

Russian Enterprises Energy Supply Problem

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Abstract—The article reveals the relevance of the Russian enterprises energy supply problem in the context of significant changes in the relationship between producers, electricity suppliers and consumers, and also revealed a new configuration of relations and tools for their optimization. It is shown that energy supply is one of the most important Russian enterprise functional subsystems, whose high costs lead to a decrease in the products competitiveness. The existing models of interaction between the energy market subjects and the features of the pricing process act as the methodology. The study found that the organizational form of interaction between the consumer and the electricity supplier selection depends on its relative efficiency, and the costs associated with the interactions form depend on the consumer behavior and on the objective properties of the factors market. A method for selecting the energy supply source and suppliers is proposed, which allows tracking structural, market and regulatory changes.

Keywords—interaction, behavior, supplier, consumer, producer, market, energy supply

I. INTRODUCTION

Energy supply is one of the main enterprise subsystems. Currently, significant changes are occurring in the interaction between producers, electricity suppliers and consumers.

Changes began after Russian economic transition towards a market economy in the early 90s of the twentieth century and continues up to the present. The greatest contribution to these changes was made by the reform of the electric power industry, resulted in fundamental change of the market participants' composition and their interaction. In the context of the enterprise, all these changes, taking place in the energy sector, form a new configuration of relations - new economic and legal relations.

The combination of these interactions is formed into a set of measures for the enterprises' energy supply, which allows realizing producers and consumers' economic interests in electrical energy, within the framework of existing technological and organizational processes [1].

The urgency enterprises' energy supply and tools for its optimization is due not only to the influence of the reforming the electricity and capacity market factor, but also due to the remaining extremely high energy intensity of Russian production.

High energy intensity in the context of increasing domestic prices for primary energy resources adversely affects the competitiveness of enterprises [2].

In order to solve this problem, a state policy in the field of energy saving and energy efficiency has been developed. This policy determines the energy-efficient development priorities of the national economy, and also focuses Russian enterprises on the implementation of tools, including the possibilities for optimizing energy consumption and the energy supply principles.

Changes in the wholesale and retail markets have created the conditions for optimizing the company's energy supply sources, including not only the existing suppliers selection, but also the creation of its own production.

In modern conditions, energy consumers face the challenge of choosing an efficient energy supply form and the optimal supplier with a reasonable price, reliability and quality of the goods (services) provided. Creating the necessary tools to solve these problems will improve the energy efficiency of enterprises.

II. ANALYSIS OF THE SOURCES OF THE PROBLEM

Energy supply is one of the most important functional subsystems of any Russian enterprise. The domestic enterprises and organizations energy supply system largely inherited the "Soviet" type system features with a very high degree of production concentration and management centralization. In the context of the unfolding energy sector reform, the problem of changing the configuration and, possibly, the principles of building an energy supply system for domestic enterprises is becoming more urgent. One of this problem's aspects is the enterprise's choice of its energy sources.

The analyze of the energy resources management in production and economic systems efficiency showed that high energy costs lead to a decrease in the competitiveness of Russian products on international and domestic markets, incentives to invest in innovative projects disappear, and production development is hampered. Modern market conditions have made economic adjustments to the centralized energy supply scheme of enterprises established before 1990.

The unified power grid, which included heat and power plants, condensation stations, hydroelectric power plants and nuclear power plants, boilers, heat and power networks and energy sales, was divided into territorial generating, transmission and power sales companies. To reduce dependence on energy companies, some large energy-intensive enterprises that have the ability to provide themselves with fuel have switched to a decentralized energy supply and created their own energy sources.

During the power industry restructuring period, importance was being increasingly attached to the accuracy of the existing accounting system and operational control over electricity consumption at enterprises. At the same time, inadequate attention was paid to energy supply - economic relations in the process of ensuring enterprise's energy supply, which represent interaction system arising from the realization of the producers and consumers interests in electrical energy in the existing generation, transmission, distribution and consumption processes frameworks.

Since the Russian energy supply is represented by practically homogeneous standardized products (electrical energy, thermal energy, process steam, etc.), the problem of supplier selection comes down, essentially, to deciding on four aspects: prices for energy supply (service) level; maintaining product (service) compliance with applicable standards; reliability of access to the consumption of energy products (services); level of costs for "tying" ("switching") energy supply service.

Maintaining the products (services) compliance with current standards and the reliability of access to the energy supply products (services) consumption are sufficiently regulated by technological requirements and institutional restrictions. Therefore, the identification by consumers of the energy suppliers competitive advantages according to these criteria is a rather complicated process. Regulation of the price level for products (services) of energy supply and the level of costs for "tying" ("switching") energy supply service allow power supply service providers determining the range of changes in the competitive advantages formation, and consumers would consider this factor, choosing a supplier [3].

III. SOLUTION METHODOLOGY

The following models of interaction between the energy market subjects were theoretically developed according to the difference in the degree of competitive relations development:

- the first model – a monopoly is present at all levels, namely: there is no competition in the field of electrical power generation, and the end-consumer is not able to choose a supplier;

- the second (purchasing agency) - the Single Buyer (Buyer) selects among several electricity producers, promoting competition in its production;

- the third is characterized by competition in the wholesale market. Distributors buy electricity from manufacturers and sell it over power lines;

- the fourth – there is competition in the retail market. The model allows each consumer choosing an electricity supplier. There is free access to power lines and distribution. The distribution is isolated from the retail sale of electrical energy (competitive environment).

The essence of reforming the Russian electric power industry is revealed in the transition from a completely monopoly model to a fully competitive market. The main tool for the implementation of structural changes in the electric power industry has become a division by activity. Generating assets stood out - power plants, which merged into wholesale generating companies and geographically generating companies. These companies subsequently became separate economic entities (legal entities).

According to the target model of the retail electric energy market logic, an unlimited number of end-consumers serviced by independent power sales companies or guaranteed suppliers competing with each other should function on it. The activities of guaranteed suppliers (in terms of setting a sales margin) and independent energy sales companies (in terms of setting tariffs for electricity transmission) are regulated by the state. In turn, the end-consumer can choose any sales company operating in the region.

The identified features of the pricing process in the target market model require the possible options examination for interaction between market participants and the conditions for the formation of an equilibrium price [4, 5]. Given the changes in the market structure, the rights and opportunities of customers, new consumer behavior paradigms emerge: various distribution companies, generation, combined and other schemes. Consumer behavior is changing - it is not only rationality, but also other consumers behavior consideration. Agents need to already consider irrational behavior. Williamson argued that: "As they say, every person has his own idea of beauty. In a sense, the same is true of behavioral prerequisites.

However, in reality, many differences between alternative approaches to the study of an organization arise precisely because of the difference in the behavioral assumptions adopted in these approaches [6]. On the one hand, the possibilities to the consumer for choosing the energy supply source are expanding, on the other hand, the probability of irrational consumer behavior increases.

IV. POWER SUPPLY IN RUSSIAN FEDERATION

Power supply is a set of measures to provide electricity to consumers and maintain comfortable living conditions. For the formation of high-quality recommendations of measures for the power supply of Russian enterprises, it is necessary to conduct the survey of power supply systems; all types of electrical measurements of equipment; energy consumption calculations; developing an energy consumption plan; technical and

economic feasibility study of energy consumption; calculation, design of internal power supply systems.

The level of energy supply efficiency of Russian enterprises is a kind of indicator of the scientific, technical and economic potential of the country, allowing one to minimize the costs of society to meet their energy needs.

Energy supply management of Russian enterprises has to meet the requirements of the state policy. The energy supply management system is formed on the basis of federal and regional legislative acts and regulatory documents of local governments. To put in place an energy supply management system, appropriate regulatory documents are required.

The procedure for concluding an energy supply contract for Russian enterprises is determined by the Civil Code of the Russian Federation. In accordance with the Civil Code, an energy supply contract is applied to relations connected with the supply of gas, oil and oil products, water and other goods through an interconnected network, unless otherwise provided by law, other legal acts, or does not follow from the substance of the obligation.

The procedure for entering into an energy supply contract varies depending on whether an agreement is concluded with a citizen or a legal entity. Taking into account the large number of energy consumers, long-term contractual relations and in order to ensure the stability of contractual relations, it is stipulated that a power supply contract concluded for a specific period is considered extended for the same period and under the same conditions, if none of the parties until its expiration declare its termination or change, or the conclusion of a new contract. This rule applies to both legal entities and individuals with whom an agreement has been concluded. It eliminates possible uncertainty in the relationship between the subscriber and the energy supplying organization for the period of renewal of the contract, sometimes lasting for months.

An energy supply contract is concluded with the subscriber if they have an energy receiving device that meets the established technical requirements and is connected to the networks of the energy supplying organization. Also, the subscriber has to have other necessary equipment and to ensure the energy consumption registration. To implement these conditions, the subscriber has to apply to the power supply organization to connect to its network. The energy supplying organization issues technical conditions, the fulfillment of which is necessary for the conclusion of the energy supply contract. After the technical conditions have been fulfilled, the energy supplying organization issues a certificate of their fulfillment and an act of admission of metering devices to the calculations. The subscriber submits this certificate to the appropriate authority of the State Energy Supervision Authority which checks the subscriber's power installation for compliance with the Rules for the installation of power installations and issues an acceptance certificate for electrical installations. Upon fulfillment of these conditions, the subscriber has the right to conclude the energy supply contract. The power supply organization offers its draft contract.

The procedure for agreeing the terms of a public contract is governed by the Civil Code. The contract will be considered

concluded from the moment of receipt by this party of the notice of acceptance of the relevant terms of the contract in its wording. Otherwise, the energy supplying organization may inform the party that has declared disagreements to the terms of the contract, about the rejection (in whole or in part) the protocol of disagreements.

Disagreements of the parties arising from the conclusion of the energy supply contract (the so-called pre-contractual disputes) include disagreements on the essential terms of the contract: on the amount of energy supplied and the mode of its consumption; about the quality of the supplied energy; about the price (tariffs) for the energy supplied and the procedure for its payment; on the liability of the parties for violation of the terms of the contract; on the amount and procedure for the recovery of contractual penalties; on the boundary of the division of responsibility; on the procedure for temporary restriction or cessation of electricity supply; on the procedure for unilateral termination of the contract.

The Civil Code provides for the right of the energy supplying organization to refuse to perform the contract unilaterally in the event of a material breach of it – namely, repeated violation of the terms of payment.

However, the law or other legal acts of the Russian Federation envisages cases when refusal from the power supply of a legal entity is not allowed, despite the non-payment for energy. These include subscribers who ensure the security of the state (military units, institutions, enterprises and organizations of federal executive bodies in which military service is provided, as well as enterprises, institutions and organizations of the penitentiary system and state fire service).

The special conditions include the obligation of the supplier and the energy supplying organization not to restrict the supply of gas, electric and thermal energy to the consumer within the limits of budgetary obligations limits set by the main manager of the federal budget funds in the event of late payment to their account. The consumer's duty is to provide confirmation of the existence of a limit set for them within budget commitments, to pay for the consumed energy monthly in full within the limits of budget commitments limits communicated to them by the main manager of the federal budget funds, to inform the principal manager (manager) of the federal budget funds about the need for fulfilment of gas, electricity and thermal energy payment obligations (registered with federal treasury body in accordance with the established procedure), in case of untimely receipt of funds on their personal account opened in the federal treasury body.

Special attention is paid to the issues of interruption, cessation and restriction of energy supply. The interruption, termination or restriction of energy supply are allowed by agreement of the parties, except when, due to the unsatisfactory condition of the subscriber's energy installations certified by the State Energy Supervision Authority, there is a risk of an accident or a threat to the lives and safety of citizens. In this case, the power supply organization is obliged to warn the subscriber about the appropriate interruption, restriction or cessation of the power supply. The power supply organization that allowed a break in the supply of electricity without

notifying the subscriber, is obliged to compensate the consumer for the damage caused by these actions.

V. RESULTS

Within the behavioral economics approaches framework, it can be argued that consumer behavior is changing. Its behavior is determined by the initial state (level of consumer capabilities and expectations) and the state of the environment in which it is located. The choice of the organizational form of interaction between the consumer and the electricity supplier depends on its relative efficiency. The costs associated with the form of interactions depend on the consumer behavior and on the objective factor market properties.

The consumer behavior rationality is influenced by consumer attitudes factors — external (culture, values, demography, social status, reference groups, family and household) and internal (perception, learning, memory, motives and emotions). It is impossible to unambiguously assess the consumer choice rationality in the new supplier free choice conditions [7].

In the field of supplying electrical energy to enterprises, consumer behavior was set by regulators. After the electric power industry restructuring, consumer have to select energy sales companies. In this situation, there was a coincidence of ambiguity of the environment (whether electricity suppliers can fulfill relevant contractual obligations) and limited rationality (the ability of consumers to solve the problem of choosing an electricity supplier), which caused an increase in the market contracts cost.

In practice, consumers are reluctant to move from default supplier to the services of independent power sales companies. Innovations are always poses a potential danger - this is the opinion of the overwhelming majority of electricity companies-consumers managers. Almost nobody wants to become a “pioneer” in the matter of introducing the systems of the Automated Information and Measuring System for Commercial Accounting for Electricity and holding a competition for choosing an energy sales organization [8, 9].

There are frequent cases when a well-known organization, having held a competition for the energy sales company choice, contributes to the emergence of economic interest in the choice of an electricity supplier among minor consumers. In this case, there is consumers’ habits revision, in order to change consumer behavior to minimize the risk when purchasing goods [10]. The well-known organization authority serves as a risk minimization guarantee [11, 12].

The method of selecting a power source and suppliers includes two main steps:

1. Determination of the technological tying type. The transport component in the final cost of electricity is determined, as well as the level of reliability. The most significant limitations when choosing a source of energy is labor-intensive technological connection to the power grids.

2. The choice of suppliers. When choosing a supplier, the following main criteria are taken into account: the products quality, works and services; supplier reliability; price; service

quality; payment terms and the possibility of unscheduled supply

In the process of choosing a source of energy supply and suppliers, the following strategic alternatives should be considered:

- internal power supply, which is applicable when it is economically profitable for the enterprise to fully supply itself with electrical and thermal energy from its own generating plants (stations);

- external power supply – full satisfaction of the enterprise’s needs in electric and thermal energy, carried out through the purchase of energy suppliers to the area of consumption;

- combined energy supply – enterprises receive electric energy from the territorial energy systems and networks, thermal energy from their own boilers.

In the developing and implementing the power supply system process, the following changes should be made: structural (to carry out the separation of energy consumers in the enterprise by activity type); market (to create and develop a commercial infrastructure that meets the chosen model and the rules of electricity suppliers); regulatory (to introduce rules for regulating energy consumption in the enterprise, allowing increasing the efficiency of vertically integrated management).

V. DISCUSSION

The retail electricity market is interaction system between the seller (supplier) and the consumer of electricity regarding the purchase of electricity and capacity on the wholesale market, as well as electricity from generating companies that are not participants in the wholesale market. The subjects of the retail electricity market are electrical energy consumers and producers.

The pricing system in the retail electricity market provides electricity sale at free prices, reflecting the cost of a competitive wholesale market for energy and power, within the limit of unregulated prices. Regulated tariffs in the retail markets of non-price zones are set by the regulatory authorities.

In the power supply of Russian enterprises with electrical energy process, it is necessary to take into account the level of their electrical consumption. The enterprise’s electrical energy consumption level is determined by its technological processes energy intensity.

The enterprise’s power supply is considered as a system of relations arising from the electrical energy producers and consumers interests realization of in the existing generation processes framework, transmission, distribution and consumption.

VI. OPTIMIZATION CRITERION

The main criteria for optimizing the energy supply of Russian enterprises are:

- quantity – to consume electricity in a strictly necessary and sufficient quantity for the implementation of the production program and the formation of appropriate ergonomic comfort conditions for staff;

- quality – to consume electricity, which quality indicators correspond to the current Interstate Standard;

- price (cost) – to consume electricity, which price (price system) is at the lowest possible level, while all things being equal in quantity and quality;

- time – to consume electricity on an optimal time-schedule (criterion for minimizing costs);

- transaction costs – relevant transaction costs must be below the critical level selected by the enterprise;

- the cost of the power supply system – the system formation and operation cost fit into an acceptable value chain.

The energy supply system development process consists of interconnected work aimed at improving efficiency, finding the optimal ratio of criteria – quantity (volume), quality, price (cost), time, transaction costs' level, expenses for the energy supply system. The main directions for improving the energy supply system are: electricity purchases optimization; consumption management for own purposes; consumption management as a service (Demand Response).

VII. CONCLUSION

Consumer behavior in the Russian enterprises' energy supply sphere was set by regulators. The consumer's need to select energy sales companies arose after the electric energy industry restructuring. In this situation, there was a coincidence of ambiguity of the environment (whether electricity suppliers can fulfill relevant contractual obligations) and limited rationality (the ability of consumers to solve the problem of choosing an electricity supplier), which caused an increase in the market contracts cost.

The identified significant changes in the retail electricity market demonstrate the need for regulating the natural monopolies and developing competition activities. The role of the consumer changes when a consumer from a passive buyer of natural monopoly products becomes an independent player with a wide range of possible actions – from his own generation to changing sales, which predetermines the development of competition, both price and non-price. The enterprise's power supply becomes an interaction system arising from the

realization of producers and consumers of electrical energy interests in the existing processes of generation, transmission, distribution and consumption framework.

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