

## II. ИНСТИТУЦИОНАЛЬНАЯ ЭКОНОМИКА: ПРОБЛЕМЫ И РЕШЕНИЯ

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### **SOCIAL GASIFICATION HELPS OVER- COME DIFFICULT TIMES IN THE COUN- TRY'S FUEL AND ENERGY COMPLEX**

The material of the proposed article seems to the authors to be extremely relevant in connection with the 12 packages adopted by the Western community against Russia, containing more than 17 thousand of all kinds of sanctions and restrictions, including in relation to the export of hydrocarbons. This circumstance has put the domestic economy in an extremely difficult situation, especially in the context of the restoration of the country's national economy. Reorientation of the oil and gas industry to the East, to the countries of Greater Eurasia, year-round transport and industrial development of the Northern Sea Route and the Arctic zone of Russia will not only overcome the problems and difficulties that have arisen, but also strengthen political and economic ties with the states of the Silk Road and the Organization of the Collective Security Treaty (CSTO). The purpose of the study is a comprehensive economic assessment of the implementation of state regional development programs based on the use of hydrocarbon raw materials, including the social gasification/additional gasification program in the constituent entities of the Federation, to which the President paid special attention in his Address to the Federal Assembly 2024. A separate task is to forecast industrial production based on processing of hydrocarbon raw materials at various stages of technological conversion into lines of consumer goods and into products intended for export. The research results obtained so far by the authors of the article boil down to a review of information sources on the identified problems, an analysis of individual issues of the dynamics of production, export supplies, transportation and pricing of domestic hydrocarbon raw materials,

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### **СОЦИАЛЬНАЯ ГАЗИФИКАЦИЯ ПОМОГА- ЕТ ПРЕОДОЛЕВАТЬ ТРУДНЫЕ ВРЕМЕНА ТОПЛИВНО-ЭНЕРГЕТИЧЕСКОГО КОМ- ПЛЕКСА СТРАНЫ**

Материал предлагаемой статьи представляется авторам чрезвычайно актуальным в связи с принятыми западным сообществом против России 12 пакетами, содержащими более 17 тысяч всевозможных санкций и ограничений, в том числе в отношении экспортных поставок углеводородов. Это обстоятельство поставило отечественную экономику в чрезвычайно сложное положение особенно в условиях восстановления народного хозяйства страны. Переориентация нефтегазовой отрасли на Восток, на страны Большой Евразии, круглогодичное транспортно-промышленное освоение Северного морского пути и Арктической зоны России позволит не только преодолеть возникшие проблемы и трудности, но и укрепить политические и экономические связи с государствами Шёлкового Пути и ОДКБ. Цель исследования заключается в комплексной экономической оценке претворения государственных программ регионального развития на базе использования углеводородного сырья, в том числе программы социальной газификации/догазификации в субъектах Федерации, на что обратил особое внимание Президент в Послании Федеральному собранию 2024 г. Отдельной задачей исследования является прогнозирование промышленного производства на базе переработки углеводородного сырья по разным степеням технологических переделов в линейки товаров народного потребления и в продукты, предназначенные на экспорт. Полученные пока авторами статьи результаты исследования сводятся к обзору информационных источников по выявленным проблемам, анализу отдельных вопросов динамики до-

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and to determining the success of the implementation of the gasification program in individual regions of the Federation. The conceptual approaches involved were discussed. The article concludes with three conclusions.

**Keywords:** gas market, gasification/post-gasification, Power of Siberia, sanctions, restrictions, industry competition, liquefied natural gas, gas transportation.

бычи, экспортных поставок, транспортировки и ценообразования на отечественное углеводородное сырьё, к определению успешности реализации программы газификации в отдельных субъектах РФ. Задействованные концептуальные подходы подверглись обсуждению. Статья завершается тремя выводами.

**Ключевые слова:** газовый рынок, газификация/догазификация, Сила Сибири, санкции, ограничения, отраслевая конкуренция, сжиженный природный газ, транспортировка газа.

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*"The state exists not to turn earthly life into paradise, but to prevent it from finally turning into hell"*  
N. A. Berdyaev

### Introduction

The time period from 2000 and, at least, until the outbreak of the global financial liquidity crisis in 2008, turned out to be extremely favorable for Russian society in terms of encouraging dynamics in the growth of household incomes. Indeed, over this period of time, the real wages of the employed population, i.e. minus inflation losses, increased by almost 3.5 times, and the actual disposable income of the entire population officially increased by 2.5 times. Wages grew in both the private and public segments of the national economy. The second half of the 2000s was also relatively successful for employees of budgetary organizations, government institutions, etc., when the gap between the wages of these categories of public sector employees and the average wage of living labor in sectors of the real economy narrowed. Pensions of various types over the same years nominally increased almost 2.8 times.

At the same time, the growth of budget revenues in the Russian Federation noticeably outpaced the dynamics of the index of industrial production in the country, which indirectly evidenced the contribution to that progressive process of a noticeable increase in the prices of oil, gas, coal, Russian-made nuclear fuel cells exported abroad for the operation of foreign nuclear power plants, as well as rough diamonds, mineral fertilizers, military equipment and small arms. However, the merit of the government was not only that one of the components of the standard of living of the population increased and unemployment decreased, but also that the adopted fiscal and monetary policies were not immediate and fleeting. These financial policies were built taking into account the long-term development prospects of the country.

Moreover, the government learned the sad economic lesson of 1998, when the market collapse in hydrocarbon prices caused, in turn, a drop in household incomes by almost 40.0%, a devaluation of the national currency, and a surge in the level of general inflation, defined as a structural component, both cost-push inflation and inflation expectations. Therefore, in order to be prepared for a possible deterioration in the external situation on the hydrocarbon market, the monetary authorities intensified the allocation of part of oil and gas revenues, first in the Stabilization Fund and then in the Reserve Fund of the country, using the so-called "budget rule" scheme.

Let us note on our own that such a financial strategy was not at all popular in society and in the blogosphere, and in order to implement it we had to overcome resistance not only from the obvious opposition, but also from opponents in power structures. By obtaining excess oil and gas revenues, external public debt was repaid, which ultimately decreased from almost 100% of GDP to a possible minimum of 6.0%. But since the crisis of 2008, and especially since the next year, a noticeable increase in corporate debt has resumed in Russia, and after 2016, the size of the debt burden exceeded 100.0% of GDP, which created real threats to the national economy [10].

True, in recent years, for obvious reasons, a slight increase in external public debt has again begun to be observed. Thus, according to the Ministry of Finance of the Russian Federation, as of January 1, 2023, it amounted to 4,039.0 billion rubles, but in general, despite the extremely difficult situation associated with numerous sanctions and restrictions on the external currency, financial and commodity markets, this The debt falls within the high-risk expectations of the relevant ministry, and at the end of the financial year it amounted to approximately 15.6%

of gross domestic product (GDP), while continuing to remain the lowest macroeconomic indicator of national statistics in the world<sup>1</sup>.

The experience of overcoming the consequences of the crisis that suddenly broke out at that time showed that the chosen financial strategy was completely justified. It is known that many countries, including countries from the so-called group developed countries not only suffered significantly from the consequences of the financial crisis, but also faced seemingly insurmountable problems in forming the state budget. To quickly resolve the problems, they were forced to rapidly reduce pensions and salaries in the public sector.

Currently, a number of these countries are faced with a decrease in the credit rating of financial institutions<sup>2</sup> with a simultaneous increase in discount rates, which makes borrowing increasingly expensive for both the state and the private sector. Russia overcame its budget problems relatively painlessly. Real wages officially decreased slightly only in 2009, but already the following year this decrease was recouped [3], and the insurance part of pensions continued to be increased using the method of annual indexation. At that time, our country had one of the lowest levels of public debt among countries in the world community. However, the fleeting events that followed towards the end of the first quarter of 2022 contributed to the creation of general economic problems for Russia, including in the field of the country's fuel and energy complex (FEC).

It is impossible to ignore the complex, multi-positional standard of living of the country's population that will have developed by 2023. Thus, according to information from the Federal State Statistics Service of the Russian Federation (Rosstat), the average monthly salary in nominal terms (as one of the main indicators of this level) in May of this year amounted to 72,851.0 rubles, an increase of 16.1% compared to May 2022. The growth in real wages, taking into account inflation, amounted to 13.3% in annual terms in May after an increase of 10.4% in April, and in general for January-May 2023, real average wages increased by 6.0% in annual terms comparison<sup>3</sup>.

#### **Clarification of the research problem**

The cash holdings accumulated in various essentially oil and gas funds not only made it possible to fulfill all budget obligations, maintain the level of wages in the public sector, and increase pensions, but they also became the source of a large-scale anti-crisis program, which ensured the preservation of jobs in a significantly reduced industry since 1990, supported the stability of the problematic labor market, and protected the diverse domestic banking sector from the devastating consequences of the financial crisis.

But it seems that times of high and extremely high exchange and over-the-counter prices for natural hydrocarbons ended after all. In the meantime, political passions have started and scientific discussions have flared up about the consequences of the adoption in the political depths of the European Union (EU) and the group of states of the "golden billion" G7 (from the English Group of Seven), as well as other countries that have joined on the basis of a herd reflex, scandalous decisions on setting a "ceiling" of prices for Russian hydrocarbons and their gradual abandonment. And immediately after agreeing on such a non-market method of regulating free prices by the Western community, on December 5, 2022, it was adopted as a kind of price ceiling for the Russian grade of oil URALS at \$60.0 per barrel.

As a result of pressure from the collective West on Russian oil supplies, the average price for three months, based on current observations, was \$57.5 per barrel, although this was never confirmed by official data on the purchase/sale of oil. Further, as of February 14, 2023, the price even dropped to the level of \$47.0. However, in a market economy system, regulation of exchange goods occurs, after all, based on the results of exchange trading, and it is the activities of energy commodity exchanges that are designed to prevent significant volatility/fluctuation/variation of prices on the open market (spot, futures and other trade and contractual procedures based on derivatives). contracts, clearing and other financial instruments).

At the same time, Poland, the Baltic countries and Ukraine insisted on a price ceiling of as much as \$30.0 per barrel, since trade in certain regions of the world continued to go at

<sup>1</sup> <https://www.vedomosti.ru/economics/articles/2023/01/25/960321-gosdolg-rossii-po-itogam-2022-goda> (date of access: 08/09/2023).

<sup>2</sup> Regularly published financial ratings are carried out by well-known and authoritative rating agencies Moody's, Standard & Poor's Global, Fitch Ratings Inc, included in the so-called. the big three international rating agencies. Thus, on 08/01/2023, Fitch downgraded the long-term credit rating of the United States from AAA (implying maximum credit quality and minimal risk of default), taking into account the actual government debt and due to poor management of financial flows, by one notch to AA+ (very low risk of default). S&P has maintained this assessment since 2011. Only Moody's estimates the government debt rating to the maximum. The same rating triad assigned a long-term sovereign credit rating in the national currency of Russia a completely trash level – BBB a year ago, i.e. before the start of the special military operation.

<sup>3</sup> <https://gogov.ru/articles/average-salary> (access date: 09/01/2023).

\$42.0-45.0 per barrel. Moreover, Bloomberg cited data on a slight increase in Russian production in the last week of December 2022 and, accordingly, indicated a possible increase in cash receipts. But in general, at the end of 2022, oil production decreased slightly, natural gas in the country as a whole fell by 13.0%, and the company Gazprom PJSC gas production even decreased by -20.0% and oil by -2.0%. However, the modernization of the methodology of taxation of oil and gas cash flows, carried out in 2024, made it possible to reduce a serious blow to the country's financial system. Thus, according to the information of the head of the Federal Tax Service of the Russian Federation, D.V. Egorov, materials, in 2022, oil and gas revenues to the consolidated budget of the Russian Federation amounted to 24.5 trillion rubles, in 2023 – 28.3 trillion rubles, i.e. income growth amounted to 15.51%. Accordingly, the share of oil and gas revenues in the consolidated budget increased last year from 73.0% to 78.0%.<sup>1</sup>

But in any case, the existence of the notorious ceiling affects the decrease in oil prices in trade transactions with China (PRC), India<sup>2</sup> and other countries. Thus, on the site of the St. Petersburg Energy Resources Exchange, the price was at an average level of \$42.7 during normal routine trading. Such average prices can be called indicative, but they should not rise above artificially established ceilings, which is recognized and accepted by default by the majority of exchange trading participants. Russia sold oil at a discount so as not to exceed the ceiling price, and the discount was provided to selected, exclusive buyers due to the risks of secondary sanctions against them, difficulties in paying for the goods and the vagaries of transport logistics.

Price restrictions led, according to the former deputy head of the Central Bank of Russia (mega-regulator), and now an ordinary financial analyst S.V. Aleksashenko, to Russia in 2022 losing \$100-110 billion from sales of domestic hydrocarbons, and the country's budget, accordingly, lost \$50 -60 billion<sup>3</sup>. Oil and gas revenues also fell due to a decrease in prices for gas itself (from an unusually high level of \$2,000 per thousand m<sup>3</sup> in 2022), a reduction in supplies due to the closure of gas pipelines through Poland (Nord Stream 1) and with limited supply through Ukraine to Slovakia, Hungary, and partially to Austria along one of the two remaining gas pipeline lines.

Currently, gas, according to the Argus agency<sup>4</sup>, costs \$300-400, but gas prices are characterized by high fluctuations at an average level with a variation of 43.0%, which leads to a temporary freezing of short-term business plans, forced to wait for price stabilization. For the reader's information, according to the International Energy Agency, during July 2023, oil was already sold at an average price of \$64.41 per barrel, which is slightly higher than the notorious ceiling. A month later, the average spot price of URALS crude oil on the International Moscow Commodity Exchange as of August 18, 2023 was \$69.54, i.e., over 52 weeks the price dropped by 15.99% from \$82.78.

This article examines, firstly, the problem, of a conditionally exogenous order, of finding untapped opportunities to provide old and new foreign partners with oil and gas raw materials and their derivative products of varying degrees of technological processing due to the temporary loss of traditional supply routes and numerous sanctions restrictions from 12 latest packages. And, secondly, the problem, also of a conditionally endogenous nature, is explored in assessing the prospects for the implementation of long-term strategic programs that improve the quality of life of the population and ensure the processes of social gasification of the Russian consumer in the vastness of the country due to excess volumes of gas production, which was given extremely important meaning in the Address of the President of Russia to the Federal Assembly on February 29, 2024. It is planned to allocate up to 50 billion m<sup>3</sup> annually to these regional development programs (but this is only half of the volumes that were previously supplied to Europe), and an additional allocation of about 32.0 billion rubles.

### **Objectives of the study**

The purpose of the proposed material is to determine the range of Russian products from gas and oil fractions that is promising for export and domestic consumption, to search for/identify sources of financing for planned gasification/additional gasification processes, to predict the break-even level and even acceptable profitability of such activities, and to provide the author's analysis of the payback period of these activities. state strategic programs. It also provides for a comprehensive assessment of the effectiveness of large-scale investments (in the understanding of the so-called budget impulse) in mechanisms for reorienting gas flows

<sup>1</sup> <https://digital.gov.ru/ru/events/49866/#:~:text=.> (access date: 03/20/2024).

<sup>2</sup> Based on the results of quarterly trading operations for 2023, India and China bought, in the author's estimate, about 80% of all Russian oil intended for export.

<sup>3</sup> <https://www.youtube.com/watch?v=21g1tVwaS1U> (access date: 03/03/2024).

<sup>4</sup> The Ministry of Finance of the Russian Federation uses data from the authoritative financial agency Argus in its analytical calculations.

mainly to the East [9], in particular ensuring the implementation of international and framework programs "Greater Eurasia", without forgetting the opportunities Russian LNG business (not yet subject to sanctions), aimed, among other things, at corporate buyers from Western European countries.

### Research methods

The tools used for long-term research work include the use of methods and techniques of dialectics, statistical observation, active comparative studies, economic, financial, and partly budgetary statistics, the index method, correlation and regression analysis, formal logic, expert assessments, scenario approach and goal tree analysis.

As is known, in addition to traditional wholesale market trading, i.e. exchange sales, for example on the well-known London, New York, Shanghai oil exchanges<sup>1</sup>, hydrocarbons from different producers are sold on various platforms during over-the-counter trading, where it is constantly present and active on its own behalf Russia trades directly through affiliated traders, say, in the mode of forward contracts and options. In any case, emerging prices will almost always change, so to speak, geometrically congruently in accordance with the real dynamics of the commodity market for oil and gas products and in real time.

But to transport both purchased volumes of hydrocarbons, Russia needs approximately 100 specialized tankers to create a kind of shadow fleet and with a significantly updated composition oil and gas traders. True, already during the sanctions period, Russian shipyards launched 4 vessels specialized for the transportation of hydrocarbons, and 4 more objects were laid down, which, of course, is clearly not enough. But, according to some information, both of these technical difficulties are expected to be virtually resolved by the current year 2023. Thus, on 08/07/2023, the Arc7 ice-class gas tanker Sergei Witte, powered by LNG fuel<sup>2</sup>, was launched from the stocks of the Russian Zvezda shipyard near Vladivostok. And on September 11, 2023, in the presence of the President of the Russian Federation, a solemn naming ceremony took place for the oil shuttle tanker "Valentin Pikul" with enhanced ice capability with ice thickness up to 170 cm, with a carrying capacity of 70 thousand tons, and the Arctic gas tanker "Alexei Kosygin" with permeability of the ice cover up to 200 cm.<sup>3</sup>

Arc7 class icebreaking gas tankers are among the most technologically sophisticated innovative vessels designed to build independent navigation in the Arctic seas. Before the introduction of sanctions, the gas carriers that Russia owned were built at the South Korean shipyard DSME, registered under different flags, and the LNG product they transported could be considered a completely anonymous exchange commodity that did not have any national coloring. Nevertheless, solving the problem of transporting Russian hydrocarbons abroad seems extremely serious and not obvious. Thus, the Indian tanker company *Gatik*, involved in the transportation of Russian oil, lost its standard industry insurance from the American Club, part of the International Group of Mutual Insurance Clubs (P&I Clubs), which previously insured 34 vessels out of a set of 48 tankers under controlled by *Gatik*.

The shipping company *Gatik Ship Management*, which also manages a fleet of oil tankers and LNG ships, lost insurance coverage and compensation for losses for its crew due to non-compliance with ceiling prices for Russian oil. Such insurance coverage protects the ship from risks including collisions, piracy, and oil spills, but such threats are not vanishingly small today. Insurance coverage, of course, is mandatory when ships call at ports for various reasons and when passing through straits, which have become increasingly dangerous in recent years. True, overproduction of LNG products is expected in the world in the next 3-5 years, and this situation should be treated especially carefully and prepared in advance.

However, as the head of the Russian Mega-regulator notes, oil production in 2023 will decrease by 70.0%, while the price per dollar is projected at 75-85 rubles. This unfavorable trend continued in the first half of 2023, and the inflation rate is projected to be 8.0-8.5% year on year. At the same time, the national currency, the ruble, will weaken in the second half of 2023. The dynamics of the ruble in previous years, which seriously worried the economy, is shown in Fig. 1 and covers the key moments of the sanctions period for 2013–2023.

<sup>1</sup> At these commodity exchanges, market pricing, in the traditional sense, occurs and payment is made there.

<sup>2</sup> LNG – liquefied natural gas.

<sup>3</sup> <https://lenta.ru/news/2023/09/11/tanker/> (date of access: 09/12/2023).

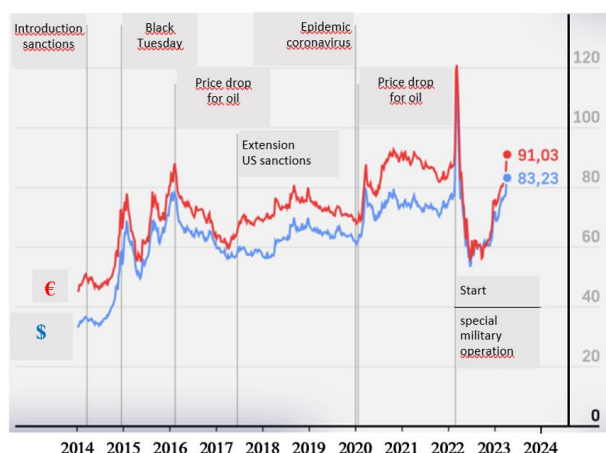


Figure 1. Dynamics of the exchange rate of the main currencies to the ruble for 2013-2023

Data source: Moscow Exchange report dated 04/07/2023, TASS.

But the establishment of a ceiling on oil and gas prices in these processes is not the main dominant predictor factor, since the main pricing factors associated with geopolitical factors are formed in the market space of forward and futures contracts. However, the effectiveness of the simple mechanism of ceiling pricing for Russian export petroleum products turned out to be extremely beneficial for American oil companies, whose activity in the foreign market, including supplies to Europe, is unpleasantly impressive. This is reliably evidenced by the dynamics of annual oil exports from the United States over the past 13 years, which is clearly presented in Fig. 2.

Particular attention in the expert and scientific community has recently been paid to the problems of pricing for domestic raw materials, in particular to the sluggish debates among specialists at various levels of presentations about the liberalization of gas prices for the domestic market of the country, since the latter are a consequence not only of economic competition between the largest Russian actors – PJSC Gazprom, PJSC Rosneft and PJSC Novatek. Such macroeconomic discourse can be considered an element of commercial confrontation and even an undeclared struggle between administrative and nomenklatura groupings of approximately equal political power within the Russian fuel and energy complex (FEC).

#### Analytical review of information sources

As for the recent problems of the domestic gas industry, China and Japan bought more Russian gas in 2021 than the entire European Union, and the hysterical desire to overcome energy dependence on Moscow through and in the form of various numerous sanctions and restrictions has already cost the united Europe €1.0 trillion in very significant losses. In turn, the situation created by the collective conditional West, of course, had a negative impact on the current economic interests of Russia. Currently, less than 10.0% of Russian gas is supplied to the European market from the total volumes (the main consumer of LNG is Belgium), previously it was about 40.0%, and oil and gas revenues in 2022, accordingly, fell by 45.0%.

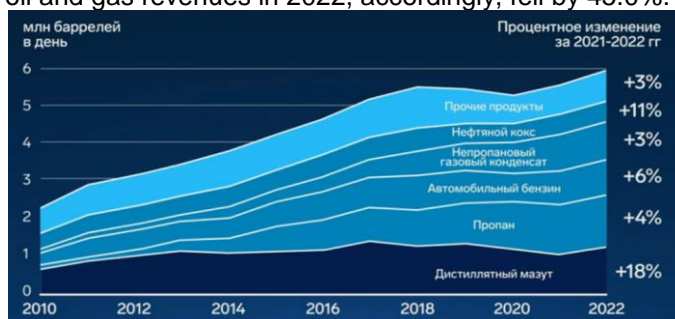


Figure 2. Dynamics of annual exports of petroleum products from the United States by individual types of products for the period 2010–2022

Information source: US Energy Information Administration, dated March 20, 2023.

The official data of the Rosstat published the figure for annual gas production in Russia for 2022 in the amount of 673.8 billion m<sup>3</sup>. For comparison, a year earlier, gas production/production amounted to 763.0 billion m<sup>3</sup>. According to the estimates of the relevant Deputy

Prime Minister, the total export of natural gas from the country fell sharply by 25.1%, to 184.4 billion m<sup>3</sup> after the start of the SMO. At the same time, exports in the form of Russian LNG increased by 7.9% and reached a volume of 45.7 billion m<sup>3</sup>. According to calculations by Vedomosti, based on official data from the European Network of Gas Transmission System Operators (ENTSOG), at the end of November 2022, Russia supplied the EU with an average of 76–77 million m<sup>3</sup> of gas per day versus 368–377 million m<sup>3</sup> at the end November 2021, i.e. daily transportation of the product fell to levels in the range of 20.42% ÷ 20.65%.

The decrease in exports and production in 2023 is, of course, due to seemingly objective reasons – the refusal of European countries to purchase Russian gas, as well as sabotage on the Nord Stream 1 and Nord Stream 2 gas pipelines. During the previous year, gas supplies to China were actively increasing. The records for daily transportation of Russian gas through the Power of Siberia gas pipeline with a length of over 3 thousand km have been updated more than once, as a result of which supplies to China increased by 48.0% and reached a historical maximum of 15.4 billion m<sup>3</sup>. At the same time, according to domestic industry analysts, the potential for further growth in the volume of gas supplied to the Asia-Pacific region (APR) is indeed becoming noticeable. To realize this potential, work has already been intensified on further technological diversification of engineering and transport infrastructure intended for export activities mainly in the eastern and northeastern directions [6].

For these purposes, the Gazprom company, on behalf of the President of Russia, is working on accelerating the construction and improvement of the "Far Eastern route", as well as the Power of Siberia-2 gas pipeline, Far Eastern gas processing enterprises, LNG plants and many others. etc. The comprehensive development of these projects will attract 4.0-5.0 trillion rubles. additional direct investment and 1.5-2.0 trillion rubles. into related industries of the real sector of the economy such as ferrous and non-ferrous metallurgy, cement, building materials, forestry and woodworking, chemical industry, heavy and chemical engineering, etc.

The main route for the supply of Russian pipeline gas to European countries remains transit through the gas transportation system of Ukraine (an average of 42-43 million m<sup>3</sup> per day) and Moldova. The remaining volume is exported to the EU through the Turkish Stream to Serbia, Bulgaria, and partly to Hungary. Gas supplies via Nord Stream were completely stopped at the end of August, exports via the Yamal-Europe pipeline have actually not been carried out since the end of 2021, and Nord Stream 2, which was fully completed last fall, unfortunately was not launched.

Updated domestic and foreign analytics highlight the following important points in the Russian gas industry. Senior analyst at Alfa Bank N. Blokhin points out that the decrease in gas production in Russia is mainly due to a reduction in Gazprom's export supplies, and this is directly reflected in the company's statistical reporting of production. At the same time, gas consumption within Russia, according to Sergei Kaufman, an analyst at the financial group *Finam*, is "decreasing moderately".

Senior analyst at BCS World of Investments R. Smith explains that domestic consumer demand in the country for hydrocarbons is also falling due to general negative trends in the Russian economy. In particular, there is a reduction in metallurgical production by 9-11% in 2022, including those sub-sectors that were focused exclusively on exporting their products. Let us note on our own that the main reason for this decrease is the 12 packages of international sanctions, which should be considered by no means the final number, taking into account the 13th package currently being prepared. As they say in the Book of Genesis, almost close to the Church Slavonic text – The Abyss of Heaven opened up [1].

S. Kaufman adds that Gazprom finds itself in a difficult situation: the loss of European market share is happening very quickly, and the reorientation to supplies to China, on the contrary, is happening much slower than the planned growth rate. The growth in production of the Rosneft company, as noted by analyst N. Blokhin, is due to the increase in production at the Kharampur field and the achievement of full capacity of the Rospan project, where the systematic growth of gas and gas condensate production continues. He also recalls that Rosneft representatives previously announced plans to increase production as part of the Rospan project by more than 50% in 2022. According to N. Blokhin, up to 17 billion m<sup>3</sup> of Novatek, additional volumes of gas in 2023 will be brought by two key fields – Severo-Russkoye, where the company is rapidly increasing gas production, and Kharbeiskoye, launched at the end of 2021. At the same time, S. Kaufman notes that production at the Yamal LNG project has been increasing since 2022, since, as the expert believes, this is probably due to abnormally high prices for LNG on the spot market.

Here it is necessary to give an explanation regarding the characteristics of the market opportunities of the main players of the fuel and energy complex triad in the domestic gas commodity market. According to Russian legislation, the so-called. independent gas producers



Rosneft and Novatek have the right to sell gas to industrial consumers at free prices. And Gazprom is obliged to sell its products only at the tariffs established by the Federal Antimonopoly Service (FAS) of the Russian Federation<sup>1</sup>. The consequence of this legal peculiarity was the loss by Gazprom of a significant share of the domestic market, which was acquired by other actors of the troika by offering potential buyers a significant discount from the tariffs established by the FAS. At the same time, full-fledged and healthy price competition for Gazprom was, naturally, inaccessible in the legal field [5].

The growth in production of Gazprom Neft, according to Blokhin, is due to the large number of projects being implemented. In addition to the gas fields of Gazprom, which the company services, the main production center, the analyst notes, is concentrated in Yamal in the portfolio of its subsidiaries - Gazpromneft-Yamal and Meretoyakhaneftegaz. He and other analysts explain the decline in production from production sharing projects (PSA)<sup>2</sup> with the departure of the American Exxon Mobil from the Sakhalin-1 project. Expert R. Smith adds that in recent weeks Rosneft has resumed oil production at the project, and, accordingly, associated gas production should also recover. According to N. Blokhin's short-term forecast, if exports continue to decline, gas production in Russia at the end of 2023 could decrease by approximately 11.0% and amount to 677.0 billion m<sup>3</sup>.

In 2023, if the current geopolitical situation continues, according to American analyst Edward Kaufman from Alfa Bank, a decrease in gas exports will continue, and the latter could fall by more than 28.0%, or about 28 billion m<sup>3</sup>. This will mean that the reduction in gas production in Russia next year 2024 will be at least 4.0%. "However, in the event of a further slowdown in the Russian economy and a possible decrease in the production of gas chemical products, this estimate may turn out to be too optimistic, and the real decline in production in 2023 will be up to 10.0%", the expert concludes<sup>3</sup>. In 2023, according to E. Kaufman, if the situation with Gazprom's exports does not improve, production may fall by another 15-30 billion m<sup>3</sup>, i.e. from 2.0% to 4.5%.

#### Observation results and discussion

1. The above-mentioned specificity of state economic regulation in the domestic gas market turned out to be the reason for the increase in gas production and sales, first by Novatek PJSC, and then by Rosneft PJSC, as shown in Fig. 3. At the first stage (2006–2011), both PJSC took clients away from Gazprom in favor of mainly Novatek, and since 2012 they have become serious competitors with each other. In 2016, Rosneft came, rather symbolically, to second place among the big three with a gas volume of 67.1 billion m<sup>3</sup>, ahead of Novatek by almost 1.0 billion m<sup>3</sup>, and planned to reach a level of 100.0 billion m<sup>3</sup> by 2020.

The downward trend in gas production multiplies socio-economic problems in such traditional territories of the country as the Yamalo-Nenets Autonomous Okrug, although in the area of Novy Urengoy a deposit of low-lying gas deposits with a volume of 40.0 trillion m<sup>3</sup> was discovered, which, at the current rate of extraction in recent years, will ensure productive operation of the field until 2040. Accordingly, gas workers have begun to develop major infrastructure projects, which spell out future proportions in the extracted volumes of gas raw materials, of which 2/3 will go for domestic consumption, and 1/3 for export.

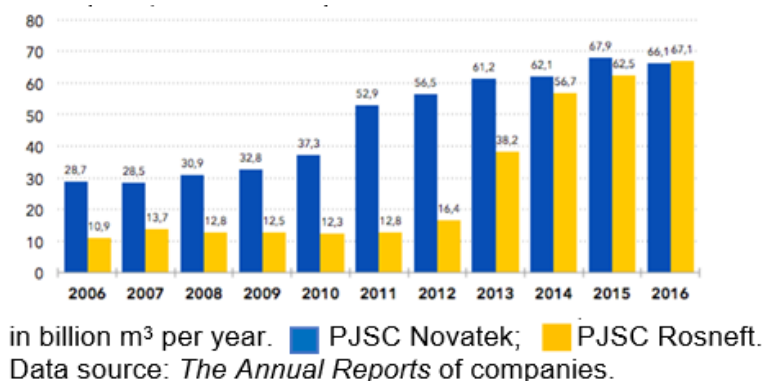


Figure 3. Dynamics of gas production so-called. independent players of the triad for 2006-2016,

<sup>1</sup> According to Federal Law-69 "On gas supply in the Russian Federation" dated March 31, 1999 (as amended on July 14, 2022).

<sup>2</sup> PSA projects are a special type of agreement on the establishment of a joint venture. In the English version – Production Sharing Agreement.

<sup>3</sup> <https://expert.ru/expert/2009/45/kaufman/> (date of access: 08.25.2023).



In 2021, Gazprom produced, excluding the share in production of those organizations in which investments are classified as joint commercial operations, 514.79 billion m<sup>3</sup> of natural and associated gas; 16.32 million tons of gas condensate; 42.90 million tons of oil. As of December 31, 2021, the Gazprom Group of Companies was developing 147 hydrocarbon fields in Russia<sup>1</sup>. The main center of gas production by Gazprom remains the Nadym-Pur-Tazovsky oil and gas region in the Yamal-Nenets Autonomous Okrug. Activities to develop the Group's oil reserves are carried out mainly in the Yamalo-Nenets Autonomous Okrug and Khanty-Mansi Autonomous Okrug-Yugra, as well as in the Tomsk, Omsk, Orenburg and Irkutsk regions, in the Pechora Sea. The direct territorial location of gas production capacities in the Russian Federation is shown in Fig. 4 and Table 1.

Taking into account the market share of the organizations of the Gazprom Group of Companies in production volumes, investments in which are also classified as joint operations (820.0 million m<sup>3</sup> of natural and associated gas and 5.26 million tons of oil), the total hydrocarbon production of the Group of Companies in 2022 amounted to 515.61 billion m<sup>3</sup> of natural and associated gas, 16.32 million tons of gas condensate and 48.16 million tons of oil. And taking into account all the losses incurred, Gazprom's gross profit at the end of 2022, as estimated by RAS, fell almost 4 times<sup>2</sup>.

In industrial gas processing, one of the stages of the production process is the liquefaction of the gas fraction. LNG forms an alternative fuel as a relatively inexpensive, fairly environmentally friendly and quite efficient source of energy. LNG is a colorless, odorless liquid that is non-toxic and non-corrosive to metals. In the production technological process of liquefaction, natural gas is converted into a liquid fraction, the volume of gas is reduced by almost 600 times, and cooling is carried out to a temperature of minus 160°C.

This type includes LNG products with a hydrocarbon base and their mixtures, which, depending on the ambient pressure and temperature, are in a gaseous or liquid state. The greatest value in the domestic sphere is a mixture of butane and propane, which is widely used in the industrial and residential sectors, as well as fuel for various types of transport, for municipal and domestic consumption. At the same time, LNG fully meets stringent international requirements for emissions of carbon dioxide (CO<sub>2</sub>) and sulfur dioxide (SO<sub>2</sub>) into the atmosphere, in concentrations above the established maximum permissible concentrations and has a low carbon footprint, which is consistent with the declared domestic "green" agenda and environmental protection state policy.



Figure 4. Operated production capacities of the Gazprom PJSC Group of Companies in the Russian Federation as of 01/01/2022

Data source: Annual report of PJSC Gazprom.

<sup>1</sup> Annual report of PJSC Gazprom for 2021.

<sup>2</sup> Annual report of PJSC Gazprom for 2022.

Table 1 – Explanation of details and symbols (text below the figure) for Figure 4

Developed fields	Explored deposits
<p>▲ Gas and gas condensate;          ▲ Oil and gas and oil and gas condensate;          ▲ Oil.</p>	<p>▲ Gas and gas condensate;          ▲ Oil and gas and oil and gas condensate;          ▲ Oil;          ● Areas of gas exploration works (GEW).</p>
<p><b>Areas of gas exploration for hydrocarbons</b></p> <p>1. Krasnodar region; 2. Astrakhan and Orenburg regions; 3. Komi Republic and Nenets Autonomous Okrug; 4. Continental shelf of the Russian Federation in Kara, Barents and Pechersk seas; 5. Khanty-Mansiysk Autonomous Okrug – Ugra; 6. North of the Taz Peninsula, Ob and Taz bays, Nadym-Pur-Taz regions; 7. Yamal Peninsula; 8. Gydan Peninsula; 9. Krasnoyarsk region, Irkutsk, Tomsk and Kemerovo region; 10. The Republic of Sakha (Yakutia); 11. Continental shelf of the Russian Federation in East Siberian and Chukchi seas; 12. Kamchatka Peninsula.</p>	

2. Russia is actively looking for ways to overcome the negative consequences of sanctions on the export of its hydrocarbons. And as one of the options for solving problems, a proposal was made to create a Turkish gas hub, which the President of the Russian Federation voiced back in October 2022, i.e., a little more than two weeks after the explosions on the main gas pipelines (MGP) Nord Stream-1 and Nord Stream-2 in the Baltic Sea. The content of such a proposal was reduced to the following positions. The lost transit volume of Russian gas can be moved to the Black Sea region, for which it is planned to create a gas hub in Turkey. Such a project involves organizing an infrastructure site for gas supplies, as shown in the diagram in Fig. 5, and the formation of a kind of price connector on the border with the EU, which can become a good alternative to other centers for determining the selling price of gas in European countries.

The location of the gas hub is envisaged in the Thrace region in the European part of Turkey, approximately in the Luleburgaz region in the Black Sea province of Kırklareli. The Turk Stream IGP line goes there, from there, according to Turkish researchers, gas can be sent along three lines: the southern line to Italy, the middle line to Bulgaria, Albania, Kosovo, Macedonia, Serbia and other countries, the northern line to Romania, Slovenia, Hungary and further to Germany.



Rice. 5. Layout of the sites of the Turkish gas hub being created

Data source: <https://neftegaz.ru/news/> (access date: 04/26/2023).

But the question of the readiness of global Europe or individual countries, both infrastructurally, technically, technologically and geopolitically, for gas purchases through the Turkish hub remains open and continues to be discussed through diplomatic channels at the state level. Due to the ban under international sanctions on gas transportation by land and rail, Russian gas logistics specialists are already organizing these transportations by sea, not always transparently.

3. The gas chemical plant in Ust-Luga is a complex for processing ethane-containing gas and producing LNG in the Leningrad Region (LO) and is the anchor project of a large gas processing and gas chemical cluster being formed in the region. The creation of such a cluster serves as an experience in practical testing of a new economic model for the integrated monetization of hydrocarbon reserves. The launch of an enterprise is of great importance for the socio-economic development of the country. It will allow increasing Russian exports of LNG, as well as liquefied hydrocarbon gases (LPG). The production of ethane, which is in great demand in domestic industries, will increase significantly.

The enterprise will become the most powerful in terms of gas processing volume in Russia and the largest in terms of LNG production volume in the North-West Europe region. The complex will annually process 45 billion m<sup>3</sup> of gas, produce 13 million tons of LNG, up to 3.8 million tons of ethane fraction, up to 2.4 million tons of LPG and 0.2 million tons of pentane-hexane fraction. The natural gas remaining after processing (about 19 billion m<sup>3</sup>) will be sent to the Gazprom gas transmission system as a commodity reserve.

Combining LNG and ethane production into a single platform significantly improves the economics and specific indicators of the project, allowing for a significant reduction resource and price risks. The raw material for the enterprise will be ethane-containing natural gas produced by Gazprom from the Achimov and Valanginian deposits of the Nadym-Pur-Taz region. At the peak of construction of the complex, over 25 thousand specialists will be involved; during the operation phase it is planned to create more than 5 thousand permanent jobs. The ethane produced by the plant is planned to be supplied to a promising gas chemical complex (project of RusGazDobycha JSC), which will produce over 3 million tons of polymers per year.

To increase the energy security of the region, taking into account the peculiarities of its location, Gazprom implemented a project for an alternative option for gas supply to consumers - using LNG delivered by sea. For this purpose, a gas receiving terminal was built in the waters and on the coast of the Baltic Sea. The key element of the terminal is a stationary sea pier with a breakwater, which is already considered a unique technological facility for domestic practice.

The facility is located five kilometers from the coastline. The depth of the sea around it reaches 19 m, which makes it possible to moor a floating regasification unit (FRGU), for example, the only FRGU in Russia so far, "Marshal Vasilevsky". The vessel transports LNG (tank capacity is 174 thousand m<sup>3</sup>) and performs its regasification, i.e. converting LNG from liquid to gaseous state. The existing PRGU has three regasification lines, including one reserve. The terminal and PRGU provide the ability to obtain natural gas by sea transport in a volume of up to 3.7 billion m<sup>3</sup> per year and are capable, if necessary, of meeting current and future needs in the enclave of the Kaliningrad region.

4. The implementation of state strategic gasification/additional gasification programs deserves special attention. By decision of the President of the Russian Federation, the Social Gasification Program is being extended and will be implemented on an indefinite basis until the optimal indicators for Russia, as believed by regional authorities and understood by relevant experts, are achieved (see link <sup>7</sup> on the article). Thus, more than 310 thousand people have already been provided with gas under this program at literally symbolic prices, and until recently the Moscow region was the leader in the implementation of such plans.

Since the start of the social gasification program in June 2021, which provides for free delivery of gas to the boundaries of the sites, 790.0 thousand applications have been accepted. 724.0 thousand contracts were concluded, i.e. 91.65% of those applications that were accepted for execution by the end of 2023<sup>1</sup>. The potential for connection has been created for more than 1,100 thousand households (gas has already been supplied free of charge to the boundaries of the plots), when gas pipeline infrastructure is carried out even if there is no application and allotments are made to land plots, albeit taking into account the prompt solution of key financing problems and current issues on state subsidies (see Fig. 6).

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<sup>1</sup> Source of information: Administration of the Leningrad Region. – IA Neftegaz.RU. (date of access: 03/02/2024).



Figure 6. Dynamics of fulfillment of contractual obligations for the implementation of the Social Gasification Program in the Leningrad Region

Data source: Gazprom Mezhsrednagaz LLC, St. Petersburg, Russian Federation.

It was also reported that a large-scale inventory of households was carried out. The potential for the number of connections has been derived, which, within the framework of the additional gasification program, is estimated for those households that are located in already gasified settlements at a level of about 2.0 million settlements. Subjects of the Russian Federation post-gasification plans were approved as part of programs that are constantly updated, and specific program objectives for 2024 and beyond were outlined. But at present, tasks for the social gasification of households are being quickly set and solved; In addition, this program is expanding to schools, medical institutions, etc. and will continue to move forward, since the program now has no final deadline. It should be clarified that the socially oriented gasification program provided for a gradual increase in the country's gasification level from 71.0% in 2021 to 82.9% by 2030. The main tasks set for the program for 2022-2023. were generally completed, the pace of construction of gas infrastructure facilities was 3 times higher than in 2021.

In 2021, the construction of 163 inter-settlement gas pipelines with a length of more than 2.7 thousand km was completed. The level of gasification with natural gas in Russia by 01/01/2022 is low and has so far reached 72.1%. The overall upward dynamics of the country's gasification level by year for the previous period 2005-2021. shown in Fig. 7. The legal documents approved by the Government of the Russian Federation note the importance of maintaining the pace of work in 2024 and beyond, as well as the need for all subjects of the Russian Federation to adopt the required regulations for beneficiaries to receive state subsidies. Thus, the minimum subsidy amount is 100.0 thousand rubles for mandatory 9 categories of citizens has already been in effect in all regions since February 15, 2023. The Russian government is allocating about 2.5 billion rubles to carry out operations to co-finance expenses incurred locally.

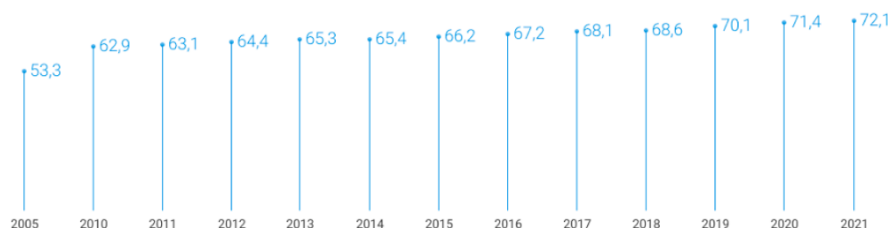


Figure 7. Dynamics of the level of natural gasification in Russia for the period 2005–2021, by the end of the year, %

Data source: Gazprom PJSC.

For example, the schedule for additional gasification of the Leningrad Region now includes 62,727 residential buildings, and the 47th subject of the Federation has become the first in the region where a comprehensive program of social additional gasification is being implemented in full. All residents of the Leningrad Region who have lived for a whole year in a permanent, registered house that is subject to gasification have the right to proportionate compensation for laying gas from the boundaries of the site to the house and for the purchase of the

necessary equipment for receiving gas. Throughout 2023, additional gasification also began in new regions of Russia.

For example, the schedule before the gasification of the LO now includes 62,727 residential buildings, and the 47th subject of Blue fuel has become more accessible to residents due to the fact that Gazprom structures supply networks to residents' land plots for free. And a number of regions allocate significant subsidies for the installation of networks in homes and on residents' land plots, the purchase of equipment, and here the positive experience of LAW turns out to be exemplary and instructive everywhere. For the period 2022-2025, the company planned to allocate 526.1 billion rubles for gasification of Russian regions, i.e. more than in all previous 17 years. The allocation of such essentially budgetary financing for the country's gasification processes is illustrated in Fig. 8.

According to S. V. Gustov, General Director of Gazprom Mezhhregiongaz LLC, more than 24 thousand settlements in 85 constituent entities of the Russian Federation are already participating in the additional gasification program; the volume of financing under concluded agreements amounted to 176.6 billion rubles. The schedule for post-gasification of the Leningrad Region now includes 62,727 private residential buildings. 22,617 applications were received from residents, 20,932 contracts were concluded, gas pipelines were laid to the borders of 10,731 areas. In the Leningrad Region, a subsidy from the budget is allocated for gasification work on the site and in the house. Its amount is from 180.0 thousand rubles. for homeowners who have lived in the Leningrad Region for more than a year, up to 200.0 thousand rubles. for beneficiaries - pensioners, disabled people, large families, etc. Veterans, persons equated to them and families of SMO participants can count on even 300.0 thousand rubles. Of the total subsidy provided in the amount of 60.0 thousand rubles. can be used to purchase gas equipment, specifically: stoves, boilers, water heaters, gas analyzers, etc.

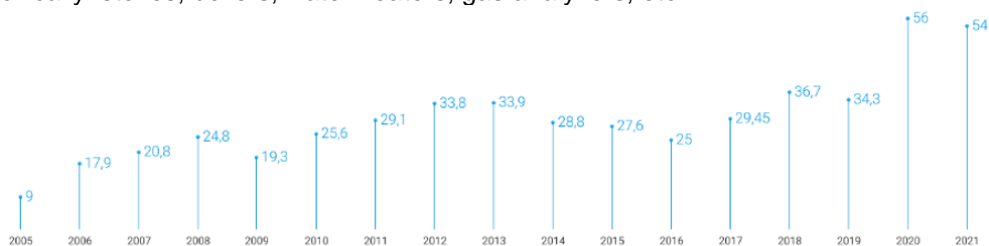


Figure 8. Amount of financing of PJSC Gazprom for gasification programs for the period 2005–2021, billion rubles

Data source: PJSC Gazprom.

Together with specialists from the Gas Distribution Organization (GDO), a division of Gazprom, any resident goes through all stages of gasification – from obtaining the necessary permits and project approval to installation work and signing a gas connection agreement. Install a boiler, stove, meter, check the equipment, install pipes, sign an agreement for regular maintenance of the equipment – gas workers will help you do all this. In many regions, gas distribution companies offer turnkey home gasification and accompany the customer at all stages of gasification.

Tariffs for GDO services for technological connection are regulated by the state. According to Federal Law No. 69 "On Gas Supply in the Russian Federation", fees for technological connection are established by the executive bodies of the constituent entities of the Russian Federation. The cost of services is indicated in the GDO price lists, which can be found on their websites. Prices for gas distribution services vary in different regions. Thus, in the Leningrad Region, standard gasification work by gas distribution companies will cost from 150 thousand to 200 thousand rubles, and in the Republic of Mordovia – from 53 thousand to 110 thousand rubles. The price depends on the features of the project, the equipment involved and the technical complexity of construction and installation work (CIM).

And here we cannot fail to mention the cost of gas transportation. One of the tasks of the GDO is to transport gas to the population and industrial enterprises. Gas transportation tariffs are set by regional authorities and change every year. The cost of gas transportation is included in the monthly gas receipt along with the wholesale price of gas and the cost of billing and collection services. This cost is growing quite dynamically, and this creates an independent problem within the gas production triad.

The essence of the problem lies in the fact that the so-called. It is profitable for independent producers to supply blue fuel to industrial consumers located close to northern areas of raw material production, i.e. to the Yamal-Nenets and Khanty-Mansi Autonomous Okrug, since



the cost of transportation significantly affects the profitability of product delivery. Accordingly, distant consumers of Novatek and Rosneft are economically of little interest. But even with such restrictions on competitors, Gazprom's share of the domestic market fell from 80% in 2010 to about 64% in 2016. The remaining part – about 18% – went to "independent" partners, and thus Gazprom can be defined as a monopolist rather conditionally, and then only in relation to the export of pipeline gas.

A challenging aspect of implementing the program is also the cost of maintenance. And an important function of the GDO is precisely the maintenance of VDGO and VKGO. Gas equipment in both apartments and private houses is checked annually. Its cost is not included in the receipt and is paid separately. It depends on the composition of the equipment in the house and the region of residence. Tariffs for GDO services for servicing gas equipment are also set by local authorities, and they are individual for each region.

Thus, in the Kabardino-Balkarian Republic, maintenance of a stove will cost from 300 to 470 rubles, depending on the number of burners, maintenance of a domestically produced water heater – 440-580 rubles, foreign production – from 1,300 rubles. In the Krasnodar Territory, maintenance of a gas stove will cost from 440 to 730 rubles, a boiler – from 490 to 4,300 rubles, a gas water heater – 506 rubles, an intra-house gas pipeline – 82 rubles. In Perm, servicing a water heater will cost from 965 rubles, a gas stove – from 343 to 455 rubles, a gas boiler – from 1,900 to 6,500 rubles, depending on its power. Information on the cost of equipment maintenance, all stages and conditions of post-gasification can be found on the website of the gas distribution department of the corresponding region or at subscriber points.

5. The practical use of natural and associated gases has a number of remarkable advantages that should definitely be listed:

- cheapness of gas as a type of fuel. The national average price for network gas is 6.27 rubles per cubic meter. When burned, a cubic meter of gas releases thermal energy equivalent to about 9.3 kWh, depending on the calorific value. According to Rosstat, the average price of electricity in Russia is 3.0 rubles/kW-hour. It turns out that gas in everyday terms is four times more profitable than electricity<sup>1</sup>. Compared to the prices of coal and firewood, the cost of gas turns out to be noticeably more attractive;

- environmental friendliness. After its combustion, no soot remains, unlike the use of firewood and coal. When natural gas is burned, it emits significantly less carbon dioxide than other energy resources, and for this reason it is called a "green fuel";

- versatility in use. You can use it to cook food, heat a room, or refuel a car. A car filled with gas leaves significantly smaller carbon footprint than gasoline-powered vehicles, and traveling in such a car is much cheaper for its owner;

- indispensable both in industrial production and in everyday life. Behind its extraction and delivery there is a complex technological infrastructure, skilled labor of hundreds of thousands of specialists, and extremely strict safety measures. The usual composition of produced gases in the Russian Federation is presented in Figure 9.

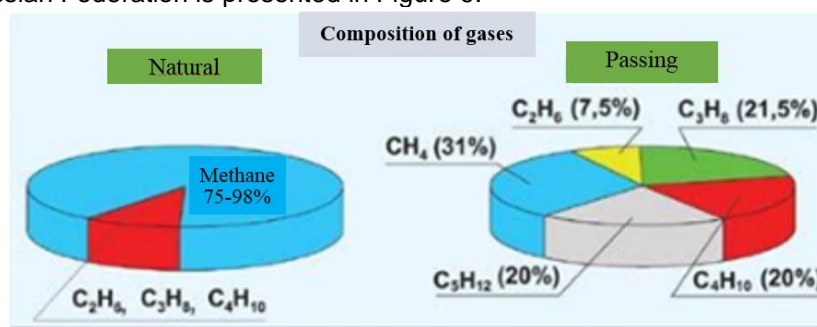


Figure 9. Composition and structure of gases produced by PJSC Gazprom on the territory of the Russian Federation

Data source: PJSC Gazprom.

The production prospects for industrial gas processing in Russia deserve special attention. Since natural gas readily participates in the chemical combustion reaction, both electrical and thermal energy are most often obtained from it. But based on gas, it is possible to make an extremely wide range of independent, finished and final products: fertilizers, various types of fuel, dyes, paints and much, much more. Significant volumes of gas are also used metallurgical

<sup>1</sup> <https://referat.co/ref/672243/read?p=4> (access date: 09/14/2023).

industry. The range of possible products produced directly from gas feedstock is shown in Fig. 10.

The production prospects for industrial gas processing in Russia deserve special attention. If we recall the 2022 export prices for Russian gas per 1,000.0 m<sup>3</sup>, they reached \$3,800.0, and domestic prices were set at \$70.0. That is, the price discrepancy exceeds 54 times, which opens up brilliant prospects for the inclusion of accessible and relatively cheap gas raw materials in production and technological complete cycles, at the end of which one or another fully-fledged product, absolutely competitive in any market, and in some cases highly innovative, appears. Moreover, precisely those products that until now have not been produced in the country at all.

Natural gas can be used as a motor fuel. Compressed (or compressed) methane costs half as much as 76-grade gasoline, extends engine life and can improve the environmental condition in cities. The natural gas engine complies with Euro-4 and Euro-5 environmental standards. Gas can be used both for conventional cars and for agricultural, water, air and rail transport, as well as in a combination of various modes of transport [2]. Compressed gas is produced at automobile gas filling compressor stations (CNG filling stations) by compressing natural gas supplied through a gas pipeline to a pressure level of 20-25 MPa (in megapascals), i.e., up to 200-250 atmospheres.

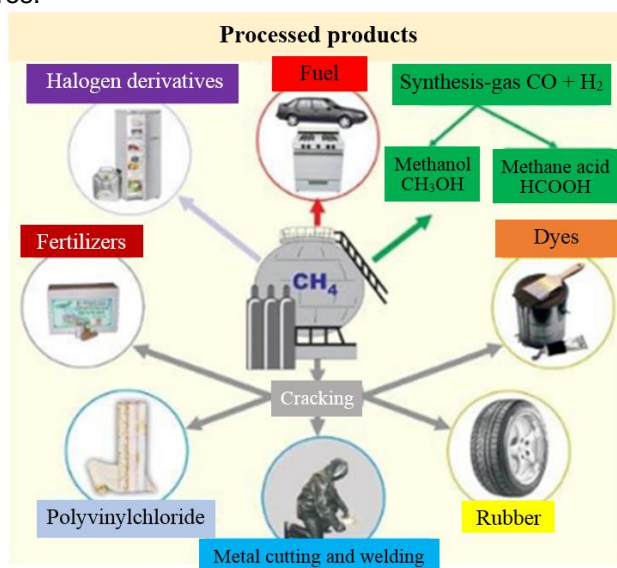


Figure 10. Diversification of industrial production on the domestic basis for processing natural and associated gas raw materials (natural sources of hydrocarbons, methods their processing, organic synthesis)

Data source: PJSC Gazprom.

It is also possible to produce liquid motor fuels from natural gas using gas-to-liquid (GTL) technology. Since natural gas is a fairly inert product, almost always during processing at the first stage it is converted into a more reactive vapor-gas mixture - the so-called. synthesis gas (a mixture of  $\text{CO}$  and  $\text{H}_2$ ). It is then sent for synthesis to produce liquid fuel. This can be so-called synthetic oil, diesel fuel, as well as lubricating oils and paraffins.

Primary gas processing occurs at gas processing plants (GPPs). In addition to methane, natural gas usually contains various impurities that need to be separated. These are nitrogen, carbon dioxide, hydrogen sulfide, helium, and water vapor. Therefore, first of all, gas feedstock at the gas processing plant undergoes special technological processing - cleaning and drying. Here the gas is compressed to the pressure required for further processing. At stripping plants, gas is separated into unstable gas gasoline and stripped gas (GSG)<sup>1</sup>, a product that is subsequently pumped into main gas pipelines. This same already purified gas goes to chemical plants, where methanol and ammonia are produced from it.

And unstable gas gasoline, after being separated from the gas, is supplied to gas fractionation units, where light hydrocarbons are separated from this mixture: ethane, propane, butane, pentane. These products also become raw materials for further processing. From them,

<sup>1</sup> Dry stripped gas is the gaseous part (methane and part of ethane) separated in low-temperature condensation (LTC) units, where gases are separated according to their liquefaction temperatures. Methane at atmospheric pressure turns into a liquid state at -161.6°C, ethane – at -88.6°C, propane – at -42°C, butane – at -0.5°C, etc.



for example, polymers and rubbers are subsequently obtained. And the mixture of propane and butane itself is a finished product, since it is pumped into cylinders and used as household fuel<sup>1</sup>.

According to a technological scheme close to the peculiarities of the physicochemical reaction according to Fischer-Tropsch, methanol ( $\text{CH}_3\text{OH}$ ) is produced from natural gas. It is used as a reagent to combat hydrate plugs that form in pipelines at low temperatures. Methanol can also become a raw material for the production of more complex chemicals: formaldehyde, insulating materials, varnishes, paints, adhesives, fuel additives, acetic acid.

Mineral fertilizers are also obtained from natural gas through several chemical transformations. At the first stage, i.e. at the initial stage, it is ammonia as a gas fraction. The process of producing ammonia from gas is similar to the gas-to-liquid process, requiring different catalysts, pressure and temperature. Ammonia itself is a fertilizer, and is also used in refrigeration units as a refrigerant and as a raw material for the production of nitrogen-containing compounds: nitric acid, ammonia saltpeter, urea and other necessary products.

First, natural gas is purified from sulfur, then it is mixed with heated water vapor and enters the reactor, where it passes through layers of catalyst. This stage is called primary reforming, or steam-gas reforming. A gas mixture consisting of hydrogen, methane, carbon dioxide ( $\text{CO}_2$ ) and carbon monoxide ( $\text{CO}$ ) comes out of the reactor. Next, this mixture is sent to secondary reforming (steam-air conversion), where it is mixed with oxygen from the air, steam and nitrogen in the required ratio. At the next stage,  $\text{CO}$  and  $\text{CO}_2$  are removed from the mixture. After this, the mixture of hydrogen and nitrogen goes, in fact, to the synthesis of ammonia.

In the process of simple chemical metamorphoses, methanol is obtained from natural gas, which is the raw material for various substances that are in demand both in the industrial sphere and in everyday life. Among them are various adhesives, paints and varnishes, insulating materials, formaldehydes, acetic acids and fuel additives. Methanol also helps remove hydrate plugs in oil and gas pipelines, as well as in hydrocarbon production wells. Special processing makes it possible to obtain high-quality mineral fertilizers from natural gas, as well as gases such as helium and ammonia, which are widely used in manufacturing, medicine, instrument making and are a market product in high demand.

The following technological operations are already carried out at Gazprom's processing enterprises: gas separation (identical to gas separation at the field), deep drying and extraction of light hydrocarbons by low-temperature condensation and rectification, production of helium and ethane by fractionated condensation of gas during deep cooling, absorption purification of gas from acidic components with amine solutions, adsorption purification of gas from mercaptans by zeolites, low-temperature oil absorption and low-temperature condensation<sup>2</sup>.

Individual hydrocarbons are obtained from associated gases, as well as petroleum cracking gases, by distillation at low temperatures. From propane and butane, unsaturated hydrocarbons are obtained by dehydrogenation - propylene, butylene and butadiene, from which rubbers and plastics are then synthesized. There are many ways to process natural gases, but the main task of such processing is the transformation of saturated hydrocarbons into more active ones, i.e. unsaturated ones, which are then converted into synthetic polymers such as rubber and plastics. In addition, organic acids, alcohols and other necessary products are obtained by oxidation of hydrocarbons.

**6.** Due to the fact that the Russian gas industry has turned out to be extremely vulnerable in its traditional European market, an orientation to the East is quickly and rapidly taking shape with the help of the so-called. forces of Siberia. In July 2022, Prime Minister of Mongolia L. Oyun Erdene announced that the construction of the Power-Siberia-2 gas pipeline through the territory of the country (as shown in Fig. 11) to China will begin in 2024. The project underwent a feasibility study and was planned to be completed by 2030. However, the so-called Taiwan issue could put an end to the implementation of the gas pipeline project. The topic of a gas pipeline through Mongolia to China has been discussed for several years now [7].

In February 2022, the famous Mongolian social and political figure, Doctor of Political Sciences S. Bayasgalan, in an interview with the REGNUM news agency, said that back in 1998, Russia and China announced a plan to build a gas pipeline passing through Mongolia. However, gradually, over the course of many years of discussions, the parties came to the conclusion that Mongolia should be excluded from the project.

<sup>1</sup> <https://referat.co/ref/672243/read?p=4> (access date: 09/14/2023).

<sup>2</sup> <https://referat.co/ref/672243/read?p=4> (access date: 09/14/2023).



Figure 11. Designed route of a new gas pipeline to China through Mongolia  
Source: PJSC Gazprom.

Leading specialist of the National Energy Security Fund I.V. Yushkov in July 2022, in an interview with Expert, also noted that the project under discussion has a very long history. Previously, it was called more modestly - the Altai gas pipeline, which was supposed to pass through the western border of the PRC with the Russian Federation. "Negotiations with China have been going on for a long time. The PRC is known for being a tough negotiator", the expert said<sup>1</sup>. However, twenty-one years later, in December 2019, the Russian President, during negotiations with the head of Mongolia, U. Khurelsukh, agreed on the construction of a pipeline through the country of the steppes. This difficult decision was previously agreed upon with the government of mainland China.

Already in August 2020, the head of Gazprom A.B. Miller and the Deputy Prime Minister of Mongolia Y. Sodbaatar signed a memorandum of intent to establish a company to develop a feasibility study for a project for the construction and operation of a gas pipeline with a capacity of up to 50 billion m<sup>3</sup> of gas per year. In January 2021, it was already reported about the start of design and survey work on the Power of Siberia-2 gas pipeline. In the current realities of the long-term conflict between Russia and the countries of the European Union, the construction of a pipeline aimed at the PRC is becoming increasingly important for the Russian economy.

Domestic analysts note that due to the gradual reduction in gas supplies to Europe, Russia could supply China not with the planned 50.0 billion m<sup>3</sup> of gas per year, but much more, by increasing the throughput of the gas pipeline [4]. According to experts from the PRC, the only reason why Moscow decided to do this was to reduce the influence of the PRC on Mongolia. Conducting a gas pipeline through the territory of a third country is not economically profitable, as this will increase the cost of transporting blue fuel, and will also create the need to pay Mongolia for transit.

However, as Chinese resources note, experts are forced to come to terms with the passage of the gas pipeline through Mongolia, since the economic benefits compensate for the additional costs incurred during construction. But no matter how Beijing delays the signing of the agreement, no matter how in bravado in front of Moscow, according to Yushkov, the PRC is in fact "in a position that is far from victorious"<sup>2</sup>. In the event of an escalation of the conflict between China and the United States, maritime supplies of LNG to China may be at risk. This is where having a pipeline from Russia could be strategically beneficial.

And since August 2022, the ongoing conflict has gradually become intensifying, as the United States actively and publicly supports the independence of Taiwan, which the PRC considers its ancestral territory. Senior officials from Washington continue to visit Taipei for defense talks, and the United States continues to supply significant quantities of military materials each year, openly ignoring Beijing's dissatisfaction. Some American congressmen are even proposing to introduce a bill to rename the Taipei Economic Representative Office, essentially the Taiwanese embassies, into the "Taiwan Representative Office".

<sup>1</sup> <https://lenta.ru/news/2023/07/31/gz/> (date of access: 08/23/2023).

<sup>2</sup> [https://lenta.ru/news/2023/06/15/pk\\_cn/](https://lenta.ru/news/2023/06/15/pk_cn/) (date of access: 08/24/2023).

Of course, Beijing cannot leave these hostile actions without due attention. Hence the constant notes of protest, military exercises off the coast of Taiwan, the imposition of sanctions on Taipei businessmen and politicians; all this is just a small fraction of what the PRC can do in the situation with Taiwan. If Beijing decides to end the problem by military means, the PRC will immediately be subject to sanctions from the US and the EU, which will mean blocking the Celestial Empire from the global economy and causing colossal damage to the latter. In several scenarios for the future development of events, the expert and scientific community is already calculating Chinese losses, which are already real today. In this regard, supplies of American LNG will also stop, and China will definitely face a serious energy crisis, in which the support of the Russian Federation will simply become irreplaceable.

An interesting situation is emerging, since after noticeable losses in the economy in 2022–2023. The PRC will not have time to build joint gas pipelines with Russia, and the project itself will stop due to the reorientation of most of the country's resources to maintaining more or less stability. Otherwise, the PRC will be forced to agree to any conditions of Russia, otherwise only the latter's gas will save the Celestial Empire from possible energy problems. However, both scenarios are not beneficial for both Mongolia and the PRC. Ulaanbaatar may forever lose the project that it has been striving to implement since 1998. Beijing, in any of these options, loses its energy independence.

Another geopolitical risk for the Soyuz-Vostok project is the potential expansion of Western sanctions to a complete ban on the purchase of Russian gas from 2024–2025. In this case, the Chinese authorities are unlikely to want to expose their economy to such significant risks and threats and, most likely, will refuse to build the gas pipeline. In this scenario, Mongolia, at best, will become a link in the "gray scheme" for gas trade between the Russian Federation and the PRC. This, in turn, will lead to a deterioration in Mongolia's relations with Western countries, on whose financing and loans the economic stability of the country depends. Will it become Ulaanbaatar sacrifice this for the sake of its closest neighbors?

One of the priorities of the state Eastern Gas Program, the implementation of which is coordinated by Gazprom, is gas supply to consumers in the territories of Eastern Siberia and the Far East of the Russian Federation. The company is carrying out large-scale work to develop existing and form new gas production centers, create gas transportation capacities and infrastructure for industrial hydrocarbon processing. These strategic projects serve as the basis for the implementation of social and industrial gasification projects in the Far Eastern regions<sup>1</sup>.

7. Thanks to the work of Gazprom, large energy facilities have already been converted to gas in a number of large cities, in particular in Kamchatka, Sakhalin, and Primorye. Inter-settlement gas pipelines and gas distribution stations are being built in the Kamchatka, Primorsky, Khabarovsk territories, Sakhalin and Amur regions. In the medium term, natural gas will reach the southern regions of Yakutia and the central regions of Sakhalin Island. Gazprom's program seems very interesting, including the development of the "Eastern Gas Supply System" trunk gas pipeline system, aimed at China and Mongolia and supported by the powerful characteristics of the gas compressor station (GCS) of the facility: GCS "Tambayskaya" with a length of 7,947 km<sup>2</sup>; CS "Khabarovsk" – 38.

The purpose of the "Eastern Gas Supply System" is a unified gas transportation system that ensures the transportation of gas from the fields of the Yamal gas production center, the fields of Eastern Siberia to the Far East for gas supply to the regions of Russia (Krasnoyarsk Territory, Irkutsk Region, the Republic of Buryatia, the Jewish Autonomous Region), export of gas to the PRC through the territory Mongolia, as well as supplying gas to the Sakhalin – Khabarovsk – Vladivostok main gas pipeline for further transportation to consumers in the Khabarovsk and Primorsky territories, to the gas processing plant located in the Khabarovsk Territory, and to the LNG plant in Vladivostok. The Siberian transportation scheme is clearly illustrated in Fig. 12. This scheme practically provides the calculation content of the following production case from work [8.476].

<sup>1</sup> Decree of the President of the Russian Federation dated May 13, 2019 No. 216 "On approval of the Energy Security Doctrine of the Russian Federation" / <https://www.garant.ru/products/ipo/prime/doc/72140884/> (date of access: 09.09.2023).

<sup>2</sup> The length of the WASH sections will be clarified based on the results of the completed engineering surveys, taking into account the "Southern" option for the Irkutsk-Belogorsk section.



Figure 12. Adjustments to the gas transportation scheme to China and Mongolia with the help of the Eastern Gas Supply System

The total volume of gas supply via WASH is provided in the amount of 11.0 billion  $\text{m}^3/\text{year}$  from 2030 to 88.8 billion  $\text{m}^3/\text{year}$  from 2037, excluding gas consumption for the CS's own needs, including gas supply for export to the PRC through the territory of Mongolia in the amount of 5.0 billion  $\text{m}^3/\text{year}$  from 2030 with a gradual increase to 50.0 billion  $\text{m}^3/\text{year}$  in 2037. The project developers, based on a base of best practices, offer optimization in the following version, presented by calculations in table. 2, with subsequent assessment of the economic effect for individual activities and for the project as a whole.

Calculations of the projected total economic effect for the full launch of the facility will amount to RUB 50,238.0 million. For the SMG "Eastern Gas Supply System", the design and construction work indicators are estimated at cost as follows: design and installation work – 59,633,269.0 thousand rubles; Construction and installation work – 1,987,775,630.0 thousand rubles. At the same time, the calculation of the economic effect from carrying out optimization measures gives 2.53% of the cost of construction and installation work. Based on the application of the "Unified Design Solutions" (UDS) template for gas transport design objects, 138 UPR albums have been developed; approved and received a positive conclusion for 87 UPR albums. At the same time, a tangible comprehensive economic effect was obtained, assessed using the method of standard optimized solutions [8], which is reflected in Table 2.

Table 2 – Optimization of incurred costs based on best practices on technical solutions and organizational measures

No. in order	Technical solutions and measures to optimize costs incurred	Specific indicator	Economic effect, million rubles
1	Increasing the distance between crane units from 30 to 60 km	RUB 518 million/1,000 km	4 116,5
2	The use of electric-welded straight-seam pipe instead of seamless pipe for the construction of pile foundations with SCPS	RUB 25.0 million/an object	950,0
3	Design of rotation angles of the main gas pipeline route (optimization of approaches to the use of hot-bending bends of factory production and cold-bending bends of line production). In order to unify the nomenclature of factory-made hot bent bends and the possibility of forming an irreducible demand for bends, route rotation angles of 30 degrees or more are carried out mainly in multiples of 15 degrees (15, 30, 45, 60). MG rotation angles of up to 30 degrees are made from cold-formed bends. The use of factory-made (hot) bends should be justified by design solutions (crossings through natural and artificial obstacles, cramped and mountainous conditions)	RUB 0.375 million/corner turning	Depending on the number of turning angles on the track
4	The use of lining materials (wooden lining strip instead of polymer profiles) of the main gas pipeline against mechanical damage during its installation	RUB 38.5 million/1 km	17 132,5
5	Optimizing the quality of road surfaces for access roads and along highway drives	RUB 15.0 million/1 km	22 785,0
6	Communication cable placement on supports with overhead lines 10 kV and above	RUB 217.0 million/1,000 km	1 453,9
7	Loopless connection of CS to MG	RUB 100.0 million/at the CS	2 800,0

The use of unified design solutions and standard documentation when designing will allow:

- 1) improve the quality of design while reducing the design and examination time in the structures of PJSC Gazprom to 6 months;
- 2) optimize the cost characteristics of the construction of Gazprom's capital construction projects;
- 3) reduce the time required for the development of project documentation (PD) and its approval by Gazprom's expertise.

Description of the site of UKPG-2 of the project "Development of the Kovyktinskoye field". Purpose and composition of the facility: The UKPG-2 site of the "Development of the Kovyktinskoye field" facility is a complex of specialized technological equipment of both domestic and foreign production, and organizational and technical auxiliary systems that ensure the preparation of reservoir gas and condensate for transport to Russian consumers in the Far East and China via the Power of Siberia gas pipeline. The maximum design capacity is 7.6 billion m<sup>3</sup>/year.

Table 3 – Assessment of the comprehensive economic effect (design and construction work) using the method standard optimized technical solutions

No. in order	Unified design solutions	Specific indicator	Economic effect, million rubles
1	For mining facilities using UPR for gas well bushes	125.0 million rubles / / bush	for mining facilities
2	For gas transportation facilities with the use of UPR MG	1 760,0 млн руб. / KC	for areal objects MG

The facility includes the following main groups of production facilities: integrated gas treatment plant; methanol regeneration section; condensate stabilization section; tank farm; VOS site; BKPS-110 / 10kV site; CDCS; administrative and household area; fire station.

The proposed optimization of the UKPG-2 site provides for a number of systemic and comprehensive measures to rationally increase the density of buildings, optimize technological solutions for the layout of specialized production equipment.

1. The buildings of the entrance threads and gas treatment are combined into one outdoor installation – the gas treatment section.

2. The ventilators adjacent to the gas treatment shop are located on the so-called book-case above the entrance threads.

3. Installations of emergency and drainage tanks in time are combined with the installation of flare separators.

4. The low-pressure flare system and, accordingly, flare separators are excluded.

5. Reflux tanks and regeneration units have been removed from the regeneration building to an open installation, only pumps remain in the building.

6. Separators and flow tanks are connected to the outdoor installation.

7. ABO methanol is placed above the pumping station building.

8. The equipment previously housed in the condensate stabilization building has been moved to an outdoor installation.

9. Equipment previously located in the stabilization furnace building has been moved to an outdoor installation.

10. The methanol and condensate tanks are combined into one group, while the fourth tank for condensate storage is excluded.

11. The positions of the receiving-drainage and drainage tanks are combined.

12. Positions for installing spark plugs with a water seal have been combined.

Results of optimization measures. As a result of the above measures, it was possible to improve the technical and economic indicators and increase the building density from 34.00% to 43.00%. Technical and economic indicators of the created gas pumping sites are presented in Table 4.

Table 4 – Technical and economic indicators of gas pumping sites along the route

No. in order	Technical and economic indicators of the UKPG-2 site, ha			
	parameter	was	became	deviation
1	Area of the territory of the gas treatment facility, in conventional terms design boundaries	66,7489	60,7847	-5,9642
2	Area of the territory of the gas treatment facility, within fencing	37,4816	32,585	-4,8966
3	Tank farm area, in the fence	5,3618	4,0929	-1,2689
4	Area of the torch area, enclosed	20,2624	20,2624	0
5	Area of the fire station territory, enclosed	1,3760	1,0522	-0,3238
6	Built-up area	12,7437	14,0554	+1,3117
7	Building density, %	34,00	43,00	+9,00



The above optimization measures make it possible to obtain a consolidated economic effect of up to 1,200.0 million rubles. The cost of design and survey work for the facility is 819.13 million rubles. The cost of construction and installation works for the facility is RUB 27,310.00 million. The total economic effect of optimization measures is 4.40% of the estimated cost of construction and installation work [11].

### Conclusions

Based on the accumulated materials of applied research, three preliminary conclusions can be drawn:

1. The implementation of the state gasification / post-gasification program is in full swing, gradually mastering the federal subjects of Siberia and the Far East. And here it is necessary to develop detailed plans for territorial routes for transporting gas to places of its consumption, with reference to both existing sources of its production and those planned for development in the near future. For each pipeline gas route, it is necessary to provide an extremely detailed feasibility study and ensure proper financing from real combined sources.

2. In connection with sanctions restrictions on pipeline gas supplies to European countries, the death of northern streams, a partial transfer of the gas industry to the transport capabilities of the LNG business should be considered not only justified, but also timely, technologically and innovatively promising, which in the multiplier mode has a beneficial effect on a number of domestic industries. The year-round operation of the Northern Sea Route will dramatically increase the scale of LNG transportation in the eastern direction. The limitation for the development of connections in the Asian space of the Russian Federation and Greater Eurasia is the insufficient domestic capacity of small-scale LNG production, in particular the complete absence of domestic technology for large-scale LNG plants. At the same time, the share of imported gas industry equipment at Russian LNG plants is close to 70.0%, and physical wear and tear exceeds 50.0%.

3. The strategy for the development of multilateral relations between Russia and partner countries within the SCO and Greater Eurasia must necessarily include, taking into account geopolitical factors, long-term, uninterrupted and mutually beneficial provision of energy resources to various consumers. Including gas supply to Russian consumers in places in Siberia where there has never been gas, to consumers both in the traditional territories of the PRC, Mongolia, the DPRK, other countries, and in new territories in other countries of Greater Eurasia and even our friendly Laos.

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