Assessment of energy efficiency of initiative budgeting projects in the Yamalo-Nenets Autonomous district

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Abstract. Some approaches to evaluating energy-efficient initiative budgeting projects are presented on the example of Yamalo-Nenets Autonomous district, the region of the Arctic zone of the Russian Federation. Formulas and an algorithm for evaluating the effectiveness of budgeting initiative project implementation to improve the energy efficiency of housing and communal complex are developed. An evaluation approach for energy efficiency of street lighting systems is proposed based on basic and optional criteria.

1. Introduction

Initiative (participatory) budgeting projects have been implemented in Russia since 2007 within the framework of various mechanisms. Most of them are characterized by the possibility of creating or reconstructing a public infrastructure object at the expense of the regional and municipal budget. An object as well as financial and (or) non-financial participation in the project has been determined by the local community of a municipality. At the same time, the main source of funding for such projects has been a regional budget.

Various mechanisms of participatory budgeting are implemented in more than 40 regions of Russia, including the Arctic zone of the Russian Federation.

The largest number of possible infrastructure facilities that can be involved in initiative budgeting is located in the Yamalo-Nenets Autonomous district. On the territory of the region, the projects under consideration are implemented within the framework of the current program "Citizens' budget initiative". The list of project objects corresponds to the issues of local significance stipulated in Federal law 131-FZ "On General principles of local self-government in the Russian Federation".

The funds provided for the implementation of local initiatives in localities of the Autonomous district are used for public infrastructure facilities, which implies the possibility of implementing energy-efficient projects.

According to the current energy efficiency rating, the Yamalo-Nenets Autonomous district is ranked 6th among the regions of the first category of estimated budget security. Subjects are divided into categories in accordance with the level of estimated budget security, determined in accordance with the decree of the Government of the Russian Federation issued on 22.11.2004 No. 670 "On the distribution
of subsidies for equalizing the budget security of the subjects of the Russian Federation" according to the following criteria: 1 and above – category 1; 0.7 – 1 – category 2; below 0.7 – category 3.

The outcome indicator of the Yamalo-Nenets Autonomous district energy efficiency rating corresponds to 45 points out of the possible 85 with an actual maximum of 59 points. The best indicators in the Arctic zone of the Russian Federation is 54.4 points by the Murmansk region.

Among the factors affecting outcome indicator, there are: energy efficiency of street lighting, the energy efficiency of the heat supply sector, promotion of energy efficiency and energy saving in the region. Those factors can be improved in the framework of implementation of energy efficient initiative budgeting projects.

In accordance with the program of the Yamalo-Nenets Autonomous district "Energy efficiency and energy development, providing high-quality housing and communal services to the population for 2014-2024", stimulating the implementation of projects in the field of energy saving and energy efficiency through the use of various economic mechanisms is noted as one of the priorities.

Special climatic conditions of the Arctic zone in the Russian Federation require the introduction of energy-efficient intelligent technologies [1].

Today, the region uses a unified methodology for evaluating initiative budgeting projects to conduct a competitive selection of projects for providing inter-budget transfers in the form of grants to municipalities of the Yamalo-Nenets Autonomous district in order to encourage the implementation of the project "Citizens' budget initiative", which does not take into account the environmental, social and budgetary effects that can be obtained from projects implemented in various areas of the infrastructure complex.

The purpose of the article is to develop approaches to evaluating and detecting energy-efficient initiative budgeting projects on the example of the Yamalo-Nenets Autonomous district.

The use of methods for evaluating energy-efficient initiative budgeting projects will allow local governments to determine the most economically justified decision at the pre-project phase, and regional authorities to include the project in the program in accordance with the highest social efficiency.

2. Methods for evaluating energy efficient projects with regional budget funding

Currently, multitude of methods for evaluating the effectiveness of projects with budget funding is well known.

"The methods used for evaluating projects and the types of project effectiveness differ depending on the point of view from which it is analyzed, and the appropriate ways to determine the benefits and costs, as well as methods for measuring and co-measuring them over time" [2].

In some works of Russian scientists, it is proposed to evaluate the effectiveness of projects with regional funding in two main directions. The first is based on the consideration of the region as an administrative-territorial unit of the Russian Federation and the identification of existing characteristics and specifics of the region that affect this assessment. The second direction for evaluating the effectiveness of projects involves the theory of evaluating capital-forming investment projects.

One of the most common methods that meet this principle is the evaluation method proposed by G. V. Bobylevet al. [3] and disclosed in the works of E. N. Parfenova [4]. The system of estimated performance indicators for a project financed from the regional budget, according to this method, is shown in figure 1.

V. P. Anufriev, et al. suggest implementing a variable assessment of the impact of priority energy efficiency projects on the energy efficiency indicators of the territory's economy and energy security. This assessment is based on taking into account the effect that each of the implemented projects has on the initial indicators of energy efficiency of the economy and energy security, as well as determining the additional cumulative effect (if any) from the implementation of a set of interrelated projects [5].

The described and other published approaches can be applied to projects of initiative budgeting, but they do not take into account the specifics of the programs under which the projects under consideration are implemented.
3. Assessment of energy-efficient projects of initiative budgeting implemented at heat and power facilities

Existing practice shows that the implementation of energy-efficient projects at specific heat and power facilities in municipalities (boilers, etc.) exclusively at the expense of private investors leads to an investment surcharge to the tariff for heat supply for the population of the territory where the project is being implemented. At the same time, since there are legal restrictions on the possibility of an annual tariff increase (an average of 4% for the Yamalo-Nenets Autonomous district over 3 years), the part of the rate increase that cannot be covered by the population, called the "inter-tariff difference", is covered by the regional and local budget.

In this case, the following formula can be used to calculate budget efficiency ($E_b$) for regional and local budgets:

$$E_b = \frac{\Delta T \times H}{F_b},$$

(1)

**Figure 1.** The system of performance indicators of projects with financing from the regional budget

*Source:* compiled by authors using [3, 4]
where \(\Delta IT\) is the planned value of the inter-tariff difference, which was avoided as a result of the implementation of an energy-efficient project within the framework of the initiative budgeting, rather than by the heat supply organization within its own investment programs, RUB/GCal.

\(H\) is useful heat output to the reconstructed object of a heat supply, sq m; 
\(F_b\) is the amount of project financing by the regional and local budgets, rubles.

Social efficiency \(E_s\), or effectiveness of the project implementation for the population living in the territory, can be defined as follows

\[
E_s = \frac{\Delta T \times HS}{F_p},
\]

where \(\Delta T\) is the planned increase in the heat supply tariff, which was avoided as a result of the implementation of an energy-efficient initiative budgeting project, RUB/sq. m; 
\(HS\) is the size of the housing stock served by the heat supply facility, sq. m; 
\(F_p\) is the amount of financing for an energy-efficient project initiated by the population of the municipality, in rubles.

Unquestionably, energy-efficient initiative budgeting projects should cause a social effect in form of improving the quality of heat supply services provided.

The algorithm for calculating the efficiency of implementation the initiative budgeting project in the direction of improving the energy efficiency of heat supply for housing and communal complex on the example of the Yamalo-Nenets Autonomous district is shown in figure 2.

The given algorithm specifies the indicator of co-financing from the population, provided that the project also involves legal entities, individual entrepreneurs, and public organizations that provide financial support to the initiatives of the population of the municipality. In all other cases, the indicator of co-financing by the population should be greater than zero.

Actual tariffs for thermal energy in municipalities of the Yamalo-Nenets Autonomous district for 2019 are shown in table 1.

| Municipality          | Rates (including VAT) | from 01.01.2019 | from 01.07.2019 |
|-----------------------|-----------------------|-----------------|-----------------|
| Salekhard             |                       | 1 434,62        | 1 459,01        |
| Labytnangi            |                       | 1 434,62        | 1 459,01        |
| Nadym                 |                       | from 1 434,62   | to 1474,62      |
| Nadym district        |                       | from 282,08     | to 1434,62      |
| Novy Urengoy          |                       | from 1 074,00   | to 1 434,62     |
| Muravlenko            |                       | from 1 374,62   | to 1 434,62     |
| Priuralsky district   |                       | from 1 374,62   | to 1 434,62     |
| Purov district        |                       | from 1 374,62   | to 1 434,62     |
| Krasnoselkupsky district |                   | from 1 374,62   | to 1 434,62     |

Source: compiled by authors based on open data from the Department of tariff policy, energy and housing and utilities of the Yamalo-Nenets Autonomous district.
Figure 2. Algorithm for calculating the efficiency of implementation of initiative budgeting projects in the direction of improving the energy efficiency of heat supply in the housing and communal complex (on the example of Yamalo-Nenets Autonomous district)

Source: compiled by authors
The variational scale of tariffs in municipalities is justified by a variety of factors, including: the state of the heat supply facility, the wear of heating networks, the type of fuel, and the technologies used. Issues of reconstruction of heat supply facilities and introduction of energy-saving technologies with an environmental component can be partially resolved within the framework of energy-efficient initiative budgeting projects.

4. Assessment of energy-efficient initiative budgeting projects implemented in the direction of street lighting

In accordance with the existing legal framework, in contrast to the tariffs for heat supply, which take into account the state of boilers and heating networks in each specific municipality, electricity tariffs are set at the regional level without taking into account the specifics of electricity supply for a specific municipality [6].

In the context of the study, we are primarily talking about energy-efficient projects for the modernization of street lighting systems (hereinafter referred to as SLS).

According to Academician V. p. Meshalkin and I. M. Makarova, the modernization of such systems can be carried out in the following areas:

- comprehensive modernization, involving the use of innovations for improvement;
- each of the elements of the SLS;
- modernization of lighting devices using the latest technological achievements and developments in this field;
- modernization of the support in terms of its design, installation method and protection from external influences;
- modernization in the field of energy supply through the use of innovative energy sources;
- modernization of the lighting control system based on the use of various information technologies” [7].

To assess the budget efficiency of an initiative budgeting project in the field of street lighting with an energy-efficient component, a formula can be used that reflects budget savings arising, for example, from the introduction of LED lighting technology. In this approach, it is quite difficult to estimate social efficiency in terms of value. Theoretically, the formula can be developed, but it will be different for each project.

At the same time, the project will receive unconditional social effects – improving the quality of life on the territory for a long period. One of the advantages of LEDs is a lot longer service life up to 100,000 hours.

At the same time, energy-efficient projects of initiative budgeting can be evaluated within the framework of a single differentiated approach, if it is adopted in the Yamalo-Nenets Autonomous district.

For differentiated assessment of energy-efficient initiative budgeting projects, the authors suggest introducing basic and variable criteria. Basic criteria are proposed for all projects, variable criteria aim at specific direction projects [8].

For projects of the "street lighting objects" typology, the variable criteria are presented in table 2. The following formula should be used for evaluating the proposed criteria:

$$ E_e = \sum_{i=1}^{n} (K_i \times B_i), $$

where $E_e$ is an indicator of evaluating the effectiveness of the initiative budgeting project; $K_i$ is a criterion for evaluating the effectiveness of an initiative budgeting project; $B_i$ is a weight coefficient of the evaluation criteria for the initiative budgeting project.

It was not the task of this study to disclose the basic part of the criteria in the framework of a differentiated approach and variable criteria for other possible areas of projects.
Table 2. Variable criteria for evaluating the effectiveness of initiative budgeting projects of the "street lighting objects" typology

| Names of competitive selection criteria | Values of competitive selection criteria | Number of points | Weight coefficient |
|----------------------------------------|------------------------------------------|------------------|--------------------|
| Installation on an emergency road section and (or) location of the project object near social facilities (at a distance less than 500 meters) | Availability | 100 | 0.10 |
| Environmental effects of implementing energy-efficient or energy-saving technologies | Availability | 100 | 0.10 |
| Missing | 0 |
| Missing | 0 |

Source: compiled by authors

5. Conclusion
To evaluate energy efficiency of budgeting initiative projects in the field of heat power engineering the budget and social effectiveness can be calculated with regards to the planned inter-tariff difference which was avoided and useful heat release by the heat supply facility.

An approach that reflects budget savings can be used to assess the budget effectiveness of an initiative budgeting project in the field of street lighting with an energy-efficient component.

Basic and variable criteria can be implemented for differentiated evaluation of energy-efficient initiative budgeting projects.

The existing approach to evaluating projects of “Citizens’ budget initiative” program in the Yamalo-Nenets Autonomous district does not allow to detect their energy-efficient component.

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