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Guarantees of electricity origin as a financial mechanism to increase investment attractiveness in the energy sector

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Abstract. In modern environment, ensuring the development of the renewable energy sector is significant for achieving the country's sustainable development goals. The introduction of a mechanism for guaranteeing the origin of electricity is one of the most effective ways to develop renewable energy, and therefore its study is relevant. The purpose of this study was to analyse the approaches to the functioning of the market of guarantees of electricity origin in the EU countries and compare them with the situation in Ukraine. The principal methods of the study were forecasting (prospects for the implementation of energy origin guarantees in Ukraine) and comparison (approaches to the formation of the mechanism of energy origin guarantees in Ukraine and the EU). The study noted the overall role of renewable energy for the development of any country and Ukraine specifically. All the main positive components that arise in countries in the development of this area were described in detail. The instrument of guarantees of energy origin stays effective for achieving the goals of renewable energy development in Ukraine. Considering the specific features of the rules for selling renewable energy guarantees, the study concluded that they are useful both for stimulating the development of the sector and for disseminating information about the need to improve the state of the renewable energy sector in Ukraine and globally. The study assessed what steps has Ukraine taken to adopt and implement this mechanism. Information on EU countries was also examined. The gradual increase in demand for such instruments every year since 2019 indicates not only the popularity of this practice, but also its need among all market players. It was shown that, after the start of Russia's full-scale invasion of Ukraine, the foreign trade balance turned negative, i.e., the volume of electricity purchases exceeded the volume of sales. The findings of this study can be used to formulate a long-term strategy for the development of a mechanism for guaranteeing the origin of electricity in Ukraine by public authorities

Keywords: social responsibility; sustainable development; crisis resilience; green economy; strategic security

INTRODUCTION

The development of green energy plays a vital role in promoting sustainable development: it is the key to ensuring this concept, as it allows meeting the needs of modern society without harming the environment and future generations. The development of green energy also helps to reduce dependence on coal and other limited energy sources, reduce greenhouse gas emissions such as carbon dioxide and methane, create new jobs, and increase energy independence. The development of this concept ensures a comprehensive improvement of the country's development level.

Considering the above factors, the production of this kind of energy and support for its producers becomes an essential issue. For this, various mechanisms are being created, one of which is the guarantee of energy origin: it allows renewable energy companies to sell certificates on the secondary market and thus assure their consumers that the energy they will consume will come from renewable sources. In Ukraine, this area is only beginning to develop, while in the EU it is much more widespread. More active work in this area could allow for greater cooperation with EU countries in the context of exporting renewable electricity. Considering of this, the study of the specifics of this system in the European Union and Ukraine stays important.

O. Chumachenko (2022) investigated the role of renewable energy sources in the energy balance of Ukraine. Based on the analysis of statistical data, the researcher

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concluded that the country should pay much greater attention to the development of renewable energy to achieve the relevant sustainable development goals than it currently does. A.V. Voronin & P.I. Panasyuk (2022) also noted that renewable energy in Ukraine is developing steadily and has promising prospects. Particular attention was paid to the prospects of biomass energy, considering the large number of agricultural enterprises in Ukraine. With this in mind, the researchers called for a much larger flow of investment in the sector to ensure its more rapid development.

K.O. Kuznetsova & O.O. Boyko (2023) also noted that the introduction of renewable energy sources in Ukraine is a crucial step in ensuring energy security and sustainable development, especially during and after the war. The researchers noted the need to assess the impact of each type of renewable energy and investigate the nature of their interaction to increase the possibilities for sustainable development in Ukraine. P.D. Lezhdenyuk & A.V. Sytnyk (2022) noted the growing role of guarantees of energy origin to ensure cleaner electricity production in Ukraine. Attention was also paid to the problems that exist in this area, namely the inaccuracy and non-transparency of green energy certification. Nevertheless, the study paid little attention to the possibilities for improving the situation. B.O. Burykin *et al.* (2022) considered approaches in the context of guarantees of origin of renewable energy in the European Union, but also did so rather briefly, focusing primarily on the significance of introducing this kind of technology.

I. Matyushenko *et al.* (2022) studied the investment climate of the EU and Ukraine. They showed that Denmark, Sweden, the Netherlands, Germany, and Finland had the highest scores on the selected indices analysed, while Croatia, Greece, Bulgaria, Romania, and Ukraine had the lowest scores. Based on the analysis conducted, the researchers also made certain recommendations for improving the situation in Ukraine: they most often focused on anti-corruption measures, restarting and reforming the judicial system, creating financial incentives for investors, simplifying bureaucratic procedures.

The literature analysis suggests that although Ukraine is actively researching the role of renewable energy sources, little attention has been paid to the mechanisms of energy origin guarantees, their capabilities, and benefits for the state. Considering this, the purpose of this study was to analyse approaches to the development of a mechanism for guaranteeing the origin of energy in the European Union and Ukraine. This allows identifying the areas where Ukraine is still falling behind the rest of the world and offer recommendations for government officials on how to improve the situation.

MATERIALS AND METHODS

The research period was defined as 2019 to 2024. The study also used some statistical data for the analysis, namely, those related to the number of transactions in the trade in guarantees of origin in the European Union. This information was taken from the website of the Association of Issuing Bodies (2024), an association that promotes the use of the standardised system of the European Energy Performance Certificate System. The data on the number of transactions of guarantees of origin was disaggregated, which made it possible to estimate both the total number of transactions and the number of transactions by individual categories, such as export, import, issue, transfer. Furthermore, it is worth noting that the data for 2024 is provided only for the period up to June. The study also generated annual data for this period under the assumption that the average transaction volume for these three months would stay the same for the entire 12 months.

The study also used certain components of the regulatory framework, namely Resolution of the Cabinet of Ministers of Ukraine No. 227-2024-p "On the Introduction of Guarantees of the Origin of Electricity Produced from Renewable Energy Sources" (2024). It describes the mechanisms of the procedure for maintaining a register of guarantees of origin of renewable energy, registration of electricity facilities and power plants for obtaining guarantees, issuance, circulation, and redemption of guarantees of origin, and inspections of facilities to confirm renewable energy production. It sets out the principles for confirming the origin of energy in a very comprehensive manner to prove that it was produced from renewable sources.

The information from Directive of the European Parliament and of the Council No. 2009/28/EC "On the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC" (2009) was analysed. The Directive explains a considerable number of principles related to the development of renewable energy. It establishes a general framework for the promotion of renewable energy, including binding national targets for the share of renewable energy in energy consumption and transport, explains the rules for the transfer of statistical data, joint projects with other countries, administrative procedures, information dissemination, training and grid access for renewable energy sources; it also describes the principles of operation of guarantees of origin within the association.

This study employed a considerable number of scientific methods. The comparison method was used to assess the approaches to the development of the mechanism of guarantees of energy origin in Ukraine and the EU countries. The analytical method was also used to assess the situation with the development of the market of guarantees of origin in the EU to assess the possible course of events in Ukraine. The forecasting method was used to form an understanding of the possible future course of events in the context of the development of this mechanism in the country based on the available information about it in the current conditions, as well as on the example of EU countries.

RESULTS

For Ukraine, like all other countries, renewable energy is one of the key areas for further development. The development of renewable energy sources helps to reduce the

country's dependence on energy imports, especially oil and gas, which increases the country's energy security. The use of such energy sources helps to reduce emissions of harmful gases and other pollutants into the atmosphere, which contributes to improving the quality of the environment and public health. The development of the renewable energy sector is contributing to the creation of new jobs in the areas of production, installation, maintenance, and research (Alper & Oguz, 2016; Zhang *et al.*, 2021). However, the key thing is that the use of clean energy from renewable sources allows businesses and the government to increase their social responsibility to society by reducing the negative impact on the environment and public health. Ukraine has considerable potential for renewable energy development due to its abundant natural resources, such as solar and wind energy, biofuels, hydropower, and even geothermal energy. The development of this industry is somewhat problematic in the context of the war: moreover, a significant amount of resources has been lost. Considering this, the use of various approaches to stimulate the development of this industry is still important in Ukraine's current strategy. This also applies to the use of such a mechanism as guarantees of electricity origin.

Guarantees of energy origin are an essential financial mechanism for increasing investment attractiveness in the energy sector. It is used to stimulate the production and consumption of "green" electricity, i.e., energy generated from renewable sources such as wind, solar, hydropower (Kyzym & Rudyka, 2018). The basic idea is that energy companies that produce green electricity receive special certificates for each megawatt-hour of such energy produced. These certificates can be sold on the internal or external market. This approach generates additional income for green energy producers, making their projects more attractive to investors. Guarantees of origin also contribute to the transparency of the electricity market and help consumers to be informed about the source of electricity, allowing them to make an informed choice in favour of clean energy. These mechanisms help to reduce dependence on coal and other harmful energy sources, promote the production of green energy and contribute to the overall improvement of the environment.

The popularity of this instrument within the European Union is only growing. This is evidenced by some statistics. Specifically, the volume of transactions in this area is growing rapidly, as presented in Figures 1, 2.

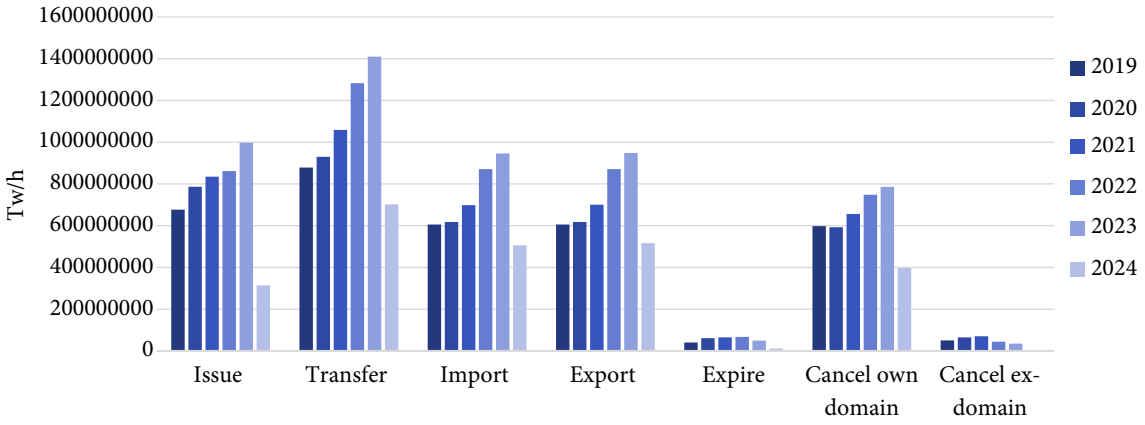

Figure 1. The number of transactions of energy guarantees in the European Union in 2019-2024, mln Tw/h
Notes: data for 2024 is provided for a period of 3 months
Source: compiled by the author of this study based on data from Association of Issuing Bodies (2024)

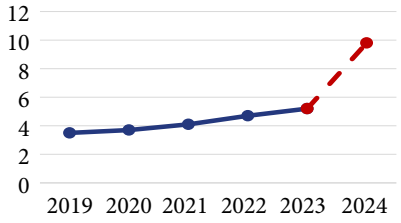

Figure 2. Data on the number of transactions of guarantees of origin in the European Union in 2019-2024, bln Tw/h
Notes: data for 2024 are provided for a period of 3 months; dashed line values indicate projected data for the whole year, based on the data for the first three months
Source: developed by the author of this study based on data from Association of Issuing Bodies (2024)

As Figures 1, 2 show, the number of transactions of diverse types related to the purchase or sale of guarantees of energy origin is constantly growing. This demonstrates the effectiveness of this initiative, as well as the benefits for all market participants, including renewable energy producers. It is also important to analyse data related to the purchase and sale of energy abroad, particularly in the EU countries. Data broken down by import and export volumes is presented in Tables 1-3. As Tables 1-3 show, for different countries, Ukraine becomes an exporter and an importer, respectively, at different times. Thus, before 2023, Ukraine was more of an exporter of electricity to Europe, while since 2023, due to Russia's strikes on the energy infrastructure, the country has increasingly needed to import electricity to supply consumers. The

solution to avoid being so vulnerable to attacks on key critical infrastructure is to decentralise the energy system and transition it to renewable sources. The price of energy for energy trade between Ukraine and other countries was roughly estimated using day-ahead market indices (DAM) (Table 4). Using the data in Table 4, one can roughly estimate Ukraine's losses from electricity imports. This information is presented in Figure 3.

Table 1. Data on electricity exports by Ukraine to selected European countries in 2020-2024, MWh

Year	2020	2021	2022	2023	2024*
Hungary	2,110,181	1,570,433	192,840	0	43,959
Slovakia	41,279	301,453	461,668	150,052	27,465
Romania	868,262	642,412	337,687	14,698	46,291
Poland	1,489,718	811,506	1,079,790	53,370	76,508
Total	4,509,440	3,325,804	2,071,985	218,120	194,223

Notes: * – data are based on information until June 2024
Source: developed by the author of this study based on Energy Map (2024)

Table 2. Data on Ukraine's electricity imports from selected European countries in 2020-2024, MWh

Year	2020	2021	2022	2023	2024*
Hungary	516,096	66,449	25	0	416,193
Slovakia	1,473,699	308,149	4,245	558,574	296,506
Romania	89,397	40,608	2	103,062	245,908
Poland	0	0	0	60,678	114,446
Total	2,079,192	415,206	4,272	722,314	1,073,053

Notes: * – data are based on information until June 2024
Source: developed by the author of this study based on Energy Map (2024)

Table 3. Electricity trade balance of Ukraine with European countries in 2020-2024, EUR

Year	2020	2021	2022	2023	2024*
Hungary	1,594,085	1,503,984	192,815	0	-372,234
Slovakia	-1,432,420	-6,696	457,423	-408,522	-269,041
Romania	778,865	601,804	337,685	-88,364	-199,617
Poland	1,489,718	811,506	1,079,790	-7,308	-37,938
Total	2,430,248	2,910,598	2,067,713	-504,194	-878,830

Notes: * – data are based on information until June 2024
Source: developed by the author of this study based on Energy Map (2024)

Table 4. DAM prices in selected EU countries and Ukraine in 2020-2024, EUR/MWh

Year	2020	2021	2022	2023	2024*	Change
Hungary	39	113.85	271.7	106.82	71.04	82%
Slovakia	34.01	102.75	264.94	104.73	70.57	107%
Romania	39.47	111.42	265.3	103.74	72.71	84%
Poland	46.65	87.03	166.72	111.65	82.66	77%
Ukraine	42.17	56.61	78.23	85.42	79.11	88%

Notes: * – data are based on information until June 2024
Source: developed by the author of this study based on Energy Map (2024)

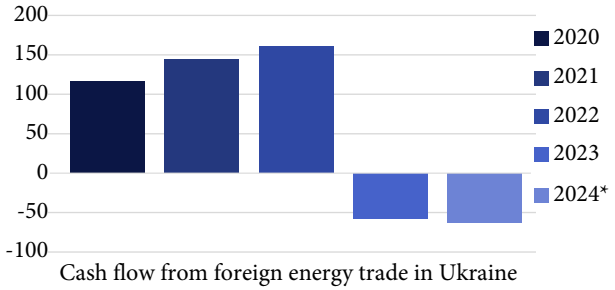

Figure 3. Data on Ukraine's losses/income from electricity trade (deduction of electricity imports from exports) in 2020 to 2024, mln EUR

Notes: * – data are based on information until June 2024

Source: developed by the author of this study based on Energy Map (2024)

As Figure 3 shows, Ukraine has had a negative balance of foreign trade in electricity since the beginning of Russia's full-scale invasion of Ukraine: the values were -57.3 mln EUR in 2023 and -62.5 mln EUR in 2024, which could have been saved if renewable energy sources had been better developed in the country. In the European Union, the principles of application of guarantees of energy origin are described in the Directive of the European Parliament and of the Council No. 2009/28/EC (2009). It describes that guarantees of origin are primarily used to prove to customers that energy comes from renewable sources, preventing double counting and other analogous errors (Bekun, 2022). Guarantees of origin can be transferred between holders but should not be sold: the Directive also describes that the sale of such certificates can support energy producers and increase the efficiency and widespread use of energy among other countries. Improving the quality of information for consumers on the distribution of energy between countries and enterprises is also considered significant (Šurić *et al.*, 2021).

The specifics of this mechanism are described in detail in Article 15 of Directive of the European Parliament and of the Council No. 2009/28/EC (2009). It states that EU Member States must ensure that guarantees of origin will be issued upon request by renewable energy producers, with each guarantee representing 1 MWh of energy and cannot be duplicated for the same unit of energy. Energy from renewable sources is counted only once, which prevents double counting. The guarantee is valid for 12 months and is cancelled thereafter; the relevant authorities oversee the issuance, transfer, and cancellation of guarantees, ensuring accuracy and independence from production and supply activities. The guarantees themselves should contain details such as energy source, production dates, energy type, production capacity information, support scheme benefits, operating dates, issuance details, and a unique identifier. Importantly, all Member States should recognise guarantees of origin issued by other Member States as proof of certain elements, with the possibility of refusing recognition based on reasonable doubts as to accuracy, reliability, or veracity. The EU, among other things, has a system of certificates introduced by the Association of Issuing Authorities. This system harmonises the issuance, sale, and cancellation processes, facilitating cross-border trade through a single European electronic centre. To take part, governments must develop protocols that follow the rules of the European Energy Performance Contracting System and obtain approval. The Guarantee of Origin is usually issued after opening an account in the national electronic registry, certifying renewable energy generation devices and contacting the registry operator. Auctions for these guarantees are held based on the volume of electricity production, and the winners are determined by the maximum bid prices. The proceeds from the sale are also used as a method of supporting renewable energy producers. All operations are carried out electronically within a specially created platform (Phan *et al.*, 2020).

In Ukraine, there is a relevant Resolution of the Cabinet of Ministers of Ukraine No. 227-2024-p (2024). Its purpose is to ensure the conditions for the functioning of the register, which would be designed to confirm the origin of energy produced from the relevant sources, the process of registration of the electricity industry itself, as well as the issuance, circulation, and redemption of these guarantees, and inspections of facilities producing such energy. The governing body is the National Energy and Utilities Regulatory Commission (NEURC). Within the framework of this register, the issuance, transfer, redemption, and cancellation of guarantees is performed exclusively between users of the register by means of electronic requests. At its core, it should ensure a safe, efficient, and transparent governance system within the market for energy guarantees. The NEURC is also the registry administrator, which is responsible for the proper functioning of the software, the accuracy of the information in it, manages account creation, access rights, and supports the process of issuing, transferring, and redeeming guarantees. Therewith, by 31 December, the administrator must publish the indicator of the environmental value of electricity for the next year. Users of this technology also have corresponding obligations, namely, to enter only true and complete information when using the register.

The Resolution also describes the conditions for registration of the relevant electricity generating facilities. For this, the user must provide detailed information about the generating facility, including the date of its start of operation, location, details of grid connection, technology and type of renewable energy, capacity, commercial metering data, and some others. The administrator reviews the information within ten business days: if the data is complete and accurate, the registration is confirmed, and if not, users receive a notification to correct and resubmit the information. Subsequently, one can request to change individual

data on power units, if necessary, or request to remove a unit from the register. In this case, each renewable energy unit must be separately registered if the user owns or has legal grounds for several units. The commercial metering administrator uploads certified commercial metering data to the register by the 20th day of the month following the operational period: guarantees of origin are automatically generated based on this certified data, confirming the amount of electricity supplied to the grid or used for own consumption. The content of the guarantees should include the type of renewable energy source, dates of energy release and production, location, capacity, and characteristics of the plant, date of commissioning, country of issue and date, environmental value, and a unique identification number. Such a guarantee certifies the owner's rights to the environmental value and benefits of renewable energy production. Any registry user can be a warranty holder, except where legal restrictions apply; they are valid for 12 months after production and must be redeemed within 18 months. Outstanding warranties will be cancelled after 18 months. Users can transfer guarantees of electricity origin using the registry's functionality by creating an electronic request, detailing the number and unique identifiers of guarantees, registration numbers of the sender's and recipient's accounts. If both users agree to the transfer, it takes place, but can be cancelled within 24 hours. The purchase and verification of guarantees of origin of renewable energy in Ukraine is also formed according to a certain algorithm, which also includes verification by the responsible authorities in case of complaints, appeals, or any violations.

The approaches used in both the EU and Ukraine are quite similar. It can be observed that all the approaches and mechanisms described in the regulations are comparable, and thus can be easily applied in the future after the country's accession to the EU. Although the mechanism of guarantees of energy origin has only just been launched in Ukraine, given the practices of EU countries, one should expect quite positive results from it in the context of ensuring the development of this area. Furthermore, the harmonisation of the practices of guarantees of origin will subsequently open the large EU market for the country in the context of cross-border trade in renewable energy certificates, which will create new incentives for the development of the sector. Overall, the implementation of the principles and practices of the system of guarantees of energy origin will lead to the modernisation of Ukraine's energy sector, promote its economic development and allow it to more effectively withstand the crises that often arise in the current environment.

DISCUSSION

The development of renewable energy sources is crucial for Ukraine's energy security and environmental sustainability, considering the possibility of reducing energy imports from other countries, lowering carbon dioxide emissions, creating jobs, and other positive components. In turn, guarantees of origin are a new and effective mechanism to support renewable energy companies. These guarantees ensure transparency in the electricity market and inform consumers about the source of their energy, promoting the use of clean energy. The EU principles on energy origin guarantees are consistent with Ukraine's goals and practices. Both systems aim to prevent double counting, facilitate cross-border trade, and support renewable energy producers. The similarities between the EU and Ukraine's approaches suggest future integration and cooperation, potentially opening new markets and new opportunities for Ukraine in the EU energy market. Such harmonisation of practices could lead to modernisation of Ukraine's energy sector, economic growth, and improved resilience to crises.

Scientists conclude in their studies that the development of renewable energy sources is crucial for ensuring the country's effective economic development. Thus, L. Yuping *et al.* (2021) conducted a study based on data from Argentina in the period from 1970 to 2018. They have shown that renewable energy consumption and globalisation reduce CO_2 emissions, reduce dependence on fossil fuels, and allow for an active investment. Scientists noted the significance of further implementation of relevant policies aimed at developing renewable energy in Argentina and other countries. A. Sharif *et al.* (2020) also concluded that the use of this type of energy reduces the ecological footprint in the long run based on data from Turkey. This is primarily due to a reduction in dependence on fossil fuels, which leads to some other positive effects, including increased economic resilience to crisis situations. The researchers recommended that the government should continue to pursue a policy of reducing dependence on fossil fuels, promote investment in the industry and strive to achieve sustainable development goals.

A. Anwar *et al.* (2021) conducted an analogous study based on data from the Association of Southeast Asian Nations (ASEAN) countries. The findings showed that the consumption of non-renewable energy increases carbon emissions, which is why it is important to switch to renewable energy sources in all countries. Particular attention was paid to developing countries, as the rapid development of the economy creates a need to increase energy capacity in the country. Considering this, the rapid introduction of renewable sources will allow not to increase the burden on the country's environmental state by increasing the rate of economic growth, which was also noted in E. Dogan *et al.* (2020).

There is also a certain synergy with the development of the stock market, as described in V. Zeqiraj *et al.* (2020). Notably, for Ukraine, the development of renewable energy sources stays the principal area of the country's development. A country can gain a noteworthy number of benefits from implementing such systems, both in terms of economic development and environmental protection, as well as some other variables. For instance, this will allow Ukraine to achieve a greater level of energy independence, which is essential in times of crisis. Furthermore, this allows for decentralisation of the system, which reduces its

dependence on the failure of individual large nodes. However, the question arises as to whether this system can be developed in times of war: that is why the circulation of guarantees of energy origin can be one of the most effective tools to support renewable sources.

M. Mulder & S. Zomer (2016) and also A. Wimmers & R. Madlener (2023) assessed trade under uncertainty in the European market for green energy guarantees. Guarantees of origin were designed to disclose information about the production of clean electricity, but do not have the effect of incentivising increased production. To have a positive impact on producers' decisions, prices should be higher than current EU prices: this should be influenced by the government, among other things, as the formation of a more efficient market for guarantees of origin can lead to better conditions for the development of renewable energy. The study achieved somewhat different results: considering the increase in the exchange of guarantees of origin, a conclusion was made about the effectiveness of this initiative. If it had not been effective, there would have been no increase in volumes: the instrument is arguably in demand. Although there are challenges in the context of developing renewable energy sources within the association, their development of guarantees of origin has proven to be one of the most effective approaches to stimulate the development of the sector.

U. Calikoglu & M.A. Koksal (2022) analysed the demand for green electricity and guarantees of renewable energy origin in the Turkish market. The researchers conducted a survey among industrial consumers, producers, and suppliers of electricity and showed that companies generally prefer green energy, while another 20% are willing to overpay for it. They are also particularly focused on this, considering the renewable energy goals of the Paris Agreement, which are a priority in the context of the country's long-term policy. With this in mind, the researchers concluded that it is necessary to develop infrastructure for the development of renewable energy, one of which they define as built around guarantees of origin. Analogous results were obtained when assessing the situation on this market in EU countries: it was shown that transactions with guarantees of energy origin are gradually increasing, which suggests an increase in their popularity among market players.

T. Martinsen & M. Mouilleron (2020) assessed the analysis of the potential of guarantees of origin for increasing new renewable energy sources in the Nordic energy system. They noted that the success of the model depends on stable market development, which ensures sufficient demand for additional issues of this type of guarantee. The analysis compares the production of renewable energy, specifically wind and solar energy, forecasting the growth and viability of the sector. Showing the growing demand for guarantees of energy origin, the researchers pointed to the need to create new and diverse facilities to meet the growing demand. It was concluded that the policy of introducing such guarantees does have the potential to increase the share of renewable energy use and reduce CO_2 emissions in countries.

A. Petryk & P. Adamik (2023) investigated guarantees of origin as a market mechanism for energy transition in Poland. They noted the presence of a strong positive correlation between prices for guarantees of origin and electricity prices in the country. Thus, according to the model, an increase in the price of electricity by PLN 1 leads to an increase in the price of guarantees of origin of electricity by PLN 0.0049. Therewith, the price increase does not affect the dynamics of trade in this instrument, which is constantly growing. This demonstrates the effectiveness and growing popularity of the mechanism of Directive of the European Parliament and of the Council No. 2009/28/EC (2009) in Poland. Researchers also noted that the introduction of such a market mechanism as guarantees of energy origin has led to better results in the development of agricultural production and certain processing sectors, which also confirms the effectiveness and role of stimulating the introduction of renewable energy in enterprises. Overall, conclusions on the popularity of this directive in the EU countries were also made in the study. Considering this, it can be assumed that the popularity of the instrument will likely increase in Ukraine over time, and thus the possible effectiveness of the instrument of guarantees of energy origin in the country as a whole.

CONCLUSIONS

The study concluded that the development and use of renewable energy sources is a key area for Ukraine's future growth, reflecting global trends towards sustainable energy practices. Considering this, it becomes important to use new mechanisms to support and develop it, to achieve more effective results in the context of its future development.

To achieve these goals, the energy guarantee instrument was developed to serve as a catalyst for investment in the energy sector, stimulating the production and consumption of green electricity from renewable sources. The study showed that the issuance and sale of renewable energy certificates contribute to market transparency and enable consumers to make a choice in favour of sustainable energy. This is especially true in EU countries, where the demand for this instrument is growing rapidly in the current environment. This trend reflects the mutual benefits for both market participants and renewable energy producers. The study also assessed data on electricity trade between Ukraine and the EU. Based on the analysis of export and import data, it was concluded that with greater opportunities for independent electricity production (the most effective approach to which is renewable energy in times of war), the country could save quite a lot of money (EUR 57.3 mln and EUR 62.5 mln in 2023 and 2024, respectively) due to the lack of energy imports.

The study concluded that the structure of the EU Directive on Guarantees of Energy Origin should serve as a model for the development of an analogous mechanism in Ukraine in the future. This is caused by many reasons, including the proven effectiveness of these approaches and the benefits that the country can gain from their implementation. This is another step towards the unification of

renewable energy markets between international economic actors, which could lead to an influx of new investments in the industry from European companies. If the country could provide itself with electricity on its own, including from renewable sources, this situation could have been avoided and considerable amounts of funds could have been saved. Despite the war, Ukraine has taken the first steps towards this by creating a relevant resolution.

Nevertheless, further work needs to be done in this area, providing opportunities for further deeper interaction of these markets between the EU and Ukraine. Further research is needed to analyse the possibility of introducing other mechanisms to support renewable energy in Ukraine, especially in times of war.

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None.

CONFLICT OF INTEREST

None.

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Гарантії походження електроенергії як фінансовий механізм підвищення інвестиційної привабливості в енергетичній галузі

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Анотація. У сучасних умовах забезпечення розвитку сфери відновлювальної енергетики є важливим для виконання цілей сталого розвитку країни. Впровадження механізму гарантій походження електроенергії є одним із дієвих способів розвитку відновлювальної енергетики, а отже його дослідження є актуальним. Ціллю роботи стало проаналізувати підходи до функціонування ринку гарантій походження електроенергії в країнах ЄС та порівняти їх з ситуацією в Україні. Основними методами дослідження стали прогнозування (перспектив впровадження гарантій походження енергії в Україні) та порівняння (підходів формування механізму гарантій походження енергії в Україні та країнах ЄС). У розвідці була визначена загальна роль відновлювальної енергетики для розвитку будь якої країни та України зокрема. Детально описані всі основні позитивні складові, що виникають в країнах при розвитку цієї сфери. Інструмент гарантій походження енергії залишається дієвим для досягнення цілей розвитку відновлювальної енергетики в Україні. Зважаючи на особливості правил продажу гарантій відновлювальної енергії, зроблено висновок стосовно їхньої корисності як для стимулювання розвитку сектору, так і розповсюдження інформації про потребу покращення стану галузі в Україні та світі. Оцінено, які кроки були зроблені з боку України для прийняття та впровадження цього механізму. Також досліджувалася інформація і стосовно країн ЄС. Поступове щорічне підвищення попиту на такого роду інструменти починаючи з 2019 року говорить не лише про популярність даної практики, але й про її потребу серед усіх гравців ринку. Було показано, що після початку повномасштабного вторгнення Росії в Україну сальдо зовнішнього торговельного балансу стало від'ємним, тобто обсяги закупівлі електроенергії перевищили обсяги продажу. Висновки, отримані в рамках дослідження, можуть бути застосовані для формування довгострокової стратегії розвитку механізму гарантій походження електроенергії в Україні з боку представників державної влади

Ключові слова: соціальна відповідальність; сталий розвиток; кризостійкість; «зелена» економіка; стратегічна безпека