

“Organizational and financial mechanisms for implementation of the projects in the field of increasing the energy efficiency of the regional economy”

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ORGANIZATIONAL AND FINANCIAL MECHANISMS FOR IMPLEMENTATION OF THE PROJECTS IN THE FIELD OF INCREASING THE ENERGY EFFICIENCY OF THE REGIONAL ECONOMY

Abstract

Nowadays budgetary funds still prevail among sources of financing of the projects in the area of increasing the energy efficiency of the regional economy in the Russian Federation. For example, in the Tver region in 2016, 82% of the projects for the modernization of the heat supply infrastructure and 100% for the modernization of the electricity supply infrastructure were implemented at the expense of the budget. At the same time, there is a decrease in the total amount of state financing of energy efficiency projects due to a high proportion of the budget deficit of the subjects of the Russian Federation. According to the agency ACRA (information dated April, 12, 2017 at www.acra-ratings.ru), 58 out of 85 regional budgets for 2017 were accepted with a total deficit of 193 billion rubles. At the same time, the urgency of applying organizational and financial mechanisms for the implementation of energy efficient projects involving alternative financing is growing. The article systematizes the views on the perspective mechanisms for implementing projects in the field of increasing the energy efficiency of the regional economy, including taking into account the analysis of problems of their application in the example of the Tver region. The authors studied existing organizational and financial mechanisms for energy-efficient projects, including public private and municipal private partnerships, and the Local Initiatives Support Program.

Keywords

investment project, increasing energy efficiency, regional economy, public private partnership (PPP), municipal private partnership (MPP), Local Initiatives Support Program (LISP)

JEL Classification O13, O18, O22

INTRODUCTION

In the countries of the European Union and in the United States, the state plays a leading role in regulating the development of energy efficiency and resource saving systems. This regulation is carried out through the adoption of relevant legislation and government programs. These programs are aimed, in particular, to improve the energy efficiency of residential buildings and objects of engineering and social infrastructure through the introduction of standardization and certification, and the priority of procurement of energy efficient goods and services for state needs, etc. (Silich, Aksenov, & Silich, 2015).

The main target "20-20-20" was adopted in accordance with the Decision of the European Commission on November 11, 2008, and created a base for the development of energy efficiency system in the

EU. This target means 20% increasing energy efficiency and reducing greenhouse gas emissions by 2020. Moving towards this goal, European countries face market barriers, and also barriers related to behavioral and social aspects of energy efficient policy (Kern, Kivimaa, & Martiskainen, 2017; Bukarica & Tomšić, 2017; Gooding & Gul, 2017). The United States declared the goal of 50% reducing greenhouse gas emissions by 2030, but some institutional barriers nowadays are challenging in achieving this goal (Romanov, 2014; Hargadon & Kenney, 2012; Lee, Kim, & Chong, 2015; Ross, Sperling, & Guhathakurta, 2016).

The task of increasing the energy efficiency in the regions of Russia is important due to widespread wasteful use of energy resources in production, maintenance and consumption spheres. Especially low level of energy efficiency is observed at the energy enterprises, organizations of the budgetary sphere, and also in housing and communal sector. Therefore, during the recent years serious steps have been taken in the country to formulate a modern energy efficiency policy, which is being successfully implemented in most developed countries. The foundations of this policy are formulated in the Law 261-FZ, in the corresponding programs and orders of the Government of the Russian Federation adopted in 2010–2016, and in other regulatory documents.

However, no obvious success in this area has been achieved so far. This is due to the lack of a comprehensive approach to the implementation of this policy in the regions. Also certain mistakes of the federal center influenced the low level of progress in energy efficiency increasing, including decision making on allocation of budget funds for conducting energy surveys and drawing up “energy passports” for public sector institutions. These “energy passports” for a number of schools, libraries and other budgetary institutions turned out to be formal and poorly used documents, and did not become a methodological base for taking specific measures to save energy and improve the energy efficiency.

Recently there was a tendency to reduction of energy intensity of the Gross Regional Product (GRP) in some regions, but the rates of this reduction are very low. In a number of regions, the GRP has even increased in 2014 compared to 2013 (Makeykina & Pankov, 2013), and this trend continues to persist.

For example, in St. Petersburg in 2016, compared with 2015, energy intensity increased from 74.83 to 83.03 kg of standard fuel per 10 thousand rubles, in the Leningrad region from 261.29 to 263.40 kg of conventional fuel per 10 thousand rubles (Liapukhin & Habachev, 2016).

The energy efficiency rating of the subjects of the Russian Federation conducted in 2016 showed that only 8 regions of 85 have comparatively low energy intensity of the GRP. In general, the country continues the tendency of uneven energy efficiency of the economy on a national scale, the indicators of subjects in the rating are from 0.1 to 59.0 (Sergeeva, 2016).

At the same time, the main tools for increasing energy efficiency in the regions are projects that can be implemented within the framework of organizational and financial mechanisms that require scientific systematization and research.

1. REVIEW OF PREVIOUS LITERATURE

Different issues of energy efficiency and resource saving were researched by scientists in wide spectrum of fields of knowledge. Feature of economic scientific works is that they identify the problem and looking for solutions primarily with positive economic effects consider other effects as complementary.

Russian economists Romanova (2014), Tulikov (2015), Chernov (2015) developed economic and organizational aspects of energy efficiency and resource saving. The works of these authors have identified international experience in implementing energy efficient projects, the potential prospects for cooperation between Russia and the European Union in the field of increasing energy efficiency, which was taken into account

in the selection of respondents for interviews.

Liapukhin and Habachev (2016) identified the principles of functioning of the energy market in Russia, and proved the absence of coordination between the electricity market and the thermal energy market. In our opinion, this aspect confirms the need for adjustments at different levels of energy policy. In the process of adjustment there should be involved authorities and energy sector enterprises.

The works of Makeykina and Pankova (2013) examines the financial aspects of the implementation of program measures on energy saving and energy efficiency in the region on the example of the Republic of Mordovia. These authors consider the target indicators of the program and identify the negative trend of consumption of fuel and energy resources in the Republic of Mordovia. The scientists outlined the path to prosperity of Russia through the reducing energy intensity of regional economies.

Analysis of the impact of various factors on the energy efficiency of territorial entities represented in the works of Aksenov, Silich and Silich (2015). The authors proved that the private investments are the necessary element for the effective functioning of the heating systems of the municipalities.

At the same time, the public authorities of the regions, first of all, are interested in solving social problems, in the development of the engineering and transport infrastructure of the territory, which, of course, is extremely important, and the energy efficiency policy is moving to a secondary level (Chernov, 2015).

Mechanisms for implementation of the projects in the sphere of increasing the energy efficiency of the regional economy have been considered in the works of various authors.

At the present stage, Russian regions implement the various practices of initiative budgeting, such as Local Initiatives Support Program (LISP), Russian project "People's Budget"; program "People's Initiative"; regional state programs in Tula region, Tambov region program "I'm planning the budget", etc. (Golubeva, 2016).

A promising mechanism for attracting investment, including in the energy sector facilities, as part of best practices of proactive budgeting, such as LISP, was described in the works of Vagin (2016), Golubeva (2016), Shulga and Sukhova (2016).

Initiating budgeting can be considered as the first phase of the development of a participatory budgeting in the Russian Federation by virtue of a significant number of its features (Vagin, 2016).

Participatory budgeting is a process of development and approval, and/or distribution of the budget of the municipality as part of the project approach with the use of forms of public participation in the implementation of local government and/or with the assistance of the Commission, consisting of representatives of the municipal administration and its population.

The best and most common practice in Russia in the field of participatory budgeting is Local Initiatives Support Program (LISP). LISP is under realization in 8 regions of Russia: Stavropol region, Kirov region, Tver region, Nizhny Novgorod region, Khabarovsk region, the Republic of Bashkortostan, the Republic of North Ossetia Alania, the Jewish autonomous region. From 2007 to 2015, in the Russian regions, there have been implemented more than 3,000 projects. By the end of 2016, their number will increase up to 4000 (Shulga & Sukhova, 2016).

Public private partnership projects as a mechanism for implementation of the projects in the field of increasing the energy efficiency of the regional economy have been studied in the works of Vorotnikov (2017), Kern, Kivimaa, and Martiskainen (2017), Li et al. (2016).

The practice of developing LED street lighting in Germany using the bank loans was studied in the works of Polzin, Flotow and Nolden (2016).

Financial leasing (equipment leasing) is the main mechanism for the projects aimed to increase energy efficiency through implementation of new information technologies (Mathew, Dunn, & Sohn, 2015; Fan et al., 2015; Koseleva & Ropaite, 2017).

Ways of developing financial mechanism of energy service were studied in the works of Aasen, Westskog, and Korneliussen (2016).

Hargadon and Kenney (2012) consider the practice of using venture capital for the development of clean technologies in the Russian regions within the framework of concession agreements. This financial mechanism requires the approval of an economically justified tariff with an investment component.

Despite the fact that presented publications studied different aspects of the implementation of energy efficient projects, there is a lack of systematized information and analysis of the possibilities of applying organizational and economic mechanisms in specific regions of the Russian Federation.

2. MATERIALS AND METHODS

2.1. Experimental research base

Experimental base for identification of problems and patterns in the test field were the representatives of the municipalities of the Tver region.

2.2. Phases of the research

The research includes the following phases:

The first phase started with the identification of the main problem, goals and objectives of the study. Then the literature review created the basis for the theoretical analysis of the given problem executed by other experts and proposed solutions. Primary data were also collected by the authors through the series of interviews with the representatives of the public authorities in the Tver region.

At the second stage, the authors continued with the qualities research of the organizational and financial mechanisms for the implementation of the projects in the field of increasing the energy efficiency of the regional economy. The main attention was paid to the following:

- specificity of using loans to finance the implementation of projects;
- financing options in the framework of public private and municipal private partnership projects;
- possibility of increasing energy efficiency through the implementation of projects of the Local Initiatives Support Program;
- features of the energy service contracts.

The third stage includes the experimental study identifying the problems of the implementation of the energy efficient projects at the pilot territory, which was the Tver Region. Based on the results of the quantitative and qualitative research, the authors developed conclusions and recommendations for the experts dealing with the implementation of the projects in the field of increasing the energy efficiency.

3. RESULTS

3.1. Available organizational and financial mechanisms for the implementation of energy efficient projects

Under the organizational and financial mechanism for the implementation of the projects in the field of increasing the energy efficiency of the regional economy, the authors understand the set of the forms of organization of financial relations, the methods of allocating and using financial resources in the region to implement the projects aimed to decrease the energy intensity of GRP and modernize the energy infrastructure. The main mechanisms, according to the authors, include:

- 1) debt financing (allocating of the loans);
- 2) financial leasing (equipment leasing);
- 3) tariff regulation (approval of an economically justified tariff with an investment component);

- 4) public private and municipal private partnership;
- 5) participatory budgeting, including the Local Initiatives Support Program;
- 6) energy service mechanism (ESCO contract).

The possibilities of applying certain organizational and financial mechanism for the implementation of investment projects in the energy sector depend to a large extent on the legal scheme for managing energy infrastructure facilities in a particular municipality (see Table 1). As an example of the energy infrastructure facilities in the Table 1 there are presented heat supply facilities, including boiler houses, thermal power plants and heat networks.

The materials of Table 1 show that municipal ownership on objects of local heating system infrastructure challenges the implementation of such financial models like bank loans or leasing.

Banks and leasing companies require a mandatory provision of the guaranties for the return of the resources provided, but the municipal property (assets) cannot be considered as liquid collateral. In addition, many municipal budgets are currently scarce and do not provide co-financing for the investment costs of municipal infrastructure projects. These conditions prove the considerable complexity (and, in practice, the impossibility) of liabilities (credit, leasing) resources for municipal projects of reconstruction and modernization of municipal infrastructure in the case of keeping

municipal ownership of heating facilities. Accordingly, the most usable financial model for the municipalities is increasing tariffs on energy services by including the investment component. This model, of course, unpopular from the point of view of the population of the territory.

However, it is easier to use banking loans and leasing models with alternative heating facility organizational charts (concession, private ownership of the object of new construction). Thus, the effective option for raising funds for reconstruction (modernization) of heating system infrastructure in modern conditions is the transfer of municipal property to private property (for a certain time – a concession, or permanently – private ownership of the newly built object). In this case, the concession scheme at present seems most appropriate for the concessionaire, as well as for the grantor.

For a new object of the heat supply infrastructure, it is important that the economically justified tariff (EJT) is established at the level sufficient for paying back the loan or returning the investments. In the case of the difference between EJT and the tariff established for the population of the territory (the so-called inter-tariff difference), it should be covered from the regional budget funds.

Thus, the effective option of raising funds for reconstruction (modernization) of energy infrastructure facilities in modern conditions is the transfer of municipal property to private ownership (for a certain time – a concession, or indefinitely – private ownership of a new constructed facility). At the same time, the concession mechanism

Table 1. Organizational and financial mechanisms for allocating investment resources under various legal schemes for managing heat supply facilities

Organizational chart of local heating systems	
Municipal ownership	Concession
	Private ownership on the object of new construction
TARIFF REGULATION	
Adding the investment component to the tariff on energy services	
FINANCIAL STRUCTURING	
Difficulties in implementation loan, leasing, sharing financing (PPP or MPP)	Easy to implement loan, leasing, sharing financing (PPP or MPP)
ENERGY SERVICE MECHANISM	
High risks for ESCO in energy service mechanism	Low risks for ESCO in energy service mechanism

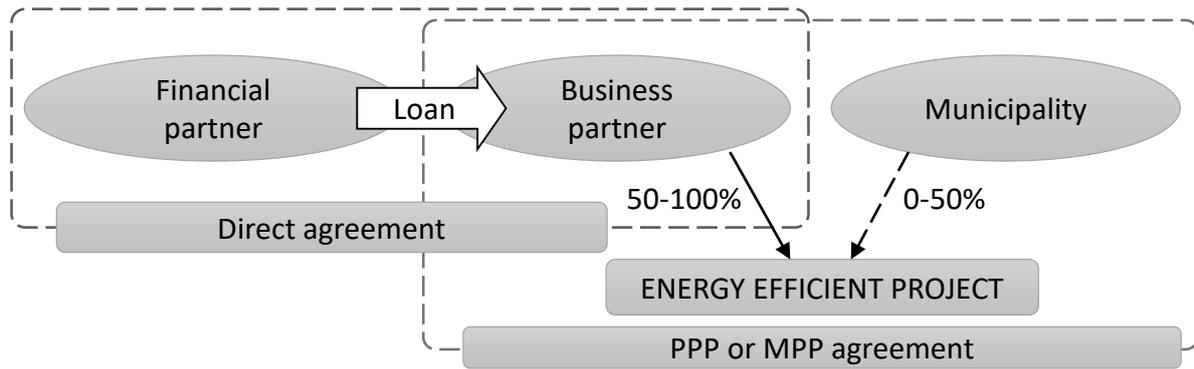


Figure 1. Organizational and financial schemes for financing energy efficiency projects through PPP and MPP

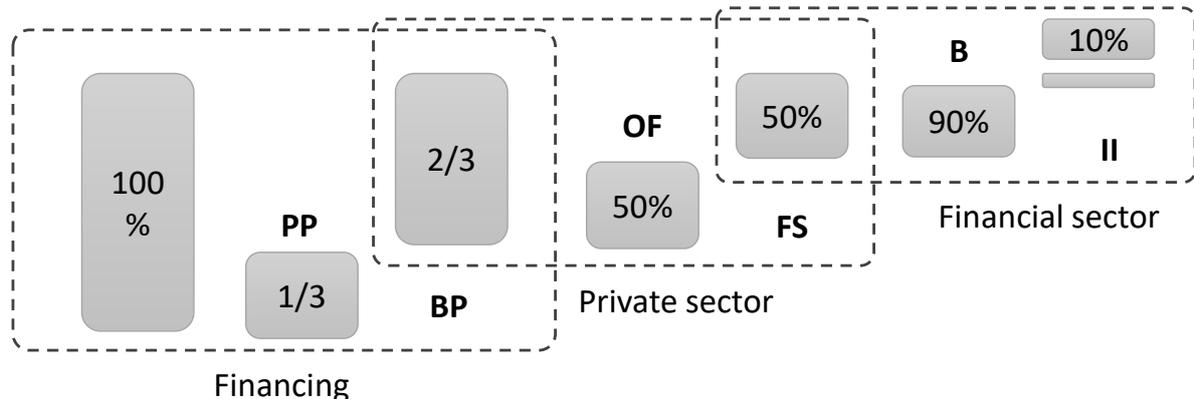
is currently the most acceptable for both the concessionaire and the concedent.

The legal regulation of the implementation of PPP and MPP projects in the Russian Federation allows business partners participating in projects to borrow funds from the financing entity. In this context, financial institutions, such as banks, factoring companies, as well as other business entities and partnerships, should be considered as the financial partner in the first place. In this case, the process of financing PPP and MPP projects can be represented in the form of the interaction shown in Figure 1.

Alternative model of financing of energy efficient projects in the framework of PPP or MPP under the direct agreement is presented in Figure 2.

When financing or co-financing the business projects within the designated structure, there are some specific risks to which entrepreneurs are more sensitive than the public partner. First of all, this is liquidity risk, because the long-term infrastructure projects are less liquid. Investing in long-term projects with the involvement of borrowed funds, businesses (especially small and medium) almost completely deprives themselves of opportunities to invest in other projects, and to change the investment decision is also not possible.

But we still can consider the funding of energy efficiency projects within the PPP or MPP as quite promising option. However, at the present stage, the implementation of such projects is challenged by the set of institutional, legal, information and



Note: PP – Public Partner; BP – Business Partner; OF – Own Financing; FS – Financial Sector; B – Banks; II – Institutional Investors.

Figure 2. Model for financing of energy efficiency projects in the framework of PPP or MPP under the direct agreement

economic problems. For solving these problems, in our opinion, the sufficient political decisions will be useful. The most important step has been taken by adopting a fundamental federal law on PPP and MPP, which allows for the first time as part of the project approach to increase the property assets of the business, which is an important aspect of the development of forms of its existence.

Financing proactive budgeting projects in Russia includes such areas like electricity, heat, gas and water supply maintenance and construction of local public roads, bridges and other engineering structures at the territory of the municipality, construction and maintenance of housing, creation of infrastructure for private housing construction, etc.

Creation of objects in the framework of LISP has three mandatory sources of co-financing: the regional budget (fixed assets of the project provided in the form of subsidies), the municipal budget (funds allocated for the solution of local problems), and the money contribution from the population. On average, according to the information from the subjects engaged in the program, 68% of the cost of the project is co-financed from the regional budget, 16% is from the local budget, and 10% is the contribution of the population. The remaining 6% is a contribution from local businesses.

Every year, in the regions of the Russian Federation, in the framework of LISP, there were conducted more than 1,500 residents meetings with participation of more than 200,000 people. In addition, even greater number of people are taking part in the so-called pre-event to discuss projects in public opinion polls, and other meetings in small group format, involving totally up to 70% of the adult population of the participating municipalities (Shulga & Sukhov, 2016).

Another promising areas for the implementation of the projects in the field of increasing the energy efficiency and resource saving using the mechanisms of PPP, MPP and LISP are the following: power generation, transmission and distribution, water and heat supply systems, solid waste management, energy efficiency of buildings (construction and modernization).

Energy efficient projects in the field of water supply, street lighting, and solid waste management

account for not less than a third of all LISP projects implemented in the subjects of the Russian Federation. Projects in the field of water supply in 8 regions of the Russian Federation from 2007 to 2016 accounted for 19% of all projects implemented, 4% projects in the field of street lighting, 8% projects in the field of solid waste management.

And despite the fact that, from the position of the amount of investments, such projects can be attributed to the microlevel, their combined implementation during the year gives a significant synergistic effect for the region.

At the same time, projects in the sphere of heat and power supply remain practically non-demanded, while their implementation will lead to positive economic effects for the regional budget, the local budget, and for the residents of the territory of project implementation, first of all, due to the reduction of tariffs for heat energy.

An alternative option for financing projects to improve energy efficiency can be energy service as a form of raising financing for the modernization of worn-out infrastructure of communal heating facilities.

Energy service contracts (ESCO) are an innovative mechanism for financing energy saving projects, which gives customers the following advantages:

- ensuring a guarantee of achieving the energy saving effect in the form of reducing the cost of generating or supplying heat, reducing heat consumption, reducing costs for repairing equipment, etc.;
- access to external investment sources. The implementation of energy-saving measures is carried out at the expense of the resources of the energy service company. This eliminates the need for the municipal Customer to release its own investment resources or to attract loans.

Currently, there are a number of projects structured under the concession scheme, but the successful implementation of these projects through the energy service mechanism is under question due to increased financial risks, as a result of which energy service companies are not yet rushing to invest in

similar projects, especially when interacting with municipal customers.

If the ESCO has achieved savings less than the ones declared in the contract, then it not only does not receive payment for services, but also still pays a penalty fee. This is possible if there is poor information about the energy state of the object, the base period or the verification method is incorrectly chosen, and not optimal technical solutions. To level the risks, it is necessary to understate the value of the claimed economy by 15-20%. This increases the payback period and reduces the interest of banks in lending the project.

The state or municipal customer, bodies authorized to place orders for these needs, are required to place orders for the supply of goods, the performance of work, services provided in accordance with the requirements of energy efficiency of these goods, works and services.

The obligation of the contractor provided for by the energy service contract is the provision of contractual savings in kind in the respective costs of the customer for the supply of energy resources without taking into account savings in value terms.

In the most advanced regions, administrations are actively involved in the implementation of energy saving programs for buildings of budgetary institutions.

3.2. Problems and practices of implementation of the projects in the field of increasing the energy efficiency in the regions of Russia

3.2.1. *Barriers to increasing the energy efficiency of the regional economy*

One of the most important objectives at the phase of elaboration of energy saving policy, both at the level of regions and at the national level, is the real assessment of the barriers to increasing the energy efficiency of the regional economy.

Within the framework of the research work carried out in 2016 on the instructions of the Union of

Enterprises for the Development of Energy Efficiency and Ecological Safety (France), the experience of the subjects of the Russian Federation in the implementation of relevant projects was analyzed, which made it possible to identify the main groups of these barriers. The barriers were classified as institutional, legal, financial and economic, scientific and technical, information and market-related.

Institutional barriers are primarily due to the lack of a state body directly responsible for the elaboration and results of the implementation of the national energy saving policy at the regional level (now the formation of such bodies has begun in accordance with the latest policy documents on energy efficiency). Also, institutional barriers are related to the procedure of establishing energy prices not under the market conditions, but under administrative decisions.

One of the main barriers is the low level of success in energy service contracts. That is, for example, if the owner of the housing property is changing, he is not obliged to continue paying the energy service contract. The next barrier is an unclear definition of the requirements for what minimum number of votes of owners of premises in an apartment building is necessary for making a decision on concluding an energy service contract.

One of the significant barriers to the implementation of energy efficiency measures in multi-apartment buildings is the need to sign an energy service contract by each owner of the premises in the house. This paragraph makes the signing of an energy service contract virtually unrealistic if the house has several hundred apartments privatized by all family members. The next barrier is the absence in the structure of fees for living quarters and energy services.

Financial and economic barriers are associated with a lack of investment resources from the state, municipalities and energy consumers and, at the same time, with weak economic stimulation of energy saving. Among them are a long period of investment payback for energy saving projects due to high interest rates of bank loans, inadequate mechanisms for the return of investments by energy service organizations from energy savings for budget organizations, lack of foreign investment in the current "economic climate"; insufficient economic stimulation of the implementation of renewable energy sources.

Widely used abroad organizational and financial mechanisms for implementation of energy efficient projects, such as financial leasing, third party financing, issuing energy saving bonds, etc., are used on a very limited scale in Russia. That leads to the lack of financial resources. Regions need to attract external investment sources, while they have very low level of own budgets.

Scientific and technical barriers are associated with a reduction in the scope of research and development in the field of energy saving in the Russian Federation under the influence of a lack of financial resources, inadequate implementation of the results of energy saving R&D already performed in industrial production, as well as a significant proportion of obsolete and consequently inefficient equipment in industries and energy consumption.

Information barriers arose due to insufficient information support for energy consumers and managers responsible for strategic decisions, including investment in the energy and other sectors of the economy, about the opportunities and benefits of saving energy, the availability and cost of various types of energy-saving equipment, appliances and energy-saving services.

Market barriers are associated, in particular, with lobbying the interests of individual manufacturing companies in the market for energy saving equipment and technologies, as well as lack of experience and culture of marketing research, business planning, project management related to energy saving.

3.2.2. Mechanisms for implementation of the projects in the field of increasing the energy efficiency in assessments of regional and local authorities

For the pilot study of difficulties of carrying out projects in the field of increasing the energy efficiency, authors have chosen the Tver region.

Today the region needs to implement large scale measures in the field of energy saving and energy efficiency at the municipal sector, including housing, communal services and transport. This means the necessity of attraction of serious

investment resources to make possible the serious improvements in the Tver region.

The tasks of increasing the energy efficiency of the regional economy and reducing energy using in the budgetary sector of the Tver region could be solved through creating the conditions for increasing the energy efficiency of communal infrastructure systems, the depreciation of which in the regions is estimated at 50-90%.

According to the latest energy efficiency rating of the subjects of the Russian Federation, the Tver region corresponds to an indicator of 27.7 with an average of about 35 in the variation range of 0.1 to 59 (Sergeeva, 2016).

In November 2016, a survey had been conducted with participation of representatives of regional (18%) and municipal (82%) authorities, whose professional activity is directly or indirectly linked to energy efficient projects.

Respondents included the following areas in the list of the most promising for carrying out projects and cooperation with potential investors in increasing energy efficiency:

- heating supply (construction of new and modernization of existing boiler houses, reconstruction of pipe lines, etc.) – 36%;
- water supply and wastewater treatment (replacing equipment with more energy-efficient, etc.) – 26%;
- solid waste management (development of waste-to-energy infrastructure, etc.) – 23%;
- housing maintenance (walls insulation, windows replacement, etc.) – 14%;
- street lighting (replacing equipment with more energy-efficient, etc.) – 1%.

Respondents evaluated existing financial models and their implementation for energy efficient projects in the Tver region. The most known and used model is within the framework of local initiatives support program (Figure 3).

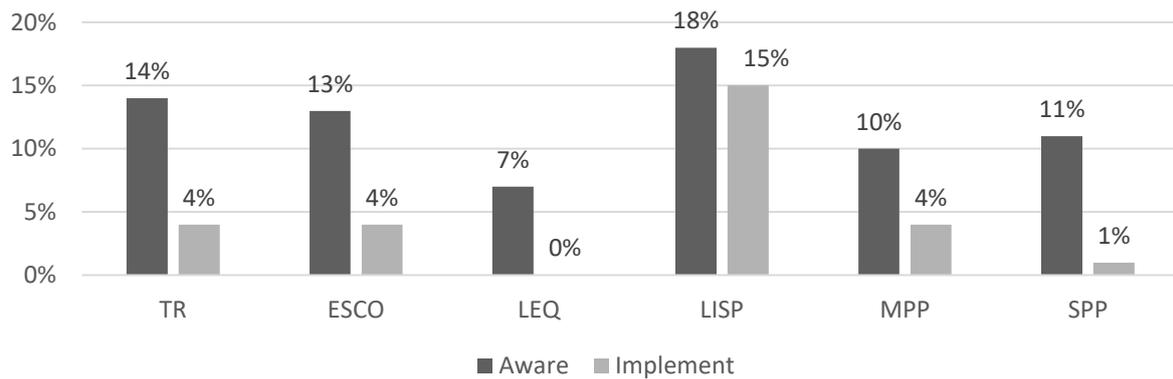


Figure 3. Percentage of awareness and implementation of the organizational and financial mechanisms for the implementation of projects in the area of increasing the energy efficiency in the Tver region

During the study, representatives of regional and municipal authorities were invited to evaluate the awareness and implementation of the following organizational and financial mechanisms in the Tver region (Figure 3):

- financing of energy saving measures through tariff regulation (TR);
- energy service contracts (ESCO);
- leasing of energy efficient equipment (LEQ);
- Local Initiatives Support Program (LISP);
- municipal private partnership (MPP);
- public private partnership (PPP).

The majority of respondents evaluated the condition of municipal infrastructure operating in the territory of the Tver region as “satisfactory” (66%), this means the objects are functioning, but need repairing in the nearest future. 26% of respondents evaluated the municipal infrastructure condition as “unsatisfactory” (facilities require urgent repair). Only 9% of respondents noted the good condition of communal infrastructure areas (facilities are operating normally, only require preventive measures). However, only 3% of respondents assess the condition of electricity supply facilities as “good”, and 6% assess the condition of the heat supply facilities as “good”. Condition of water supply and waste water treatment is estimated as “satisfactory” only by 65% of respondents, and

“unsatisfactory” by 35%. Evaluation of energy efficiency of social infrastructure buildings in the territory of the region can be represented as follows:

- 6% of buildings have a good level of energy efficiency;
- 80% of buildings have a satisfactory level of energy efficiency;
- 14% of buildings have an unsatisfactory level of energy efficiency.

Good condition means that special programs were implemented to improve the energy efficiency of the social infrastructure buildings, e.g., energy efficient windows were installed. Satisfactory condition means, that energy efficient programs were partially implemented, e.g., only energy efficiency certificates were issued. Unsatisfactory condition means that even energy efficiency certificates were not issued, no activities have been conducted.

As the most promising for implementation in the Tver region, authorities consider the projects on construction of waste processing facilities (57%), development of separate collection of municipal solid waste (29%), construction of processing facilities for certain types of waste (11%), organizing of biogas collection at the landfills (3%).

69% of respondents noted that energy efficiency increasing aspects during the construction or

Table 2. The distribution of investments in the objects of municipal infrastructure of the Tver region

Objects	Period		
	Within the last year B – 82 % P – 1 % J – 17 %	Within 2-3 years B – 61 % P – 18 % J – 21 %	Within 3-5 years B – 49 % P – 16 % J – 35 %
Heating supply	B – 82 % P – 9 % J – 9 %	B – 73 % P – 18 % J – 9 %	B – 50 % P – 38 % J – 12 %
Water supply/waste water treatment	B – 56 % J – 44 %	B – 44 % J – 56 %	B – 55 % P – 9 % J – 36 %
Electricity supply	B – 100 %	B – 67 % P – 33 %	B – 42 % P – 17 % J – 41 %
Solid waste management	B – 85 % J – 15 %	B – 60 % P – 20 % J – 20 %	B – 50 % J – 50 %

major repairs of buildings in the territory are taken into account. At the same time, 86% of respondents said that the funds allocated from the budget of the territory is not enough to solve the problems in the area of energy efficiency of social infrastructure facilities. No one municipality does not have sufficient funding of these expenses from the local budget.

Recent investments in municipal infrastructure were made over the past 5 years from private and budgetary sources in the equal proportions. Within the last year (32%), within 2-3 years (32%) and (36%) within 3-5 years. The distribution of municipal infrastructure objects and investments by groups of “budgetary investments” (B), “private investment” (P), “joint investments” (J) is presented in Table 2.

Thus, the trends in the distribution of investment by source (in general, for all objects) can be represented as follows (Figure 4).

Some parameters of investing in the projects of communal infrastructure, such as the average volume of investments over a certain period of time on a certain type of object, the maximum and minimum amounts invested are presented in Table 3.

Some municipalities (about 2%) didn't have any investments in electricity facilities, and municipal solid waste management infrastructure for more than 10 years.

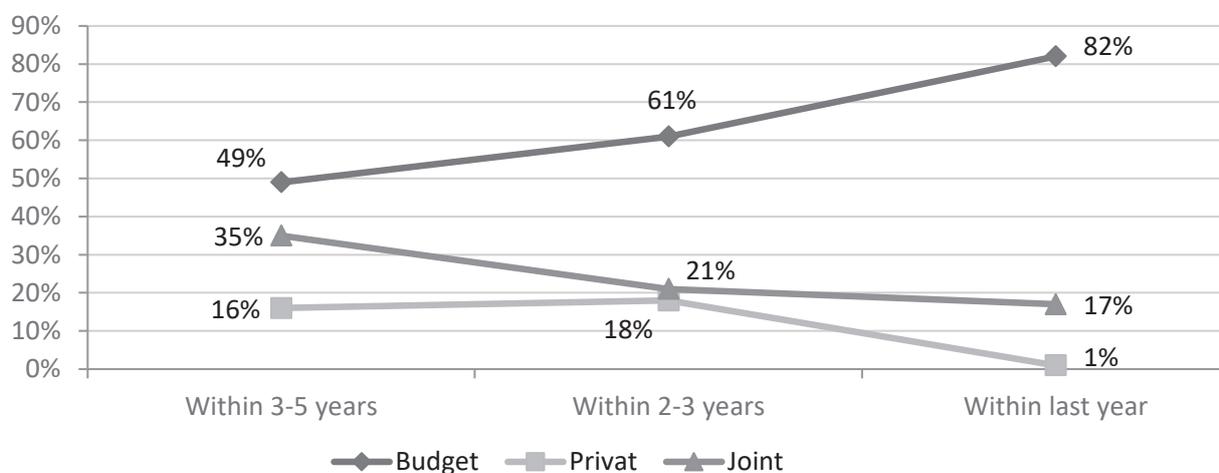


Figure 4. Trends in the distribution of investments in the communal infrastructure (by source)

Table 3. The volume of investments per municipality in the Tver region

Period Objects	Within the last year	Within 2-3 years	Within 3-5 years
Heating supply	\bar{X} – 40,6 million RUR X_{\max} – 155 million RUR X_{\min} – 0,4 million RUR	\bar{X} – 8,3 million RUR X_{\max} – 15 million RUR X_{\min} – 3,8 million RUR Example: 10 million RUR in the framework of investments program	\bar{X} – 8,8 million RUR X_{\max} – 40 million RUR X_{\min} – 0,8 million RUR
Water supply/waste water treatment	\bar{X} – 4,98 million RUR X_{\max} – 10 million RUR X_{\min} – 1 million RUR	\bar{X} – 5,5 million RUR X_{\max} – 15 million RUR X_{\min} – 0,3 million RUR	\bar{X} – 8,3 million RUR X_{\max} – 20 million RUR X_{\min} – 1,2 million RUR
Electricity supply	\bar{X} – 0,9 million RUR X_{\max} – 1,2 million RUR X_{\min} – 0,5 million RUR Example: 1,2 million RUR in the framework of LISP	\bar{X} – 22,5 million RUR X_{\max} – 30 million RUR X_{\min} – 15 million RUR	–
Solid waste management	–	X – 2 million RUR (investments in one municipality)	X – 100 million RUR (investments in one municipality)

CONCLUSION

At present, in the Russian Federation, the problem of high energy intensity of GRP impedes sustainable growth of regions, while the tendency of uneven energy efficiency of the economy on a national scale remains.

The regional and municipal authorities are aware of the problem of high energy intensity of the GRP. But until now contractors do not seriously take into consideration aspects of the energy efficiency during construction and capital repairs of buildings in the regions, first of all, due to insufficient financial security of the budgets of regions and municipalities.

Within the period under review (5 years), the number of energy-efficient projects and the amount of involving private capital decreased significantly. This fact led to the necessity of allocation of budget funds for the maintenance of heat, water and electricity supply systems, and solid waste management and sanitation facilities.

The identified problems are correlated with the barriers described in this study. The barriers were classified as institutional, legal, financial and economic, scientific and technical, information and market-related. These barriers are typical for all subjects of the Russian Federation, and to overcome them the regions need to developed and implement the strategy for increasing energy efficiency, involving studied organizational and financial mechanisms.

The main mechanisms for implementing projects in the sphere of increasing the energy efficiency of the regional economy in Russia are the following: allocation of the loans, financial leasing, tariff regulation, public private partnership and municipal private partnership, participatory budgeting, energy service.

The authors analyzed the existing practice and possibilities of the application of organizational and financial mechanisms for implementation of the projects in the field of increasing the energy efficiency in the Tver region, and came to the following conclusions.

Most representatives of regional and municipal authorities do not have enough knowledge about possible options for implementation of energy efficient projects. For example, only 7% of respondents aware of the mechanism that presupposes the leasing of energy-efficient equipment.

The practice of applying these mechanisms also remains quite rare, despite the fact that almost a third of the communal infrastructure facilities in the region are worn out, requires urgent repairs. Most projects at the objects of social infrastructure (health, education, culture, sports) are focused on the implementation of approved energy saving measures to increase energy efficiency of the buildings. At the same time, the regions need to take the broader approach to energy efficient modernization of communal complex, including building ecoindustrial parks for waste processing.

RECOMMENDATIONS

This paper provides information for regional and municipal authorities, energy sector representatives, investors and enterprises of various organizational and legal forms, involved in generation, transmission and use of energy. In particular, in the field of heating, water supply, solid waste management, construction and modernization of buildings.

REFERENCES

1. Aasen, M., Westskog, H., & Korneliussen, K. (2016). Energy performance contracts in the municipal sector in Norway: overcoming barriers to energy savings? *Energy Efficiency*, 9, 171-185.
2. Bukarica, V., and Tomšić, Ž. (2017). Energy efficiency policy evaluation by moving from techno-economic towards whole society perspective on energy efficiency market. *Renewable and Sustainable Energy Reviews*, 70, 968-975. Retrieved from <http://www.sciencedirect.com/science/article/pii/S1364032116310747>
3. Chernov, S. S. (2015). Факторный анализ энергоэффективности экономики Новосибирской области [Faktornyy analiz energoeffektivnosti ekonomiki Novosibirskoy oblasti]. *Innovatsii*, 1(195), 103-107.
4. Gooding, L., & Gul, M. S. (2017). Achieving growth within the UK's Domestic Energy Efficiency Retrofitting Services sector, practitioner experiences and strategies moving forward. *Energy Policy*, 105, 173-182. Retrieved from <http://www.sciencedirect.com/science/article/pii/S030142151730126X>
5. Golubeva, Ye. (2016). Внедрение программ инициативного бюджетирования в регионах России [Vnedrenie programm initsiativnogo byudzhetrovaniya v regionakh Rossii]. *Munitsipalnaya vlast*, 2-3, 7.
6. Fan, C., Xiao, F., Madsen, H., & Wang, D. (2015). Temporal Knowledge Discovery in Big BAS Data for Building Energy Management. *Energy and Buildings*, 190, 75-89.
7. Hargadon, A. B., & Kenney, M. (2012). Misguided Policy? Following Venture Capital into Clean Technology. *California Management Review*, 54(2), 118-139.
8. Kern, F., Kivimaa, P., & Martiskainen, M. (2017). Policy packaging or policy patching? The development of complex energy efficiency policy mixes. *Energy Research & Social Science*, 23(1), 11-25. Retrieved from <http://www.sciencedirect.com/science/article/pii/S2214629616302638>
9. Koseleva, N., & Ropaite, G. (2017). Big Data in Building Energy Efficiency: Understanding of Big Data and Main Challenges *Procedia Engineering*, 172, 544-549.
10. Lyapukhin, N. Ye., Khabachev, L. D. (2016). Принципы, организация и условия функционирования энергетических рынков в России [Printsipy, organizatsiya i usloviya funktsionirovaniya energeticheskikh rynkov v Rossii]. *Nedelya nauki SPbPU materialy nauchnoy konferentsii s mezhdunarodnym uchastiyem. Rossiya, Sankt-Peterburg: Sankt-Peterburgskiy politekhnicheskiiy universitet Petra Velikogo* (pp. 279-281).
11. Lee, S., Kim, Y., & Chong, W. K. (2015). A Statistical Analysis of Effectiveness of Energy Policy in the United States: Incentives vs. Regulations. *Procedia Engineering*, 118, 1282-1287. Retrieved from <http://www.sciencedirect.com/science/article/pii/S1877705815021384>
12. Li, J., Gong, L., Chen, Z., Zeng, L., Yang, G., & Zhang, J. (2016). The Hierarchy and Transition of China's Urban Energy Efficiency. *Energy Procedia*, 104, 110-117. Retrieved from <http://www.sciencedirect.com/science/article/pii/S1876610216315752>
13. Makeikina, S. M., & Pankova, R. I. (2013). Финансовое обеспечение программных мероприятий энергоэффективного произ-

- водства и энергосбережения в регионе [Finansovoe obespechenie programnykh meropriyatiy energoeffektivnogo proizvodstva i energoberezheniya v regione]. *Regionologiya*, 4(85), 155-164.
14. Mathew, P. A., Dunn, L. N., & Sohn, M. D. (2015). Big-data for building energy performance: Lessons from assembling a very large national database of building energy use, *Applied Energy. Procedia Engineering*, 140, 85-93.
 15. Polzin F., Flotow, P., & Nolden, C. (2016). Modes of governance for municipal energy efficiency services – The case of LED street lighting in Germany. *Journal of Cleaner Production*, 139, 133-145. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0959652616309969>
 16. Romanova, T. A. (2014). Нераскрытый потенциал сотрудничества России и Европейского союза в области энергоэффективности и возможности Балтийского региона [Neraskrytuyu potentsial sotrudnichestva Rossi i Evropeyskogo soyuza v oblasti energoeffektivnosti i vozmozhnosti Baltiyskogo regiona]. *Baltiyskiy region*, 1(19), 29-45.
 17. Ross, C., Sperling, E., & Guhathakurta, S. (2016). Adopting a New Energy Economy in the United States. *Energy Procedia*, 88, 139-145. Retrieved from <http://www.sciencedirect.com/science/article/pii/S1876610216301023>
 18. Sergeeva, E. (2016). Югра возглавила общероссийский рейтинг по энергоэффективности [Yugra vozglavila obscherossiyskiy reyting po energoeffektivnosti]. *Regionalnaya energetika i energoberezhenie*, 6, 60-61.
 19. Shulga, I., Sukhova, A. (2016). Программа поддержки местных инициатив в России: пример лучшей практики инициативного бюджетирования [Programma podderzhki mestnykh initsiativ v Rossii: primer luchshey praktiki initsiativnogo budzhetrovaniya]. *Munitsipalnaya vlast*, 2-3, 8-19.
 20. Silich, M. P., Aksenov, S. V., & Silich, V. A. (2015). Analysis of factors influence the energy efficiency of territorial entities. *Modern informatization problems in economics and safety Proceedings of the XX-th International Open Science Conference* (pp. 134-139). Yelm, WA, USA.
 21. Tulikov, A. V. (2015). Энергосервис – по плану [Energoservis – po planu]. *Regionalnaya energetika i energoberezhenie*, 1, 25-31.
 22. Vagin, V. V. (2016). Теоретические аспекты развития инициативного бюджетирования в России [Teoreticheskie aspekty razvitiya initsiativnogo budzhetrovaniya v Rossii]. *Nauchno-issledovatel'skiy finansovyi institut: Finansovyi zhurnal*, 3(31), 105-114.
 23. Vorotnikov, A. M. (2017). Использование государственно-частного партнерства для финансирования проектов создания и развития минерально-сырьевых центров [Ispolzovanie gosudarstvenno-chastnogo partnertstva dlia finansirovaniya proektov sozdaniya i razvitiya mineralno-syrevykh tsentrov]. *Regionalnaya energetika i energoberezhenie*, 2, 56-57.