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**Institutional and economic mechanisms for the balanced development
of renewable and non-renewable energy**

Specialization 5.2.3 – Regional and Industrial Economics

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THESIS BRIEF

For the Doctor of Economic Science Degree

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Core results of the thesis by Alexander Buchnev
Institutional and economic mechanisms for the balanced development
of renewable and non-renewable energy

The Doctor of Economic Science thesis (Specialisation 5.2.3 – Regional and Industrial Economics) by Alexander Buchnev is an integrated study of the urgent issue of setting up some mechanisms for the balanced development of renewable and non-renewable energy creating conditions for positive socio-economic effects at different levels of the economic hierarchy.

Urgency of the research follows from the importance of sustainable development of the world economy. The possibility of its accelerated recovery after various crisis shocks are significantly interconnected with the use of the advantages of clean renewable energy, confidently supplementing and replacing non-renewable energy that uses non-renewable resources. Thanks to the institutional foundations laid in the last quarter of the last century in response to urgent energy-economic and, subsequently, environmental challenges, renewable energy resources (RES) has become a center of innovation and a promising energy market that has proven resilient both during the 2008 global financial crisis and in the current turbulence. Even in spite of the well-known difficulties associated primarily with constant energy production, there is undiminished investor interest, especially in light of the growing popularity of non-financial criteria for evaluating investments in recent years.

The vast majority of modern states have implemented the principles of RES development in their national strategies, more than half of which have set the goal of building a carbon-neutral economy. Annual total investments at the level of over a quarter of a trillion dollars, regardless of the political and economic situation, have not only proved the profitability of the industry of the future, but also turned it into a unique humanistic tool to combat poverty, and above all - energy poverty as a deterrent to economic development.

In fact, the acronym RES has gone beyond the term associated exclusively with the relevant energy sector and has become the core of the culture of responsible energy use in general. The rapid growth of installed capacities of wind and solar generation, along with the demand for other renewable energy solutions, has put additional requirements for technologies of redistribution and storage of energy, means of dispatching in the context of decentralized energy systems, which was a factor in the involvement of related industries in a single innovation process and their adaptation to use mainly renewable energy as a reliable and affordable energy resource, providing a positive impact of renewable energy on the triad of sustainable development: economy, social sphere and ecology, which allows us to talk about this phenomenon as a factor in creating a new paradigm of energy and economy of the future.

"All types of alternative energy must be supported and developed. <...> it is necessary to work on hydrogen energy, solar energy, the use of tidal and wind energy," the President of the Russian Federation V.V. Putin in 2015.

At the same time, the use of renewable energy resources is still not possible without the availability of conventional energy capacity, which, in turn, is the result of years of improvement, including environmental requirements of our time. For most of the leading countries in the field of RES promotion, the use of fossil energy resources seems to be forced and temporary choice, but even in the long-term goal we cannot expect that the relevant energy sector will lose its importance, not to mention nuclear power, which occupies a special place on a par with RES.

Nevertheless, modern economies have achieved significant results in the decarbonization paradigm. If three decades ago the world community considered reaching the threshold of 10 percent of electricity production by means of renewable energy of the total share as an excellent result, today the main task is considered to be building a low-carbon and then carbon-neutral economy. The current thirty-year target is 10 times greater than in the previous similar time period.

Carbon neutrality in this case is not the ultimate goal of transforming the global economy, as it reflects largely a short-term goal of exceeding the ability to

absorb carbon dioxide equivalent over its emissions. In fact, these are two multidirectional processes whose indicators require maximizing the negative balance under the major supranational agreements of the present to reduce the negative impact of human economic activity on the global climate. In this regard, the most likely future benchmarks for sustainable development will be the construction of a carbon-negative economy and a further reduction of this indicator.

It is worth noting that the active introduction of RES provides primarily those states that depend on imports of both primary and secondary energy sources, as on a par with the growth of energy security it is the most important savings of financial resources at the macro level. At the same time, the favorable economic effect of diversification of energy resources used due to RES in the case of weak or no dependence on energy imports also takes place and is a factor of regional alignment (relevant for Russia), as well as the acquisition of appropriate competencies to expand export potential.

The latter is especially important in the light of the goals of systematic reduction of the carbon footprint of modern industries, minimizing environmental damage and, as a consequence, the processes of compression of the world market of traditional fossil resources and the growth of costs in the sale of obsolete products. Given that the countries-leaders of decarbonization of the economy began this process with a noticeable temporary advantage, the traditional countries-exporters of energy raw materials seem to need not only to set benchmarks for achieving carbon neutrality, but also to ensure accelerated integration of this concept at all levels of government regulation.

A reliable assessment of the feasibility of the tasks set by the world community, the study of the current results, the study of country strategies of leaders in the use of renewable energy, their direct impact on the national fuel and energy balances and changing environmental conditions and the formation of innovative adjacent industries will allow to develop methodological recommendations to adapt world experience in domestic conditions, which is especially important due to the systemic failure to achieve the targets in the sector in

Despite a number of policy documents defining the concept of low-carbon development, as well as the direct determination of RES development as one of the strategic priorities of the Russian Federation, the positioning of this energy sector does not take into account all the possibilities of positive impact on the economy and society, which limits the importance of RES at the federal level by a combination of mainly energy and environmental factors.

Against the background of the unconditional dominance of non-renewable energy resources, it seems necessary to specify the expected socio-economic results to justify the feasibility of full-scale stimulation of the domestic renewable energy sector and, as a consequence, the balanced development of renewable and non-renewable energy. The main objectives of state policy are the overall growth of welfare of the population and macroeconomic effects as a result of loading inter-sectoral links in the localization of production equipment, accumulation and redistribution of renewable energy.

Due to the widespread need for energy resources, intensifying the development and implementation of renewable energy technologies will create an innovative industrial cluster, which could become an endogenous factor of economic development with an extremely wide range of applications. With regard to innovation, it is important to note that technologies based on RES are largely ahead of solutions for traditional energy sources because the concept of their use initially implies functioning in complex decentralized systems, which corresponds to the emerging technological paradigm as a whole. It is also quite important that, along with the opportunities for social leveling due to energy production at the micro- and mesolevels, the benefits of integration with the global RES market takes the secondary importance and can be seen as an additional (but not mandatory) factor in the need for active development of RES.

The presence of a more explicit structure of interaction between government agencies and consistent measures to achieve the integrated objectives of renewable energy development also seems important, as it will form additional benchmarks for

long-term and sustainable development of the domestic economy, regardless of global trends.

For the Russian Federation, as a country of enormous reserves of energy resources and competences in the field of traditional fuel and energy complex, it seems particularly important to find its own national way, combining its own and global experience to achieve the best synergistic effect in the context of the global energy transformation.

Object of the research is socio-economic development of regional economies in the process of transforming the ratio of renewable and non-renewable energy sources as key components of the energy sector.

Subject of the research is institutional and economic mechanisms of the innovative influence of RES on modern socio-economic development.

Objective of the research is to develop a set of institutional and economic mechanisms to ensure the implementation of a balanced development of renewable and non-renewable energy in the Russian Federation on the basis of the identified features of the global energy transformation.

The following **tasks** have been set to achieve the goal:

1. Identify and assess the dynamics of institutional and economic processes that influence the development of renewable and non-renewable energy.
2. To show the historical peculiarities of RES influence on the profile of N. Kondratiev's cycles against the background of J. Schumpeter's innovation waves.
3. To identify the structural shift in favor of renewable energy sources among the largest regional economies and analyze the key institutional and economic mechanisms which support this process.
4. To identify the nature of economic and institutional feasibility of RES application on the basis of the studied practices and to assess the impact of RES development on the triad of sustainable development.
5. To substantiate methodological approaches to assess the integral macroeconomic effect of the mass application of RES.

6. To develop a toolkit of state regulation ensuring a balance of production and consumption of renewable and non-renewable energy on the basis of the identified world experience adapted to domestic conditions.

7. To identify opportunities for the Russian Federation, taking into account the peculiarities of global processes during the energy transition.

8. To develop recommendations for creating a Concept for Balanced Development of Renewable and Non-Renewable Energy, contributing to the Russian economy's achievement of sustainable development goals.

Scientific novelty of the research is to solve the urgent problem of developing a set of institutional and economic mechanisms to ensure a balanced development of renewable and non-renewable energy of the Russian Federation to achieve sustainable development goals, taking into account regional characteristics and the importance of the Russian economy in the context of the global shift of the world energy sector in favor of the active use of renewable energy sources.

More detailed, scientific novelty of the research includes the following thesis statements to be defended:

1. A stable worldwide trend of innovative development of RES, formed on the basis of the development of a system of state support measures aimed both at replacing retiring capacities of non-renewable energy, and at their advanced introduction to cover the increasing demand for energy from consumers, regardless of the prices of fossil fuels, based on the basic institutional principle that combines the global, including non-energy, importance of RES and the inevitable long-term state costs, linked to the following

2. It was proved that the dynamic development of renewable energy against the background of innovation waves of J. Schumpeter acquired irreversible nature, supported by a unique potential of changing the profile of individual phases of cycles N.D. Kondratiev based on the disclosure of new opportunities for saving financial resources for producers of renewable energy at the micro, meso and macro levels, devoid of dependence on the short and long-term price situation and

associated with the benefits of their local application and simultaneous integration into the overall energy infrastructure.

3. It has been revealed that with a decrease in the total energy intensity of GDP of the largest regional economies, there is a stable tendency towards an increase in the RES share in the energy resources production structure, supported by the priority consumption of renewable energy and the specifics of its generation, not affected by the dynamics of the total primary energy supply (stabilization in the USA, reduction in the EU countries and growth in the PRC).

4. Approaches to state regulation of renewable and non-renewable energy balance at global, macro-, meso- and micro-levels, which take into account modern trends of renewable energy innovative development and change of energy consumption structure to stimulate economic activity growth and energy efficiency of economic activity and create objective preconditions for achieving sustainable development goals, in particular such as

- a. affordable and clean energy;
- b. decent work and economic growth;
- c. reducing inequality;
- d. responsible consumption and production;
- e. combating climate change;
- f. partnerships for sustainable development.

5. The article reveals the significant macroeconomic importance of the development of the RES sector due to the unique specifics of the relevant investment projects, the involvement and transformation of related industries in accordance with the needs of the "economy of the future", as well as the creation of competitive jobs and increasing tax deductions to various levels of the budget system. The methodological approaches to the assessment of the integral macroeconomic effect are substantiated. The main properties of investment projects in the field of RES include:

- a. scalability and universality of energy generation and redistribution equipment, as well as unification of RES production capacities;

b. optimal distribution of relatively low capital costs and investment decisions over time in comparison with other types of generation;

c. leveling of cost differentiation of electric energy tariff in the region of presence.

6. Based on the analysis of world experience, effective tools to stimulate innovative development of renewable energy, including the creation of new industries associated with renewable energy, were developed and adapted to domestic conditions. They include:

a. localization of production of renewable energy generators, as well as energy storage, storage and redistribution systems up to 100%;

b. lifting the unconditional limit of 15 kW of installed capacity of micro-generation equipment to create on this basis the prerequisites for self-sufficiency of households;

c. setting the tariff for the purchase of electricity produced by microgeneration at a level not lower than the actual sales tariff for a particular consumer;

d. ensuring the possibility for the owner of two or more properties to use a single microgeneration equipment for their energy supply;

e. creation of subsidies from the federal budget to compensate up to 50% of the cost of installation and construction work for the commissioning of RES generators;

f. creation of local communities with the provision of incentive banking instruments to intensify the use of RES, energy storage, storage and distribution systems for municipal needs;

g. use of life cycle contracting methodology, taking into account the peculiarities of the implementation of RES projects.

7. The influence of RES on the triad of sustainable development as a set of technological solutions and measures to ensure the efficient use of renewable energy in the form of interrelated favorable economic, social and environmental

effects, which is potentially limited in terms of initial resources and can be used in the Russian Federation for:

- a. development of the domestic energy sector, taking into account the possibility of expansion into the field of energy-intensive industries, as well as processing of released hydrocarbon raw materials in order to produce products with high added value;

- b. creation of principally new branches of economy and qualified working places, increase of demand on production of hi-tech productions;

- c. Creation of a class of energy consumers, which will ensure the growth of middle class prosperity;

- d. reducing environmental pollution and increasing public involvement in addressing global environmental issues;

- e. attracting socially responsible investors by making sure the solutions and mechanisms we develop meet the ESG criteria.

8. The structure of balanced development of renewable and non-renewable energy concept in the transition to a low-carbon economy have been developed, as well as methodological recommendations for its implementation, based on the use of procedures for assessing the regulatory impact and including measures of institutional support for the output of renewable energy and related sectors of the economy on the path of innovative development. The supporting structure of this concept can be considered as:

- a. priority development of RES based on socio-economic importance of this energy sector for the economy and society as a whole;

- b. administrative mechanism of target production of the most advanced equipment for the needs of regional renewable energy and providing functioning of renewable energy sector in general taking into account existing toolkit of stimulating economic policy measures and strategic development plans

- c. baseline assessment of the feasibility of regional RES development based on the cost of their use for the generation of electricity at the micro level;

d. cyclic commissioning of renewable energy capacities under conditions of growing energy demand, regional feasibility of specific RES types, and planned retirement of RES-based capacities.

Theoretical importance of the research is that the development and implementation of the concept of balanced development of renewable and non-renewable energy, taking into account the trends of the world economy as a whole and individual countries, is a necessary condition for energy security, a catalyst for improving socio-economic and environmental policies, creating the objective prerequisites for improving living standards and reducing energy poverty in energy-deficient regions, as well as synergistic effect of using new sub-energy

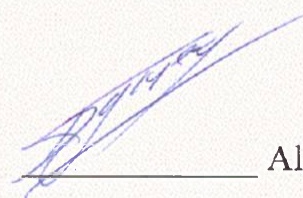
Practical significance of the research consists in the possibility of using the results obtained by the author in the development of conceptual provisions of the strategic development of the Russian Federation, one of the key elements of which is the balanced development of renewable and non-renewable energy, and the preparation of the relevant public administration regulatory and legal documents necessary for effective regulation of the formation of the "economy of the future".

Research results testing and evaluation. Key provisions and results of the dissertation research were presented at international practical conferences "Modern megacity: the formation of green economy", were approbated when assessing the applicability of renewable energy at own facilities of the TMK, were discussed at the scientific and practical seminar "Economics of energy and the environment" of Moscow State University, were used in the programs of additional MBA Institute of Economics and Management of Large Cities in Moscow International University, and were also used in the educational process of the National Research University "Moscow Power Engineering Institute", as well as at the Institute of Finance and Sustainable Development of RANEPA.

The methodological provisions and practical recommendations on the balanced use of renewable and non-renewable energy proposed in this dissertation are used in evaluating the effectiveness of public-private partnership projects implemented by the Non-governmental development institute TRANSPROEKT.

Publications. On 32 research papers have been published on the topic of the thesis, which reflected the main content of the dissertation, including 21 – in publications recommended by the Higher Qualification Committee under the Ministry of Education and Science of the Russian Federation, and 8 publications in journals recommended by the RANEPA scientific council to publish articles on economic science.

Structurally, taking into account the logic of the research, the thesis consists of the introduction, four chapters and the conclusion; the paper includes 73 figures, 46 tables, bibliography with a list of 444 items, and 9 appendices.



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