

В статье изложены принципиальные основы формирования системы генерации, распределения и оплаты электрической энергии потребителями. В числе подходов, с помощью которых сформулированы эти принципы, имеются формально-логический, причинно-следственный, диалектический и морально-этический. В условиях существующего в Украине и в мире в целом кризиса управления и электрической отраслью и государства в целом, автор предлагает сформировать новые и/или обновленные философские принципы, на которых отрасль и государство сможет основывать свою деятельность в условиях наступающего пост-модерна. Вклад автора 25%

Energy Crisis and Electricity Reform of Ukraine - First Results

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Abstract — This paper presents a study of the reform of the electricity sector of Ukraine, the transition to the electricity market. The structure of electricity generation, problems of financing and payments for electricity between energy companies are shown. The world experience of functioning of energy markets is given. The influence of state regulation in the field of energy on the development of the industry is analyzed. It is shown how the uncontrolled development of "green" energy has led to a crisis of non-payment in the energy sector of Ukraine. A way out of the crisis due to the concept of "large-scale construction" is proposed. Possibilities of attracting financing for this concept are given. The possibility of applying financial mechanisms to the functioning of the energy market of Ukraine is considered.

Keywords— reform, electricity, electricity market, integrated energy system, market "day ahead", renewable energy sources, nuclear power plant

I. INTRODUCTION

The development of modern civilization is difficult to imagine without adequate energy supply. Over time, the structure of energy sources is transformed - the share of alternative, renewable. An important role in streamlining the relationships that arise in the production, distribution / redistribution and consumption of energy resources is given to the energy market.

Since the ultimate purpose of goods and services is their consumption, it is obvious that the market is a crucial condition for direct and inverse communication between

production and consumer, performing the functions of sale and distribution of electricity. All economic laws of commodity production apply to the market.

The market regulates the production and circulation of goods; establishes and maintains certain optimal proportions in the production of electricity; it stimulates a constant increase in generation productivity and the development of new energy sources in the country.

Therefore, the question of the correct market model, its regulation by the state or market laws needs to be studied, because it is from the efficiency of the electricity market, largely depends on the development of energy and, consequently, the national economy.

Significant scientific contribution to the study of the essence of the market was made by foreign and domestic scientists: V. Bazylevych, W. Jevons, A. Marshall, S. Mocherny, A. Timmerman. The works of V. Barannik, N. Kuzminchuk, B. Slupsky, O. Sukhodoli and others are devoted to the functioning of energy resources markets.

At the same time, despite the thorough scientific research of the above-mentioned scientists, the research on the functioning of the modern energy market in Ukraine does not lose its relevance.

The purpose of this article is to study the theoretical foundations of the energy market in Ukraine.

On July 1, 2019, the Law of Ukraine «On the Electricity Market» came into force. According to the document, in two

years Ukraine must adapt its electricity market to European standards. The main objectives of the law were declared:

	12 months of 2018		12 months of 2019		+/- until 2018	
	produced in a year, million kWh	in % to total production	produced in a year, million kWh	in % to total production	million kWh	%
Electricity generation - total	159350,6	100,0	153967,1	100,0	-5383,5	-3,4
including:						
TPP and CHPP, including:	58807,8	36,9	55785,0	36,2	3022,8	-5,1
TPP - total:	47791,9	30,0	44915,1	29,2	2876,8	-6,0
CHPP and cogeneration plants:	11015,9	6,9	10869,9	7,1	-146,0	-1,3
HPP and PSP, including:	12008,4	7,5	7868,6	5,1	4139,8	-34,5
HPP	10429,4	6,5	6521,8	4,2	3907,6	-37,5
PSP	1579,0	1,0	1346,8	0,9	-232,2	-14,7
NPP, total alternative sources (WPP, SES, biomass)	84398,2	53,0	83002,7	53,9	1395,5	-1,7
Block stations and other sources	1503,5	0,9	1768,6	1,1	265,1	17,6

- optimization of financial flows on a market basis in order to concentrate financial resources aimed at modernizing the generating and transporting capacities of Ukraine;

- due to the growth of competition in the electricity market to achieve lower electricity prices for different types of consumers.

Have you managed to achieve these goals at least in trend? Hardly...

II. ANALYSIS OF THE STRUCTURE OF ELECTRICITY PRODUCTION AND ITS PRICE IN THE WHOLESALE ELECTRICITY MARKET.

Real financial flows in the energy sector are a mystery, so it is impossible to establish the exact situation. We can assess the situation only according to official statistics. However, the situation when consumers owe Ukrenergo UAH 5 billion, Ukrenergo owes UAH 13 billion to Guaranteed Consumer, and the latter in turn owes Energoatom UAH 5 billion, can hardly be called "optimization". This is with a total market size of about UAH 50 billion. [1]

That is, in the "anamnesis" we have a classic financial "crust", which not only puts an end to the possibility of modernization, but also greatly complicates the current operation of power plants. Moreover, we must realize that the crisis of electricity generation did not begin yesterday. In 1985, about 300 billion MWh were produced, in 2012 - 196 billion, the results of 2019 compared to 2018 the Ministry of Energy summarizes in the following figures Table I: [2]

TABLE I DYNAMICS AND STRUCTURE OF ELECTRICITY PRODUCTION IN UKRAINE

Thus, it can be stated that the depression in electricity generation continues, associated with the general deindustrialization of the country, which is superimposed on artificial growth by expensive "green" energy. The fact that this growth is artificial - obviously, it is enough to compare tariffs of 0.57 UAH / kWh. for ordinary and 4-5 UAH / kWh. for "green". Such incentives for clean energy could be welcomed, if not for two main aspects - increasing the weighted average cost of electricity on the one hand, and the inability of alternative energy to produce a stable specific (by area or amount of investment - it does not matter) aggregate capacity. That is, alternative energy is not a full-fledged replacement for conventional energy, and it is much more expensive. The basis of generation is still nuclear and thermal energy, in which the volume of generation is steadily declining with the simultaneous aging of fixed assets. The trend accelerated in 2020 - in January, the generation volume decreased by 8% compared to January 2019.

The conclusion is simple - the problem of optimizing financial flows in the industry could not be solved.

The second task is even worse. Tariffs for the population are artificially restrained by imposing on state nuclear power plants purely social tasks to the detriment of their profitability and, consequently, security. Tariffs for still operating enterprises have increased significantly, which has led to a decrease in their profitability and efficiency. Hopes of competition and lower prices did not materialize. For comparison, we present graphs of changes in prices in the wholesale electricity market (day-ahead market (DAM)) in Ukraine and Slovakia, which is geographically and economically close to us, Figure 1. That is, the price skew remained - with all its shortcomings.

Conclusion - the goal has not been achieved.

Electricity price, EUR / MWh July - October 2019

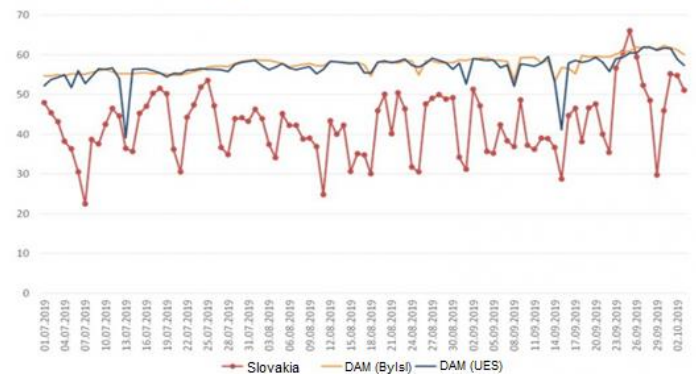


Fig. 1 Comparison of the price on the wholesale electricity market in Slovakia, for DAM of Burshtyn Energy Island and DAM of Unified Energy System, EUR / MWh.

The reasons for this lie in the inapplicability of the market paradigm to the energy sector - demand gives rise to supply. The main consumers of electricity are not households. And even more so - not agricultural corporations. The main consumers are industrial enterprises. In Germany, France, Great Britain, industries of all kinds consume 70-80% of the total. For the industrial regions (Bavaria and Ruhr, Hop-Pas-de-Calais and Lorraine, Wales and the Midlands), this figure is

close to 90-95%. Of course, New York is also very large in terms of consumption, but it is a unique city in every sense. In Ukraine, the share of industry among consumers does not exceed 30% and it has been steadily falling about three times since 1991.

Thus, on the one hand, no one will build (and modernize) power plants if there is no stable consumption; on the other hand, no one will invest in industry if there is no guarantee of a stable energy supply.

III. POSSIBLE WAYS OUT OF THE CRISIS OF THE ELECTRICITY SECTOR OF UKRAINE

In some countries, as a result of the transition to a competitive market, there is a reduction of large generating facilities (NPPs, TPPs, HPPs) in the form of high capital intensity and long payback periods of such investment projects. Moreover, there is a partial return to the regulated electricity market in a number of states in the United States, the provinces of Canada and Japan. For example, in Ontario, projects related to "green energy" are completely curtailed because they lead to higher costs in the economy. In Germany, alternative electricity generation has not yet been abandoned, but the main focus is on relatively large but inexpensive gas turbine power plants - this is primarily due to EU environmental standards, as well as the active replacement of individual gas heating in the residential sector by heat pumps - that inevitably causes an increase in energy consumption. In Norway and Sweden, with the functional independence of companies and the introduction of exchange mechanisms, no disintegration and privatization has taken place, but in these countries there is a significant excess of capacity, so increased competition has led to significant reductions in electricity and transportation prices [3].

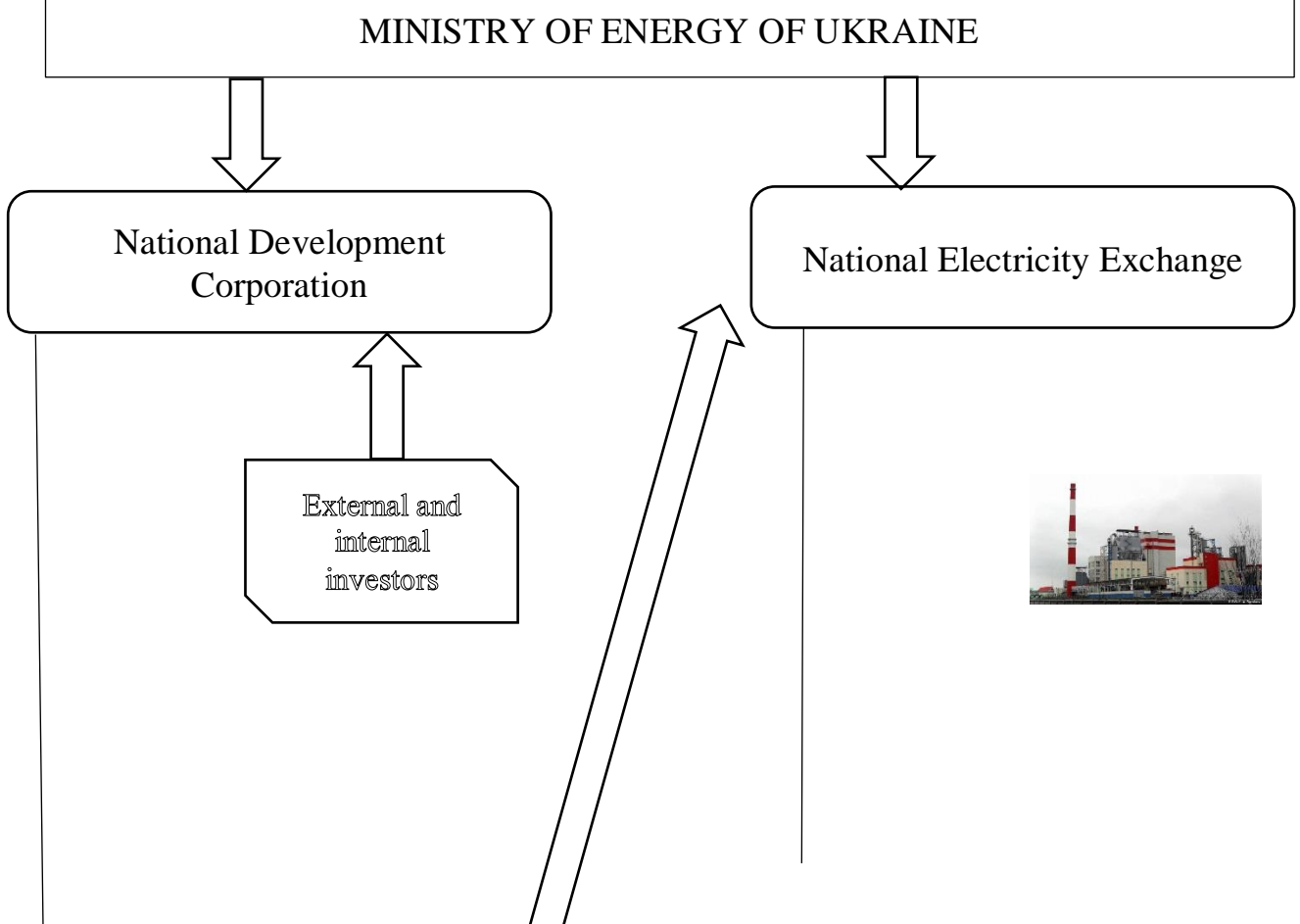
It is not necessary to expect the growth of large industry (as an effect of tariff reductions for it) - investments of such volumes from national sources are impossible due to their insignificance, and foreign investment is rapidly declining in industry is almost non-existent.

There are two main directions that the economic history of foreign countries can tell us.

The first way is the way of Roosevelt's New Deal. This means the active construction of generating capacity. It is worth recalling that the Federal Development Corporation, founded by Roosevelt, was engaged not only in the construction of roads and cities, planting forests and developing peat deposits. A significant place in it was occupied by the creation of the cheapest at that time power generation - hydroelectric power plants. Between 1933 and 1939, thirty-five large hydropower plants were built on the Mississippi, Missouri, Potomac, Hudson, and other rivers at the expense of the federal budget. The goal and result was not only increased employment in large-scale construction and increased demand for electrical engineering and building materials, but also cheap electricity, which contributed to the development of industry in these regions, as well as agricultural development as a result of arid steppe irrigation. Subsequently, these hydropower plants were gradually privatized at prices significantly higher than government construction costs, which in a strategic sense led to higher revenues rather than federal budget expenditures.

For Ukraine, such a locomotive could be nuclear power plants, especially given the significant reserves of uranium ore in the country. Competition between companies specializing in the construction of nuclear power plants can help reduce government spending under this program, forcing them to offer the customer a full range of services - construction, operation, staff training, environmental measures, waste removal and storage, and on-site rehabilitation measures. NPP operation. In total, the programs are designed for up to 50 years, and if they also include the production of nuclear fuel from Ukrainian uranium ore, storage of spent fuel and training of personnel in Ukrainian educational institutions - this will be almost ideal.

These proposals are presented in the form of a block diagram and are shown in Figure 2.



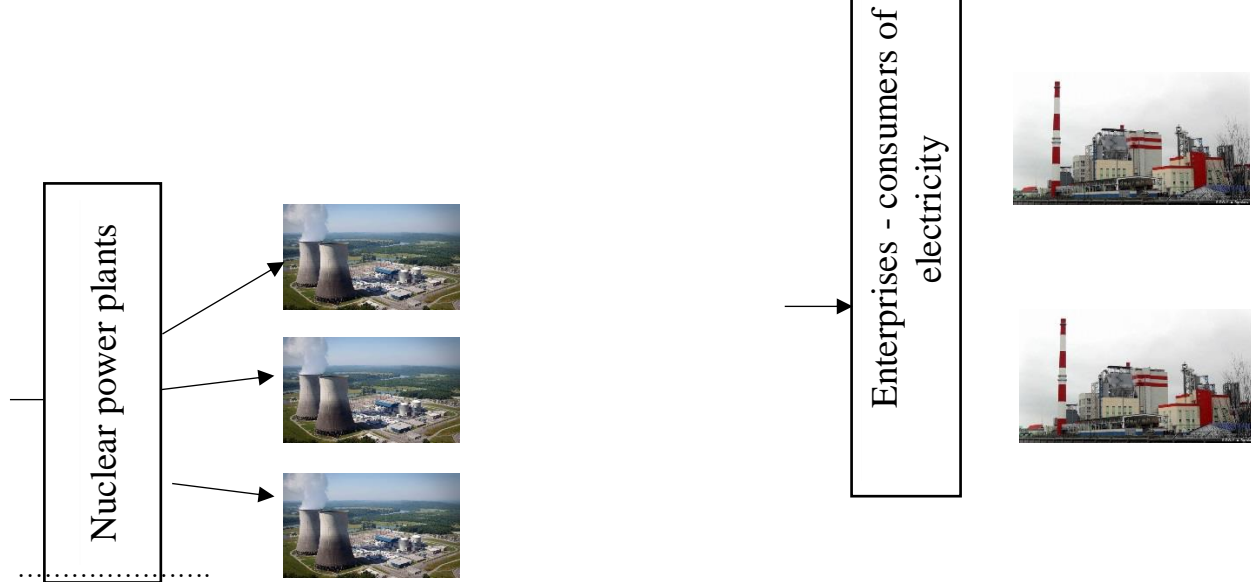


Fig. 2 Structural scheme of development of the electric power sector of Ukraine.

The negative factor is the extremely unstable political and economic situation in Ukraine as a whole, as well as the negative demographics, which will inevitably lead to a decrease in electricity consumption in the long run, regardless of other factors. Without delving into the political slums, we can suggest mentioning the already mentioned EU directive on the environment. The EU Energy Development Concept envisages the complete closure of coal-fired thermal power plants and nuclear power plants by 2030. Coal TPPs are gradually being closed, for NPPs, obviously, this is not a dogma, but a guide to action and in each case will be approached individually. However, the general trend of increasing electricity consumption in the EU with the reduction of traditional generation is difficult not to notice, and the fact that "green energy" in its capacity in the near future is not an adequate replacement - is obvious. In these conditions, it seems promising to link new nuclear power plants to the sale of electricity to EU countries, at least in Eastern Europe, and in the long run in Central Europe. The already well-established experience of Burshtyn TPP, which is highlighted in the so-called "Amber Island" and is actively working to export electricity to Poland, Hungary, Slovakia within the ENTSO-E (single energy network of Europe). So technical problems are generally solved, and a significant share of sales in the EU of total generation will guarantee the financial stability of new NPPs and important sources of foreign exchange earnings for payments to investors (or investors - if several corporations agree to participate in the project).

Distribution and sales inevitably become the second important component of industry reform. In our opinion, the proposed mechanism, although it corresponds to the Third Energy Package of the EU, but does not fully meet the requirement of forming a competitive market. For example, direct long-term contracts between large industrial consumers and generating companies take them out of the competitive environment. Therefore, it is necessary to withdraw these long-term contracts through the exchange mechanism option and futures contracts with the payment of collateral margin by the participants. This margin is a significant financial damper of strong price fluctuations in the medium term and, as a last resort, insurance coverage in the event of price jumps. Elements of this technology have been implemented and are being developed at the Nord Pool, which serves the electricity market in Norway, Sweden, Finland, Denmark, Germany, Estonia, Lithuania and the United Kingdom [3].

The volume of trading on this exchange is still small, but the estimated financial mechanisms used there are quite suitable as a basis for Ukraine. Naturally, it is necessary to take into account the features and differences of energy systems in these countries from Ukraine - the structure of generation and consumption in the first place. This concerns the need to give priority in one form or another to social and domestic consumers - in this case, the deformation of prices will not be so noticeable that it will lead to less catastrophic consequences for the population.

On the daily and balancing markets should focus on another derivative - the price index. For these markets, trading lots should be significantly smaller than for long-term futures and options within home consumption for the trading period. From all supply prices, a total value index of kilowatts is formed, which, in fact, is the object of trade. Changes in the index will cause decompression in the physical supply market, which will be followed by a time lag (in hours, minutes). Unfortunately, there is no world experience in trading in electricity indices, the topic needs further research. Therefore, it is possible that Ukraine will have to become a pioneer in the use of this tool in the electricity market.

CONCLUSIONS

The law of Ukraine, which introduces new rules for electricity trade in the country, is clearly imperfect and its direct application will cause serious undesirable effects of both socio-economic and technological nature. The way out of the situation can be the actions of the state and three levels.

In the strategic aspect, the stability and development of the electricity market provides only and exclusively the growth of generation. Moreover, not an expensive alternative (wind, solar and others), but a relatively cheap nuclear. There are certain prospects for this, interested institutions and organizations will be able to use them - the question of the competence of their leadership.

In the short run, the daily market, which provides the second level of reform and the balancing market (third level) should be organized not just as a stock market, but as a market for derivatives - futures and options for the first, indices - for the second.

Thus, it is proposed to create two verticals of state bodies for the implementation of the program of renovation and

development of the power generation industry - investment and exchange.

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