

Assessment of the efficiency of innovation projects in the energy sector

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Abstract. The aim of the study is to develop methods for assessing the efficiency of innovation and investment projects in the energy sector of the economy. As a result of the analysis of existing approaches, the modern problems of assessment are revealed, and possible ways of their solution are identified. A comprehensive analysis of the impact of innovation projects was carried out, and indicators and criteria for assessing their efficiency were determined. The assessment methods were structured on the basis of a combined approach, adequate to the target orientation of the projects, and a set of methodological recommendations was developed for assessing the efficiency of innovation and investment projects in the energy sector.

1 Introduction

Studies of the problems of assessing the efficiency of innovation projects suggest that at present, there are almost no criteria for their assessment. Indirectly, the efficiency of innovation and investment projects in the energy sector is assessed as an element of development of the level of services for the industry as a whole and relies primarily on the social component, along with the economic one (commercial, budget and national economy) (Figure 1). Describing the economic component of assessing the efficiency of innovation projects, it should be noted that commercial efficiency reflects the direct financial implications of the project for its participants. Budget efficiency reflects the financial implications of a project for a budget of one level or another (federal, regional or local). The national economic efficiency of an innovation project is usually considered for large projects, takes into account economic costs and results that go beyond the direct financial interests of project participants, and allows for a cost measurement [1].

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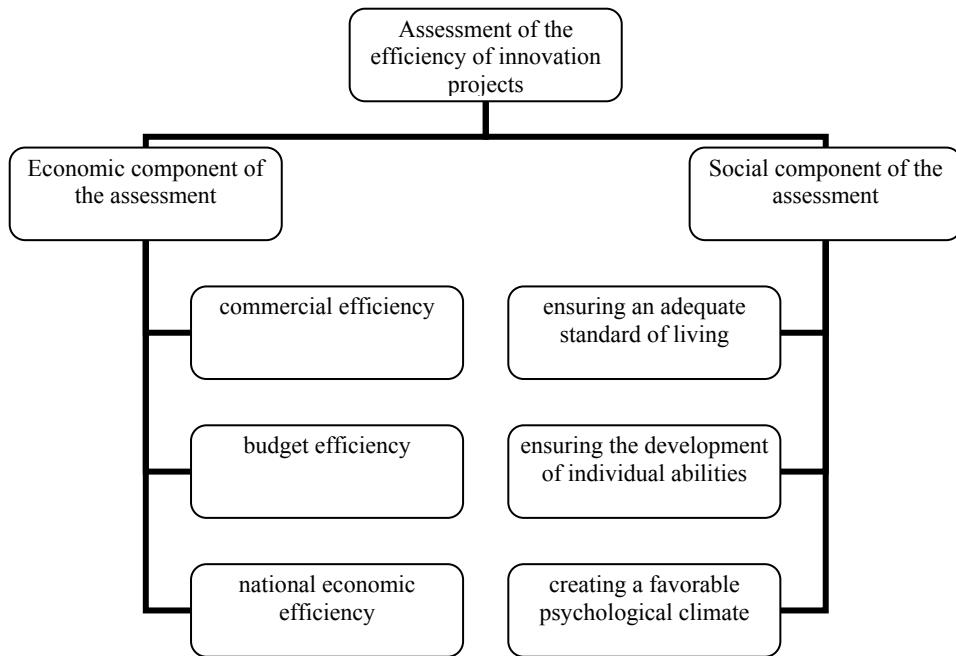


Fig. 1. A typical scheme for assessing the efficiency of modern innovation projects.

Considering the social component of assessing the efficiency of innovation projects, it should be noted that the component of ensuring an adequate standard of living includes: favorable working conditions, high wages, effective social services. The development and implementation of individual abilities imply the formation of conditions for the successful implementation of a certain type of activity. Creating a favorable socio-psychological climate generally implies the formation of an effective communication environment ensuring non-conflicting relations with management, colleagues, etc [2].

It should be noted that the efficiency of innovation projects in the energy sector is part of the national economic efficiency, since the latter reflects the degree of utilization of total social labor and is determined by the ratio of the value of the created net output to the total social cost of production.

2 Materials and methods

Thus, the efficiency of innovation projects is an indirect part of both the social and economic components of the efficiency of innovation projects. However, the efficiency of innovation projects, in turn, largely determines the budget efficiency of innovation projects (in terms of the economic component of the assessment) and ensuring an adequate standard of living (in terms of the social component of the assessment).

At the same time, it should be noted that social indicators for assessing the efficiency of innovation projects (along with environmental, political and other) are in most cases considered as not quantifiable, and therefore are considered as an additional qualitative criterion when deciding if it is reasonable to implement projects [3, 4].

The existing criteria for assessing the efficiency of projects in the energy sector are shown in Figure 2. They demonstrate that the efficiency of the innovation component is taken into account by determining the scientific and technical level of the use of modern knowledge in the energy industry.

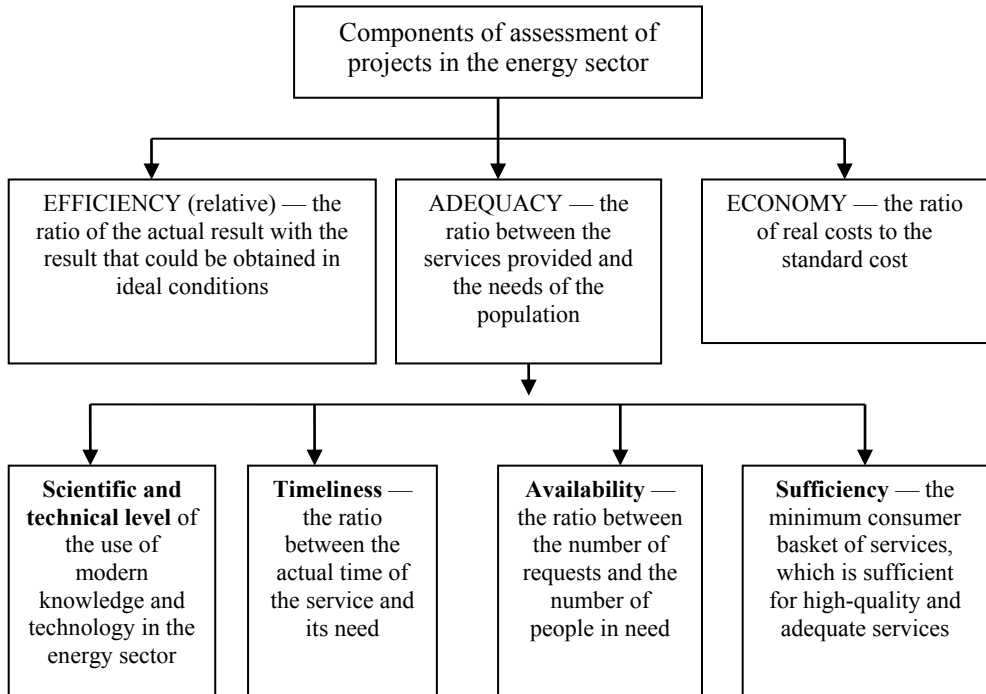


Fig. 2. Existing criteria for assessing the efficiency of projects in the energy sector.

According to the scale of the impact of innovation on the level of social development of society, macroeconomic, mesoeconomic, and microeconomic factors are allocated. At the same time, the interrelation between inducing and resulting factors of the impact of innovation on the level of social development of society at the state, regional, and local levels is obvious.

When solving the scientific problem of forming a methodological approach to assessing the efficiency of innovation projects in the energy sector, the issue of defining indicators and criteria for their assessment was considered at the first stage [5].

The proposed system of indicators and criteria for assessing the efficiency of innovation projects is multi-level. To assess the complex impact, the integral criterion (K_0) of the following form is proposed:

$$K_0 = K_1 + \alpha \cdot K_2 + \beta \cdot K_3 + \chi \cdot K_4 + \delta \cdot K_5, \quad (1)$$

where K_1 - a direct assessment of the efficiency of an innovation project; K_2 - potential increment of various characteristics; K_3 - potential increment of guaranteed provision of the population with quality services; K_4 - potential increment of the level of development of the entire energy sector; K_5 - potential increment of the level of implementation of systemic transformations in the Russian Federation; $\alpha, \beta, \chi, \delta$ - weighting factors of the criteria for assessing the efficiency of K_2, \dots, K_5 , determined by the scale and direction of project implementation ($0 \leq \alpha, \beta, \chi, \delta \leq 1$).

For a direct assessment of the efficiency of the innovation project (K_1), a criterion of the following type is proposed:

$$K_1 = \gamma_1 \cdot K_{11} + \gamma_2 \cdot K_{12} + \gamma_3 \cdot K_{13} + \gamma_4 \cdot K_{14} + \gamma_5 \cdot K_{15} \quad (2)$$

where K_{11} – criterion for assessing the efficiency of marketing innovation within the project; K_{12} - criterion for assessing the efficiency of the implementation of product

innovation within the project; K13 - criterion for assessing the efficiency of the implementation of technological innovations within the project; K14 - criterion for assessing the efficiency of the implementation of organizational innovations within the project; K15 - criterion for assessing the efficiency of the implementation of market innovations within the project; $\gamma_j = \gamma_1, \dots, \gamma_5$ - weighting factors for assessing the efficiency of marketing, product, technological, organizational, and market innovation, respectively, based on the level provided:

$\gamma = 0,25$ - if innovation meets the regional level,

$\gamma = 0,50$ - if innovation meets the state level,

$\gamma = 0,75$ - if innovation meets the world level,

$\gamma = 1,00$ - if innovation exceeds the world level.

The values of performance criteria for specific innovation areas K1j are determined on the basis of the following relationships:

$$K_{1j} = \frac{[P_{1j}]^{\varphi_1} \cdot [T_{1j}]^{\varphi_2}}{[C_{1j}]^{\varphi_3}}, \quad (3)$$

where P_{1j} – indicator of the functional efficiency of innovation, determined from the relationship:

$$P_{1j} = \frac{P_{1j}^f - P_{1j}^{\min}}{P_{1j}^b - P_{1j}^{\min}}, \quad (4)$$

P_{1j}^f - the actual value of functional efficiency in the j-th direction of innovation; P_{1j}^b - the basic value of functional efficiency in the j-th direction of innovation; P_{1j}^{\min} - the minimum acceptable value of functional efficiency in the j-th direction of innovation; T_{1j} - an indicator of the time efficiency of innovation, determined from the ratio

$$T_{1j} = \frac{T_{1j}^b}{T_{1j}^f}; \quad (5)$$

T_{1j}^b - the base time of implementation of the proposed function in the j-th direction of innovation; T_{1j}^f - the actual time of implementation of the proposed function in the j-th direction of innovation; C_{1j} - an indicator of investment costs for innovation, determined from the ratio

$$C_{1j} = \frac{C_{1j}^b}{C_{1j}^f}, \quad (6)$$

C_{1j}^b - basic investment costs for the implementation of the proposed function in the j-th direction of innovation; C_{1j}^f - actual investment costs for the implementation of the proposed function in the j-th direction of innovation, $\varphi_1, \varphi_2, \varphi_3$ - weighting factors of the functional, time efficiency indicators and the investment costs indicator determined from the condition $\varphi_1 + \varphi_2 + \varphi_3 = 1$.

Based on the proposed multi-level system of indicators and criteria for assessing the efficiency of innovation projects, the technology of integral assessment of project performance was formed (Figure 3).

In the developed approach, a rational set of methods for assessing the efficiency of innovation projects is determined by the type of innovation used (in accordance with the classification of J. Schumpeter) and the level of innovation technology used (in accordance with the classification of Arthur D. Little (ADL/LC)). At the same time, the quantitative composition of the methods and technologies involved in the integrated assessment of the implementation of projects is determined from the ratio

$$N = [(N_x)^{N_y}]^{N_z}, \quad (7)$$

where N_x – the number of methods for assessing project efficiency parameters ($N_x = 3$); N_y - the number of types of innovations involved in the project ($N_y = 1, \dots, 5$); N_z - the number of levels of innovation technologies used ($N_z = 3$).

In the final part of the study, a set of methodological recommendations for assessing the efficiency of innovation projects in the energy sector was developed.

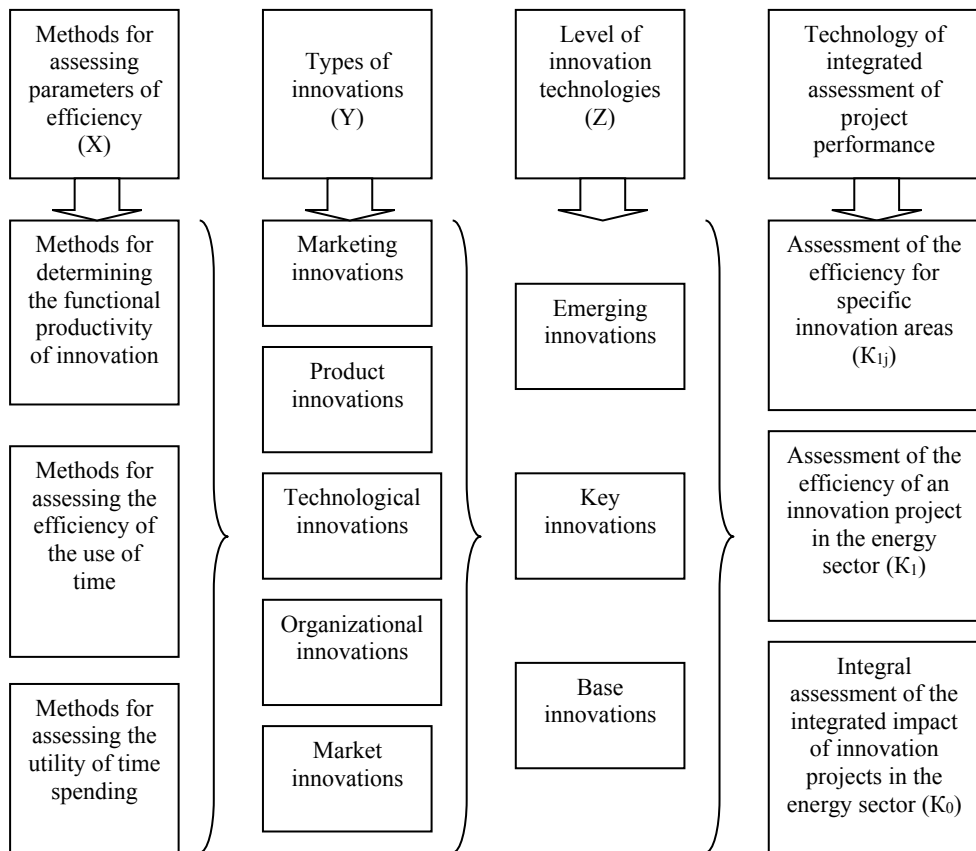


Fig. 3. Rational set of methods for assessing the efficiency of innovation projects.

The developed set of methodological recommendations for assessing the efficiency of innovation projects includes recommendations on the formation and use of an algorithm for solving assessment problems, taking into account the target orientation of the project [7]. The main results of the work can be used to further improve the methodological framework for assessing the efficiency of innovation projects in the energy sector. The proposed set of methodological recommendations allows for the management of innovation projects using factor analysis of the impact of innovation. The results of the work can be used in the

development of strategies for future policy of implementation of innovation projects, as well as in identifying assessment problems and finding potential solutions.

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