Forming of a new "low-carbon" model of ecological development

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Abstract. The evolution of the development of the "low-carbon" economy concept, its concept as a new model of the economic development and ecological regulation is considered in this article. The scientific research allowing to open the main mechanisms and methods as well as to classify the indicators of resource and energy efficiency and to reveal the key factors of forming of "low-carbon" economy is studied. The relevant trends of "low-carbon" economy are systematized. The relevance of the article is in the fact that the development of "low-carbon" economy in the conditions of serious transformations of power industry and the whole economy, is the main lever of gradual transition to the ecological civilization, providing interaction and coordination of economic, social and ecological aspects. According to the results of the conducted research the conclusions which can help with forming of the programmes of economic development, projects of optimization of resource-and energy efficiency, actions for elimination of negative influences on the ecological sphere, are created.

1 Introduction

In the modern world the need of transition to the low-carbon development and achievement of carbon neutrality is never called into question any more. Three largest international forums, at which the issues connected with the climatic agenda were discussed, took place during the last half a year. However, the countries with different types of economy can hardly agree about what and how to do for prevention of possible climatic disaster.

The issues of the development and transformation of a new model of "low-carbon" economy, its influence on urban, and social-and-economic development, climatic changes, development of alternative power engineering, support of decarbonization of national economy became the serious and discussed subject among foreign and Russian scientists, such as Mengru Liu [1], Matthias Speich [2], Boqiang Lin [3], Zeyu Xing [4], Ernest Baba Ali [5], Yan Long [6], Jacobson [7], Hyunwoong Choo [8], Bashmakova I.A. [9], I.S. Belik, N.V. Starodubets, T. V. [10], Elsibaye N. [11], Bobyliov S.N. [12], Petukhova E. [15], Porfiryev B.N. [16, 17], Hairova E.A. [18], Shirova A.A. [19, 20], Yashalova N. H. [21], Timofeev R.A. [22], T. Sobol [23], L. Kravchenko [24].

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The radical increase in the resource - and energy efficiency is the main trend of the development of "green" economy. The concept of "low-carbon" economy promptly rushed and fixed in world economy [1, 10] as the result. The model of "low-carbon" economy promptly enters various processes of economic development and practically allows to interact and develop most effectively economic, social and ecological aspects during the last twenty years [12, 14, 15, 18].

Nowadays all international experts, politicians, non-governmental organizations at world level, came to the general opinion that the "green" ("low-carbon") economy is the important direction for the achievement of the sustainable development of economy, social policy and ecology [14, 15, 18].

The most widespread and commonly accepted determination of sustainable development was offered by the commission of the UN under the direction of G.H. Brundlantd in 1987: "Sustainable development is the development, which provides needs of modern generation, without subjecting to threat vital needs of future generations".

For the first time the concept "low-carbon" economy was used in the government documents in the British power white book in 2003 "Our power future is the creation of "low-carbon economy". Being a pioneer of the first industrial revolution and the island country with insufficient resources, the United Kingdom is fully aware of threats of energy security and climate change. It passes from self-sufficient power supply to an era of bigger dependence on import. According to the consumption pattern of 2003, it was expected that 80% of energy of Great Britain should be imported in 2024. Moreover, the effects of climate change are already inevitable.

For the first time the attempt to cooperate around the subject of the decrease in emissions of CO2 took place in the Japanese city of Kyoto on December 11, 1997. The purpose of the Kyoto protocol is to reduce emissions by 5% relatively 1990 during 10 years (during the period from 2008 to 2012). However, the USA and India refused participation in the project, along with Russia and Australia, which did not assume the liability. And in 2012 the protocol operation was stopped.

The purpose of the Parisian agreement of 2016 is the set of actions, including:

1) for the international community: to promote achievement of carbon neutrality to the middle of 21 centuries;

2) for each country: to create and adopt the development strategy, a complex of actions in pursuance of the purposes in compliance to effective objectives;

3) each country is obliged to measure, analyze and provide information on the level of emissions;

4) the countries have to develop a package of measures in a complex for providing with finance and technologies of the projects, directed to the decrease in emissions.

Figure 1 presents the evolution of formation and plans of implementation of "low-carbon" economy.

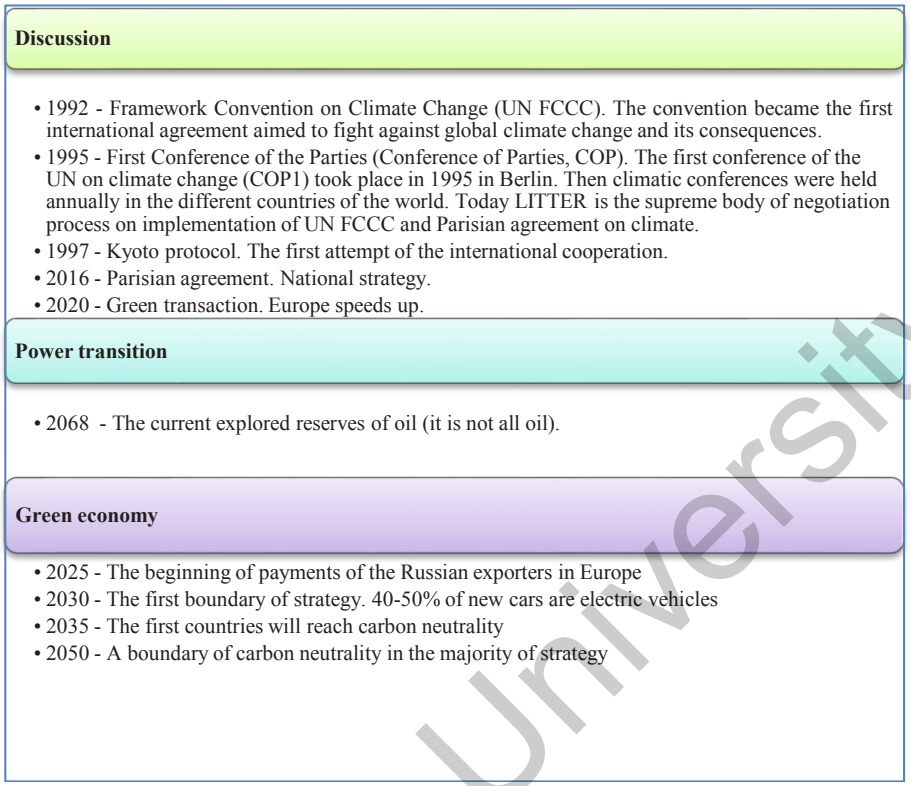

Fig.1. Evolution of "low-carbon" economy formation

2 Purposes and methods

Generalization and systematization of scientific and statistical data, their comparative analysis, synthesis, application of system approach, data handling with the use of methods of the economic analysis and general theory of statistics were the main methods of the research. During the research when forming conclusions methods of the general scientific analysis and comparison, tabular and graphic approaches of visualization of calculations were used.

3 Results and discussion

The new method of gradual promotion to the ecological civilization can become the result of serious changes in power, economy. Respectively, the refusal of traditional models of growth in the 20th century, the use of the innovation technologies and mechanisms, realization of a new model of economic development, "low-carbon" economy, and global transformation of the way of life in the 21st century, will promote the achievement of sustainable social and ecological development [14].

Global climate change, along with environmental pollution and loss of biodiversity create threat of the planetary crisis that causes the increasing concern around the world. Climate change involves some negative consequences, including extreme weather events, sea level rise, degradation of farmlands and the forced population shift.

In the conditions of global warming the "low-carbon" economy, based on low energy consumption and low level of pollution, became a global hot spot [13], some of new trends and strategy appeared as a result (fig. 2):

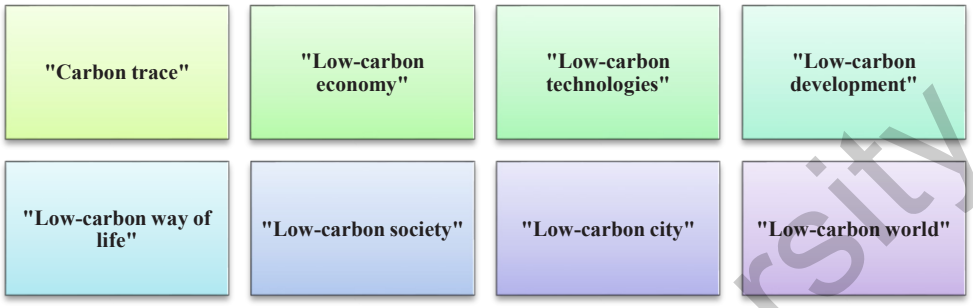

Fig. 2. Trends of "low-carbon" economy development

Developed countries of Europe and the United States vigorously advanced "low-carbon revolution" [16, 17] which cornerstone is the energy efficiency and low emissions, paying special attention to development of "low-carbon technologies" and introducing serious amendments in industrial, power, technology, trade and other policy to seize this opportunity and to take high positions in the industry. Fight for "low-carbon" economy imperceptibly began worldwide.

It is obvious that without the interests of developing countries which make the increasing contribution to emission of greenhouse gases it will not be possible to reach carbon neutrality on the planet. Therefore the parties should agree.

Within realization of actions of the Parisian agreement, the President of Russia in 2020 signed the Decree on emission reduction of greenhouse gases by 2030. The countries with different types of economy can hardly agree about what to do for prevention of possible climatic disaster. Collision of two positions arose, the contradictions of positions among the countries are considered and presented in figure 3.

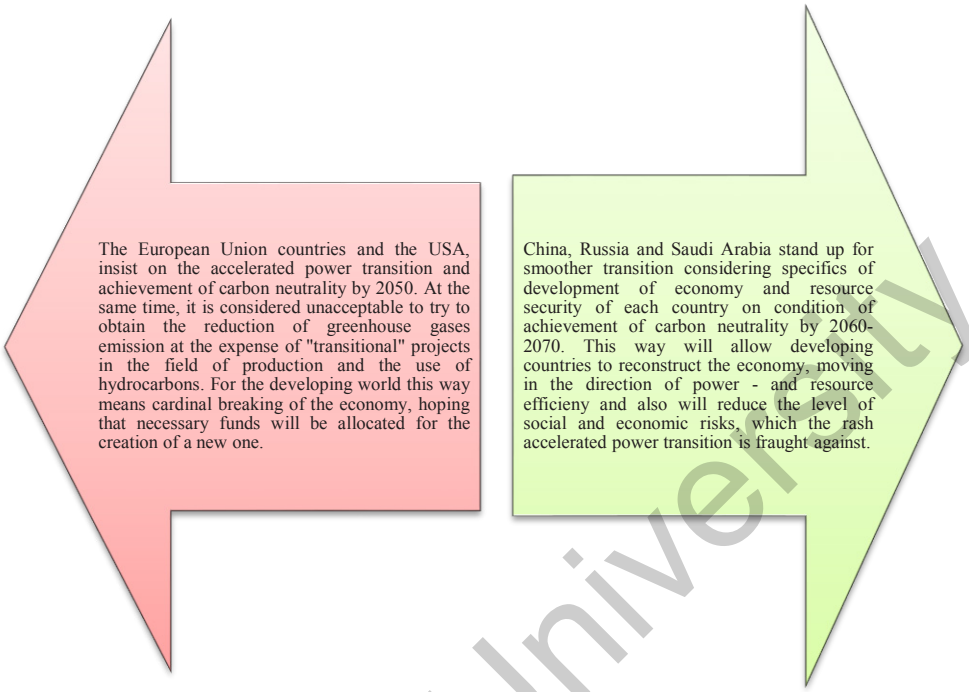

Fig. 3. Contradictions of two positions

Russia announced the first defined at the national level deposit (ONUV) in 2020 within realization of actions of the Parisian agreement. The document contained national priority actions, including:

- to limit the volume of emissions of greenhouse gases as much as possible,
- to adapt new processes, in accordance with the terms of climate changes
- to give the maximum support to the developing countries.

The further delivered stages and methods of their realization approved by the "low-carbon" agenda of Russia are also considered and presented in figure 4.

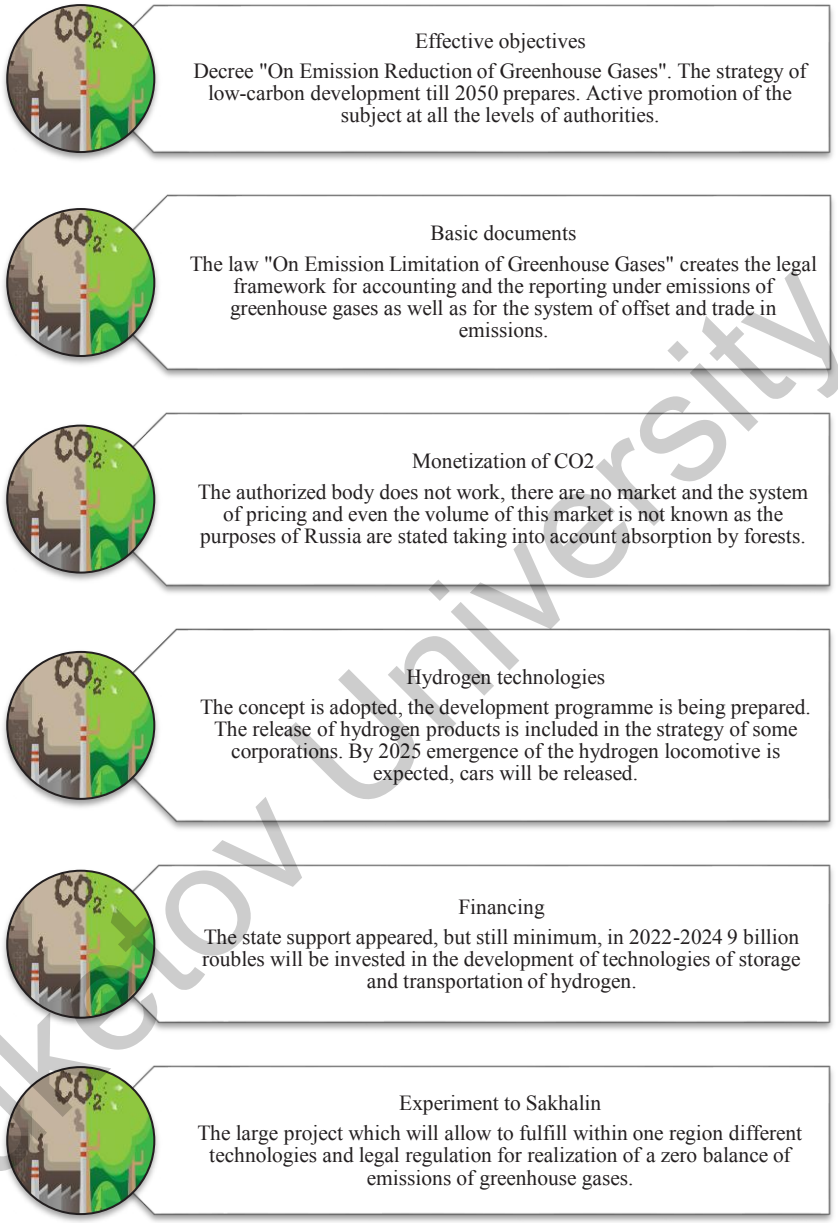

Fig. 4. Stages of the "low-carbon" agenda in Russia

The accelerated rates of decarbonization will demand much bigger investments in Russia, in comparison with the achievement of the same result on the obtaining net zero in later terms. Five main figures about low-carbon development of Russia are presented in figure 5.

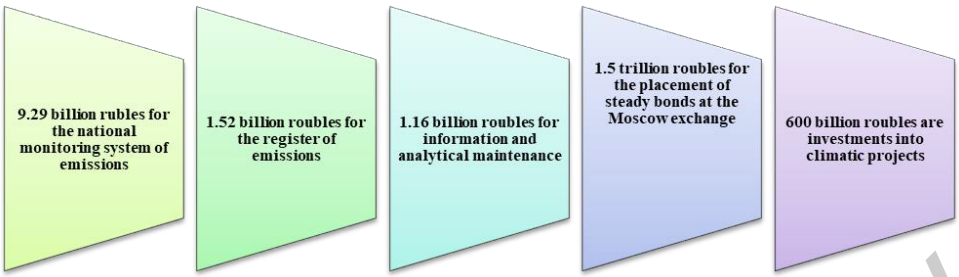

Fig. 5. Five figures of low-carbon development of Russia

It is necessary to attract investments into low-carbon development of Russia to reach carbon neutrality by 2050. That will cost 458 trillion roubles (more than 16 trillion rouble a year). If to postpone achievement of carbon neutrality for 2060, the total volume of investments will decrease four times.

It should be noted, that investment into "low-carbon" economy of Russia is at the initial stage. However, it is possible to note the growth of investment streams in ecological projects. Effective development of modern model of economy, "low-carbon" economy, large-scale support at all levels of the government, are serious factors, for the investment of ecological projects as well as the projects promoting favorable impact on climatic conditions [19, 20].

Nowadays it is possible to speak about the positive trend of growth of the Russian market of "green" bonds. In 2021 the Government of the Russian Federation approved national criteria (taxonomy) - projects of sustainable development as well as the list of requirements to the system of their verification is approved. There are also problematic issues of the development of green economy. One of such, considerable lag of the development of technology of catching, storage and use of carbon (CCUS), moreover in the territory of the country is not present any acting or even preparing the project yet.

Let us concept the concept of "low-carbon" economy again.

The "low-carbon" economy is the economy based on energy efficiency, decrease in emissions of greenhouse gases, increase in the share of the renewable energy resources (RER) [21].

Three most important sources of carbon dioxide and their percentage in the total amount of emissions are presented in figure 6.

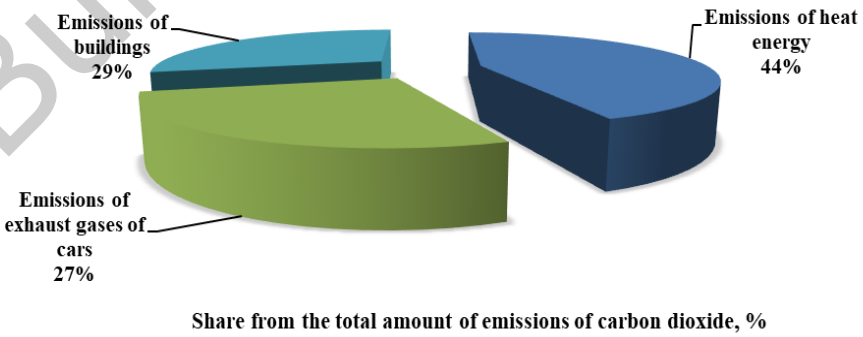

Fig. 6. Sources of carbon dioxide

The gobal purpose of the research of the development and the use of technologies of carbon binding is the reduction of CO2 maintenance in the atmosphere as well as achievements of maximum efficiency of economic and social development and environment protection within the economic development model [3, 4, 5].

"Low-carbon" economy, being the main mechanism promoting reduction energy consumption, low environmental pollution and low emissions, influences some factors functionally [1, 2, 6-8]:

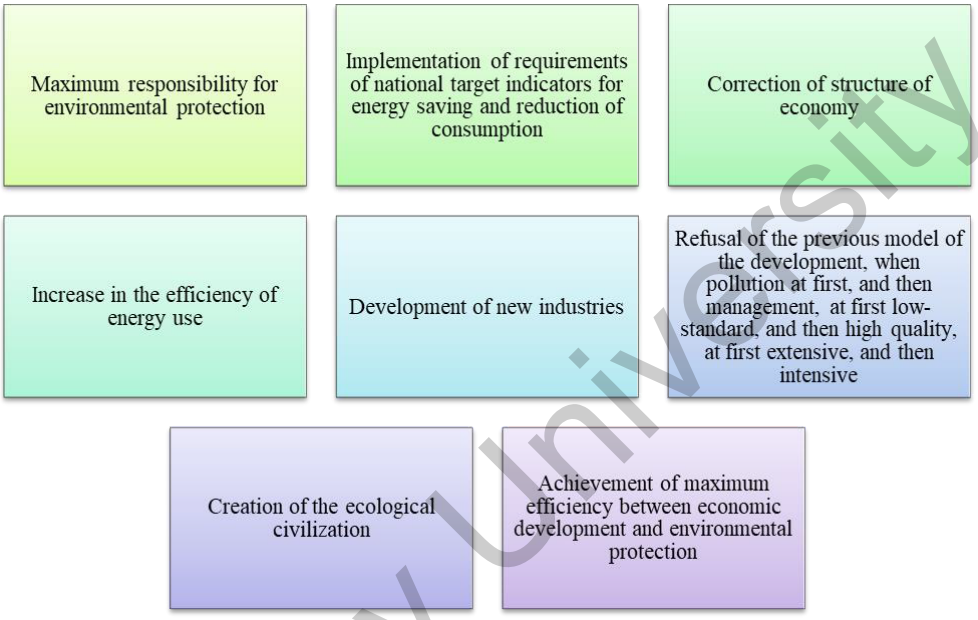

Fig. 7. List of values of "low-carbon" economy influence

The "low-carbon" power system refers to the development of net power sources, including wind energy, solar energy, nuclear energy, geothermal power and energy of biomass, for replacement of fossil power sources, such as coal and oil, for the reduction of carbon dioxide emission [9,10,12,13].

"Low-carbon" technologies include technology of pure coal (IGCC) and technology of catching and storage of carbon dioxide (CCS). The "low-carbon" industrial system includes:

- emission reduction of heat energy,
- new power vehicles,
- energy saving buildings,
- industrial energy saving and emission reduction,
- economy of the closed cycle,
- processing of resources,
- equipment for environment protection,
- energy saving materials and so on.

In the conditions of the continuous growth of the population of the planet and scales of economy the environmental problems, caused by energy use, include not only danger of smog, photochemical smog and acid rains, but also the global climate change, caused by the increase in concentration of carbon dioxide in the atmosphere. And that is an indisputable fact.

Figure 8 presents the modern trends of "low-carbon" economy aimed at the rapid development of renewable energy resources.

Fig. 8. Modern trends of renewable energy resources

At the same time, once we pay attention to some factors because of which, renewable energy resources, such, solar batteries and concentrators, land and sea wind generators, are not capable to fast replacement of the traditional power engineering which are in detail presented in figure 9:

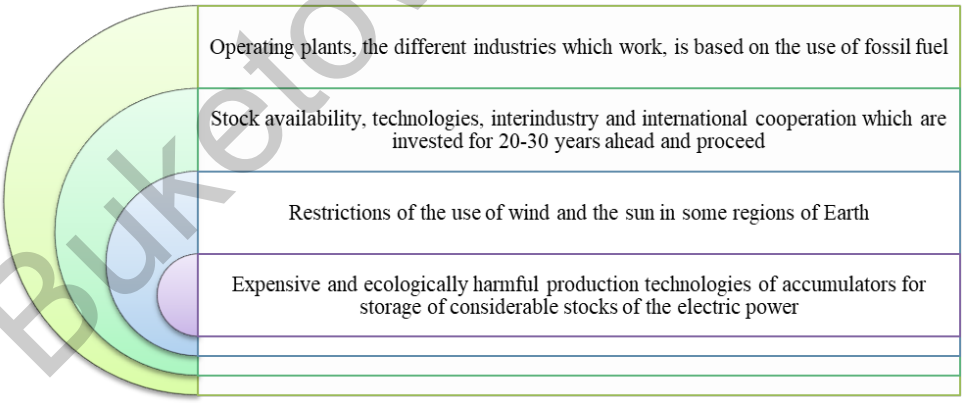

Fig. 9. Factors which are negatively influence on the processes of replacement of the traditional power engineering with renewable energy resources

For the purpose of effective creation, achievement of target indicators, development of "low-carbon" economy as drivers of sustainable social, economic, ecological development of Russia, the introduction of the following events is necessary:

1. Firstly, from the state: to strengthen the measures of responsibility and to order interactions of public authorities, commercial structures, individuals, including:

- to introduce the mechanisms, based on modern trends of sustainable social, economic development and maintenance of the ecology;

- to standardly fix target indicators of the emission reduction in the strategy of low-carbon development till 2050. This measure will lead to understanding and growth of responsibility in the conditions of global changes.

2. Secondly, to implement pilot projects, covering all possible branches of the economy, promptly for the purpose of obtaining maximum efficiency.

3. Thirdly, to create the new structure of the government responsible for forming, introduction, realization and the further leadership in all the processes of "low-carbon" economy.

Taking into account, that introduction of "low-carbon" economy is the system project, demanding cooperation of the whole society, the development of both administrative, and legal and economic resources are required for environmental improvement and forming of resource-saving and environmentally friendly model of economic.

4. Fourthly, to master the best international practices, to formulate and introduce policy of industrial import; politicy of the land use support; politicy of the capital support; to use scientific and technical theories; to systematize standards of industrial certification and testing of products as well as to accelerate training of future professionals.

Russia needs to develop her own programmes of low-carbon development aimed at social and economic development of the country taking into account the resources, which are available for us, and the structure of the economy, at the same time using all foreign achievements and analyzing foreign experience.

5. Fifthly, to develop the "low-carbon" industry vigorously.

It is recommended to accelerate all the development processes, to increase competitiveness of the country in the field of "low-carbon" economy and scientific technologies for the achievement of low-carbon level, during the transformation it is necessary to develop more new points of economic growth and to introduce innovations.

Leaders from more than 190 countries will discuss the global agreement on climate change, aimed at the reduction of global emissions of greenhouse gases and prevention of threat, which is posed by dangerous climate change at the forthcoming Parisian conference on climate change. Carbon dioxide emissions still are in the center of discussion at the conference, and it is expected that the "low-carbon" economy will come into the own.

The largest emission sources and regions already undertook obligations. European Union will reduce the emissions by 40% since 1990 in relation to 2030, the United States will cut down the emissions for 26-28% by 2025 in relation 2005, and Russia will reach the peak of emission reduction in 2050.

4 Conclusions and directions for the further research

As the result of the conducted research, offers on forming of new model of "low-carbon economy" are formulated:

• the essence of new model of the economy consists in the effective use of energy, development of environmentally friendly power and aspiration to green economy.

• the kernel of the concept are the innovations in the field of energy technologies and technologies of emission reduction, an innovation in industrial structure and a system and also fundamental transformation of the concept of survival and development of the person.

• the general background of "low-carbon" economy is the serious challenge for the world population of global warming.

In the modern world the need of transition to low-carbon development and achievement of carbon neutrality is not called into question. Three largest international forums, at which the issues connected with the climatic agenda were discussed, passed during the last half a

year. However, to the countries with different types of economy will hardly agree about what is necessary to do for prevention of possible climatic disaster.

Global changes in planetary climate, threat of catastrophic changes of ecology, are the objective and important reasons which obviously prove the need of the urgent and fast-realized measures. For this purpose it is necessary to accelerate transformation of modern economic development of "low-carbon" and "green" economy. The main global trend of process of transformation are the attempt of compulsory "gardening" of world economy, including not only the monopolists consuming hydrocarbon resources and the electric power, but the monopolists extracting and processing these resources first of all.

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