POLICY TRANSITION TO LOW-CARBON ECONOMY IN RUSSIA:

STATE SUPPORT MEASURES

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Abstract
Transition to a low-carbon ("green") economy is a strategic priority for Russia's long-term and balanced socio-economic development in the context of the ongoing globalization of the world economy and the current state of the environment. Russia's economy is notoriously resource-oriented with the dominant influence of the fuel and energy complex, so this fact impedes a low-carbon transformation. Currently, Russia is in a transitional stage, which allows to create favorable conditions for the future high-tech and environmentally safe development of the country's economy. Despite a number of challenges that have had a definite impact on the sustainability of the Russian economy, low-carbon development remains one of the focus areas of state policy, included in most of the targeted federal-level documents. The authors of the study are analyzing a set of state support and policy measures for the development of a green economy, in particular microgeneration and energy saving. The study contributes to the literature by proposing a new approach of complex evaluation of efficiency of different stimuli and supporting policies, which are introduced both independently and jointly.

Key words: Public-private partnerships, low carbon economy, green economy, policy, new technologies.

JEL Code: H540, H500, L520.

Introduction

In recent years, Russia has created and tested mechanisms to stimulate the development of a low carbon economy, but primarily for the purpose of support system is not the decarbonisation of the economy but the modernization of the production base and the introduction of innovative technologies in the energy sector, industry and housing. Improving the energy efficiency of the Russian economy is one of the key problems, and the country's competitiveness in the global market depends on improvement of energy efficiency. At present, Russia is inferior to almost all leading developed countries in terms of energy efficiency. The energy intensity of the Russian

Federation exceeds the level of EU energy consumption by 2 times, the USA - by 1.5, and China - by 1.1 times.

Modern trends in increasing the efficiency of energy enterprises set the main goal - The creation of an innovative and efficient energy sector of the country for sustainable economic growth, improving the quality of life of the population and helping to strengthen its foreign economic positions (Balashova 2016; Berezin, Gomonov, Balashova, & Matyushok, 2017). Energy efficient solutions in energy-intensive sectors such as Oil&Gas, cement, glass and iron&steel production are required in order to tackle CO2 emissions and meet the growing energy demand (Berezin, Campana, & Rossetti, 2016). Falling cost of technology, rising rates for grid services, and concerted policy efforts to reduce global greenhouse gas emissions are primarily driving this shift from the traditional centralized grid structure to one with perhaps a larger role for microgrids (Hanna, Ghonima, Kleissl, Tynan, & Victor, 2017).

Budget financing of various incentive measures to improve energy efficiency over the past 5 years (starting from 2013) has been carried out within the framework of the Russian State Program Federation "Energy Efficiency and Energy Development" (Tab. 1). Since the beginning of this program, about 75 billion rubles have been financed in all areas of energy development, and in the next two years, another 21.5 billion rubles will be spent. Moreover, despite the crisis of 2014-2017 for the Russian economy, the state funding of the Program is carried out almost in full. The scale of budget allocation is moderate, and government incentive should be combined with private investments and innovative forms of financing such as energy service contracts (Berezin, Sergi, & Gorodnova, 2018). For energy service industry, the strategy of energy conservation and energy efficiency is an important component of government regulation that supports the social and economic development in many countries (Gorodnova, Chernov, Shablova, Rossetti, & Berezin, 2016).

Tab. 1 - Structure of the State Program of the Russian Federation "Energy Efficiency and Energy Development" in the period 2013-2020.

Subprograms	Financing, thousand rubles
Energy conservation and energy efficiency	19 527 582.9
Development and modernization of electric power	28,037 861.1
Development of the oil industry	1 300 000
Development of the gas industry	0
Restructuring and development of coal and peat industry	27,651 432.2
Development of renewable energy sources	156 794,8

Implementation of the state program of the Russian Federation "energy efficiency and energy development"	19 708 744.7

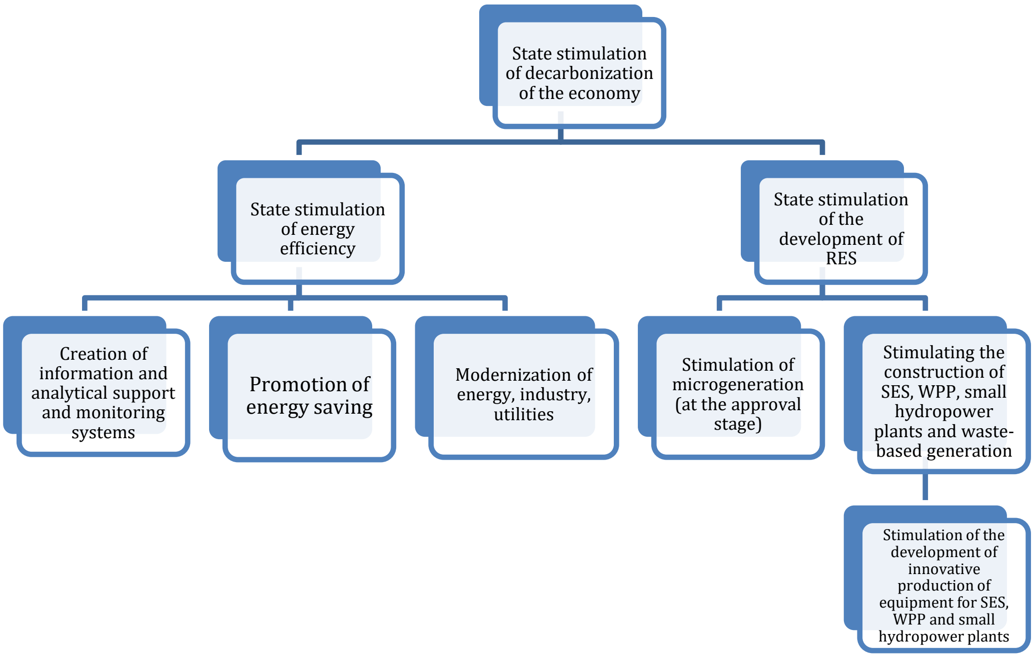
Source: State Program of the Russian Federation "Energy Efficiency and Energy Development" in the period 2013-2020

The purpose of this paper is to analyze and assess the effectiveness of policies to decarbonize Russia's economy in the framework of this national program. Moreover, unlike most works of Russian economists, evaluating the effectiveness of public policy only in terms of the degree of achievement of the stated goals (Vitliemov, Kolev, Marinov 2019; Valuev, Lozinskaya 2018; Klimenko, Klimenko, Tereshin, Mitrova 2019), we use an approach based on estimating the cost of avoided CO2 emissions (Thapar, Sharma, Verma 2016; McKinsey & Company 2009). In addition, when calculating GHG reduction volumes, we consider them throughout the entire life cycle of electricity production in accordance with ISO 14040-14043 standards.

1. Analysis of the effectiveness of the current policy in the field of decarbonization of the economy

All the low-carbon economy support mechanisms currently operating in Russia can be divided into two large groups - measures to support energy efficiency and energy saving and measures to stimulate the development of renewable energy (Fig. 1).

Fig. 1 State system of support for decarbonization of the economy under the program "Energy Efficiency and Energy Development"



Source: Authors analysis

A review of the regulatory legal acts constituting the framework of the energy efficiency management system is given in Tab. 2, in the system for managing the development of renewable energy sources - in Tab. 3

Tab. 2 - Overview of the regulatory acts governing the support of measures to improve energy and environmental efficiency

Regulatory act	Brief explanation
Presidential Decree No. 889 of 4 June 2008 “On some measures to improve the energy and environmental efficiency of the Russian economy”	The goal has been defined - to reduce by 2020 the energy intensity of GDP by at least 40% from the 2007 level.
Federal Law No. 261-ФЗ of November 23, 2009 “On Energy Saving and Improving Energy Efficiency and Making and Changes in Selected Legislative Acts of the Russian Federation ”	Creation of legal, economic and organizational bases for stimulating energy saving and increasing energy efficiency.
The state program "Energy Saving and Energy Efficiency Improvement for the Period until 2020".	Key goal of the Program is to reduce energy intensity
Decree of the Government of the Russian Federation of January 25, 2011 No. 18 “On Approval of the Rules for Establishing Energy Efficiency Requirements for Buildings, Buildings, Structures and Requirements for the Rules for Determining the Energy Efficiency Class of Multi-Dwelling Houses”	Mandatory use of energy efficient lighting and ITP with automatic weather regulation since 1 January 2018 during the construction, reconstruction and overhaul for a number of types of buildings, structures, structures.
Resolution of the Government of the Russian Federation of June 17, 2015 No. 600 "On approving the list of objects and technologies that relate to objects and technologies of high energy efficiency"	Approved the list of facilities and technologies that relate to objects and technologies of high energy efficiency. In accordance with the list of available benefits under the tax laws. Realized promotional activities implementation of best available technologies in the industry production of building materials.

Tab. 3 - Overview of legal acts, regulating RES support

Regulatory act	Brief Explanation
Federal Law "On Electric Power Industry" dated 26.03.2003 N 35-FZ of	the Basic Law, defining the key concepts and fundamentals of electric power industry in Russia.
Russian Federation Government Resolution dated December 27, 2010 № 1172 "On approval of the market rules of electricity and capacity, and on amendments to some acts of	Establishes the legal framework functioning of the wholesale market electrical energy and power

the Russian Federation on the issues of functioning of the electric energy and power wholesale market	
Russian Federation Government Resolution dated May 28, 2013 N 449 "On the mechanism of promoting the use of renewable energies in the wholesale electricity market and power"	To approve rules for determining prices for power generating facilities operating on the basis of renewable energy sources. In the original edition only SES, WPP and small hydropower plants are considered. The editorial board dated September 27, 2018 takes into account power plants operating on the basis of the use of production and consumption waste.
Order of the Government of the Russian Federation of January 8, 2009 No. 1-p "On the main directions of the state policy in the field of increasing the energy efficiency of the electric power industry based on the use of renewable energy sources for the period up to 2024"	Approves the main directions of the state policy in the field of increasing the energy efficiency of the electric power industry containing target indicators the volume of production and consumption of electrical energy using renewable energy sources or peat in the total balance production and consumption of electrical energy. Thus, in accordance with the order until 2024, Russia plans to increase the installed capacity of RES power plants to 5.5 GW: 3.3 GW of wind power, 1.76 GW of solar, 425.4 MW of small hydropower plants (up to 25 MW).
Government Decree of 03.06.2008 N 426 "On the Qualification of a Generating Facility Functioning on the Basis of Using Renewable Energy Sources"	Establishes the rules, criteria and procedure for qualifying a generating facility operating on the basis of using renewable energy sources or peat, as corresponding to the targets set in accordance with the main directions of the state policy in the field of increasing the energy efficiency of the power industry. The generating facilities operating on the basis of the use of renewable energy sources or peat include objects that carry out combined generation of electric and thermal energy, in case these objects use renewable energy sources or peat to generate electric and thermal energy.
Government Decree of 20.10.2010 N 850 "On approval of criteria for the provision of subsidies from the federal budget in order to compensate for the cost of technological connection of generating facilities with an installed generating capacity of not more than 25 MW, recognized as qualified facilities operating on the basis of using renewable energy sources, that these objects belong to the ownership or on other legal grounds,	Approves criteria for federal budget subsidies approval for technological connection cost compensation of generating facilities with installed generating capacity under 25 MW recognized as qualified generating based facilities use of renewable sources energy or peat, to those who are objects are owned or any other legal basis.

Decree of the Government of the Russian Federation of January 23, 2015 No. 47 “On Amendments to Certain Acts of the Government of the Russian Federation on the Promotion of the Use of Renewable Energy Sources on Retail Electricity Markets”	Fixes measures to support the construction of renewable energy facilities for work in the retail energy market.
Decree of the Government of the Russian Federation of October 17, 2009 N 823 “On schemes and programs for the perspective development of the electric power industry”	Fixes the principles and procedure for including renewable energy facilities in the schemes for the perspective development of the electric power industry.
Order of the FAS of Russia of September 30, 2015 N 900/15 “On approval of the Methodological Guidelines on the establishment of prices (tariffs) and / or marginal (minimum and (or) maximum) levels of prices (tariffs) for electrical energy (power) produced on operating on the basis of renewable energy generating facilities and skilled acquired in order to compensate for losses in electrical networks	"Approve order price calculation (rates) for electric energy (power) generated based on operations of renewable energy sources or peat qualified generating facilities and acquired in order to compensate for losses in electric networks.
Resolution of the Government of the Russian Federation of September 23, 2016 No. 961	Established the **procedure and conditions for the provision** of subsidies from the federal budget in order to compensate for the cost of technological connection of generating facilities based on renewable energy sources.

Evaluation of the effectiveness of incentive policies in the field of energy efficiency and in the development of renewable energy within the framework of the State Program is carried out only by the criterion of whether the planned indicators have been achieved, for example, to reduce the energy intensity of GDP or the selection of renewable energy projects. Obviously, such an approach is rather formal and does not provide reliable information about how well-designed support measures are implemented in practice.

As an alternative to this current approach, we attempted to assess the positions achieved in the period 2013-2018 in the field of energy efficiency and renewable energy development based on the ratio of budget expenditures to CO2 emission reductions achieved due to the practical implementation of the funded package of measures. The easiest way was to apply this approach to assessing the development of renewable energy, since data on the growth of electricity generation based on renewable energy and budget expenditures to support the development of renewable energy are available and easily interpretable (Table 1, line 6). NP Market Council estimated volumes of renewable power generation 25461 MWh in 2014, 103566 MWh in 2015, 191266 MWh in 2016, 269690 MWh in 2017, 497944 MWh in 2018.

Estimates of GHG emissions over the full life cycle, reduced to 1 kWh of electricity from traditional methods of generation and photovoltaics, obtained from the EcoInvent database are given in Tab. 4. Photovoltaics was chosen from a number of other renewable energy technologies, as the most dynamically developing renewable energy sector in Russia. As the traditional method, we consider the most energy efficient of modern technologies for generating electricity based on hydrocarbons — a combined cycle power plant (CCPP*)*.

Tab. 4- GHG emissions for the full life cycle for various technologies for generating electricity (data for Russia)

Technology	Referent product	GHG-emissions in CO_2-eq.
CCPP	1 kWh	1.54
PV	1 kWt	0.09
Natural gas production	1 m^3	0.2
Coal production	1 kg	0.32

Source: compiled by authors based on EcoInvent data

So, the calculation of avoided GHG emissions due to state support of renewable energy will be carried out according to the following formula:

$$GHG=(RenProduced(2018)-RenProduced(2014))*(GHG_{ccpp}-GHG_{PV}) \quad (1)$$

where

RenProduced(2018) - the amount of renewable energy (solar) produced in 2018, MWh;

RenProduced(2014) - the amount of renewable energy (solar) produced in 2014 (the start of the renewable energy support program), MWh;

GHG_{ccpp} - GHG emissions throughout life cycle from traditional generation (EcoInvent estimate, CO2-eq);

GHG_{PV} - GHG emissions over the entire photovoltaic life cycle (the average value of EcoInvent estimates in various ways installations of the PV-panel according to (Ratner, Lychev, 2019)).

To calculate the cost of avoided GHG, we need to divide the amount spent on the development of RES by the amount of avoided GHG.

The calculation of the cost of emissions reduction achieved through improvement in the energy efficiency of the power industry was carried out under the following assumptions: According to State report on the state of energy conservation and energy efficiency in the Russian Federation in 2017 done by Ministry of Economic Development of the Russian Federation, the total volume of electricity generation in 2017 by thermal power plants was 622.4 billion kWh, while the reduction in specific fuel consumption was 23 compared to the base year 2012 , 2 g per

1 kWh. Thus, in 2017 alone, 14.43 million tons of fuel were saved, of which about 2/3 is natural gas, and 1/3 is coal. For simplicity, we assume that out of 14.43 million tons of fuel, 10 million tons were natural gas, and the rest is coal. Using estimates of emissions from natural gas combustion as 1.26 tons of CO2-eq. and coal as 2.5 tons of CO2-eq. We get the desired CO2 emissions reductions at the electricity generation stage:

10,000,000 (tons of natural gas) * 1.26 (tons of CO2) +4,430,000 (tons of coal) * (2.5 tons of CO2) = 23 675,000 tons.

In order to estimate GHG emissions at the earlier stages of the life cycle, namely at the stage of production of natural gas and coal, we again use the EcoInvent data (Tab. 4).

The total amount avoided GHG due to the increase in energy efficiency was:

$$GHG = GHG_{burn} + GHG_{coal\_prod} + GHG_{gas\_prod} \qquad (2)$$

where

GHG_{burn} is the volume of GHG reduction due to fuel economy during combustion (23675000 tons);

GHG_{coal_prod} - the volume of GHG reduction due to savings in coal production over the full life cycle (1417600 tons);

GHG_{gas_prod} - the volume of GHG reduction by saving natural gas production throughout the entire life cycle (2380952 tons).

All the above-described preliminary data allow us to obtain the following estimates of the cost of reducing GHG emissions: the cost of reducing emissions through the implementation of the renewable energy incentive program is 228 rubles or $ 3.6 per ton, the cost of reduction due to the implementation of the program of modernization of the power industry is 717 rubles or $ 11.33 per ton. Compared to the average global estimates of the cost of reducing GHG emissions, for example, in sources (McKinsey & Company, 2009), these values are much lower.

Conclusion

Thus, despite the fact that the overall reduction in energy intensity of the Russian economy is still far from the goals, the individual directions of state support systems for energy efficiency and development of renewable energy sources can be considered effective and comparable with the best world practices. The most effective measure can be considered a policy in the field of renewable energy. To achieve more significant results in the field of renewable energy development, it is necessary to simulate the development of microgeneration based on renewable energy sources, which is included in the state support scheme only in perspective. Historically, high capital costs have been a major impediment to PV adoption (Burger & Luke, 2017).

In Russia, the current legislation regulates the process of connecting to the networks of only major producers based on renewable energy sources (with a capacity of at least 5 MW) and so far does not mention small ones at all, which greatly hinders the growth in demand for such solutions and limits the development of relevant areas of Russian industry (Valuev, Lozinskaya 2018). At the same time, consumers (for the most part these are industrial enterprises and farms) consider their own generation, falling under the criteria of small and distributed, as an effective way to reduce costs and solve problems with connecting to power grids (Ratner, Nizhegorodtsev, 2018).

To eliminate these gaps in the regulatory space, on behalf of the Deputy Chairman of the Government of the Russian Federation, in February 2017, work began on preparing a plan to stimulate the development of micro-generation based on renewable energy sources (RES) installed at energy consumers, including individuals. The specialists of the Ministry of Energy on the basis of attracting a wide range of experts and representatives of interested parties developed a draft federal law "On Amendments to the Federal Law" On Electric Power Industry "regarding microgeneration development", which was approved at a government meeting on October 31, 2018, and on February 6, 2019 was unanimously adopted by the State Duma of the Russian Federation.

The draft law provides for the sale by owners of microgeneration facilities of electric power generated using them in retail markets to guaranteed suppliers and energy sales organizations, which is in line with world practice of encouraging microgeneration based on renewable energy sources. At the same time, the generation of electricity based on renewable energy for such owners is not considered an entrepreneurial activity and, as a result, the potential income from the sale of electricity to the grid is not taxable. The adoption of such measures will accelerate the development of renewable energy and intensify the decarbonization processes in the Russian economy.

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