
Formation Tools of Low-Carbon Trajectory of Innovative Development of Russia

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Abstract:

The article presents the concept of “low-carbon economy”. Different views on the essence of “low-carbon economy” are considered. Low-carbon trajectory of the innovative development means energy efficiency and energy saving increase, maximum use of low-carbon energy (electrification, biofuel) by the end users.

Thus, low-carbon infrastructure with reduction of specific CO₂ emissions per unit of electricity generation and fuel consumption is created.

It is concluded that ecological innovations, “green” economy are the spheres where the possibilities for the further sustainable development are concentrated. Innovative development is to be accompanied with “green” technologies introduction in all spheres of economy. The “green” technologies objectives are identified. The conditions for institutional and infrastructure environment of the transition towards “green” economy are formed. It is concluded that “low-carbon economy” nowadays is an important component of a new economic model. Economic tools to form “low-carbon economy” are defined.

Keywords: *economy decarbonization, green economy drivers, innovative development, green economy institutions, low-carbon infrastructure.*

JEL classification codes: *Q40, Q50*

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1. Introduction

Natural ecosystems, whose main elements (atmosphere, soil, and water resources) are polluted, have experienced essential changes for the last decades. Crisis and anthropogenic load on the ecosystems have forced a lot of institutions and international organizations to research economic growth quality more actively and make them seek the innovative models to provide harmonious development of both a human being and nature.

One of such models, proposed by the UN is a concept of “green” growth involving qualitative changes in production and consumption, “green” innovations in business and infrastructure greening.

2. Theoretical, Informational, Empirical, and Methodological Grounds of the Research

The essence of “green” economy is connected with low-carbon compounds emissions and effective resources use. State and private investments, by reducing carbon emissions and pollution, energy and resources effective use increasing and preventing loss of biodiversity and ecosystem services, provide income and employment growth in “green” economy (Belik, 2008; Havlicek *et al.*, 2013).

The most known foreign scientist, the supporters of “green” economy D. Corten, B. Faller, H. Daly, D. Meadows, J. Jacobs, R. Carson, E. F. Schumacher, R. Costantz, P. Houken define “green” economy as an economy which is a dependent component of the natural environment where it exists and is a part of global ecosystem. The term “green” economy and its derivatives have become crucial in the determining guidelines of the sustainable development in the OECD and the UN papers since 2009 (Declaration on Green Growth. OECD, 25 June 2009).

To implement low-carbon development a number of interconnected problems are to be solved: to increase energy efficiency, to use renewable types of energy, to protection and to increase quality of greenhouse gases absorbers, to reduce or to limit emission, to develop the technologies for greenhouse gases absorption, to refuse from subsidies and other methods encouraging ecologically destructive activity.

The production structure and energy consumption with present absolute carbon domination (Figure 1) will change in favor of renewable energy resources in the energy consumption structure (Figure 2) in accordance with most probable scenario of human civilization development (Declaration on Green Growth, OECD, 2009; Pociovalisteanu *et al.*, 2010; Tcvetkov *et al.*, 2015; Medvedeva *et al.*, 2015).

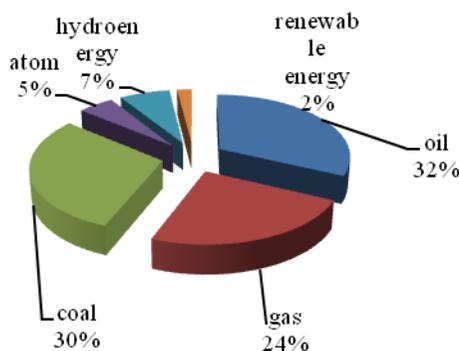


Figure 1. Energy consumption Structure, 2012

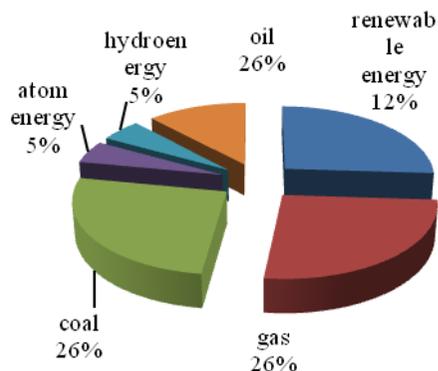


Figure 2. Energy consumption Structure, 2035.

According to the UN FCCC Secretariat Russia's share of greenhouse gas emissions of the developed countries is 4%, in terms of greenhouse gas emissions Russia ranks the fifth after China, the USA, India and the EU, and formally Russia is one the most successful countries in terms of greenhouse gas emission reduction (United Nations Development Program, 2011). However this position is rather an external indicator than evidence of actual low-carbon economy development.

This situation is due to the fact that the country having good possibilities of greenhouse gas absorption, big fossil fuel stock, traditional technologies electric and heat power engineering has not considered the opportunity of greenhouse gas emissions reduction as a priority one.

Russia's potential to use renewable fuel resources and energy sources (geothermal, solar, wind, oceanic, biomass energy, etc.) is about 4,6 bln toe a year, that is five times more than Russia's current volume of fuel and energy resources consumption (Belik, 2008).

The share of energy resources generated with renewable energy sources in total volume of energy production (%) is presented in Table 1. It is possible to mention that their share is not big yet, it tends to increase.

Table 1. The share of energy resources produced with renewable energy sources in total volume of energy production (%)

Russian Federation Subject	years			
	2012	2013	2014	2015
Russian Federation	15,3	17,1	16,4	15,8
Central Federal District	0,8	0,8	0,4	0,3
North- West Federal District	11,9	10,9	10,2	11,2

Southern Federal District	22,5	23,0	20,4	18,4
North-Caucasian Federal District	27,1	35,4	26,3	26,3
Volga Federal District	13,8	14,9	14,4	15,1
Ural Federal District	0,01	0,01	0,01	0,02
Siberian Federal District	40,3	46,7	46,2	43,7
Far East Federal District	34,8	37,7	35,5	30,5
Crimean Federal District	-	-	18,8	28,5

The share of electricity generation by generating facilities operating on the basis of renewable energy sources in the total volume of electricity production (excluding hydroelectric power plants with an installed capacity of over 25 MW) (%) is reflected in Table 2. As we can see, the largest resources in all Federal Districts, except the Crimean Federal District, generate energy with traditional sources.

Table 2. *The share of electricity generation by generating facilities operating on the basis of renewable energy sources in the total volume of electricity production (%)*

Russian Federation Subject	Годы		
	2013	2014	2015
Russian Federation	0,12	0,14	0,19
Central Federal District	0,02	0,02	0,01
North-West Federal District	0,29	0,15	0,32
Southern Federal District	0,07	0,34	0,33
North-Caucasian Federal District	1,47	1,06	1,71
Volga Federal District	0,02	0,02	0,02
Ural Federal District	0,01	0,01	0,02
Siberian Federal District	-	0,01	0,01
Far East Federal District	0,90	0,92	0,93
Crimean Federal District	-	18,84	28,52

Table 3 shows that 13.0 tons of fuel and energy resources are on average consumed per worker engaged the country's economy. Such types of economic activities as mining, gas and water production and distribution, processing industry consume the most.

Table 3. *Consumed fuel and energy resources per worker engaged the country's economy according the types of economic activity (toe)*

Types of economic activity	years		
	2012	2013	2014
Total in the national economy	13,0	12,8	13,1
On types of economic activity:			
Agriculture, hunting and forestry	2,9	2,4	2,8
Fishery, fish farming	8,3	7,9	7,7

Mining	62,9	63,9	72,8
Processing industries	29,0	28,9	28,7
Production and distribution of electricity, gas and water	30,1	28,9	30,5
Building	2,2	2,3	2,3
Transport and communication	21,0	20,5	20,1
Other activities	8,8	8,5	8,7

The indicator value in the Russian Federation is less than the indicator value according to the types of economic activity due to changes of proportion of volume of fuel and energy final consumption (tons of oil equivalents) and the number of employed.

3. Results

Due to the fact that Russia as the most of the least developed countries has hidden concerns about potential impact of “green” economy strategies on its own economic prospective, on the possibility for all countries to access the technologies and needed investments, etc, explains sluggishness in the low carbon development.

Figure 3. The share of high-tech and knowledge-intensive industries in the gross domestic product

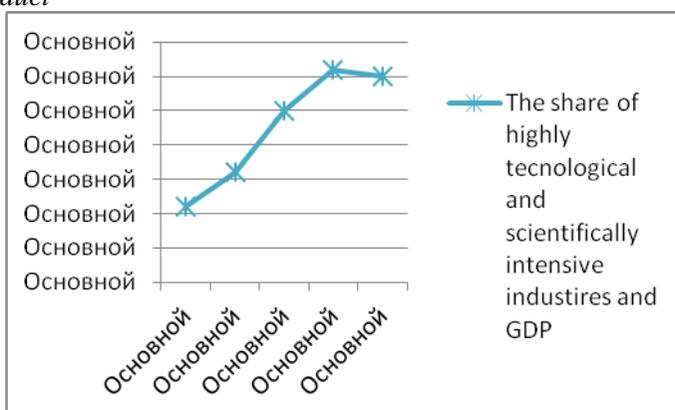


Figure 3 shows, that these concerns are not valid and the share of high-tech and knowledge-intensive industries in the GDP has insignificant tendency to grow. The BRICS countries believe that transition to “green” economy must mean change of consumption and production models and first of all in industrially developed countries.

Besides it is necessary to discuss the issues of the global standards and certification systems, connected with transition to “green” economy, “green” protectionism and market access restriction. However, according to the common opinion, there is no an

alternative scenario of the world development. At present a wide range of tools to transit to “green” economy is available:

- pricing, according to principles of sustainable development, including refuse from inefficient subsidies, natural resources financial assessment and introduction of pollution taxes;
- public procurement policy, that encourages environmentally friendly production and use of environmentally friendly production methods;
- reforms of “ecological” taxation , that means to focus on pollution taxes rather than labor force tax;
- growth of public investments into ecological infrastructure (public transportation, renewable energy sources, construction energy efficient buildings) and natural capital to reconstruct, support, and where it is possible, to increase natural capital volume;
- targeted public support of researches and development aimed at development of ecologically friendly technologies;
- social strategies to ensure harmonization between of social objectives and existing or proposed economic strategies.

China, Taiwan, South Korea, Japan, India, Brazil, Argentina, Canada, USA, the European Union countries, Australia, New Zealand, Iceland, South Africa, Bangladesh, Malaysia, Thailand, Uzbekistan, Belarus and Kazakhstan are among those countries that have started the “green” industries development.

Law and regulatory framework, transition indicators, incentives system, educational programs, new technologies and other tools to transit to “green” economy are being developed in these countries (Center for Energy Efficiency, 2014; Piskulova, 2016; Stroeva *et al.*, 2015; Epifanova *et al.*, 2015).

The analysis of barriers as well as world experience allowed the authors to formulate the following tool groups to transit to low-carbon economy: administrative, economic and information.

1. Administrative tools are to set certain rules control over their compliance, penalties. According to the authors the technological rationing, based on the best available technologies, introduction of the improved company ecological management system, are prospective and effective tools in Russia as well.

2. The economic tools are to internalize external effects connected with negative impacts on the environment (payments for resource use, pollution taxes). Given other countries’ experience public financing as well as R&D financing in the given sphere, play an important role in new environmentally friendly technologies promotion. The authors consider that creation of the market of environmental pollution quotas trade is a prospective market mechanism to transit to “green”

economy. Together with eco taxes this market mechanism is to internalize costs due to pollution and include them in goods and services price.

The crucial difference is that using taxes the government sets the pollution unit cost and allows the market to regulate the pollution volume, if we speak about environmental pollution quotas trade, the government sets the limit on emission volume, and market in its turn sets prices. The advantage of the given tool is the government can reach targeted values on the emission reduction as well as the possibility to unite environmental pollution quotas trade markets of different countries. In the frame of environmental pollution quotas trade system the enterprises, sources of pollution, are informed about the individual emission norms, called permission for emissions (discharges, waste allocation). Emission norms observance by the enterprisers-polluters is to provide environmental quality corresponding to regional standards.

The enterprises are entitled to exchange (sell and buy) pollution rights within observance of regional ecological standards. Due to this exchange Pollution rights get market price. Market mechanism use allows concentrating pollution rights in those companies that possess the most effective environmental technologies, and thus save significantly ecological costs to reach the needed level of environment quality.

3. Information tools influence on other tools and can significantly simplify their successful application as well as form individual behavior of both those making decisions and those consuming goods and services.

4. Results

International regulation, state regulation, regional and municipal regulation, public regulation, corporate regulation is the regulating elements of low-carbon development of innovative economy. These elements can influence the organizational structures, such as big corporations, small and medium business, and non-profit organizations through available mechanisms.

Different international agreements; work out of development strategies and regulatory basis; creation of institutional environment of “green” economy; development of tax and market tools of regulation; investments in “green” technologies, forming of resource consumption culture we consider as the impact mechanisms

Technological innovations inspire institutional, organizational and economic, legal changes. Functioning of institutions is crucial for innovations performance. The development of these or those institutions has a great impact on technology, production process, use of breaking through technologies. Innovations often are developing faster than institutions, which deters their development.

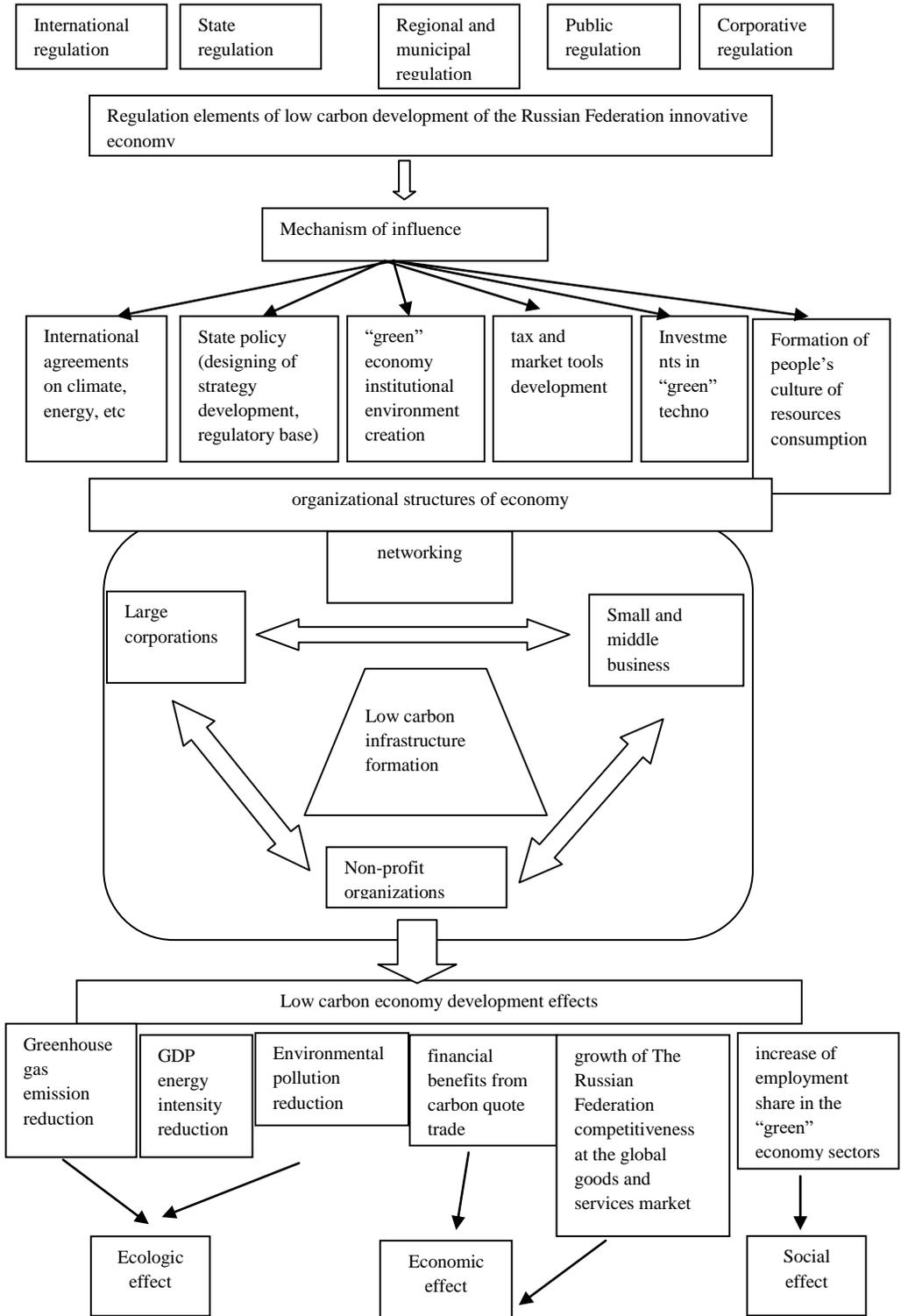
Business should be ecologically neutral. Only in this case business can compete at the global market. Industries doing irreparable harm for the environment cannot be supported at global level of goods and services (UNEP Green Economy Review, 2011).

Low-carbon infrastructure of innovative economy comprises: energy system with low greenhouse gases emission level (energy generating with renewable energy resources), energy efficiency and energy consumption management (“smart” nets), city and transport systems with low greenhouse gases emission level (transportation means with zero/low emissions, multimodal systems of public transport, town planning, the third-generation bio fuel), “clean” production of household, commercial and industrial equipment / machinery and manufactured goods (e.g. refrigerators and air-conditioners), the waste reduction and waste separation, 3R concept (waste reduction, recycling), utilization and waste neutralization, collection and utilization of products containing ozone destructing substances, peat lands remediation, rangeland management, afforestation, management of forests, coastal ecosystems (carbon stocks in water systems), etc. Low-carbon economy development effects:

- GDP energy intensity reduction;
- increase of employment share in the “green” economy sectors;
- greenhouse gas emission reduction;
- financial benefits from carbon quote trade;
- growth of The Russian Federation competitiveness at the global goods and services market;
- environmental pollution reduction.

Figure 4 presents the scheme of low-carbon trajectory of innovative development of Russia.

Figure 4. *Scheme of low carbon trajectory of innovative development of Russia*



4. Conclusions and recommendations

Nowadays there are certain barriers that prevent from transitioning to low-carbon economy.

They exist mainly due to the traditional economy stimulates intended to energy intensive resources consuming industries together with low level of state regulation of “green” technologies development, with low level of business and consumers awareness about danger of further environment degradation as well as about the benefits from “green” technologies applications. Among the barriers preventing from transitioning to low-carbon economy the authors put the following:

- low price on natural resources and energy produced from traditional sources;
- high costs of “green” technologies introduction and large payback period;
- established business models focused on traditional technologies application;
- variety of subjects involved in transition to low carbon development which causes difficulties while seeking for the decisions suitable for all;
- investors, companies and end users are short of information on existing effective “green” technologies and benefits from their introduction in the long-run, etc.;
- companies and consumers’ lack of awareness on harm on the environment in general and human health in particular, caused by traditional energy sources.

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