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## Energy poverty leap during the pandemic: the case of Ukraine

**ABSTRACT:** As recent studies showed, the post-communist countries have relatively the highest level of energy poverty in Europe. The poorest of them still are not explored. So, the authors decided to study this problem for Ukraine as one of the largest and poorest post-communist countries in Europe. This Eastern European country experienced a number of challenges before the pandemic, including a war with Russia in the east of the country, high external debt, high energy intensity and low added value of the economy. The purpose of this study is to measure how deep the energy poverty problem in Ukraine is and how it changed during the COVID-19 pandemic. Applying selected quantitative and financial indicators, the authors showed the problem of energy poverty in Ukraine remained acute at the beginning of 2020, especially in terms of heating. Moreover, its level in Ukraine was three times higher than the average level for the all the EU countries. Furthermore, in 2020, during

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the pandemic, there were drastic increasing arrears of households on utility bills that meant a new leap of energy poverty in Ukraine. This study did not search for the causes of the identified leap in energy poverty, which apparently connected with the global and local economic and social consequences of the pandemic. However, it revealed the depth of this problem and the lower impact of the nature factor (air temperature) on energy poverty during and after the COVID-19 pandemic. Further research is required to identify the underlying drivers and develop possible solutions to this problem in Ukraine and other European countries suffering from high energy poverty.

KEYWORDS: energy poverty, arrears, households, pandemic, Ukraine

## Introduction

The COVID-19 pandemic has shown how governments and politicians are socially responsible and able to lend a helping hand to citizens and businesses in need. However, it identified a number of challenges in health systems (McGuire et al. 2020), security (Ma et al. 2021) and other important areas of life support. Some countries turned out to be more disciplined, honestly observing quarantine restrictions. The others showed disobedience, which negatively affected the health of fellow citizens. However, the main problem of the pandemic is saving the balance between economic interests (Susskind and Vines 2020) and ensuring the safety of the society (Gostin and Wiley 2020). Unfortunately, not all states have coped with this problem. Countries with high levels of poverty have become especially vulnerable (Cénat 2020; Pereira and Oliveira 2020), in which already before the pandemic it was difficult for people to pay for utilities (Buheji et al. 2020). But when hotels, shops, restaurants, cafes, hairdressers, other businesses close down, and the state is not ready to provide adequate compensation to people who lose their jobs, most of the population is on the verge of survival, not getting what they need.

Ukraine has become one of these countries. This Eastern European country experienced a number of challenges before the pandemic, including a war with Russia in the east of the country (Robinson 2016), high external debt (But et al. 2020), high energy intensity (Pysar et al. 2020) and low added value of the economy (Bessonova et al. 2015). As recent studies show (Goncharuk et al. 2019), in 2018 most of the Ukrainian households were constrained to apply for subsidies from the state to pay for utilities. At the same time, the state's tariff policy contributed to the destruction of the middle class, in fact, obliging it to pay the highest price for energy and gas (Goncharuk and Cirella 2020), considering the natural gas is the main resource for heating in Ukraine (Goncharuk and Lo Storto 2017). Apparently, with the introduction of the lockdown in the spring of 2020, the middle class continued to lose its positions like the major part of the economy (Ceylan et al. 2020). However, cheaper energy resources after the pandemic's beginning (Fig. 1) could somewhat brighten the overall picture, at least in terms of reducing energy poverty.

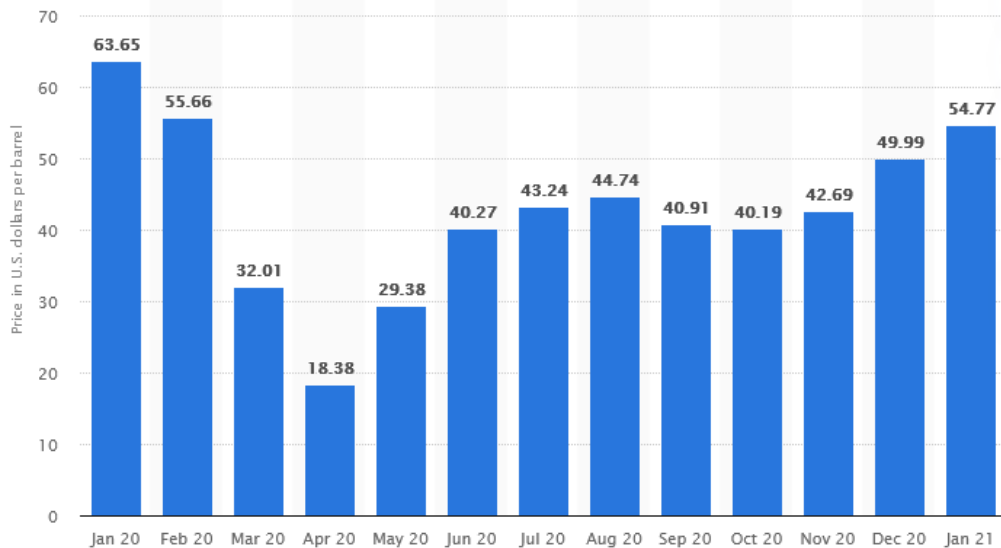


Fig. 1. Average monthly Brent crude oil price from January 2020 to January 2021 (in U.S. dollars per barrel)  
Source: Statista 2021

Rys. 1. Średnie miesięczne ceny ropy Brent od stycznia 2020 do stycznia 2021 roku (w dolarach amerykańskich za baryłkę)

Since crude oil and natural gas prices usually move together in the same direction (Tiwari et al. 2019), most energy prices for households seemed to be lower during the 2020 pandemic year. Hence, it would be logical to assume that in the conditions of decreasing prices for energy resources, energy poverty should also decrease. But has there been a real reduction in energy poverty during the 2020 pandemic? In this article, we tried to find an answer to this question by analyzing the official statistics and surveys of Ukrainian households.

## 1. Literature review

As Bouzarovski (2014) wrote, a situation in which a household lacks a socially and materially necessitated level of energy services can be considered as energy poverty. This is predicated upon low household incomes, high energy prices, inefficient buildings and appliances, and specific households energy needs (electricity, gas, heating, other utilities). In Europe, these conditions are peculiar to the Southern, Central and Eastern countries, where energy poverty tends to affect groups who are already vulnerable to income poverty.

As it turned out, the problem of energy poverty has been studied relatively recently and mainly for Ireland and UK (Bouzarovski 2014; Castaño-Rosa et al. 2020). So, only in recent years has it received a serious impetus to studying and policy-making in continental Europe (EU 2020).

The recent studies highlighted the relatively higher level of energy poverty at the Southern (Anteprima et al. 2020) and post-communist Europe (Jigla et al. 2020), i.e. Bulgaria (Jeliazkova et al. 2020), Czech Republic (Lehotský 2020), Hungary (Kőszeghy 2020), Lithuania (Murauskaitė 2020), North Macedonia (Stojilovska 2020), Poland (Sokołowski et al. 2020), Romania (Sinea 2020), Slovakia (Dokupilová and Filčák 2020), Slovenia (Živčič and Tkalec 2020) and Eastern Germany (Biermann 2020). Despite the effective transitions over the past three decades, these countries still face major challenges to providing clean and affordable energy to its citizens and renovating existing housing stock. Unfortunately, the problem of energy poverty still is not explored for the poorest post-communist countries like Moldova and Ukraine. As they are not EU member countries, these countries are not covered by the EU commitment to tackling energy poverty by its roots and protecting vulnerable consumers, and an appropriate policy priority in the Clean energy for all Europeans package, adopted in 2019 (EU 2019). Hence, these countries are left face to face with the problem of energy poverty.

According to the results of 2019, the level of inability to keep homes adequately warm for 28 EU countries was 7.0%, and arrears on utility bills – 6.1% (EU-SILC Survey 2019). In Ukraine, these indicators in 2019 were 21.8% and 18.8% respectively (UA Survey 2019). This confirms the depth of Ukraine's energy poverty in comparison with other European countries.

Therefore, we decided to study this problem for Ukraine as one of the largest and poorest post-communist countries in Europe. So, the purpose of this study is to measure how deep the energy poverty problem is in Ukraine and how it changed during and under the COVID-19 pandemic.

## 2. Methodology

As Halkos and Gkampoura (2021) have just found on the case of 28 European countries for 2004–2019 the main energy poverty drivers are the energy prices. Following this logic, the decline in energy prices noted above (see Fig. 1) would lead to a reduction in energy poverty. But did this rule work during the 2020 pandemic? To test this hypothesis, we decided to compare the indicators of energy poverty in Ukraine before the pandemic and during it.

So, the logic of this study is as follows (Fig. 2):

- ◆ at the *first stage* we will measure the level of energy poverty before the pandemic, i.e. at the beginning of 2020 and earlier;
- ◆ at the *second stage* we will track the changes in energy poverty indicators during 2020;
- ◆ at the *third (final) stage* we will try to measure the possible impact of the COVID-19 pandemic on the energy poverty changes by excluding the effect of changing average air tempera-

ture. This will be done using linear regression analysis and the coefficient of determination (Helland 1987) before and during the pandemic.

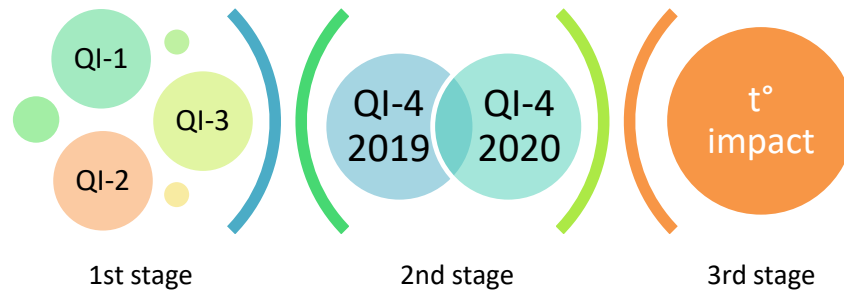


Fig. 2. The main stages of the study

Rys. 2. Główne etapy badania

To measure energy poverty in this study we suggest applying the following quantitative and financial indicators:

- (1) The number of households that are unable to maintain a comfortable temperature in their homes (as a percentage of the total number of households) (QI-1);
- (2) The number of households with the lack of normal living conditions due to lack of funds (as a percentage of the total number of households) (QI-2);
- (3) The number of households with insufficient funds for timely and full payment on utility bills (as a percentage of the total number of households) (QI-3);
- (4) Arrears of households on utility bills (as a percentage of the total amount of utilities consumed) (QI-4).

The first three indicators are annual and will be applied to realize the deepness and trends in energy poverty in Ukraine before the pandemic (in 2007–2019) at a strategic level. The fourth indicator is monthly and will be used to trace possible changes of energy poverty during the pandemic at the tactic level.

### 3. The data

The indicators (1) (2) and (3) will be mined from the household self-assessment of the availability of certain goods and services, which was conducted in 2007–2019 biannually by the State statistics service of Ukraine (UA Survey 2007, 2009, 2011, 2013, 2015, 2017 and 2019) as a survey of 8,000 selected households in Ukraine. They will be used at the first stage of this study.

Indicators (4) will be collected from the official monthly statistics of Ukraine on the state of payment by the households for utilities for 2019 and 2020 (SSSU 2019, 2020). They will be used mainly at the second and third stages of this study.

The data of the average monthly air temperatures for 2019 and 2020 in Ukraine from Meteo (2021) will be used to measure the effect of temperature on the energy poverty.

The descriptive statistics of the sample of selected indicators are described in Table 1.

TABLE 1. Descriptive statistics of the sample of Ukrainian households for 2019–2020

TABELA 1. Statystyka opisowa próby ukraińskich gospodarstw domowych na lata 2019–2020

Indicator	Number of observations	Average	Median	St. dev.
Average monthly air temperature [°C]	24	12.9	11.6	8.142
Number of households that are unable to maintain a comfortable temperature in their houses, as a percentage of the total number of households (QI-1)	7	18.04	16.6	5.791
Number of households with lack of normal living conditions due to lack of funds, as a percentage of the total number of households (QI-2)	7	11.79	9.7	3.699
Number of households with insufficient funds for the timely and full payment on utility bills, as a percentage of the total number of households (QI-3)	7	16.87	16.9	5.263
Arrears of households on utility bills in Ukraine for 2019–2020, billion UAH (QI-4)	24	1.088	−0.450	4.753

## 4. The results

Measuring the level of energy poverty before the pandemic, we tried to reveal any trend in changes of quantitative indicators. So, the changes of indicator (1), (2), and (3) (respectively QI-1, QI-2, and QI-3) from 2007 to 2019 can be viewed in Figure 3.

As can be seen, a downtrend of the percentage of the number of households with lack of normal living conditions due to the lack of funds (QI-2) is visible. Moreover, since 2013, this indicator has not exceed 10 percent, which is undoubtedly a positive trend. This shows that over 90 percent of households in the past 7 years have had the means to maintain adequate living conditions, including a non-leaking roof, dry walls, floors and foundations, and non-rotten windows and floors.

However, unlike QI-2, QI-1 and QI-3 after the fall in 2007–2013 had a drastic growth during 2015–2017. It is these two indicators that, to a greater extent, precisely characterize energy po-

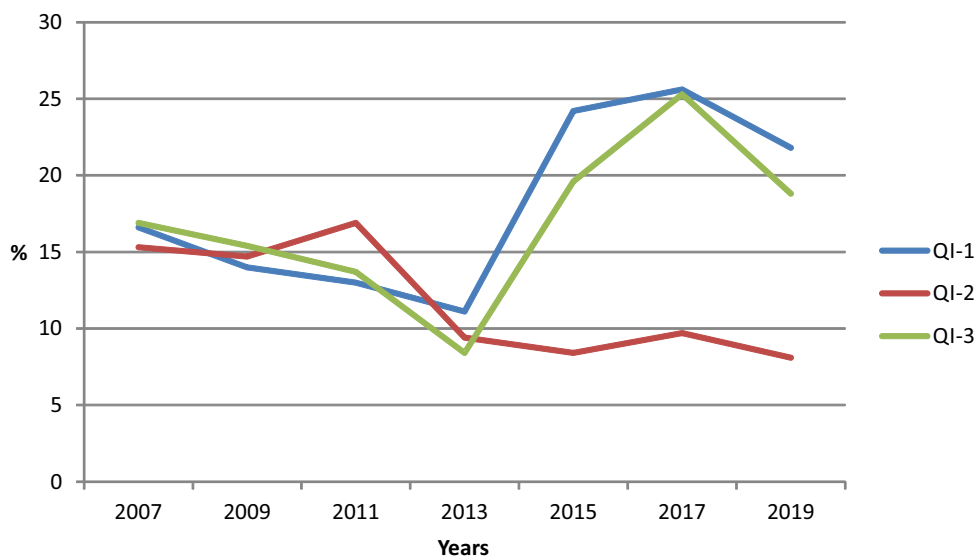


Fig. 3. Changes of quantitative indicators of energy poverty in Ukraine for 2007–2019  
Source: own study based on results of UA Surveys (2007–2019)

Rys. 3. Zmiany ilościowych wskaźników ubóstwa energetycznego na Ukrainie w latach 2007–2019

verty. Comparing similar trends of changes in indicators (1) and (3), it can be seen that starting from 2013 indicator (1) had values 1–4 percent higher. This indicates that in the period 2013–2019, it became much more difficult for Ukrainian households to pay for utilities and especially to maintain a comfortable temperature in their houses. It was heating that became unavailable for more than a quarter of households in the country in 2017. Apparently, the reason for this was the increase in utility (natural gas and heating) tariffs described by Goncharuk and Cirella (2020).

Thus, the first stage of the study showed that, despite the gradual improvement of ability to fund the normal living conditions, the number of households with high energy poverty in Ukraine increased sharply in 2015–2017 and remained very high by the end of 2019. Moreover, in the pre-epidemic 2019, more households (by 6.5%) were able to pay for utilities, but a major part of them (above 50%) did not allow themselves a comfortable temperature in their houses. This indicates that the problem of energy poverty in Ukraine remains acute at the beginning of 2020, especially in terms of heating.

Further, on the second stage, we considered the arrears of households on utility bills, including natural gas supply, district heating and hot water supply, etc. Comparing monthly changes in arrears during 2019 and 2020 (Fig. 4) we found noticeable differences between their values in 2019 and 2020.

As can be seen, seasonal changes of arrears on utility bills in Ukraine bring debt mainly during the cold months, starting from October and until February. Starting from March and until September, there is a negative value of arrears that means a households' overpayment on

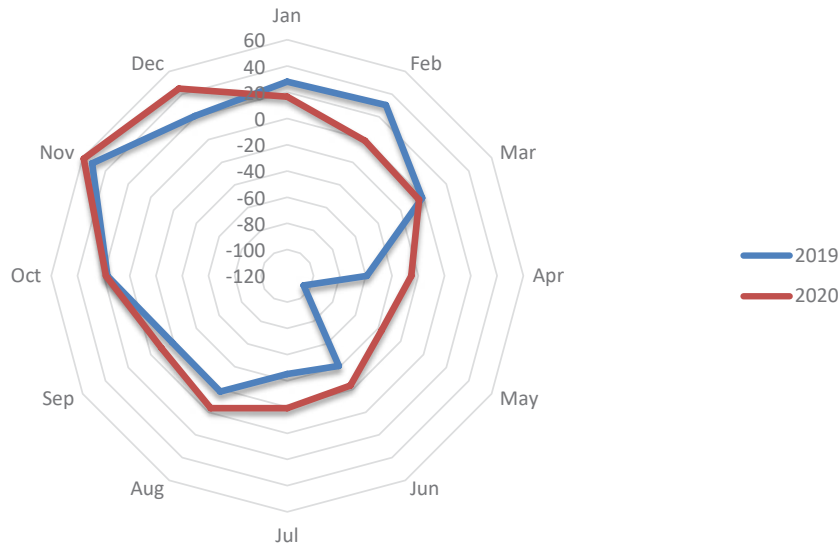


Fig. 4. Arrears of households on utility bills in Ukraine for 2019–2020 [%]  
Source: own study based on the data from SSSU (2019 and 2020)

Rys. 4. Zaległości ukraińskich gospodarstw domowych w płaceniu rachunków za media w latach 2019–2020 [%]

utility bills. So, in May 2019, households paid a double amount of the utility bills. However, in May 2020, this overpayment was much lower (37% only). Apart from this, during all the warm months (from April to September) the overpayments in 2020 were much lower than in 2019. Moreover, the first months of 2020 (from January to March) the level of arrears was much lower than in 2019. However, during the pandemic months of 2020, the level of arrears in 2020 was higher and the level of arrears was much lower than the same periods in 2019.

Realizing that the weather factor significantly affects the total amount of utility bills (mainly on heating), we decided to evaluate the effect of the influence of air temperature on the arrears. So, thirdly, we tested the relationship between average monthly air temperature and arrears of households on utility bills (with one-month lag) before and during the COVID-19 pandemic (Fig. 5).

We compared the data on arrears with a one-month lag, since utility bills in Ukraine usually come to households in the next month after receiving services. So, the relationship began to weaken during the pandemic, i.e. the impact of temperature on arrears became lower (from 0.7778 to 0.6353). Apart from this, the temperature at which arrears appear on average has increased markedly: from 10.4°C before the pandemic to 12.6°C during the pandemic. These mean the other factors have increased their influence on the arrears of households on utility bills during the COVID-19 pandemic.

Thus, the entire monthly level shift reflects on annual indicator (4) that increased from 6% in 2019 up to 11% in 2020. So drastic increasing arrears of households on utility bills mean a presence of the leap of energy poverty in Ukraine during the COVID-19 pandemic. Considering the



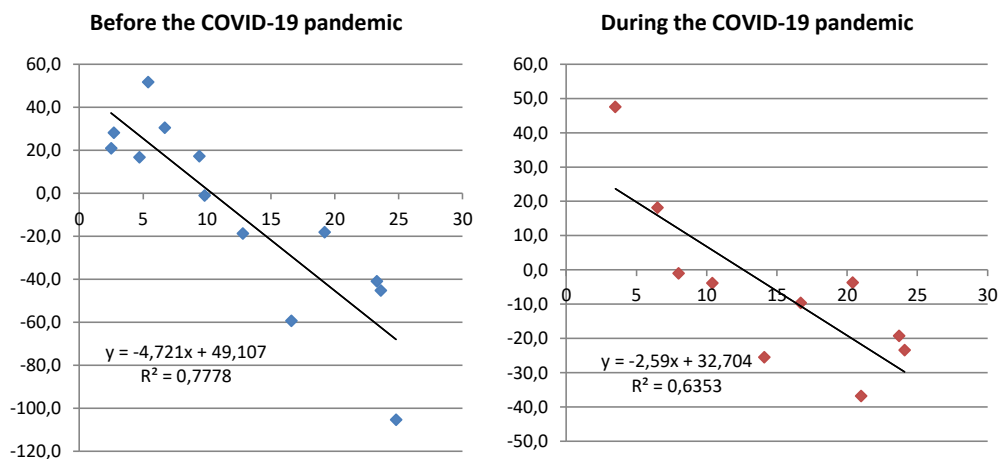


Fig. 5. Relationship between arrears of households on utility bills and average air temperature in Ukraine before and during the COVID-19 pandemic (2019–2020)

Source: own study based on the data from SSSU (2019 and 2020) and Meteo (2021)

Rys. 5. Zależność między zaległościami gospodarstw domowych w płaceniu rachunków za media a średnią temperaturą powietrza na Ukrainie przed i w trakcie pandemii COVID-19 (2019–2020)

revealed weakening of the impact of air temperature, it is obvious that such a leap was caused by a combination of the other factors that arose during the pandemic. These can be financial, economic, behavioral, and other factors that endogenously or exogenously contribute to the growth of arrears of households on utility bills and induce a leap of energy poverty in Ukraine. Given the still insignificant period for the statistically significant time series for a multivariate analysis, a deeper study will be conducted later. However, apparently, as before, most of the arrears of households on energy utility bills during the pandemic were arrears on heating and hot water that confirm a high pressure of heating tariffs on Ukrainian households. Moreover, utility tariffs continued their growth in early 2021 that has not yet given a chance at reducing energy poverty in Ukraine in the near future.

## Conclusions

The measuring quantitative and financial indicators showed a depth of energy poverty problem in Ukraine. If from 2007 to 2013 energy poverty in this country was gradually decreasing, later it has grown dramatically and remains at a high level. Moreover, its current level in Ukraine is three times higher than the average level for 28 EU countries.

The features of the change in energy poverty before and during the COVID-19 pandemic in Ukraine were revealed. Thus, despite the gradual improvement of the ability to fund normal living conditions, the number of households with high energy poverty in Ukraine increased sharply in 2015–2017 and remained very high by the beginning of 2020. Moreover, in the pre-epidemic 2019, more households were able to pay for utilities, but a majority did not allow themselves a comfortable temperature in their houses. So, the problem of energy poverty in Ukraine remained acute at the beginning of 2020, especially in terms of heating. Unfortunately, further in 2020, during the pandemic there were drastic increasing arrears of households on utility bills up to 11% that mean a new leap of energy poverty in Ukraine.

As defined, during the pandemic, the impact of air temperature on the arrears of households on utility bills has become lower (from 0.7778 to 0.6353). Moreover, the temperature at which arrears appear on average has increased markedly. These mean the other factors (financial, economic, behavioral, etc.) have increased their influence on the arrears of households on utility bills during the COVID-19 pandemics.

This study did not search for the causes of the identified leap in energy poverty, which apparently connected with the global and local economic and social consequences of the pandemic. However, it revealed the depth of this problem and the lower impact of the nature factor (air temperature). Further research is required to identify the underlying drivers and develop possible solutions to this problem in Ukraine and other European countries suffering from high energy poverty.

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## Wzrost ubóstwa energetycznego podczas pandemii: przypadek Ukrainy

### Streszczenie

Jak pokazały ostatnie badania, kraje postkomunistyczne mają relatywnie wysoki poziom ubóstwa energetycznego w Europie. Te kraje nadal nie są badane. Dlatego autorzy postanowili zbadać ów problem na przykładzie Ukrainy, jako jednego z największych i najbiedniejszych krajów postkomunistycznych w Europie. Ten wschodnioeuropejski kraj doświadczył wielu wyzwań przed pandemią, w tym wojny z Rosją na wschodzie kraju, wysokiego zadłużenia zagranicznego, dużej energochłonności i niskiej wartości dodanej gospodarki. Celem badania jest zmierzenie, jak głęboki jest problem ubóstwa energetycznego na Ukrainie i jak zmienił się podczas pandemii COVID-19. Posługując się wybranymi wskaźnikami ilościowymi i finansowymi, autorzy wykazali, że problem ubóstwa energetycznego na Ukrainie na początku 2020 r. był problemem dotkliwym, zwłaszcza w zakresie ogrzewania. Jego poziom na Ukrainie był trzykrotnie wyższy niż średni poziom dla wszystkich krajów UE. Co więcej, w 2020 r. podczas pandemii drastycznie narastały zaległości gospodarstw domowych w opłacaniu rachunków za media, co oznaczało nowy skok ubóstwa energetycznego na Ukrainie. W niniejszym opracowaniu nie poszukiwano przyczyn zidentyfikowanego wzrostu ubóstwa energetycznego, który najwyraźniej wiązał się z globalnymi i lokalnymi ekonomicznymi i społecznymi konsekwencjami pandemii. Ujawniło ono jednak głębię problemu i udowodniło, że wpływ czynnika przyrodniczego (temperatury powietrza) na ubóstwo energetyczne w trakcie i po pandemii COVID-19 nie był zbyt istotny. Konieczne są dalsze badania w celu zidentyfikowania przyczyn i opracowania możliwych rozwiązań tego problemu na Ukrainie i w innych krajach europejskich dotkniętych wysokim ubóstwem energetycznym.

SŁOWA KLUCZOWE: ubóstwo energetyczne, zaległości w płatnościach, gospodarstwa domowe, pandemia, Ukraina

