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Renewable energy certificates: Application potential and effiency

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ABSTRACT

At the international level, the problem of the need to increase the contribution of renewable energy sources to domestic electricity demand is highly relevant. Since the production of renewable energy sources is quite expensive, many countries are developing various state and market incentives for investment in such energy sources. One such incentive is renewable energy certificates. The role of these certificates in the development of global renewable energy markets is invaluable. They not only help businesses achieve their goals in the field of renewable energy, but also reduce consumer payments for other renewable energy development programs. This article analyzes the current trends in the use of renewable energy certificates in the world and identifies the prospects for their use in the Russian Federation. In addition, the author of the article studied the issue of cost-effectiveness of renewable certificates. In order to assess the positive economic impact of the application of the certification system, calculations have been made to reduce the financial burden on participants in the Wholesale Electricity and Power Market by taking into account the funds received from the sale of these certificates to reduce payments by market participants to generators based on renewable sources under the program of agreements on the provision of capacity for generating objects operating on the basis of renewable energy sources, from the date of the start of supply of electric energy and of the last planned facility until the date of the last payment under the power capacity agreement. In addition, the author of the article studied the need for renewable energy certificates not only to obtain reliable data on the use of renewable energy sources, but also to create efficient electricity markets using renewable energy sources around the world.

KEYWORDS:

renewable energy certificates, development of renewable energy sources, carbon dioxide emissions, global warming, electric energy consumption.

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1. INTRODUCTION

In the past few years, policies to increase the production and consumption of renewable energy sources (RES) have been actively implemented at international level in order to limit global warming. For example, by 2030, global CO2 emissions should be reduced by at least 45% compared to 2010 levels, and doubling the global share of RES is key to achieving this goal.

Power generation processes are responsible for 30-40% of global emissions, of which half is accounted for by enterprises.

Today, there are very few technologies for carbon capture and absorption, and other technologies for reducing emissions are not sufficiently developed to reduce CO2 emissions on an economically competitive scale. Electricity from renewable energy sources is mainly wind and solar energy, which depends on the weather and usually requires large investments [Chuangab et al., 2018]. Therefore, by using and producing renewable energy sources, companies can influence climate and open up new business opportunities-primarily in order to meet expectations of investors, government authorities and consumers.

One of the tools for accounting and monitoring production and consumption of electricity based on renewable sources is renewable energy certificates, or so-called "green" certificates. This system first appeared as a tool for accounting and monitoring production and consumption of electricity based on RES in the Netherlands in 1997-1998 under the name Green label system. This is where the name of certificates came from, which has since been assigned to them [Popova, 2019]. Renewable energy certificates are issued to confirm the generation of a certain amount of electricity from renewable sources. In other words, these are technological and environmental (non-energy) indicators that provide proof that 1 MWh of electricity was produced from an established renewable energy resource in a certain period of time and can be sold separately from the basic generated electricity with which it is associated [unified energy system of Russia..., 2019].

Such certificates allow you to calculate the actual volume of generation from renewable energy sources, reveal energy balance of territories, increase social responsibility of companies, and most importantly - support producers of "clean" electricity (for example, specified certificate may confirm the right of a generator to a subsidy or the right of an industrial consumer to assert carbon neutrality of its products).

In essence, renewable energy certificates are a modern analog of forest carbon Offsets. These offsets were a way for industrial producers to offset their carbon footprint by planting trees in set amounts. Forest Carbon Credits mechanism became widely used as an adequate measure to combat carbon pollution after the signing of Paris agreement in 2015. However, the development of forest offsets faced

serious economic restrictions that significantly reduced their attractiveness to potential users. They were too expensive and will not be needed until there is a major increase in the price of carbon emissions [Peterson St-Laurent et al., 107].

Renewable energy certificates perform a similar function, but allow you to create a market where they are a commodity, thus allowing all participants to participate in the development of renewable energy and reduce carbon emissions without significant organizational problems.

2. INTERNATIONAL PRACTICE OF APPLYING RENEWABLE ENERGY CERTIFICATES

Global practice of using renewable energy certificates shows that their acquisition in developing regions allows companies to compare energy consumption in all countries where they operate, while creating a demand signal that will stimulate market development. As the demand for renewable energy certificates outside of Europe and North America continues to grow, renewable energy infrastructure is still important for businesses to make a credible claim for RES. Businesses can support the development of this infrastructure in emerging markets by purchasing international renewable energy certificates (EACs). One of these international certificates – international standard REC (I-REC) – was developed by an international group of experts on renewable energy sources. This certificate gives buyers of electric energy the opportunity to choose renewable energy sources in any region of the world. I-REC certification mechanism provides a system for tracking electricity usage that can be implemented in any country. In addition to the United States and the European Union, the certificate is used in Brazil, China, Israel, Mexico, the Philippines, and Thailand in order to meet the needs of customers to confirm the use of renewable energy in international operations.

The concept of "green" certificates, formed by I-REC and reflected in the I-REC STANDARD guide, formulates a number of rules, compliance with which will allow participants around the world to join the international system of trade in renewable energy certificates. One of the key conditions is the presence of the so-called operating centre approved by the government of the country concerned, whose task will be to issue green certificate, metering, organization of exchange of "green" certificates, and registration and acknowledgement of conformity of the generating facilities of international standards renewable generation. If there is no confirmed issuer of certificates in the country, I-REC is ready to provide its services for organizing the turnover of "green" certificates.

The certificate trading process can be organized in two ways: "Green" certificates can be sold either on a bilateral contractual basis between distributor and manufacturer, or centrally on a common market. The easiest way to achieve transparency in the turnover of green certificates is to create a centralized certificate exchange. Moreover, a centralized organized pool will reduce the cost of searching for contractors, as well as information costs. Transactions for the sale of certificates can be arranged through existing stock exchanges or in electricity market, which, responding to the price signals of the certificate market, will develop more effectively [Nielsen, Jeppesen, 2000].https://papers.ssrn.com/sol3/cf_dev/AbsByAuth.cfm?per_id=201405

Confirmation of the compliance of generating facilities with I-REC standards takes place in several stages, which also include a visit by an I-REC representative to verify their operation parameters. In addition, it should be noted the difference in approaches to ensuring the functioning of electric energy certification systems.

Since 2001, the use of the Guarantee of Origin certification system has been mandatory for European Union countries, and they have considerable freedom in choosing the conditions for the operation of their own system. This leads to differences in quality assurance and market organization.

Each EU country must designate a certification body that is responsible for issuing and revoking certificates and facilitating trade. More than one certifier can be assigned, but each of them is responsible for a separate geographical area. As a result, only one monopoly certifier is active in most countries, with the exception of Greece and Belgium, where there are several regional monopolists. Countries are free to decide whether to appoint a public or private certification body. France, the Czech Republic and Portugal are the only countries with a current or previously existing private certifier [Hulshof et al., 2019].

The rules of operation of the I-REC system prohibit cross-border trade in "green" certificates, in order to prevent overfinancing of regions that are redundant in the production of electricity obtained from renewable sources. However, the generating companies of the Republic of Turkey, which are part of the I-REC system, implement certificates on the territory of the EU countries.

Through studies that model trade in different types of certificates in many regions, there are indications that cross-border trade in certificates leads to inequality in the regional distribution of renewable energy consumption. Thus, allowing free trade in certificates can significantly reduce the effect of electric energy certification in countries that are importers of certificates obtained outside the region [Wang et al., 2019].

At the same time, within the NORDPOOL system, cross-border trade in "green" certificates is practiced on a basic basis

The significance of renewable energy certificates for the development of such energy is noted at the international level. For example, at the renewable energy markets conference (REM 2017)" Obstacles and opportunities in global renewable energy procurement", held in new York on October 22-24, 2017 [Jones, 2017], a group of experts discussed the role that renewable energy certificates can play in helping businesses achieve their goals. According to experts, without renewable energy certificates, there will be no renewable energy markets in the world, since only certificates act as a guarantee that applications for electricity supply are reliable, traceable and trustworthy.

If we consider the experience of the United States and the EU on the use of certificates over the past three years, it becomes clear that the use of such certificates is growing every year (Fig. 1).

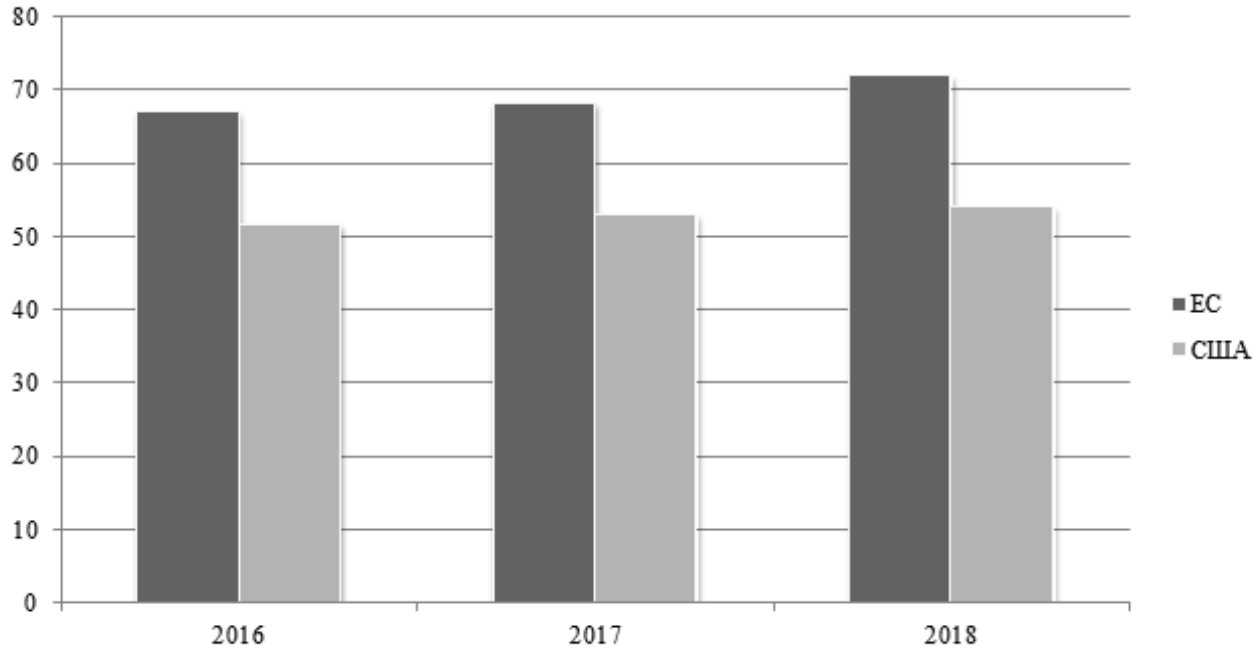
The data presented in the Annex confirms that the share of renewable energy certificates used at the international level is increasing dynamically every year.

For example, the report "State and trends in the voluntary "green" energy market in the United States " indicates that sales of renewable energy certificates (sold separately from physical electricity) increased by 22% in 2016, mainly due to an increase in corporate purchases of electricity produced on the basis of RES. In fact, of the 95.45 million MWh of renewable energy sold in the US in 2016, 51.8 million MWh was obtained through certificates. It uses American renewable energy certificates (REC), European renewable energy origin guarantees (GOs), and international RECs (I - REC), which have acquired 85% of US companies and 60% of companies operating around the world.

3. OPPORTUNITIES FOR APPLYING RENEWABLE ENERGY CERTIFICATES IN THE RUSSIAN FEDERATION

Renewable energy certificates are not used in the Russian Federation. Despite the fact that the country's policy and corporate policy of the largest companies in Russia have long been acting in accordance with the strategy of reducing carbon emissions, the existing approaches to energy are quite complex and fragmented. For a number of Russian companies that are seeking to refocus their energy purchases on renewable sources, this creates additional difficulties in addition to the costs associated with renewable energy

Fig. 1. The amount of energy obtained using renewable energy certificates (million MWh)



Sources: [NREL, 2017; IRENA, 2019].

sources in the Russian Federation.

Energy sector is replete with opportunities for the application of blockchain technology. One of the most understandable use cases is the green certificate markets-mainly renewable energy certificates (REC) in the US and guarantees of origin (GO) in Europe. However, tracking involves complex, expensive, and time-consuming interaction between multiple parties, and fraud is not uncommon in the process. By providing a shared and trusted master list of all transactions, blockchain eliminates the need for registry providers, intermediaries, and third-party verification. All these qualities are ideal for creating a platform for turnover and repayment of "green" certificates [Motyka, 2018]. Mikhail Andronov, President of Rusenergosbyt, noted at the international investment forum "Vetroenergetika-2019" that "in 2019, EnergyNet together with the market Council plan to launch a pilot project for the use of green blockchain certificates of renewable energy in Russia.[1] The use of blockchain platform guarantees reliability and transparency and allows you to control the entire path of the certificate from creation to maturity [2]." However, at the end of December 2019, pilot project has not been launched. Obviously, this situation is related to various barriers at the state level that prevent introduction of renewable energy certificates in the country. However, suspension of the project does not mean that Russian Federation does not pay attention to the problem of introducing and using renewable energy certificates in national practice.

On November 14, 2019, a meeting was held of the working groups under the Supervisory Board of the Association "NP "Market Council"" on the operation of generating facilities based on renewable energy with participation of representatives of the Ministry of energy, discussed the issue "On projects of normative legal acts aimed at the introduction of a system for the treatment of "green" certificates" following the meeting of November 28, 2019 the government of the Russian Federation announced the start of consideration of the concept of "green" certificates confirming the use of electricity from renewable sources, directed energy.[3]

Based on the results of the meeting, a General concept of the principles of operation of the renewable energy certificate market was formed. The "green" certificate can be understood as an electronic document that meets the established requirements, issued to the manufacturer of electric energy and confirming the fact of its production using renewable energy sources at a qualified generating facility in the amount and during the time period specified in this document. In fact, such a document is a form of certification and involvement in the economic turnover of a set of environmental, social and other socially significant effects that are caused by the special nature of electricity production based on the use of RES ("green" generation) and are created during this production.

Useful properties of the certificate are realized by its repayment at consumption (purchase) of electric energy in the amount (volume) specified in the extinguished "green" certificates. The person who redeemed the certificate gets the right to declare that their electricity consumption is provided by "green" generation in the amount of the redeemed certificate, and also gets other rights and opportunities in accordance with the legislation and (or) the rules of the relevant certificate system. At the time of redemption, the certificate is no longer in circulation.

It is assumed that the certificate can be issued on a voluntary basis and be an independent object of civil transactions using a specialized trading platform. Economic benefit for the person purchasing the certificate may consist, inter alia, in the possibility of a proportionate reduction in the cost of electric energy.

Despite the fact that since 2008 attempts have been made to create a full-fledged system of "green" certification in Russia, in the end we can only talk about some formal examples, since in practice they were not viable. According to I. L. Zerchaninova, this is due to the fact that "green" certificates are not yet integrated into the accounting, tax, etc. systems adopted in Russia if they are issued and used in accordance with the rules adopted in other countries and/or in accordance with international standards [Zerchaninova, 2011. P. 56]. As of December 31, 2019, the legal nature of the "green certificate" as a security, type of property rights, or other object of civil rights has not been established. At the same time, specific features of certificate circulation system, their pricing and their relationship with other mechanisms for supporting renewable energy sources, in particular with contracts for the provision of capacity (PDM) for qualified renewable energy facilities to the wholesale market, are currently being actively worked out and are at the stage of project approval.

A. E. Kopylov and I. L. Zerchaninova in [Kopylov, Zerchaninova, YEAR?], in addition, point to the problem of slowing down the pace of implementation of certification systems for electric energy. The main reason, according to researchers, is the attempts to launch a combined system (certificates-guarantees + "half-support certificates"), while in world practice, to prevent a number of problems,

[1] This refers to the Association " NP "Market Council"".
[2] Green certificates will contribute to the development of wind energy. URL: http://www.energoatlas.ru/2019/03/04/mihail-andronov-rusehnergosbyt-zelenye-sertifikaty-budut-sodejstvovat-razvitiyu-vetroehnergetiki/.
[3] Vavina E. Government will consider the concept of "green certificates" / / Vedomosti. 2019. November 28. URL: https://www.vedomosti.ru/business/articles/2019/11/28/817449-kontseptsiyu-zelenih-sertifikatov/.

"green" certificates are usually divided into two categories: certificates of support and certificates-guarantees. While having basically the same set of details, support certificates and guarantee certificates nevertheless perform different functions and have different legal bases.

Support certificates are included in national RES support schemes, often resembling those of the Kyoto Protocol. The right to support can be transferred, and the introduction of such certificates in Russia requires considerable effort. Although in a simple case, "green" certificates can be presented by energy generators once as a basis for obtaining appropriate support.

Certificates-guarantees (known in Europe as Guarantees of Origin) only confirm the fact of production of a certain amount of energy from RES [Kopylov, Zerchaninova, 2012]. Currently, global market players operating in the Russian Federation that have committed to switching to renewable energy, such as the American Unilever and the Swedish Ikea, are interested in using renewable energy certificates, and the certification process itself will be voluntary. Certificate system will also be of considerable interest to large industrial consumers (reducing the cost of power supplied under power supply agreements for generating facilities operating on the basis of RES by the cost of certificates sold).

This approach differs from the original one, which was proposed at the end of 2018 and included the issue of certificates on a mandatory basis. So, in 2018, the working group of the Russian wind industry Association considered several options for applying renewable energy certificates used in international practice, and developed four directions for the development of such certificates in the Russian Federation. The first option is to issue certificates to all electric power generators without exception, regardless of participation in state support schemes. The second option was to issue certificates exclusively for electricity generated in excess of the standard coefficient of use of installed capacity. The third one provided for issuing certificates for the amount of electricity produced at qualified generating facilities operating on the basis of RES, within the framework of the power supply contracts program, according to the standard coefficient of installed capacity utilization to everyone, but only at a special auction. Payments under contracts for the supply of power were to be reduced by the amount of revenue from the sale of certificates. The fourth option was to issue "green" certificates to all qualified generating facilities based on RES with special conditions for facilities with concluded power supply contracts.[4]

Actual February 2020 edition of the draft Federal law (hereinafter – the draft law) "On low-carbon certificates" introduces a new concept low-carbon certificate and additional conditions for the functioning of certification system that continues to cause disagreement among the participants of wholesale market of electric energy and capacity, delaying project implementation.

In this draft Federal law, nuclear power plants are classified as objects that are issued a "low-carbon" certificate, which allows the NPP to implement the issued certificates for the entire amount of electricity produced in relevant market.

The decision to include a nuclear power plant in renewable energy certification system may negatively affect the possibility of integrating domestic system into international ones. Since, according to the Green-e® standards, electricity produced from the following resources can be certified: solar energy, air mass energy, energy obtained from biomass processing, and water energy at low-impact HPPs [Lau, Aga, 2008].https://www.wri.org/profile/chris-lau According to the data of the System operator [unified energy system..., 2019], the share of nuclear power plants in generating electricity in "carbon-free" generation for 2019 was 52.11%. According to information provided by the Russian Ministry of energy, the installed capacity of solar and wind generation facilities in the unified energy system is 1362 and 184 MW, or 0.55 and 0.07%, respectively. At the same time, the installed capacity of hydroelectric power plants in the Russian Federation is 49,870.29 MW, which corresponds to 20.24% of the total balance. [5]

Thus, generating facilities of nuclear power will de facto occupy a monopoly position in the market of "low-carbon" certificates.

It should be noted that new nuclear power plants are built under contracts for the provision of capacity, which guarantee a return on investment. Also, operating nuclear power plants sell power at competitive power take-off prices and, according to the Decree of the Government of the Russian Federation dated 27.12.2010 No. 1172, since 2015 they receive an additional payment for safety.[6] At the same time, electricity prices and low production costs at nuclear power plants provide a high level of margin profit compared to thermal power plants. Thus, according to interested participants in the electricity market, there is no need to support the development of nuclear power plants through participation in the market of "low-carbon" certificates.

Also, to achieve the targets of the state policy in the sphere of energy efficiency of power industry based on

[4] Selivanova A. Russia will introduce "green" certificates to support renewable energy sources. URL: https://nangs.org/news/renewables/v-rossii-vvedut-zelenye-sertifikaty-dlya-podderzhki-vie.
[5] Main characteristics of the Russian electric power industry. URL: https://minenergo.gov.ru/node/532.
[6] The decree of the RF Government dated 27.12.2010 No. 1172 "On approval of Rules of the wholesale market of electric energy and capacity and about modification of some acts of the Government of the Russian Federation on organization of functioning of the wholesale market of electric energy and power". URL: http://www.consultant.ru/document/cons_doc_LAW_112537/.

renewable energy, approved by Decree of the Government of the Russian Federation of 08.01.2009 No.1-r, from the volume of electricity production of RES facilities excluded generating facilities functioning on the basis of energy of water installed capacity more than or equal to 25 MW.[7]

In addition, in order to support the development of new technologies in the field of renewable energy in the Russian Federation, according to the Decree of the Government of the Russian Federation dated 28.05.2013 No. 449 (paragraph b), the generating facility is a power plant with an installed capacity of less than 25 MW, operating on the basis of the use of water flow energy, thus, RES includes only small HPPs that do not participate in the wholesale market of electric energy and capacity.

As a result of these decisions, there is a conflict of norms, which slows down the development of the national certification system.

At the government level and at the level of individual organizations in the country's energy sector, the problem of slowing down the process is being discussed quite actively, but at the same time, the Russian Government also points to the need for consistent implementation of renewable energy certificates at an accelerated pace.

Thus, according to major participants in the electricity market, the inclusion of nuclear power plants and large HPPs in the turnover of "low-carbon" certificates will cause a multiple excess of supply over demand, a drop in the sale price of these certificates and will not allow to meet the goals of the state policy to support and develop RES.

In view of the above, it is clearly necessary to exclude nuclear power plants and hydroelectric power plants with an installed capacity of 25 MW or more from the circulation of "low-carbon" certificates in order to effectively operate the certification system.

The key issue in the discussion is how to prevent large hydro-generating capacities and nuclear power facilities from completely absorbing the market for "low-carbon" certificates, which will undoubtedly contradict the main goal of certifying produced energy – to develop renewable energy in regions with a shortage of electricity produced from renewable sources. In the European countries that are part of the NORDPOOL system, the market as a self-sufficient system has solved this problem. Given the ability to track the type of generating object that the certificate was issued to, consumers can choose the generating objects they need. At the same time, it is believed that a large hydrogenation with a large reservoir mirror area is a source of greenhouse gas emissions in bottom sediments, which is why the demand for electricity from large HPPs remains consistently lower than the demand for electric energy obtained from other renewable sources. Thus, large hydroelectric power plants do not get an advantage. In the long run, market price regulation will resolve this contradiction.

As for the monopolization of the certificate market by nuclear and large hydro-generating facilities, the Ministry of energy of the Russian Federation reports that there are no such prerequisites, since in order to meet the needs of various groups of consumers of electric energy generated using low-carbon energy sources, the bill provides for the division of "low-carbon" certificates by type of energy sources. In addition, the bill provides for the free circulation of "low-carbon" certificates. Thus, consumers who need to confirm the use of electric energy from an SES or WPP have the right to purchase "low-carbon" certificates issued only by the SES and WPP, while consumers who purchase electric energy from a HPP have the right to receive "low-carbon" certificates for the specified electric energy.

It should be noted that the inclusion of nuclear power plants and large HPPs in the system of circulation of "low-carbon" certificates contradicts the international practice of stimulating the development of new areas of renewable energy. However, the issue of economic justification for issuing "low-carbon" certificates to large HPPs and nuclear power plants is much more significant.

A logical solution for the development of the electric energy market will be non-proliferation of conditions for issuing "low-carbon" certificates for renewable energy facilities that supply capacity for renewable energy on the wholesale electricity and capacity market, or the implementation of the possibility to exclude income from the sale of certificates from the price of capacity for renewable energy, as proposed in early versions of the draft Federal law.

At the same time, the implementation of the proposed norms will lead to a change in the current mechanism of the renewable energy DPM, which will be a negative precedent for foreign investors. At the same time, the proposed approach contradicts the basic conditions for concluding power supply agreements (PTA) and calls into question the possibility of returning investment in renewable energy projects on the terms guaranteed by the government of the Russian Federation when concluding these agreements.

The position of the opponents of the exclusion of income from the sale of certificates of prices for capacity under CSA RES is formulated as follows: implementation of a low-carbon certificates should be made only on the basis of voluntary participation of the generating companies and the application of this mechanism should not lead to the withdrawal of funds from the sale of electric energy and

[7] Decree of the Government of the Russian Federation dated 08.01.2009 No. 1-r "on the main directions of state policy in the field of improving the energy efficiency of the electric power industry based on the use of renewable energy sources for the period up to 2024". URL: http://www.consultant.ru/document/cons_doc_LAW_83805/.

capacity, under the terms of the PDM RES.

However, the development of a system of "low-carbon" certificates, as well as the entire energy system as a whole, should take into account the interests of all participants in the electricity market.

The idea of using renewable energy certificates as an additional source of funds for the development of renewable energy was laid down from the very beginning in the concept of electric energy certification. However, according to Joel Mack, an American environmental regulatory analyst, certification systems, in addition to developing self-sufficiency of energy systems, stabilizing electricity prices, and equalizing supply and demand for electricity, have the potential to add value to the development and financing of renewable energy projects, but due to regulatory issues, this potential has not yet been fully realized [Mack et al., 2011].

According to the author of this article, a logical development of certification scheme for electrical energy for domestic power system and measure the most significant economic effect will be the exclusion of income from the sale of certificates of prices for capacity under CSA renewable energy in order to reduce the economic burden on large consumers. This solution will effectively regulate the development of renewable energy in the Russian Federation, while not overloading consumers with expenses.

4. CALCULATING THE ECONOMIC EFFECTS OF RENEWABLE ENERGY CERTIFICATES

Research methodology and data

The economic effect for large industrial and retail consumers after applying the mechanism of reducing the price of power due to sold certificates can be calculated by estimating the potential demand for renewable energy certificates and the total amount of funds from the sale of these certificates, aimed at reducing the cost of power supplied under the RES DPM. Thus, according to favorable estimates, as well as taking into account the increasing development of the process of decarbonizing production around the world, the demand for electric energy supplied under "low-carbon" certificates will amount to about 30% of the total amount of electricity generated at generating facilities using RES. In order to assess the potential reduction of the financial burden on consumers of the wholesale market for paying for power delivered under the renewable energy contract, it is necessary to exclude from the total amount of power payment an amount equal to the potential income received after the sale of "low-carbon" certificates.

Based on the data presented in the Annex to Executive order of the Government of the Russian Federation of April 18, 2020 No. 1081-r, you can calculate the total power production of all generating facilities based on RES, the total cost of all electric energy produced by generating facilities based on RES and the amount of the payment capacity of the whole program PDM RES.[8]

Calculation results

By the end of 2024, the total electricity generation at all qualified generating facilities operating on the basis of RES with an installed capacity factor of 100% will be: 5,863,7 MW * 8760 h = 51,366,012 MW*h.

The average cost of 1 MWh produced on the basis of RES by the end of 2024, according to data provided by the Association "NP market Council", will be 2.98694 million rubles per MWh.

The total cost of all electricity produced based on RES at the end of 2024 will be 153,427 million rubles (Appendix 1).

Taking into account that certificates will be issued for 30% of the total electricity generation at all qualified generating facilities operating on the basis of RES, it should be concluded that 15,409,803.6 MW*h per year will be certified.

At the current average cost of "green" certificates in the I-REC system of 40 kopecks per certificate, the potential funds received under the domestic program of "low-carbon" certificates will amount to 6,163,921. 44 rubles per year.

However, it should be taken into account that renewable energy generating facilities in the Russian Federation have a relatively low installed capacity utilization rate of 14%, so the real amount of funds received from the sale of certificates will approximately amount to 862,949 rubles per year.

Under the existing program, the last payment under the capacity agreement will be paid in accordance with the schedule in 2038. Thus, the system of "low-carbon" certificates will reduce the load on electricity consumers by 12,081,286 rubles only within the framework of the entire program of renewable energy DPM since the last power plant was commissioned on the basis of RES. In the future, certification systems, as well as the development of renewable energy generation, will continue to improve the efficiency of the Russian energy system.

[8] URL: http://www.consultant.ru/document/cons_doc_LAW_350905/f62ee45faefd8e2a11d6d88941ac66824f848bc2/.

5. DISCUSSION OF RESEARCH RESULTS

If we take international practice as a basis and analyze which scheme of renewable energy certificates is optimal – voluntary or mandatory, it is not possible to formulate an unambiguous answer to this question. Although there are some similarities between mandatory and voluntary renewable energy certificate schemes, their differences often create problems for cross-border trade.

In Europe, much of the trade in renewable energy certificates is done on a voluntary basis. Only four European countries – the United Kingdom, Belgium, Italy and Sweden - have adopted mandatory national targets for renewable energy sources and, accordingly, have implemented mandatory renewable energy certification schemes. These schemes impose obligations on various market participants. For example, the British and Belgian renewable energy certification schemes impose obligations on suppliers. The scheme adopted in Italy imposes obligations on producers and importers, while the Swedish one imposes obligations on consumers. RES targets are also part of the European growth strategy 2020, in particular its flagship initiative to create a resource-efficient Europe.

Along with the mandatory use of "green" certificates, there are also voluntary mechanisms, mainly in Canada, Japan, and South Africa. A voluntary system of electricity consumption based on renewable energy sources is associated with the social responsibility of business.

Fulfillment of voluntary obligations for the consumption of electric energy obtained from renewable energy sources is carried out either by creating their own power plants powered by renewable energy sources, or by obtaining "green" certificates from other manufacturers. In the first case, significant investment and time are required, which is not always available to the consumer. In the second case, any consumer can be involved in this process at any time with relatively small investments [Rafaelyan, 2018].

The Russian draft Federal law on "low-carbon" certificates implies mandatory certification, which is fiercely criticized by large consumers of electric energy. In the current version, when an organized system appears, the repayment of" low-carbon " certificates will be the only possible way for its owner to confirm the fact of electric energy consumption due to its production at qualified generating facilities operating on the basis of RES use. Without paying off the green certificates, it is proposed to prohibit the dissemination of information about green energy consumption, including in public speeches, advertising, for the formation of an "eco-friendly" image and labeling of goods, as well as when quantifying indirect energy emissions of greenhouse gases, to apply emission factors established by the legislation of the Russian Federation.

On the territory of the Russian Federation, there are a number of companies with high costs for electric energy in the cost of production that sell their products abroad. One of the key competitive advantages in international markets is the ability to use electricity purchased from environmentally neutral hydroelectric power plants. Within the framework of the existing wholesale electricity and capacity market in Russia, large consumers participating in the wholesale market have the opportunity to enter into free bilateral agreements for the entire volume of electricity consumed. Thus, based on the results of audit studies, industrial companies receive a conclusion about the neutrality of their products within the framework of carbon footprint accounting and the ability to reliably assert the production of products with a low carbon footprint.

This leads to the conclusion that the proposed system of confirming the production of products using renewable energy will offset the existing positive economic effects for large industrial consumers with a high share of the cost of purchasing electricity, including contributing to the restriction of exports and, consequently, reducing GDP growth.

According to preliminary estimates, the decision to apply mandatory certification will jeopardize the achievement of the indicators of the national project "international cooperation and export" for export growth in the metallurgical industry by 2024 in the amount of up to 50 billion dollars per year.

According to experts, the expected benefits from the introduction of a system of turnover of "low-carbon" certificates will be incomparable with the losses that will occur for exporters when the bill with the described restrictions is adopted.

6. FURTHER DEVELOPMENT OF RENEWABLE ENERGY CERTIFICATES AND REDUCTION OF BARRIERS TO THEIR USE

The main barrier to applying renewable energy certificates is the lack of common standards and the need for further harmonization of certification requirements.

For example, various U.S. government renewable energy programs and related certification schemes differ from state to state. For example, participants in a renewable energy certification scheme in new Jersey can meet specific requirements for solar energy production only by actually

producing it, or by submitting solar renewable energy certificates, which are environmental standards only when using solar energy. This requirement is in addition to other renewable energy requirements in new Jersey for trading other types of renewable energy certificates. Unlike new Jersey, Maryland does not issue separate solar certificates, instead a certificate can be issued for various renewable energy sources such as wind, geothermal, or solar energy.

Such differences between government schemes may mean that a renewable energy certificate obtained in one state cannot be used in another unless it can be proved that the certificate was originally granted to obtain energy from an acceptable renewable source in that state. Therefore, the interchangeability of renewable energy certificates in different States may be limited, which creates obstacles to interstate trade.[9]

Incompatible with the requirements of certification schemes renewable energy at the country level have a negative impact on the liquidity of the markets for renewable energy. The only solution in this case is seen to harmonize certification schemes renewable energy, including rules governing the issuance of certificates of renewable energy, and the documentation used for their trade at the international level, it is most effective to implement a global policy to increase production and consumption of renewable energy to limit global warming.

At the level of individual countries, attempts to harmonize requirements for certification schemes are often made, but not always successfully. For example, back in 2006, Sweden and Norway attempted to create the first cross-border trade system, the goal of which was for Norway to join the renewable energy certification system in Sweden. In the end, Norway decided not to do this, as the costs would be too high for both Norwegian consumers and industry. Countries were unable to agree on burden-sharing. Leading renewable energy industry associations have responded to the failure of the joint Swedish-Norwegian scheme, saying that a political solution is needed to integrate European renewable energy certification markets. Market participants call on the European Commission to start assimilating European renewable energy certification schemes, since without harmonization, support for RES will be significantly distorted and the potential of renewable energy sources will not be fully developed.[10] The United States has also repeatedly taken the initiative to unify requirements for renewable energy certification.

It is logical to assume that the harmonization of renewable energy certification schemes at the international level will increase the liquidity of renewable energy markets and the cost-effectiveness of meeting renewable energy targets. Attempts by various countries to create a joint market for renewable energy certification show that market participants are striving for greater harmonization and standardization and are ready to explore various options for further development of renewable energy certification. An acceptable option may be, for example, to bring all requirements to the same international requirements of the International standard REC (I-REC).

However, if countries that have been using renewable energy certification systems for a long time cannot solve the problems associated with different certification requirements, it will be even more difficult to do so in the Russian Federation. Thus, " in Russia, renewable energy has great prospects, but the pace of its development lags behind the pace necessary for the sustainable development of the country's energy system, and there are significant difficulties in finding investors whose terms of providing funds will not increase the financial burden on consumers of electric energy due to economic and political features. At the same time, insufficient attention is paid to the heat supply system using renewable sources" [Sheryazov et al., 2019. P. 48]. Some problems are related to the promotion of renewable energy certificates, in particular with the expansion of the number of countries that could participate in this program.

7. CONCLUSIONS AND FURTHER RESEARCH

Despite the fact that not all countries of the world make renewable energy certificates mandatory, and certificates themselves are not a support tool, without them it is quite difficult to build a harmonious system that ensures a fair redistribution of funds to compensate for the increased costs of renewable energy generators resulting from existing measures of support for the population (cross-subsidies and other non-market surcharges) in the increased costs of large industrial consumers, the latter is particularly relevant for our country. At the same time, renewable energy certificates can be both documents, the basis for such support, and, being the subject of purchase/sale, serve as an additional source of funds to compensate for part of the cost of extremely expensive power supplied under power supply agreements for generating facilities operating on RES [unified energy system..., 2019].

According to the analysis of international practice in the use of renewable energy certificates, various benefits and

[9] EPA Green Power Partnership Webinar on REC Tracking Systems. URL: https://www.epa.gov/sites/production/files/2016-01/documents/webinar_20150430_fredregill.pdf.
[10] Trading in renewable energy certificates // Lexology.com. URL: https://www.lexology.com/library/detail.aspx?g=24a4f8f9-3e66-43e4-9a6e-5899dcd2911f.

compensations from the use of certificates can be provided to both suppliers and consumers of renewable energy, as well as its producers, depending on the volume of renewable energy certificates presented by them. As noted in [Kopylov, Zerchaninova, 2012], "the transfer(assignment) of rights or requisites of energy, secured by "green" certificates, from market entities – generators of renewable energy, to market entities – generators of any other energy deprives the former of the opportunity to publicly present their energy as renewable".

A similar principle applies in relations between different entities of the renewable energy market: when selling renewable energy certificates before their repayment, the intermediary automatically mediates the transfer (assignment) of the relevant rights and details. Thus, renewable energy support funds only work with those who were able to present certificates.

Based on this, it can be concluded that renewable energy certificates are holders of certain rights to renewable energy or to the renewable nature of the energy produced, as well as a market instrument that provides an economic incentive for the production of electricity from renewable energy sources. Purchasing renewable energy certificates demonstrates environmental leadership and sends a signal to the market that an economic entity is choosing renewable energy and is ready to change its energy behavior. If we consider the advantages of certificates in terms of renewable energy production, this is an additional source of income for energy producers, which makes participation in certification mechanisms more attractive and contributes to increasing renewable energy production. Thus, renewable energy certificates are necessary not only to obtain reliable data on renewable energy sources, but also to create efficient renewable energy markets around the world. Certificates help to place emphasis on energy consumption from renewable sources as the final stage and goal of the action program. This is why renewable energy certificates are so often used by governments developing renewable energy [Sorokin, 2015].

In addition, it should be noted that the current international practice of using renewable energy certificates shows that both voluntary and mandatory certification of renewable energy is used. Although there are some similarities between mandatory and voluntary renewable energy certificate

APPENDIX

Forecast calculation of the Association "NP" market Council" " on financial transactions within the framework of DPM programs

Параметры	2020	2021	2022	2023	2024	2025	2026	2027	2028
Потребление (млн кВт*ч)	706 637	710 170	713 721	720 293	727 918	735 602	743 345	751 146	755 929
Электроэнергия (млн руб.)	821 984	851 850	881 383	914 622	948 183	981 029	1 013 580	1 045 558	1 073 259
ТЭС (КОМ и ВР) (млн руб.)	127 902	151 623	155 105	167 776	180 744	195 148	203 219	211 417	217 368
АЭС (КОМ) (млн руб.)	33 262	36 100	37 257	38 664	40 055	41 423	42 580	43 728	44 672
ГЭС (КОМ) (млн руб.)	60 063	70 995	73 446	76 606	79 764	82 908	85 451	88 029	89 994
ДПМ (млн руб.)	296 699	268 426	226 098	184 324	117 395	45 073	30 811	15 226	6 718
ДПМ АЭС (млн руб.)	201 251	202 247	228 649	229 782	230 920	232 064	233 214	234 369	235 531
ДПМ ГЭС (млн руб.)	18 288	18 313	18 337	18 362	33 507	33 608	33 709	33 811	33 913
ВИЭ (млн руб.)	75 002	104 613	119 992	152 831	153 427	152 652	151 800	150 811	149 647
ТБО (млн руб.)	0	0	1 754	20 936	20 784	20 619	20 439	20 242	20 028
Крым ТПЕ (млн руб.)	4 563	4 425	3 551	350	0	0	0	0	0
КОМ НГО (Крым и Тамань) (млн руб.)	2 832	8 621	11 515	11 515	11 515	11 515	11 515	11 515	11 515
Калининград (млн руб.)	26 564	26 336	26 085	25 806	25 497	25 154	24 771	24 345	23 867
Итого (млн руб.)	1 668 411	1 743 549	1 783 172	1 841 574	1 841 792	1 821 193	1 851 089	1 879 052	1 906 512
Стоимость (руб./МВт*ч)	2361,06	2455,11	2498,42	2556,70	2530,22	2475,78	2490,22	2501,58	2522,08
Рост цены (%)	2,5	4,0	1,8	2,3	-1,0	-2,2	0,6	0,5	0,8

schemes, their differences often create problems for cross-border trade in renewable energy sources. Incompatible requirements of renewable energy certification schemes at the country level have a negative impact on the liquidity of renewable energy markets. The only solution to the problem is the harmonization of renewable energy certification schemes at the international level, which will increase the liquidity of renewable energy markets and economic Efficiency in meeting renewable energy targets. Attempts by various countries to create a joint market for renewable energy certification show that market participants are striving for greater harmonization and standardization and that they are willing to explore various options for further developing renewable energy certification. An acceptable option, including for the Russian Federation, may be to bring all requirements to the same international requirements of the International standard REC (I-REC).

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	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	итого за период
	759 708	763 507	767 324	771 161	775 017	778 892	782 786	786 700	790 634	794 587	
	1 100 198	1 127 813	1 156 121	1 185 140	1 214 887	1 245 380	1 276 639	1 308 683	1 341 531	1 375 203	
	222 489	226 716	231 531	235 944	241 093	245 763	251 782	256 917	262 852	267 935	
	45 569	46 449	48 882	49 828	52 393	53 407	55 970	57 362	62 049	63 561	
	91 804	93 548	95 626	97 485	99 558	101 458	104 141	106 182	108 634	110 735	
	0	0	0	0	0	0	0	0	0	0	
	234 713	235 756	228 470	229 613	213 439	214 506	212 730	199 479	114 378	111 685	
	34 015	34 119	32 522	31 917	32 010	32 103	26 824	26 904	26 984	27 064	
	148 314	146 039	138 233	128 292	116 197	94 601	72 735	45 612	30 141	1 080	2 132 019
	19 794	19 537	19 256	18 947	18 607	18 233	17 820	17 365	15 472	0	
	0	0	0	0	0	0	0	0	0	0	
	11 515	11 515	11 515	11 515	9 627	8 683	2 171	0	0	0	
	23 331	22 729	22 057	21 304	14 758	1 748	0	0	0	0	
	1 931 742	1 964 222	1 984 214	2 009 984	2 012 568	2 015 883	2 020 811	2 018 505	1 962 040	1 957 264	
	2542,74	2572,63	2585,89	2606,44	2596,81	2588,14	2581,56	2565,79	2481,60	2463,25	
	0,8	1,2	0,5	0,8	-0,4	-0,3	-0,3	-0,6	-3,3	-0,7	

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