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Bachelor Thesis

Economic growth and environmental issues in Russia

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Thesis title

Economic growth and environmental issues in Russia

Objectives of thesis

The object of research is the economy of Russia and the dynamics of its growth. The subject of the research is the strategies and mechanisms of economic growth of the Russian Federation taking into account environmental consequences. The aim of the work is to conduct a study of economic growth and its environmental consequences in Russia.
Objectives of the study:
- to study scientific approaches to the study of economic growth;
- to study global economic growth trends and the impact of economic growth on the environment;
- to assess the features of the impact of economic growth on the environment of Russia;
- to develop a mathematical model of the impact of economic growth on the environment of Russia;
- to assess the problems of the Russian environment in the context of economic growth;
- to develop practical recommendations for the development of the ”green economy” model in Russia.

Methodology

Among the general scientific methods used in this work are: methods of description and explanation, induction and deduction, analysis and synthesis, comparison and analogy, generalization and conceptualization, as well as the principles of historicism, scientific objectivity, and integrity.

The proposed extent of the thesis

40 – 60 pages

Keywords

economic growth, ecology, Russia, Economics, mathematical model, ”green economy”, sustainable development, environment, pollution.

Recommended information sources

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Declaration

I declare that I have worked on my bachelor thesis titled “Economic growth and environmental issues in Russia” by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 27 November 2019 _____

Natalia Mosunova

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Economic growth and environmental issues in Russia

Abstract

The relevance of the study is to develop a mathematical model of the impact of economic growth on the environment of Russia, on the basis of which will be formed practical recommendations for the development "green economy" aimed at minimizing environmental damage while maintaining the pace of economic growth. Ensuring the reduction of emissions and pollution, the widespread introduction of alternative energy and environmental materials are important trends in the world economy. For Russia, which has a raw material model of economic growth, the transition to a "green economy" is an opportunity to reach a new level of regulation of its own industry. It is necessary to reduce the risks of environmental disasters by improving the quality of life of Russian citizens and preserving the unique ecosystem of Russian nature for posterity.

Keywords: economic growth, ecology, Russia, Economics, mathematical model, "green economy", sustainable development, environment, pollution.

Ekonomický růst a ekologické problémy v Rusku

Abstrakt

Aktuálnost studie se skládá z matematického modelu dopadu ekonomického růstu na ekologii Ruska, na jejímž základě budou vytvořena praktická doporučení k rozvoji „zelené ekonomiky“ zaměřené na minimalizaci škod na životním prostředí při zachování tempa hospodářského růstu. Důležitým trendem světové ekonomiky je zajištění snižování emisí a znečištění. Pro Rusko, které má surovinový model hospodářského růstu, přechod na zelené hospodářství je příležitostí k dosažení nové úrovně regulace vlastního průmyslu. Je třeba snížit rizika ekologických katastrof pomoci zlepšení kvality života ruských občanů a zachování jedinečného ekosystému ruské přírody pro potomstvo.

Klíčová slova: ekonomický růst, ekologie, Rusko, ekonomie, matematický model, “zelená ekonomie”, udržitelný rozvoj, životní prostředí, znečištění.

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List of abbreviations

GDP	Gross Domestic Product
IMF	International Monetary Fund
EC	European Commission
CBR	The Central Bank of the Russian Federation
GNI	Gross National Income
CO_2	Carbon dioxide
UN	United Nations
℃	Celsius
WHO	World Health Organization
EU	European Union
kg.	kilograms
MBA	Master of Business Administration
GRP	Gross Rating Point
GHG	Greenhouse gas
BAT	Best available technology
USD	The United States dollar
OPEC	The Organization of the Petroleum Exporting Countries

1 Introduction

The relevance of the study is the strategic importance of economic growth for Russia. Growing environmental risks, rising emissions, and obsolescence of technologies is the flip side of the commodity economy. At the same time, Russia has many promising technologies for the development of a "green economy" that require practical probation and testing in the real work of economic entities.

In the current unstable economic situation, it is especially important to look for ways of optimal interaction that will allow expanding environmental technologies in economic recovery. In the situation of the fall of the national currency, the development of the policy of attracting "green technologies" is especially important for Russia, as it allows to increase the competitiveness of domestic business in the world market. Management of capital flows taking into account environmental safety and sustainable development concepts is a problematic issue for the entire corporate sector of the Russian Federation, focused on strengthening international cooperation.

Theoretical foundations of economic growth were considered by such researchers as Harrod-Domar, Robert Lucas Jr., Rebelo, P. Romer, N. D. Kondratyev.

The issues of economic growth and ecology connection participation are studied mainly by foreign authors, in particular, S. J. Grossman[1], K. Peattie[2], P. Roberts[3], R. Welford[4], F. Cairncross[5], D. Esty[6]. Harvard business school Professor M. Porter is one of the first to consider ecology as one of the most important means of achieving international competitive advantages - states and companies. Subsequently, other scientists have developed this concept. Their research deserves attention from the point of view of the possibility of applying foreign experience in Russia.

However, many significant aspects of the current state of these problems have not been sufficiently studied, both because of the emergence of new environmental technologies and methods, and because of the transformation of Russia's economic growth priorities.

[1] Grossman G. and Krueger A. Environmental Impacts of a-North American Free Trade Agreement: In Garber P. (Ed.) The U.S. Mexico Free Trade Agreement. MIT Press, 1994.
[2] Peattie K. Environmental Marketing Management. London, 1995.
[3] Roberts P. Environmentally Sustainable Business. London, 1995.
[4] Welford R: and Gouldson A. Environmental Management and Business Strategy. Glasgow, 1993.
[5] Cairncross F. Costing the Earth. Boston, 1993.
[6] Esty D. Strengthening the International Environmental Regime: A Transatlantic Perspective. Ernst-Ulrich Petersmann and Mark A. Pollack / Transatlantic Economic Disputes: The EU, The US and,The WTO First Proof 15.7.2003.

2 Objectives and Methodology

2.1 Objectives

The object of research is the economy of Russia and the dynamics of its growth.

The subject of the research is the strategies and mechanisms of economic growth of the Russian Federation taking into account environmental consequences.

The aim of the work is to conduct a study of economic growth and its environmental consequences in Russia.

Objectives of the study:

- to study scientific approaches to the study of economic growth;

- to study global economic growth trends and the impact of economic growth on the environment;

- to assess the features of the impact of economic growth on the environment of Russia;

- to develop a mathematical model of the impact of economic growth on the environment of Russia;

- to assess the problems of the Russian environment in the context of economic growth;

- to develop practical recommendations for the development of the "green economy" model in Russia.

The hypothesis of the study is to recognize the impact of economic growth on the ecology of Russia.

2.2 Methodology

The study is based on the theory of constructivism because the key principle of this theory is based on the belief that environmental growth in the state is formed under the influence of environmental technologies, sustainable development strategies, the legal status of key enterprises. This study has a comprehensive nature, involving the study of various factors and aspects of economic cooperation of the Russian Federation. According to this, the work is based on a wide range of methods of scientific knowledge.

Among the general scientific methods used in this work are: methods of description and explanation, induction and deduction, analysis and synthesis, comparison and analogy, generalization and conceptualization, as well as the principles of historicism, scientific objectivity, and integrity.

The method of description is necessary for the study, presentation and primary analysis of the factual material underlying the study. The method of explanation helps to establish causal relationships between different processes and events.

Methods of induction and deduction complement each other, expanding the amount of knowledge gained. In the topic under study, the induction method allows us to move from single facts to general trends, as well as to identify the relationship between events. The method of deduction, on the contrary, allows us to draw a conclusion of a particular nature, based on the basic provisions.

Methods of analysis and synthesis allow forming a general idea of the problem of economic growth, taking into account environmental consequences.

The method of comparison involves the identification of differences and similarities between the individual areas, stages, and factors of economic growth. The method of analogy makes it possible to compare the result obtained when considering one of the elements of the environmental technology management process with other aspects not yet considered.

The method of generalization allows on the basis of a variety of events and facts to form a complete picture of a process. The method of conceptualization involves a theoretical understanding of the process and its schematization into a system of similar processes.

The empirical methods used in the work include the analysis of statistical information, the collection of data on law enforcement practices and precedents of economic growth in the environmental aspect.

Statistical analysis methods were also used to assess the impact of economic growth on the environment.

To assess the relationship of indicators, the following methodology was used – based on statistical analysis of data using statistical methods.

2.2.1 Multiple Linear Regression

The method used in this thesis is multiple linear regression analysis using Microsoft Excel 2019, where it will be possible to understand if there is a relationship between the economic and environmental indicators. The model attempts the relationship between two or more explanatory variables and a response variable by fitting a linear equation to observed data. The goal of multiple linear regression is to model the linear relationship between the explanatory (independent) variables and response (dependent) variable by equation $y = a + b_1x_1 + b_2x_2 + \ldots + b_nx_n$, where a is a rate of change and b represent the intercept with the y-axis. The development of this model allows the attribution of a certain parameter which explains how the dependent variable is likely to be affected by a one-unit change of each of the independent. The model aims to assess the impact of economic growth on the environmental situation in Russia.

2.3 Selection of source data

The data are taken on the basis of statistics, which is published on the official website of the Federal State Statistic Service and from Statista.com. For the study, the following indicators were taken, which may be correlated:

- GDP at current prices (billion rubles);
- GHG emissions (million tons of CO2 equivalent per year);
- Oil consumption (in million metric tons);
- Production and consumption waste generation (million tons);
- Emissions of pollutants from stationary sources into the atmosphere (million tons);
- Investments in fixed assets aimed at protecting the environment (million rubls).

GDP at current prices will be considered as the main indicator of economic growth. GHG emissions will be considered as the main environmental indicator. All these mentioned indicators are related to both the economic sector and the environmental sector.

3 Literature Review

3.1 Scientific approaches to the study of economic growth

Modeling economic growth in modern theory dates back to the work of Frank P. Ramsey in 1928. The next model was the Harrod-Domar model. Behind it begins the heyday of the neoclassical growth theory Solow–Swan model and its many modifications. The theory of endogenous economic growth began with the modification of the Solow model (Lucas, Rebelo, P. Romer) in the 1970s. Today, the main direction can be considered the so-called New theory of economic growth, which is based on complex models of endogenous growth and especially models with endogenous technological progress.

In this chain, there was no place for one very interesting and, perhaps, revolutionary for its time model. N. D. Kondratiev proposed a model of economic growth, which at first glance can be attributed to the neoclassical[7]. However, the mechanism of the model is fundamentally different from all existing today. This makes it possible to raise the question of determining its place in the theory of economic growth.

N. D. Kondratyev writes: "the aim of the research was to determine the laws of the main trends (or trend) of the dynamics of the national economy and to formulate them mathematically"[8]. There are ten endogenous variables in the model, and ten equations are used to determine their values.

Modern authors, working in line with the neoclassical approach to economic growth, in review publications on the development of the theory of economic growth, often do not even mention the work Of R. Harrod and E. Domar, starting the presentation of "modern growth theory" directly from the model of R. Solow. The problem of growth as such is put by them in the General context of the “wealth of nations“ – in this regard, the name of Adam Smith is mentioned, although the theory of economic growth he did not create.

This approach is presented, in particular, in the work of E. Helpman[9]. As the main indicator of economic growth, E. Helpman calls the rate of growth of real income per capita, and all cross-country comparisons, which are given in the first Chapter of his work, are associated with this indicator or the associated indicator of GDP per capita. At the same time, we are talking about the long – term dynamics of this indicator, for a decade or more.

The relationship of income growth with the increase of the economic potential and problem of its full use, which was the center of attention in Keynesian growth models (and, as shown above,

[7] N. Kondratyev, Suzdal letters. M.: Economics, 2004. Letter No. 142 of September 5, 1934, Pp. 405-409.
[8] N. Kondratyev, Suzdal letters. M.: Economics, 2004. Letter No. 142 of September 5, 1934, p. 405
[9] E. Helpman, The mystery of economic growth / Publishing House Of The Gaidar Institute, 2011.

is sometimes found in the modern educational literature), here goes on the second plan. This criterion of economic growth is narrower than some of the definitions discussed above since it excludes from the analysis a simple increase in real output (even taken in the long run) if it is not accompanied by an increase in living standards (measured as income per capita).

Well-known researcher Robert Lucas Jr., who made a significant contribution to the modern theory of growth, in his book, which incorporates his earlier work on economic growth, also connects the problems of economic growth and development primarily with the growth of real income per capita, as well as with the growth of real GDP. "Under the problem of economic development, – writes R. Lucas, - I understand simply the problem of compliance with certain patterns that existed in different countries and at different times, in terms of levels and rates of growth of per capita income"[10].

R. Lucas notes that the modern theory of growth, which was developed in the 1960s, "was created as a model to explain the recent past of several very successful societies," primarily the United States, as well as post-war Japan and Europe. The main task of the modern growth theory R. Lucas sees is to "achieve a common understanding of the rich and poor economies in the world of huge incomes and differences in growth rates"[11].

Thus, the authors, who share in General the neoclassical approach to economic growth, consider it primarily through the improvement of living standards (growth of per capita income). For Keynesians, however, it is important not so much to analyze the growth of income in itself, but rather to analyze the conditions that ensure the full use of economic potential in dynamics.

3.2 Trends of economic growth in Russia

Let us consider the key trends in Russia's economic growth. Consistent analysis of the main scenarios of the Russian economy on the basis of IMF forecasts, data of the Central Bank of the Russian Federation and expert assessments, correlated with the mathematical analysis carried out in the study allows us to develop strategic planning options for Russian enterprises, taking into account the most likely conditions for attracting financial resources to domestic business.

Foreign experts are characterized by less positive forecasts of the current state and prospects for the development of the capital market in the Russian economy as a whole. This is largely due to the limited access of such expert groups to economic information. In this regard, foreign analysts and specialized agencies are cautious in their assessments. Let us consider such estimates of the growth prospects of the Russian economy. Understanding the greater instability

[10] Robert Lucas Jr. Lectures on economic growth, Publishing House Of The Gaidar Institute 2013.
[11] Robert Lucas Jr. Lectures on economic growth, Publishing House Of The Gaidar Institute 2013.

of foreign markets, the threat of inflation and the incompleteness of the processes of structural adjustment in their assessments of foreign experts consider a major period in the development of the Russian economy with negligible growth rates.

Let us consider such estimates in the context of existing trends on specific examples.

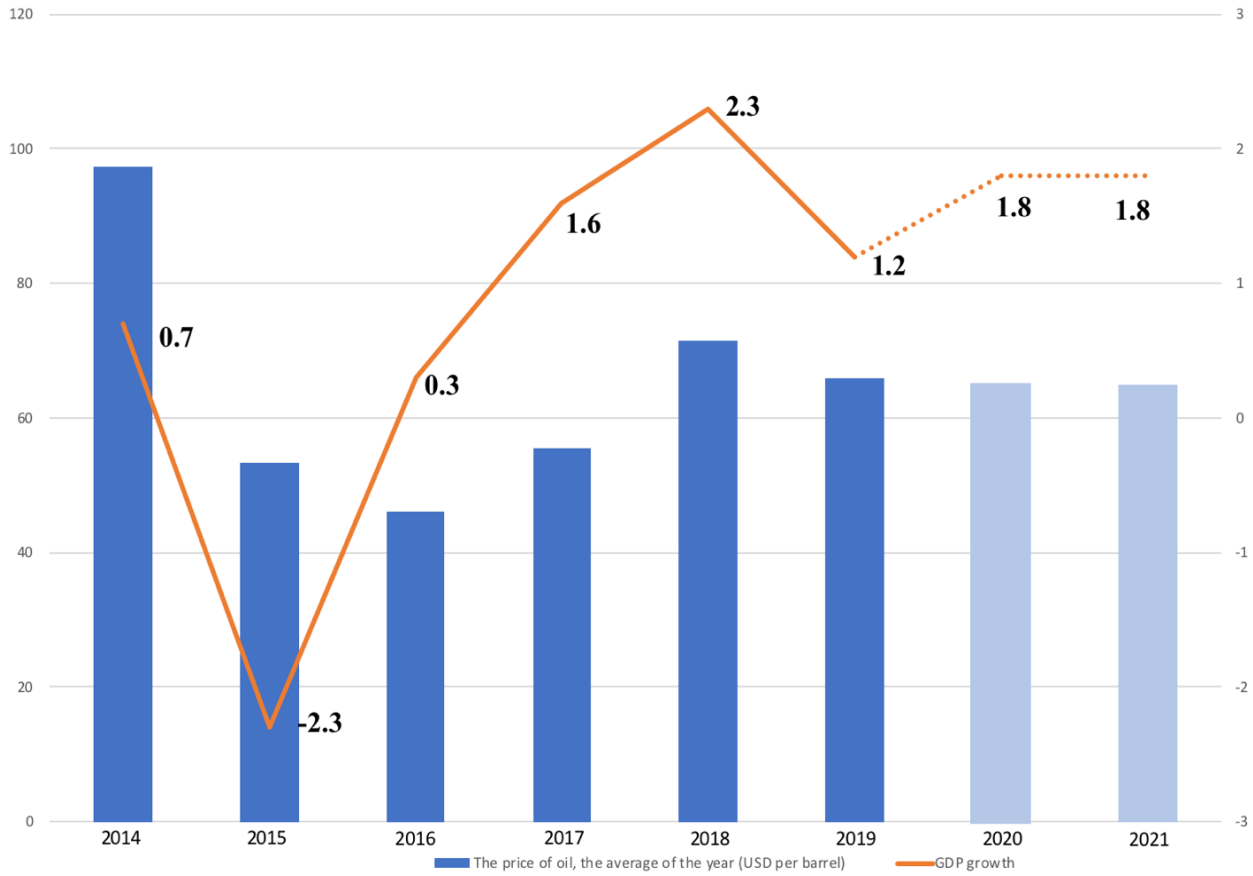

Figure 1: Dependence of GDP growth of the Russian economy on the dynamics of market price quotations for oil[12].

Pursuing a relatively tight monetary policy, along with a softening financial environment for emerging markets, have helped to limit inflationary pressures. The macroeconomic policy of 2017-2019, carried out in the framework of budget rules and in accordance with the principles of inflation targeting, has led to a significant increase in the stability of domestic economic and financial parameters to changes in the external economic environment. In particular, the dependence of the ruble exchange rate on fluctuations in oil prices has practically disappeared. At the same time, the price of oil balancing the budget fell by more than 2 times: from the level of 100 USD per barrel in 2014 to about 60 USD per barrel in 2018-2019.

[12] Author's own creation,using Microsoft Excel: materials of the official website of the World Bank. URL – http://www. worldbank.org/;
Materials of the official website of Federal State Statistic Service. URL - https://eng.gks.ru

The forecasts of World Bank analysts on the development of the Russian economy are quite variable. Some growth is projected from the current level of crude oil prices to 66 USD per barrel in 2019 and 65 USD per barrel in 2020-2021 (Figure 1). Against the backdrop of favorable global economic growth, higher oil prices, improved tax administration, a one-time effect of construction projects and the holding of the World Cup in Russia in 2018, GDP growth accelerated to 2.3 % compared to 1.6 % in 2017. However, due to a decrease in oil production, GDP growth slowed to 1.2 %.

With the support of relatively high oil prices in 2019-2021 it is expected to maintain a surplus of the consolidated budget of the Russian Federation. The decision of the participants of the OPEC+ deal to extend it for another 9 months on the same terms restrained from a more significant reduction in prices[13]. At the Ministerial meeting of the participants of the OPEC+ deal, the Charter of cooperation of oil producing countries was signed.

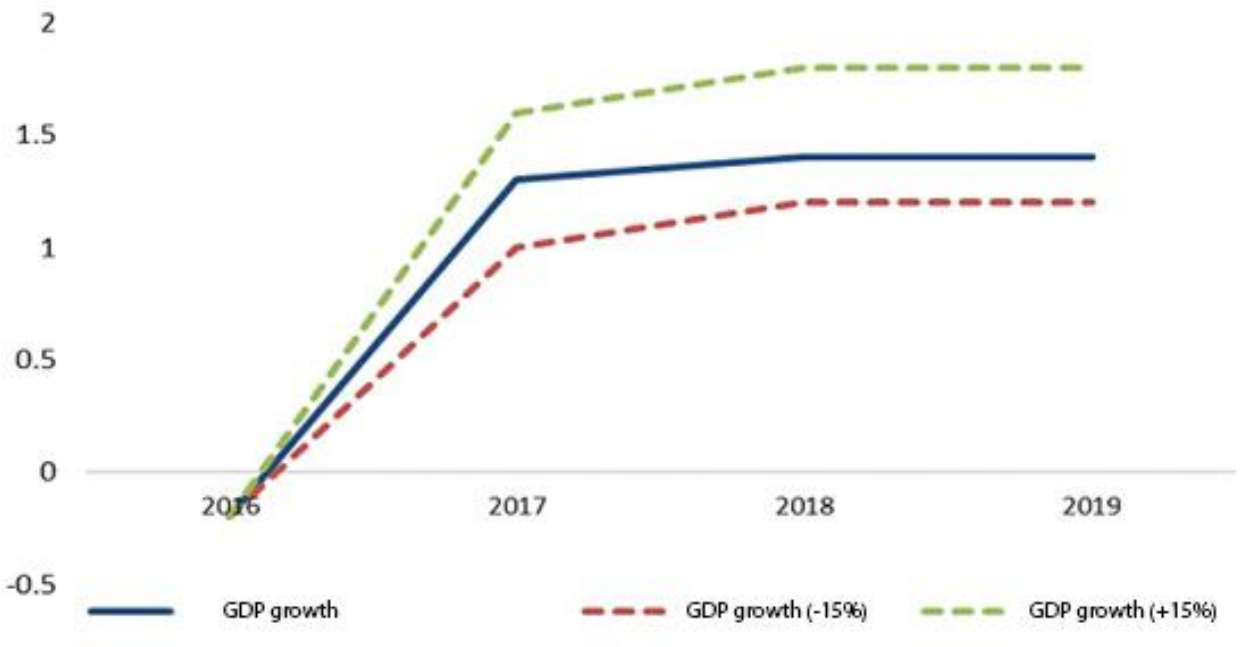

Figure 2: Forecast scenarios of GDP growth in the Russian economy in 2017-2019[14].

Various scenarios of development of the Russian economy are justified by the dynamics of market price quotations for oil – which does not solve the main problem of the country's economy – namely commodity dependence. Only the implementation of measures to restructure the Russian economy will provide long-term growth of macroeconomic indicators.

[13] https://www.opec.org/opec_web/en/press_room/5594.htm
[14] Materials of the official website of the World Bank. URL – http://www. worldbank.org/.

Figure 2 shows the forecast scenarios for 2017-2019. The negative scenario considers a shift in the dynamics of market price quotations for oil in the downward direction compared to the baseline scenario. In such a situation, the negative impact of external risks on the country's economy will continue. Following from the data in figure 1, you can see the dependence of oil prices and GDP growth. The positive scenario considers the shift of the dynamics of the market price quotations for oil in the direction of increase in comparison with the basic scenario. The forecast for 2017-2019 turned out to be true, the scenario was confirmed both in a positive and negative way.

In the table 1, the forecast of growth of the Russian economy for 2019-2021 remains restrained: from 1.2 % to 1.8 % in 2019-2021 in accordance with the current trends of potential growth. In 2019, the projected growth is 1.2 %. In addition to weak domestic demand, the factors slowing GDP growth include a further decline in oil production and the deterioration of the external economic environment (which negatively affects the growth of exports). Easing monetary policy and accelerating the implementation of national projects can help to accelerate growth. However, it is expected that due to the transfer effect, the weak growth dynamics in the first half of the year will negatively affect the annual growth indicators. GDP growth is expected to accelerate to 1.8 % in 2020 and 2021. After the slowdown in 2019, it is expected to resume the growth of population consumption, and the implementation of national projects will support investment demand.

The main parameters of the forecast	2017	2018	2019	2020	2021
GDP growth, %	1.6	2.3	1.2	1.8	1.8
Consumption growth, %	3.1	1.8	0.9	1.3	1.4
Growth of gross fixed capital formation, %	5.2	2.9	1.6	3.3	3.7
Balance of the consolidated budget of the Russian Federation, % of GDP	-1.5	2.9	1.7	1.6	1.5
Current account (USD billion)	33.3	114.9	86.3	82.3	80.1
Current account, % of GDP	2.1	6.9	5.1	4.7	4.4
Exports (GNFS), billion us dollars	441.3	508.7	493.5	504.5	521
Imports (GNFS), billion us dollars	326.9	344.5	354.9	369.4	386
Trade balance (GNFS), billion us dollars	84.3	164.2	138.6	135.1	135
Trade balance (GNFS), % of GDP	5.3	11.7	8.2	7.7	7.4

Table 1: Key indicators of the Russian economy and their forecast estimates by World Bank experts.

According to the World Bank forecasts, it can be concluded that the Russian economy has emerged from recession and is returning to moderate growth rates.

Experts of the European Commission (EC) predicted minor improvements in the development of the Russian economy for 2019-2020. Thus, they associated the improvement of the forecast for GDP growth with some stabilization of the ruble exchange rate and the dynamics of market price quotations in the hydrocarbon markets. Based on the action of these factors, they believed that the GDP growth of the Russian economy at the end of 2019 will be 1.7 %, but then this forecast is dominated by pessimistic estimates, according to which the expected GDP growth of the Russian economy will slow to 1.6 % at the end of 2019, followed by its decline to 1.5 % at the end of 2020. However, the forecast of the EC was not confirmed, in 2019 GDP growth will not rise above 1.2 %[15].

According to the Ministry of Economic Development, the main factor in accelerating economic growth in the coming years will be an increase in investment activity. The second most important factor in accelerating economic growth will be an increase in labor force participation. At the same time, taking into account the unfavorable demographic situation, the contribution of this factor will be limited. A certain contribution to the increase in the growth rate of per capita GDP will also be made by an increase in the total factor productivity, which will result from an increase in innovation activity in the Russian economy.

Table 2 shows, that GDP growth rate is projected to remain at 1.7 % in 2020. At the same time, it is expected that the growth rate of consumer demand will slow down under the influence of the slowdown in the growth of consumer loans. At the same time, the negative contribution of this factor will only be partially offset by the growth of other types of credit and a decrease in the savings rate through other channels, as well as a gradual acceleration in the growth of real disposable incomes. At the same time, in 2020, the growth rate of investment in fixed assets is expected to accelerate, taking into account the implementation of structural reforms and the deployment of investment projects with the participation of the state.

The Russian economy, after an actual stop of growth in the first quarter of 2019 against the background of a deficit in aggregate demand, returned to growth. At the end of 2019, GDP growth will be 1.3 %. Amid recovery in final demand and structural changes, growth will accelerate to 3.1–3.2 % in 2021–2022. By the end of the year 2019, inflation will fall below the target level of the Bank of Russia and, according to estimates, will be 3.8 %, which will result from weak domestic demand and weak dynamics of real disposable incomes of the population.

[15] European Economic Forecast. Autumn 2017. European Economy Institutional Papers. INSTITUTIONAL PAPER 063 / NOVEMBER 2017. Luxembourg: Publications Office of the European Union. – p.193.

The main parameters of the forecast	2018	2019	2020	2021	2022	2023
GDP growth, %	2.3	1.3	1.7	3.1	3.2	3.3
Inflation, %	4.3	3.8	3.0	4.0	4.0	4.0
Investment, %	4.3	2.0	5.0	6.5	5.8	5.6
Share of investments in GDP, %	20.6	21.6	22.6	23.4	24.0	24.5
Industry, %	2.9	2.3	2.4	2.7	2.9	3.0
Manufacturing activity	2.6	2.0	2.6	3.1	3.5	3.6
Retail trade turnover, %	2.8	1.3	0.6	2.2	2.5	2.6
Real wages, %	8.5	1.5	2.3	2.3	2.5	2.5
Poverty rate, % of population	12.6	12.5	11.7	10.8	9.4	7.9
Unemployment rate, %	4.8	4.6	4.5	4.5	4.5	4.4
Exports of goods, billion USD	443	407	406	426	448	478
Imports of goods, billion USD	249	248	259	276	296	318

Table 2: Key indicators of the Russian economy and their forecast estimates by the Ministry of economic development.

As can be seen in the table 2, industrial activity decreased due to the implementation of the oil production restriction agreement. Pollution of the main oil pipeline to Europe also had a negative impact. Growth in retail sales slowed due to higher VAT.

Also, relatively tight monetary policy, along with easing financial conditions for emerging markets, helped to limit inflationary pressures. However, household inflation expectations and business price expectations remain elevated.

The poverty rate under the national definition fell slightly to 12.5 % in 2019. Further decline may be due to the growth of the main sources of income, salaries and pensions.

As part of the work to increase the rate of economic growth, the Government of the Russian Federation has developed and is implementing a package of structural measures aimed at overcoming the restrictions on the growth of the Russian economy and expanding its production potential.

In comparison with the previous estimates of experts of the World Bank, only a conservative scenario assumes a fall in GDP growth rates – and other scenarios consider the positive dynamics of this indicator. The basis for such forecasts is a drop in the inflation rate to 3.8 % at the end of 2019, as well as an increase in oil prices. However, the lack of access to a wide range of credit resources for western banks constrains the economy, which in conditions of

moderate growth prevents the disclosure of production and investment opportunities of Russian business.

Low potential growth remains a major challenge for the Russian economy. Potential growth is currently estimated at around 1-1.2 % of GDP. Potential growth is hindered by accumulated structural and potential problems, as well as demographic challenges. In the medium term, national projects aimed at achieving such important goals as the development of human capital, public infrastructure and demography can have a positive impact on the potential growth of the Russian economy[16].

Summarizing the forecast estimates of the development prospects of the Russian economy made by international organizations and specialized agencies, as well as taking into account statistical indicators, it can be concluded that its transition to growth has already come. At the same time, the growth rate of the Russian economy will lag slightly behind the growth rate of the world economy as a whole, but will gradually approach them. This will certainly have a positive impact on the living standards of the population, create favorable conditions for attracting foreign and domestic investors, open up new opportunities for the accumulation of human capital and strengthen Russia's position on the world stage.

Considering the complex impact of the environmental situation on the Russian economy, it is necessary to note their positive impact on a number of economic processes. With regard to changes in the capital markets, the development of the green economy is a motive for finding and establishing new financial ties with foreign partners – in particular, from Asia. For example, Gazprom in 2015 for the first time attracted 1.5 billion dollars from a consortium of Chinese banks, and in 2016 the company signed an agreement with Bank of China to open a credit line for 2 billion euros[17]. Also, new directions of the policy of promotion of Russian companies are developing – in February 2017, Rusal company agreed to place its bonds in the amount of 1.5 billion dollars on the Shanghai stock exchange.

Russian companies have shown successful experience in finding strategic investors outside of the USA and Europe markets, as exemplified by the sale of 19.5% of Rosneft's shares in 2016 to the international consortium Glencore and the sovereign wealth fund of Qatar[18]. This shows real prospects for diversifying the structure of capital sources through enhanced cooperation with developing countries.

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[16] Moderate growth of the economy: 41st report on the Russian economy // World bank group, June 2019. URL - http://documents.vsemirnyjbank.org/curated/ru/628951561127248518/pdf/Russia-Economic-Report-Modest-Growth-Focus-on-Informality.pdf

[17] Three years of sanctions against Russia: losses and acquisitions// news from Russia, 18.03.2017. Electronic source. Access mode: http://новости-россии.ru-an.info.

[18] RBK Group. 08.09.2017. Electronic source. https://www.rbc.ru/business/08/09/2017/59b288709a7947e036ff602a.

Another positive example in the financial sphere is the launch of the national payment system "Mir" after attempts to limit transactions of a number of Russian banks in Visa and MasterCard systems. The considered facts show that the measures to stimulate economic growth serve as a stimulating mechanism for the Russian economy, encouraging the search for new growth reserves for business – both in the financial, industrial and environmental spheres.

3.3 Russia's environmental problems in the context of economic growth

The current level of transformation of the natural environment in Russia has reached those critical violations in which the deterioration of the state of its components may lead to their degradation and the impossibility of maintaining a favorable natural environment for future generations. The environment in cities and adjacent territories, where 74% of the country's population lives, is exposed to a significant negative impact, the sources of which are industrial, construction, energy and transport facilities[19]. About 55 million people, or 53% of the urban population, live in cities with high and very high levels of air pollution.

Reduction of pollutants from sources of anthropogenic impact into the environment cannot quickly and unequivocally lead to an improvement in their condition since the volumes of pollutants still significantly exceed the ability of the biosphere to process and purify them, and therefore these substances accumulate, increasing the size of the accumulated environmental damage. Man is an exceptional component of the environment, representing, on the one hand, part of the natural environment, and on the other - its active converter. These transformations are carried out with such speed and on such scales, which are incommensurably greater than the possibilities of the natural evolution of natural systems. Under such loads, the natural environment loses the ability to heal itself due to natural processes of self-regulation (small biological and large geological circulation of substances), which leads to its pollution, depletion, damage and, eventually, destruction. Therefore, necessary mechanisms for regulating the anthropogenic impact on the environment, ensuring the preservation of its ability to heal itself. This is the only way to preserve humanity itself as an integral part of the natural environment.

Let us consider some factors of violation of the country's ecology in the context of the study of the prospects of its environmental growth.

In large cities, vehicle emissions account for 50 to 90% of the number of pollutants entering the atmosphere. Motor transport is one of the main sources of the air intake of hazardous substances such as carbon monoxide, nitrogen oxides, polycyclic aromatic hydrocarbons, ultrafine

[19] N. Vukovich "Green" Economy: definition and contemporary ecological-economic model // Vestnik Urfu. Series: Economics and management.2018. T. 17. № 1. Pp. 128-145.

particulate matter, and greenhouse gases. Transport makes a significant contribution to noise pollution: up to 70% of the urban population lives in areas of noise discomfort associated with traffic[20].

The share of emissions of pollutants from mobile sources in 2018 accounted for 44.7%. With the growth of the car fleet in 2000-2018, emissions first increased twice, but then, as the transition to more environmentally friendly types of liquid fuels and transport, decreased and returned to the level of the year 2000. In the total structure of emissions, the share of mobile sources continues to increase, since the reduction of emissions by industrial enterprises is faster than the reduction of emissions by motor transport.

Due to the pollution coming from industrial and domestic sewage, effluents from agricultural lands, the state of 15% of water bodies used as sources of centralized drinking water supply does not meet sanitary and epidemiological requirements.

The total discharge of polluted wastewaters decreased in 1990-2000 Dynamic decline continued after 2000. As a result, in the years 2000-2019, the decline was almost 30%. Regarding this parameter, the concept of double decoupling was practically realized. With GDP growth of 76%, freshwater abstraction decreased by 19% and the discharge of polluted wastewater by almost 30%. The main source of polluted wastewater discharge was the generation of electricity and heat[21].

Despite tangible progress in reducing discharges of polluted wastewater in 1990–2018, a significant portion of surface water in the Russian Federation is still assessed as “dirty” and “extremely dirty”; pollution of water bodies is practically not observed.

There is also a danger of oil and oil product spills, resulting in a prolonged negative impact on the environment in the areas of production, transportation, transshipment and storage of oil hydrocarbons, including in the Arctic zone of the Russian Federation.

On the background of reducing emissions of pollutants into the air and discharge of pollutants into water bodies and, albeit slowly, but improving the indicators of air pollution and water bodies, soil pollution is not reduced. This shows that the existing state regulatory measures do not ensure the preservation of the soil as a resource ensuring the country’s food security and as a component of the natural environment ensuring the sustainable functioning of ecosystems.

In almost all regions of Russia, there is a tendency to deterioration of soil and land. Land degradation, soil and vegetation cover, is due to water and wind erosion, waterlogging and

[20] A. Nurseitov, Sh. Ernazar, E. Aleksenko "Green" Economy / / Vestnik of Turan University. 2018. № 1 (77). Pp. 46-51.
[21] A. Nurseitov, Sh. Ernazar, E. Aleksenko "Green" Economy / / Vestnik of Turan University. 2018. № 1 (77). Pp. 46-51.

waterlogging, flooding, salinization, and salinization. More than half of the area of agricultural land is subject to these processes. Desertification to some extent covered the territory of 27 subjects of the Russian Federation on an area of more than 100 million hectares[22]. As a result, natural pastures lose their productivity. The area of polluted lands in economic circulation is 75 million hectares. Zones of pollutants that can accumulate in the soil, cover an area of 18 million hectares directly around industrial complexes using outdated technologies. The area that has lost the economic value of disturbed lands or lands that are a source of negative environmental impact exceeds 1 million hectares.

We will highlight the main problems associated with soil degradation and depletion for the Russian economy.

Low share of reclaimed land - 7.5% of the total arable land area of the country with twice the need for sustainable agriculture and food security. There is no necessary legal framework regulating relations in the field of land reclamation.

The annual removal of nutrients from the soil, almost three times higher than their supply with mineral and organic fertilizers, is the result of fertilizer systems that do not meet modern scientific concepts, practiced by farmers on their land.

Misuse of agricultural land - millions of hectares of idle arable land on land owned by unscrupulous owners; and transferring of agricultural land to other categories not related to agriculture. Over the past three years, prosecution authorities have identified about 45 thousand violations of legislation in this area; universally authorized executive authorities and local authorities allowed violations when making decisions on transferring agricultural land to other categories of land or changing the type of permitted use - only in the Moscow region prevented the illegal change of permitted use of land plots with a total area of over 4.8 thousand hectares.

Imperfect mechanisms of land use regulation on agricultural land - about 100 million hectares of agricultural land are cultivated because of lease agreements, a quarter of which are concluded for less than one year, which does not encourage tenants to preserve soil fertility, to comply with crop cultivation technologies, including scientifically based crop rotation.

Destruction, disturbance of soil on agricultural lands because of mining operations on agricultural lands, including for the personal needs of the owners.

Land desertification - a complex of adverse natural factors in an arid climate, combined with the negative effects of economic activity leads to soil degradation. The share of lands subject

[22] M. Kubarev, Transformation of goals, objectives, and mechanisms of state regulation of environmental management in the light of sustainable development // proceedings of higher education institutions. Mining Journal.2018. № 3. Pp. 14-25.

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to desertification in the Russian Federation accounts for about 7% of the total area of the country; Desertification is most common in the Republics of Kalmykia and Dagestan, Astrakhan, Volgograd, and Rostov regions. There are processes of desertification in the Altai Territory, the Omsk Region, the Republic of Tyva, the Republic of Khakassia, the Republic of Buryatia, and in the Orenburg and Saratov regions, with about 100 million hectares affected by desertification (46.8%) of farmland.

The growth of waste in recent years could not be stopped. At the end of 2015, the total amount of accumulated and recorded production and consumption waste generation amounted to 31.5 billion tons, which occupy an area equal to the territory of Switzerland. According to Russian statistics, the volume of waste increases by over 5 billion tons. It is 2 times more than all EU countries for the comparable range of accounting. Only in one Kemerovo region formed 2.65 billion tons or 52% of the total. And in the Urals, the total amount of accumulated waste reaches 10 billion tons[23].

Most of them (slightly less than 98%) are not hazardous mineral wastes from the extractive industry (overburden and associated rocks, inert tailings). Basically, they are not dangerous. Therefore, for example, the Kemerovo Region proposes to allocate overburden as a separate line in statistical accounting forms to more adequately reflect the environmental situation. The annual extraction of natural resources from the subsoil (fuel, metal ores and raw materials for building materials), and the use of biomass exceeds 2.4 billion tons. There are 2 tons of waste (waste dumps, construction waste, etc.) per 1 ton of extracted natural raw materials. The volume of use and disposal of waste amounted in 2015 to 2.7 billion tons (53%). This is close to the EU rate (52%). The increase in the storage or disposal of waste on the territory of enterprises in 2015 was equal to 2.3 billion tons against 1.1 billion tons in the EU. Per capita in Russia, this figure is 7 times higher. Most landfills for waste disposal do not meet regulatory requirements, so they are a source of continuous release into the environment of various types of pollutants. More than 300 million tons of waste are generated annually in the manufacturing industry, agriculture, construction, transport, and services. Approximately 35% of this value is neutralized and processed, and 65% is sent for long-term storage, mainly in production areas[24]. There are problems with the disposal of slag waste from past periods of the objects of metallurgy and power system.

[23] T. Evtodieva, Green Logistics as a component of the concept of shared responsibility // Bulletin of the South Ural State University. Series: Economics and Management. 2018. T. 12. № 1. Pp. 167-174.

[24] M. Kubarev, Transformation of goals, objectives, and mechanisms of state regulation of environmental management in the light of sustainable development // News of higher educational institutions. Mountain Journal. 2018. № 3. Pp. 14-25.

Russian regions differ significantly (by more than 2 orders of magnitude) in terms of primary energy consumption. After 2008, there was no significant increase in primary energy consumption in most regions, and GRP increased 0.9-1.4 times during this period. Thus, economic growth was largely driven by the stabilization or very slow increase in primary energy consumption. This was made possible by reducing the energy intensity of the Gross Regional Product.

Ecology and the solution of environmental problems are now becoming one of the officially recognized priorities for the development of most countries, including the Russian Federation. This confirms the adoption of environmental legislation both at the level of individual States and within the framework of the United Nations, the European Union, the Group of eight and a number of other international organizations and structures. At the same time, the leading international positions in solving environmental issues are assigned to the United Nations.

Among the significant list of environmental problems of mankind, a special place belongs to the problem of global climate change. Much of the climate change in recent decades has been attributed to increased greenhouse gas emissions, which include CO_2, methane, nitrogen, sulfur hexafluoride and some gases of artificial origin.

For today, special attention is paid to the development and improvement of regulatory instruments aimed at reducing greenhouse gas emissions. Today, many countries of the world have adopted the UN Framework Convention on climate change and the Kyoto Protocol — an international agreement named at the place of holding and signing (Kyoto, Japan). The Protocol obliges developed countries and countries with economies in transition to reduce or stabilize greenhouse gas emissions. The agreement was the first global environmental treaty to be based on a market — based regulatory mechanism - the international trading mechanism for greenhouse gas emissions.

The focus on greenhouse gas emissions is linked to Global warming. This term is called the gradual increase in the average annual temperature of the earth's atmosphere and oceans.

Since the beginning of the industrial revolution (XVIII century), the planet's temperature has increased by about 0.7 ° C. It is expected that during the XXI it will grow by 1.1–6.4° C.

Melting glaciers, rising sea levels, redistribution of rainfall, droughts, hurricanes, floods and other disasters are the most powerful arguments against global warming. Therefore, this problem captures the attention of scientists around the world. The increase in average annual air temperature is a well-established fact, so the question is: "is global warming a myth or a reality?" — incorrectly. The dispute is only about the mechanisms of the phenomenon, and how significant is the role of the anthropogenic greenhouse effect in this process. However, most researchers believe that human exposure plays a major role in increasing the temperature.

The causes of global warming have not yet been established with absolute certainty. However, most scientists are inclined to believe that the main culprit for the increase in temperature on Earth is a man. If earlier an increase in the average annual air temperature by tenths of a degree occurred for thousands of years, with the beginning of active human activity for this enough a couple of decades.

Climate change will have a devastating impact on such sectors of the economy as agriculture and tourism and will worsen living conditions in many countries. The UN expects that by the middle of this century the number of "climate" refugees will reach 200 million people.

Global greenhouse gas emissions are growing at a record pace, despite the efforts of the signatories to the Kyoto Protocol. Thus, the greatest contribution to environmental pollution is made by China, India, USA, Russia and the European Union. The US emits about 5.299 billion tons of carbon dioxide per year, China -7 .687 billion tons, India-about 2 billion tons.

According to the study of experts from the Global Carbon Project, since 1990, global emissions of harmful gases have not decreased relative to the baseline, but, on the contrary, increased by almost 50%. And in the last decade, emissions have grown by more than 3% per year – three times faster than in the 1990s. In 2017, the level of carbon dioxide in the atmosphere was 400 particles per million, that is, 400 CO_2 molecules per million molecules in the air. The last time this level of carbon dioxide existed on Earth was about 3-5 million years ago, before the last ice age.

3.4 Features of the impact of economic growth on the environment of Russia

Environmental pollution has a negative impact on human health. According to the world health organization (WHO), the role of environmental factors in increasing morbidity is 17-20%. Today there are new types of pathology associated with chronic poisoning of heavy metals (lead, mercury, etc.), increased the number of chronic diseases, increased levels of diseases of the circulatory system, chronic respiratory diseases, endocrine, and allergic diseases[25].

Air pollution is particularly dangerous. Asthma has increased in industrialized countries. According to American scientists, in cities with high levels of air pollution during influenza epidemics, the incidence increases by 200%, and in cities with low levels of pollution – by 20%. In 2017, 136 Russian cities (where 55% of the urban population lives) were characterized by high and very high levels of air pollution. In Russia, the contribution of suspended particles to mortality is 15-17%[26].

[25] T. Akimova, V. V. Haskin, Ecology. 4th edition / Textbook for higher education institutions. M.: UNITY, 2016.
[26] Y. Gubernsky. Ecological and hygienic certification of residential buildings and premises / methods of conformity assessment №11, 2009.

The high level of morbidity of the population entails economic losses associated with the cost of treatment and loss of working time, and consequently a decrease in the gross product of the country. Thus, in the United States, the cost of treatment of diseases caused by air pollution, in the 70s of the XX century reached 10 billion dollars. In Japan, the cost of compensation for human health damage due to air pollution increased from 4 billion yen to 73 billion yen between 1974 and 1981.

The increase in environmental pollution is due to the low efficiency of treatment facilities, the weakening of state environmental control, but also pollution resulting from accidents at industrial facilities. Therefore, an integral part of the environmental safety system is the safety of technological systems and complexes. Scientific and technological progress associated with the involvement in the economic turnover of an increasing number of natural resources, the use of increasingly complex technological systems, the growth of energy consumed by mankind, at the same time causes an increase in the likelihood of technological accidents and catastrophes.

The total damage from accidents consists of the cost of the material values destroyed by the accident, the costs of their restoration, compensation to the people affected by the accident, the restoration of the environment and other socio-economic, moral, political and cultural losses of society. On the territory of Russia operated more than 2,300 high-risk facilities (including 800 nuclear facilities), which, on average, once every 10-15 years there are accidents with damage of more than 1 billion rubles., every 8-12 months-with damage of up to 1 billion rubles, every 115-145 days-with damage of up to 200 million rubles (in 1993 prices). On average, a year in the country is up to 800 emergency situations of technogenic and natural-technogenic character. According to the Institute of market problems of the Russian Academy of Sciences, the economic damage from accidental environmental pollution in Russia in 2007 was estimated at 38.5-38.7 billion rubles[27].

Thus, effective mechanisms aimed at reducing environmental pollution are needed.

In the EU countries, much attention is paid to the reduction of environmental pollution, it is expected that as a result of the ongoing activities by 2020, the pollution of ecosystems will decrease by 44% (compared to 2000). In Russia, the financing of programs aimed at environmental protection is limited by the budget. At the same time, the decree of the President of the Russian Federation dated 12.05.09 No. 537 "About strategy of national security of the Russian Federation up to 2020" defined the strategic goal of the environmental security:

- preservation of the natural environment and its protection;

[27] Motkin G. A. Justification of the draft Federal law "On compulsory environmental insurance"..

- elimination of environmental consequences of economic activity in the context of increasing economic activity and global climate change.

One of the steps towards environmental modernization in Russia is the introduction of environmental management systems at enterprises in accordance with the requirements of industry standards. This implementation will reduce the pollution of the environment, get the company more profitable and enter the international market. In addition, it is necessary to adopt the tax policy to the system of accounting for the environmental policy of individual companies, which stimulates the formation of a "green economy" in Russia.

4 Practical Part

4.1 Paris Agreement

The Paris Agreement is an agreement under the UN Framework Convention on Climate, governing measures to reduce carbon dioxide in the mountains since 2020. The agreement was prepared to replace the Kyoto Protocol during the climate Conference in Paris and adopted by consensus on 12 December 2015 and signed on 22 April 2016. In contrast to the Kyoto Protocol, where the main criterion was the total threshold values of greenhouse gas emissions, a different approach is adopted, based directly on containing the increase in the average world temperature lower than 1.5 ℃ degrees in 2100 compared to 1900. According to the UN, Russia ranks third in terms of greenhouse gas emissions among the participants of the Paris agreement and fourth among countries in terms of carbon dioxide emissions. Russia was the only country that did not ratify the document of the 15 leading countries in emissions. By a government resolution of September 21, 2019, the Agreement was "adopted" but not ratified by the Duma. More than three years passed between the signature and the adoption, as the adoption of the agreement had opponents. They believed that the agreement would have a negative impact on economic growth.

According to international scientific and political consensus, the main cause of climate change occurring on the planet is the increase in the average annual temperature of the atmosphere. The reason for this is the increase in the greenhouse effect due to the increase in the content of greenhouse gases in the atmosphere. Climate change threatens to destroy the ecological balance and increases the risks for the development of key sectors of the economy. This can be called one of the main environmental problems today. Now Russia is obliged to fight for the reduction of greenhouse gas emissions into the atmosphere and modernize production so that emissions become more environmentally friendly.

4.2 Analysis of environmental and economic indicators

The data used in the practical part will be secondary (collected from statistical databases). The data collected for analysis should be from both an economic and an environmental perspective. The data period will be selected according to both its availability and its significance for the study.

The initial belief is that environmental problems depend on economic growth. Economic growth refers to the development of the national economy, which increases the volume of output of goods and services. In this practical part, the GDP at current prices will be considered as economic growth. Climate change due to air pollution and global warming significantly affects

human life and has much more serious consequences than we can imagine, so the total GHG emissions will be considered as an environmental problem.

4.3 Development of a mathematical model of the impact of economic growth on the environment of Russia

The main practical outcome from this thesis will be provided by a regression model. Regression analysis is a statistical analytical method that allows you to calculate the estimated relationship between a dependent variable of one or more independent variables. The main task is to identify which independent variable is related to the dependent and understand the relationship between the dependent and independent variables. The indicators used to explain the dependent variable will relate to economics and the environment.

The forthcoming data analysis is intended to provide an overview of the main factors influencing the impact of economic and environmental indicators on economic growth. Two mathematical models will be created for the proving of the relationship between economic growth and environmental problems. In the first model, the dependent variable will be economic growth, and in the second model, the dependent variable will be one of the main environmental problems.

4.4 Methodology

Year	Name of indicator					
	GDP at current prices (billion rubles)	Total GHG emissions (million tons of CO_2 equivalent per year)	Oil consumption (in million metric tons)	Production and consumption waste generation (million tons)	Emissions of pollutants from stationary sources into the atmosphere (million tons)	Investments in fixed assets aimed at protecting the environment
2008	41276.8	2047.1	138.1	3876.9	20.1	368627
2009	38807.2	2016.2	132.5	3505	19.0	343368
2010	46308.5	2057.7	137.9	3734.7	19.1	372382
2011	60282.5	2120.5	147.0	4303.3	19.2	412014
2012	68163.9	2146.3	149.6	5007.9	19.6	445817

2013	73133.9	2090.7	149.5	5152.8	18.4	479384
2014	87757	2089.5	157.4	5168.3	17.5	158636
2015	83094.3	2093.7	149.4	5062.2	17.3	151788
2016	86014.2	2097.5	153.1	5441.3	17.3	139677
2017	92101.3	2155.5	151.5	6220.6	17.5	154042
2018	103875.8	2197.8	152.3	7266.1	17.1	157651

Table 3: Initial data for the mathematical assessment of the correlation of economic growth and environmental issues[28].

4.5 Multiple linear regression model

The first model shown of linear regression in function 2 were built to assess the impact of mainly economic and environmental indicators on the GDP. The second model of linear regression in function 3 has its focus on how total GHG emissions are affected by economic and environmental indicators. The main goal of this part is to provide a better understanding about cause-effect relationships and its significance for each of the indicators. Each of the indicators includes 11 observations from 2008 until 2018. The time period was chosen according to its availability as well as according to its significance when concerning the increasing measures applied by the Russian Federation in terms of economics and environment. Be familiar with this kind of information can be helpful to people who would like to get a certain preview of the Russian environmental situation in the last 10 years.

Function 1: Multiple regression model

$$y = a + b_1x_1 + b_2x_2 + \ldots + b_nx_n \quad (1)$$

Where,

y is dependent variable;

x is explanatory variables;

a is a rate of change;

[28] Source: URL - https://www.gks.ru; https://www.statista.com

b represents the intercept with the y-axis.

Used software:

Microsoft Excel 2019

4.5.1 First multiple regression model

The dependent variable is the GDP at current prices in Russia (in billion rubles) and independent variables are:

x_1 – oil consumption (in million metric tons),

x_2 – production and consumption waste generation (million tons),

x_3 – emissions of pollutants from stationary sources into the atmosphere (million tons),

a – intercept.

Function 2: Multiple regression model 1

$$GDP = a + b_1 * x_1 + b_2 * x_2 + b_3 * x_3 + u_1 \quad (2)$$

Research contains 1 dependent variable and 3 independent variables which affect the dependent variable. The main goal is to find the significance of each indicator on the GDP at current prices. This research gives only a very narrow view how and what role play selected economic and environmental indicators. However, it is important to determine assumptions concerning the cause-effect relationships between each of the independent variables and the dependent.

Parameters` estimation of the first model:

Regression statistics:

As it is visible in the figure 3, R^2 is 0.995222306. The high R^2 achieved in this regression model means that 99 % of the variation of GDP can be explained by other 3 variables. R^2 of 95 % or more is considered a good fit. The adjusted R^2 only measures how significant independent variables affect the dependent variable. The standard error (that shows the average distance that the data points fall from the regression line) is of approximately 1520 billion rubles.

ANOVA			
	df	*F*	*Significance F*
Regression	3	695.3533	5.02995E-09
Residual	7		
Total	10		

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-18218.77	22293.9151	-0.81720818	0.44073249
Oil consumption	1032.4303	102.256489	10.0964774	2.0081E-05
Production and consumption waste generation	8.8946091	0.76712327	11.5947586	8.0044E-06
Emissions of pollutants from stationary sources into the atmosphere	-5821.094	702.267587	-8.28899661	7.2618E-05

Regression Statistics			
R Square	0.996655614	Standard Error	1519.96019
Adjusted R Square	0.995222306	Observations	11

Figure 3: Outputs from the first model[29]

Anova:

The Significance F value gives an idea of how reliable the results are. P-value of F is Significance F. If Significance F is less than 0.05 (5 %), that means model is statisticly significant. In our case the Significance F is less than 0.05, this model is statisticly significant.

Regression analysis output:

[29] Source: Microsoft Excel 2019. Author`s computation.

According to the P-values of each coefficient, it can be assumed that they are all significant at the 0.05 significance level.

Function 3: Estimated multiple regression model 1

$$GDP = -18218.7697048719 + 1032.43032491817 * x_1 + 8.89460912003763 * x_2 - 5821.09364742277 * x_3 + u_1 \quad (3)$$

4.5.2 Second multiple regression model

The dependent variable is the total GHG emissions (million tons of CO_2 equivalent per year) and independent variables are:

x_1 – GDP at current prices (billion rubles),

x_2 – oil consumption, (in million metric tons),

x_3 – production and consumption waste generation (million tons),

x_4 – emissions of pollutants from stationary sources into the atmosphere (million tons),

x_5 – investments in fixed assets aimed at protecting the environment (million rubls),

a – intercept.

Function 4: Multiple regression model 2

$$Total\ GHG\ emissions = a + b_1 * x_1 + b_2 * x_2 + b_3 * x_3 + b_4 * x_4 + b_5 * x_5 + u_1. \quad (4)$$

Research contains 1 dependent variable and 5 independent variables which affect the dependent variable. The main goal is to find the significance of each indicator on the GHG emissions (million tons of CO_2 equivalent per year).

ANOVA			
	df	*F*	*Significance F*
Regression	5	61.9166587	0.000170078
Residual	5		
Total	10		

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	1475.55964	145.9024886	10.11332741	0.00016195
GDP at current prices	0.01220914	0.002453201	4.976819504	0.004187145
Oil consumption	-8.9656977	2.486924639	-3.605134458	0.015459406
Production and consumption waste generation	-0.0476107	0.021686701	-2.195389124	0.079554595
Emissions of pollutants from stationary sources into the atmosphere	81.2516239	14.17157556	5.733422059	0.002260306
Investments in fixed assets aimed at protecting the environment	-0.0014275	0.000324947	-4.392890754	0.007068723

Regression Statistics			
R Square	0.98410596	Standard Error	9.272501346
Adjusted R Square	0.96821192	Observations	11

Figure 4: Outputs from the second model[30]

Parameters` estimation of the second model:

Regression statistics:

As it is visible in the figure 4, R^2 is 0.98410596. The high R^2 achieved in this regression model means that almost 99 % of the variation of total GHG emissions can be explained by other 5 variables. R^2 of 95 % or more is considered a good fit. The adjusted R^2 only measures how significant independent variables affect the dependent variable. The standard error (that shows the average distance that the data points fall from the regression line) is of approximately 9.272501346 million tons of CO2 equivalent, that is significantly smaller than in the first model.

Anova:

[30] Source: Microsoft Excel 2019. Author`s computation.

The Significance F value gives an idea of how reliable the results are. P-value of F is Significance F. If Significance F is less than 0.05 (5 %), that means model is statisticly significant. In our case the Significance F is less than 0.05, this model is statisticly significant.

Regression analysis output:

According to the p-values of each coefficient, it can be assumed that they are all significant at the 0.05 significance level except production and consumption waste generation. It will be excluded from the model.

Function 5: Estimated multiple regression model 2

$$\text{Total GHG emissions} = 1475.55963670765 + 0.0122091375807726 * x_1 - 8.96569770966527 * x_2 + 81.2516239173612 * x_4 - 0.00142745835722505 * x_5 + u_1 \quad (5)$$

4.6 Interpretation of results

4.6.1 First multiple regression model:

- If all explanatory variables equal 0, then the GDP at current prices will be almost -18218.77 billion rubles. However, the coefficient is not significant (p-value = 0.44).
- If oil consumption is increased by 1 million metric tons, the GDP at current prices will increase by 1032.43.
- If production and consumption waste generation is increased by 1 million tons, the GDP at current prices will increase by 8.895.
- If emissions of pollutants from stationary sources into the atmosphere are increased by 1 million tons, the GDP at current prices will decrease by 5821.09.

4.6.2 Second multiple regression model:

- If all explanatory variables would equal 0, then total GHG emissions would be of - 6 1475.56 million tons of CO_2 equivalent per year.
- If GDP at current prices increases by 1 billion rubles, then the total GHG emissions will increase by 0.0122.
- If oil consumption is increased by 1 million metric tons, then the total GHG emissions will decrease by -8.965.
- If emissions of pollutants from stationary sources into the atmosphere increase by 1 million tons, then the total GHG emissions will increase by 81.25.

- If investments in fixed assets aimed at protecting the environment are increased by 1 million rubles, then the total GHG emissions will decrease by 0.00143.

Currently, it is possible to determine which of the indicators are most related, as well as the economic and environmental aspects that influenced greenhouse emissions in the period from 2008 to 2018. Starting with the first model, the selected independent variables explain GDP at current prices in 99% of the time. The intercept is not statistically significant, but it is not much important. The intercept's significance level does not affect the accuracy. In this model the data obtained do not reflect the correct reality, since GDP is mostly influenced by economic indicators, not environmental ones. Nevertheless, our task was to find a correlation between the selected indicators, which was successfully achieved. All the explanatory variables used in the regression model fulfil the expectations of a positive correlation with the total GDP in current prices. GDP at current prices as an economic indicator of economic growth has a correlation with oil consumption, and this is quite logical, since production in industries such as manufacturing, transport and electricity production requires a significant amount of oil. With the distribution of GDP by sectors of the economy, the share of industry is 30.48%[31]. The correlation between the GDP at current prices and production and consumption is relatively high, and this result also has a logical meaning. Production and consumption waste is accumulated through the activities of all sectors of the economy and is generally regarded as an inevitable byproduct of economic activity. The high level of production and consumption waste generation is related to industrial growth and industrial growth has a direct link to economic growth. Under the emissions of pollutants into the atmosphere is understood as the receipt of pollutants into the air, that is, having a negative effect on the health and activities of the population or on the environment. In the first model it is proved that emissions of pollutants into the atmosphere have correlation with GDP at current prices. An unhealthy nation and an unfavorable environment will never benefit economic growth.

In the second model, total greenhouse gas emissions were chosen as the dependent variable. Greenhouse gas emissions are a global environmental problem and have a great impact on the environment, and the goal was to understand what economic and environmental indicators affect these emissions. The second model`s independent variables explain the dependent in 98%. The lowest p-value (highest significance) was achieved by emissions of pollutants from stationary sources into the atmosphere. More pollution emissions from stationary sources lead to more greenhouse gas emissions. The second most significant indicator was the GDP at current prices,

[31] Statista, URL: https://www.statista.com/statistics/271378/distribution-of-gross-domestic-product-gdp-across-economic-sectors-in-russia/

and it proves the negative impact of economic growth on environment. The third explanatory variable, production and consumption waste generation, was excluded due to its identified insignificance in the model. The fifth and least significant explanatory variable is investments in fixed assets aimed at protecting the environment, and the model showed that investments in environmental protection lead to a decrease in total greenhouse gases.

5 Results and Discussion

5.1 Prospects for solving the identified problems

Threats to environmental safety persist, despite measures to reduce the levels of exposure to chemical, physical, biological and other factors on the environment, to prevent accidents at hazardous installations, natural and anthropogenic origin emergencies and to eliminate their consequences, to adapt to adverse environmental changes.

Almost a third of the constituent entities of the Russian Federation locates in areas at significant risk of natural and anthropogenic origin emergencies. In the area of their impact may be about 115 million people.

On 15% of the territory of the Russian Federation, where most the country's population concentrates, the main production facilities and the most productive agricultural land, natural ecosystems are severely depressed or degraded. A significant part (65%) of the territory of the Russian Federation is little affected by economic activities, and ecosystems almost completely preserve yielding capacity and biodiversity. The quality of environmental components in another 20% of the territory is satisfactory[32].

The state of the environment by 20-25% determines the state of human health. Currently, according to experts, at least 90 million people are at risk of health deterioration as a result of adverse environmental (chemical, physical and biological) factors. In the impact zones of large production facilities using outdated technologies, the population living there, as a rule, has an increased incidence of respiratory and nervous system organs, blood and digestive organs, the growth of allergic and oncological diseases, immunodeficiency. Children, women of childbearing age, people with disabilities, and the elderly especially manifest these pathologies.

The country has a significant number of hazardous production facilities. With a general tendency to reduce the number of accidents at hazardous production facilities, however, there remains the risk of causing harm to human life and health, material damage, and environmental pollution as a result of accidents.

On the territory of Russia, there are zones of radioactive contamination in which certain groups of citizens are at risk of radiation exposure. Increased levels of radiation are observed in the territories exposed to radioactive contamination because of past radiation accidents, the activities of nuclear fuel cycle enterprises and enterprises of the nuclear weapons complex, local radioactive fallout after nuclear weapons tests.

[32]T. Evtodieva, Green logistics as a component of the concept of shared responsibility / / Vestnik of the South Ural State University. Series: Economics and management. 2018. Vol. 12. No. 1. Pp. 167-174.

Historical features of the development of the natural and economic complex of the Russian Federation and inherited from the Soviet Union environmental problems of industries and regions led to the emergence and development of a variety of internal threats to environmental safety, the most important of which are:

- High level of air pollution exceeding sanitary and hygienic standards for many pollutants in most urban agglomerations, including as a result of high emissions from vehicles using motor fuel of relatively low quality against the background of the backward transport network and undeveloped infrastructure;

- Poor water quality in most surface water bodies due to discharges of untreated or insufficiently treated wastewater of different origin, pollution of underground water sources as a result of a violation of operational requirements;

- Pollution of large areas adjacent to industrial enterprises and industrial complexes, primarily heavy metals, petroleum hydrocarbons, sulfates, and nitrates as a result of emissions of pollutants into the atmosphere and discharges to the terrain, accidents on pipelines;

- Large volumes of production and consumption wastes, including hazardous chemical and radioactive wastes, located throughout the country, and not only in specially designated areas under conditions that often do not meet regulatory requirements in the form of numerous unorganized landfills;

- Undeveloped waste management industry, resulting in a steady increase in their accumulation, as well as a low proportion of their use as secondary raw materials;

- Low level of environmental literacy of the population, a small number of public organizations and civil society institutions involved in solving problems of environmental safety at the level of the Russian Federation;

- Reduction of biological diversity in terrestrial and aquatic ecosystems, loss of gene pool of plant and animal communities;

- High energy and resource intensity of many sectors of the economy, causing a significant negative impact on the environment at all levels of technological chains;

- Outdated and environmentally inefficient technical and technological base in most sectors of the economy, depreciation of fixed assets;

- Low level of financing of the state programs of the Russian Federation, Federal target programs, the state programs of subjects of the Russian Federation, the branch and corporate programs directed on the solution of nature protection problems and an increase of the level of ecological safety;

To counter the threats to the environmental security of the Russian Federation, which are the result of global challenges, it is necessary to:

- To increase investment in the development and large-scale introduction of innovative and "green" technologies in all sectors of the Russian economy to the withdrawal of the national production and technological complex on the level of the best world standards;

- To increase funding for research and development centers and complexes that develop technologies and equipment for waste management, wastewater treatment and emissions of pollutants, elimination of past (accumulated) environmental damage, thereby expanding the opportunities to attract the industry that solves the problem in the field of environmental safety, the most qualified Russian and foreign specialists;

- To extend state support to companies and entities engaged in the solution of practical problems in the field of environmental safety, rational use of natural resources, renewable energy, conservation and development of resource potential, provision of environmental services, prevention of environment-related diseases, increasing the possibility of solving Russian problems in the field of environmental security by the most qualified Russian and foreign specialists;

5.2 Preparation of practical guides for the development of the “green economy” model in Russia

In this section of the study, we will present practical recommendations for the development of the "green economy" model in Russia.

According to expert estimates, the annual loss of Russia's GDP due to environmental degradation and related economic factors is 4-6% and taking into account the damage to human health – can reach 10-15% of GDP. Challenges and threats to environmental security of the Russian Federation in the long term can be divided into four groups:

- Challenges and threats posed by the General changes in the world economy;

- Global challenges and threats posed by climate change and transboundary impacts;

- Regional threats caused by economic and other activities of the States having common borders with the Russian Federation;

- Internal threats caused by the nature of economic and other activities on the territory of the Russian Federation both now and in the past.

To counter the threats to the environmental security of the Russian Federation caused by climate change, as well as dangerous natural processes and phenomena arising or occurring in remote areas (water areas) or in extraterrestrial space, and to adapt to them, it is necessary to:

- Carry out (including in cooperation with foreign national and international specialized structures and organizations) monitoring of processes and phenomena occurring in the environment as a result of climate change;

- Develop methods for assessing the effects of climate change;

- Develop programs of adaptation to climate change of branches of economy, production associations and the enterprises.

In order to counter the threats to environmental safety caused by the transboundary transfer of pollutants and man-made radionuclides to the territory of the country, it is necessary to take measures to compel neighboring countries, enterprises and production associations of which are the source of emissions and discharges of pollutants, to comply with the requirements of international treaties limiting these types of impacts.

To counter regional threats to environmental security arising from economic growth, it is necessary to implement the following solutions:

- To take measures to compel countries engaged in discharges of pollutants into transboundary watercourses and water bodies;

- To take measures to prevent the migration of harmful organisms, pathogens of various diseases of people or objects of wildlife to the territory of the Russian Federation, including through the strengthening of control and Supervisory services;

- To carry out monitoring in the adjacent territories, including within the framework of bilateral and multilateral cooperation, processes and phenomena related to the development and migration of harmful organisms, pathogens of various diseases of people or wildlife;

- Monitor fire danger in adjacent territories and take measures to prevent the spread of transborder fires in the territory of the Russian Federation.

It is essential to use in the field of environmental protection, international cooperation, and environmental safety, including in order to reduce environmental risks in the border territories of the Russian Federation.

5.2.1 National project “Ecology”:

This is a national project, which is designed for the period from October 1, 2018 to December 31, 2024. The project budget is 4,041.0 billion rubles, of which most are supposed to be financed from extrabudgetary sources (79.3%)[33].

The main objectives of the project include[34]:

- efficient management of production and consumption waste, including the elimination of all unauthorized landfills identified on January 1, 2018 within the boundaries of cities;

[33] 52nd Bulletin on current trends of the Russian economy // Ecology and economy: the dynamics of air pollution in the country ahead of the ratification of the Paris agreement // URL - http://ac.gov.ru/files/publication/a/23713.pdf
[34] Passport of the national project "Ecology" // URL - http://www.mnr.gov.ru/upload/medialibrary/5e7/ecology.pdf

- reduction of air pollution in large industrial centers;
- improving the quality of drinking water for the population;
- ecological improvement of water bodies, including the Volga River, as well as preservation of unique water systems, including Lake Baikal and Teletskoye;
- conservation of biological diversity, including through the creation of at least 24 new specially protected natural areas;
- ensuring the balance of forest retirement and reproduction in the ratio of 100% by 2024.

Types of industrial production	2016	2017	2018
Coal mining	3 377 939.9	3 874 534.2	4 816 499.8
Mining of metal ores	957 557.3	1 522 341.6	1 643 674.5
Extraction of other minerals	376 242.8	376 197.9	377 504.7
Manufacturing activity	549 325.3	274 816.8	243 767.8
Metallurgy	190 626.0	150 802.2	136 065.2

Table 4: Production and consumption waste generation[35]

(thousand tons)

Types of industrial production	2016	2017	2018
Coal mining	2 307 633.4	2 157 948.6	2 547 252.1
Mining of metal ores	480 025.4	780 710.2	944 605.1
Extraction of other minerals	94 837.3	79 901.2	90 234.0
Manufacturing activity	243 365.5	135 905.3	128 270.3
Metallurgy	99 165.1	74 046.0	72 953.2

Table 5: Utilization and neutralization of production and consumption wastes[36]

(thousand tons)

[35] Source: Federal state statistics service // URL - https://www.gks.ru
[36] Source: Federal state statistics service // URL - https://www.gks.ru

In 2018, the main volume of production and consumption waste generation was in the mining sector (94.3%), as well as manufacturing (3.4%). The total volume of waste in the same year increased by 16.8%, the mining sector increased by 18.4%, and the manufacturing sector, by contrast, decreased by 11.3%.

Table 4 shows that production and consumption of coal mining increased significantly in 2018. But table 5 shows that its utilization was not accompanied by the same sharp increase. A significant increase in the production and consumption waste generation of metallurgical ore mining was also accompanied by a significant increase in its utilization. Special attention should be paid to manufacturing activities and metallurgy, where it is possible to make utilization of their waste of production and consumption in half.

As of August 1, 2019, the budget of the national project (in terms of the federal budget) was implemented only by 13.6%.

The need for Russia to break the link between economic growth and consumption of natural resources is obvious but requires additional efforts. This is one of the key ways to reduce environmental pressures. To provide information to solve this problem, a system of accounting for material flows has appeared and developed in recent years. It introduces an indicator of the "material trace" of resource consumption, which reflects the number of materials needed to meet final demand (household and state consumption and capital investment) in a country and shows the true impact of individual economies on the scale of global material use. Unfortunately, Russia does not yet apply this system.

6 Conclusion

The model confirmed its main goal that there is a correlation between economic growth and environmental problems in Russia. Another main goal achieved was to provide a theoretical and practical basis for the environmental economy along with an overview of other environmental issues.

The development of mechanisms of "green" investments, "green" financing should be based on the economic principles of a strict consideration of environmental costs and on the purposeful achievement of a specific environmental result. Commitments on targeted green financial instruments should be based on responsibility for the environmental outcome.

The purposeful development of environmental principles in investment and financial policy requires the inclusion of assessments of environmental costs, first of all, the cost of greenhouse emissions in the evaluation of investment projects, in the criteria for assessing the results of project financing. It is necessary to develop a procedure for including the cost of environmental damage in the assessment of investment projects and in the criteria for assessing the results of financing development banks. For the latter, it is necessary to consider the possibility of introducing a requirement for a minimum share of green investments and.

It is necessary to create and ensure the effective functioning of environmental funds to finance projects of ecological and technological modernization and provide the transition to BAT (the best available technologies), targeted financing of environmental activities by restoring "earmarked" pollution fines by providing mechanisms for state and public control over the use of environmental funds.

It is also proposed to consider the possibility of allocating funds directed by companies to finance work on the conservation of biological diversity as part of the implementation of relevant corporate policies, to costs, and provide for the possibility of directing part of pollution charges from resource companies to environmental protection, biodiversity conservation, and climate projects these companies.

In recent years, it has been recognized worldwide that the effectiveness of an environmental policy based primarily on the administrative model of technical regulation has limits. While preserving and developing the positive potential accumulated by the Russian system of environmental protection and environmental management, it is necessary to use a wide range of economic mechanisms to a much greater extent, taking into account international experience gained in their use. Mechanisms such as the introduction of emissions trading of pollutants and greenhouse gases, the possibility of environmental taxes, fuel, and energy taxes or carbon taxes should be studied for their feasibility; taxes on the purchase of cars depending on their

environmental characteristics, transport tax, taxes for the use of transport and urban infrastructure. It is important to launch pilot projects, which, if successful, could be replicated after 2020. These may include such instruments as quotas for emissions of pollutants and greenhouse gases and the establishment of a quota trading system.

It is necessary to transform the tax system: maximum taxes should be levied on environmentally hazardous and polluting activities while minimizing the tax burden on the manufacturing, processing, high-tech and infrastructure sectors.

At the same time, the total amount of taxes does not increase due to the redistribution of the tax burden (fiscal neutrality). Thus, sustainable economic development of Russia is impossible without an effective environmental policy, which will be actively promoted not only by the state but also by business at various levels.

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