The development and energy efficiency of LNG in Russia

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Abstract. The state data of the market structure and the development of liquefied natural gas (LNG). The major LNG projects being implemented or planned for implementation on the territory of Russia. Characterized prospects for the development of LNG production in Russia up to 2023. The main problem of LNG projects implementation. Marked instruments contributing to the development and the energy efficiency industry improvement.

Keywords: energy efficiency, market liquefied natural gas, LNG projects in Russia, the prospects of LNG market development in Russia.

In the last decade, speaking about energy resources and their use is increasingly discussed issue of energy efficiency. With the ultimate resources used also plays a significant role and makes an active search and exploration of alternative energy sources. So share the use of gas, oil and coal in the country significantly activities has changed (Figure 1) [1].

![Figure 1. Structure of the use of energy in 2017.](image-url)
The threat of global warming, caused by increased emissions of greenhouse gases into the atmosphere, also led the heads of state to think about improving the environment and energy efficiency of production. So on December 12, 2015, Russia signed the Paris Agreement, which will enter into force in 2020, by which the member countries pledged to reduce emissions of hydrocarbons to the atmosphere (currently 68%), by restructuring the energy structure and transferring production to more efficient and environmentally friendly technologies.

At the same time, alternative generation and non-traditional hydrocarbons are introduced as new sources of energy. The given process proceeds impermissibly slowly, in comparison with a rate of growth of volumes of consumption of energy by the population. However, despite the existing barriers and specifics of implementation, significant results over the past 5 years are still achieved. So the percentage of energy received from renewable energy sources in Russia's total energy production increased by an average of 2%. The non-traditional hydrocarbons production in Russia is about 5% in the total world production.

At the same time, one of the most promising areas for the development of Russia's energy industry is the production and liquefied natural gas (LNG) supply.

The LNG production in the world is stimulated, first of all, by the need to transport fuel to countries that are disadvantaged in geographical terms from the perspective of the exporter. As the range of transportation increases, it becomes cheaper to transport gas by tankers, rather than to pump it through the main pipeline. Liquefying natural gas increases its density by hundreds of times, which reduces the volume during transportation and storage. In addition, the delivery of natural gas in the form of LNG allows you to avoid problems associated with transit and negotiations on transport routes. Over the past decade, the volume of the liquefied natural gas market has more than doubled - up to 250 million tons per year. About 30 countries are engaged in importing LNG, producing and exporting about 20 ones.

Currently, according to various experts, domestic producers occupy about 4-5% of the world LNG market. At the end of 2016, the volume of production of liquefied natural gas in Russia amounted to 10,928.7 thousand tons. In 2017, the volume of production has worsened by an average of 19%. At the same time, the share of exported liquefied natural gas occupies 88.5% of the total volume of production.

In 2016, the volume of export supplies of liquefied natural gas amounted to 10,867.9 thousand tons, which is 13.2% more than the same indicator in 2015, which was 9601.7 thousand tons. In 2017, Russia exported 21.4% more energy resources.

According to forecasts, by 2020 the LNG production volume will reach 15109 thousand tons (an increase of 38.2% relative to 2016) [2].

As part of the Energy Strategy project, Russia's share as an LNG supplier on the world market should grow to 12% (against today's 5%) [3]. This is possible due to the introduction of export-oriented LNG projects. The largest of them are: Sakhalin-2, Far East LNG, Vladivostok LNG, Yamal LNG, Pechora LNG, Baltic LNG, Vysotsk and Arctic LNG.

As of 2017, the LNG plant, launched under the Sakhalin-2 project in 2010, is being operated. However, the project plans to increase the capacity and productivity of the plant by 56% by 2021. Another project - Yamal LNG is in the process of implementation. To date, it is planned to launch the first of the three lines of the plant, the production capacity of which will be 5.5 million tons / year. The output to full design capacity is planned in 2019. The remaining projects are in a state of freezing for a number of reasons. First of all, the economic sanctions of the US and the EU led to problems with attracting investments to projects. The fall in oil prices entails a fall in prices for LNG, which also has a negative impact on the return on investment. Finally, the question of import substitution of the equipment used [4].

The analysis shows that foreign equipment is used for running and planned to launch projects. This is mainly due to the lack of domestic analogues with the required characteristics. At the same time, Russian companies have all the necessary resources (technological, legal, personnel, financial) to create competitive equipment. However, if we look at the issue in more detail, it becomes clear that the main brake on decision-making is the managerial resource, namely, it is not always clear how to assess in advance the degree of competitiveness of the projected product.
The solution to these problems can be the production control algorithm, built on the basis of the cost model. Obviously, 80% of the cost of technological equipment is made up of its materials, while the overall dimensions directly depend on the characteristics that the equipment must meet. The calculation is based on the design methodology and design features of the equipment, but the mass-size indicator in the general case can be determined by the formula (1).

$$M = \sum_i \rho_i \int \int \int Q_i(V) \, dV \equiv \sum_i \rho_i \int \int \int f(P, v, p, t) \, dV$$

(1)

Here $M$ - is the mass of the article, $Q_i(V)$ - is the mathematical description of the unit of the surface of the body, $f$ - is the function of the mass-dimensional parameters of the product in question, $P$ - is the product power, $v$ - is the productivity, $p$ - is the working pressure, and $t$ - is the temperature of the working medium.

Then the model of calculation of the cost price will have the form (2).

$$S = f(M, s) \equiv f(P, v, p, t, s)$$

(2)

Here $S$ - product cost, $s$ - production seriality

Thus, the cost price can be represented as a function of the consumed materials and the parameter that affects the technological costs due to the production volumes of the goods.

Management of a manufacturing enterprise always involves preliminary analysis and identification of key parameters characterizing the economic and economic activity of the enterprise, the so-called significant factors, the indicators for which must be fixed or optimized. Identify these indicators is possible by analyzing the strengths and weaknesses of the enterprise, using a balanced system of indicators, expert method, etc. Using a balanced system of indicators, it is possible to present a strategic map of the LNG industry in Russia in the form of Fig.2.

![Figure 2. Strategic map of the Russian LNG industry](image)

By grouping the selected activities, seven main factors can be formulated for the enterprises of the oil and gas engineering industry:

- production energy efficiency,
- production environmental friendliness,
- innovative production,
- production volumes,
- market share,
- qualified personnel,
- production costs optimization
The management algorithm is a systematic approach to managing key indicators, according to nine basic management functions. These functions: forecasting, planning, organization, rationing, accounting, control, analysis, regulation and coordination allow each of the significant factors to be considered in detail and to compile the process graph using the matrix data of the management subprocesses (Table 1) [5].

Table 1. The matrix of control subprocesses

| Objects                        | standardization | prediction | planning | organization | accounting | control | analysis | regulation | coordination |
|--------------------------------|-----------------|------------|----------|--------------|------------|---------|----------|------------|-------------|
| production energy efficiency   | -               | +          | -        | -            | +          | +       | +        | -          | 0           |
| production environmental friendliness | -           | +          | -        | -            | +          | -       | +        | -          | 0           |
| production innovation          | -               | -          | +        | -            | -          | +       | +        | +          | +           |
| production volume              | +               | +          | -        | -            | *          | +       | +        | +          | +           |
| market share                   | +               | +          | -        | -            | +          | -       | -        | 0          | 0           |
| qualified personnel            | 0               | -          | +        | 0            | +          | +       | +        | +          | +           |
| cost optimization              | -               | +          | -        | -            | +          | +       | +        | +          | -           |

In the matrix, the sign "+" marks real problems, "0" means the absence of the physical meaning of this operation, ",-" - the existence of the problem is possible under certain conditions, ",+ *" is a task related to the task of another object.

The system of graphs obtained from the analysis of tasks of the matrix of control of subprocesses and will make up an algorithm of production management, based on the model for calculating the prime cost (object "optimization of cost"). This algorithm will not only assess the competitiveness and rationality of production of a new product, but also optimize the production process of the existing one, while increasing the energy efficiency of both the enterprise and the entire industry.

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