products from these sectors. The situation with the main indicators of the development and functioning of Azerbaijan's oil and gas production in the period from 2010 to 2018, with the allocation of the role of hydrocarbon reserves of the Caspian shelf, can be judged from the data in Table 1 above (2010 is the peak in oil production in the country).

At the same time, a number of strategic documents were adopted to stabilize the use of natural gas in the country's energy balance. In the strategic roadmaps of the national economy and major sectors of the economy, signed by the President of the Republic of Azerbaijan on December 6, 2016 [14], intensive development of alternative and renewable energy sources is provided. Table 2 shows the volumes and terms of introducing new renewable energy sources into the energy system of Azerbaijan by 2020.

Table 2: Renewable Energy Input Expected by 2020

	MW
Wind farms	350
Solar power plants	50
Biofuel power plants	20
Total	420

The introduction of 420 MW of new renewable energy generating capacities by 2020 should lead to the release of an additional approximately 250 million m³ of natural gas, which will increase gas exports (or offset the growing domestic consumption as a result of increased gasification in the country). By 2025, the use of renewable energy will release 1.6 billion m³ of gas, which can be exported.

Table 3: The Main Indicators of the Azerbaijan Oil and Gas Sector

Indicators	2010	2015	2016	2017	2018	2019	2020
Proven oil reserves: countrywide, billion tons	1	1	1	1	1	1	1
including on the shelf of the Caspian Sea, million tons	0.9·10 ³						
Oil production: in the whole country, million tons	50.8	42.0	41.4	39.1	39.2	39.0-39.5	39.0-40.0
including on the shelf of the Caspian Sea, million tons	45.0	38.0	37.0	36.0	36.0	35.5-36.0	35.5-36.0
Oil export total ¹ , million tons	46.1	35.5	34.9	32.6	32.9	33.0-33.5	33.2-33.7
Domestic oil consumption, million tons	4.7	6.5	6.5	6.5	6.3	6.3-6.4	6.3-6.4
Proved natural gas reserves: countrywide, trillion m ³	1.2	1.3	1.3	1.3	2.0	2.3-2.5	2.5-3.0
including offshore ² Caspian Sea, trillion m ³	1.15	1.25	1.25	1.25	2.05	2.5-2.7	2.7-3.0
Natural gas production: in the whole country, billion m ³	16.3	18.8	18.3	17.8	18.8	19.0-20.0	19.0-20.0
including offshore ² Caspian Sea, trillion m ³	16.3	18.8	18.3	17.8	18.8	19.0-20.0	19.0-20.0
Domestic gas consumption, billion m ³	8.1	11.5	10.9	10.6	10.8	10.5-11.0	10.5-11.0
Import of natural gas to Azerbaijan, billion m ³	-	-	1.0	1.7	1.7	1.5-1.7	1.3-1.5
Export of Azerbaijani natural gas, billion m ³	8.2	7.3	8.4	8.9	9.7	10.0-11.0	10.0-11.0

Sources – [9, 10, 12]. 2010-2018 values are actual. 2019 and 2020 values are expected.

Table 3 shows the forecast values of the main indicators of the development and functioning of the oil and gas complex of Azerbaijan for 2019 and 2020, including the expected values of the proved hydrocarbon reserves on its Caspian shelf and the volumes of oil and gas production there. These predicted values are based on the assumption that:

- proven oil reserves (across the country and on the Caspian shelf) will remain at approximately the same level as in 2018 because if there is any increase in its reserves, they will be “eaten up” due to production;
- annual increases in oil production levels are insignificant; the same applies to the volume of export of Azerbaijani oil;
- domestic consumption should remain at the level of 2018 since, for Azerbaijan, the fulfillment of external obligations is a priority;
- the proven reserves of natural gas will grow and grow noticeably, although not as sharply as during the transition from 2017 to 2018;
- despite a noticeable increase in proved reserves of natural gas, it is impossible to expect an equally noticeable increase in its production in 2019 and 2020;
- one cannot expect a noticeable increase or a noticeable decrease in annual levels of domestic consumption of natural gas (there are no prerequisites for either);
- with a slight increase in gas production with constant volumes of its domestic consumption and, judging by the favourable situation for Azerbaijan that develops around its gas export, this export should grow; however, its exports in 2019 and 2020 will not differ dramatically in comparison with 2018;
- gas imports by Azerbaijan in 2019 and 2020 apparently will remain, but its volume should not grow.

Table 3 does not contain information about associated gas produced in the country's oil fields in the amount of up to 12 billion m³ per year, because almost all of it (with some exceptions) is pumped back into oil reservoirs to maintain an acceptable reservoir pressure.

Conclusion

The oil and gas complex of Azerbaijan, which is based on hydrocarbon deposits on the shelf of the Caspian Sea, is of exceptional importance for the country's economy and for ensuring its energy security at the national level. A special role in the development of the oil and gas Caspian shelf of Azerbaijan today is influenced by geopolitics - both inhibiting the development of this shelf and conducive to its development. The first factors require their mitigation or the complete cessation of their action, and the second requires their strengthening.

Firstly, Azerbaijan should become the initiator of a global resolution of the problem of dividing the bottom of the Caspian Sea between the Caspian states. And secondly, the Government of this country consider all possible measures to maintain a favourable investment climate for investors in the oil and gas sector. In addition, to reduce the country's dependence on the oil and gas sector, it is necessary to try to increase the influx of investments in other sectors of the economy, for example, as already mentioned in the creation of generating capacities based on renewable energy sources.

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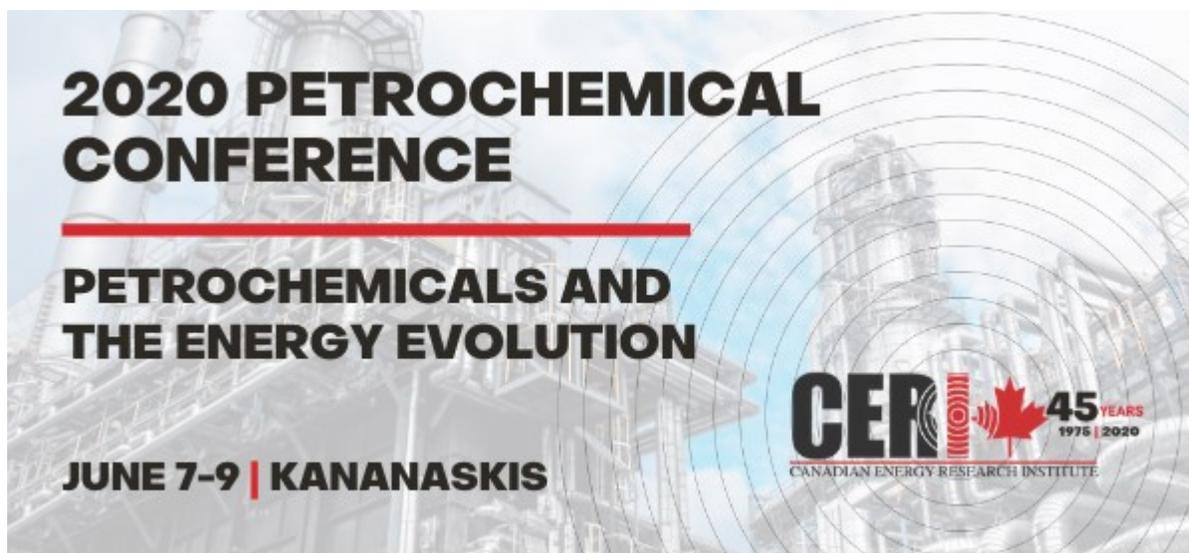
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