

Електронний журнал «Ефективна економіка» включено до переліку наукових фахових видань України з питань економіки (Категорія «Б», Наказ Міністерства освіти і науки України № 975 від 11.07.2019). Спеціальності – 051, 071, 072, 073, 075, 076, 292.
Ефективна економіка. 2024. № 4.

DOI: <http://doi.org/10.32702/2307-2105.2024.4.11>

УДК 620.91(477+061.1ЄС)J005.412-026.16

T. Tunytsya,
Doctor of Economic Sciences, Professor, Professor of the Department of
International Economic Relation,
Vasyl Stefanyk Precarpathian National University
ORCID ID: <https://orcid.org/0009-0007-5024-3667>
O. Kohut-Ferens,
PhD in Economics, Associate Professor of the Department
of International Economic Relations,
Vasyl Stefanyk Precarpathian National University, Ivano-Frankivsk, Ukraine
ORCID ID: <https://orcid.org/0000-0001-6015-5205>

PRINCIPLES OF FUNCTIONING AND DEVELOPMENT OF EUROPEAN AND UKRAINIAN ENERGY MARKET

Т. Ю. Туниця,
д. е. н., професор, професор кафедри міжнародних економічних відносин
Прикарпатського національного університету імені Василя Стефаника,
м. Івано-Франківськ, Україна
О. І. Когут-Ференс,
к. е. н., доцент, доцент кафедри міжнародних економічних відносин
Прикарпатського національного університету імені Василя Стефаника,
м. Івано-Франківськ, Україна

ПРИНЦИПИ ФУНКЦІОНУВАННЯ ТА РОЗВИТКУ ЄВРОПЕЙСЬКОГО ТА УКРАЇНСЬКОГО РИНКУ ЕНЕРГЕТИКИ

The article analyzes the regulation of European energy markets and their connection with the current political context of the European Union. The main regulatory instruments, such as EU secondary legislation, including regulations, directives and decisions, as well as bilateral and multilateral treaties that affect energy markets, are described. In particular, emphasis is placed on the "Clean Energy Package", the introduction of which was completed in June 2019, and the new EU goals for reducing greenhouse gas emissions and increasing the share of renewable energy sources. The role of national regulators and the European Union in regulating energy markets is also noted.

This article presents the results of a comparative diagnosis of trends in the development of the electric power system of Ukraine in comparison with Europe in 2001-2020, as well as the provisions and requirements for the regulation of energy markets in the European Union. Special attention is paid to the separation of energy transmission and distribution systems from production and supply, as well as to the creation of conditions for open and non-discriminatory access to energy networks. Provisions regarding the appointment and certification of transmission and distribution system operators, as well as their tasks and obligations, were studied in detail. In addition, important aspects related to market principles, the implementation of market pricing systems and measures to promote the development of renewable energy sources are highlighted. It is important to note that the EU's energy policy has led to the growth of the power plant park, in particular with the use of renewable energy sources (RES), but the growth rate has slowed down in the last ten years. Ukraine is also characterized by low growth rates, but the insufficient development of maneuverable capacities complicates the situation. Therefore, it is important to increase energy efficiency in both contexts, because it will contribute to the sustainable development of the energy industry.

The article identifies the main factors that determine the increase in energy efficiency and suggests the next steps that need to be resolved for the consistent coordination of physical and commercial electricity in accordance with national interests.

У статті проаналізовано регулювання європейських енергетичних ринків та їх зв'язок із сучасним політичним контекстом Європейського Союзу. Описано основні інструменти регулювання, такі як вторинне законодавство ЄС, включаючи регламенти, директиви та рішення, а також двосторонні та багатосторонні договори, які впливають на енергетичні ринки. Зокрема, зроблено акцент на «Пакет чистої енергії», введення якого було завершено у червні 2019 року, і нові цілі ЄС щодо скорочення викидів парникових газів та збільшення частки відновлюваних джерел енергії. Також зазначається роль національних регуляторів та Європейського Союзу у регулюванні енергетичних ринків.

У даній статті представлено результати порівняльної діагностики тенденцій розвитку електроенергетичної системи України у порівнянні з Європою у 2001-2020 роках, а також розглянуто положення та вимоги щодо регулювання енергетичних ринків у Європейському Союзі. Особлива увага звертається на відокремлення систем передачі та розподілу енергії від виробництва та постачання, а також на створення умов для відкритого та недискримінаційного доступу до енергетичних мереж. Детально досліджено положення щодо призначення та сертифікації операторів системи передачі та розподілу, а також їхні завдання та зобов'язання. Крім того, висвітлено важливі аспекти стосовно ринкових принципів, впровадження систем ринкового ціноутворення та заходи для сприяння розвитку відновлюваних джерел енергії. Важливо зазначити, що енергетична політика ЄС призвела до зростання парку електростанцій, зокрема з використанням відновлюваних джерел енергії (ВДЕ), проте уповільнення темпів зростання спостерігається в останні десять років. Україна також відзначається низькими темпами зростання, але недостатність розвитку маневрених потужностей ускладнює ситуацію. Тому, важливим є підвищення енергоефективності в обох контекстах, адже це сприятиме сталому розвитку енергетики.

У статті визначено основні чинники, які зумовлюють підвищення енергоефективності та запропоновано наступні кроки, які необхідно вирішити для послідовної координації фізичної та комерційної електроенергії відповідно до національних інтересів.

Keywords: *energy system, energy efficiency, energy market, electric power industry, renewable energy.*

Ключові слова: *енергетична система, енергоефективність, енергетичний ринок, електроенергетика, відновлювана енергетика.*

Problem statement. The energy policies of the EU and Ukraine face challenges related to energy efficiency, the development of renewable energy sources (RES), and flexible power capacity. In the EU, there is a slowdown in growth rates, particularly due to insufficient flexible power capacity, while in Ukraine, the low level of development of flexible power capacity complicates the integration of RES and increases the risks of inadequate energy efficiency.

Analysis of publications. The theoretical and methodological foundations and practical aspects of the development and principles of the functioning of the energy market have been studied by many scientists, in particular M. Osinska, M. Kyzym, V Khaustova, O. Ilyash and T. Salashenko [1], M. Bichler [2], G. Pollitt [3] and other researchers. However, the new challenges that appear before the countries of the European Union and Ukraine necessitate new research and in-depth analysis of energy efficiency and the implementation of new legislative acts in the field of energy.

Formulation of the goals of the article (task statement). Based on the assessment of the challenges faced by the energy policies of the EU and Ukraine in terms of energy efficiency, the development of renewable energy sources (RES) and flexible energy capacity.

Presentation of the main material of the study with a full justification of the obtained scientific results. European energy markets are primarily regulated

by a large array of secondary legislation of the European Union. In addition to secondary legislation, which consists of regulations (which have direct effect in member states), directives (which are subject to transposition into domestic legislation), decisions (which have direct effect and are binding), recommendations, conclusions and atypical acts (ie communications, guidelines, white and green papers), the regulation of European energy markets should be seen in the wider context of a number of bilateral and multilateral treaties.

These include the treaties of the European Union, namely the Treaty on European Union, the Treaty on the Functioning of the European Union, the Treaty establishing the European Atomic Energy Community and the Charter of Fundamental Rights of the European Union. Other treaties include the Energy Charter Treaty, the Energy Community Treaty, the United Nations Framework Convention on Climate Change and the Paris Agreement, as well as bilateral investment treaties and bilateral agreements on specific projects, such as pipeline or interconnector projects.

In June 2019, the Clean Energy Package was fully implemented, establishing a new regulatory regime for the electricity industry, building on the Third Energy Package of 2009. It consists of the following legislative acts:

- Directive on energy performance of buildings (EU) 2018/844;
- the updated Directive on renewable energy sources (EU) 2018/2001;
- amended Energy Efficiency Directive (EU) 2018/2002;
- new Regulation on the management of the Energy Union (EU) 2018/1999;
- new edition of the Electricity Directive (EU) 2019/944;
- new Regulation on access to electricity (EU) 2019/943;
- updated ACER Regulation (EU) 2019/942;
- new Regulation on risk-preparedness in the electricity sector (EU) 2019/941 [4, 5, 6, 7].

The system of regulation of European energy markets is actually divided into two levels: the national level and the level of the European Union. At the

national level, the Electricity Directive and the Gas Directive require member states to appoint national regulatory authorities (NRAs) - independent bodies primarily responsible for setting national transmission or distribution tariffs, cooperating with other NRAs on cross-border issues, monitoring investment plans of national transmission system operators (TSOs) and ensuring transparency of consumption data for consumers.

At the level of the European Union, the ACER Regulation provides for the establishment and legal status of the Agency for the Cooperation of Energy Regulators (ACER), a European forum for the cooperation of NRAs. It defines its tasks, in particular, regarding NROs, conditions for access to cross-border infrastructure and operational security, obligations for consultation and transparency, monitoring and reporting in the electricity and natural gas sectors, organizational structure and budget. The updated ACER Regulation includes provisions on new tasks and restructuring, reflecting the strengthening of ACER's role in the Energy Union, and allowing ACER to establish local representations in Member States.

However, the current political agenda is driven by bringing the EU's energy targets in line with the climate targets of the new "Fit For 55" package proposed in July 2021, including:

- reduction of greenhouse gas emissions by at least 55% compared to the level of 1990 by 2030;
- reduction of greenhouse gas emissions to net zero by 2050.
- the comprehensive integrated climate and energy policy, adopted by the European Council on October 24, 2014 and revised in December 2018, provides for the achievement of these goals by 2030:
 - increase the share of renewable energy sources in energy consumption up to 32%;
 - increase in energy efficiency by 32.5%;
 - unification of at least 15% of EU electricity systems.

New EU energy targets are currently under discussion. In particular, the following goals will be proposed for 2030:

- increasing the share of renewable energy sources in energy consumption up to 42-45%;
- reduction of primary energy consumption in the EU by 40-42% and final energy consumption by 36-40% [8].

It should also be mentioned that the Electricity Directive focuses on the creation of the European internal electricity market. In particular, it establishes obligations regarding the provision of public services for electric power enterprises and obligations regarding the protection of consumer rights, monitoring of supply security by member states, technical regulations and promotion of regional cooperation between member states and NROs.

In addition, transmission systems and TSOs must be separated from generation and supply through the natural monopoly that results from ownership of transmission and distribution; however, member states may instead appoint an independent system operator. The unbundling provisions include the designation and certification of TSOs by the NRA, their tasks, ownership unbundling, dispatching, and balancing, confidentiality, and the determination of the TSO's authority to make decisions on the connection of new power plants.

Distribution system operators (DSOs) must also be separated. The Directive provides for their appointment by Member States, their tasks and confidentiality obligations, as well as provisions on optional closed distribution systems. For both TSOs and DSOs, the unbundling process includes the transparency of their accounts to Member States or any designated authority.

The Directive also regulates access to transmission and distribution systems, in particular freedom of third-party access, market opening and reciprocity, as well as direct lines to all relevant customers.

The Directive establishes NRAs, including their objectives, responsibilities, and organizational structure, and contains provisions on retail markets, safeguards

in response to a sudden crisis in the energy market and the non-discriminatory nature of the implementation of the Directive.

The updated Electricity Directive contains provisions on the further development of market pricing with the possibility of state intervention for vulnerable consumers, the expansion of consumer rights, the expansion of the tasks of NROs regarding regional cooperation on cross-border issues, clarification of the role of TSOs regarding energy storage and regional coordination centers, as well as clarification of the role of DSOs regarding energy storage and recharging points for electric vehicles.

The Electricity Directive is combined with the Access to Electricity Regulation, which creates the European Network of Transmission System Operators for Electricity (ENTSO-E), a European forum for the cooperation of GTS operators whose task is to monitor national GTS operators and their EU-wide network development plans. The Regulation defines tasks for ENTSO-E and monitoring obligations for ACER.

The Regulation also establishes network codes, regulates network access charges, provision of information to TSOs, general principles of congestion management and special provisions for new interstate connections.

The updated Regulation on access to energy contains provisions on basic market principles, in particular:

- that electricity prices are formed on the basis of demand and supply, as well as a ban on setting maximum or minimum wholesale prices;
- introduction of rules regarding balancing markets;
- non-discriminatory and market principles of electricity production and dispatching in accordance with supply and demand;
- introducing the definition of trade zone boundaries;
- introduction of a European cooperation platform for operators of distribution networks.

Also, the European Commission published the Regulation on risk-preparedness in the electricity sector, which defines measures for risk assessment

and preparedness for them, as well as management of any crisis situations in the electricity sector in the Union. In particular, the Regulation establishes a methodology for assessing the security of electricity supply and identifying crisis situations both at the level of member states and at the level of their regions.

The updated Renewable Energy Directive (RED II) is a key directive that sets out the European Union's commitment to the production and consumption of energy from renewable sources, setting a specific target of meeting at least 32% of total energy needs from renewable sources by 2030, and includes measures for various sectors aimed at achieving this goal. These include provisions for creating conditions for self-consumption of renewable energy, increasing the share of renewable fuels in transport up to 14% by 2030, and strengthening criteria to ensure the sustainability of bioenergy.

RED II requires member states to set binding national targets and measures for the use of energy from renewable sources, as well as to adopt national renewable energy action plans. To achieve these objectives, the Directive provides for the transfer of statistical data, joint projects between member states or third countries and joint support schemes between member states.

Member states are required to provide consumers, builders, architects and equipment suppliers with information and training on support measures, as well as providing detailed information on the benefits, costs, and energy efficiency of energy from renewable sources. The Directive also regulates access to energy transmission and distribution networks, sustainability criteria for biofuels and bioliquids, and verification of their compliance. In addition, the Commission is required to monitor and report on the origin and impact of biofuels.

Another key aspect of RED II concerns guarantees of origin (GO) for electricity, heat and cold produced from renewable energy sources. The GO system was created under the first Renewable Energy Directive (RED) to ensure the guarantee of origin of electricity produced from renewable energy sources; it then evolved under the Renewable Energy Directive I (RED I), which redefined the scope of the GO system to provide end-users with evidence of the share or amount

of energy from renewable sources in the energy supplier's energy balance. RED II expanded RED's goal from RED I to include disclosure of the supplier's fuel balance structure and clear evidence of consumers' renewable energy consumption.

Under RED II, RED was expanded beyond renewable electricity to renewable gas and hydrogen. RED II further opened up national support schemes (including those involving mandatory renewable energy certificates) to include generation in other EU member states, allowing member states to support renewable electricity producers in other EU member states. In addition, there are new requirements for the accounting of raw material stocks issued to producers who receive support, as well as the right of consumers who produce their own electricity (so-called "self-consumers") to sell any surplus, while retaining their rights as a consumer.

The original Energy Efficiency Directive aimed to promote energy efficiency across the European Union in order to meet the European Union's 2020 target of 20% energy efficiency, thereby removing barriers limiting the efficiency of energy supply and use. Adopted as part of the Clean Energy Package, the amended Energy Efficiency Directive updates the policy framework by 2030 and beyond. It entered into force in December 2018, and member states had time until 25 October 2020 to make changes in line with the current Energy Efficiency Directive.

A key element of the updated Directive is the energy efficiency target for 2030 at the level of at least 32.5%. The target, to be achieved collectively across the EU, is set against the 2007 model projections for 2030. The amended Directive further updates the obligations of member states regarding energy saving and expands the rights of consumers, in particular, regarding billing and information on energy consumption using smart metering systems.

The amended Directive requires member states to set national energy efficiency targets and strategies for mobilizing investments to improve the energy efficiency of buildings, with public authorities to play a role model. The Directive regulates public procurement in the field of energy efficiency, requires member

states to create energy efficiency obligation schemes and establishes a number of consumer obligations.

Member states should encourage the use of energy audits and energy management systems for end-users, provide end-users with meters, free access to metering and billing information and energy information, as well as implement a consumer empowerment program.

Member States are additionally required to conduct a comprehensive assessment of the potential for the use of highly efficient cogeneration and efficient centralized heating and cooling, as well as to ensure that the NROs consider energy efficiency measures in the performance of their duties.

The amended Directive provides for a system of qualification, accreditation and certification of energy service providers, energy auditors, energy managers and installers of building elements related to energy consumption, if the member state considers that it does not have the necessary technical competence.

In addition, Member States are obliged to promote the development of energy service markets for small and medium-sized enterprises and have the right to create national energy efficiency funds and provide other financial and technical support to improve energy efficiency in various sectors.

Also, after the global financial crisis of 2008-2009, the European Union adopted a number of legislative instruments to stabilize financial markets, limit the volatility of commodity prices and provide markets with sufficient capital. The purpose of this study is not to discuss financial regulation; however, even though it is not specific to energy, it should be kept in mind that the energy market is affected by European legislation on financial markets.

Together with the Third Energy Package, the Clean Energy Package and REMIT, this legislation introduced additional obligations for energy markets, including reporting obligations, transparency requirements, the treatment of certain types of energy or emission allowances as financial instruments or derivatives, organizational market requirements, introduction of new trading venues,

mandatory use of regulated markets for certain products and clearing obligations for certain trades.

Therefore, at least two main external factors are likely to determine the energy policy of the European Union in the future: the Paris Agreement (including its implementation at the next conferences of the parties to the UN Framework Convention on Climate Change) and the need for diversification and security of energy supply, which has become a key priority for the EU in light of the Russian invasion in Ukraine.

The European Green Deal, presented in December 2019, builds on the Energy Union presented by the previous Juncker Commission, and aims to make the European Union the first climate-neutral continent.

The European Union has already set mandatory targets for increasing the share of renewable energy sources in the European energy balance, which correspond to the goal of the Paris Agreement. After the ratification of the Paris Agreement, the Third Energy Package, and the Clean Energy Package, underpinned by the European Green Deal, the European Union and its member states undertook additional commitments to decarbonize the economy

If we consider the Ukrainian legislation, the key regulatory act in the development of the energy market is the Law of Ukraine "On the Electric Energy Market", adopted on November 9, 2017. From the economic content point of view, based on Article 3 of the specified Law, according to the principles of functioning of the electric energy market, we observe a similarity with European principles, which is manifested, first of all, in the equality of rights to sell and buy electricity, non-discriminatory pricing and fair competition [9].

However, if we consider the Ukrainian electricity system, it developed in contrast to the European one, which can be confirmed by numerous trends in electricity consumption, production and trade (Table 1).

Table 1. Trends in the development of the electric power system of Ukraine in comparison with Europe in 2001-2020

Indicator	Ukraine				EU-27			
	2001	2011	2016	2020	2001	2011	2016	2020
Final electricity consumption, TWh	122	152	130	119	2356	2571	2565	2462
Electricity consumption per capita, MWh/person	2.5	3.3	3.1	2.9	5.5	5.8	5.8	5.5
CAGR of final electricity consumption, % CAGR of final electricity consumption		2.2	0.4	-0.1		0.9	0.6	0.2
Share of households in electricity consumption, %	18	25	28	31	27	27	28	29
The share of the budget sector in electricity consumption, %	14	16	16	18	24	28	29	28
Share of industry in electricity consumption, %.	46	41	38	38	41	37	36	36
Network losses, TWh	34.1	21.3	16.6	16.4	186.3	182.1	180	174.4
Share of network losses in released electricity, %.	21.0	11.8	10.9	11.7	6.6	5.9	5.7	5.7
Net electricity generation, TWh	160	180	152	137	2588	2789	2784	2664
CAGR of net electricity generation, % CAGR of net electricity generation		1.2	-0.3	-0.8		0.8	0.5	0.2
Index of electricity production by HHI resources	3148	3232	3466	3302	1851	1618	1556	1518
The share of RES in electricity production, %.	7.0	5.7	6.6	11.7	17.6	23.5	31.5	39.8
Share of CHP in electricity production, %.	11.3	9.7	9.6	11.1	18.5	22.9	22.1	21.9
Efficiency of production of electric power, % Efficiency of combined production of heat and electric power	40.6	38.3	38.8	40.6	40.4	42.8	45.5	49.6
Efficiency of combined production of heat and electric power, %.	72.1	66.4	62.8	61.6	61.4	60.9	61.7	62.9
Generating capacity, GW	50.7	51.5	53.4	52.8	587	732	799	946
CAGR of generating capacity, % CAGR of generating capacity		0.2	0.1	0.1		2.2	1.5	1.2
Share of unstable RES in total capacities, %.	0.2	0.4	1.5	11.6	2.9	19.3	28.8	33.3

Continuation of table 1.

Indicator	Ukraine				EU-27			
	2001	2011	2016	2020	2001	2011	2016	2020
The share of maneuverable capacities in the total volume of capacities, %.	10.1	10.7	11.6	11.7	26.9	22.3	20.9	18.5
Capacity utilization factor, %.	45.6	43.2	34.9	32.0	41.5	36.2	31.8	25.1
Import of electricity, TWh	2.1	0	0.1	2.7	252	321	363	381
Import dependence on electricity, %.	1.7	0	0	2.3	10.7	12.5	14.1	15.5
Export of electricity, TWh	5.2	6.3	3.8	5.1	256	320	363	367
Export dependence on electricity, %.	3.3	3.5	2.5	3.7	9.9	11.5	13	13.8
Greenhouse gas emissions from electricity production, mln tons of CO ₂ -eq.	128	131	101	80	1154	1079	944	656
CAGR of greenhouse gas emissions from electricity production, % CAGR of greenhouse gas emissions from electricity production, mln tons of CO ₂ -eq.		0.2	-1.6	-2.4		-0.7	-1.3	-2.9
Intensity of CO ₂ emissions during electricity production, kg/MWh	802	729	665	561	446	387	389	246

Source: formed by the authors using [10]

Trends in electricity consumption in Ukraine differ from trends in the EU.

Firstly, electricity consumption per capita was one of the lowest in Europe: 2.9 MWh/person versus 5.5 MWh/person in the EU average.

Secondly, the average annual growth rate (CAGR) of electricity consumption in Ukraine was more extreme. In 2001, the lowest level of electricity consumption since 1991 and until 2020 was recorded. From 2002 to 2011, electricity consumption grew due to the recovery of social and economic activity. In 2011, it reached the highest level since the beginning of the XXI century. However, the occupation of part of the territories of Ukraine in 2014 and the loss of economic potential led to an overestimation of the electricity market volumes and, as a result, to a tendency to decrease electricity consumption. From 2017 to 2019, the Ukrainian electricity market reached roughly the same level of 120 TWh, and during the first year of the Covid-19 pandemic, electricity consumption decreased by less than 1 TWh compared to 2019.

Secondly, the average annual growth rate (CAGR) of electricity consumption in Ukraine was more extreme. In 2001, the lowest level of electricity consumption since 1991 and until 2020 was recorded. From 2002 till 2011, electricity consumption grew due to the recovery of social and economic activity. In 2011, it reached the highest level since the beginning of the XXI century. However, the occupation of part of the territories of Ukraine in 2014 and the loss of economic potential led to an overestimation of the electricity market volumes and, as a result, to a tendency to decrease electricity consumption. From 2017 till 2019, the Ukrainian electricity market reached roughly the same level of 120 TWh, and during the first year of the Covid-19 pandemic, electricity consumption decreased by less than 1 TWh compared to 2019.

Thirdly, the restructuring of the Ukrainian economy led to changes in the structure of electricity consumption: in 2011, the total share of households and the public sector in electricity consumption exceeded the share of the industrial sector. All these reasons changed the demand on the Ukrainian electricity market.

Ukraine and the EU also differ in the structure of electricity production. No two electricity sectors are the same in the EU, which leads to a low concentration of Union resources according to the HHI index, and the deployment of renewable energy sources (RES) leads to a downward trend. Although different types of generation are represented in the Ukrainian electricity industry, nuclear and coal generation are dominant, which leads to a high concentration of resources, as measured by the Herfindahl-Hirschman index (HHI index). The deployment of unstable generation from RES, especially solar, in Ukraine manifests itself in the form of a "green-coal" paradox, which leads to an increase in the HHI index. Hydropower and coal-fired thermal power plants are used to balance the power system. A common practice is to limit the use of nuclear power capacities, but not to use them as maneuverable units. All this leads to supply disproportions in the Ukrainian electricity market.

The EU's energy policy has led to a rapid growth of the power plant park over the past 20 years. However, over the past ten years, there has been a

slowdown in average annual growth rates. A high share of flexible capacities initially ensured the deployment of RES-based generation in the EU, and the subsequent integration of the electricity markets of the EU member states made it possible to restrain their growth rates. Since 2016, the share of generating capacity from RES operating intermittently exceeds the share of flexible capacity.

On the other hand, Ukraine has a low growth rate of generating capacities, which are formed due to the successful development of unstable RES capacities and the decommissioning of outdated TPP and CHP units. At the same time, the development of RES capacities was not supported by the development of maneuverable capacities. Hydropower remains the only highly maneuverable power plant in Ukraine. In 2020, the share of unstable RES capacities approximately equaled the share of maneuverable ones. At the same time, there is a significant decrease in capacity utilization in the EU and Ukraine, what causes risks of payback of power units in conditions of unstable market.

It is also a priority that the current state of the electric power industry is determined by the energy efficiency of converting resources into useful energy. In the EU electricity sector, there is a gradual increase in energy efficiency due to:

- constant growth of the share of RES, which are an inexhaustible source of energy, and therefore their energy efficiency is considered as equal to 100%;
- implementation of combined generation cycles, such as combined production of heat and electricity, as well as combined gas-steam turbine generation;
- improvement of physical characteristics of resources, energy carriers and materials of power units.

Conclusions from this study and prospects for further exploration in this direction. Thus, the state of the electricity system in Ukraine is the main challenge for the introduction of a competitive model of the electricity market based on the European approach. It is necessary to ensure consistent coordination

of physical and commercial electricity in accordance with national interests by solving the following issues:

1) the growing unevenness of the consumption load and the inability of market participants to manage the demand for electricity of household and utility consumers.

2) protection of domestic consumers from market manipulation and admission of external participants to trade on the Ukrainian electricity market.

3) dividing the cost of electricity by time and periods of supply.

4) integration of electricity generation from renewable energy sources in a market-responsible manner and efficient distribution of it between suppliers.

5) ensuring a constant balance between commercial and physical electricity flows in real time.

It was possible to reverse the general trend of falling energy efficiency only by increasing the share of unstable generation from renewable energy sources and partly by transferring thermal power units to the category of supercritical technologies. Instead, reverse trends are occurring in Ukraine. The physical obsolescence of traditional power units leads to a constant decrease in energy efficiency. At the same time, the share of cogeneration in the electricity generation of Ukraine is constantly decreasing, both due to the physical obsolescence of thermal power plants, and due to the change in the proportion of generation between electric and thermal energy due to the drop in demand for centralized heat supply. All these energy efficiency trends have a negative impact on electricity buyers in Ukraine, who are forced to pay a higher price.

Література

1. Osińska, M., Kyzym, M., Khaustova, V., Ilyash, O., Salashenko, T. (2022). Does the Ukrainian electricity market correspond to the European model? *Utilities Policy*. Volume 79, December 2022, <https://doi.org/10.1016/j.jup.2022.101436>.

2. Bichler et al., (2022) Electricity markets in a time of change: a call to arms for business research, *Schmalenbach Journal of Business Research*, pp. 1-26.

3. Pollitt, G. (2021). The future design of the electricity market, Handbook on Electricity Markets, Edward Elgar Publishing (2021), pp. 428-442.
4. Directive 2009/28/EC on the promotion of the use of energy from renewable sources. URL: https://www.energy-community.org/dam/jcr:717cc830-bbfb-4cd9-a420-9d15ae2ff92f/Directive_2009_28_RE.pdf (дата звернення: 30.01.2024).
5. Directive 2012/27/EU on energy efficiency. URL: <https://leap.unep.org/en/countries/eu/national-legislation/directive-201227eu-european-parliament-and-council-energy> (дата звернення: 31.01.2024).
6. Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources, recasting Directive 2009/28/EC. URL: <https://www.legislation.gov.uk/eudr/2018/2001/contents> (дата звернення: 31.01.2024).
7. Commission Regulation (EU) 2017/1485 establishing a guideline on electricity transmission system operation. URL: <https://www.legislation.gov.uk/eur/2017/1485/contents> (дата звернення: 01.02.2024).
8. Офіційний сторінка Європейського парламенту. Energy policy: general principles. URL: <https://www.europarl.europa.eu/factsheets/en/sheet/68/energy-policy-general-principles> (дата звернення: 03.02.2024).
9. Закон України «Про ринок електричної енергії». Стаття 3. Принципи функціонування ринку електричної енергії. URL: <https://zakon.rada.gov.ua/laws/show/2019-19#n1789> (дата звернення: 24.03.2024).
10. Офіційна сторінка Eurostat. URL: <https://ec.europa.eu/eurostat/data/database>. (дата звернення: 24.03.2024).

References

1. Osińska, M., Kyzym, M., Khaustova, V., Ilyash, O., Salashenko, T. (2022), “Does the Ukrainian electricity market correspond to the european model?”, Utilities Policy, Vol. 79. <https://doi.org/10.1016/j.jup.2022.101436>.
2. Bichler, M. (2022), “Electricity markets in a time of change: a call to arms for business research”, Schmalenbach Journal of Business Research, pp. 1-26.

3. Pollitt, G. (2021), “The future design of the electricity market, Handbook on Electricity Markets”, Edward Elgar Publishing, pp. 428-442.
4. EU (2012), “Directive 2009/28/EC on the promotion of the use of energy from renewable sources”, available at: https://www.energy-community.org/dam/jcr:717cc830-bbfb-4cd9-a420-9d15ae2ff92f/Directive_2009_28_RE.pdf (Accessed 01 January 2024).
5. EU (2012), “Directive 2012/27/EU on energy efficiency”, available at: <https://leap.unep.org/en/countries/eu/national-legislation/directive-201227eu-european-parliament-and-council-energy> (Accessed 31 January 2024).
6. EU (2018), “Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources, recasting Directive 2009/28/EC”, available at: <https://www.legislation.gov.uk/eudr/2018/2001/contents> (Accessed 31 January 2024).
7. EU (2017), “Commission Regulation (EU) 2017/1485 establishing a guideline on electricity transmission system operation”, available at: <https://www.legislation.gov.uk/eur/2017/1485/contents> (Accessed 01 February 2024).
8. The official site of European Parliament (2023), “Energy policy: general principles”, available at: <https://www.europarl.europa.eu/factsheets/en/sheet/68/energy-policy-general-principles> (Accessed 03 February 2024).
9. Verkhovna Rada of Ukraine (2019), Law of Ukraine “On the electric energy market”. Article 3. Principles of operation of the electric energy market”, available at: <https://zakon.rada.gov.ua/laws/show/2019-19#n1789>. (Accessed 24 March 2024).
10. The official site of Eurostat (2024), available at: <https://ec.europa.eu/eurostat/data/database>. (Accessed 24 March 2024).

Стаття надійшла до редакції 04.04.2024 р.