УДК 338.51:621.6.02

KEY ASPECTS OF ECONOMIC EFFICIENCY AND COST OF NATURAL GAS PIPELINE TRANSPORTATION

Alexandr Sergeev

Анотація. *В статті проведено огляд етапів розвитку газового ринку, діяльності газотранспортних компаній в ринкових умовах; обґрунтовано подальші перспективні напрями розвитку ринку газу в Україні; запропоновано методичний підхід до оцінювання ефективності використання задіяних у газотранспортному виробництві ресурсів.*

Ключові слова: газ, ринок, технологія, трубопровід, транспорт, дохід, витрати, ефект.

Gas Complex are constantly changing under the influence of technological, economic, social, political and other factors, and at each stage of development he characterized certain characteristics - number of private companies in comparison with the state and the effectiveness of energy supply on a competitive basis compared with monopoly power supply.

In world practice it is adopted to isolate several types of gas complex models that reflect a number of alternatives, ranging from models of vertically integrated monopoly model of the company and ending with a fully competitive market. So, for the past 50 years, the gas industry has gone from a vertically integrated state monopoly to a competitive market in natural gas.

For France, the Netherlands, Italy, Norway is typical model of a vertically integrated monopoly. State monopoly company supplies gas to all consumers. Almost all activities in the energy sector (oil and gas extraction, energy production, transportation, distribution, etc.) are controlled by the state. Percentage involvement of private companies is very low. But not always the same state company owns all segments of the gas or oil circuit.

The gas extraction is usually carried by the state gas production company, but transportation and sale of natural gas is realized by a separate state gas transportation company. Gas distribution system is often separated from the main transport and owned by local or regional authorities. Integrated natural gas distribution and pipeline companies also may include regional public companies. In this model, energy prices do not always match supply and economic conditions and often set cross-subsidy tariff for different consumer groups. [1]

In some countries, the functions performed by the national vertical gas companies go beyond the established understanding of the competencies of the company. Closest to private vertically-integrated monopoly structure is now a gas complex of Russia, where a monopoly is "Gazprom". Such a model has many similarities with the previous one, but the difference is that the oil and gas infrastructure is owned and managed by the private sector.

In such industry can operate several companies, but each can be a regional monopoly. For example, in Germany there is monopoly gas transmission company ("Ruhrgas") and a significant number of regional (level lands) and municipal companies.

Organizational and functional structure of gas transmission companies affects the formation of economic relations between entities gas markets. There are two types of competitive markets: wholesale and retail more liberalized. That is, if the first type assumes that operators (in the American model, as in Ukraine, called gas traders) buying natural gas mining companies and sell its regional marketing companies or large industrial consumers, the defining feature of the second type is a choice of provider for all consumers.

Typically, the operation of a competitive retail market is more expensive because of increasing administrative costs. This form of market is impossible without the "free" non-discriminatory access operators (traders) to the transmission system. Therefore, in countries such as Australia, the United Kingdom and Argentina, the separation of transporting natural gas from supply supported by normative legal provisions on the possibility to have a company licensed to work in the oil and gas sector only one type (i.e., transportation , supply or distribution) and required sure to condition the license to publish certain information in the regulatory body, as well as publishing it in other ways. Vendors also tend to buy a package of services for transportation of hydrocarbons.

Analysis of foreign experience in the formation and regulation of gas indicates that the organization of the gas market in Ukraine in the best suited to the conditions prevailing in the markets of Italy, France, of Denmark, Sweden, Iran, Mexico, where in varying degrees, state agencies regulate market actors in the field of gas production, transportation and sale of gas, coordinate investment programs and tariff policy companies [2].

From these positions can justify further perspective directions in forming gas market of Ukraine in accordance with European trends in the industry, due to the practical interaction of the Ukrainian gas transportation infrastructure of this market. In particular, the European way involves the gradual shift from territorial consolidation of state gas transmission companies not only at the regional level, but also nationally. On the domestic gas market it is necessary to ensure competitiveness of gas as a commodity. It should be noted that this contributes to the current Law of Ukraine "On Oil and Gas", where the gas is considered a commodity. However, to date not yet determined the list of substitutes and complementary products (eg, individual heating systems) is not carried assess the levels of quality and prices for gas and competing products. Quality gas can evaluate the physical and chemical parameters, indicators destination hygienic indicators transportability and security. Justify prices and tariffs for gas, you can use marketing research directed to the gas quality characteristics and needs of consumers with their subsequent differentiation. Thus, the implementation of these areas requires the introduction of the gas markets of new economic instruments and especially such as marketing.

The originality of gas as a commodity is determined by the fact that in many areas of consumer use of gas is a direct competitor of electricity, coal, petroleum, which is both goods-substitutes, an increase in consumption which is now too difficult. Compliance gas quality specific standards helps ensure competitiveness him only on the basis of price competition, as opposed to services of supply, competitiveness which provide both price and non-price factors.

To determine the target segments and identification of the main factors contributing to the success of them, need structuring of market participants and its infrastructure. Examine gas markets services appropriate to the principles of a systems approach that enables structured services according to their functions and place to meet the needs of end users of gas resources.

In this aspect, service gas markets should be combined into the following two groups:

• provide consumers with gas resources;

• supply of gas companies and transport industrial and financial resources necessary for their effective functioning.

The basic characteristic of the system topics pipeline transporting gas (PTG) is economic efficiency of utilization of resources expended. In a market environment performance measured by profitability gas transporting production that is concretized specified difference between all revenues and all wastes of energy resources. Since revenues are dependent on the price of gas transportation services, and wastes depend on specific technology of natural gas pipeline transportation, the level of resources and economic cooperation with integrity management solutions, the problem of the cost-effective technology pipeline transporting gas becomes discordant by key indicators.

Basic guidelines and market economy model with its foundation universal law of "common sense". Set the author or discoverer of the law of "common sense" virtually impossible. This law is known since ancient times and in a market economy has been widely recognized and used as the basis for the formation of base performance decisions from a position of value "cost – benefit". In the sphere of material production ratio "cost − benefit» is equivalent yield to "costs – revenues".

In the scorecard income − expenses the cost of gas transportation services, and energy costs intensive resources − are interrelated and act in opposite directions. Therefore, the market conditions to look for the best compromise between the interests of producers and consumers of gas transportation services. Substantive and multifaceted experience gained in the pre-market period meaningless. Now the problem with using market ideology quantitative analysis of inter influence the cost structure of production resources and income for gas transportation services, which ultimately determines the direction key in solving the problem of pricing in pipeline gas transportation. Reforming the methodological basis evaluating how effective is the use of resources involved in gas transportation and cost of gas transport services is not only economic but also political aspects and dimensions.

The main realistically possible development means evaluating and forming optimal compromise option is to build a production function gas transport manufacture as two-coordinative dependence of the number of consumable resources during volume of transported gas and market circuit formation optimization space coordinates gross income − deductible. The problems of production function pipelines defining are now acutely relevant and fundamentally solved in terms of a unified methodology.

The concept of market approach consists of the analytical modeling techniques depending on the cost of production capacity of the volume of gas transported gas. Gas thermodynamic system models of production functions and linear field compressor stations are correlated with the range of no project pipelines works. This created a new approach to solving the problem of evaluating the full cost of pipeline transportation of gas, dependent of potential gas transport technologies.

Calculating the full cost of pipeline gas transportation produced by the following methodological approaches:

• using the principle of variable proportions between the volume of gas transported and the number of energy resources that are spent on the process of transportation;

• using the principle of comparison of gross revenues and gross costs;

• using the principle of comparing marginal revenue and marginal costs;

• methodological approaches combining with conditional distribution of two main factors of gas transport: expenditures for maintenance of fixed assets and the cost of fuel and energy resources.

Determination of maximum profit and the full cost of pipeline gas targeted for use in the short term, that is, within which gas transport infrastructure sector quantitatively and qualitatively unchanged. Also features a short period by the level of gas flows depending on climatic conditions (seasons) and contract-situational factors.

It is known that in the short run production capacity of gas transportation structures is constant. However industrials have enough time to use his power more or less intense. Change quantity and quality of resources used, according to the new situation industrials have time only in the long run.

We must accept the condition that the price of gas transportation services in the short term does not depend on the volume of transported gas. The price of fuel and energy resources and stock also remains unchanged. This is imaginary analogue purely competitive market, which in today's economy is a benchmark for comparison with other types of markets.

Methodological approach to the calculation of the efficiency of PTG is based on the assumption that the interests of gas transmission structures and public interests are identical. Public interest responsible use of resources in the production of gas transportation with the least cost, i.e. economic combination of inputs should be as profitable. Thesis maximize economic profit P mathematically reproduced difference dependence between gross income G_i and gross expenditure G_e

$$P = G_i - G_e \qquad (1)$$

in which gross income and deductible in monetary terms are respectively

$$G_i = P_f \cdot Q \qquad (2)$$

$$G_e = P_e \cdot N + C_{fa} \cdot Q \cdot R_a, \qquad (3)$$

where P_f – price (full price) gas transportation services; Q − volume of transported gas; P_e − the price of fuel and the energy resources; N − amount of fuel and energy resources consumed in transportation of natural gas; C_{fa} − cost of resources spent on maintenance of fixed assets; R_a − amount of resources spent on servicing assets.

Calculations by formulas (1) − (3) acquire great significance in terms of economic equilibrium in which interdependence and interdependence prices P_f, P_e and C_{fa} is a regulatory tool in the field of gas transport production and the national economy as a whole. Economic equilibrium is achieved in the dynamics and through the influence of the process is not constant. Local balance is merely a prerequisite equilibrium. Therefore, formula (1) − (3) adapted to the short run, psychological and other factors in the long-term prospects are not taken into account.

In formulas (2) and (3) the cost of energy resources N are calculated based on the production function (productivity) pipeline $Q = f(N)$ in the range $0 - Q_{max}$, and maintenance costs of fixed assets - in fractions of a unit of resources for N full load pipeline.

The costs of forming circuit structures of pipeline transporting gas (fixed assets) are irreversible. These costs (as well as full replacement cost of assets) in the calculation of the cost of pipeline transportation of natural gas are not included because they are not relevant. In the gas and transport manufacturing real factor influencing the price structure is changing regulatory costs for maintenance.

In manufacturing practices commonly used such modification scheme for their calculation

$$R_a = A_1 + A_2 + C + O + D \qquad (4)$$

where A_1 − administrative and management costs, A_2 − depreciation based on the book value of fixed assets, the cost of repair according to the standard term operation of process equipment, etc.; C − resource costs associated with the performance of the transmission and creation of conditions for gas transportation ; O − overhead; D − mandatory payments and deductions.

There are different approaches to the calculation of depreciation A_2. The most famous of them are based on the use of the following factors: initial and replacement cost depreciated significantly liquid assets; regulatory period and the actual period of use of technical resources. Distributed as accelerated depreciation. Not controversial, there are other kinds of methods of depreciation of these resources. For model (1) worked, binding and final volume is sufficient assets or standard cost for any variant modifications formula (4).

To maximize profit P is sufficient to increase the marginal cost trajectory according to the law of diminishing returns has been rising.

In the short term mandatory maintenance costs of fixed assets are permanent.

Generalized quantitative description of the costs of servicing of fixed assets can be taken as

$$C_{sf} = C_{fa} \cdot R_a = \Sigma(n \cdot k_n \cdot (P_f \cdot D \cdot K_n)), \qquad (5)$$

where k_n and $(P_f \cdot D \cdot K_n)$ − index and full replacement cost of the n-th technical resource that is used in the transportation of gas, respectively; K_n − statutory rate deductions for maintenance n-th resource.

The famous triad is the key issues of gas transportation: the problem of maximizing the productive capacity of pipelines $Q = f(N)$, the problem of normalization of the cost of servicing assets $R_a \neq f(Q, N) = const$ and the problem of increasing the economic efficiency of gas transport systems $P = f(Q, N, R_a)$. Determining the structure of prices for pipeline gas transport $P_f = f(P, Q, N, R_a)$, except for self-sufficiency, is important as a means of quantitative evaluation of the practical result of solving these problems.

Given the complexity of the analytical thermodynamic model reproduction technology pipeline transporting gas transmission system production function $Q = f(N, R_a)$ to calculate the full cost of pipeline transportation of gas to be used as tables [3].

Information basis of calculation of profitability and prices for pipeline gas transportation system is performed transmission characteristics of addiction as controllable variable costs of generating capacity for the transportation of gas and the number of permanent, independent of the volume of gas transported Q, servicing costs of production of R_a. System characteristics of transmission process parameters such as gas compression and expansion at CS (own transportation) of gas per linear plots.

There are two ways to determine the effectiveness and cost of pipeline transportation of gas. The first is based on the principle of comparison of gross income from deductible. Second, the comparison of marginal revenue with marginal cost. Both methods are self-sufficient for market models as purely competitive type and purely monopolistic type monopolistic competition and oligopoly environment.

Both approaches have the right to use in the system of gas pipelines to determine the maximum profit. Development of models (1) − (5) using these principles enables a fundamentally new basic foundations of alternative selection strategies of market oriented reform and development of gas transportation industry. A concrete result of its implementation will be efficient and timely receipt of information on the effectiveness of management decisions in terms of income-dependent cost structure and production capacity of pipelines [3].

Model maximizing profits operating in a legal, moral and social constraints. The negative effects of these limitations are minimized administrative experience using market mechanisms in specific production situations. In a market environment management ability to increase the efficiency of utilization of resources is one of the most effective factors of gas transport. However, the focus on the automatic effect of management decisions without proper scientific and methodological support itself solves nothing: there is no market economy, which automatically and effectively solves economic problems.

An essential prerequisite for implementation in practical market oriented performance criteria pipeline transporting gas is:

− development of methodological terms and normalized using market oriented unit (meter) for products. Such products for gas transportation pipeline industry are service;

− development and implementation of methods to optimize flows. The problem of optimizing gas flows by economic content appears in the formation of market relations. It is the foundation of the market concept evaluation and efficiency of pipeline transportation of gas, but it is still not resolved. Approaches to have to rely on a qualitatively new methodological framework to maximize the efficiency of the pipelines;

− a fundamental restructuring by reorganizing and reforming the methodology of computer calculations regime-technological and techno-economic performance in the operation of pipeline transportation of natural gas.

The position on solving these problems as an ideological initial use of the principles of the market economy to improve the efficiency of reconstruction and development pipelines Modified time. Her performance − a key element of the market concept use of energy and resources fund industry pipeline transporting gas.

Using the basic principles of the market economy creates conditions to enhance the effect of management resource potential in the gas transmission industry and strengthen the position of producers of gas transportation services in the contractual relationship between the internal and external vapor through the pricing mechanism.

In a situation where market forces yield substituted political decisions, the economic equilibrium of gas transportation is disrupted. The mechanism of functioning of the economy imbalanced pipeline transporting gas is extremely complex. To investigate this mechanism should involve appropriate models and principles of economic theory [4].

List of references:
1. Terletskyj A. Organizational structure natural gas market in Ukraine: Estimation, problems, areas of improvement / A. Terletskyj // Economic reforms today. - 2000. - № 30. - P. 62.
2. Dutchak V. Analytical review of multinational oil companies operating in Ukraine / V. Dutchak // Oil and gas. - 2002. - № 4 (40). - P. 96-109.
3. Zhydkova M. O./ Methodical principles calculation of the efficiency and cost of pipeline transportation of gas / M. O. Zhydkova, S. F. Bilyk, A. A. Rudnik // Oil and gas industry. - 2004. - № 1. - P. 43-46.
4. Horal L. T. Theory and Practice of Restructuring transmission system: a monograph / L.T. Horal - Ivano-Frankivsk: IFNTUOG, 2011. - 326 p.: Il.

Рекомендовано до друку
доктором екон. наук, доцентом Гораль Л. Т.