Saiymova, Meiramkul; Shakharova, Aliya; Rakaeva, Aliya et al.

Article

Energy security, economics and environment in the Eurasian Economic Union : current and future scenarios

Reference: Saiymova, Meiramkul/Shakharova, Aliya et. al. (2020). Energy security, economics and environment in the Eurasian Economic Union : current and future scenarios. In: International Journal of Energy Economics and Policy 10 (4), S. 293 - 299.
https://www.econjournals.com/index.php/ijeep/article/download/9127/5134.
doi:10.32479/ijeep.9127.

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2020, 10(4), 293-299.

Energy Security, Economics and Environment in the Eurasian Economic Union: Current and Future Scenarios

Meiramkul Saiymova[1]*, Aliya Shakharova[2], Aliya Rakaeva[2], Madina Serikova[2], Aslan Tasmaganbetov[3], Yuliya Tyurina[4], Zhibek Bimagambetova[5]

[1]Turan-Astana University, Nursultan, Kazakhstan, [2]Gumilyov Eurasian National University, Nursultan, Kazakhstan, [3]Zhubanov Aktobe Regional State University, Aktobe, Kazakhstan, [4]Financial University under the Government of the Russian Federation, Moscow, Russia, [5]Al-Farabi Kazakh National University, Almaty, Kazakhstan. *Email: meiramkul.Saiymova@tau-edu.kz

Received: 19 December 2019 **Accepted:** 13 April 2020 **DOI:** https://doi.org/10.32479/ijeep.9127

ABSTRACT

The Eurasian Economic Union (EAEU) countries have actively taken a direction to promote political initiatives to strengthen energy security. Major policy initiatives are programmes to increase domestic renewable energy production, improve energy efficiency and reduce CO_2 emissions from fossil fuel combustion. This paper aims to show how energy security indicators namely primary energy intensity (EI) of gross domestic product, primary energy dependence (PE), net import dependence (ID), supplier dependency (SD) vary in a range of energy security policies - renewable energy development, Energy Efficiency Reduction (EFF), and Greenhouse Gas Reduction (GHG). Furthermore, factors preventing the development of non-traditional and renewable sources of energy in countries of EAEU are considered. Mechanisms of solving existing contradictions are proposed. Particular attention is paid to the need to include environmental costs and pollution losses in economic analysis, which will improve the competitiveness of alternative energy sources. The necessity of accelerated development of alternative energy to increase energy supply, energy saving, energy and environmental security is shown.

Keywords: Renewable Energy, Energy Security, Sustainable Development
JEL Classifications: 0130, Q400, Q430

1. INTRODUCTION

In the global structure of energy reserves, the share of countries of the Eurasian Economic Union (EAEU) is 8% for oil, 18% for gas, 20% for coal, and 21% for uranium (IEA, 2018). The incoming part of the EAEU energy balance exceeds the outcoming part by about 700 million tons of oil equivalent. This allows to supply the largest volume of primary fossil fuel resources in the world to international and regional markets. By comparison, the total export potential of energy resources of Russia and Kazakhstan is about 1.5 times higher than that of Saudi Arabia. Furthermore, the EAEU's countries are considering to expand the use of renewable energy sources (RES) in their national energy balances. At the moment, the EAEU's countries mainly provide their demand for energy resources from traditional energy sources, but the situation is changing, along with this, the technologies and economics of energy production processes are changing. In fact, the process of increasing renewable energy production capacities has been launched in all EAEU countries. According to national balance, the share in the energy balance of renewable energy in Armenia was about 32.5% in 2018, in Belarus - 4%, in Kazakhstan – 8.5%, in Kyrgyzstan and Russia - 6.1 and 19% including large hydropower plants, respectively (WB, 2018). If to compare, the current energy generation structure in the EAEU countries is well balanced in Armenia. RES and hydropower plants account for about a third of the energy balance, another 32.5% for nuclear power plants and thermal power plants (TPPs), that is, about a third for each of the sources of electricity generation (OECD, 2018). For comparison, in the Russian Federation more than half of the installed capacity (58.5%) is accounted for by TPPs, the rest is distributed between nuclear power plants (18.9%) and RESs with hydropower (IEA, 2018). At the same time, almost all EAEU countries have plans to increase the potential of renewable sources in electricity production. Armenia announced plans to increase the share of RES in the energy balance of the country to 70%. Belarus is very actively engaged in the construction of renewable energy plants, by 2020 it is expected to increase the volume of renewable energy production capacity to 890 MW (BP, 2016). In Kazakhstan RES in recent years are positioned as one of the vectors of energy complex development. The Concept on the Transition to a Green Economy set the goal to increase the share of alternative energy sources to 10% by 2030, to 50% by 2050 (Karatayev et al., 2016). In Russia, there are certain changes in the field of renewable energy. In 2018, the volume of RES capacity introduction is markedly higher than in the previous two years. 130 MW of RES capacity was introduced during 2015-2017, 170 MW in 2018 (REN21, 2018). Nevertheless, RES has not been properly distributed in EAEU's countries, and it is strategically necessary to develop RES-generating capacity, therefore, the following part of paper review and analyze the basic factors that impede the development of RES in EAEU' members.

2. COUNTRY ENERGY OVERVIEW

2.1. Armenia

In terms of geopolitical position, the Republic of Armenia is considered as a bridge to the Middle East, the Mediterranean and African regions. The country has no significant hydrocarbon reserves. The country's basis of energy system is Armenia Nuclear Power Station, two large heat power stations - Yerevan CHPP and Razdanskaya CHPP, ten hydroelectric power plants of Vovanskaya and Sevan-Razdan cascades (Elliott et al., 2003). Armenia's unified energy system operates in an autonomous regime. For comparison, the energy system of neighboring countries, Georgia and Azerbaijan, operating in parallel with Russia's energy system. The country's gas pipeline system is controlled by Russian enterprises. Gas is supplied from Russia through the territory of Georgia. The history of the Armenian Nuclear Power Station is dramatic and complex (the first reactor was put into operation in 1976, the second reactor in 1980). Since 2003 Armenian Nuclear Power Station is managed by Russian company Inter RAO. The specific weight of the power plant in the total power generation of country exceeds 30% (Vagliasindi, 2012). In 2015, Russian company Rosatom started a project to extend the life of this facility by 10-15 years. However, it is quite likely that Armenian Nuclear Power Station will be decommissioned between 2030 and 2035 (Sheffield and Sheffield, 2009).

The energy generation sector is characterized by a high level of capacity wear. The average period of operation of the main power producers of the Sevan-Razdan hydroelectric power plant exceeds 50 years. Since 2003 the complex has been owned by International Energy Corporation RusHydro. The program of technical re-equipment of fixed assets began to operate in 2015. Modernization of the hydroelectric power plant of the Vovanskaya cascade is proceeding slowly. Hydroelectric power plants are owned by two companies from the United States, which have undertaken to rebuild the facilities until 2040 (Chakryan, 2010). Plans for RES sector development and energy saving are being implemented in Armenia. The construction of 60 small hydroelectric power stations is planned, a solar atlas is being created, and projects are being implemented to create wind farms. It is expected that a state program for the development of renewable energy can be adopted by national government in 2020.

Armenia is developing cooperation with China. Currently, both countries are considering the possibility of implementing projects to build gas generating capacities and expand the capacity of the Armenia-Georgia and Armenia-Iran power transmission lines on the territory of the Republic of Armenia. Armenian power stations are expected to use Iranian and Russian gas (which is currently supplied to Armenia at preferential prices). Some of the electricity produced in Armenia can be used in Armenia's neighboring states, in Georgia.

2.2. Belarus

The Republic of Belarus is considered a western bridgehead. Belarus is an important corridor in the system of transportation of oil, natural gas and petroleum products to Kaliningrad region of Russia, Western European states (about 70% of total transit), Poland, Baltic states, and Ukraine. The resource supply of the country with hydrocarbons is weak. Belarus consumes 40 Mtoe per year and only 15% is provided with its own resources (EIA, 2019). About 8.5 billion US dollars a year is spent on the purchase of missing energy and electricity, which is about 20% of the total imports of country and makes its economy dependent on external factors. In the structure of energy consumption, the share of one energy resource of natural gas is large (97.2% in energy balance), which are imported from Russia (Balmaceda, 2013). There are five thousand deposits containing about 30 types of mineral raw materials have been identified, including in small volumes - oil, associated oil gas, peat of energy types, brown coal, combustible shale. National energy relies on the import of primary energy resources, mainly from Russia. The share of Belarusian hydrocarbons in the national consumption of oil and gas is 12%. The electricity industry of Belarus is on the verge of qualitative changes (Yafimava, 2011). This is due to the creation of nuclear power, modernization of TPPs, increase of the number of stations based on local types of energy resources and RES, reconstruction of power networks, formation of local power generation systems, transformation of electric and thermal energy markets. Using the potential of the Chinese initiative "One Belt, One Road," it is possible to create new and expand existing electric power bridges in order to increase the export of electric energy from Belarus to Ukraine, Poland, Moldova, the Baltic states, Scandinavia and further into the EU unified energy system (Balmaceda and Balmaceda, 2006).

The strategic direction for Belarus in the field of energy in the near future is to increase the use of RESs. From 2000 to 2018, the share of RESs in gross energy production increased from 0.8% to 1.1%. In 2018 12 mini-combined heat and power plants used wood fuel and peat with a total electric power of 23.8 MW, 10 biogas complexes with the general it is established ache with an electric power of 15 MW, 49 hydroelectric power stations with the general rated volume about 33.4 MW (the greatest on the

Grodno hydroelectric power station - 17 MW), 18 wind power installations with a general power of 4 MW (the greatest - 1.5 MW in Novogrudsky district) (Raslavičius, 2012; Guliyev and Mekhdiev, 2017). In accordance with the National Programme for the Development of Local and RESs, the Government plans to build and restore 33 hydroelectric plants with a total capacity of 102.1 MW, to build wind power plants with a total electric capacity of 440-460 MW, to introduce 126 heat pumps for the use of low-potential secondary energy resources and geothermal energy with a capacity of 8.9 MW, to introduce 172 solar plants and other equipment (Guliyev and Mekhdiev, 2017). Significant investment is required to achieve the goals. In this regard, a mechanism of state support for RES projects has been established to attract private and foreign capital to the use of RESs. According to this mechanism, land plots for the creation of facilities for the use of RES are not taxed, imported equipment is exempt from payment of customs duties and taxes, connection to power transmission networks and purchase of generated electricity at increased tariffs is guaranteed.

2.3. Kazakhstan

The Republic of Kazakhstan is considered as the eastern gateway of EAEU. Kazakhstan has the largest fossil fuel deposits. The national structure of natural energy reserves is dominated by uranium, the share of which is estimated at 47% (Aitimov et al., 2016). Coal, oil and gas account for 33%, 13% and 7% respectively (Karatayev et al., 2016). More than half of the oil fields of Kazakhstan located onshore in Western part of country are in the phase of reduction production (Teleuyev, 2017). The problems of the oil sector are also the high cost of production at new fields, the complex and little-learned physical and chemical composition of oil. The domestic oil market is characterized by deficit of oil products (Koshim et al., 2018).

Gas production is conducted generally on oil-gas condensate fields. Quality of natural gas is low. The overwhelming volume of natural gas downloads in the underground horizons in view of need of maintenance of reservoir pressure and also poor development of gas transmission infrastructure, the shortage of capacities for gas processing (Karatayev and Clarke, 2014). In the long term these factors enhance risks of emergence of deficit of gaseous fuel in domestic market. The gas transmission system of the country was created in the 20 century therefore it is functionally oriented to supply of natural gas from Central Asia to the northern regions of Russia and Ukraine (Xiong et al., 2015). The gas transmission system of the country does not possess the developed network. The centralized supply of gas covers the settlements and objects of the industry which are near transit gas pipelines (Mudarissov and Lee, 2014). Besides, the gas transmission system does not allow to direct gas from the western part of the country to the southern and northern regions in view of lack of jumpers between main gas pipelines (Karatayev and Hall, 2017).

The RES sector is in the early stages of development. The immediate plans of Kazakhstan include development of 106 RES-stations with a total capacity of more than 3GWt, including 34 wind stations (1,787 MW), 41 small HPP (539 MW), 28 solar stations (713.5 MW), 3 biofuel power plants 15.05 MW (Karatayev and Clarke, 2016).

2.4. Kyrgyzstan

The Kyrgyz Republic is viewed as the key to South Asia. The country's basic resource for energy production is water (Hamiche et al., 2016). In terms of hydropotential, Kyrgyzstan ranks the second in Central Asia and third in CIS. Oil and gas production are extremely low. Coal mining mainly provides domestic needs, but its quality is low. Large reserves of high-quality of coal resources are located in hard-to-reach areas with poorly developed infrastructure. Introduction of new coal deposits into industrial circulation will require large-scale investments, restoration of the base of documents containing geological and other information accumulated during the USSR, attraction of foreign qualified personnel. The mining industry, which requires a complete renewal of fixed assets, has an average growth potential, the disclosure of which will provide part of the domestic demand for oil and oil products and in full - for coal. The fixed assets of the Kyrgyzstan have been operating without reconstruction for several decades and are in a state close to critical (Apergis and Payne, 2010). The exception is the few modernized facilities in the sectors of generation and transmission of electricity, production and distribution of thermal energy, oil refining (new oil refineries were created with the support of China).

The energy sector is dominant by hydropower, the significance of which is great not only for industrial production and agriculture, but also for the country's social sphere. Promising areas of energy development include the renewable energy sector, primarily wind and small hydropower, energy efficiency and energy saving. The relevance of the use of renewable energy resources is due to the need for the massive creation of decentralized energy supply systems in remote and inaccessible areas with a limited number of consumers. In the long term, Kyrgyzstan intends to solve the tasks of increasing energy production on the basis of large, medium and small hydroelectric power stations, TPPs. Furthermore, country's energy policy aims to explore new industrial deposits of hydrocarbons, uranium raw materials, developing the export of fuel and energy products, harmonizing the EAEU standard s and technical conditions for electricity, coal, oil and gas raw materials and high value-added products.

Kyrgyzstan has significant technical potential of RESs: wind power - 2400 GWh per year; Hydropower - 6800 GWh per year. Using solar energy, it is possible to obtain 12887 TJ per year of heat and 0.071 TJ per year of energy, bioenergy - 10259 TJ per year of heat and 593 TJ per year of electric energy (Toğrul and Kizi, 2008; Akhmetov, 2015). There is also some potential for geothermal energy. However, currently in Kyrgyzstan the contribution of RES to the energy balance of the country does not exceed 1% (EIA, 2019). The main reasons for this situation are inadequate legal and regulatory provisions; lack of a fully-fledged state policy; low levels of funding for research and development; lack of awareness and conservatism among potential producers and the general public; lack of qualified engineering personnel.

2.5. Russia

In Russia, the need to use alternative energy is specified in the Energy Strategy, the Framework of State Policy in the Field of Environmental Development of the Russian Federation, the

Climate Doctrine and other fundamental documents defining the prospects for further development (Lobova et al., 2018). One of the last events confirming Russia's commitment to environmentally sound development was the signing of the Paris Climate Agreement on April 22, 2016, where we commit ourselves to carrying out a set of measures for technological rearmament and adaptation to climate change, reducing greenhouse gas emissions by 2020. Given that about 70% of carbon dioxide production in Russia is accounted for by energy, a large part of the activities should be aimed at the development of environmentally friendly alternative energy (Overland and Kjærnet, 2016).

In Russia, it is planned to reduce the energy intensity (EI) of gross domestic product (GDP) by 25% by 2025 (Alekseev et al., 2019). Currently, in Russia, the EI of gross national product is more than 2 times higher than that of the United States, although in 1970 this figure was lower in the USSR than in the United States (Martinot, 1999). The reason is Russia's export of raw materials and energy-intensive products when importing knowledge-intensive and low-energy products (Mukhametshin et al., 2019). It is impossible to achieve this goal without the development of alternative energy sources, so until 2020 it is planned to put into operation new generating facilities operating on the basis of RESs with a target capacity of 5,871 MW (Zeng et al., 2017). According to the Ministry of Natural Resources and Ecology, in the near future more than 1.5 GWt of solar generation will be introduced in Russia, and until 2035 it is planned to attract 53 billion USD for the development of RESs (Boute and Willems, 2012).

However, the contribution of RES is minimum. The first reason of minimum contribution is the provision of Russia with its own primary energy resources. This factor has been seen solely as positive and conducive to economic development (Vasiljeva et al., 2019). The use of own energy resources on power generating capacities makes the cost of traditional electricity minimal, excluding competition with alternative energy sources. There are many more incentives for RES development in countries that do not have sufficient traditional energy resources (Bogoviz et al., 2018). It should be noted that in a number of countries there are also programs for the development of nuclear energy, which allow to generate significant capacities at a low cost of 1 kWh (WNA, 2013). After the tragic events at the Japanese station Fukushima, built on U.S. project, many countries (France, Japan) are adjusting their development plans towards reduction and ensuring greater control and reliability. The share of nuclear electricity in Russia is about 17%, by 2035 it is planned to increase to 20% (Bogoviz et al., 2017).

3. FUTURE ENERGY TRAJECTORIES AND IMPACT

Energy security is usually measured by a variety of indicators, such as the EI of GDP, the share of energy imports, the variety of fuel combinations, or the variety of external primary energy suppliers (Karatayev et al., 2019). The use of energy security indicators can provide important information on specific characteristics and additional aspects of energy and sustainability dependence (IPCC, 2007). For example, indicators may indicate how major events, such as military conflicts, embargoes, or the implementation of transformative energy system policies, alter vulnerabilities and influence trade-offs, as well as similarities between different aspects of energy security (EIA, 2019). However, indicators do not make sense to replace a rigorous economic analysis of the costs and benefits of energy security policies. Without a microeconomic framework, energy security indicators remain descriptive and cannot guide the desirability of intervention in the energy market from a regulatory point of view.

The EAEU has actively taken a direction to promote political initiatives to strengthen energy security. Major among the initiatives are programmes to increase domestic renewable energy production, promote energy efficiency and reduce CO_2 emissions from fossil fuel combustion. These programmes are implemented through renewable energy subsidies in electricity generation; taxes on the use of primary energy to improve energy efficiency; pollution taxes to reduce CO_2 emissions. Subsidies are funded through a representative institution.

Figures 1-3 show how energy security indicators namely primary EI of GDP (EI), primary energy dependence (PE), net import dependence (ID), supplier dependency (SD) vary in a range of energy security policies - Renewable Energy Development (REN), Energy Efficiency Reduction (EFF), and Greenhouse Gas Reduction (GHG). The X-axis shows the policy targets, and the Y-axis shows the improvement as percentages relative to the base year level. From these figures it is visible that only the policy in the field of energy efficiency (EFF) has positive impact on energy security indicators while the policy of reduction of CO_2 (CO_2) and stimulation of use of renewables (REN) causes ambiguous consequences.

Renewable energy subsidies in electricity generation (REN scenario shown in Figure 2) improves net ID and primary energy dependence (PE) across a range of target levels. This is mainly due to the fact that, while nuclear energy consumption remains at the established upper end of the base year, renewable energy consumption increases through fossil primary energy consumption, which in turn implies a reduction in primary energy imports and a more equal share of energy supply. Different primary energy carriers in total primary energy. However, as coal consumption decreases more than gas consumption, the share of gas supplier imports increases over the share of coal supplier imports.

The CO_2 pricing reduces the primary EI of GDP (EI). The improvement in both indicators is due to a decrease in total consumption of fossil primary energy. In contrast, primary energy dependence (PE) is deteriorating as primary energy diversity and external primary energy supplier diversity decrease. This is mainly caused by the following three effects. First, carbon taxes reduce fossil primary energy consumption, while nuclear energy consumption remains at the top base year and renewable energy consumption increases. Thus, the decline in fossil primary energy consumption compensates for the increase in renewable energy consumption. Second, because of differences in carbon intensity, carbon taxes cause coal to be replaced by gas. Third, replacing coal with gas

Figure 1: Forecasting RES usage

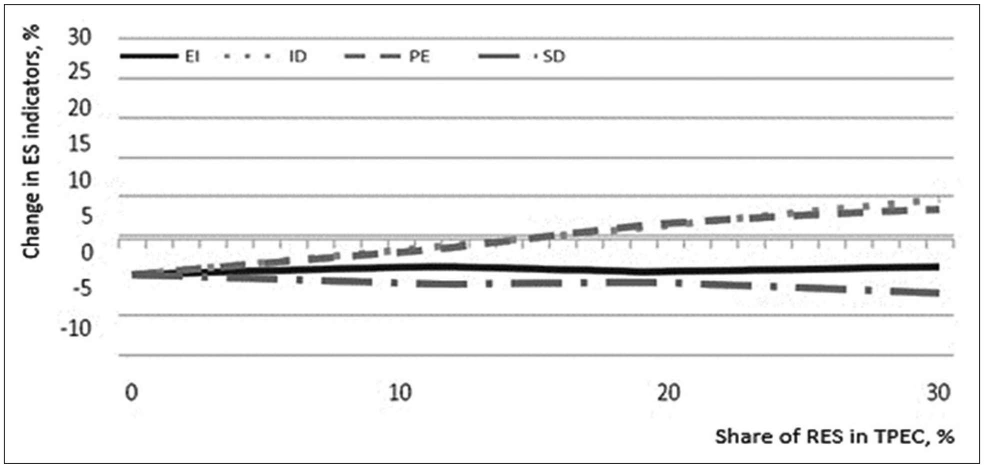


Figure 2: Forecasting import dependency

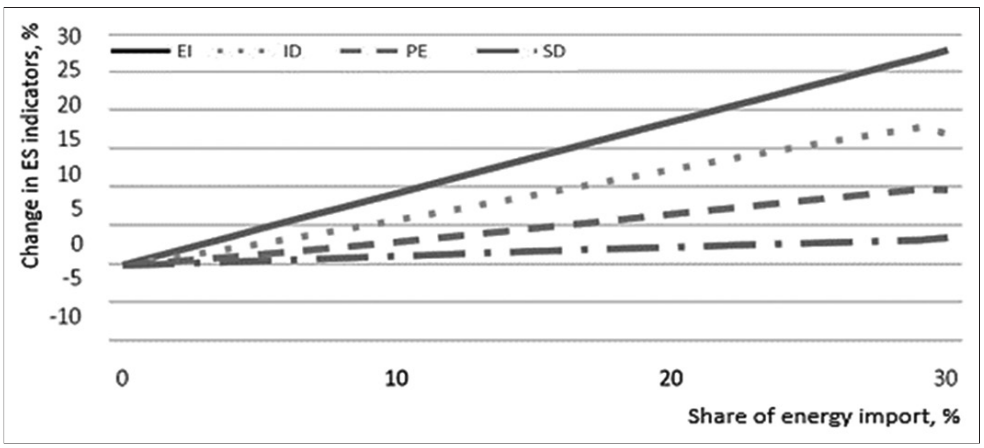
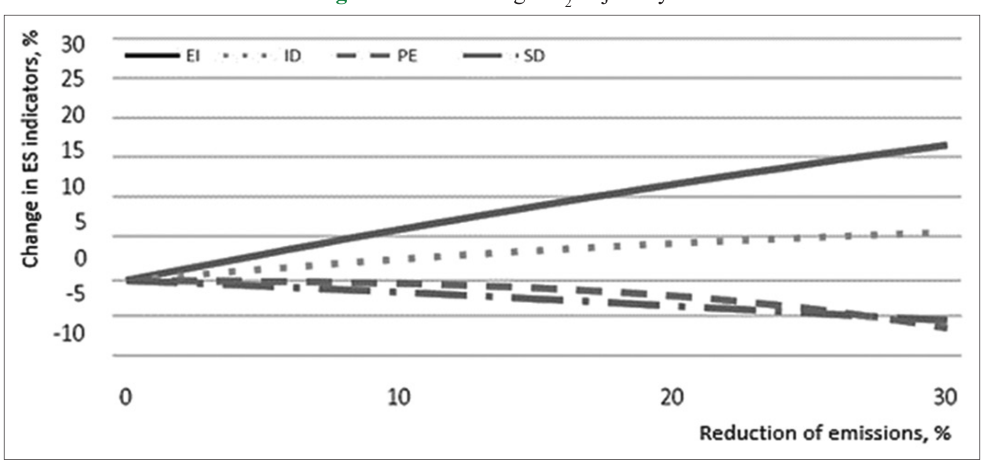


Figure 3: Forecasting CO_2 trajectory



leads to a change of suppliers, which implies a higher share of gas supplier imports in total primary energy imports.

4. CONCLUSION

The analysis shows that, despite the challenges, the trend towards increased use of local and RESs is positive in the EAEU countries and relies on both public, private and foreign investments from a number of international projects. However, in order to create a more transparent and competitive renewable energy market in the EAEU countries, it is advisable to reform price subsidies so that the prices of harvested fuel and energy resources and energy produced fully cover the costs of producers and ensure a level of profitability. Synergies require synergies and coordination among the various agencies and organizations involved in the production and supply of renewable energy. Pooling of resources could enhance the effectiveness of their activities, for example, by sharing procurement and management expertise. In order to reduce the financial burden on the state, it is necessary to involve private companies more in the energy sector of the country, especially in the implementation of projects in the field of wood fuel, biogas plants, heat pumps, wind energy, solar energy, etc. It seems desirable to develop and create production facilities for biogas plants, wind power plants, heat pumps and solar water heaters. It is necessary to further develop the training of highly qualified specialists, both developing and operating the latest equipment, and the corresponding material support of educational institutions.

5. ACKNOWLEDGMENT

This manuscript was written under grant from Kazakhstan Ministry of Education and Science No. AP05135081 “The problem of energy security within EAEU of energy policy-making framework” coordinated by Prof. Dr Galiya Movkebayeva (Al-Farabi Kazakh National University) and Dr Zhibek Bimagambetova (Al-Farabi Kazakh National University).

REFERENCES

Aitimov, B.Z., Dussipov, E.S., Altynbekkyzy, A., Ashimova, D.I., Nurbek, D.T., Urazymbetov, T.E. (2016), Non-profit ecological organizations in the function of the realization of the right to freedom of association and the development of civil environmental liability in Kazakhstan. International Journal of Environmental and Science Education, 11(15), 7990-8005.

Akhmetov, A. (2015), Measuring the security of external energy supply and energy exports demand in central Asia. International Journal of Energy Economics and Policy, 5(4), 901-909.

Alekseev, A.N., Bogoviz, A.V., Goncharenko, L.P., Sybachin, S.A. (2019), A critical review of Russia’s energy strategy in the period until 2035. International Journal of Energy Economics and Policy, 9(6), 95-102.

Apergis, N., Payne, J.E. (2010), Renewable energy consumption and growth in Eurasia. Energy Economics, 32(6), 1392-1397.

Balmaceda, M.M. (2013), The Politics of Energy Dependency: Ukraine, Belarus, and Lithuania between Domestic Oligarchs and Russian Pressure. Vol. 40. Toronto, Canada: University of Toronto Press.

Balmaceda, M.M., Balmaceda, M.M. (2006), Belarus: Oil, Gas, Transit Pipelines and Russian Foreign Energy Policy. London: GMB Publishing Ltd.

Bogoviz, A.V., Lobova, S.V., Ragulina, Y.V., Alekseev, A.N. (2017), A comprehensive analysis of energy security in the member states of the Eurasian Economic Union, 2000-2014. International Journal of Energy Economics and Policy, 7(5), 93-101.

Bogoviz, A.V., Lobova, S.V., Ragulina, Y.V., Alekseev, A.N. (2018), Russia’s energy security doctrine: Addressing emerging challenges and opportunities. International Journal of Energy Economics and Policy, 8(5), 1-6.

Boute, A., Willems, P. (2012), RUSTEC: Greening Europe’s energy supply by developing Russia’s renewable energy potential. Energy Policy, 51, 618-629.

BP (2016). British Petrolium Annual Report 2016. Available from: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/investors/bp-annual-report-and-form-20f-2016.pdf [Last accessed on 2020 Jan 06].

Chakryan, H. (2010), Turkey’s policy towards Armenia and energy security in the South Caucasus. Turkish Policy Quarterly, 9(2), 117120.

EIA. (2019), Country Analysis Brief: Kazakhstan. Available from: https://www.eia.gov. [Last accessed on 2019 May 02].

Elliott, D., Schwartz, M., Scott, G., Haymes, S., Heimiller, D., George, R. (2003), Wind Energy Resource Atlas of Armenia. Golden, CO, United States. National Renewable Energy Lab.

Guliyev, I.A., Mekhdiev, E.T. (2017), The role of fuel and energy sector in the Eurasian economic community integration process. International Journal of Energy Economics and Policy, 7(2), 72-75.

Hamiche, A.M., Stambouli, A.B., Flazi, S. (2016), A review of the water-energy nexus. Renewable and Sustainable Energy Reviews, 65, 319-331.

International Energy Agency (IEA). 2018. World Energy Statistics. OECD Publishing: Paris. Available from: https://www.iea.org/. [Last accessed on 2020 Feb 23].

IPCC. (2007), Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II, and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.

Karatayev, M., Clarke, M.L. (2014), Current energy resources in Kazakhstan and the future potential of renewables: A review. Energy Procedia, 59, 97-104.

Karatayev, M., Clarke, M.L. (2016), A review of current energy systems and green energy potential in Kazakhstan. Renewable and Sustainable Energy Reviews, 55, 491-504.

Karatayev, M., Hall, S. (2017), Integration of wind and solar power in Kazakhstan: Incentives and barriers. In: Sustainable Energy in Kazakhstan. Abingdon, United Kingdom: Routledge. p65-89.

Karatayev, M., Hall, S., Kalyuzhnova, Y., Clarke, M.L. (2016), Renewable energy technology uptake in Kazakhstan: Policy drivers and barriers in a transitional economy. Renewable and Sustainable Energy Reviews, 66, 120-136.

Karatayev, M., Movkebayeva, G., Bimagambetova, Z. (2019), Increasing utilisation of renewable energy sources: Comparative analysis of scenarios until 2050. In: Energy Security. London, United Kingdom: Palgrave Macmillan. p37-68.

Koshim, A., Karatayev, M., Clarke, M.L., Nock, W. (2018), Spatial assessment of the distribution and potential of bioenergy resources in Kazakhstan. Advances in Geosciences, 45, 217-225.

Lobova, S.V., Bogoviz, A.V., Ragulina, Y.V., Alekseev, A.N. (2018), The fuel and energy complex of Russia: Analyzing energy efficiency policies at the federal level. International Journal of Energy Economics and Policy, 9(1), 205-211.

Martinot, E. (1999), Renewable energy in Russia: Markets, development and technology transfer. Renewable and Sustainable Energy Reviews, 3(1), 49-75.

Mudarissov, B.A., Lee, Y. (2014), The relationship between energy consumption and economic growth in Kazakhstan. Geosystem Engineering, 17(1), 63-68.

Mukhametshin, R.Z., Kryukova, N.I., Beloborodova, A.V., Grinenko, A.V., Popova, O.V. (2019), Implementation of efficient energy policy in Russia: Energy consumption monitoring and problem analysis. International Journal of Energy Economics and Policy, 9(4), 224-232.

OECD (2018). Primary energy supply. Available from: https://data.oecd.org/energy/primary-energy-supply.htm [Last accessed on 2020 Feb 23].

Overland, I., Kjærnet, H. (2016), Russian Renewable Energy: The Potential for International Cooperation. Abingdon, United Kingdom: Routledge.

Raslavičius, L. (2012), Renewable energy sector in Belarus: A review. Renewable and Sustainable Energy Reviews, 16(7), 5399-5413.

REN21, R. (2018). Global Status Report, REN21 Secretariat, Paris. France. Tech. Rep. Available from: https://www.ren21.net/wp-content/uploads/2019/05/GSR2018_Full-Report_English.pdf [Last accessed on 2020 Feb 23].

Sheffield, J.W., Sheffield, Ç., editors. (2009), Assessment of Hydrogen Energy for Sustainable Development. Berlin, Germany: Springer.

Teleuyev, G.B. (2017), Problems of legal regulation for use and development of renewable energy sources in the republic of Kazakhstan. International Journal of Energy Economics and Policy, 7, 1-6.

Toğrul, İ., Kizi, M. (2008), Determination of wind energy potential and wind speed data in Bishkek, Kyrgyzstan. International Journal of Green Energy, 5(3), 157-173.

Vagliasindi, M. (2012), Implementing Energy Subsidy Reforms: Evidence from Developing Countries. Washington, DC, United States: The World Bank.

Vasiljeva, M.V., Ponkratov, V.V., Kharlamova, E.Y., Kuznetsov, N.V., Maramygin, M.S., Volkova, M.V. (2019), Problems and prospects of development of the oil exchange market in the Russian federation. International Journal of Energy Economics and Policy, 9(3), 77-86.

WB (World Bank). 2018. Kazakhstan - Europe and Central Asia-P130013- Kazakhstan Energy Efficiency Project - Procurement Plan. Available from: http://documents.worldbank.org/curated/en/938821580197975175/Kazakhstan-europe-and-central-asia-p130013-Kazakhstan-Energy-Efficiency-Project-Procurement-Plan. [Last accessed on 2020 March 28].

WNA. (2013), Cooling Power Plants, London, UK. Available from: http://www.world-nuclear.org. [Last accessed on 2019 Jun 23].

Xiong, C., Yang, D., Huo, J., Zhao, Y. (2015), The relationship between energy consumption and economic growth and the development strategy of a low-carbon economy in Kazakhstan. Journal of Arid Land, 7(5), 706-715.

Yafimava, K. (2011), The Transit Dimension of EU Energy Security: Russian Gas Transit Across Ukraine, Belarus, and Moldova. Oxford: OUP Catalogue.

Zeng, S., Liu, Y., Liu, C., Nan, X. (2017), A review of renewable energy investment in the BRICS countries: History, models, problems and solutions. Renewable and Sustainable Energy Reviews, 74, 860-872.