Study of ecological and economic efficiency for resource supplying organizations in the transition to alternative sources

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Abstract. In modern conditions, environmental and economic efficiency is a necessary development factor for the infrastructure of housing and communal services. When conducting a feasibility study of measures to modernize resource-supplying organizations, payments for negative impact are often not fully taken into account as averted financial costs. Resource supplying organizations as users of natural resources cause damage to the environment mainly in the form of emissions into the air, for which they make payments to the budget of the Russian Federation. At the same time, the more emissions enter the atmosphere, the more significant the amount of payments. The analysis of this factor allows us to conclude that the transition to alternative sources of heat supply leads not only to a decrease in environmental damage, but also to a decrease for payments for the owners of heat generating equipment. In this work, it is proved by the example of the boiler house of settlement Lisvyanka, Irkutsk region, which the use of modern technical equipment leads to a decrease in payments for the negative impact in terms of air pollution. The results obtained may indicate the possibility of reducing the tariff when calculating utilities, which is an additional motivating factor in the modernization of infrastructure facilities for housing and communal services.

1. Introduction

Eastern Siberia is characterized by a sharply continental climate and a long winter period, which necessitates the widespread use of heat supply systems. The operation of apartment buildings, public and business centers, social facilities involves the constant consumption of energy resources, mainly in the form of thermal energy \[1-4\]. In this case, the supplier of thermal energy is a resource supplying organization, whose activities are directly related to the generation and transportation of thermal energy. On the territory of the Irkutsk region, the predominant method of obtaining thermal energy is the combustion of organic fuel or oil products, as a result of which pollutants in the form of nitrogen oxides, carbon oxides, sulfur oxides, soot, etc. enter the atmospheric air. In accordance with modern environmental legislation \[5, 6\], a legal entity on whose balance sheet is an object that includes stationary sources of emissions (for example, a boiler house) is obliged to make payments for negative impact on the environment.

In the settlements of the Irkutsk region, especially high levels of air pollution are observed in the winter months, the period of the highest heating load and the lowest ability of the atmosphere to self-purify due to climatic features.
The transition to alternative sources of heat supply in modern conditions is due not only to the need for technical and economic indicators of the heat supply system, but also to an increase in the level of «environmental friendliness» of the system as a whole. Since there is an annual increase in energy consumption in the system of housing and communal services [7].

During the operation of heat supply sources, a negative impact is noted in the form of emissions into the atmospheric air, the formation of waste and wastewater. An integral part of the negative impact on the environment is the financial burden in the form of quarterly (annual) payments. In this case, the amount of payments is determined both by the mass of the emitted pollutants and the degree of their danger. Previous studies in this direction showed that when transferring a heat source of the heat supply system of the village Listvyanka for wood fuel (pellets), the total indicator of prevented environmental and economic damage amounted to 3,147,550 rubles (in prices for 2020) [8].

2. Implementation of the principle of «payment» in nature management

The mechanism for regulating the use of natural resources in the Russian Federation is based on the observance of the basic principles, one of which is the principle of «payment». In other words, the use of natural resources, in particular, their pollution, carries a financial burden for users of natural resources (Fig. 1). The main source of pollution for heat generating enterprises is air pollution as a result of emissions into the air during the operation of boiler plants. All substances entering the environment are subject to accounting and regulation. Accounting for gross and maximum one-time emissions can be carried out both by calculation and by instrumental methods and is an object of industrial environmental control.

Fee for negative impact, being a fiscal levy, is included in the cost of production. At the same time, in case of exceeding the established limits on the amount of emitted substances, the total excess in monetary terms is calculated from the profit of the enterprise. Due to changes in environmental and tax legislation, payments from natural resources for pollution are planned to be levied in the form of an «environmental tax».

The ecological and economic efficiency in the transition to alternative sources of heat supply is both in reducing damage to the environment and in reducing payments for negative impacts. Thus, the resource supplying organization reduces the operating costs for the generation of heat energy, which ultimately can affect the formation of the tariff when calculating communal service.

3. Methodology for calculating payments for negative impact on atmospheric air

Payments for negative impact are made in accordance with the requirements of modern environmental legislation [5, 6] according to the methodology established in [9]. In this case, the payment base is the volume or mass of emissions of pollutants in the reporting period. The rates of payment for emissions of pollutants into the air from stationary sources are applied in accordance with [10].

In accordance with [11], resource-supplying organizations that provide the communal sphere with heat energy are classified as objects of category I or II, depending on the amount of energy generated.
It is the belonging of the resource-supplying organization to a certain category that ensures the use of increasing coefficients when calculating the payment for a negative impact.

The fee within the limits of the standards of permissible emissions of pollutants or discharges of pollutants is calculated by the formula:

\[ F_{p,i} = \sum_{i=1}^{n} (B_i \times P_i \times k_{ad} \times k_p) , \]

where \( B_i \) is payment base for emissions or discharges of the \( i \)-th pollutant, t/year; \( P_i \) is rate of payment for the emission or discharge of the \( i \)-th pollutant, rubles/t; \( k_{ad} \) is additional coefficient to the rates of payment in respect of territories and objects under special protection in accordance with federal laws, equal to 2; \( k_p \) is coefficient to the rates of payment for the emission of the \( i \)-th pollutant for the volume or mass of emissions of pollutants within the limits of permissible emissions, permissible discharge standards, equal to 1; \( n \) is the amount of pollutants.

**4. Comparison of payments for emissions of pollutants when burning oil and wood fuels**

The object of this study is the boiler house of Listvyanka settlement of the Irkutsk region, which is a supplier of heat energy for the residential sector and social facilities.

When burning, wood fuel has the lowest ash content and emissions of harmful substances. The residue formed after combustion, wood ash, is a safe organic fertilizer and can be used in various sectors of the national economy. A comparative analysis of emissions of pollutants into the atmosphere from the operation of the boiler house on fuel oil and wood fuels shows the dynamics of change in a positive direction [12, 13].

Table 1 shows the results of calculating gross emissions during operation of the boiler house using the main fuel (oil) and alternative fuel (pellets).

**Table 1. Results of comparing gross and maximum one-time emissions when using fuel oil and pellets.**

| Code | Emission name          | maximum one-time emission, g/c | Gross emission, t/year |
|------|------------------------|---------------------------------|------------------------|
|      |                        |                                 |                        |
|      | Oil fuel               |                                 |                        |
| 0301 | Nitrogen (IV) oxide    | 0.2738901                       | 5.422760               |
| 0304 | Nitrogen (II) oxide    | 0.0445071                       | 0.881199               |
| 0330 | Sulphur dioxide        | 1.7735530                       | 35.114772              |
| 0337 | Carbon oxide           | 0.3735252                       | 7.395466               |
| 0703 | Benz / a / pyrene      | 0.0000007263                    | 0.0000143689           |
| 2904 | Suspended matter       | 0.0047007                       | 0.092996               |
|      | Pellets                |                                 |                        |
| 0301 | Nitrogen (IV) oxide    | 0.0005410                       | 10.625498              |
| 0304 | Nitrogen (II) oxide    | 0.0000879                       | 1.726643               |
| 0330 | Sulphur dioxide        | 0.0000286                       | 0.561000               |
| 0337 | Carbon oxide           | 0.0004824                       | 9.476181               |
| 0703 | Benz / a / pyrene      | 0.00000011231                   | 0.00220429278          |

Analysis of the data showed that a significant decrease in gross emissions is noted when using a pellet boiler. When using a fuel oil boiler, more than 35 tons of sulfur dioxide are released into the air annually. When using pellet fuel, nitrogen dioxide makes the main contribution to air pollution [9.10].

The results of calculating payments for emissions are presented in Table 2.

**Table 2. Payment for negative impact on the environment.**

| Amount of payment (thousand rubbles) | Oil fuel boiler house | Pellets boiler house | Decrease, increase fee |
|-------------------------------------|----------------------|---------------------|------------------------|
|                                     | 8103.73              | 5076.97             | -3026.76               |
Thus, the savings in payments for the negative impact for resource supplying organizations will amount to 3027 thousand rubles.

As a result of the study, it has been proven that when transition to alternative sources of heat supply; it leads not only to a decrease in environmental damage, but also to a decrease in the financial burden in the form of mandatory payments for negative impacts in terms of emissions into the air.

5. Conclusions
Based on the data obtained, it can be concluded that payments for emissions for the resource supplying organization will decrease when transition to alternative, more environmentally friendly fuels. Thus, the transfer of the boiler house of Listvyanka village for operation on reserve fuel, in terms of economics, will not only lead to projected production costs, but will also reduce direct costs. As a result of the study, it was proved that the use of innovative technologies, the modernization of equipment, the use of alternative sources of heat supply can affect the formation of the tariff when calculating utility services for providing heat energy and hot water supply by reducing the payment base when calculating payments for negative impact.

Environmental and economic efficiency can be used as a stimulating factor in the development of technical solutions for resource supplying enterprises, as well as in the feasibility study of the transition to alternative sources of heat supply.

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