UDC: 351

DOI: 10.5281/zenodo.11181246

THE WORLD EXPERIENCE OF PUBLIC ADMINISTRATION OF LOGISTICS PROCESSES IN THE FIELD OF ENERGY

Druhova Olena
PhD (Economics), Associate Professor, Associate Professor of Management and Business Department, Simon Kuznets Kharkiv National University of Economics
ORCID ID: 0000-0002-2404-1910

Bril Mikhailo
PhD of Economics, Associate Professor, Associate Professor of Public Administration and Economic Policy Department, Simon Kuznets Kharkiv National University of Economics
ORCID ID: 0000-0001-6529-7747

Abstract

The article is devoted to the research of the world experience of public administration of logistics processes in the field of energy. The authors note that two models of producers' access to the network infrastructure are most widely used in the electric power sector: the access model of third-party participants and the competitive pool model. In this context the competitive pool model (independent system operator model) that is a combination of network access rules and a competitive market (pool) is deeply analyzed. The authors show that electric pools can be mandatory (mandated) and voluntary (non-mandated), when two-way trade outside the pool is also allowed. The voluntary pool is a kind of intermediate link between the third-party access model and the mandated pool model. The authors think that modern trends in restructuring, expressed in the separation of the natural monopoly core of the industry – transmission and distribution of electricity in development of competition in the generation and sales sector, – have led to the

emergence and development of new price regulation mechanisms in the electricity sector.

Keywords: *logistic processes, public administration, pool model, energy sector, competitive market.*

Introduction

Since the mid-1880s, for a century, the electricity generation sector in world practice was considered a natural monopoly due to the scale effect provided by the concentration of production: larger power plants were also more economically efficient. It was also assumed that the production and transmission of electricity are inevitably connected to each other. As the capacity of energy markets increased, the optimal size of power plants increased steadily, from 70 MW in the 1930s to 1,000 MW in the 1980s. However, then this process began to regress: the development of new technologies led to a decrease in the minimum effective power in electricity generation to 50–350 MW by the end of the 1990s. It became obvious that electricity production lost the nature of a natural monopoly. The above mentioned determines the relevance of the selected topic of research.

Literature review. The paper (Kulińska, E.; Dendera-Gruszka, 2022) analyzes the logistic processes in the energy sector. The impact of the logistics processes being analyzed is critical to the alternative energy industry. This article focuses on home photovoltaic installations. The basis for further research is the previously identified stages of logistic processes associated with photovoltaic installations. Separate logistic processes and their impact on the implementation of photovoltaic installations and research results are described in detail. The basis of the study is conducting of a survey among randomly selected people who have owned a photovoltaic installation since 2018 in Poland. This paper is the beginning of further research on the analysis of logistic processes in other areas of energy.

The author (Wehner, J., 2018) thinks that logistics operations are energy intensive and have a negative impact on the environment. Improving energy

efficiency in logistics is critical to environmental sustainability and can be achieved by increasing capacity utilization. This article uses an interactive approach to capacity utilization to promote sustainable cargo transportation and logistics, identifying its causes and mitigation. The author developed a conceptual framework for highlighting of different levels of the logistics system, in which the potential for improving energy efficiency can be found. Through semi-structured interviews with representatives of nine companies, empirical data were collected to test the basis of the reasons for unused potential and proposed mitigations. The results show that measures such as inflexibility and limited information sharing, as well as excessive delivery of logistics service subjects, are not appropriate indicators for environmental impact assessment.

The paper (Stet, Mihaela, 2019) considers the problem of reduction of costs in the logistics channel taking into account the complex of energy management measures. It is emphasized that logistics of cargo distribution includes a number of measures for physical transfer of goods, such as processing, storage, transportation, each of which requires at least one type of energy cost. The main objective of the study is to identify the most important actions in order to reduce energy costs in the supply chain, also presenting some specific energy efficiency indicators for different activities throughout the logistics channel.

The article (Stefan Gold & Stefan Seuring, 2011) presents a literary review of articles that cover the bioenergy production interface and logistics and supply chain management issues. The authors note that while biomass supply chains for energy use are diverse in terms of size, design and functioning, the most pressing issues regarding supply chain management and bioenergy production logistics have been identified. The results are being discussed against the background of bioenergy as a sustainable renewable energy option.

The paper (Sergey Barykin, Vyacheslav Provotorov, Irina Kapustina, Sergey Sergeev, Elena Naumova & Natalia Dedyukhina, 2022) presents an approach that is used to analyze network streaming phenomena and processes for transmitting

continuous and discrete traffic flows over network-like n-dimensional network structures. The authors developed an approach focused on the development of algorithms built into the servers of integrated platforms for the functioning of logistic network processes and are in demand for the formation of a stable digital environment. The originality of the author's approach is to expand the theoretical control apparatus by including software solutions built on the basis of complex mathematical n-dimensional models. The proposed research results develop a general approach to solving one-dimensional problems of network logistics, which can, accordingly, be applied to the field of energy.

Nevertheless, there is no generalization of world experience with the allocation of the most practical models of energy market development in modern scientific works. Accordingly, **the purpose of the article** is to research the world experience of public administration of logistics processes in the field of energy.

Methodology. The theoretical and methodological basis of the study is the fundamental provisions of the theory of public administration of logistic processes and the functioning of logistic systems. The following methods of general and special scientific knowledge are used in the work:

- hypothetical-deductive one – to clarify the essence of the subject of study;
- generalizing and comparative one – to study the laws of public administration of logistics processes in the field of energy in the countries of the world;
- process approach – to substantiate the application of the system of logistic processes in public administration of energy infrastructure development;
- categorical analysis – for substantiation of theoretical foundations of improvement of state energy policy;
- trend analysis – to track the dynamics of power changes in renewable energy sector of the world;
- systematic approach – to determine the structure of the state energy policy;

- descriptive modeling – to detail the directions of sustainable development of the system of public administration of logistics processes in the field of energy.

Main part

The idea of competition in the production of electricity was brought by the The Public Utilities Regulatory Policies Act (PURPA, 1978). According PURPA, at the first stage of the introduction of competition at that time, vertically integrated companies dominated the electric power industry, which were obliged to purchase electricity from independent producers at prices equal to the vertically integrated companies' own costs for generation. The costs of independent power producers turned out to be much lower than the costs of traditional vertically integrated companies. Independent power producers soon began to flourish, earning high economic profits: by 1993, about 50% of new power generation capacity in the USA was built by independent power producers. Large end consumers became interested in the possibility of buying electricity directly from independent electricity producers. Thus, the emergence of independent electricity producers in the USA in 1978 contributed to the formation of the need for electricity supply as a separate type of service [2; 9].

At the beginning of 1988, the British government published the “White Paper”, which provided for the privatization and restructuring of the national electricity industry. This reform implied the division of state ownership of the Central Electricity Generating Authority (CEGB), which owned all power plants and the power transmission system. The distribution system was also state-owned and existed in the form of twelve separate companies. Each of these companies had the right to monopoly service to local customers and could only purchase electricity from CEGB. According to the “White Paper”:

- power plants were subject to division between two electricity production companies;

- new independent producers were encouraged to enter the market;

- creation of a separate electricity transmission company was envisaged;

- distribution companies had to provide local transportation, and customers were given the right to choose their suppliers, which contributed to the development of competition [1; 4].

Two models of producers' access to the network infrastructure are most widely used in the electric power sector: the access model of third-party participants and the competitive pool model.

The third-party access model is used in the USA, in some provinces of Canada, Finland, Germany, Japan, the Netherlands, and Portugal. A monopolist that owns and operates the network must allow competitors to use the network on non-discriminatory terms. Access conditions may be determined during negotiations between the network owner and enterprises seeking access ("negotiated" access regime), or may be established by independent regulatory bodies ("regulated" access regime).

At first glance, the negotiated access regime requires less government intervention and regulation than the regulated access regime, because during the negotiations the parties themselves set the tariff at which the producers are given the opportunity to use the network. In the case of regulated access, this tariff is determined by the regulatory authorities. However, an unregulated monopolist (owner of the network) in the course of closed negotiations has the possibility of abusing market power and restricting the admission of efficient enterprises. Therefore, the amount of necessary state intervention may turn out to be no less than under the regime of regulated access [3; 5].

In this context it is necessary to analyze the competitive pool model (independent system operator model) that is a combination of network access rules and a competitive market (pool). The pool is traditionally organized as a short-term electricity market, the participants of which can be generators, distribution companies and end consumers. The competitive pool model has been used in Great Britain, the USA (California), Australia, Sweden, Canada (Alberta), New Zealand, Norway and Spain. The successful operation of the competitive pool requires restructuring

according to the following principle: mandatory vertical separation of generation and transmission, generation and supply, as well as sufficient development of competition in generation, i.e. excessive supply of electricity. All generators supply electricity to the pool, all consumers receive energy from the network. Competition between generators is organized on the basis of auctions that are repeated frequently. The competitive electricity market is based on a system of evaluating competitive bids. The price bids received from the generators are processed by an independent system operator who, based on this estimate, derives the supply curve. The wholesale market combines the demand of all electricity consumers. By combining information about supply and demand, the independent system operator derives the equilibrium price and determines the preferred order of engaging generators for service [7; 8].

Electric pools can be mandatory (mandated) and voluntary (non-mandated), when two-way trade outside the pool is also allowed. The voluntary pool is a kind of intermediate link between the third-party access model and the mandated pool model.

Theoretically, the competitive pool model allows to maximize the effect of savings from coordination, since the independent system operator determines the best order of engaging generators for service and optimizes the operation of the network. However, to realize these benefits, the system operator needs much more information than current power system controllers have, including detailed information about the continuously changing supply and demand curves. In addition, to optimize the operation of the network, the independent system operator must have enormous power over all market participants. Therefore, effective implementation of this organizational form in practice is very difficult [1; 10].

In the branches of electric power, represented by vertically integrated natural monopolies, the state traditionally uses methods of direct price regulation for end consumers. This is the limitation of the rate of profit, the appointment of price limits or price “corridors”, as well as effective multi-rate tariffs that can be differentiated by consumer groups, by consumption volumes, as well as by the time of consumption of electricity and capacity.

Modern trends in restructuring, expressed in the separation of the natural monopoly core of the industry – transmission and distribution of electricity in development of competition in the generation and sales sector, – have led to the emergence and development of new price regulation mechanisms in the electricity sector.

Today, a number of American energy companies actively offer their consumers various voluntary and mandatory electricity consumption programs at tariffs that depend on the volume of demand for it. Voluntary programs offer consumers to choose a tariff plan for electricity payment set in advance for different periods of the day. After the end of the term specified in the contract (most often after 1 year), the consumer can either continue electricity payments according to this scheme, or return to uniform tariffs. Mandatory programs for the use of peak prices are used by companies for all consumer groups only in the presence of certain circumstances [3; 11].

The most modern alternative to the classic pricing of electricity tariffs in the USA today is the so-called “real time: pricing, in which tariffs vary from hour to hour. Such a scheme of calculations provides for a high technological level of control and accounting of the amount of electricity consumed. Therefore, this method is used exclusively for legal entities capable of automating and computerizing the accounting process in accordance with the requirements set forth by the energy company.

Positive experience of using time-differentiated tariffs is also demonstrated by France. Thus, in 1982–1986, a new system of electricity tariffs was introduced in France, which is characterized by wide differentiation by seasons, by time of day, by types of consumers, by the density of filling the load schedule and other parameters. Such tariffs ensured a reduction in the burden on consumers in the winter period due to the effect of preferential tariffs in the rest of the year. Due to the wide differentiation of tariffs, peak electricity in some cases cost more than 20 times more than the basic summer electricity. In general, average annual electricity prices in France are lower than in most Western European countries. This is achieved due to a

large extent by optimizing electricity production and consumption schedules using tariffs [2; 4].

As for the methods of indirect price regulation in electricity, the theory distinguishes market environments compatible with a natural monopoly, which encourage it to increase the efficiency of its functioning. These environments include the following models of competition: available market competition, competition for the market, and yardstick competition.

The concept of available market. An accessible market is defined as a market with free entry and loss-free exit. Despite the impossibility of fulfilling the conditions of this model, according to some experts, it represents a concept that has prospects for practical implementation in the field of electric power. Thus, the appearance of small gas turbine generating units, the transmission and distribution of electricity acquires characteristics of competitive activities. Owners of power transmission lines will not gain anything from reducing the price to the level where consumers switch to self-generation of electricity with the help of small gas turbine generators. Based on the premise of competitiveness of electricity transmission and distribution markets, it can be assumed that the market power of vertically integrated energy companies in the unregulated market becomes significantly smaller. Therefore, it is possible to preserve vertically integrated energy companies, at the same time to eliminate all regulatory bodies and norms, and entrust the search for the best solution to market forces. It should be noted that not all electricity consumers will be able to install their own generators, and those who will not be able to do so will have to pay for electricity in the free access regime more, not less, than in the regulation regime [3; 7].

Of course, the introduction of the open access regime is a difficult task, the implementation of which requires a lot of preparatory work (research of cost functions and industry demand, accounting of social aspects of market liberalization).

The concept of market competition is that regulatory bodies organize the sale of a monopoly franchise by auction. Participants' applications contain information about

the price at which the applicant company intends to sell the goods to consumers in the future. Regulators choose the lowest price; the company that offered it becomes the winner, and a contract is concluded with it. During the auction, the price is reduced to the true price, which ensures zero economic profit and minimization of costs. There is no need to carry out price regulation in relation to the monopolist, since production becomes efficient.

The global renewable energy market size was estimated at US $970 billion in 2022 and is expected to reach over US $2182.99 billion by 2032 is showed on Figure 1 [6].

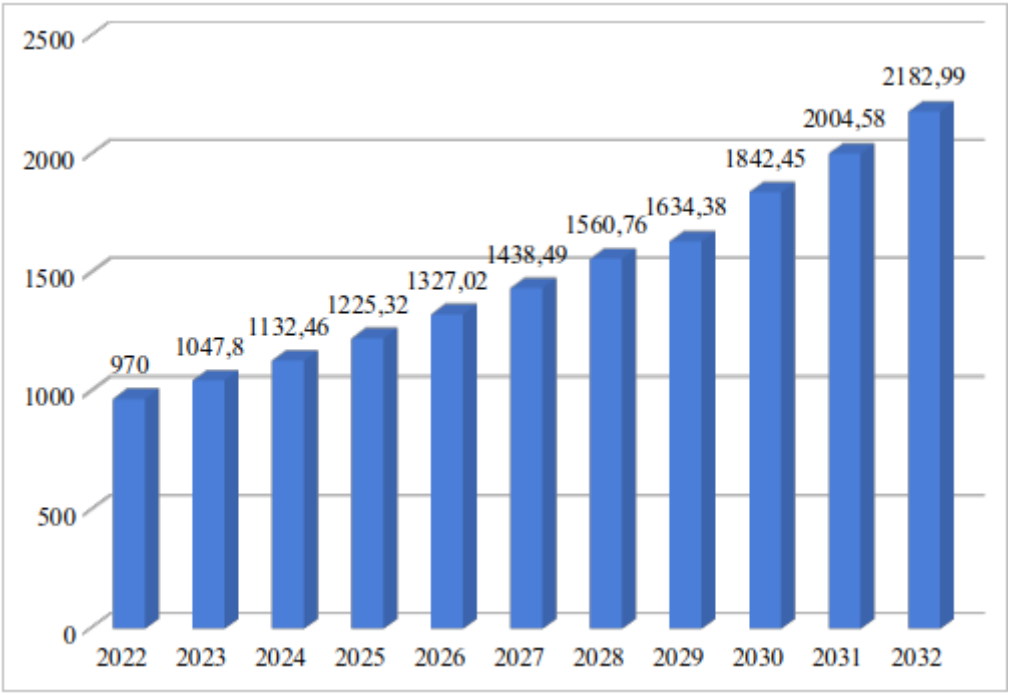

Figure 1. The prospective global renewable energy market size

Competitive bidding in generation has become quite common in the power industry. The great advantage of this model is that the competitive auction does not require restructuring of the industry, and therefore it can be organized already at the initial stages of deregulation of the electricity market. But in order for the price to really decrease to the price that ensures zero profit and minimizing costs during the auction, it is necessary to have an excess supply in the field of electricity generation.

The disadvantages of this model are related to the problem of taking into account the time factor. The price that is optimal at a certain point in time and fixed in the contract may be far from optimal in a month, week or year, which is difficult to take into account in a long-term contract. And short-term contracts create risks of underinvestment in long-term assets. In addition, the contract cannot guarantee that the companies' cost reductions will not lead to a reduction in service quality [1; 9].

The third type of competition is yardstick competition. The element of competitiveness is brought in by comparing this company and the results of its work with other companies operating in similar conditions. This approach can be used where there are several regulated companies using similar technology to serve different markets. For example, in Great Britain, some electricity companies were privatized not as national, but as regional monopolies. In this situation, it became possible to use and compare information about the results of the functioning of regional monopolies that make up the industry. As a limitation imposed by the regulatory bodies on the enterprise, an assessment of the price level of products is used, based not so much on the level of expenses of the regulated enterprise, but on the level of expenses of other enterprises operating in similar conditions. Such a regime creates incentives to reduce costs, as it enables regulatory bodies to withdraw from enterprises the benefit received from cost reduction [2; 7].

Conclusions. It was determined that the global trends in the development of structural policy in the energy industry have created problems of improving the public administration processes of the industry not only in the direction of realizing social responsibility, but also in relation to the development of competition and antimonopoly regulation.

It is shown, for example, that the complete restructuring of the electric power industry, which is envisaged by the most radical fourth model, is carried out by removing potentially competitive types of activities (generation and supply of electricity) from vertically integrated monopolists and their further liberalization, as a result of which these areas are opened to competitors. In this case, the monopoly is preserved only in the field of electricity transmission and distribution. Such countries

as Great Britain, Italy, Portugal, the Netherlands, Sweden, Denmark, Spain and Luxembourg followed the path of complete restructuring. In the case of partial restructuring, which is foreseen by more moderate models of reform, the monopolist retains its position and does not lose the right to operate in potentially competitive areas, although other enterprises also get the opportunity to operate in these areas together with it. Germany, France, Switzerland and other countries followed this path.

Discussion. Strategic guidelines for public administration of logistics processes in the field of energy at the state, regional and local levels are allocated through the introduction of institutional transformations in the energy sector and mechanisms for managing state property; implementation of agreed structural, tariff, tax, customs and antitrust policy; introduction of new technical regulations, national standards for logistics processes in the field of energy and norms for strengthening control over their implementation, as well as stimulation and support of strategic initiatives of economic entities in the investment, innovation and energy-saving spheres.

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