

Relationship between the energy and the environment at the current stage of energy market development

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Abstract. The authors analyzed the current situation related to the global consumption of fossil fuels, as well as environmental problems caused by their extraction, production and consumption. The official statistical data were used, reflecting the volumes of export of fossil raw materials from the Russian Federation, the directions of raw materials flows, characterizing the demand for oil, gas, peat coal in international trade. The authors note that negative factors caused by currency fluctuations, pandemic and other factors did not lead to global changes in the fossil fuel market. The article presents the provisions of international documents adopted in order to prevent climate warming by reducing greenhouse gas emissions. In addition, attention is focused on distribution of responsibility between the developed and developing countries of the world. The authors analyzed the measures implemented in the territory of the Russian Federation, and identified positive trends to reduce emissions of pollutants into the atmosphere. Wherein, the article reflects the environmental risks associated with use of alternative energy sources and nuclear facilities, the assessment of which must be carried out during commissioning the corresponding facilities.

1 Introduction

Currently, the search for optimal solutions regarding use of energy sources that satisfy both environmental and economic interests is relevant for all countries of the world [1, 2]. Importance of such solutions is due to the problem of global warming, associated, among other things, with the active use of fossil fuels in the energy and other industries. Slowing down global warming requires stabilizing the concentration of carbon dioxide (CO₂), as well as other greenhouse gases in the atmosphere. Wherein, the fact of stabilization of the concentration of these gases in the atmosphere does not entail a simultaneous cessation of the temperature rise, since there is a certain "lag". Therefore, the temperature will continue to rise for a certain number of years, including provided that atmospheric emissions are stabilized [3]. Wherein, the difficulty of working out the only and correct decision regarding the use (non-use) of fossil fuels is objectively difficult, but it is necessary due to a combination of various reasons, including: insufficient development of alternative energy sources, interruptions in energy production using renewable sources, dependence of national economies on fossil fuels, exhaustion of fossil fuels, presence of emissions into the environment as a result of the use of fossil fuels, ecosystem disturbances accompanying the

process of mining, the need for land reclamation, and etc. It is obvious that the search for a solution to the corresponding problems is interesting for the Russian Federation - a country where there are significant deposits of oil, gas and other types of organic fuel (for example, coal, peat), which make it possible to meet both internal needs for heat and energy production, and to supply these products to the world market, receiving the corresponding income from their sale to the budget. Accordingly, certain changes in the spheres, one way or another affecting the extraction, use, sale of organic fuels, are tangible for the Russian economy.

The increased attention to energy issues in the modern period of time is additionally associated with such categories as "green energy", "decarbonization", "carbon tax", "cross-border carbon regulation (CarbonBorderAdjustmentMechanism, CBAM)", which affect the economic interests of a wide range of entities: companies, whose activities are related to geological exploration, mining, export of various types of fuel, production of electricity (heat energy), as well as for public authorities monitoring the situation and developing response measures adequate to real conditions.

2 Materials and Methods

This paper analyzes the current state of affairs in the Russian Federation in areas related to traditional and alternative energy, based on the results of which conclusions are formulated about their further development prospects, considering the measures taken to minimize the negative impact on the environment. Within the framework of the work carried out, a systematic approach was applied, as well as methods such as: normative and legal analysis of international treaties, federal laws and other legal acts, statistical analysis, comparative analysis.

3 Results and Discussion

An analysis of the official statistical information shows that the commodity structure of the Russian Federation's exports, despite a certain instability of oil prices, the epidemiological situation (COVID 19), as well as the European Union's policy on introduction of a mechanism for cross-border carbon regulation, continues to be represented by goods from the fuel and energy complex (FEC), which are exported to various countries of the world. Therefore, in January-June 2021, the volume of value exports of this category of goods (group 27 of the EAEU TN VED) to non-CIS countries amounted to 105,028,667.9 thousand US dollars (the growth rate to the same the period of the last year is estimated at 124.6 %), which is 58 % of the total value of exports of the Russian Federation to the far abroad in the period under review; to neighboring countries, the value of exports of the fuel and energy complex is estimated at 7,191,675.2 thousand US dollars (the growth rate compared to the same period last year is estimated at 134.8 %) and is 26 % of the total value of Russian exports in January-June of 2021 in neighboring countries [4].

Detailing the value of the fuel and energy complex goods exported to the far and near abroad, there is an obvious advantage of oil and petroleum products. Therefore, the value of crude oil exports (commodity item 2709) in January-June of 2021 amounted to 47,632.7 million US dollar (growth rate over the same period last year is 121.5 %), or 22.8 % in total value exports; 31,960.7 million US dollar or 15.3 % of the value of export falls on petroleum products (commodity item 2710), the growth rate compared to the previous period is 122.4 %. In the structure of exports there is also a large share (9.6 %, or 20,010.3 million US dollar) of natural gas (commodity item 2711), the growth rate of which in relation to the comparable period was 172.9 %. The value of the export of other goods of

the fuel and energy complex in the analyzed period is significantly lower and in aggregate is no more than 10 %, while it shall be noted that the value of the growth rate of their physical volume in relation to the base period has a positive trend, for example: 109% - coal (commodity item 2701, physical volume of export - 101,886.4 thousand tons), 148 % - coke and semi-coke from coal, lignite or peat, retort coal (commodity item 2704, physical volume of export - 1658.7 thousand tons), 102 % - liquid fuels, not containing biodiesel (commodity item 2710, the physical volume of export - 29,553.1 thousand tons) [5].

The countries of destination of the exported fuel and energy complex products are different, for example [6]:

- crude oil (commodity item 2709) was exported to 32 countries of the world, the largest volumes of deliveries were made to the Netherlands (18,144.1 tons), Germany (8,806.9 tons), the Republic of Korea (7,637.6 tons), Belarus (6,949.6 tons), Poland (5,313.9 tons), Italy (4 543.2 tons), USA (3,444.5 tons), Finland (2,653.6 tons), Japan (2,356.4 tons), United Kingdom (1,616.3 tons), Lithuania (1,575.9 tons), etc.;

- petroleum products (commodity item 2710) were exported to more than 140 countries of the world, for example, to the Netherlands (16,154,985.0 tons), the USA (6,243,319.9 tons), Turkey (3,783,421.2 tons), China (3,388,516.1 tons), France (2,694,233.6 tons), the Republic of Korea (2,671,459.4 tons), Belgium (2,433,973.5 tons), Greece (2,285,024.3 tons), Germany (2,079,151.5 tons), the United Arab Emirates (1,684,932.3 tons);

- other gas and hydrocarbons (commodity item 2711) were exported to 52 countries of the world, including Japan (3,325,677.8 tons), China (2,748,304.9 tons), France (1,887,557.16 tons), the United Kingdom (1,620,596 tons), Spain (1,437,976 tons), the Republic of Korea (1,181,701.5 tons), the Netherlands (885,329 tons), Belgium (881,464 tons), Poland (625,749.8 tons), Portugal (441,643.0 tons);

- hard coal (commodity item 2701) was exported to 74 countries of the world, including China (20,145,241.5 tons), Turkey (7,558,176.2 tons), Ukraine (6,802,512.9 tons), Germany (3,185,327.5 tons), Brazil (2,090,151.7 tons), France (1,377,862.3 tons), Italy (1,004,799.8 tons), the United Kingdom (788,559.8 tons), Belgium (697,935.6 tons), Indonesia (692,754.0 tons);

- peat (commodity item 2703) was supplied to 44 countries of the world, for example, to Germany (41,328.0 tons), Poland (33,016.0 tons), Slovakia (12,588.0 tons), China (11,166.5 tons), Finland (5,661.6 tons), Belgium (5,428.0 tons), Belarus (4,153.0 tons), the Netherlands (3,875.7 tons), Ukraine (2,411.8 tons), Latvia (2,342.2 tons).

In general, in the past period of 2021, the Russian Federation recorded higher export rates of fuel and energy complex products compared to 2020. It shall be noted that the events of 2020 significantly influenced not only companies exporting oil and gas products, but also companies engaged in other types of activities associated with production and sale of oil, gas and other types of fossil fuels. For example, fluctuations in world oil prices in 2020 had a certain impact on Rosgeologia's orders for geological exploration of hydrocarbons; however, they led to a slight decrease in the company's revenue (by 7 %) from the planned one. A fairly optimistic result was achieved thanks to a shift in focus towards solid minerals, as well as thanks to a "multimodal strategy", which, among other things, involves the company's participation in the global market. Namely, in 2020, an international contract was signed with India for implementation of seismic exploration. Wherein, Rosgeologia plans to further expand international cooperation in carrying out this kind of work and to ensure that the company will receive in the near future up to 30 % of the proceeds from the implementation of international contracts [7]. The forecasted plans for cooperation in geological exploration with foreign countries indicate the continued demand on the world market for the extraction and use of fossil raw materials, including for fuel purposes. Representatives of the state authorities in the Russian Federation also give

appropriate assessments about the continuing leading positions of oil and gas, despite the beginning of the energy transition, for example, according to available forecasts, by 2050 the share of gas in the world's energy balance is expected to increase to 27 %, and gas is considered as "an integral part of the energy transformation" [8].

Modern realities are such that even in the face of aggravating environmental problems, society is not ready to abandon the use of hydrocarbons, including due to the fact that alternative sources do not currently allow satisfying the existing demand. In this regard, the search for ways to reduce the harmful impact on the environment is acquiring additional relevance.

Climate warming is a global problem, therefore, its solution is possible only with participation of all countries of the world. Such work is currently being carried out under the United Nations Framework Convention on Climate Change (UNFCCC) 1992 (the text of the convention is in Arabic, Chinese, English, French, Russian and Spanish, which are authentic). The main goal of the convention is to ensure a safe level of concentration of greenhouse gases in the atmosphere. In the provisions of the UNFCCC, the significant role of developed countries in the volume of greenhouse gas emissions into the atmosphere is noted. As a result, differentiated responsibility of states is established to participate in the work on adoption of response measures in connection with global climate change. Developed countries are given a special place in taking appropriate measures, this approach seems to be justified in terms of their use of organic fuels in the past and current trends, as evidenced by the statistics on export volumes by country of destination given earlier. The role of developing countries in the negative impact on the environment is significantly lower, however, according to experts' forecasts, it will increase over time. The provisions of the UNFCCC explicitly state that when solving environmental problems, the needs of developing countries shall be taken into account, including the eradication of poverty as a priority. In addition, it is noted that the policies and measures being implemented to prevent climate change shall consider the various conditions of the socio-economic development of states. Also, the convention prescribes the need for adoption at the national level of legal acts in the field of the environment with the obligatory consideration of the interests of other states. For development of the UNFCCC provisions, the Kyoto Protocol was signed in 1998, and in 2015 the Paris Agreement on Climate was signed that was ratified by the Russian Federation in 2019. One of the priority tasks of this agreement is to contain the temperature rise to 1.5 °C [9, 10, 11]. The countries participating in the UNFCCC submit reports on the activities carried out and their results in accordance with the established procedure; the Russian Federation also provides relevant information. From the official reporting of the Russian Federation it follows that: the main share of greenhouse gas emissions in the country is associated with extraction, transportation, processing and use of fossil fuels (mainly oil, natural and oil (associated) gas, coal, peat and oil shale in an insignificant volume); to ensure objective monitoring of the volumes of relevant emissions in the territory of the country, interdepartmental interaction of state authorities is being implemented, which provides a comprehensive assessment of emissions and absorption of greenhouse gases; the country's leadership approves legal acts (federal laws, presidential decrees, government orders, etc.) defining specific measures aimed at reducing greenhouse gas emissions, with establishment of certain deadlines for achieving the planned results. For example, on December 30, 2021, the Federal Law "On Limiting Greenhouse Gas Emissions" will enter into force, the provisions of which, among other things, regulate the issues of setting targets for reducing greenhouse gas emissions, provide for state accounting of relevant emissions, and regulate implementation of audits of reports reflecting emissions volumes, provide for creation of a register of carbon units and its maintenance. In April 2021, the Ministry of Economic Development of the Russian Federation prepared a draft legal act, according to which the Sakhalin Oblast provides for approbation of measures to

achieve carbon neutrality, including the provisions of the draft document establish special requirements for companies which production results in greenhouse gas emissions are 50 thousand tons CO₂-eq. and above, and it is also supposed to monitor the introduced new technologies to reduce emissions of pollutants, absorb greenhouse gases, and etc. In addition, among the activities carried out in Russia the following of them are important: projects for utilization of associated petroleum gas, improving the functioning of thermal power plants, improving the main infrastructure, developing renewable energy sources, increasing the sustainability of the forest sector [12,13,14,15,16, 17]. It shall be noted that according to the information of the officials of the Russian Federation, the country managed to ensure a reduction in greenhouse gas emissions by 40 billion tons, this volume is comparable to the annual emission of pollutants from all countries of the world, based on this, the global warming of the climate directly by Russia has been restrained for one year [18]. Therefore, within the framework of implementation of obligations in accordance with the UNFCCC, certain positive shifts on the part of the Russian Federation in terms of reducing emissions into the environment shall be noted.

Renewable energy sources (RES) have been given significant attention in maintaining the existing result. In 2020, despite the fact that this year was not easy for all countries of the world, new renewable energy facilities were launched in Russia: generating electricity using the sun (SPP), wind (WPP), water (HPP), the capacity of which exceeds the value of 2019 year by 82 % and is estimated at 1 GW, including the Gukovskaya Wind Farm – the capacity of 198 MW, obtained by means of 52 turbines with the capacity of 3.8 MW each; Sulinskaya Wind Farm - the capacity of 100 MW, obtained by means of 26 units with the capacity of 3.8 MW each; Staromaryevskaya SPP – the power of 100 MW, obtained by means of 83,334 photovoltaic modules; Perovo SPP – capacity of 105 MW, obtained by means of 440,000 crystalline solar photovoltaic modules, the use of which prevents 105 thousand tons of carbon dioxide emissions. In addition, there is a significant number of renewable energy facilities under construction or design, the feasibility of commissioning of which is justified by the subsequent reduction of greenhouse gas emissions into the atmosphere. For example, in the Stavropol Territory, it is planned to build a Windpark Rodnikovsky Wind Farm, the generated electricity of which shall ensure a reduction in release of 180 thousand tons of carbon dioxide into the atmosphere. In the territory of Siberia, in conditions of unfavorable climatic conditions (high seismicity, permafrost), it is planned to build and commission the Telmamskaya HPP, on the Iturup Island (Sakhalin Region) the Okeanskaya-2 Geothermal Power Plant will be restored, the operation of which will be based on the energy of the Baransky volcano [19, 20]. Therefore, despite the wide distribution of fossil raw materials in the territory of Russia, the renewable energy sources are functioning and their number tends to increase, which is favorable in the context of the tasks being solved to reduce pollutant emissions. Wherein, despite the obvious importance of measures to introduce renewable energy sources into large energy in order to reduce emissions into the atmosphere, leading to a warming of the climate, it is necessary to take into account the existing environmental problems associated with the construction and operation of facilities based on renewable energy sources, for example, energy production through hydroelectric power plants is associated with flooding and salinization of lands, disappearance of fish, climate change due to evaporation of water from reservoirs; energy production by means of SPP is associated with the death of birds due to exposure to sunlight, the use of components for SPP made with use of chemicals that are dangerous to living organisms; energy production through wind farms is associated with climate change due to the slowing down of air masses, and etc.) [21,22]. Therefore, construction of facilities for alternative energy sources is also associated with environmental risks, the assessment of which is necessary to make reasonable forecasts regarding their negative impact on the climate.

Nuclear power plants play an important role in energy production in relation to reducing CO₂ emissions. In Russia, they account for about 19 % of generated electricity. Similarly, in some countries of the world, for example, Japan, nuclear power occupies one of the leading positions and does not tend to decline [23]. Considering the specifics of the raw materials used at these facilities (nuclear fuel), the considered power plants require increased attention in terms of the safety of their operation, since accidents at such facilities bring irreparable harm to all living things both in the adjacent territories and far and beyond (as an example, Fukushima-1 NPP, Chernobyl NPP). In this regard, in the territory of the Russian Federation, construction and operation of nuclear power plants is carried out considering the negative experience of disasters and relying on new modern technologies.

4 Conclusions

Providing the population with energy and heat is the basic task of any state, the solution of which is individual for each country and is determined by the physical and geographical location, the presence of minerals in the territory, climate characteristics and other conditions for construction of facilities based on renewable energy sources or fossil raw materials. However, when solving this problem, it is necessary to consider possible environmental consequences and take measures to minimize the predicted risks. Currently, according to international treaties, the priority is to contain all countries of the world of climate warming. Among the proposed instruments, the European Union is working on introduction of a "carbon tax" and use of "green energy". Wherein, when using alternative energy sources, there are negative environmental consequences, which indicates an insufficient justification for abandoning some energy sources in favor of others. Without use of new technologies in the operation of facilities based on energy sources of all types, comprehensive monitoring of negative consequences on the environment, it will be difficult to achieve positive changes and keep them.

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