

# **Impact of energy efficiency factors on natural gas consumption in the industrial sector of Russia**

**Kirshina Irina Arturovna**

*Candidate of Economical Sciences, Associate Professor  
Russian State University of Oil and Gas (National Research University) named after I.M.  
Gubkin*

*doctoral student*

*Ural Federal University named after the first President of Russia B.N. Yeltsin*

**Koksharov Vladimir Alekseevich**

*Doctor of Economical Sciences, Full Professor*

*Ural Federal University named after the first President of Russia B.N. Yeltsin,  
Ural State Transport University*

**Abstract.** The paper identifies the need to create a systematic assessment for the systematization of energy efficiency factors that affect the consumption of natural gas at industrial enterprises. Factors and conditions affecting the energy efficiency of natural gas consumption by industrial enterprises are considered and grouped into a classification. The systematization of energy efficiency factors was carried out on the basis of 3 groups of industrial enterprises.

The interrelationships of the components of the classification of factors are determined, and the key prerequisites for improving energy efficiency at industrial enterprises are identified.

**Keywords:** energy efficiency, energy efficiency factors, natural gas, industrial enterprises, energy, classification.

## **Introduction**

The management of natural gas consumption by industrial enterprises in the modern conditions of the development of the Russian economy requires a fundamentally new mechanism for increasing energy efficiency. To do this, it is necessary to identify the factors that in one way or another affect the energy efficiency of natural gas consumption. Establishing and maintaining sound policies requires quality, timely, comparable and detailed data that go well beyond energy balances and reflect the distinctive characteristics of economic activities and resources available in each country.

The formation of a mechanism for managing the energy consumption of an industrial enterprise involves the systematization of factors for increasing the efficiency of energy consumption. In a general sense, energy efficiency factors are the reasons that affect the specific energy consumption and a set of indicators that give rise to their economical use [5].

Factors and conditions affecting energy efficiency can be the same and differ

significantly depending on the field of activity. Therefore, it is important to identify the points of view of scientists about the influence of various factors on the energy efficiency of industrial production. This will make it possible to establish the relationship between energy efficiency factors and the degree of their influence on the consumption of fuel and energy resources [2].

**Purpose of the study** – to establish the key factors and features with regards to formation of energy efficiency of natural gas consumption by industrial enterprises.

The creation of a mechanism for managing the energy consumption of an industrial enterprise involves the systematization of factors for increasing the efficiency of energy consumption.

The largest consumers of natural gas among the sectors of the Russian economy are metallurgy, power engineering and mechanical engineering, in this regard, energy efficiency factors are considered on their example. In metallurgy and mechanical engineering, natural gas is widely used in pig iron smelting and for heating rolling, forging and smelting furnaces, in the electric power industry - for generating electrical energy.

It is advisable to systematize factors by grouping them into 5 types:

- production;
- technological;
- organizational;
- socio-economic;
- climatic.

Production factors include:

- product production plan;
- production structure;
- production program of the enterprise;
- schedules of production processes;
- loading of production facilities;
- repairs and accidents;
- the level of personnel training.

Technological factors include:

- features of technological production;
- physical characteristics of the production process;
- share of equipment utilization;
- calorific value of the burnt gas;
- duration of the production cycle;

- energy efficiency class of equipment;
- level of equipment wear.

Organizational factors include:

- planning of energy consumption of production resources;
- balance of production capacities;
- energy management system;
- analysis and control of production processes;
- introduction of energy service contracts.

Production, technological and organizational factors, in turn, relate to production technology. The enterprise cannot strongly influence these factors, but it must necessarily take them into account in its activities. Organizational factors make it possible to combine all factors into a single process for an effective assessment of the degree of achievement of the goals of the organization of production, which is a necessary basis for the strategic management of natural gas consumption.

Their presence is a defining moment in the systematization of the factors of energy efficiency of natural gas consumption by industrial enterprises.

Socio-economic factors include:

- the level of gas prices;
- schedule and working hours;
- schedule of technological processes;
- material incentives for energy saving.

Climatic factors include:

- duration of the heating period;
- ambient temperature;
- daylight hours;
- air humidity and precipitation.

Socio-economic and climatic factors of energy efficiency are represented by the groups “heating needs and auxiliary production”. An enterprise can actively influence them and try to reduce the influence of these factors to a certain level.

Table 1 shows the relationship between the energy efficiency of natural gas consumption by industrial enterprises and various factors.

Table 1 - Impact of energy efficiency factors on natural gas consumption in the industrial sector

Level of	Economic sector
----------	-----------------

<b>factor influence</b>	<b>Metallurgy</b>	<b>Electrical energy industry</b>	<b>Machinery manufacturing</b>
<b>High</b>	Product production plan; Loading of production capacities; Features of technological production; Equipment energy efficiency class; Energy planning for production resources	Product production plan; Loading of production capacities; Features of technological production; Calorific value of the burnt gas; Equipment energy efficiency class; Energy planning for production resources	Product production plan; The duration of the production cycle; Equipment energy efficiency class;
<b>Medium</b>	Production structure; Production program of the enterprise; Production process graphs; Schedules of work of production related processes; Physical deterioration of buildings; Physical characteristics of the processed raw materials; Technological process modes; The duration of the production cycle; Concentration, specialization and optimization of production processes; Formation of an energy saving program; Analysis and control of production processes	Production structure Production program of the enterprise Production process graphs Schedules of work of production related processes Physical deterioration of buildings; Technological process modes; Formation of an energy saving program; Analysis and control of production processes	Production capacity utilization Physical deterioration of buildings Features of technological production Physical characteristics of the processed raw materials Technological process modes; The duration of the production cycle; Energy planning of production resources; Formation of an energy saving program; Analysis and control of production processes
<b>Low</b>	Personnel training level; Share of equipment utilization; Calorific value of the burnt gas; Equipment wear rate; Production capacity balance; Energy Management System; Drawing up an energy passport; Implementation of energy service contracts	Personnel training level; Physical characteristics of the processed raw materials; Share of equipment utilization; Equipment wear rate; Production capacity balance; Concentration, specialization and optimization of production processes; Energy Management System; Drawing up an energy passport; Implementation of energy service contracts	Production structure; Production program of the enterprise; Production process graphs; Schedules of work of production related processes; Personnel training level; Share of equipment utilization; Calorific value of the burnt gas; Thermal VER output; Equipment wear rate; Production capacity

			balance; Concentration, specialization and optimization of production processes; Energy Management System; Drawing up an energy passport; Implementation of energy service contracts
--	--	--	--

Source: compiled by the author on the basis of an analysis of studies of a number of works [2, 3, 4, 5, 6]

The market model for natural gas consumption includes the following indicators:

- tariffs for gas transportation;
- energy prices;
- prices for gas consumers;
- investments in the development and reconstruction of gas production and consumption;
- type of market (regional, zonal, national);
- level of gasification of the region;
- reliability of natural gas supply;
- technical level and condition of fixed assets of the gas industry;
- quality of the environment;
- prices for other fuel and energy resources;
- efficient use of natural gas and increasing the level of gasification in the region.

### **Results and discussion**

When forming a balanced system for the efficient use of natural gas in the industrial sector of Russia, the key ones are:

- indicator of gasification of production;
- indicator of the use of secondary energy resources from the use of natural gas in technological processes;
- indicator of energy intensity of production;
- reduction of the energy component in the structure of production costs.

Profitability is an important indicator of an enterprise's ability to sustainably develop. Therefore, prioritization of these two indicators turns out to be necessary in managing the decision-making process for the efficient use of natural gas.

In the formation of a sustainable strategy for the effective use of natural gas in the long term, additional investments in energy-saving innovative technologies play an important role [1, 7].

### **Conclusion**

Development of effective energy saving and energy efficiency management system is a key factor in the successful functioning of industrial enterprises and the country's economy as a whole. The degree of influence of factors on energy efficiency is expressed in three categories: high, medium, low. In this case, only those factors were taken into account that can be controlled in the production process.

The paper analyzes the main approaches to the systematization and classification of energy efficiency factors for natural gas consumption in the industrial sector. The considered approaches revealed the absence of a group of organizational factors.

The proposed classification of energy efficiency factors among industrial enterprises makes it possible to determine the relationship of the main elements that provide the prerequisites for managing the natural gas consumption system in the industrial sector of Russia. This classification reveals the main features of the formation of energy efficiency of natural gas consumption by industrial enterprises.

### **References**

1. Vesnin V.R., Kafidov V.V. Strategic management: textbook - SPb: Peter, 2017 .-- 256 p.
2. Golovanova L.A., Moskovtseva A.A. Factors and conditions of energy efficiency in industry. PNU Bulletin, 2014, No. 3 (34) P.137-146;
3. Dzyuba A.P., Solovyova I.A. Short-term forecasting of natural gas consumption parameters as an element of price-dependent energy consumption management at industrial enterprises. VolSU Bulletin. Series 3, Economics. Ecology. 2018. Vol. 20.No. 1, pp. 78 - 90;
4. Koksharov V.A. Systematization of factors of energy efficiency of an industrial enterprise. Perm University Bulletin. Series: Economics, 2016, no. 1 (28), P. 147-156;
5. Marchenko E.M., Belova T.D. Analysis of the factors affecting the energy efficiency of the region: the management aspect. [Electronic resource] URL: <http://vestnik.uapa.ru/ru/issue/2015/04/15/> (date of treatment 01/12/2019);
6. Moruleva L.A. Analysis of factors influencing the energy efficiency of the economy. International Research Journal, 2015,6-3 (37), pp. 75-77;
7. Koksharov V.A., Kirshina I.A. Conceptual approach to the formation of a strategy for the effective use of natural gas by an industrial enterprise // Bulletin of the Perm University. Ser. "Economics", 2020. Volume 15. No. 4. P. 587-606.