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Economic efficiency of gas industry investment projects in Russia on the example of export gas pipelines

Maxim V. Chernyaev ✉, Aleksandra A. Boiko

Peoples' Friendship University of Russia,
6 Miklukho-Maklaya St, Moscow, 117198, Russian Federation

✉ chernyaev-mv@rudn.ru

Abstract. The efficiency of domestic and export supplies of natural gas largely determines the sustainable development of the Russian economy and national security. At present, in the context of sanction restrictions and increasing uncertainty in the global energy market, the theoretical and practical aspects of the economic efficiency of investment projects in the gas industry are of fundamental importance and require further development. The article discusses the theoretical foundations of the category "economic efficiency" and methodological approaches to its assessment on the example of investment projects in the gas industry. A comparative analysis of the standard methodology for determining economic efficiency of capital investments and the methodological recommendations for evaluating the effectiveness of investment projects in the planned and market economics has been performed based on the criteria specified by the authors. A review of published studies on methods for assessing economic efficiency of investment projects in the oil and gas sector has been performed. It is concluded that to assess the efficiency of investments is proposed to use the discounted cash flow method as the main approach, as well as the alternative methods in the papers of Russian authors. Two large-scale projects of the Russian gas industry have been considered, a review of published studies on the efficiency assessment has been performed with emphasis on the external effects due to implementation of the projects under consideration. According to the study results, the uniqueness of the implementation conditions of each gas transportation project, fundamental importance of the influence of non-economic factors on the project implementation and the need to develop assessment methods for the economic efficiency of investment projects were noted with due regard to the uncertainty and risk impact.

Keywords: economic efficiency, investment project, Russian gas industry, export gas pipeline

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Экономическая эффективность инвестиционных проектов газовой отрасли России на примере экспортных газопроводов

М.В. Черняев ✉, А.А. Бойко

Российский университет дружбы народов,
Российская Федерация, Москва, 117198, ул. Миклухо-Маклая, 6

✉ chernyaev-mv@rudn.ru

Аннотация. Эффективность внутренних и экспортных поставок природного газа во многом определяет устойчивое развитие российской экономики и обеспечение национальной безопасности страны. В настоящее время, в условиях санкционных ограничений и возрастающей неопределенности на мировом рынке энергоресурсов, теоретические и практические аспекты экономической эффективности инвестиционных проектов в газовой отрасли приобретают принципиальное значение и требуют дальнейшего развития. Рассмотрены теоретические основы категории «экономическая эффективность» и методические подходы к ее оценке на примере инвестиционных проектов газовой отрасли. Проведен сравнительный анализ типовой методики определения экономической эффективности капитальных вложений и методических рекомендаций по оценке эффективности инвестиционных проектов в плановой и рыночной экономиках на основе выделенных авторами критериев. Выполнен обзор опубликованных исследований о методах оценки экономической эффективности инвестиционных проектов в нефтегазовом секторе. Сделан вывод о том, что в работах российских авторов для определения эффективности инвестиций предлагается использовать метод дисконтированных денежных потоков как основной, а также альтернативные методы. Рассмотрены два крупномасштабных проекта газовой отрасли России, выполнен обзор опубликованных исследований по оценке эффективности; выделены внешние эффекты от реализации рассматриваемых проектов. По результатам проведенного исследования отмечены уникальность условий реализации каждого газотранспортного проекта, принципиальное значение влияния внеэкономических факторов на реализацию проекта и необходимость совершенствования методов оценки экономической эффективности инвестиционных проектов с учетом неопределенности и риска.

Ключевые слова: экономическая эффективность, инвестиционный проект, газовая отрасль России, экспортный газопровод

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«Комплексное решение повышения экономической эффективности угольной промышленности как условие усиления энергетической безопасности России», выполненной на базе кафедры национальной экономики экономического факультета РУДН.

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Introduction

The concept of "efficiency" has been considered in numerous works of domestic and foreign scientists at different stages of the development of productive forces. Today, the issues of efficiency and its evaluation occupy key positions in research activities not only among economists, the definition of conditions for optimizing costs and improving efficiency is required in various fields of knowledge.

The development of economic thought, designed to solve the problem of maximum satisfaction of needs in conditions of limited resources, was accompanied by issues of cost-benefit commensuration. The concept of "efficiency" is considered in the studies of the classics of political economy: in the main work of D. Ricardo "On the Principles of Political Economy and Taxation" (Ricardo, 2016) — it is used in the context of assessing the use of capital; in the neoclassical direction of economic theory — in the "Principles of economics" of A. Marshall (Marshall, 1993), V. Pareto defines the criterion of effective resource allocation (Pareto optimality) (Pareto, 2016). After the world economic crisis of 1929–1933, the principles of economic efficiency were developed in the works of J.M. Keynes in the context of macroeconomics and economic growth; in the work "The General Theory of Employment, Interest and Money" (Keynes, 2013), Keynes introduces the concept of "marginal efficiency of capital" and "the principle of effective demand". In the research of neo-institutionalists, aspects of the efficiency of resource allocation are revealed in the context of the development of the theory of property rights, one of the founders of which was R. Coase (Coase, 1993).

The Soviet economist T.S. Khachaturov defines economic efficiency as the ratio of the economic effect to the resources spent on obtaining it (Khachaturov, 1979).

P. Heyne in his book "The Economic Way of Thinking" (Heyne, 1997) notes that efficiency, along with economy, "characterize the "effectiveness" of using funds to achieve goals."

In the dictionary of economic terms, economic efficiency is defined as "the effectiveness of economic activity, economic programs and measures, characterized by the ratio of the economic effect obtained, the result to the costs of factors, resources that caused the receipt of this result." (Raizberg, Lozovskii, 2008).

Using various definitions, economic scientists reveal the concept of "economic efficiency" primarily as a ratio, which indicates that this concept is evaluative and requires measurement.

Literature Review

The issues of theory and methodology of increasing and measuring economic efficiency were studied by Soviet and Russian economists. In the search for a solution to the economic problem of increasing the output of industrial products while minimizing costs, a significant amount of work relates to the study of the effectiveness of capital investments: T.S. Khachaturov, "Economic Efficiency of Capital Investments" (Khachaturov, 1964), V.P. Krasovskii, "Ways to Increase the Economic Efficiency of Capital Investments and Fixed Assets in the USSR" (Krasovskii, 1968), L.M. Smyshlyaeva, "The Structure of Capital Investments and Their Actual Efficiency" (Smyshlyaeva, 1970), etc.

In the Standard Methodology for Determining the Economic Efficiency of Capital Investments in 1969[1], developed in the conditions of a planned economy in the USSR, efficiency is determined by comparing the effect and costs and is estimated based on the calculation of:

- static indicators of overall (absolute) economic efficiency;
- indicators of comparative economic efficiency (taking into account the time factor).

At the same time, capital investments are assessed as effective if the mandatory condition for improving the efficiency of the entire national economy, and not just of a single industry or enterprise, is met. The standard coefficient of efficiency of capital investments for the entire national economy as a whole was set at least 0.12 (i.e. about 8 years of payback), and the features of evaluating the effectiveness of capital investments in certain sectors of the economy were reflected in industry instructions developed on the basis of a Standard Methodology[1].

In the market economy of foreign countries, the efficiency of capital investments since the mid-twentieth century has been calculated mainly using discounted indicators. The use of the discounted cash flow (DCF) method, described in the 1930s by the economists I. Fisher ("The Theory of Interest", 1930) (Fisher, 1930) and J. Williams ("The Theory of Investment Value", 1938) (Williams, 1997), and is currently used in world practice to assess the effectiveness of investments.

Methodology

In order to identify the theoretical foundations of the category "economic efficiency" and methodological approaches to its assessment on the example of investment projects in the gas industry the authors analyzed both Russian and

[1] Resolution of the State Planning Committee of the Council of Ministers of the USSR, the State Committee of the Council of Ministers of the USSR for Construction and the Presidium of the Academy of Sciences of the USSR dated September 8, 1969, No. 40/100/33 «On Approval of a Standard Methodology for Determining the Economic Efficiency of Capital Investments». Retrieved April 03, 2022, from https://normativ.kontur.ru/document?moduleId=1&documentId=145572.

foreign scientific sources, regulatory documents, data of energy companies, within the research, as well as used general scientific methods: comparative analysis, synthesis, analogy approach.

Industry experts' assessments and forecasts have also become the information base of the research.

Results

In accordance with the Methodological Recommendations currently in force in Russia on evaluating the effectiveness of investment projects[2], the development of which takes into account the approaches of world experience (in particular, the principles of the methodology for evaluating investment projects developed by the United Nations Industrial Development Organization (UNIDO) in 1978) and the specifics of Russian conditions, it is proposed to use two types of efficiency:

- the project as a whole, including socio-economic and commercial efficiency: at this stage, the immediate results, costs of the project and the external effects of its implementation are measured;
- participation in the project: development of a financing scheme, determination of the composition of participants and evaluation of the effectiveness of investing in the project of each of the participants — enterprise, industry, region, etc.

The main indicators for calculating the effectiveness of an investment project, established by the Methodological Recommendations for evaluating the effectiveness of investment projects, and their names in foreign economic literature are as follows:

- Net Present Value, NPV;
- Net Value, NV;
- Internal Rate of Return, IRR;
- Payback Period, PP;
- Profitability Index, PI; Discounted Profitability Index, DPI, etc.

Some particular qualities of approaches to assessing the economic efficiency of investments described in two documents — one developed during the planned economy in the USSR and one operating in a market economy in Russia, are combined in the table.

Methodological approaches to assessing the economic efficiency of investments in the oil and gas sector take into account the main provisions of the methodological recommendations for evaluating the effectiveness of investment projects. An analysis of published studies on this topic shows that the discounted cash flow method is used as the main one to assess the effectiveness of investment projects in the oil and gas industries, as well as additions to it, and alternative methods (Table 1).

[2] Methodological recommendations for evaluating the effectiveness of investment projects, approved by Ministry of Economy of the Russian Federation, Ministry of Finance of the Russian Federation, State Committee of the Russian Federation on Construction, Architecture and Housing Policy on June 21, 1999 No. ВК 477. Retrieved April 03, 2022, from http://www.consultant.ru/document/cons_doc_LAW_28224 / (accessed: 03.04.2022).

Table 1

Particularities of methodological approaches to assessing the economic efficiency of investments in planned and market economies

Criterion	Standard methodology for determining the economic efficiency of capital investments (1969)	Methodological recommendations for evaluating the effectiveness of investment projects (1999)
Types of efficiency	Total (absolute) economic efficiency; Comparative economic efficiency	The efficiency of the project as a whole; The efficiency of participation in the project
National economic approach	Prerequisite for efficiency (improving the efficiency of the industry, related industries, the entire national economy)	Public efficiency is determined for socially significant projects
Efficiency indicators	Static (the ratio of the increase in the annual volume of national income / profit / savings from cost reduction to the capital investments that caused this increase / savings; the payback period of capital investments; additional indicators); Minimum of the reduced costs (taking into account the time factor)	Static (NV, payback period, etc.); Discounted (NPV, IRR, discounted payback period etc.)
Assessment of external effects	Calculations of the economic efficiency of capital investments are carried out taking into account the associated costs and effects of related production facilities / industries	Assessment of the overall results of the project includes an assessment of external effects and public goods
Evaluation of efficiency in conditions of uncertainty	—	Taking into account risk factors and uncertainty when forming a project, assessing its sustainability and calculating efficiency indicators

Source: compiled by the authors.

In most works of Russian authors, investment projects in the oil and gas sector are considered, taking into account their scale, as significantly affecting "the economic, social or environmental situation in certain regions or industries of the country,"[3] this condition affects the development and application, along with the traditional ones, of additional tools for analyzing economic efficiency and their combinations:

- measurement of public efficiency based on the assessment of external effects from the implementation of the project through a system of indicators (Evseeva, Cherepovitsyn, 2019);

[3] Methodological recommendations for evaluating the effectiveness of investment projects, approved by the Ministry of Economy of the Russian Federation, Ministry of Finance of the Russian Federation, State Committee of the Russian Federation on Construction, Architecture and Housing Policy on June 21, 1999. No. BK 477. Retrieved April 03, 2022, from http://www.consultant.ru/document/cons_doc_LAW_28224 / (accessed: 03.04. 2022).

- integrated assessment of the effectiveness of projects based on the use of a scenario approach to account for uncertainty in calculating the amount of income in combination with risk analysis based on the method of expert assessments (Kulygin et al., 2013);
- evaluation of comparative efficiency by the criterion of minimum discounted costs, provided the same economic result from the implementation of projects, but different amounts of capital investments and operating costs (Krivko, 2020);
- application of the Modern Asset Pricing MAP, based on the method of real options, in order to measure the effectiveness of the project in conditions of uncertainty (Nechaeva, Remizov, 2015);
- assessment of external effects due to implementation of the investment projects using the dynamic model of economic interactions FrEEDM (Far Eastern Economic Dynamic Model) (Dzhurka, Dyomina, 2018);
- application of fractal theory tools in assessing the project risks (Vasiltsov, Vasiltsova, 2018);
- macroeconomic assessment of multiplier effects due to the project implementation based on the input-output method (Kryukov et al., 2020);
- application of the principles of financial mathematics in evaluating the effectiveness of investment projects (Shevkunov et al., 2017).

Thus, the research is aimed at developing methods for assessing the economic efficiency of investment projects, in particular, such stages as:

- calculation of economic efficiency indicators;
- uncertainty and risk analysis;
- analysis of alternatives (evaluation of comparative effectiveness);
- determination of external effects;
- development of a financing scheme.

Tools for measuring economic efficiency are becoming more complex as the degree of influence of non-economic — that is social, environmental, political and other factors on the results of the project implementation increases. Methodological recommendations provide for taking into account the influence of such factors in quantitative form on the effectiveness of the project, but there is no comprehensive system of indicators for evaluation.

In order to complete the analysis and take into account all the influencing factors when measuring the economic efficiency of investment projects in the gas industry, it is necessary to take into account its specific features, among which it is advisable to note:

- large-scale production infrastructure;
- high level of socio-economic significance;
- high level of capital investments;
- mainly long-term nature of projects;
- limited investment resources;
- request for innovative technological development;
- a wide range of risks;

- the presence of environmental impact;
- placement of production facilities in hard-to-reach, remote areas.

Thus, in accordance with the identified features of the gas industry and the concept of a large-scale investment project, it is possible to determine some features of evaluating its economic efficiency, which are of fundamental importance, in comparison with local short-term investment projects:

• emphasis on the use of discounted rates, due to the long-term nature of the project;

• the need to quantify significant externalities;

• development of a financing scheme taking into account large-scale capital investments and a wide range of risks.

Large-scale financing of investment projects in the gas industry can be carried out, for example, on the basis of the principles of project financing, this scheme is applied in the implementation of large-scale projects Nord Stream 2, Amur Gas Processing Plant, etc.

Based on the analysis of methodological recommendations in evaluating the effectiveness of socially significant investment projects, the considered approaches to evaluating projects in the oil and gas sector, the identified features of evaluating the effectiveness of large-scale projects, it is possible to conclude that the evaluation of the economic efficiency of large-scale investment projects is conditionally divided into two levels — public efficiency and efficiency for individual investor — using the relevant groups of indicators.

Currently, large-scale gas transportation projects are being implemented in the Russian gas industry at various stages of implementation: export gas pipelines Turkish Stream, Nord Stream, Power of Siberia, Power of Siberia 2 and its continuation Soyuz-Vostok, etc.

Starting from the late 2021, the Nord Stream 2 offshore gas pipeline is ready for operation, the construction of which is based on the Nord Stream gas pipeline project, with a capacity of 55 billion m^3 of gas per year for natural gas supplies from Russia to Europe.

The scheme for financing the construction of the Nord Stream 2 export gas pipeline was developed on the basis of project financing, the structure of which is as follows: 50 % of the total cost of the project was provided by Gazprom PJSC, 50 % — external financing by European companies. [4]

The prerequisites for the implementation of the Nord Stream 2 project include the efficiency of the Nord Stream, the projected increase in demand for natural gas from European consumers in terms of energy transition and the reduction of own gas production in Europe.

The following studies quantify the external effects of the large-scale Nord Stream 2 project based on economic modeling and cost-benefit analysis.

[4] Report of Alexey Miller, Chairman of the Gazprom Management Board, at the Annual General Meeting of Shareholders. URL: https://www.gazprom.ru/press/news/miller-journal/2017/340087/ (accessed: April 05, 2022).

At the request of the operator of the Nord Stream 2 gas pipeline Nord Stream 2 AG, at various stages of the investment period of the project, foreign specialists conducted studies to assess its effectiveness.

In 2017 and in 2019, Arthur D. Little conducted an assessment of the direct, indirect and induced effects of large–scale infrastructure investments in the construction of the Nord Stream 2 gas pipeline carried out at the following two stages were evaluated:

1) in the period up to July 2017 in the amount of 4.4 billion euros[5];

2) in the period up to December 2018 in the amount of 8 billion euros[6].

The assessment of the economic consequences of the project, including employment (using the equivalent of full employment as an indicator) and welfare (based on the GDP indicator) for the countries involved was carried out using the economic modeling tool IMPLAN (Impact Analysis for Planning) and cost-benefit analysis; the assessment methodology is based on the principle of quantifying benefits "without a project" and "with the project".

According to the results of the study, the total economic benefit at the first stage is estimated at more than 8.36 billion euros, including the creation of 90,100 full–time equivalents (1 FTE corresponds to the full employment of 1 employee for 1 year) and GDP growth in the amount of 3.54 billion euros (including 0.8 billion euros for the Russian economy).

At the second stage, i.e. at the time when most of the construction financing was already provided, the total economic benefit for the states involved was estimated at 17.66 billion euros, including the creation of 216,140 full-time equivalents and GDP growth of 8.32 billion euros (including 2.69 billion euros for the Russian economy), i.e. with an 82 % increase in investments, the cumulative effect has more than doubled relative to the indicators of the previous stage.

In 2017 and 2020, the results of studies performed by Ewi Energy Research & Scenarios[7] and in cooperation with Frontier Economics[8] on the impact of the Nord Stream 2 offshore gas pipeline on the natural gas markets of the European Union (EU) countries were published.

The assessment of the economic consequences of the construction of the Nord Stream 2 gas pipeline was carried out using the TIGER model of the European gas infrastructure and the global gas market model COLUMBUS.

The results of modelling showed a decrease in gas prices in the EU as a whole, as well as in each EU state separately, in the conditions of competition between Russian

[5] Economic impact on Europe of the Nord Stream 2 project. Retrieved April 30, 2022, from https://www.adlittle.com/en/insights/viewpoints/economic-impact-europe-nord-stream-2-project.

[6] Nord Stream 2 Economic Impact on Europe. Retrieved April 30, 2022, from https://www.adlittle.com/en/insights/report/nord-stream-2-economic-impact-europe.

[7] Impacts of Nord Stream 2 on the EU natural gas market. Retrieved April 30, 2022, from https://www.ewi.uni-koeln.de/en/publications/impacts-of-nord-stream-2-on-the-eu-natural-gas-market/

[8] Impact of infrastructure investments such as the Nord Stream 2 pipeline on the European gas market. Retrieved April 30, 2022, from https://www.ewi.uni-koeln.de/en/publications/impact-of-infrastructure-investments-such-as-the-nord-stream-2-pipeline-on-the-european-gas-market/

gas and global LNG (liquefied natural gas) supplies on the European market under the option "with the Nord Stream 2 project".

In addition to the results of the economic assessment of the effectiveness of the Nord Stream 2 project, in 2017 a report was published by experts in the field of ESG standards (Environmental, Social, Governance — environmental, social development, corporate governance) on the study[9] in which the carbon footprint of two methods of gas supplies to EU countries was compared: via the gas pipeline Nord Stream 2 and LNG import options from the USA, Qatar, Australia and Algeria.

It is reasonable to consider such indicators to assess the public effectiveness of the implementation of a large-scale project and in the analysis of alternatives.

According to the results of the study, the indicators for potential greenhouse gas emissions in case of LNG import are 2.4–4.6 times higher than emissions in case of natural gas supplies via the Nord Stream 2 gas pipeline. The pipeline route from Russia has the lowest greenhouse gas emissions — 6.3 g of CO_2 equivalent per megajoule of delivered gas, compared with other sources of natural gas imported by Europe: LNG from Qatar — 14.9 gCO_2-eq/MJ, from Algeria — 16.9 gCO_2-eq/MJ, from Australia — 20–28.7 gCO_2-eq/MJ; American LNG — 23.6 gCO_2-eq/MJ.

Thus, on the basis of the studies considered, it is possible to distinguish such external effects from the implementation of the Nord Stream 2 project as:

1. Socio-economic effect:
   - the possibility of creating jobs in the participating countries of the project, as well as the overall increase in GDP and tax revenues to state budgets;
   - establishment of a competitive gas price on the market;
   - influence on the development of the economy of related industries and regions involved in the work;
2. Environmental effect — acceleration of the transition to low-emission and environmentally friendly fuel in the conditions of abandonment of coal and nuclear energy by European states.

Assessment of the impact of uncertainty and risks on the results of the implementation of an investment project is one of the most important components of the analysis of its economic efficiency. In the works published on this topic and prepared by E.A. Razumovskaya, (Razumovskaya et al., 2021), Yu.V. Kozhukhov (Kozhukhov et al., 2020), S.Z. Zhiznin, V.M. Timokhov (Zhiznin, Timokhov, 2019), L.A. Kolesnikova, A.S. Novikov (Kolesnikova, Novikov, 2019), Zh.A. Frankevich, A.Yu. Gagarina (Frankevich, Gagarina, 2018), A.S. Lebedev (Lebedev, 2020) various uncertainty aspects, risks and their classifications are presented, however, in less detail it is possible to identify risk groups in the implementation of large-scale export gas pipeline projects, the importance of which is most often noted by the authors:

[9] GHG Intensity of Natural Gas Transport Comparison of Additional Natural Gas Imports to Europe by Nord Stream 2 Pipeline and LNG Import Alternatives. Retrieved May 05, 2022, from https://cdn2.hubspot.net/hubfs/2591272/2017-03-24_thinkstep_-_ghg_intensity_of_natural_gas_transport_-_final_report-2.pdf

- country: in particular, political, transit;
- market;
- environmental contradictions, etc.

These risks are also applicable to the implementation of Nord Stream 2, with the exception of transit — the peculiarity of the offshore gas pipeline project is that gas is not transported through the territory of third countries.

When implementing the Nord Stream 2 project, the influence of non-economic factors is of fundamental importance, despite the results of investment calculations and benefit assessments carried out by expert groups. Currently, the Nord Stream 2 offshore gas pipeline, the construction of which was fully completed in 2021, is not being used for political reasons; also in early 2022, European investors decided to reconsider their participation in the project.

According to experts' forecasts, the consumption of natural gas in the world in the coming decades will tend to increase due to its availability, developed supply infrastructure and the permissibility of use in conditions of energy transition.

Russia's largest gas transportation system in the world, provided with a resource base of fossil fuels with high environmental friendliness, has great potential for development, including through diversification of supplies and expansion of the export market in the eastern direction.

The spatial development strategy of the Russian Federation for the period up to 2025 provides for "expansion, modernization and optimization of the capacities of the Unified Gas Supply System, taking into account the need to create new export routes and further gasification of the subjects of the Russian Federation, the creation of gas transportation infrastructure in Eastern Siberia and the Far East with the possibility of its integration into a Unified Gas Supply System." [10]

The construction and operation of the Power of Siberia gas pipeline is being carried out within the framework of Gazprom PJSC's implementation of the largest state megaproject in the history of the world gas industry, the Eastern Gas Program[11], which includes the development of gas production centers, processing projects, construction of gas transportation infrastructure within the country and for export.

Natural gas via the Power of Siberia gas pipeline has been supplied to China since 2019 on the basis of a long-term bilateral natural gas purchase and sale agreement concluded in 2014 between Gazprom PJSC and the state oil and gas company of China — China National Petroleum Corporation (CNPC) — for a period of 30 years and an estimated volume of 38 billion m^3 of gas per year.

The resource base of the project is the Chayandinskoye field in the Republic of Sakha (Yakutia) and Kovyktinskoye field (from the end of 2022) in Irkutsk region,

[10] Ordinance of the Government of the Russian Federation dated February 13, 2019. No. 207-p. Retrieved May 26, 2022, from https://www.consultant.ru/document/cons_doc_LAW_318094/

[11] Order of the Ministry of Industry and Energy of the Russian Federation No. 340 dated September 3, 2007 "On the Program for the Creation of a Unified Gas Production, Transportation and Supply System in Eastern Siberia and the Far East Taking into Account the Possible Gas Exports to the Markets of China and Other Countries of the Asia-Pacific Region." Retrieved May 26, 2022, from https://base.garant.ru/192224 /

the gas pipeline has a length of 3000 km, export capacity of 38 billion m^3 per year, and passes through the territories of Irkutsk Region, the Republic of Sakha (Yakutia) and Amur Region, provides for the supply of gas to the Far East Russia and China[12].

The direct impact on the formation of cash flow during the implementation of the project at the operational stage is primarily due to the expansion of the sales market at the expense of external (export to China) and internal (gasification of the regions of Eastern Siberia and the Far East) consumers.

In addition, the features of the gas resource base of the project, namely the high content of valuable components, contribute to the development of gas chemical and gas processing industries. The Amur Gas Processing Plant with a design capacity of 42 billion m^3 of gas per year, including the world's largest helium production, is an important link in the technological supply chain of gas through the Power of Siberia[13] gas pipeline.

When evaluating the effectiveness of the Power of Siberia project, it should be noted such external effects as:

1. Socio-economic effect:
- creation of jobs in the construction and operation of gas infrastructure facilities;
- development of related industries: metallurgy, pipe industry (Russian-made pipes were used for the construction of the gas pipeline); electric power industry (construction of substations for the power supply of the main gas pipeline Power of Siberia in the Republic of Sakha (Yakutia), in Amur Region[14]); development of the gas potential of fields by oil companies in connection with the construction of gas transportation infrastructure, etc.

2. Environmental effect:
- reducing the negative impact on the environment through the use of more environmentally friendly natural gas by consumers instead of other types of fossil fuels;
- the possibility of receiving associated petroleum gas from subsurface users due to the development of gas transportation infrastructure.

The export-oriented gas transportation projects reviewed above have unique conditions of implementation, economic consequences and effects, in connection with which it can be concluded that when measuring the effectiveness of investment projects, a list of factors of the external and internal environment, risks and the degree of their influence should be determined, and, as a consequence, the possibilities of expanding and adapting methods for evaluating results, taking into account the specifics of each project.

[12] Power of Siberia gas pipeline. Retrieved April 24, 2022, from https://www.gazprom.ru/projects/power-of-siberia/

[13] Amur Gas Processing Plant. Retrieved April 24, 2022, from https://www.gazprom.ru/projects/amur-gpp/

[14] RusHydro has completed the construction of substations for the power supply of the Power of Siberia-1 MGP. Retrieved April 24, 2022, from https://neftegaz.ru/news/energy/653750-rusgidro-zavershilo-stroitelstvo-podstantsiy-dlya-energosnabzheniya-mgp-sila-sibiri-1 /

Table 2 provides the organized information relating to the considered projects based on the criteria used in Table 1 for comparing the methodological recommendations, as the analytical components in assessing the economic efficiency. Evaluation of the project effectiveness requires further decomposition of the evaluated specifications, measurement of the factor impact degree on the project implementation and adaptation of the evaluation methods with due regard to the implementation conditions of each specific project.

Table 2

Methodological recommendations

Component of the analysis	Evaluated specification	For the Nord Stream 2 project	For the Power of Siberia project
Public value	Long-term megaproject	+	+
Assessment of external effects	Socio-economic	+	+
	Environmental	+	+
Calculation of efficiency indicators	Dynamic and static	+	+
Assessment of uncertainty and risks	Political	+	+
	Transit	-	-
	Market	+	+
	Environmental, etc.	+	+
Project Information:	*Readiness / Operation*	*+/-*	*+/+*

Source: compiled by the authors.

Conclusion

Based on the analysis of the economic literature, it can be concluded that the principles of economic efficiency are based on the concept of limited resources and maximizing the benefits from their use.

When determining the economic efficiency of large-scale gas industry projects, mainly dynamic methods of investment calculations used in the world practice of market economies are applied.

As a result of the work carried out, the specific features of the gas industry are formulated, which it is advisable to take into account when measuring the economic efficiency of investment projects.

Uncertainty and risks are of fundamental importance when assessing the results of investment projects in the gas industry. The classification of influencing factors and the degree of their impact on efficiency are unique for each project.

Besides, given the scale of export gas transportation projects, it is necessary to evaluate a wide range of external effects when measuring efficiency.

Analysis of methodological recommendations[15] and published works has shown that in order to predict the results of investment projects, it is necessary to develop and improve methods of risk assessment, accounting for uncertainty and quantitative measurement of external effects.

Methodological approaches to assessing the economic efficiency of investment projects in the gas industry require further development, taking into account the specifics of the industry as a whole and the conditions for the implementation of each project individually.

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Bio notes / Сведения об авторах

Maxim V. Chernyaev, Candidate of Economic Sciences, Associate Professor, Deputy Dean Faculty of Economics, Peoples' Friendship University of Russia (RUDN University). ORCID: 0000-0003-4638-5623. E-mail: chernyaev-mv@rudn.ru

Aleksandra A. Boiko, Postgraduate Student, Department of National Economics of the Economic Faculty, Peoples' Friendship University of Russia (RUDN University). E-mail: 1042200243@rudn.university

Черняев Максим Васильевич, кандидат экономических наук, доцент, заместитель декана экономического факультета, Российский университет дружбы народов. ORCID: 0000-0003-4638-5623. E-mail: chernyaev-mv@rudn.ru.

Бойко Александра Александровна, аспирант кафедры национальной экономики экономического факультета, Российский университет дружбы народов. E-mail: 1042200243@rudn.university