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MAIN DIRECTIONS OF RUSSIAN STATE ENERGY SAVING POLICY IN THE FIELD OF ELECTRIC POWER ENGINEERING

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ABSTRACT

The article describes the issues of strategic planning and legal regulation of activities aimed at energy saving and energy efficiency in the Russian Federation. The authors set the goal to determine the directions for strategic planning of the energy saving policy of the Russian Federation based on a comparative legal analysis in order to achieve the goals of sustainable development of an energy-saving economy. The article considers advanced technologies designed to ensure the most effective implementation of the provisions of legal acts adopted in the last decade in Russia.

The methodology of this scientific research is the use of hermeneutics, interpreting legal texts and application of formal logical instruments within the system analysis of current Russian strategic planning acts for long-term (medium-term) period to coordinate the activities of economic entities and public authorities in the appropriate direction. Besides, it includes normative acts that establish the legal, economic and organizational basis for stimulating energy conservation and improving energy efficiency as well as legal documents of other countries that determine their policies in this area.

The authors come to the conclusion that it is required to consult various specialists, including ophthalmologists, when creating norms of Russian legislation in the field of energy saving; to account for technical and technological characteristics of LED (light emitting diode) modules, chips, other light sources; to take into consideration the possibility of their use in various fields in order to achieve energy efficiency.

Keywords: electric power industry, energy saving, energy efficiency, LED light sources, lamps, energy-saving technologies

1. INTRODUCTION

Energy saving and increasing energy efficiency is no longer a problem only for consumers of energy resources. It has become a nation-wide global problem affecting among other things, the state of economic security. Therefore, it is stated in the Strategy for Economic Security of Russia, adopted in May 2017, for the period until 2030, that the main challenges and threats to economic security are as follows. They include a change in the structure of global demand for energy resources and consumption patterns, development of energy-saving technologies and reduction of material consumption as well as development of "green technologies" in this area. In the situation when energy consumption is growing in a geometric progression and opportunities in this area are limited, issues related to the creation of legal, economic and institutional framework for stimulating energy conservation and increasing energy efficiency, have been taken up by state authorities in the countries with a high level of economic development. According to the statistics of the International Energy Agency, in the USA, by 2020, it is planned to reduce the energy intensity of the economy by 25 % compared to 2005. In China, the current task is to reduce the energy intensity of the economy by 49 % in relation to the indicators of 2006 [1], and in the European Union by 20 %, compared with the 2007 data [2]. Russia is not an exception in this sense. Taking into consideration the fact

that the Russian Federation is neither the last nor the first in the production and consumption of electricity [3], it is worth noting that in terms of energy efficiency the situation is not encouraging. "… Being the third in the world in terms of energy consumption, Russia spends more energy per unit of GDP than any other country belonging to the top ten energy consumers" [4] though Russia began to deal with issues of energy conservation and improving energy efficiency long ago. The legal basis for such a focus is the Federal Law of April 3, 1996 on energy conservation. It means that more than 20 years have passed since the implementation of the state course aimed at increasing the efficiency of the use of consumed energy.

Energy conservation and energy efficiency issues are considerably relevant for the electrical industry. Electric power industry is not only the basis of lighting technology but also of energy as it provides power for the entire economy of the country on the basis of rational production, distribution and consumption of electricity. This type of energy is in demand in all spheres of life of modern society, while the consumption of electricity in recent years has been steadily growing. According to the data of "SO EU" JSC, the electricity consumption in the Unified Energy System of Russia in 2017 amounted to 1039.7 billion kW / h, which is 1.3 % more than the consumption volume in 2016. Electricity consumption in Russia in 2017 was 1059 billion kW / h, which is 0.5 % more than in 2016 [5]. In this regard, it should be noted that the cost of creating kW generation capacity in power plants of different types is about from $1,000 up to $3,000 while a reduction in installed capacity per kilowatt of lighting costs $150 – $200. Besides, this is connected with the solution of the most important problem of reducing harmful emissions into the atmosphere [6]. At the same time, artificial lighting systems are the most common end-users of electricity, which accounts for about 13 % of all generated electrical energy [7]. It is apparent that effective implementation of the state energy saving policy in such a significant segment of electricity consumers will significantly affect the overall picture of the economy and increase the energy efficiency of energy-consuming systems.

The relevance of the topic has determined its goal: to prove the need for further development of the legal provision of energy-consuming systems efficiency in general and electro-savings in particular, namely the use of LED technology. Achieving this goal requires the solution of the following tasks:

– To analyze the system of legislation regulating the sphere of energy saving;

– To identify corresponding gaps and shortcomings in legal support;

– To substantiate the need for further improvement of the legal framework on the basis of a comparative analysis of Russian and foreign experience;

– To reveal the relationship between the guarantee of the right to health of Russian citizens, technical and economic effectiveness of LED technologies;

– To show the prospects for the development of LED technology.

2. METHODS OF SOLUTION

The research has shown that in the modern scientific and technical literature much attention is given to the analysis of technical and economic advantages of the development of various energy-saving systems. At the same time, the analysis of the legal support for this problem, the protection of human and citizen's rights and freedoms, when using various technologies, primarily modern lighting, is not necessarily in the spotlight. The authors of this article believe that the problems of financial and economic development often take priority while incorrect application of social, technical and legal norms, as well as the legality of legislation in the field of energy conservation can lead to irreversible consequences. Therefore, it is necessary to improve the legislation in the sphere of energy saving and adopt the Technological Regulations on the requirements for the energy efficiency of electric energy consuming devices.

3. RESULTS

Taking into consideration the main directions of the state policy in the sphere of energy saving and energy efficiency improvement, it should be noted that the act fixing these most basic directions is not provided in the legislation. However, according to p. 1 of Article 6 of the Federal Law "On Energy Saving and on Improving Energy Efficiency and on Amending Certain Legislative Acts of the Russian Federation" [8], one of the powers of the bodies of state power in Russia is the formation and implementation of state policy in the field

of energy conservation and energy efficiency. In this case, item 14.1 of Article 6, introduced by Federal Law No. 399-FZ on December 28, 2013 assigns to state bodies the function of monitoring and analyzing the effectiveness of the implementation of state policy, regulatory and legal regulation in the area under consideration. In 2009 the Government of the Russian Federation approved "Main Directions of the State Policy in the Sphere of Improving the Energy Efficiency of the Electric Power Industry Using Renewable Energy Sources for the Period until 2024" [9]. There is no doubt it was an important decision but it did not completely determine the state policy in the field of energy saving and increasing energy efficiency. We believe that under such circumstances it is worth taking into consideration that monitoring and analysis of the effectiveness of state policy implementation cannot but face some difficulties in practice. Nevertheless, it should be noted that despite obvious difficulties, the work is undoubtedly being carried out. Implementing one more item of Article 6, namely 14.2, which provides for the preparation of an annual state report on the state of energy conservation and improving energy efficiency in Russia, the Government of the Russian Federation approved the Resolution "On the preparation and dissemination of the annual state report on the state of energy conservation and energy efficiency in the Russian Federation" [10]. This document was designed to summarize the results of the implementation of the state policy under consideration for the previous reporting year. According to this Resolution, the Report is prepared by the Ministry of Energy of the Russian Federation and includes among other things the following:

1) Indicators that characterize the level of technologies implementation that have high energy efficiency;

2) Information on planned initiatives in the field of energy conservation, energy efficiency and proposals on the directions for the development of public policy in this regard;

3) Information on the potential for energy conservation and improving energy efficiency.

It presents certain interest to find out whether there are some achievements in these areas and whether the lighting industry and issues of artificial lighting are mentioned in connection with it. In this regard, it is interesting to become familiar with the content of similar reports made in recent years. Unfortunately, it is not yet possible to get acquainted with the results of 2017, in the area under study, for the reason that the Rules for the preparation and dissemination of the annual state report on the state of energy conservation and improving energy efficiency. The deadline for placing the Report on the Internet is October 15, following the previous year, therefore it is missing in the information system. As follows from the text of the State report on the state of energy conservation and increase of energy efficiency in 2016 [11], the average specific electricity consumption for the supply of state and municipal health facilities in Russia in 2016 was 57.99 kW / h / m^2. In the Central, North-western and Southern Federal Districts, the average electricity consumption for supplying state and municipal health facilities is higher than in Russia by 6 %, 9 % and 15 %, respectively. The average specific electric power consumption for the supply of educational institutions in 2016 increased by 4 % and amounted to 31.8 kW / h / m^2. In the North-western Federal District, the average specific electricity consumption for the supply of educational institutions is higher than in Russia by 45 %. To analyze the general state of energy conservation and improve energy efficiency in the budgetary sector, indicators of the introduction of key energy-efficient technologies, including the share of LED light sources in public and municipal institutions were used. It follows from the data of the Report that the average share of LED light sources in the coverage of state and municipal institutions, according to energy declarations in 2015, was 5.6 %. The average share of such sources in the coverage of these institutions for 2016 has already increased by 1.2 and amounted to 6.6 %. At the same time, the share of LED light sources in all subordinate institutions of the federal executive authorities reviewed is above average for Russia for all budget institutions. For example, the supply of LED sources in the institutions of the Ministry of Justice of Russian Federation and the Federal Penitentiary Service of Russia is almost twice as high as the average for Russia. Despite this growth, such a situation indicates a significant potential for energy conservation with the help of the further introduction of LED sources. As shown in Table 1, these light sources, by all parameters, are much better and more often used for lighting purposes than incandescent lamps.

However, despite obvious leaders among the light sources, the Ministry of Construction approved the orders on August 17, 2016, No. 572 "On the ap-

Table 1. Indicators of Light Sources [6]

Type of light source	Average service life, thousand hours	Colour rendering index, R_a *	Luminous efficacy, lm/w	Specific luminous energy produced during the service life (average)	
				mlm h/W	Units
Incandescent lamps (IL)	1	100	8–17	0.013	1
Fluorescent lamps (FL)	10–20	57–92	48–104	1.140	88
Compact Fluorescent Lamps (CFL)	5–15	80–85	65–87	0.780	60
Arc mercury lamps (AML)	12–24	40–57	19–63	0.738	57
High Pressure Sodium Lamps (HPSL)	10–28	21–60	66–150	2.050	157
Metal halide lamps (MHL)	3.5–20	65–93	68–105	1.020	78
LEDs	25	85–90	(80–90)→120	2.5	192

proval of the code of rules "Buildings of educational organizations. Design Rules." And on August 17, 2016, document No. 573 "On the approval of the code of rules "Buildings of pre-school educational organizations. Design Rules" was approved, which do not contain provisions aimed at stimulating the introduction of energy-efficient technologies. In particular, the Order No. 572 contains a proposal to provide compact and tubular fluorescent lamps containing mercury compounds and incandescent lamps for lighting in educational institutions. Taking into account that the vast majority of educational institutions are built and reconstructed at the expense of the budget, the application of these design rules can lead to inefficient spending of budget funds at the stage of operation of educational institutions.

Item 8 of Article 10, the Law on Energy Saving, provides that from January 1, 2011, incandescent lamps with the power of 100 W or more are not allowed to circulate in Russia, which can be used in alternating current circuits for lighting purposes. In addition, from the same moment it is prohibited to purchase electric incandescent lamps to provide state or municipal needs that can be used in alternating current circuits for lighting purposes. As prospective measures, the same item 8, satisfies the possibility of prohibiting the turnover of electric incandescent lamps with the power of 75 W or more, and from January 1, 2014, with the power of 25 W and more. However, so far such a ban has not been implemented. In addition, Government Resolution No. 898, August 28, 2015, "On Amendments to Clause 7 of the Rules for Establishing Energy Efficiency Requirements for Goods, Works, and Services in the Conduct of Procurement for Provision of State and Municipal Needs" introduced a number of restrictions on procurement from July 1, 2016 energetically inefficient light sources and lighting devices, namely: double-capped fluorescent lamps with phosphor sodium halo-phosphate and a colour rendering index of no more than 80, arc mercury fluorescent lamps, compact luminescent [12]. These measures were to stimulate the introduction of LED technology at the regional level.

Item 6 of Article 48 of the Law on Energy Conservation contains a standard on specific requirements for lighting devices, electric lamps used in alternating current circuits for lighting purposes, which should have been put in place by the Government of the Russian Federation before March 1, 2010. These rules were adopted in 2011. The Government Resolution No. 602 "On Approval of Requirements for Lighting Devices and Electric Lamps Used in Alternating Current Circuits for Illumination", and in November 2017 by Government Resolution No. 1356 "On Approving Requirements to Lighting Devices and Electric Lamps Used in Alternating Current Circuits for Lighting Purposes "(hereinafter the "Rules"). As mentioned above the "Rules" establish that the application of the requirements for lighting devices and electric lamps used in alternating current circuits for lighting purposes is carried out in two stages: Stage I from July

Table 2. Minimum Normalized Values of Light Output

Rated lamp power, W	η_{min}, lm / W	
	Stage I	Stage II
5	50	65
7	50	65
11	55	70
15	55	70
20	60	75
24	65	75
26	65	75
30	65	75
45	70	80

1, 2018 to December 31, 2019; Stage II from January 1, 2020. In both stages, special requirements are implemented on lamps and general purpose lamps, in accordance with which they must meet the requirements for energy efficiency and performance characteristics, as stipulated in the relevant document. In addition, at Stage II, the level of active power loss in the starting and regulating equipment of luminaires for public and industrial premises with fluorescent or induction lamps should not exceed 8 %. Further, according to the text of the Rules, the requirements for the energy efficiency of lamps and general purpose lamps are established, depending on their type and their nominal power, as well as the performance characteristics of lamps and general purpose lamps.

As an example of the requirements for individual types of lamps, it is given that the requirements for fluorescent lamps with integrated ballast: minimum normalized values of light output ($\eta_{\min}$) of compact fluorescent lamps (hereinafter referred to as CFLs) of non-directional light with a general colour rendering index of less than 90 (Table 2).

The following requirements are established for the performance of CFLs (Table 3).

As an example of the requirements for individual types of luminaires, the requirements for luminaires with dual based fluorescent and induction fluorescent lamps of different power (P) are given. For such luminaires intended for use in public premises, the minimum normalized values of the light output ($\eta_{\min}$) at stages I and II are the values indicated in Table 4.

The following minimum requirements for power factor of the luminaires are illustrated in Table 5.

Similar requirements are established for other types of lamps and luminaires. In the new Rules, unlike in previous ones, tungsten incandescent lamps are not mentioned at all, that is, the use of the latter is not implemented. This, of course, can be considered a positive direction in energy saving and improving the energy efficiency of lighting systems. However, the extent to which the national economy will be ready to apply these rules is primary. Taking into account fact that in the absence of the previous requirements for energy efficiency of lighting equipment the use of price as the main criterion in procurement for government or municipal needs often lead to the acquisition of the cheapest and most energy efficient goods. It should be noted that in order to solve this predicament, the Resolution of the Government of the Russian Federation “On the Approval of the Rules for Establishing Energy Efficiency Requirements for Goods, Works, and Services in the Conduct of Procurement for Ensuring State and Municipal Needs”, Decree No. 486 of the Government of the Russian Federation April 21, 2018 [13], changes were made. The Ministry of Economic Development of the Russian Federation is required starting from 2018 to conduct an annual analysis of the goods, their energy efficiency in procurement for the provision of the state or municipal needs. It is done for the purpose of identifying the categories of goods that use energy resources in amounts that make up a significant share in the consumption structure of certain groups of

Table 3. Phased performance of CFLs

Characteristic	Stage I	Stage II
Ignition Time	not more than 2 seconds	for lamps with a rated power less than 10 W not more than 1.5 seconds; for lamps with a rated power of at least 10 W not more than 1 second
Flare time to achieve 60 percent steady-state luminous flux	less than 60 seconds (less than 120 seconds for lamps that contain mercury amalgam)	less than 40 seconds (less than 100 seconds for lamps that contain mercury amalgam)
Lamp power factor	for lamps with a rated power less than 25 W not less than 0.5; for lamps with a rated power of at least 25 W not less than 0.9	for lamps with a rated power less than 25 W not less than 0.5; for lamps with a rated power of at least 25 W not less than 0.9
Total Colour Rendering Index	not less than 80	not less than 80
Coefficient of pulsation of the luminous flux	not specified	not more than 10 %

Table 4. Minimum Normalized Values of Luminous Efficiency

Lamps / Construction	Fluorescent T8		Fluorescent T5 (diameter 16 mm) (high light output)		Fluorescent T5 (diameter 16 mm) (high luminous flux)		Induction luminescent	
	P, W	η_{min}, lm/W	P, W	η_{min}, lm/W	P, W	η_{min}, lm/W	P, W	η_{min}, lm/W
Mirror reflector and diffuse diffuser	18	45	14	50	not used		70	45
			21	50			100	50
	36	50	28	55			150	50
	58	50	35	55			250	50
Mirror reflector and prismatic diffuser	18	50	14	55	not used		70	50
			21	55			100	55
	36	55	28	60			150	55
	58	55	35	60			250	55
Mirror reflector and open outlet	18	55	14	60	24	55	70	55
	36	60	21	60	39	60	100	60
			28	65	49	60	150	60
	58	60	35	65	54	60	250	60
					80	60		

state or municipal customers. The customers carrying out similar activities as well as the requirements of energy efficiency of goods, works, services in the implementation of public procurements, established by the legislation of foreign states, and the possibility of their application in the Russian Federation.

4. CONCLUSION

The study showed that the process of developing an energy-efficient economy, in general, and the electric power industry, in particular, in Russia, is at the stage of progressive development, al-

Table 5. Minimum Requirements for the Power Factor of Luminaires

Type of luminaire	Power factor, not less than	
	Stage I	Stage II
With fluorescent lamps	0.9	0.95
With sodium lamps of high pressure, with metal-halide lamps or with mercury lamps of high pressure	0.85	0.85
With LEDs at power consumption no more than 8 W	0.7	0.75
With LEDs at power consumption from 8 to 20 W	0.85	0.9
With LEDs at a power consumption of more than 20 W	0.9	0.95

though, not as active as is necessary for the purpose of building an information economy. At the same time, Russia still lags behind the leading countries in this area which actualizes the need for its careful legislative regulation. Despite the successful steps towards enhancing the efficiency of light energy, it must be remembered that LEDs and LED chips, which are becoming increasingly popular, despite their cost-effectiveness, progressiveness and ease of production may lead to a growing number of health concerns in the opinion of a number of health professionals as a result of the use of new technologies in the electric power industry [14]. Section 2.2 of the EU Green Paper states that the countries are responsible for the quality and safety of the LED products that are purchased and sold in Europe, and the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) Preliminary Recommendations of the Scientific Committee on New and Revealed Health Risks require that action be taken to reduce the abuse of artificial lighting in general. Therefore, before introducing LEDs with certain technical characteristics in Russian market and, primarily, with a large dose of blue light, especially for lighting schools and health care institutions in Russia, which is conducted under the SCENIHR and under UNDP (United Nations Development Program) program, it is required to obtain opinions from ophthalmologists, hygienists and electrical engineers of All-Russian Scientific-Research Light Engineering Institute, named in honour of S.I. Vavilov on the possibility of their use in public institutions without harm to human health. Therefore, it is required to include in the current legislation norms that not only promote the development of light energy in Russia but also to protect the health of Russians achieving the goals of constant development, for which it is apparent in determining all the technological characteristics of used LED modules and chips.

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