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Neustroev, Sergey S.; Arinushkina, Anna A.

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Kontakt/Contact

ZBW – Leibniz-Informationszentrum Wirtschaft/Leibniz Information Centre for Economics

Düsternbrooker Weg 120

24105 Kiel (Germany)

E-Mail: [rights\[at\]zbw.eu](mailto:rights[at]zbw.eu)

<https://www.zbw.eu/econis-archiv/>

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Energy Efficiency and Energy Saving in Public Schools: Federal Policy and Regional Perspectives from Russia

Sergey S. Neustroev, Anna A. Arinushkina*

Institute of Education Management of the Russian Academy of Education, 16 Zhukovskogo Str., 105062, Moscow, Russia.

*Email: anna.arin@mail.ru

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ABSTRACT

In general, the paper addresses the challenge of high energy intensity of the public organization in Russia. In particular, the study aims to investigate the key aspects of energy efficiency and energy saving policies in public schools, which have been adopted at the federal level and implemented in the regions of Russia. The paper provides a legal review of these policies in order to analyze the existing mechanisms of increasing energy efficiency in public schools. The monitoring mechanisms of public schools' energy efficiency and saving policies is also critically reviewed. In order to comprehensively analyze certain challenges of increasing energy efficiency in public schools, the paper includes results of in-depth interviews with school principals of both urban and rural educational organizations from the Siberian Federal District. Relying on the best world experiences and advanced scholarship, the authors provide a number of recommendations that could help to increase and sustain energy efficiency in the Russian public schools.

Keywords: Public School, Energy Efficiency, Energy Saving, Policy, Region, Russia

JEL Classifications: A29, I21, I25, Q38, Q48

1. INTRODUCTION

According to various estimates, Russia demonstrates one of the highest values of energy intensity of its GDP among all other industrially developed countries (ERIRAS, 2014; Byers Jr., 2017; Enerdata, 2018). More than that, the economic crisis in 2014-2015 heavily influenced the situation with Russia's energy intensity of GDP in a negative way (ACGRF, 2015, p. 11). Taking into account the challenges faced by Russia in terms of energy efficiency and energy saving, these issues are extensively covered in the contemporary scholarship. If one conducted a comprehensive review of the field, she or he would divide the whole pool of the literature into several categories.

First of all, there are studies that cover an array of general issues to energy efficiency and energy saving in Russia. Describing the general context of energy efficiency policies conducted by the Government

of Russia, the scholars focus in the effectiveness of such policies, including in a comparative perspective (Bulatov, 2012), analyze energy effectiveness of the Russian economy (Strakhova and Lebedinsky, 2012; Bessel', 2013), and review objectives and methods used for analyzing energy efficiency in an economy, employing Russia as an example (Chaika, 2018). Other researchers prefer to analyze Russia's energy efficiency performance in contrast to other BRICS or G7 countries (Camio et al., 2016), or they propose unconventional concepts (such as "green economy") for improving Russia's policies in the field of energy efficiency and saving (Matraeva et al., 2019). Taking into account Russia's size and uneven both geographical and economic development, a number of scholars prefer to focus on regional dimensions of energy efficiency and energy saving policies (Bayev et al., 2013; Ratner and Ratner, 2016).

Second, a great part of the contemporary scholarship deals with legal issues and regulatory frameworks in the field of energy

efficiency and saving. Concepts and general characteristics of electric power efficiency under the Russian energy legislation are reviewed in (Laskovaya, 2012). A comprehensive review of the Russian new energy efficiency act is presented in the paper written by (Malmendier, 2011), while the recent trends in the development of legislation and regulation of energy efficiency in Russia are covered by (Popov et al., 2012). More than that, such issues as Russia's energy efficiency accounting system (Bashmakov and Myshak, 2014), carbon taxation for better energy efficiency performance (Orlov et al., 2013), and energy efficiency investments (Boute, 2012) are also extensively analyzed in the contemporary scholarship.

Third, some researchers discuss energy efficiency of particular industries of the Russian economy. Of course, the fuel and energy complex is analyzed with special attention (Taraskina, 2008; Sokolov et al., 2017; Simonova et al., 2016; Syngellakis and Brebbia, 2018). Other industries are also covered, including agriculture (Taran et al., 2011; Bogoviz et al., 2018a), industrial production (Bogoviz et al., 2018b), civil construction (Gagarin and Kozlov, 2011; Gagarin and Kozlov, 2012; Bashmakov, 2016; Meshcheryakova, 2018).

Fourth, relevant energy efficiency and energy saving technologies, which might be used or already applied in Russia, are also actively reviewed by various researchers. It is worth noting the research conducted by (Tyutikov et al., 2016), in which they discuss the use of heat-reflective window screens in different regions of Russia. The impact of alternative energy technologies on energy efficiency of Russia's economy is also addressed in a number of research papers (Arbuzova et al., 2012).

Despite the urgency of increasing energy efficiency on Russia and the availability of many high-quality studies on this agenda, there is no single study analyzing energy efficiency policies aimed at increasing energy efficiency and energy saving of public schools. Public schools have to spend significant financial resources on energy consumption (FSSS, 2018). And this tremendous drain of educational rubles could be used for other educational purpose if energy saving and energy efficiency would increase. This would also help to reduce the management costs of public authorities and contribute to the reduction of greenhouse gas emissions. According to the research conducted by the Russian Academy of Education, by studying citizen's appeals, the issues of energy efficiency and energy saving in public schools are of high importance (Arinushkina et al., 2019).

We would like to note that there is a distinctive body of scientific research on energy efficiency and energy saving in public schools published in other countries of the world. First of all, they focus on space heating systems, ventilation, and cooling systems (Dall'O and Sarto, 2013; Wang et al., 2014a; Wang et al., 2014b). General indicators of energy consumption and strategies of energy preservation in schools constitute another subfield (Butala and Novak, 1999; Thewes et al., 2014; Salvalai et al., 2017). Other researchable topics on schools include benchmarking energy indicators (Sharp and Ridge, 1998; Filippín, 2000; Salleh et al., 2016), energy performance assessment (De Santoli et al., 2013), zero energy building targets (Ferrari and Romeo, 2017), energy and environment monitoring (Zinzi, 2015), etc.

Consequently, the goal of this research is to analyze the key aspects of energy efficiency and energy saving policies in public schools, which have been adopted and implemented in Russia. First of all, we critically review the existing legal framework, regulatory aspects, and monitoring mechanisms used in application to public schools in Russia in order to create a comprehensive understanding and identify concerning aspects. Then we provide results of in-depth interviews with school principals, indicating their perspectives, challenges, and concerns regarding energy efficiency and energy saving performance. On the basis of the analysis conducted and taking into account the best world experiences and advanced scholarship, we provide a number of recommendations that could help to increase and sustain energy efficiency in the Russian public schools in particular and in the budget sector in general.

2. MATERIALS AND METHODS

The paper presents an analysis of the key legal and program documents adopted by the Government of Russia with respect to increasing Russia's energy efficiency and energy saving. In particular, our analysis includes the following documents: (1) Presidential Decree No 889 of July 04, 2008 on Some Measures to Increase the Energy and Environmental Efficiency of Russia's Economy. (OPLI, 2008); (2) Federal Law No 261 of November 23, 2009 on Energy Saving, Improving Energy Efficiency, and Amending Certain Legislative Acts of the Russian Federation (OPLI, 2009); (3) Federal Program on Energy Efficiency and the Development of Energy in the Russian Federation until 2020 (Government of Russia, 2010); (4) Order of the Ministry of Energy of Russia of June 30, 2014 N 401 "On approval of the procedure for submitting information on energy saving and on improving energy efficiency" (Ministry of Energy, 2014). All these documents have established the mandatory for all regions federal policies and a monitoring mechanism used to trace energy efficiency and energy saving performance. Of course, we focus in our analysis only on those aspects that directly relate to energy efficiency and energy saving in public schools.

More than that, we conducted a series of in-depth interviews with school principals from the Siberian Federal District (SFD) with the purpose of analyzing their attitudes towards all these policies, their challenges, concerns, and trade-offs. We decided to turn to the SFD because of its cold climatic conditions and strong dependency on federal policies in the context of lacking financial resources. In particular, we focused on both urban and rural public schools in the Novosibirsk oblast (3 urban and 3 rural) and Altaiskiy krai (2 urban and 2 rural). All the interviews had open questions and were conducted by phone in March 2019.

The next section of the paper presents a legal analysis and results of our in-depth interviews with school principals.

3. RESULTS AND DISCUSSION

3.1. Legal Framework, Regulation, and Monitoring

This part of the paper carefully reviews the legal basis of energy saving and energy efficiency policies in Russia, including those

focused specifically on public schools. First of all, we provide a general overview of the key decisions adopted on the federal basis that solely establish the very foundation of energy saving and energy efficiency in Russia. Second, we turn our attention to the legal framework used to regulate energy efficiency and energy saving in the organizations owned by the state or municipalities, which allows to focus on the policies applied in public schools. And third, the monitoring mechanism used to track the progress in public schools' energy efficiency and saving performance is described and critically analyzed. This allows to build a comprehensive understanding of both policies and the monitoring mechanism in Russia's public schools. The documents reviewed in this part are presented in Table 1.

The Government of Russia seriously turned to the issues of energy security and energy saving during the presidency of Dmitri Medvedev, who signed the very famous Decree No 889 of July 04, 2008 on Some Measures to Increase the Energy and Environmental Efficiency of Russia's Economy (OPLI, 2008). The purpose of the Decree was to reduce the energy intensity of the gross domestic product of the Russian Federation by no <40% by 2020 compared to 2007, achieving rational and environmentally responsible use of energy and energy resources. In particular, Dmitri Medvedev instructed the Government of Russia to take certain measures on technical regulation of Russia's industry, construction, transport, housing and utilities for increasing their energy efficiency performance.

Another focus of the Decree considers stimulating and supporting energy-saving and environmentally friendly technologies, as well as strengthening the responsibility of business entities for non-compliance with standards for permissible environmental impact in order to stimulate the transition to energy-saving and environmentally friendly technologies. With respect to education, the Decree has the following provision: "... To consider the issue of incorporating the basis of ecological knowledge into federal state educational standards of basic general education."

It is worth noting that this Decree does not specify the need to include information on energy efficiency of Russia's economy (OPLI, 2008).

One year later, the State Duma passed the Federal Law No 261 on Energy Saving, Improving Energy Efficiency and Amending Certain Legislative Acts of the Russian Federation (OPLI, 2009), which was aimed at creating legal, economic, and organizational frameworks to stimulate energy conservation and energy efficiency in the country. According to the Law, Russia's legal regulation in the field of energy saving and energy efficiency is based on a number of principles, including (1) efficiency and rationality in using energy resources; (2) supporting and encouraging energy saving and energy efficiency; (3) ensuring systemic implementation of measures aimed at increasing energy efficiency and saving; (4) energy conservation and energy efficiency (OPLI, 2009).

The Law also (1) established powers and competencies of federal, regional, and local authorities in the field of energy saving and energy security; (2) provided for state regulation in the field of energy-saving and enhancing energy efficiency; (3) discussed energy saving and self-regulated organizations in the field of energy survey; (4) defined state support and state control in the field of energy saving and energy efficiency; and (5) regulated energy efficiency and energy saving in organizations with participation of the state or municipal establishments.

Of particular interest is the last point, because it strictly concerns public educational organizations. According to Article 25, organizations with state or municipality participation and organizations engaged in regulated activities must approve and implement programs in the field of energy saving and energy efficiency, containing: (1) The target indicators of energy saving and energy efficiency, the achievement of which should be achieved as a result of the implementation of these programs, and their values; (2) energy saving and energy efficiency measures,

Table 1: Energy efficiency and energy saving in Russia in the public sector: Legal and regulatory framework, statistical monitoring

No.	Date	Document	Policy/Measure
1	July 04, 2008	The Presidential Decree No 889 of July 04, 2008 on Some Measures to Increase the Energy and Environmental Efficiency of Russia's Economy. (OPLI, 2008)	The first official document on energy efficiency that sets a goal to reduce energy intensity of Russia's GDP by 2020 by no <40% from 2007 level.
2	November 23, 2009	The Federal Law No 261 of November 23, 2009 on Energy Saving, Improving Energy Efficiency, and Amending Certain Legislative Acts of the Russian Federation (OPLI, 2009)	Creates legal, economic, and organizational bases for stimulating energy conservation and improving energy efficiency in Russia's economy.
3	December 27, 2010	The Federal Program on Energy Efficiency and the Development of Energy in the Russian Federation until 2020 (Government of Russia, 2010)	Fully describe the public sector, etc.; make an emphasize on "budget organizations"
4	April 15, 2014	The State Program on the Development of Energy in the Russian Federation. (Government of Russia, 2014)	The Program states the following goal: "Ensuring reliable, high-quality and economically sound provision of the domestic market needs for energy carriers, energy and raw materials on the principles of energy saving and energy efficiency." This program includes the previous one. The measures are
5	June 30, 2014	Order of the Ministry of Energy of Russia of June 30, 2014 N 401 "On approval of the procedure for submitting information on energy saving and on improving energy efficiency" (Ministry of Energy, 2014)	The monitoring mechanism is approved.

expected results (in physical and monetary terms), including the economic effect of these activities. More than that, requirements for the form of programs in the field of energy conservation and energy efficiency of organizations with the participation of the state or municipality, organizations engaged in regulated activities, and reporting on the progress of their implementation are established by the authorized federal executive body (OPLI, 2009).

The Law also establishes certain requirements for programs in the field of energy conservation and energy efficiency, including: (1) Target indicators of energy saving and energy efficiency, which should be achieved as a result of the implementation of these programs (without specifying their values); (2) a list of mandatory measures for energy conservation and energy efficiency with the timing of their implementation; (3) energy efficiency indicators of facilities, the creation or modernization of which is scheduled, or investment programs of organizations engaged in regulated activities (OPLI, 2009).

In short, the Law established the legal foundation that regulates the issues of energy efficiency and energy saving policies in public organizations, obliging them to set target indicators and adopt energy efficiency and energy saving programs. Also, the Law established strict time limits for public organizations to mandatory install metering devices, their commissioning and transition to payments for energy resources according to an organization's actual consumption. In particular, public schools, according to the Law, all public schools in Russia had to reduce the volume of energy consumed over 5 years by at least 15% of the volume actually consumed in 2009, achieving the annual decrease of such volume by at least 3% (OPLI, 2009).

Another key stone in federal policies is the adoption of the first State Program on Energy Efficiency and the Development of Energy in the Russian Federation (Government of Russia, 2010), which later becomes subprogram of a larger one – the State Program on the Development of Energy in the Russian Federation (Government of Russia, 2014). Both these programs address issues of energy efficiency and saving in the budget organization, stating ambitious goals for reducing energy intensity and introducing energy efficient and energy saving technologies. It is worth noting that the Russian public schools are not indicated separately in these programs, but treated as part of all educational organizations owned by federal, regional, and local authorities.

The Order of the Ministry of Energy of Russia N 401 “On approval of the procedure for submitting information on energy saving and on improving energy efficiency” (June 30, 2014) sets up the monitoring mechanism used to evaluate energy efficiency and energy saving performance in public organizations, including in public schools (Ministry of Energy, 2014).

The mechanism is based on a number of forms of official statistics, namely: (1) No. 22-HCS “Information on the work of housing and communal organizations in the context of reform;” (2) No. VPO-2 “Information about the material and information base, financial and economic activities of the educational organization of higher education;” (3) No. SPO-2 “Information on the material and information base, financial and economic activities of a

professional educational organization;” (4) No. OO-2 “Information about the material, technical, and information base, financial and economic activity of the general education organization” (Ministry of Energy, 2014). In particular, only two indicators are used to monitor energy efficiency and energy saving performance in public school: (1) Specific heat consumption for the supply of state and municipal educational institutions, Gcal/sq. m; (2) specific consumption of electric energy for the supply of state and municipal educational institutions, kWh/sq. m.

In summary, the Government of Russia has created strong federal policies in the field of energy efficiency and energy saving, which are based on the comprehensive Federal Law No. 261 and two federal programs. Public schools are considered in the categories of “state-owned educational organizations,” “general educational organizations,” “budget organizations,” etc. They have to develop and submit organizational plans for increasing energy saving and energy efficiency, and their performance is monitored by only two indicators (consumption of heat and electric power).

3.2. School Principals on Energy Efficiency and Saving: In-depth Interviews

Since the publicly available results of monitoring do not provide enough information on the contemporary situation with energy efficiency and energy saving policies in public schools of Russia, we decided to conduct a series of in-depth interviews with school principals from both urban and rural education establishments in the SFD. As already mentioned in the Materials and Methods section, our interviews were conducted by phone and included (while not being limited by scope) the core questions regarding energy efficiency and energy saving policies in public schools.

On the basis of in-depth interviews, the following groups of issues could be identified: (1) Difficulties in achieving the target goals in current conditions; (2) formality of the existing monitoring mechanism; (3) lack of financial resources needed to significantly improve energy efficiency and saving performance; (4) absence of regional standards in energy management in public schools, as well as poor performance; (5) overwhelming presence of energy efficiency and saving propaganda vs. technical approaches, especially in rural schools. Let's review the results obtained in details.

First of all, the school principals interviewed by us are deeply concerned with the main provisions of the Federal Law No. 261 on Energy Saving, Improving Energy Efficiency and Amending Certain Legislative Acts of the Russian Federation. As already mentioned above, this Law forces public organization to significantly improve energy efficiency and saving at once and then continue this trend by at least 3%/year. They emphasize that this approach is too general and does not depend on other preexisting conditions, such as how old a school building is, what type of a heating system it has, how much resources have been received and could be allocated (Interviews No. SFD-1, SFD-4, SFD-5, SFD-9). One interviewee notes that “... the pressure is high, everyone has to perform well, but there are no substantial assistance and free financial resources” (Int. No. SFD-4).

Second, all school principals negatively reviews the existing monitoring mechanism put in place by the federal Ministry of Energy. In their perspective, the information collected by the authorities does not really represent schools' energy efficiency performance and is not linked to any stimulation mechanisms (Int. No. SFD-1-10). In other words, even if a school made certain progress, there would be no guarantees that its excellent performance is noted and financially supported. They argue in favor of a much more comprehensive monitoring mechanism, which can be also a part of a wider stimulation mechanisms, enforcing the public schools to perform better each year (Int. No. SFD-1, 2, 5, 10). More than that, such a monitoring mechanism should be regionally specific, taking into account climate conditions, regional funds allocated for educational organizations, and individual organization's stance (Int. No. SFD-3, 7).

Third, all schools are experiencing the lack of financial resources to significantly improve their energy efficiency and saving. Our research clearly shows that the school principals totally acknowledge the importance of energy saving and increasing energy efficiency, but the really effective solutions involve significant financial resources, which are not available to many of them. Some school heads (SFD-3, SFD-7, SFD-9, SFD-10) also treat the issue of energy efficiency and energy saving as a "luxury" one, because there are much more important questions to deal with (and how to spent very limited budgets): The material base (desks, tables, computers, office equipment, sanitary goods, etc.), catering, staff, educational process (books, sports equipment, chemical reagents, etc.), and others.

Fourth, the absence of regional standards and poor performance is another major common concern noted among the school principals interviewed by us. Regional standards are necessary when developing and strengthening regional policies aimed at increasing energy efficiency and energy saving, because Russia has a very diverse climate and all public schools cannot be treated in the same way (Int. No. SFD-2, 5, 9, 10). In particular, the Interviewee No. 2 argues that the previous energy audits went to nothing, and higher authorities just submitted these results without turning them into any measures and policies. Some school principals also note that there should be regional standard of energy audits being connected to the regional policies and strongly incorporated into organizational energy efficiency plans (Int. No. SFD-1, 4, 5). More than that, several school principals discuss the absence of an effective system for training energy management competencies for ensuring better energy efficiency and saving policies (Int. No. SFD-1, 2, 6, 7, 8, 10). They just receive, as noted by Interviewee No. 8, "dry" recommendations which are not linked to any previous best available practices or technologies and often do not make sense in a regional context.

Fifth, in the context of the already mentioned challenges faced by the school principals, we noted a worth noting aspect in the use of energy efficiency and energy saving propaganda in schools. Both rural and urban school principals argue that in the context of poor financial resources and, consequently, the inability of school principals to allocate educational rubles into energy efficiency, they are forced to expand the array of their measures and even

solely rely on energy efficiency and energy saving propaganda, in order to report at least some progress (Int. No. SFD-3, 4, 5, 8, 9).

Thus, our in-depth interviews with the school principals from SFD allowed us to get insights into their attitudes towards all these policies, their challenges, concerns, and trade-offs. In short, they experience difficulties in achieving the target goals in current conditions and do not approve the existing monitoring mechanism. They note the lack of financial resources needed to significantly improve energy efficiency and saving performance and speak in favor of creating regional standards in energy management in public schools. The interviewees argue that there is no effective system for providing training in energy management and note the overwhelming presence of energy efficiency and saving propaganda vs. technical approaches, especially in rural schools.

3.4. Policy Recommendations

We would like to provide a number of policy recommendations for both federal and regional authorities on the basis of the conducted analysis.

First of all, there is an urgent need to significantly improve the monitoring mechanism which is used to evaluate public school's energy efficiency and energy saving performance. We propose to use the benchmarking system based on regional and local characteristics and needs, i.e. it is to be developed by regional and municipal authorities, in accordance with general standards and requirements, especially because they are mostly aware of such characteristics and opportunities. A well-developed set of primary determinants of energy use would be much more precise and serve a clear indicator and standard for school principals.

Such a monitoring mechanism should not "exist solely for itself," but be effectively connected in the already existing system of education governance and financial support in order to create necessary incentives for increasing energy efficiency and saving in public schools. In our perspective, the Ministry of Education could better cooperate and coordinate its policies with the Ministry of Energy's leading role in energy efficiency policies, stimulating both federal and regional authorities to implement more coherent measures.

Second, in spite the occupant behavior is very important in increasing energy saving and efficiency (De Leon Barido et al., 2018; Ebrahimigharehbaghi et al., 2019), cultural and educational measures should not dominate in school's efforts to improve its energy performance. There should be, in our perspective, much more financial opportunities provided for schools on a competitive basis to cover costly costs of changing the heating systems, isolation systems, ventilation systems, etc., i.e. those systems making up the technical characteristics of building. All these measures should be incorporated in development strategies of schools and strictly monitored.

Third, our research identifies the urgent need to improve energy management in schools. Despite educational seminars and training programs to be available for school principals and those in charge of public school's energy efficiency, regional and local authorities

need to develop for schools and with schools a set of strategies that would help to set performance and cost-effective targets. This could also help to improve the absence of an effective energy retrofit planning and increase awareness of the current state of energy efficiency and energy saving challenges. Another coin of such recommendation is the dissemination of best available technologies and practices.

4. CONCLUSION

The analysis conducted in the paper reveal the key aspects of energy efficiency and energy saving policies in public schools, which have been adopted at the federal level and implemented in the regions of Russia. The paper provided a legal review of these policies with the purpose of analyzing the existing mechanisms of increasing energy efficiency in public schools. The monitoring mechanisms of public schools' energy efficiency and saving policies was also critically reviewed. In order to comprehensively analyze certain challenges of increasing energy efficiency in public schools, the paper relied on the results of in-depth interviews with school principals of both urban and rural educational organizations from the SFD, which provided highly valuable insights into their attitudes towards all these policies, their challenges, concerns, and trade-offs. More than that, the authors provide a number of recommendations that could help to increase and sustain energy efficiency in the Russian public schools.

REFERENCES

- ACGRF, Analytical Center of the Government of the Russian Federation. (2015), Russian Energy. Available from: <http://www.ac.gov.ru/files/publication/a/10205.pdf>.
- Arbuzova, E.V., Shcheklein, S.E., Gladikov, I.A., Kholmakov, A.A., Shastin, A.G. (2012), Technological aspects of efficiency of biomass energy potential in Russia. *Alternative Energy and Ecology*, 3(107), 82-88.
- Arinushkina, A., Neustroev, S., Bakhtin, M., Dovbysh, S. (2019), Ensuring citizens' needs and interests with respect to general education in Russia and abroad: Management approaches. *Journal of History Culture and Art Research*, 8(1), 67-78.
- Bashmakov, I. (2016), Improving the energy efficiency of Russian buildings: Forecast to 2050. *Problems of Economic Transition*, 58(11-12), 1096-1128.
- Bashmakov, I., Myshak, A. (2014), Russian energy efficiency accounting system. *Energy Efficiency*, 7(5), 743-759.
- Bayev, I.A., Solovyova, I.A., Dzyuba, A.P. (2013), Regional reserves of energy efficiency. *Ekonomika Regiona*, 3, 180-189.
- Bessel, V. (2013), On assessment of the Russian economy's energy efficiency. *Drilling and Oil*, 12, 18-23.
- Bogoviz, A.V., Lobova, S.V., Ragulina, Y.V., Alekseev, A.N. (2018a), A critical review of Russia's energy efficiency policies in agriculture. *International Journal of Energy Economics and Policy*, 8(3), 67-75.
- Bogoviz, A.V., Lobova, S.V., Ragulina, Y.V., Alekseev, A.N. (2018b), Russia's energy efficiency policies in the industry sector: Critical perspectives. *International Journal of Energy Economics and Policy*, 8(3), 48-56.
- Boute, A. (2012), Modernizing the Russian district heating sector: Financing energy efficiency and renewable energy investments under the new federal heat law. *Pace Environmental Law Review*, 29(3), 746-810.
- Bulatov, A.M. (2012), Accessing the effectiveness of energy policies: A comparative analysis of the US and Russia. *Russian Foreign Economic Newsletter*, 6, 25-41.
- Butala, V., Novak, P. (1999), Energy consumption and potential energy savings in old school buildings. *Energy and Buildings*, 29, 241-246.
- Byers, J.R Jr. (2017), Russian energy efficiency: Can extraction tax policy improve energy intensity? Available from: https://www.eu.spb.ru/images/centres/ENERPO_RC/Reports/2017-07-03_Russian_Energy_Efficiency.pdf.
- Camio, F.C., Morales, H.F., Mariano, E.B., Rebelatto, D.A.N. (2016), Energy efficiency analysis of G7 and BRICS considering total-factor structure. *Journal of Cleaner Production*, 122, 67-77.
- Chaika, L.V. (2018), Objectives and methods of analyzing energy efficiency in the economy. *Economic and Social Changes: Facts, Trends, Forecasts/Ekonomicheskie i Sotsialnye Peremeny: Fakty, Tendencii, Prognoz*, 11(2), 117-126.
- Dall'O, G., Sarto, L. (2013), Potential and limits to improve energy efficiency in space heating in existing school buildings in northern Italy. *Energy and Buildings*, 67, 298-308.
- De Leon Barido, D.P., Suffian, S., Kammen, D.M., Callaway, D. (2018), Opportunities for behavioral energy efficiency and flexible demand in data-limited low-carbon resource constrained environments. *Applied Energy*, 228, 512-523.
- De Santoli, L., Fraticelli, F., Fornari, F., Calice, C. (2013), Energy performance assessment and a retrofit strategies in public school buildings in Rome. *Energy and Buildings*, 68, Part A, 196-202.
- Ebrahimigharehbaghi, S., Qian, Q.K., Meijer, F.M., Visscher, H.J. (2019), Unravelling Dutch homeowners' behaviour towards energy efficiency renovations: What drives and hinders their decision-making? *Energy Policy*, 129, 546-561.
- Enerdata. (2018), Energy Intensity Russia. Available from: <https://www.yearbook.enerdata.net/total-energy/world-energy-intensity-gdp-data.html>.
- ERIRAS, Energy Research Institute of the Russian Academy of Sciences. (2014), Global and Russian Energy Outlook. Available from: https://www.eriras.ru/files/2014/forecast_2040_en.pdf.
- Ferrari, S., Romeo, C. (2017), Retrofitting under protection constraints according to the nearly Zero Energy Building (nZEB) target: The case of an Italian cultural heritage's school building. *Energy Procedia*, 140, 495-505.
- Filippin, C. (2000), Benchmarking the energy efficiency and greenhouse gases emissions of school buildings in central Argentina. *Building and Environment*, 35(5), 407-414.
- FSSS, Federal State Statistics Service. (2018), Russia in Numbers. Available from: http://www.gks.ru/free_doc/doc_2018/rusfig/rus18.pdf.
- Gagarin, V.G., Kozlov, V.V. (2011), Prospects for energy efficiency improvement of residential buildings in Russia. *MGSU Bulletin*, 3(1), 192-200.
- Gagarin, V.G., Kozlov, V.V. (2012), Energy efficiency improvement of residential buildings in Russia. *Energy: Economics, Technology, Ecology*, 5, 25-32.
- Government of Russia. (2010), Order of the Government of the Russian Federation. Available from: <http://www.garant.ru/products/ipo/prime/doc/55070341>.
- Government of Russia. (2014), Resolution of the Government of the Russian Federation. Available from: <https://www.minenergo.gov.ru/system/download/323/95096>.
- Laskovaya, I.A. (2012), Electropower Efficiency in the Russian Federation: Concepts and General Characteristics Under the Energy Legislation of Russia. Vol. 3. Moscow: Bulletin Moscow University of the MIA of Russia. p31-35.
- Malmendier, B. (2011), New Russian energy efficiency Act. *Journal of Energy and Natural Resources Law*, 29(2), 177-208.

- Matraeva, L., Solodukha, P., Erokhin, S., Babenko, M. (2019), Improvement of Russian energy efficiency strategy within the framework of “green economy” concept (based on the analysis of experience of foreign countries). *Energy Policy*, 125, 478-486.
- Meshcheryakova, T. (2018), Increase in Energy Efficiency of the Residential Building in Russia. Vol. 193. MATEC Web of Conferences. p05005.
- Ministry of Energy. (2014), Order of the Ministry of Energy of Russia. Available from: <https://www.gisee.ru/articles/documentation/56557>.
- OPLI, Official Portal of Legal Information. (2008), Executive Order No 889 on Some Measures to Increase the Energy and Environmental Efficiency of Russia’s Economy. Available from: <http://www.pravo.gov.ru/proxy/ips/?docbody=&nd=102122361>.
- OPLI. (2009), The Federal Law No 261. Available from: <http://www.pravo.gov.ru/proxy/ips/?docbody=&nd=102133970>.
- Orlov, A., Grethe, H., McDonald, S. (2013), Carbon taxation in Russia: Prospects for a double dividend and improved energy efficiency. *Energy Economics*, 37, 128-140.
- Popov, V.A., Polyakova, E.A., Dzhavatova, D.A. (2012), Development of legislation and regulatory regulation of energy efficiency in Russia. *Standards and Quality*, 7, 22-27.
- Ratner, S.V., Ratner, P.D. (2016), Regional energy efficiency programs in Russia: The factors of success. *Region*, 3(1), 71-87.
- Salleh, M.N.M., Kandar, M.Z., Sakip, S.R.M. (2016), Benchmarking for energy efficiency on school buildings design: A review. *Procedia Social and Behavioral Sciences*, 222, 211-218.
- Salvalai, G., Malighetti, L.E., Luchini, L., Girola, S. (2017), Analysis of different energy conservation strategies on existing school buildings in a pre-alpine region. *Energy and Buildings*, 145, 92-106.
- Sharp, T.R., Ridge, O. (1998), Benchmarking Energy Use in Schools. Proceedings of the ACEEE 1998 Summer Study on Energy Efficiency in Buildings. Available from: <http://www.citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.172.1234>.
- Simonova, L., Rudenko, D., Kholodionova, A. (2016), Energy Efficiency Management in the Russian gas Industry. Vol. 1. Bulgaria: Proceedings of the International Multidisciplinary Scientific GeoConference SGEM. p317-323.
- Sokolov, A.D., Muzychuk, S.Y., Muzychuk, R.I. (2017), Energy-economic analysis of the far East fuel and energy complex. *Bulletin of Irkutsk State Technical University*, 21(1), 141-155.
- Strakhova, N.A., Lebedinsly, P.A. (2012), Analysis of energy efficiency of the Russian economy. *Don Engineering Newsletter*, 3(21), 840-843.
- Syngellakis, S., Brebbia, C.C. editors. (2018), Challenges and Solutions in the Russian Energy Sector. Cham: Springer International Publishing: Imprint: Springer.
- Taran, V.V., Magomedov, A.D., Sokolova, J.E. (2011), Energy efficiency of agriculture abroad and in Russia. *AIC: Economics, Management*, 7, 83-88.
- Taraskina, Y.V. (2008), About factors of efficiency growth of fuel and energy complex in Russia and the Astrakhan region. *Bulletin of Astrakhan State Technical University*, 4(45), 147-153.
- Thewes, A., Maas, S., Scholzen, F., Waldmann, D., Zürbes, A. (2014), Field study on the energy consumption of school buildings in Luxembourg. *Energy and Buildings*, 68, 460-470.
- Tyutikov, V.V., Smirnov, N.N., Lapateev, D.A. (2016), Analysis of energy efficiency from the use of heat-reflective window screens in different regions of Russia and France. *Procedia Engineering*, 150, 1657-1662.
- Wang, Y., Zhao, F.Y., Kuckelkorn, J., Li, X.H., Wang, H.Q. (2014b), Indoor air environment and night cooling energy efficiency of a southern German passive public school building operated by the heat recovery air conditioning unit. *Energy and Buildings*, 81, 9-17.
- Wang, Y., Zhao, F.Y., Kuckelkorn, J., Liu, D., Liu, J., Zhang, J.L. (2014a), Classroom energy efficiency and air environment with displacement natural ventilation in a passive public school building. *Energy and Buildings*, 70, 258-270.
- Zinzi, M., Battistini, G., Ragazzini, V. (2015), Energy and environmental monitoring of a school building deep energy renovation in Italy. *Energy Procedia*, 78, 3318-3323.