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Fiscal stimuli to improve energy efficiency under the economic recovery policy: an empirical approach of Ukraine

ABSTRACT: The world economy is constantly faced with crises that cause a significant negative impact. Each crisis poses new challenges to the economy and, on the one hand, inhibits economic growth, and on the other hand, can become a powerful stimulus for the development and rethinking of fundamental approaches to its construction. Conducting an analysis and establishing relationships between the economic situation and the state of the energy sector make it possible not only to predict the future but also to develop specific steps to prevent crises or reduce their negative impact. At the same time, establishing and evaluating the relationship between key economic and energy indicators, the main one of which is definitely the energy intensity of GDP, will provide an opportunity to understand

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how improving energy security will affect the economic situation in the country. The generalization of Ukraine's experience in rebuilding and recovering the economy after the biggest crisis creates a basis for further research in the field of energy management, crisis management, economics, and the construction of investment policy.

The reconstruction of Ukraine after the war has the potential to become the most significant stimulus for development and economic growth. During the crisis, it is very important to pay attention to the country's energy security. In particular, it is necessary to ensure the diversification of energy resources, taking into account their rising cost. Energy markets are currently experiencing extreme volatility caused by geopolitical tensions, which requires additional attention in the development and implementation of strategic guidelines for sustainable economic recovery in Ukraine.

KEYWORDS: energy efficiency, energy intensity, GDP, energy security, financial crisis

Introduction

The international financial and economic crisis of 2008–2009, which arose as a result of the actions of banks in reaction to massive loan defaults, after its end led to the flow of capital from the markets of developed countries to countries with developing economies, as well as the reorientation of financial flows to raw materials and energy assets (Hrytsiuk and Sak 2021).

The COVID-19 pandemic at the end of 2019 caused a significant economic and social crisis around the world, forced a large number of people to rethink their own relationship with health, and forced companies to rethink their approaches to the organization of work. The COVID-19 pandemic had a significant negative impact on Ukraine's economy. Thus, according to various forecasts, Ukraine's GDP will fall by 4–8% compared to 2019 as a result of the pandemic. Such a reaction of the economy is a consequence, first of all, of the loss of raw material markets, the closing of borders, and a decrease in the volume of imports and exports, etc. According to forecasts of the National Bank of Ukraine, the drop in exports should be 10%, imports should be 14.5%, and the budget deficit will reach 8% of GDP. The economic crisis inside Ukraine will cause a deterioration in the quality of life of the population and an increase in the unemployment rate of almost 10%.

The aforementioned crises were caused by problems in the banking and financial system, caused by the global spread of a new disease, then at the end of the winter of 2022, the Russian Federation launched a large-scale military invasion of the territory of Ukraine, effectively starting a war in the center of Europe. This is a war that will have an extremely negative impact not only on the economy of Ukraine, but also on other countries.

Different types of crises have different effects on the economy and its sectors. Furthermore, the general approaches of the state to overcome the consequences of crisis phenomena are relatively stable and depend, for the most part, not on the type of specific crisis but on the understanding of economic theory. What steps the Government will take to overcome the crisis depends

not only on the macroeconomic situation, but also on how they were overcome in the past. Humanity at the current stage of development had not faced pandemics, so there were simply no developed response mechanisms. It will be easier for countries to cope with such challenges in the future, as the COVID-19 pandemic has taught the global community a lot.

Despite Ukraine having a long history, it is a young independent state. Several revolutions, a financial crisis, a pandemic and a war do not provide any opportunity to maintain a steady pace of development but instead require quick and effective decisions at all levels. A crisis requires relevant experience.

Energy is the basis of the entire economy, and the energy intensity of GDP is a key indicator of the country's development. In fact, it reflects how much energy resources the country spends to create a unit of GDP. Any crisis will have a negative impact on energy efficiency and energy intensity, as GDP decreases, people lose jobs and cannot pay for basic needs and loans, and in accordance with this, the banking system also suffers losses, demand for products decreases and inflation increases. During crises, Governments resort to old approaches in energy: they return to their energy mix (or increase the share) of fossil energy resources, for example, coal or gas. Taking into account the desire of Europe and the whole world to have a carbon-free economy by 2050, the development of solutions to overcome the crisis should be oriented to include, but not limited to, the continuous development of renewable energy sources, the stimulation of investments in energy efficiency, the reduction of harmful emissions of greenhouse gases, the enhanced use of nuclear power generation and the prevention of a complete return to fossil fuels.

It is also important to understand the relationship between energy and the economy, identifying all the connections and points of contact. Thus, the determination of fiscal incentives that will influence the improvement of energy efficiency will lead not only to concrete consequences in the energy sector but also to the implementation of an effective policy of economic recovery of the country.

Many international scientists have been engaged in the study of the relationship between the economy and energy. Some of these have concentrated on the study of energy efficiency. One such example is the work of [Vasylieva et al. \(2021\)](#), who explored opportunities to reduce gaps in approaches to energy efficiency policy implementation. The authors established that the energy efficiency level reached the largest gaps in 2009 and 2015, which is during the crises. [Simeonovski et al. \(2021\)](#) also studied energy efficiency in EU countries, using an integrated model of the relationship between labor and capital as factors of energy production and consumption to create GDP. The results of the analysis show that countries that have been members of the EU for a longer time are more efficient in terms of energy use in contrast with countries that have gained EU membership relatively recently.

[Kassi et al. \(2020\)](#) paid more attention to the study of the financial aspect of economic development. The authors focus on improving the financial system in terms of investment policy, risk management, etc. [Brockway et al. \(2021\)](#) conducted a study of the relationship between energy consumption and GDP, and in particular, analyzed the economic effect of increasing energy efficiency.

Scientists are also conducting research on the role of certain technologies in ensuring energy efficiency. As an example, [Paramati et al. \(2022\)](#) use econometric methods to determine the impact of new technologies on energy efficiency and energy consumption. The study proved that environmental technologies have a positive effect on the demand for energy resources by reducing it. In addition, scientists propose a number of political solutions.

Abdulrasheed Zakari, Irfan Khan, Duoqiao Tan, Rafael Alvarado, Vishal Dagar in the scientific article “Energy efficiency and sustainable development goals (SDGs)” ([Zakari et al. 2022](#)) revealed the relationship between energy efficiency and the SDGs, in particular concluding that sustainable economic development is closely related with positive rates of change in energy efficiency. This connection is realized, inter alia, through the development of the financial sphere. Among all the factors, the implementation of green innovations has a very positive effect on energy efficiency, which is most correlated with the SDGs.

The determination of the impact of fiscal decentralization on ecological sustainability has been investigated by [Sun et al. \(2022\)](#). Other scientists in the article “The effect of financial development on renewable energy demand: The case of developing countries” ([Shahbaz et al. 2021](#)) emphasized the importance of renewables not only in the context of achieving climate goals, but also in economic development. In particular, the impact of financial development on renewables consumption in thirty-four developing countries was determined. The results of the study clearly indicate the relationship between the consumption of energy from renewable sources and the financial development of the country. The higher the financial development of the country, the higher the energy consumption. The data shows that financial development causes an increase in the demand for energy from renewables. It is also important to increase investments in renewables projects in which the state’s participation is determined through public-private partnerships (with the help of financial mechanisms).

Many scientists focus on researching the issue of the demand for energy resources. It is known that in the coming years, even decades, the demand for energy resources will grow. Simultaneously, the number of households unable to independently cover their energy needs is increasing. Energy poverty is a problem that even developed economies face. The connection between energy poverty and energy efficiency has been investigated by [Li et al. \(2021\)](#). The researchers examined the empirical relationship between energy poverty and energy efficiency and concluded that energy poverty not only negatively affects the energy sector but also leads to a decrease in GDP. However, more attention should be paid to cost-induced energy poverty than to consumption-induced energy poverty. Such conclusions appeal to the fact that the primary task facing politicians is to develop effective policies and effective mechanisms to increase the efficiency of energy production, rather than make attempts to reduce consumption.

Analysts of international agencies, such as the World Bank and the IEA, also pay considerable attention to studies of the impact of crises on the world economy and offer specific solutions for their resolution. In particular, the IEA in the report “Energy Efficiency 2022” ([IEA 2022b](#)) defines the main trends of energy policy and outlines the directions of changes in the demand and supply of energy resources in accordance with the energy crisis of 2022. Analysts note that the rate of increase in energy intensity has slowed down, which is due to the pandemic and the war

in Ukraine. The report also focuses on the significant increase in energy prices caused by military actions on the territory of Ukraine as well as what countries can do to reduce the negative impact on their economies and prevent the loss of progress in achieving climate neutrality on the European continent. More information about the impact of the events of 2022 on energy policy and the world economy is presented in the document “World Energy Outlook 2022” (Beyer and Vandermosten 2021).

The policy paper “Ukraine: Facilitating Municipal Energy Efficiency Finance” (IBRD 2015) was prepared by the World Bank, which examines changes in Ukraine’s energy consumption and outlines the actions of the Government of Ukraine in restoring the energy sector, which has undergone significant infrastructural destruction due to the introduction of financial incentives. In particular, the World Bank notes that the importance of energy efficiency lies in ensuring energy security and in the creation of financial savings, financial space and economic competition. Other organizations also conducted similar studies. The OECD prepared the document “Analyzing energy subsidies in the countries of Eastern Europe, caucasus and Central Asia” (OECD 2013), and the European Commission document “Report from the commission to the European Parliament and the Council. 2022 Report on Energy Subsidies in the EU” (European Commission 2022).

Every year, the issue of energy attracts increasing attention of the scientific community. The connection between energy and the economy is undeniable; the question is how strong this connection is and what tools can be used to influence it.

1. Results

The pandemic contributed to the development of digitalization and increased volumes of online trade. Urbanization processes slowed down as a result of the quarantine restrictions that were introduced in many countries. As a result of the crisis caused by COVID-19, as well as during the international crisis of 2008–2009, global oil prices tended to decrease due to several reasons: many people worked remotely and did not need to use transport, there was a reduction in the instances of interstate transportation, and the financial crisis hit business solvency. Global emissions of CO₂, which are the result of the work of energy companies, had an increasing trend during the pandemic. The growth of CO₂ emissions is associated with the growing demand for coal (IEA 2021).

There is a worldwide tendency to increase the demand for electricity, and from this, there is a growing demand for increasing energy efficiency. To overcome the consequences of the crisis caused by COVID-19, a political framework was established, economic and financial instruments were developed, which should direct investments to achieve the goals of sustainable development by identifying priority investment projects and providing tax privileges to investors. Key recommendations include: the phasing out of fossil fuels, the reforming of energy markets,

the alignment of the policy to overcome the economic and social consequences of the pandemic with the policy of implementing the goals of sustainable development and the Paris Agreement (Polack 2021). Regulatory and legal acts should clearly define the current investment rules and contribute to the creation of an appropriate legal environment.

During the crisis of 2008–2009 the volume of greenhouse gas emissions decreased, which was also associated with a decline in economic activity, but over the following years, the world economy recovered and greenhouse gas emissions began to rise again. A similar situation could be observed during the pandemic. Note that, taking into account the SDGs and the Paris Agreement, governments should simultaneously apply various economic incentives, such as “green” construction, energy-efficient modernization, the expanding the use of renewable energy sources for long-term economic and environmental growth. One of the most important and common reasons why countries cannot achieve SDGs is limited financial space, which is especially characteristic of developing countries, which accordingly have a smaller tax base and are more vulnerable to the external impact of the crisis (A Comparison of Selected Stimulus Packages in 2008 and 2020: investing in Renewable Energy, Sustainable Agriculture and Food Security, and Gender Equality and the Empowerment of Women for Structural Economic transformation 2020).

Despite the partial return from gas to coal, global emissions may decline slightly in 2022–2023. The reason for this is the slowdown in demand for electricity and the development of renewable energy sources. In particular, sluggish economic growth is expected to slow electricity demand growth to less than double its 2021 level. In 2021, the growth in electricity demand was 6 % and was caused by the recovery of the economy after the easing of quarantine. Growth in electricity demand will slow to 2.4% in 2022, which corresponds to the average for 2015–2019. The expansion of the use of renewables will contribute to global electricity production by more than 10% in 2022. Furthermore, the production of low-carbon energy should increase by about 7%, which would cause a drop in the volume of electricity production based on fossil fuels by 1% (IEA 2022a).

Russia’s war against Ukraine has already caused an increase in world fuel prices. For decades, Russia has remained a key player in the energy market and has done everything possible to put the EU on the gas and oil “needle”. An international working group prepared the Energy Sanctions Roadmap, which contains strategies that make it possible to make EU countries independent of Russian energy resources. The developers of the Energy Sanctions Roadmap claim that since the beginning of the full-scale war, the EU has paid about 800 million US dollars every day for the import of Russian energy resources (The International Working Group on Russian Sanctions 2022). Thus, Russia supplies Europe with 47% of natural gas and 25% of oil (according to World Bank data).

The first hypothesis of the study is aimed at determining the correlation between the level of energy efficiency of the economy and its recovery in crisis conditions.

Hypothesis 1: the increase in energy efficiency of Ukraine's economy has a positive effect on the level of economic recovery in times of crisis.

Ukraine is one of the least energy efficient countries in the world. Ukraine's GDP energy intensity level in 2021 was 0.077 koe/\$15p, while Germany's GDP energy intensity level is 0.070 koe/\$15p, France – 0.082 koe/\$15p, Poland – 0.086 koe/\$15p, Kazakhstan – 0.156 koe/\$15p (World Energy & Climate Statistics – Yearbook 2022).

According to the World Bank, the domestic national income of Ukraine in 2021 amounted to 170.7 billion US dollars with a surface area of 603.6 square kilometers and a population of 43.8 million. Focusing on the commensurability of GNI, we selected such countries for comparison as: Hungary (172.2 billion US dollars), Qatar (167.4 billion US dollars) and Kazakhstan (165.8 billion US dollars). It should be noted that despite the approximately same level of GNI, the selected countries differ significantly in terms of territory and population. Kazakhstan is the largest country by surface area, but has the lowest level of GNI, while Hungary, which is more than twenty-nine times smaller than Kazakhstan, has the highest level of GNI. This speaks of the success of the economic policy and the effectiveness of the government in overcoming the consequences of crisis phenomena.

In 2018, the World Economic Forum developed an Energy Transition Index (ETI) to assess the success of the countries' energy transition. The energy transition involves the introduction of energy-efficient standards, the reduction of the energy intensity of GDP and contributes to the achievement of the goals defined in the Paris Agreement. In general, in recent years, about 70% of the countries for which the ETI is assessed together with the sub-indices have improved their results, which indicates the development of their energy systems (World Economic Forum 2021).

In 2021, the ETI of Ukraine was 52%, which is 11% more than the indicator of 2018. Despite the fact that among the studied countries, Ukraine has the lowest ETI in absolute terms, the growth rate of ETI is the highest and is 27% compared to 2018, which was chosen as the base year (the growth rate for Hungary, Qatar and Kazakhstan is 18%, 13% and 8%, respectively). Reforming the energy markets, observing the principles of corporate governance and approaching European standards in the context of the implementation of the Association Agreement with the EU and granting Ukraine the status of a candidate for EU membership in 2022 are all strategies that would have a positive impact on the growth of ETI. For European countries with an ETI of more than 70% in 2021 (Austria – 75%, UK – 72%, France – 71%), the growth rate calculated over the base period is between 3 and 9%, while for during the same period, Ukraine showed growth by almost a third. Likewise the rates of growth of sub-indices (system performance and transition readiness) in Ukraine are the highest among similar countries. Ukraine demonstrates the ability to quickly adapt to crisis phenomena and can offer an effective crisis recovery policy. However, the consequences of the war are currently difficult to assess and it is also difficult to make predictions about changes in indices in future periods.

The level of energy intensity of Ukraine's GDP is lower than a similar indicator for most EU countries. When analyzing the state of the economy of Ukraine, it is worth noting that during the years 2007-2020, the GDP of Ukraine increased (from 2007 to 2020, GDP growth was 5%).

Despite overall GDP growth, average GDP per capita growth declined from 8.86% in 2007 to -3.35% in 2020. The lowest values of the average GDP per capita fall precisely during the crisis – 2009 (-14.76%), 2015 (-9.44%), 2020 (-3.35%). As a consequence, the energy intensity of GDP also decreases (during the studied period, the energy intensity of GDP decreased by 29%).

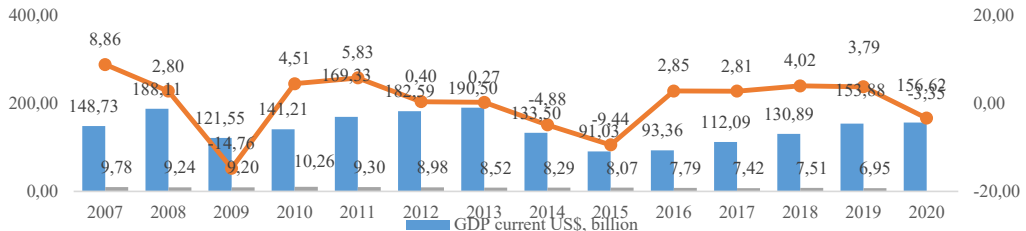


Fig. 1. Dynamics of GDP and energy intensity of GDP, 2007–2020

Source: constructed by the authors based on the World Bank statistics

Rys. 1. Dynamika PKB i energochłonność PKB w latach 2007–2020

The dynamics of indicators are quite low and indicate not only the impact of crises on the economy but also the ineffectiveness of reforming systems, which may be a consequence of the government's inconsistent and uncoordinated policy. A significant impact is also caused by the ongoing war since 2014, because of which, part of the territory of Ukraine is occupied, which does not allow evaluation of the data and the obtaining of complete information about the state of energy efficiency and GDP of Ukraine. One of the main reasons why Ukraine's economy lags behind the EU member states is that Ukraine does not fully use the available potential (for example, it develops only 36% of the explored mineral deposits, it does not fully use the available forest areas, it uses only 62% of the hydropower potential of reservoirs etc.) (Cabinet of Ministers of Ukraine 2023).

During the analyzed period, the total primary energy supply decreased, which is especially noticeable after 2015. The reason for the decrease is the occupation of the territories of Ukraine in the east, where in fact, many energy facilities are located. Total primary energy supply remained relatively stable during the COVID-19 crisis. At the same time, energy consumption from renewable sources is growing. Thus, during the period 2007–2020, the supply of energy from renewables increased by more than two times. Energy intensity of the total primary energy supply tends to decrease by almost 1.5 times.

If in the case of energy intensity we observe a certain synchronicity and consistency of changes, then several conclusions can be drawn regarding the absolute value of the total primary supply of energy and its final consumption. First, during the analysed period, the total primary energy supply decreased by 38%, while the final energy consumption decreased by 44% (the respective energy capacities decreased by 29% and 35%). The changes are primarily due to the occupation of the territories of Ukraine, this is clear from the fact that we observed a sharp drop in both the absolute values of the total primary energy supply and final con-

sumption in 2015. Secondly, it should be noted that despite the downward trend of the overall primary energy supply, the energy supply from renewables is increasing. This is due to Ukraine's commitments to the international community in the framework of various documents, as well as the development of energy efficiency, the adoption of relevant acts and the development of strategies. Thirdly, the development of renewable and alternative energy sources is not sufficient for a significant reduction in the energy intensity of total primary energy supply and final energy consumption.

Energy production in Ukraine during the period 2007–2020 decreased significantly (by 33%), which, as preciously mentioned, is due to the fact that a significant part of the production energy capacities are located in the occupied territories of the Donetsk and Luhansk regions. Additionally, the import of energy resources, although it had a tendency to decrease by two times, has started to grow in recent years. The state's policy in the energy sector, the implementation of EU Directives and the implementation of the Association Agreement with the EU are the reasons for this growth. According to calculations, the import of energy resources decreased by 53%, and the export by 84%. However, these trends are characteristic of the period 2007–2020 and do not take into account the joining of the United Power System of Ukraine to ENTSO-E in 2022, as a result of which, not only will the dynamics of export-import change but also its structure. In any case, a significant share of the import of energy resources indicates the insufficient ability of the country to independently provide itself with the necessary resources, which is due to the significant size of the territory of Ukraine and the general imbalance of the industry. In addition, obsolescence of equipment and the lack of a quick response to threats and challenges facing Ukraine's energy system are indicated.

Ukraine's economy reacted differently to the crises of recent decades. During the period 2005–2021, we observe uneven dynamics of changes in key economic indicators: GDP, GNI, consumer prices inflation, etc. According to forecasts of the World Bank, Ukraine's GDP would have fallen by 45% already 2022, which is equivalent to the figure of 2017. The lowest level of GNI per capita was recorded in the crisis year of 2009. Despite the fact that Ukraine is one of the largest countries in Europe, it ranks 56th in the world in terms of GDP, and 119th in terms of GDP per capita. Ukraine's lagging behind the majority of European Union countries, unfortunately, is not only characteristic of the crisis and post-crisis years but has accumulated during almost the entire period of independence.

One of the most important indicators of economic development and the state of the economy is the inflation rate. In the period 2005–2021, the indicators of inflation in consumer prices and the GDP deflator changed almost identically, which only emphasizes the presence of a close connection between them. After 2014, we can observe a significant increase in the inflation rate and its gradual decrease after 2015 and up until 2021. From the middle of 2022, the inflationary processes in Ukraine have experienced a new impetus, and currently there are no grounds for making positive forecasts regarding their further dynamics.

In the context of Ukraine's international obligations, in particular the Paris Agreement, the SDGs and the European Green Deal, the analysis of the structure of the economy would not be complete without a study of the dynamics of CO₂ emission changes. As part of the implementa-

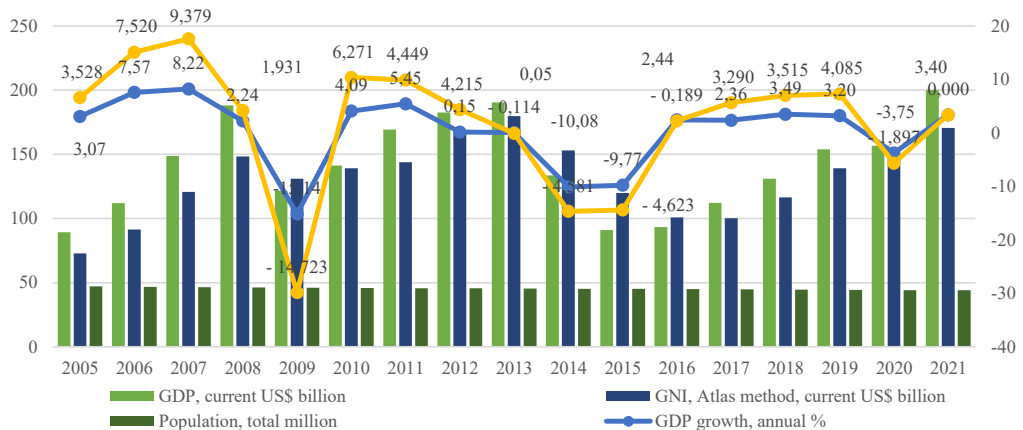


Fig. 2. Dynamics of the key economic indicators, 2005–2021

Source: constructed by the authors based on the World Bank statistics

Rys. 2. Dynamika kluczowych wskaźników ekonomicznych w latach 2005–2021

tion of the Paris Agreement, in July 2021, Ukraine set a rather ambitious climate goal – reducing CO₂ emissions to 35% of the 1990 emissions level.

We can observe that CO₂ emissions since 2015 do not exceed the limit determined by Ukraine's nationally determined contribution to the Paris Agreement. However, this does not speak about the efficient modernization of the energy sector or about the success of the energy-efficient modernization of the housing stock. Such results are a consequence of the fact that since 2014, the territory of Donetsk, Luhansk districts and Crimea has not been taken into account in emissions calculations. Specifically, in the Donetsk and Luhansk regions the largest number of industrial enterprises and coal mines are concentrated, which causes the largest number of emissions. The process of reducing emissions will be accompanied not only by technological risks but also by the success of the state's political steps in returning the occupied territories. The consequences of the war in 2022 only complicate the situation because the front line is changing and other cities of Ukraine are occupied. Furthermore, there is a risk of not fulfilling the set goal, since the return of uncontrolled territories in itself does not change the energy situation for the better and, in particular, does not affect CO₂ emissions.

Hypothesis 1 was partially confirmed. This is due to the fact that the consequences of the 2022 crisis are currently difficult to assess. The occupation of the territories of Ukraine does not make it possible to objectively and fully assess the impact of energy efficiency measures on the economy. Furthermore, the implementation of energy efficiency measures and the attraction of investments in the development of energy efficiency had a positive impact on the country's economy after previous crises.

The second hypothesis of the study is aimed at assessing the level of influence of the implementation of energy-efficient measures on the socio-economic development of the country in crisis conditions.

Hypothesis 2: government (internal and external) financial stimulation of energy efficiency has a positive effect on the level of socio-economic development in crisis conditions.

To overcome the consequences of the pandemic, the Government of Ukraine took a number of economic and financial measures, in particular, fines for certain violations of tax legislation were canceled for the period from March 01 to the last day of quarantine (except for activities related to excise goods), the deadline for submitting the annual declaration was extended on income and property status, and a moratorium on tax audits was introduced. In addition, the Verkhovna Rada of Ukraine adopted a law on raising the thresholds of the simplified taxation regime, introduced a tax holiday for small and medium-sized enterprises to pay the tax until May 31, 2020, and approved an allowance of up to 300% of the salary of medical personnel who work with patients with COVID-19. Medicines and medical equipment used to treat the coronavirus were exempted from import duty and VAT. At the same time, in order to support the economy during the pandemic, the National Bank of Ukraine softened the monetary policy from June 12, 2020, lowering the discount rate to 6%. Banks were also recommended to refrain from paying dividends until the end of 2020 in order to increase the margin of safety of financial institutions. The National Bank of Ukraine and the EBRD agreed to create a currency swap mechanism worth 500 million US dollars to support the real economy and strengthen the macro-financial stability of Ukraine (IMF).

In the wake of the pandemic, the energy sector has become more vulnerable and has suffered significant losses due to reduced energy consumption. The crisis caused a deepening of the shortage of funds to cover the operating costs incurred by electricity producers (Cabinet of Ministers of Ukraine 2020).

As of 2021, the COVID-19 pandemic has significantly negative environmental trends in the world, as most countries have not used the pandemic as an opportunity to make a green energy transition. The three most populous countries (China, the USA and India) have slightly improved their performance due to the launch of a carbon market (China) and investment in clean energy (India). Countries with developing economies has also not taken advantage of this opportunity, primarily due to weak regulatory oversight. Some EU countries and Canada demonstrated better results in energy transition. Furthermore, the total amount of global fiscal incentives that had an ecological direction is only 4.8 trillion US dollars (respectively, fiscal incentives that did not take into account the ecology – 12.4 trillion US dollars) (Beyer and Vandermosten 2021). The experience of successful countries in responding to crises shows the need to develop an appropriate package of measures at the very beginning of a crisis, even in the face of uncertainty about its duration and the impossibility of estimating the final amount of losses.

According to the forecasts of the World Bank, the economy of Ukraine will shrink by 45% in 2022 (World Bank 2022) due to the destruction of infrastructure, the stoppage of business, the inhibition of investment activity, capital outflow, etc.

According to the survey of the European Business Association, in March 2022, 42% of enterprises completely stopped their work, only 13% worked at their normal level, and the remainder suspended their activities (Melnyk 2022). According to the latest research, in the two months since the start of the full-scale war in Ukraine, about 50% of new businesses have

been registered compared to the same period in April 2021. This indicates a faster adaptation of society and business to war conditions than to the COVID-19 pandemic (29% more new businesses were registered in 2022 than in the same period of 2020) (Revival of Ukrainian business in war conditions: analytics for two months). In order to support business activity and stimulate enterprises to work in this extremely difficult period, the Government of Ukraine has reduced the tax burden, particularly through the introduction of the following strategies: the taxation system has been simplified, the rates of the single tax have been reduced to 2% of the turnover without VAT, taxpayers of first and second groups have been made exempt from paying the single tax and separate tax benefits have been introduced for enterprises that are located or were located in the territories where hostilities are / were conducted or which were occupied.

Now it is impossible to estimate the final amount of losses, but according to the Prime Minister of Ukraine, the daily costs of the state budget related to the war amount to about 2 billion UAH, and losses related to the destruction of infrastructure are estimated to be at up to 4 billion US dollars per day. As a result of the joint work of the KSE Institute, government bodies and partner organizations within the framework of the activities of the National Council for the Recovery of Ukraine from the Consequences of the War, the amount of direct documented damage to infrastructure was determined to be 110.4 billion US dollars, of which direct costs in energy constitute 1.8 billion US dollars (Russia will pay the project of collecting, evaluating, analyzing, and documenting information on direct losses to civilian infrastructure in connection with Russian aggression).

The crisis of 2008–2010 and the COVID-19 pandemic showed that one of the effective ways to get out of the crisis and overcome its consequences is the introduction of fiscal incentives, particularly within the energy sector. Thus, increasing energy efficiency is associated with the need for low-carbon growth, which includes increasing investment activity in the areas of education, industrial development and, of course, improving social security. The direction of investments in the field of transport, infrastructure and industry enables not only the overcoming of the consequences of the crisis, but also the achievement of the necessary climate goals, which are constantly emphasized by Ukraine's partners in the EU. The criteria for investment projects in particular included the condition of their compliance with environmental legislation and safety for the environment. Therefore, investment in the development of renewables was a priority. Undoubtedly, the war and overcoming its consequences will result in adjustments to both the criteria for selecting energy projects and to the priority of the spheres of their direction. Thus, Hypothesis 2 is confirmed. During crises, state financial stimulation of energy efficiency has a positive effect both on the economy's overcoming of the crisis and on the general socio-economic level.

The third hypothesis of the study is aimed at researching the existing fiscal incentives to support energy efficiency and their impact on GDP.

Hypothesis 3: fiscal incentives to support energy efficiency have a positive effect on the growth rate of real GDP.

Based on the empirical experience of the domestic practice of the last decade, it is possible to emphasize that the main fiscal incentives for increasing the energy efficiency of Ukraine's economy during the recovery period primarily include:

- ◆ the creation of an attractive investment climate by adopting changes to tax legislation;
- ◆ the popularization of the use of energy-efficient technologies by providing subsidies from the state budget and imposing restrictions on energy-intensive products (including those that increase CO₂ emissions);
- ◆ the reduction of the VAT rate for energy-efficient goods;
- ◆ the rejection of the Feed-in tariff in favor of a Feed-in-premium;
- ◆ the introduction of competitive conditions to stimulate the development of renewables;
- ◆ the reduction of the tax burden on crediting energy-efficient measures;
- ◆ the use of fiscal incentives for the development of conserved natural gas wells;
- ◆ the decentralization of energy;
- ◆ the enhanced development of hydrogen energy in order to reduce the economy's dependence on fossil fuels;
- ◆ the reforming of energy markets, as well as their de-monopolization;
- ◆ the resolution of the issue of significant debt in the energy market;
- ◆ the introduction of energy audit and energy management at enterprises;
- ◆ the provision of state support for the implementation of energy-efficient mechanisms at enterprises;
- ◆ the channeling of the CO₂ tax to increase energy efficiency by enterprises (targeted use of funds).

Due to the circumstances in recent years, Ukraine has clearly intensified its goals in the energy and fiscal sphere to ensure the above-mentioned measures. Thus, for the last two years, the Government of Ukraine has been taking many steps to contain the economic crisis, the consequences of which will be felt by every citizen. Considering that the majority of the population now faces a constant risk to life, a significant part of the population have lost their jobs or the opportunity to live where they lived before the war, the Cabinet of Ministers of Ukraine adopted Resolution No. 502 of April 29, 2022, which recommended the following measures: not increasing tariffs on thermal energy (its production, transportation and supply), including tariffs for thermal energy produced using alternative energy sources, services for the supply of thermal energy and the supply of hot water; providing centralized water supply and centralized water drainage for the population and applying them to the consumer (population) at the level of tariffs applied as of February 24, 2022; not increasing tariffs for gas and its distribution, heat and hot water. It was also stated that compensatory mechanisms will be defined, which will allow maintaining the appropriate level of critical infrastructure and its restoration.

On July 4, 2022, in the Swiss city of Lugano, the Ukraine Recovery Plan was presented, which is based on five core guiding principles: starting now and ramping up gradually; growing prosperity in an equitable way; integration in EU; building back better at national and regio-

nal scales; enabling private investments. The Ukraine Recovery Plan includes 850 projects that concern all spheres of the economy. The term of implementation of the plan is ten years, during which the annual GDP impact will be more than 7%. According to the plan, the Economic Complexity Index and the Human Capital Index correspond to the top twenty-five countries. The necessary project financing is estimated at more than 750 billion US dollars. After the presentation in Lugano, the plan should be finalized by experts, in particular, by the National Council for the Recovery of Ukraine from the Consequences of War, established by the President of Ukraine.

The EU, assessing the effectiveness of the implementation of the Association Agreement with the EU, noted progress in reforms in the areas of energy efficiency and low-carbon development. In 2021, the Law of Ukraine “On Energy Efficiency” was adopted, which aims to implement the provisions of the EU Energy Efficiency Directive and the EU Ecodesign Directive. Currently, in compliance with the specified law, the State Agency of Energy Efficiency and Energy Saving of Ukraine is working on the following measures: the implementation of energy audit and energy management system; the implementation of the national energy efficiency monitoring system; the development of the energy service; the implementation of eco-design and energy labeling of energy-consuming products; the development of local energy planning; the ensuring of constant improvement of energy efficiency of final energy consumption, etc.

In addition to the mentioned steps, the Government of Ukraine has adopted a number of important decisions that will contribute to the implementation of energy-efficient measures in the housing sector in the field of heat supply and others, which will contribute to the reconstruction of the country after the end of the war. In particular, we are referring to the long-term strategy for the thermal modernization of buildings up until 2050 and the concept of the state target program to support the thermal modernization of buildings for the period 2022–2030. The specified documents provide for the establishment of the target goal of thermal modernization by 2030, 2040 and 2050, the definition of strategic goals, priorities and tasks for their achievement, particularly state incentive measures. Concepts of state target programs for the energy modernization of centralized heat supply systems of settlements and water supply and drainage systems up until 2030 envisage measures to modernize such systems capable of reducing energy and water losses by 50% or more.

Investments in the field of energy are currently driven by such factors as: rising prices for energy resources, economic uncertainty and the growing importance of strengthening energy security. It is expected that in 2022, global investments in energy will grow by 8% and reach 2.4 trillion US dollars, which is due primarily to the military aggression of the Russian Federation and its influence on global energy. As previously mentioned, investments in energy are mostly directed to the implementation of projects related to the development of renewable and alternative energy sources. Investments in fossil fuels, such as oil, gas, or coal, have decreased significantly in recent years. Additionally, the average annual growth rate of investments in clean energy during the five years after the signing of the Paris Agreement in 2015 was just over 2% in 2019, according to IEA analytics. During the pandemic, the amount of such investments increased significantly up to 12%. The highest levels of clean energy investment in 2021 were recorded in China (380 billion US dollars), the European Union (260 billion US dollars) and the United States (215 billion US dollars) (IEA

2022d). The primary field in which projects related to energy efficiency are implemented is construction. According to the UNEP, construction accounts for about 37% of global CO₂ emissions. The IEA estimates that the total investment in construction is expected to rise to approximately 5.4 trillion US dollars in 2050 (4.9 trillion US dollars in 2017).

After the end of the war, the Government of Ukraine will face a very wide range of problems that will need to be solved in order to stabilize the economy. The financial instruments that can initially be used by the government to attract investments aimed at increasing the energy efficiency of buildings (a significant part of which is destroyed and in need of restoration) include: the use of equity financing, the provision of equipment for rent, the provision of commercial loans, grant financing, the creation of private and public funds for energy efficiency, subsidization, the issuing of “green” bonds.

In order to attract investors, not only are judicial reform and the fight against corruption, which are constantly emphasized by Ukraine’s Western partners, necessary but also a competent, well-thought-out fiscal policy. Fiscal incentives should encourage investors to invest in low-carbon energy projects, and the state should guarantee the safety of their implementation.

In order to successfully attract investment in the development of the energy sector of the economy and the development of energy efficiency, it is necessary to use fiscal incentives, in particular, by providing tax benefits, such steps will in turn contribute to both the creation of new jobs and economic growth in the post-crisis period. An example of one of the solutions offered by Ukraine in the context of reducing the demand for energy resources, in particular gas, is to adjust the fiscal policy by:

- ◆ the targeting of exceeding the established basic level of consumption and distribution of income among households/enterprises most affected by higher electricity prices;
- ◆ the combination of high domestic and industrial gas prices with compensatory payments, which will stimulate the transition to the use of alternative fuels ([The International Working Group on Russian Sanctions 2022](#)).

In addition, an increase in taxes on the use of fossil fuels and the introduction of climate crowdfunding are also possible instruments. An important step for the implementation of the energy transition and overcoming the consequences of crises is the revision of the subsidy policy. In 2017, global energy subsidies rose to 5.2 trillion US dollars, representing 6.5 percent of total global GDP. According to recent research by the International Institute for Sustainable Development, only 10–30% of fossil fuel subsidies will pay for the global clean energy transition ([United Nations Industrial Development Organization 2020](#)). In 2020, the situation was worsened by the drop in oil prices as a reaction to the pandemic. However, world oil prices are already hitting record highs as a result of the war in Ukraine, just as natural gas prices are rising. Subsidization can be used as an effective mechanism of government influence on market prices.

Even despite the crisis, Ukraine’s GDP has been growing in recent years. At the same time, the dynamics of changes in energy intensity decrease. Therefore, it can be concluded that the introduction of energy-efficient technologies and promotion of energy efficiency by the government has a positive effect (among other things) on GDP growth. In recent years, Ukraine faced various crises and did not pay enough attention to the modernization of the energy system, first

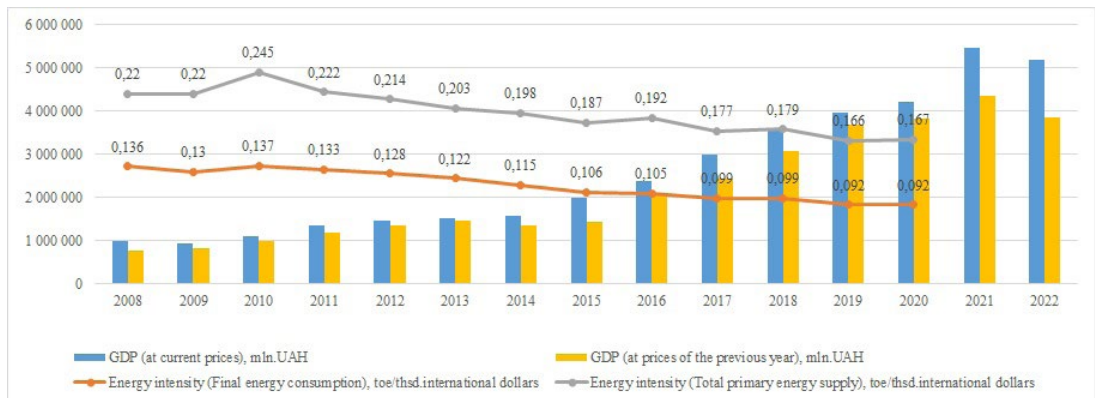


Fig. 3. Dynamics of the GDP and Energy Intensity, 2008–2022

Source: constructed by the authors based on the State Statistics Service of Ukraine

Rys. 3. Dynamika PKB i energochłonności w latach 2008–2022

of all, to the energy infrastructure. Lack of funds and insufficient attention from investors make rapid changes in energy impossible. However, Ukraine has taken significant steps in reforming approaches to its functioning, as well as in revising existing legislation and implementing European approaches and norms.

The European Union supports Ukraine in its struggle for independence. The European Investment Bank allocated another amount of targeted credit to Ukraine for the repair of damaged infrastructure and the restoration of critically important projects – 1.59 billion euros. This is the second loan package within the framework of the so-called emergency measures of solidarity with Ukraine, which was prepared in cooperation with the European Commission. The European Investment Bank noted that the aid package consists of two blocks: the first is immediate financing to the amount of 1.05 billion euros, which should help the government of Ukraine cover priority short-term needs, including supporting urgent energy and energy efficiency measures in preparation for the heating season; the second is the resumption of the implementation of the European Investment Bank projects in Ukraine to the amount of 540 million euros. As of July 1, 2022, the total amount of the European Investment Bank financial assistance amounted to more than 7.5 billion euros. To reduce dependence on Russian energy resources, in March 2022, the IEA proposed a document that is actually recommendations for EU citizens on what specific steps they can take to overcome the crisis. The IEA in cooperation with the European Commission has calculated that if all EU citizens follow the specified recommendations, it will help save 220 million barrels of oil per year and about 17 billion cubic meters of gas (IEA 2022c).

Successful decentralization is an important factor in improving energy efficiency in Ukraine. Rational energy consumption leads to a reduction in the costs of local budgets and allows the community to save funds that can be directed to other needs in the future. In 2020, community budget expenditures on heat supply, water supply, electricity, natural gas, and payment for other energy services accounted for an average of 3–8% of total expenditures. Additionally, most com-

munities (59%) have not implemented energy saving incentive systems (*Research of energy budgets of Ukrainian communities 2021*). There are many opportunities for communities to improve energy efficiency, including the use of energy service companies (ESCOs). The practice of working with such companies is widespread in Europe and is available in Ukraine. Ukraine also has the “Agreement of Mayors”, which is an initiative of a voluntary association of authorities of various levels with the aim of increasing energy efficiency and stimulating the use of renewables (an initiative launched by the EU). A community that joins the Agreement of Mayors receives various forms of financial support: receiving grants from the World Bank, the US Agency for International Development, loans from the EBRD and the EIB, etc.

The EU considers energy efficiency to be one of the key factors in achieving climate goals and making the energy transition. In accordance with this, many efforts of the EU countries are aimed at the implementation of various initiatives to improve energy efficiency, first of all increasing the energy efficiency of buildings, which account for 40% of energy. In Ukraine, the share of households in final energy consumption is about 30%. Furthermore, the largest share in the structure of final energy consumption by households is heating. This indicates that measures for the thermal modernization of buildings would help to significantly reduce the level of energy use by households.

In 2020, expenditures on energy modernization of public buildings and infrastructure facilities from community budgets amounted to UAH 1,151.3 million (79% of which were loan and grant funds) (*Research of energy budgets of Ukrainian communities 2021*).

In 2022, EU countries faced an energy crisis, the main manifestation of which was an increase in energy prices. In order to help their citizens withstand the consequences of such an increase, the governments of the countries have adopted funding decisions to protect consumers. Thus, 7.4% of GDP was allocated to Germany, 3.7% to France, 5.2% to Italy, 3.8% to Great Britain, 2.2% to Poland, and 4% to Slovenia. Among the measures taken by these governments, the following can be distinguished: a reduction of the tax burden (primarily VAT), the regulation of retail prices, the subsidization of vulnerable segments of the population, business support (*Sgaravatti et al. 2021*).

The development of renewables can also help to increase energy efficiency. In Ukraine, the share of renewables in the total supply of primary energy is a growing trend. Ukraine’s energy strategy takes into account world trends towards decarbonization and emission reduction, so the state’s energy policy is aimed at attracting investments in the development of renewables, the implementation of new projects in wind generation and the use of solar energy.

Ukraine has significant potential for increasing energy efficiency. The realization of this potential gives the country significant advantages. The successful experience of European countries can serve as a guide for the implementation of such projects as well as help in post-war reconstruction.

Hypothesis 3 was fully confirmed. Fiscal incentives to support energy efficiency have a positive effect on real GDP growth rates in the long term. Fiscal incentives to support energy efficiency can stimulate increased investment in sectors that promote energy efficiency, such as renewable energy and energy management. This can increase output and increase consumer spending, which increases real GDP. Furthermore, the implementation of energy-efficient practices creates new jobs, which in turn has a positive effect on the country’s economy, in particular on the GDP.

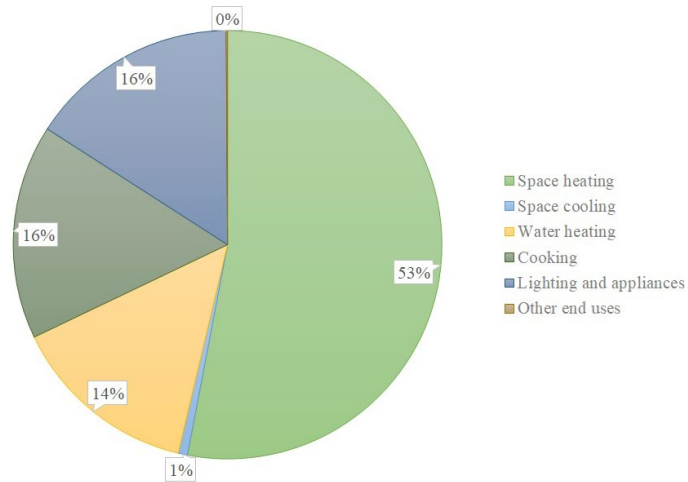


Fig. 4. Final energy consumption in households in 2020

Source: constructed by the authors based on the State Statistics Service of Ukraine

Rys. 4. Finalne zużycie energii w gospodarstwach domowych w 2020 r.

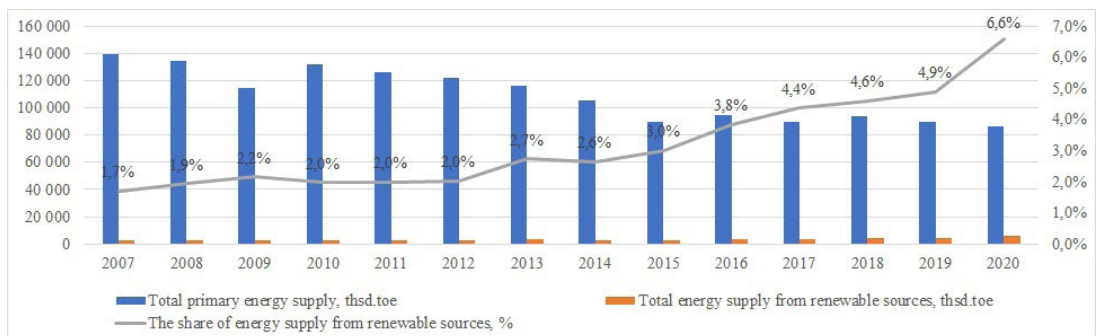


Fig. 5. The share of energy supply from renewable sources in total primary energy supply, 2007–2020

Source: constructed by the authors based on the State Statistics Service of Ukraine

Rys. 5. Udział dostaw energii ze źródeł odnawialnych w całkowitej podaży energii pierwotnej w latach 2007–2020

Conclusions

Since 1991, Ukraine has faced several economic crises. Energy markets are currently experiencing extreme volatility caused by geopolitical tensions. By 2050, electricity, hydrogen, and synthetic fuels may account for up to 50% of the energy mix, and renewable generation may

reach 80–90% of the world’s energy balance due to increased rates of construction of solar and wind farms. Furthermore, in the next five years the demand for oil will increase and reach its peak. Additionally, despite the ambitious goals of countries to achieve carbon neutrality, global warming is projected to reach 1.7 degrees Celsius by 2100. The investment growth rate will be about 4% per year, and the annual investment in energy saving will be up to 1.6 trillion US dollars. EBIT in decarbonization-related technologies is also expected to grow by 5% annually and outpace growth in underlying investments (McKinsey & Company 2022). In all scenarios, the demand for natural gas is predicted to grow by 10% over the next decade.

In order to overcome crises and ensure stable economic growth, it is important and necessary to change the approach to energy policy, which should initially be focused on the development of renewables. Currently, the growth of the production of “green” energy in Ukraine is impossible due to the ongoing military invasion and the logical fears of investors. In other words, it is simply impossible to implement renewables investment projects at the moment. Furthermore, it is necessary to review the current legislation, in particular with regard to the “green tariff” (*Feed-in tariff*). The current tariff formation model should be replaced by *Feed-in-premium*, which would create market competition between producers. The introduction of a new approach to setting the tariff could also be one of the steps to solve the problem of significant debt in the market, which was formed as a result of the action of the “green” tariff. In addition to the green tariff, all fiscal measures to ensure energy efficiency should be effectively used to restore our country’s economy,

Ukraine has faced the biggest crisis of the entire time of its independence. Despite significant help from EU countries and the governments of the USA, Canada and Great Britain, the country, represented by the Cabinet of Ministers of Ukraine, the Verkhovna Rada of Ukraine and all central authorities, must unite its efforts and direct them to achieve a single goal – a rapid victory by achieving complete independence, which will be the first step in building a strong and stable economy.

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Anastasiia HRYHORENKO, Hanna KOTINA, Maryna STEPURA, Hanna ZAVYSTOVSKA

Bodźce fiskalne do poprawy efektywności energetycznej w ramach polityki ożywienia gospodarczego: podejście empiryczne Ukrainy

Streszczenie

Gospodarka światowa nieustannie boryka się z kryzysami, które negatywnie na nią wpływają. Każdy kryzys stawia przed nią nowe wyzwania i z jednej strony hamuje jej wzrost, z drugiej może stać się potężnym bodźcem do rozwoju i przemyslenia fundamentalnych podejść do jej budowy. Przeprowadzenie analizy i ustalenie zależności między sytuacją gospodarczą a stanem sektora energetycznego pozwala nie tylko przewidywać przyszłość, ale także opracować konkretne działania zapobiegające kryzysom lub zmniejszające ich negatywne skutki. Jednocześnie ustalenie i ocena relacji między kluczowymi wskaźnikami ekonomicznymi i energetycznymi, z których głównym jest zdecydowanie energochłonność PKB, pomoże zrozumieć, w jaki sposób poprawa bezpieczeństwa energetycznego wpłynie na sytuację gospodarczą kraju. Uogólnienie doświadczeń Ukrainy w odbudowie gospodarki po największym kryzysie stwarza podstawę do dalszych badań w zakresie zarządzania energią, zarządzania kryzysowego, ekonomii oraz budowy polityki inwestycyjnej. Odbudowa Ukrainy po wojnie ma potencjał, by stać się najważniejszym bodźcem rozwoju i wzrostu gospodarczego tego kraju. W czasie kryzysu bardzo ważne jest zwrócenie uwagi na bezpieczeństwo energetyczne. W szczególności konieczne jest zapewnienie dywersyfikacji źródeł energii przy uwzględnieniu ich rosnących kosztów. Rynki energii doświadczają obecnie skrajnej niestabilności spowodowanej napięciami geopolitycznymi, co wymaga dodatkowej uwagi przy opracowywaniu i wdrażaniu strategicznych wytycznych dla trwałego ożywienia gospodarczego na Ukrainie.

Słowa kluczowe: efektywność energetyczna, energochłonność, PKB, bezpieczeństwo energetyczne, kryzys finansowy