

# Creation of the Energy Consumer Theory of the Firm as an Objective Necessity

Burganov Rais Abrarovich

Department of Business Administration, Kazan State Power Engineering University, Kazan, Russia

## Email address

burganov-r@mail.ru

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**Abstract:** The article is devoted to the possibility of creating an electric consumer theory of a firm based on the methodology of the neoclassical direction of economic science. In the opinion of the authors, the question "are energy consumption and energy efficiency not in line with the theories of firms?" Requires further study. A review of scientific research relevant to the research topic is given, attention is paid to the role of price and quality of electricity in the energy market. Based on specific examples of the firm's activities, the structure of the cost price and revenues, energy use indicators, etc., affecting the rationale for creating an electric consumer theory of the firm, are considered. The definition of "The marginal product of energy supply and energy consumption" is given.

**Keywords:** Theory of the Firm, Energy Consumer Theory, Marginal Product, Cost of Energy

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## 1. Introduction

In modern conditions, the need to consider the energy efficiency of any firm is in demand by the modern stage of business development, as well as by state policy. However, the question "are energy consumption and energy efficiency not contradictory to the theories of firms?" Requires further study. It should be noted that the study of increasing energy efficiency has an interdisciplinary nature and is in the field of view of both domestic and foreign researchers.

1) Based on the identification of foreign studies that substantiate the creation of different theories of firms (the founders of the theories of A. Marshall, J. Hicks, etc., and their developing Bemsetz H. [1], Jensen M. C. [2], Foss N. J. [3], Cohendet P., Llerena P. [4].

2) Based on the evaluation of the studies, considering the applied aspects of energy consumption and energy conservation without establishing a direct link with the fundamental provisions of economic theory and its methodology. Among foreign scientists dealing with energy saving and energy efficiency of the activities, it can be noted the significant contribution of such scientists as Chen S. [5], Erol U. [6], Kilian L. [7].

Among the many theories of firms, neoclassical theory occupies a special place. It is thanks to it that the theoretical

basis for expanding the company's production, financial and economic capabilities is created. Rational behavior of the company's management, based on the distribution and connection of various resources in the course of production activities; advantageous use of market equilibrium in the course of selling the company's products; maximization of utility and profit in different conditions of management and types of the market are in the center of attention as scientists and practitioners.

## 2. Review of Scientific Research

In the neoclassical theory of the company, the problems of energy consumption and energy efficiency are mainly considered within the distribution and use of factors of production. Analysis of the use of the concepts of "energy market", "energy consumption", "energy efficiency", "elasticity of energy services", etc., in the works of neoclassical theory makes it possible to judge that the consideration and solution of energy consumption problems remained in the background. Such indicators of energy efficiency, as a change in the share of energy costs in the cost of goods sold, energy consumption per ruble of sold products, etc. basically are not considered. Only in some works there are arguments about the need to take energy resources into account

in the course of activities. So, in A. Marshall's research there are separate positions about a role of an electric power sphere in formation of behavior of consumers and manufacturers of the goods and services. In particular, it is noted that "new methods of transferring the energy of gas, oil and electricity can have the same effect on many other sectors [8].

### 3. Main Part

The basis of neoclassical consideration of any economic and other processes is the definition of the product as a product for exchange. In this perspective, electricity is a commodity, like goods and services of prime necessity. J. Schumpeter writes that some "forces of nature" in the physical sense will also have the character of products for us - as, for example, the electric current produced for industrial use. On the one hand, these are material, and on the other - intangible objects [9]. That is, when selling electricity, it is necessary to take into account its production and sales characteristics and the possibility of an ambiguous

determination of its price. So, the quality of electricity affects the work of consumers, the amount of energy and resources. Unlike the final product, the quality of electrical energy must ensure the normal functioning of electrical, electronic, radio electronic and other means of consumers of electrical energy. However, in practice, there may be deviations in the parameters of electric energy supplied to consumers from the required standardized values. These deviations may occur as a result of short circuits in the distribution network; accidents in the electrical network; electromagnetic and network processes associated with the inclusion, shutdown and operation of powerful electricity consumers, etc. Claiming a supplier for the quality of electricity from its consumer is a complex process.

The process of energy consumption is an integral part of the production function, which allows to solve the problem of optimizing the allocation of resources, ensuring maximum profit to the manufacturer. The increase in the cost of production of energy resources will be reflected in the company's revenue (table 1, 2).

*Table 1. The cost structure of JSC Tatenergo"(by directions) [10].*

The name of the direction	2015	2016	The absolute change 2016 to 2015, million rubles.	Change in%
Electricity	18 542	19 092	550	3.0
Heat power	10 400	10 620	220	2.1
Hot water supply	2739	2543	-196	-7.2
Other	404	411	7	1.7

*Table 2. Revenue structure of JSC Tatenergo."*

The name of the direction	2015	2016	The absolute change 2016 to 2015, million rubles.	Change in%
Electricity	21 695	21 759	64	0.3
Heat power	10 867	11 494	627	5.8
Hot water supply	1949	1902	-47	-2.4
Other	536	487	-49	-9.1

Based on the analysis of the data, you can see that when the electricity volume was changed by 3.0%, the revenue changed only 0.3%, which characterizes the reduction in the energy efficiency of production.

Using the electric power capacity of the enterprise, it is possible to determine the potential production volume and, accordingly, the maximum profit level, which allows to determine that the optimal size of the enterprise and its boundaries depend on the electric potential. In the framework of the neoclassical theory, energy efficiency indicators such as the specific energy consumption per unit of output, the energy component in the production cost, the energy quality indicators, the energy consumption for own, technological and economic needs, the energy intensity of the output, the specific energy consumption per one employee, etc.

From the neoclassical direction of economic science it is known that the volume of production that provides the producer with the maximum profit corresponds to the situation when the marginal (incremental) costs are equal to the marginal (incremental) income:  $MC = MR$  [11]. An additional connection to power transmission devices should be reflected in the additional volume of output or services.

This condition of maximum profit is preserved in all types (perfect and imperfect) types of the market.

The process of energy consumption must have a so-called marginal product of energy supply. The marginal product of energy supply is an additional volume of output obtained from the use of an additional unit of energy resources.

Solving the problems of saving energy resources and increasing the energy efficiency of production is directly reflected in the tandem costs-output. The implementation of any investment project in the field of energy conservation is associated with an increase in energy consumption. For a system analysis of the problem, engineers introduced the concept of "clean energy", which is defined as the difference between the expectation from the project implementation by the increase in the amount of energy and the amount that in the course of this realization [12]. Soon it became clear that engineering calculations have one major drawback: "if we denote the energy vector consumed per unit of output, like  $D$ , the Leontief matrix  $-A$ , the total amount of energy consumed will be:

$$D + DA + DA^2 + \dots + DA^n + \dots$$

However, most of the engineers who performed clean energy calculations took only D into account as a measure of the energy consumed. More complex calculations took into account DA. Very few people singled out DA2, and there were no such people who went even farther; thus it was assumed that  $DA3 + \dots = 0$ .

Calculating all energy costs using the input-output model using official statistics on the US economy produced very unexpected results. W. Baumoll notes that "a conventional approach that takes into account only direct energy costs does not take into account, on average, more than 60% of energy costs." Even if we take into account the "second round" of energy costs - the energy costs necessary to ensure direct outlay costs, then out of account, approximately 28% of the total energy consumption will still remain. Thus, calculations using the "input-output" model showed that investments in energy-saving projects that promise to give a gain of 20% of net energy are likely to actually require even more of its expenditure.

The electric power market belongs to an imperfect market, and most of it is connected with the monopolistic behavior of the enterprise. However, in order to deregulate the manifestations of monopolism in the electric power industry, competing electricity producers need access to power lines owned by the utility company, which itself is also an electricity producer.

The behavior of the enterprise in the market requires finding the optimal choice of goals, which the manager sets himself. In this case, there may be contradictions in the goals. Alternative goals of the firm is clearly manifested when using energy resources. In economic analysis, the most common assumption is the desire of any firm to maximize the total amount of profit. However, with the introduction of energy-saving technologies, profit obviously goes down. Accordingly, the minimum level of profit determines the permissible level of implementation of energy-saving technologies. But the state can change the situation through the tools of state support.

However, the rational behavior of economic agents depends on the organizational and managerial structure of the enterprise, which must take into account the interests of the firm, managers, department heads, employees, shareholders whose actions can increase electricity costs. J. Schumpeter notes that "the energy-saving and stimulating function of firmly established habits of thinking (the inertia of thinking) rest on the fact that they are rooted in our subconscious, that the results of this thinking are automatically given out" [13]. Therefore, the neoclassical theory of the firm, based on the analysis of energy consumption, must have a touch with the institutional theory of the firm. The necessity of incomplete accounting of institutional factors in the economy is considered in the author's works [14], [15].

#### 4. Conclusion

In general, an overview of the most closely related studies to the topic of the work, allows to note that in the theory of

the firm there is a gap on the scientific justification of the place and the value of energy consumption and energy efficiency in the firm's activities from the standpoint of the provisions of economic theory and its methodology. The existing versions of the company theory do not sufficiently take into account the complex processes of energy consumption and energy saving, they do not provide recommendations for the management of the company to achieve certain success in the field of energy efficiency, thereby not contributing to the achievement of the energy strategy of the firm and the national economy. In such conditions, it is necessary to create and justify the theory of the firm, which considers the features of the internal environment of the firm in the process of using energy resources. The creation of an energy-consuming theory of a firm is urgently needed. Her research subject, according to the author, is the marginal product of energy supply and energy consumption, which affects the results of financial and economic activities of any firm. From the point of view of electric power industry, the company's system-forming element is the use of energy. Energy is coordinated with such concepts of the sphere of economy as "energy price", "useful energy", "energy loss". In particular, the energy efficiency factor is defined as the ratio of all the energy used in the firm to the total amount of energy expended. Accordingly, the creation of the energy-consuming theory of the company, based on the use of energy as a product, is justified.

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