

A Service of

ZBW

Leibniz-Informationszentrum Wirtschaft Leibniz Information Centre for Economics

Petrariu, Radu Ioan et al.

# Article

# Analysis of Responsible Energy Consumer's Behaviour in the Context of REPowerEU Plan

Amfiteatru Economic

Provided in Cooperation with:

The Bucharest University of Economic Studies

*Suggested Citation:* Petrariu, Radu Ioan et al. (2023) : Analysis of Responsible Energy Consumer's Behaviour in the Context of REPowerEU Plan, Amfiteatru Economic, ISSN 2247-9104, The Bucharest University of Economic Studies, Bucharest, Vol. 25, Iss. 64, pp. 743-759, https://doi.org/10.24818/EA/2023/64/743

This Version is available at: https://hdl.handle.net/10419/281730

#### Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.



https://creativecommons.org/licenses/by/4.0/

#### Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.





# ANALYSIS OF RESPONSIBLE ENERGY CONSUMER'S BEHAVIOUR In the context of repowereu plan

# Radu Ioan Petrariu<sup>1</sup>, Marian Năstase<sup>2</sup>, Gabriel Croitoru<sup>3</sup>, Nicoleta Valentina Florea<sup>4</sup>, Nicoleta Cristache<sup>5</sup> and Mihaela Cristina Onica Ibinceanu<sup>6</sup>

<sup>1),2)</sup> Bucharest University of Economic Studies, Bucharest, Romania.
<sup>3),4)</sup> Valahia University of Târgovişte, Târgovişte, Romania.
<sup>5),6)</sup> "Dunărea de Jos" University of Galați, Galați, Romania.

|--|

## Abstract

The planet's resources are finite and must be used rationally and responsibly to ensure a sustainable economy. On the basis of modern innovations and technologies, new sources of consumption or new ways to reduce the environmental impact of consumption can be found. Changes in the external environment and incredibly disruptive international events significantly influence consumer behaviour. In view of geopolitical changes, the energy crisis, Russia's invasion of Ukraine, and the instability of the energy market, the European Commission has drawn up a series of plans to ensure Europe's independence from Russia's energy resources. Research focusses on analysing the behaviour of responsible energy consumers as part of the objectives of REPowerEU and ANRE (Romanian Energy Regulatory Authority). To this end, 250 energy consumers were interviewed to observe their participation in reducing energy consumption and the measures implemented according to the REPowerEU plan. The consumers involved in the study have already implemented some important measures that have led to awareness of the negative consequences of geopolitical instability and the impact of natural resource consumption.

**Keywords:** Responsible energy consumer behaviour, renewable sources, energy prices, social and demographic variables, energy consumption, energy policy, sustainable development.

JEL classification: O13, O44, Q01, Q2, Q4

\*Corresponding author, Năstase Marian – e-mail: nastasem1@yahoo.com

This is an Open Access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. © 2023 The Author(s).

 $(\cdot)$ 

CC





#### Introduction

Natural resources are limited, so we need to behave responsibly by consuming them, based on sustainable thinking, eco-economics, and the protection of global and local ecosystems. As the population grows, the consumption of natural resources, especially energy, is increasing, and the energy consumption profile is dominated by fossil fuels as non-renewable energy sources (84% of total energy in 2019). Thus, renewable energy sources (solar, wind, hydro and geothermal) should increase the consumption. In response to the objectives of efficient use of energy resources to decrease the dependence of EU countries on Russian energy resources, the REPowerEU plan (European Green Deal, 2019) has been developed: to motivate European consumers to save energy, to stimulate the production of clean energy and to stimulate industry to diversify the production of energy sources and consumers to use different energy sources.

The causes of the energy crisis are diverse, many of them known, of which we can mention only a few, but all with a major impact both on the EU and Romanian economy. For example, the COVID-19 crisis, the constant and continuous rise in prices, and the Russian invasion of Ukraine have led to a global energy crisis, influencing energy consumption worldwide for individuals. The price of electricity in the EU is contingent on various factors, such as the geopolitical situation, the reliance on various imports, supply and demand, excise and tax levels, unfavourable weather conditions, grid costs, each country's energy situation, and specific environmental costs. The April 2022 report by Eurostat, the European Commission's statistical office, showed that Romania ranked first in the EU in average household electricity prices, recording an undesirable record (the increase was +112%). According to Eurostat, in the second half of 2022, average EU household electricity prices continued to show an increase compared to the same period in 2021. Thus, from an average of €23.5 per 100 kWh in 2021, it rose to €28.4 in 2022 (with Romania well above this level at €34.11).

In response to this crisis, EU governments have proposed a number of measures to manage the energy crisis: saving energy as the safest, cheapest and cleanest way to reduce dependence on imports from Russia, price caps, consumer vouchers, temporary tax exemptions or reduced taxes, lump sum support, and some countries have even applied regulated prices, citizen awareness with a positive impact on prices, directly reducing energy bills, making the economy more resilient and accelerating the EU's transition to clean energy. The EU Commission has proposed to achieve renewables from 40% to 45% by 2030, and the REPowerEU plan would bring the total renewable energy generation capacity from 1067 GW to 1236 GW by 2030 (Europa.eu, 2019).

Other ways to decrease energy consumption include:

• efficient use of household appliances, lighting switch off, switching more to public transport and reducing heating temperatures,

• informing on distribution and procurement of energy options, working with international energy organisations to identify and promote the most effective energy saving actions,

• informing and educating individuals and families about the more efficient use of energy.

• using innovation, new technologies, and eco-innovation to develop smart cities, smart homes, and smart consumers.

The uniqueness of this study is the analysis of the responsible behaviour of consumers in Târgoviște, Romania, and the degree of implementation of the measures proposed at the European level through the RePowerERU plan and locally through ANRE.



This study begins with the Introduction section, where topics such as natural resource consumption and the role of renewable resources are presented and discussed. The research methodology uses a survey that analyses the future behaviour of energy consumers in Romania based on the measures developed by the RePowerEU plan and local policies in the industry. The results are presented and sections on discussed, and sections on Conclusions and Proposals are elaborated. A discussion section is developed to find future opportunities for individuals, society, and the environment.

### 1. Review of the specific literature and research hypotheses

### **1.1. Specific literature review**

The performance of natural resource management has received much attention as it relates to the sustainable development of a society and economy (Zhang et al., 2022; Tyc, 2020), responsible consumption (Stanisic et al., 2022), conservation of natural resources (Khan et al., 2022), building a green environment (Qiu et al., 2022; Jančíková and Pásztorová, 2021), engaging citizens in the sustainability of resource consumption (Chau et al., 2022) and the use of non-renewable energy sources (Opeyemi, 2021).

Various political (political instability due to the Russian-Ukrainian war, which also led to the energy crisis) (Halkos and Zisiadou, 2023), economic (rising energy costs, rising demand for energy) (Smal and Wieprow, 2023), social (population growth) (Mohseni et al., 2022), environmental and legislative factors have led to influencing global energy consumption for individuals (Surahman et al., 2022). The problems that have arisen have led the governments of each EU member country to find various ways to reduce energy consumption, such as efficient use of household appliances, turning off lights, reducing heating temperatures, proper information on purchasing energy options (European Commission, 2022), or saving household energy, which accounts for the largest share in consumption (Alexandru and Jitaru, 2007).

There are other ways to reduce energy consumption, for example:

• building in energy smart cities (Liang et al., 2022), use of daylight, solar shading, and natural ventilation (Hax et al., 2022), reduction of air conditioning consumption (European Commission, 2022), zero-pollution evaporative cooling systems are preferred to reduce consumption;

• turning to innovations and new energy sources (Shah et al., 2023), alternative energy sources (Tyurina et al., 2023), and using clean energy (Dolgun et al., 2023), to achieve dependence on natural resource consumption (Lasisi et al., 2022);

• improving environmental quality through reduced consumption of natural resources, in line with the 2005 Kyoto Protocol (Khalid, Hanif and Rasul, 2022);

• use of smart home appliances (Aksanli and Rosing, 2020), use of the average consumption indicator, reduction of peak hour consumption, and improvement of comfort levels (Ahmad et al., 2021);

• more frequent use of public transport (Jing et al., 2022) or cost-saving electric buses (Liu et al., 2022);

• reducing energy consumption when energy prices are higher (Maryasin and Lukashov, 2022), promoting energy system reform in rural areas (Liu et al., 2022). Natural resource prices fluctuate (Li et al., 2022), and disparity in energy consumption is the key to product



pricing (Zhang et al., 2022). They are volatile (Zhou et al., 2022), becoming an important global issue, especially for policy makers and researchers. According to official data, electricity prices at the EU-27 level are continuously increasing (from 0.172 kW in 2010 to 0.220 kW in 2021). Romania recorded 0.153 Kw-hours in 2021 (Eurostat, 2020b);

• replacement of old bulbs with LEDs (80% less consumption) (National Energy Regulatory Authority, 2022);

• performance of regular energy audits, Romanian energy price caps (L.357/2022), national support programmes, predictive control, early fault detection, use of modelling in energy consumption (An and Ma, 2022) and quality energy policies using sensors and Internet of Things (IoT) for smart control of appliances.

## **1.2. Research hypotheses**

## 1.2.1. REPower-EU and ANRE information and responsible energy behaviour

The sustainability of natural resources has become a global issue (OECD, 2020; Zakari et al., 2022) and is considered vital in addressing climate change or scarce energy resources (Tan et al., 2022).

The share of renewable energy increased significantly from 14.54% in 2011 to 22.09% in 2020 (Eurostat, 2022), with the EU approximately 2% above the target. The share of renewables in gross final energy consumption was 9.6% in 2004, an achievement adopted by Directive 2009/28/EC (EC Directive, 2009). The COVID-19 pandemic has affected the decrease in fossil fuel consumption (Jekabsone et al., 2022). For the EU-27 countries, the target has been met, but this action was not possible for some EU members. For the European Green Deal (EU Monitor, 2019), the target is to become the world's first climate-neutral continent by 2050. Interest in consuming energy from renewable sources is observed, from 1555 (Twh) in 2000 to 3243 (Twh) in 2020 (OECD, 2020). ANRE has also been constantly involved in this information campaign, receiving transparent information from subscribers on prices and tariffs, information using the media (radio, TV, leaflets) or on actual electricity consumption, and the advantages and risks of the contracts concluded (www.anre.ro).

To achieve environmental sustainability, it is essential to shift from energy derived from 'dirty' fossil fuels to 'clean', renewable sources (Pata et al., 2022). Informing citizens can lead to reduced energy consumption and bills through the use of modern green manufacturing (Liu et al., 2022) and the Industrial Internet of Things (I-IoT), as well as better monitoring of energy consumption (Tian et al., 2022). Thus, it can be concluded that:

**H1** - There is a strong and positive relationship between the information provided by local distributors (ANRE) and the measures proposed by the REPowerEU plan and the behaviour of responsible energy consumers.

# **1.2.2 Energy consumption and women's responsibility**

Due to industrialisation, population growth, and living standards, energy has become increasingly important (Demircioğlu and EsIyok, 2022). Energy consumption levels are often linked to the economic growth of countries (Duran et al., 2022). Households are responsible for almost 30% of final energy consumption at the EU level (Eurostat, 2020a), so it is very important to promote sustainable energy consumption in households (Streimikiene et al., 2022). The final energy consumption at the EU-27 level was 906.8 (million tonnes or oil equivalent) and Romania 23.5%. Between 2010 and 2020, final energy consumption decreased (1024 mtoe in 2010) and Romania experienced a slow increase from 2.6 and, respectively, 22.5 mtoe (Eurostat, 2021).



Many studies have found that women are more concerned about environmental quality and participation in environmental activities (Senjawati et al., 2018). Most studies indicate a positive and statistically significant influence of renewable energy consumption on economic growth (Berradia et al., 2022). A study in 2021 indicated that the share of women in the labour market led to an increase in renewable energy consumption. Therefore, women have a positive role in sustainable development (Mujeed et al., 2021). Under these circumstances, we can state that:

H2 - Women are more responsible than men for energy consumption.

# **1.2.3.** Energy consumption and education level of the population

Some studies have shown that there is a significant association between household energy consumption and educational level (Liu X. et al., 2020; Wang et al., 2020; Aixiang, 2011). Increasing the level of education can lead to energy conservation (Jia, Zhang and Xu, 2022). And another study shows that the effects of increasing the education level have a moderate impact on energy consumption (Osuntuyi and Lean, 2023).

Therefore, this process of educating the population is a challenge to change attitudes toward reducing domestic energy consumption. A number of methods have been proposed to persuade the population to have this sustainable behaviour through a series of educational approaches such as the game-based approach, convincing games, and aimed at changing negative habits of high energy consumption or the information-based approach or collaboration and competition (Madeira et al., 2011). So, we can conclude that:

H3 - A more educated person is more responsible for energy consumption.

# 1.2.4. Energy consumption and age of the population

The results showed that when more time is spent at home (e.g., for retired people), household electricity consumption increases by 20.03% to 32.13% and is more present among those elderly but with high income, high level of education, and good health (Zhu and Lin, 2022).

Other studies have indicated that countries with an older population (e.g., Australia) face the problem of increased domestic energy consumption; therefore, structural measures have been proposed and behavioural factors have been analysed to help support efficient residential energy consumption. By developing effective policies and initiatives, they can lead to better welfare, reduced energy costs through successful home management, and reduced carbon emissions from the population (Romanach et al., 2017). As early as 2001, a study in Romania states that from a supplier's point of view, it is more sustainable to invest in the consumer than in generation, transmission, or distribution. The development strategies of the distribution company in Romania through RENEL's own programmes have allocated significant funds for the purchase of LED bulbs especially for household consumers, especially elderly people (large consumers) and for the budget sector (hospitals, orphanages, schools, and other institutions) (Burlacu, 2001). For these reasons, the following hypothesis is proposed:

H4 - Older people consume more energy.

#### 1.2.5. Energy consumption and income

There is a causal relationship between economic growth and energy consumption in the short and medium term (Tan et al., 2022). The annual GDP growth rate allows comparisons of economic development (Eurostat, 2022), and for EU-27 countries, it has increased from 2.2% in 2010 to 5.4% in 2021. The values have also recorded negative values, the peak being during the pandemic period, 2020 (-5.7%). In Romania, 5.1% was recorded in 2021 and -



3.7% during the pandemic (2020). Some studies have indicated that there is an important link between household energy consumption and household income (Liu et al., 2020); an increase in income increases energy consumption and an increase in energy prices reduces energy consumption (Tang et al., 2022), especially for low-income households and leads to the use of photovoltaic panels or small wind turbines using hybrid energy systems to lower energy costs (Kgopana and Popoola, 2023). Therefore, we develop the following hypothesis:

**H5** - Significantly higher income leads to higher energy consumption.

#### 2. Research methodology

## 2.1. Research objectives

The prediction of energy consumption is significant for energy savings and energy security, so the research focusses on achieving an important objective: analysing the behaviour of responsible energy consumers in Romania, as part of the proposed objectives of the REPowerEU plan. Other objectives: the analysis of willingness to reduce energy consumption and the measures applied according to REPowerEU plan, the division of consumers into three energy consumption categories and the determination of the socio-demographic variables impact on responsible energy consumption behaviour. E-views and SPSS were used for data analysis.

**2.2. Analysis of energy consumer behaviour in the context of the REPowerEU purpose** 250 energy consumers were surveyed to observe their willingness and commitment to reduce energy consumption and the measures they have implemented according to the REPowerEU plan.

Sample size - A questionnaire was distributed among energy consumers in the municipality of Târgoviște, Dâmbovița County, Romania. The sampling method chosen was the non-probability or non-random, convenience method, in which people easily reached were included: acquaintances, colleagues, students, master's students, PhD students, all being energy consumers.

*Questionnaire* - The questionnaire included 32 statements on respondents' involvement in reducing energy consumption and specific measures applied.

Variable	Topic	Ν	%	Variable	Торіс	Ν	%
Condon	Female	20 1	80.4		Married without children	154	61.6
Gender	Male	49	19.6	Marital	Married with children	11	4.4
	High school education	71	28.4	status	Single without children	2	0.8
Level of	of Bachelor 81 32.4	Single with children	83	33.2			
education	Master	71	28.4		Employee	205	82
	Doctorate	27	10.8	Position	Management position	45	18
	2<20 years	78	31.2	Owning	Personal property	245	98
Age	21-29 years old	29	11.6	property	Leased property	5	2
	430-39 years	3	1.2		<ron 1600<="" td=""><td>16</td><td>6.4</td></ron>	16	6.4

Lable not it Democraphic character istics	Fable no.	1. Demographic	characteristics
---	-----------	----------------	-----------------



Variable	Торіс	Ν	%	Variable	Topic	Ν	%
	40-49 years	13 8	55.2	Net income	RON 2.1601-2500	93	37.2
	>50-59 years	ſ	0.8		RON 3.2501-4000	61	24.4
		Z	0.8		RON 4.4001-5500	49	19.6
Househol d type	House	21 8	87.2		> RON 5501	31	12.4
	Apartment	32	12.8				

Source: Authors' calculations using SPSS 20.

The evaluation heading used Likert's scale from 1 (strongly disagree) to 5 (strongly agree). The respondents filled in the survey questionnaire between November and December 2022. Of 275 questionnaires, 264 were received and 250 were usable (94 were completed online and 156 face-to-face), with a response rate of 90.9%. Table 1 describes the demographics of the respondents: female (75%) and male (25%). Most of the respondents are in the age group of 40-49 years (55.2%), without a management position (82%), married with children (61.6%), 98% have personal property and 87.2% own a house, and with respect to the level of education, 32.4% have a bachelor's degree, 28.4% a high school degree and a master's degree, and 10.8% have a doctorate degree (Table 1). The description of data series distributions is shown in Table no. 2.

Table no. 2. Descriptive statistics

Feature	Mean	Feature	Mean		
C1- once consumed, natural resources are lost	4.27	M1- Disconnect household appliances	4.29	M12- I have reduced air conditioning usage time	4.29
C2- responsible individual behaviour has a positive impact on energy consumption	3.99	M2- I avoid using household appliances during peak hours	3.23	M13- I have reduced the thermostat temperature for low consumption	3.75
C3- responsible behaviour will have an impact on reducing energy costs	4.22	M3- I use the washing machine at full load capacity	3.74	M14- I have reduced my daily shower time to save money	3.17
I1- We learnt about the RePower EU measures as a result of the unstable geopolitical situation.	3.97	M4- I have reduced the high temperature and the washing time of clothes	3.57	M15- I have reduced the ventilation time of the rooms	3.17
I2- The local energy distributor (ANRE) has informed me about measures to reduce energy consumption.	3.87	M5- I have reduced the use of long washing programmes	3.65	M16- I have replaced old appliances with newer ones and reduced energy consumption	3.72
I3- I am more responsible for my energy consumption since ANRE informed me about efficiency measures.	4.35	M6- I do not let the freezer form ice flakes for low consumption	3.78	M17- I do not let the tap use the water when I brush my teeth	4.05
I4- I understand the consequences of irresponsible energy consumption behaviour	4.30	M7- I have removed the freezer and refrigerator from the heating source	3.92	M18- I do not leave the tap running when I wash the dishes	3.82



#### Analysis of Responsible Energy Consumer's Behaviour in the Context of REPowerEU Plan

Feature	Mean	Feature	Mean		
I5- Every consumer, if responsible, would save money.	4.44	M8- I turn off the electricity when I leave the room.	4.42	M19- I drive vehicles more economically	3.81
I6- Our homes are our largest energy consumers	4.00	M9- I do not use electricity when there is natural light.	4.54	M20- I use public transport and active mobility more frequently	3.45
I7- The refrigerator is the biggest consumer of electricity in the house	3.54	M10- I installed energy saving light bulbs in the house (LED)	4.34	M21- I use sensors for low energy consumption	1.98
		M11- I have reduced the thermostat temperature to reduce energy costs.	4.16	M22- I turn on household appliances or heat using IoT	1.26

Source: Authors' calculations using E-views 10

\*Note: C-Behaviour, I-Information and M-Measures

From the research, three types of energy consumption behaviour were observed (according to measures M1-M22):

• Active energy consumer behaviour (3.67 - 5 points) was recorded in 14 of 22 measures, such as M1, M3, M6, M7-M13 and M16-M19. Being environmentally responsible by becoming responsible energy consumers is indicated by the following measures: unplugging electrical appliances, using the washing machine at full capacity, keeping the refrigerator from freezing or moving it away from the heating source, turning off the light when leaving the room or not using it when there is natural daylight, installing LED light bulbs, reducing the room temperature on the thermostat to reduce costs and consumption of natural resources, and reducing the time of air conditioning use. These consumers have also increased their consuming appliances with new ones, turning off the water when brushing teeth or washing dishes, or reducing vehicle use.

• Passive behaviour of energy consumers (2.34-3.66 points): M2, M4, M5, M14, M15, M20 - six measures. As passive energy consumers, interest is low for the respondents who answered that avoiding using household appliances for long hours, reducing the temperature or time to wash clothes, reducing the time for a daily shower or airing the room, and using public transport and active movement are of medium interest.

• An indifferent behaviour of energy consumers (1- 2.33 points): M21, M22- two measures indicating that Romanian consumers are not yet ready for change in terms of using new technologies to reduce energy consumption and costs; the low score for using sensors or IoT to reduce energy consumption in a smart way and become green energy consumers is at the beginning.

Below is described the regression function between the dependent variable (being C2responsible energy consumption) and the independent variables: gender, net income, personal status, property type, age, education level, property, position. The regression equation is as follows:

 $\begin{aligned} \text{Resp en cons} &= a + b \times \text{gender} + c \times \text{net income} + d \times \text{state} + e \times \text{prop type} + f \times \text{age} + g \times \\ \text{edu level} + h \times \text{prop} + i \times \text{pos} \end{aligned} \tag{1}$ 

AE

 $\begin{array}{l} \mbox{Resp en cons} = a + b \times 0.12 + c \times 0.96 - d \times 0.27 - e \times 0.88 - f \times 0.67 + g \times 0.39 + h \times 1.8 - i \times 2.84 \end{array}$ 

The regression model shows that a 1-point increase in energy consumer responsibility will result in a 0.86-point increase in net income, a 1.86-point increase in property ownership, and a 2.84-point decrease in ownership position, while the other variables remain almost unchanged (between -0.88 and 0.39). This calculation has the following significance: an increase in net income leads to a significant increase in energy consumption (0.86), the more spacious is the property owned, the higher is the energy consumption (1.86), while the type of property negatively influences consumption (-0.88), as does the age of the consumer (-0.67), that is, an older age leads to higher consumption because more time is spent at home; and the level of education positively influences consumption, in the sense that the higher the level of education, the lower the energy consumption (0.39). These direct relationships can also be seen in the calculations and data below.

The value obtained for  $R^2$  is 0.4711 and shows the suitability of using this model for the analysis, indicating that 47.11% of the model is explained using these variables.

# Measuring the impact of socio-demographic variables on responsible energy consumption behaviour

We now analyse the impact of gender, education level, net income, and age on responsible energy consumption (variable C2) (Table 3).

Analysing the data below, we can conclude that respondents with a higher level of education are more responsible in their energy consumption, a higher income leads to more responsible energy consumption (and a low income leads to irresponsible energy behaviour for young consumers, as they are not paying the bills but their parents), and as they get older, consumers consume more energy, staying at home longer due to retirement. Thus, the research hypothesis H2 – women are more responsible than men in energy consumption is partially fulfilled, as we note from the study that both genders are responsible (the score achieved is above average, close to 4 for both genders). Hypothesis H4 – older people consume more energy (people in the 40-49 age group score is higher than 4.71, and those over 50 have a score 3), therefore hypothesis H4 is partially met. As for hypotheses, H3- a more educated person is more responsible with energy consumption (for people with a master's degree the score was 4.43 and for those with a PhD the score was 5) and H5 – a more significant income leads to more energy consumption (the score was 4.22 and 5 for the last two income groups) were both met. A more comprehensive overview of the results obtained and proposed measures for improvement is described below in the Discussion section.

Factor	200	(responsible energy consumption)- C2							
геац	ires	1	2	3	4	5	Total	score	
Condon	1	6	59	4	40	92	201	3.76	
Gender	2	0	0	2	0	47	49	4.91	
	1	0	44	6	0	21	71	2.97	
Level of	2	6	15	0	0	60	81	4.14	
education	3	0	0	0	40	31	71	4.43	
	4	0	0	0	0	27	27	5.00	
Net	1	0	0	2	0	14	16	4.75	
income	2	0	59	0	0	34	93	3.09	

Table no. 3. Variables that influence responsible energy consumption

AE

Esstance		(responsible energy consumption)- C2							
reatu	ires	1	2	3	4	5	Total	Score	
	3	0	0	4	40	17	61	4.21	
	4	0	0	0	0	49	49	5.00	
	5	6	0	0	0	25	31	4.22	
	1	0	44	0	0	34	78	3.30	
	2	6	15	3	0	5	29	2.41	
Age	3	0	0	1	0	2	3	4.33	
	4	0	0	0	40	98	138	4.71	
	5	0	0	2	0	0	2	3.00	

Source: Authors' calculations using SPSS 20

*The correlation matrix* is determined below and calculated between the responsible behaviour (energy consumption reduction - C2 and energy cost reduction - C3) and the information received (through RePowerEU plan - I1 and ANRE - I2) (Table 4).

Information/Behaviour	C2	C3
I1	0.6056	0.5300
I2	0.5019	0.3270

#### Table no. 4. Correlation matrix

#### Source: author's contribution

As we can see, there are positive correlations between responsible energy behaviour (C2 and C3) and continuous and constant information received from the EU through the REPowerEU report and ANRE (I1 and I2), indicating that through the RePowerEU plan (60.56%), and Romania, through ANRE (50.19%), have provided information that has led to responsible energy behaviour on the part of Romanian, local, electricity consumers.

#### 3. Results and discussion

Responsible household energy consumption can offer many benefits for energy savings, renewable energy sources, and GHG emissions.

The study shows that of the 22 measures analysed to improve responsibility in energy consumption, 14 are located in the active zone, where Romanian energy consumers are responsible for resource consumption and are interested in disconnecting electrical appliances when not in use (4.29), using the washing machine at full capacity (3.74), avoiding the refrigerator to freeze (3,78) or moving it away from the heating source (3.92), turning off the light when leaving the room (4.42) or not using it when there is natural daylight during the day (4.54), installing LED light bulbs (4.34), reducing the temperature in the room on the thermostat to reduce costs and consumption of natural resources (4.16) and reducing the time spent using air conditioning. (4,29). What we can see is that these consumers have increased their contribution to improving the environment, but also energy costs by replacing old energy-consuming appliances with new ones (3.72), turning off the water when brushing their teeth (4.05) or dishes (3.82) or reducing the use of their own vehicles (3.81) and using public transport responsibly (3.45).

Six measures are indicated in the passive area (avoiding the use of household appliances during peak hours- 3.23, reducing the washing times of the washing machine- 3.65, shower

time- 3.17 or ventilation time- 3.17 or replacing old clothes with new energy efficient ones-3.72, and it is proposed to improve this situation and transfer it to the active area by raising awareness of investing in low energy appliances, or awareness that being responsible for reducing the time to wash clothes or showering can lead to household savings in the medium and long term, saving money and saving the environment. A local, national, and European programme such as the ones presented can bring sustainability for individuals and society. In the indifferent area, only two measures exist on the use of sensors (1.98) and IoT (1.26) to reduce energy consumption and energy costs. It may be mentioned that these energy consumers have already implemented specific measures to reduce energy consumption, reduce environmental impacts, and reduce energy costs. Therefore, it can be indicated that by analysing, Romanian energy consumers have a responsible behaviour and that the information provided by the ANRE and RePowerEU plan has led to responsible behaviour.

Analysing the behaviour characteristic (C), it can be added that responsible behaviour will reduce consumption (3.99) and energy prices (4.22) indicate that there is responsible energy behaviour.

Regarding characteristic I- information, it can be added: the behaviour of Romanian energy consumers is aligned with the REPowerEU plan and ANRE information, as the score obtained for the first characteristic is 3.97 and the second is 3.87.

There are positive correlations between responsible energy behaviour (C2 and C3) and the continuous and constant information received from the EU through the REPowerEU and the ANRE report (I1 and I2). These data lead us to the fact that the EU, through the RePowerEU plan (60.56%), and Romania, through ANRE (50.19%), provided information that led to responsible energy behaviour on the part of Romanian local electricity consumers. The reduction of energy costs due to constant information is positive, one above average (REPowerEU- with 53%) and below average (ANRE- with 32,70%). However, responsible energy consumption behaviour can be improved, as we can see from the proposed measures.

Thus, the research hypothesis, H1 – There is a strong and positive relationship between the information provided by local distributors (ANRE) and the measures proposed by the REPowerEU plan and the responsible behaviour of the energy consumer is confirmed. As for the hypothesis, H2 – women are more responsible than men in their energy consumption, which is partially confirmed, as both genders are interested in this responsible behaviour (obtaining scores close to 4 and 5 respectively). The highest scores are obtained by the highest level of education (4.43 for Master's degree and 5 for PhD). Thus, the research hypothesis, H3 – a more educated person is more responsible for energy consumption, is fulfilled. The highest score is obtained by the 40-49 age group (4.71) and the lowest by the over – 50 age group (3.0) in terms of energy consumption responsibility. Therefore, the least responsible energy consumers are older people (40-49 and over 50 years old because they stay at home longer and consume more energy). Thus, the research hypothesis H4 – older people consume more energy, is fulfilled. Hypothesis H5 – a more significant income leads to more energy consumption (the score was 4.22 and 5 for the last two income groups) was met.

Developing measures to make young energy consumers more responsible energy consumers

• Use better information on the RePowerEU plan and ANRE measures through responsible energy consumption.

• Use events and PR campaigns based on information or behaviour change.

• Use local or national public figures in these campaigns to challenge the younger generation to follow a positive example.



• Conducting visits to schools, colleges, and universities to better inform and change behaviour, with specific studies and statistics showing the percentage that can be saved by responsible energy behaviour.

#### Conclusions

This study aimed to analyse the responsible behaviour of Romanian energy consumers, as part of the objectives proposed by the REPowerEU plan. We note that these energy consumers are responsible for their use and are informed about the REPowerEU plan and ANRE. We noted from our analysis that out of the 22 measures, 14 are measures with good and very good scores (3.67-5 points), indicating that Romanian energy consumers are active consumers. The results indicated that age, position, income, and gender are significant in analysing their impact on energy consumption. The younger generation seems to be less responsible for their energy sustainable. Energy consumption is more significant for consumers over 50 due to retirement and time spent at home. In terms of gender, both women and men are committed to being responsible energy consumers (scores of 3.76 and 4.91). Even if consumers have a more significant income, they are still responsible energy consumers (the more responsible are those in the fourth income group, with a score of 5). Education level also influences energy consumption, the more educated they are, the lower the consumption (4.43 for consumers with a Master's degree and 5 for those with a PhD).

It can be seen that there is a positive correlation between responsible energy behaviour and continuous and constant information (between 32.70% and 60.56%), so the EU, through its RePowerEU plan at regional level and Romania through the ANRE plan at national level, has reached their target, which could be increased using a better information plan as proposed. The study provides theoretical significance by analysing in three phases the behaviour, information and actions taken by Romanian energy consumers after the information on the RePowerEU plan and ANRE. This study could serve as a guide for best practices in the responsible energy consumption field, thus, proposals can be made.

*For managers,* they can track the degree of responsible involvement and the saving of natural resources and cost reduction. *For society,* governments could develop specific policies for energy consumers and develop guidelines for responsible energy behaviour. *For organisations,* they could observe and analyse specific information and use special events for better information or to develop simulation programmes for forecasting energy consumption in specific areas or to include consumers in terms of their participation in measures implemented by area, age, gender, and level of education. *For individuals,* such a study may help consumers reduce energy costs, save natural resources, and participate in a healthier environment in accordance with the RePowerEU plan and the ANRE information.

Despite its importance, this study has some limitations that should be diminished by future research. Firstly, this study was carried out at the local level, but can be used as an idea for larger studies in areas, even countries, and also it had evaluated only four factors that have an impact on renewables. Therefore, future studies can be developed by assessing responsible energy behaviour, and other variables could be considered. Future patterns of energy consumption and consumer involvement in being responsible energy consumers will be indicated.

#### References

- Ahmad, M., Javaid, N., Niaz, I.A., Almogren, A. and Radwan, A., 2021. A Cost-Effective Optimization for Scheduling of Household Appliances and Energy Resources. *IEEE Access*, 9, pp.160145-160162. https://doi.org/10.1109/ACCESS.2021.3131233.
- Aixiang, T., 2011. Research on Relationship between Energy Consumption Quality and Education, Science and Technology based on Grey Relation Theory. *Energy Procedia*, 5, pp.1718-1721. https://doi.org/10.1016/j.egypro.2011.03.292.
- Aksanli, B. and Rosing, T.S., 2020. Human Behavior Aware Energy Management in Residential Cyber-Physical Systems. *IEEE Transactions on Emerging Topics in Computing*, 8(1), pp.45-57. https://doi.org/10.1109/TETC.2017.2680322.
- Alexandru, A. and Jitaru, E., 2007. Education for energy saving in the house. In: Helmis, C., Celikyay, S., *Energy and Environmental Engineering Series*, WSEAS, Arcachon, France.
- An, H. and Ma, X., 2022. Dynamic coupling real-time energy consumption modeling for data centers. *Energy Reports*, 8, pp.1184-1192. https://doi.org/10.1016/j.egyr.2022.06.085.
- Berradia, H., Abid, M., Sakrafi, H., Gheraia, Z. and Abdelli, H., 2022. The effect of renewable energy consumption on economic growth in KSA: A bootstrap causality test. *Energy & Environment*, https://doi.org/10.1177/0958305X221096856.
- Brito, T.C. and Brito, M.A., 2022. Forecasting of Energy Consumption: Artificial Intelligence Methods. In: 2022 17<sup>th</sup> Iberian Conference on Information Systems and Technologies (CISTI). Madrid, Spain: IEEE. pp.1-4. https://doi.org/10.23919/ CISTI54924.2022.9820078.
- Burlacu, C., 2001. CFL assembly at some budgetary consumers A DSM action financed by CONEL/SC ELECTRICA S.A. In: Bertoldi, P. ed. 2<sup>nd</sup> International Conference Energy Efficiency in Household Appliances and Lighting, Italy, pp.330-340
- Chau, K.Y., Moslehpour, M., Tu, Y.-T., Tai, N.T., Tien, N.H. and Huy, P.Q., 2022. Exploring the impact of green energy and consumption on the sustainability of natural resources: Empirical evidence from G7 countries. *Renewable Energy*, 196, pp.1241-1249. https://doi.org/10.1016/j.renene.2022.07.085.
- Demircioğlu, M. and Eşİyok, S., 2022. Energy consumption forecast of Turkey using artificial neural networks from a sustainability perspective. *International Journal of Sustainable Energy*, 41(8), pp.1127-1141. https://doi.org/10.1080/14786451. 2022.2026357.
- Directive 2009/28/EC, 2009. On the use of renewable resources. [pdf] Available at: <a href="https://lexparency.org/eu/32009L0028/">https://lexparency.org/eu/32009L0028/</a>> [Accessed 20 November 2022].
- Dolgun, G.K., Koşan, M., Kayfeci, M., Georgiev, A.G. and Keçebaş, A., 2023. Life Cycle Assessment and Cumulative Energy Demand Analyses of a Photovoltaic/Thermal System with MWCNT/Water and GNP/Water Nanofluids. *Processes*, 11(3), no. art.832. https://doi.org/10.3390/pr11030832.
- Duran, M.S., Bozkaya, Ş., Onifade, S.T. and Kaya, M.G., 2022. Nuclear energy consumption and energy-driven growth nexus: a system GMM analysis of 27 nuclear utilizing countries across the globe. *Environmental Science and Pollution Research*, 29(46), pp.70564-70572. https://doi.org/10.1007/s11356-022-22951-8.
- EU Monitor, 2022. European Ecological Pact. [pdf] Available at: <a href="https://www.eumonitor.eu/9353000/1/j9vvik7m1c3gyxp/vl4cnhyp1ort">https://www.eumonitor.eu/9353000/1/j9vvik7m1c3gyxp/vl4cnhyp1ort</a> [Accessed 20 November 2022].

- Europa.eu, 2019. *Affordable, secure and sustainable energy*. [pdf] Available at: <<u>https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/</u> repowereu-affordable-secure-and-sustainable-energy-europe\_ro#energie-curat> [Accessed 20 November 2022].
- European Commission, 2022. *Ways to improve energy consumption*. [pdf] Available at: <a href="https://ec.europa.eu/commission/presscorner/detail/en/fs\_22\_3137">https://ec.europa.eu/commission/presscorner/detail/en/fs\_22\_3137</a> [Accessed 20 November 2022].
- European Green Deal, 2019. *Sustainable energy*. [pdf] Available at: <a href="https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/">https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/</a> repower eu-affordable-secure-and-sustainable-energy-europe.ro> [Accessed 08 June 2022].
- Eurostat, 2020a. *Prices for energy by user type*. [pdf] Available at: <a href="https://ec.europa.eu/eurostat/databrowser/view/ten00117/default/table?lang=ro">https://ec.europa.eu/eurostat/databrowser/view/ten00117/default/table?lang=ro</a> [Accessed 17 November 2022].
- Eurostat, 2020b. *Final energy consumption*. [pdf] Available at: <a href="https://ec.europa.eu/">https://ec.europa.eu/</a> eurostat/statistics-explained/index.php?title= Glossary: Final\_energy \_consumption> [Accessed 20 November 2022].
- Eurostat, 2021. *Share of energy from renewable sources (%)*. [pdf] Available at: <<u>https://ec.europa.eu/eurostat/databrowser/view/nrg\_ind\_ren/default/table?lang=ro></u> [Accessed 17 November 2022].
- Eurostat, 2022. *Real GDP growth rate volume (%)*. [pdf] Available at: <<u>https://ec.europa.eu/eurostat/databrowser/view/tec00115/default/table?lang=ro></u> [Accessed 18 November 2022].
- Halkos, G. and Zisiadou, A., 2023. Energy Crisis Risk Mitigation through Nuclear Power and RES as Alternative Solutions towards Self-Sufficiency. *Journal of Risk and Financial Management*, 16(1), no. art.45. https://doi.org/10.3390/jrfm16010045.
- Hax, D.R., Leitzke, R.K., Da Silva, A.C.S.B. and Da Cunha, E.G., 2022. Influence of user behavior on energy consumption in a university building versus automation costs. *Energy and Buildings*, 256, no. art.111730. https://doi.org/10.1016/ j.enbuild.2021.111730.
- Jančíková, E. and Pásztorová, J., 2021. Promoting EU values in international agreements, *Juridical Tribune - Tribuna Juridica*, 11(2), p. 211.
- Jekabsone, A., Rosa, M. and Kamenders, A., 2022. Impact of COVID-19 on Energy Consumption in Public Buildings. *Environmental and Climate Technologies*, 26(1), pp.306-318. https://doi.org/10.2478/rtuect-2022-0023.
- Jia, L., Zhang, H. and Xu, R., 2022. The simultaneous impact of urbanization and education on renewable energy consumption: empirical evidence from China. *Transformations in Business & Economics*, 21(3C), pp.531-548.
- Jing, Q.-L., Liu, H.-Z., Yu, W.-Q. and He, X., 2022. The Impact of Public Transportation on Carbon Emissions – From the Perspective of Energy Consumption. *Sustainability*, 14(10), no. art.6248. https://doi.org/10.3390/su14106248.
- Kgopana, K. and Popoola, O., 2023. Improved utilization of hybrid energy for low-income houses based on energy consumption pattern. *AIMS Energy*, 11(1), pp.79-109. https://doi.org/10.3934/energy.2023005.
- Khalid, L., Hanif, I. and Rasul, F., 2022. How are urbanization, energy consumption and globalization influencing the environmental quality of the G-7. *Green Finance*, 4(2), pp.231-252. DOI 10.3934/GF.2022011.



- Khan, I., Zakari, A., Ahmad, M., Irfan, M. and Hou, F., 2022. Linking energy transitions, energy consumption, and environmental sustainability in OECD countries. *Gondwana Research*, 103, pp.445-457. https://doi.org/10.1016/j.gr.2021.10.026.
- L.357/2022. Law on capping electricity and natural gas prices for non-household customers. [pdf] Available at: <a href="https://lege5.ro/free/geztcmbwgezds/law-nr-357-2022">https://lege5.ro/free/geztcmbwgezds/law-nr-357-2022</a>.> [Accessed 18 November 2022].
- Lasisi, T.T., Alola, A.A., Muoneke, O.B. and Eluwole, K.K., 2022. The moderating role of environmental-related innovation and technologies in growth-energy utilization nexus in highest-performing eco-innovation economies. *Technological Forecasting and Social Change*, 183, no. art.121953. https://doi.org/10.1016/j.techfore.2022.121953.
- Li, Y., Cong, Z., Xie, Y., Wang, Y. and Wang, H., 2022. The relationship between green finance, economic factors, geopolitical risk and natural resources commodity prices: Evidence from five most natural resources holding countries. *Resources Policy*, 78, no. art.102733. https://doi.org/10.1016/j.resourpol.2022.102733.
- Liang, R., Le-Hung, T. and Nguyen-Thoi, T., 2022. Energy consumption prediction of airconditioning systems in eco-buildings using hunger games search optimization-based artificial neural network model. *Journal of Building Engineering*, 59, no. art.105087. https://doi.org/10.1016/j.jobe.2022.105087.
- Liu, K., Gao, H., Wang, Y., Feng, T. and Li, C., 2022. Robust charging strategies for electric bus fleets under energy consumption uncertainty. *Transportation Research Part D: Transport and Environment*, 104, no. art.103215. https://doi.org/10.1016/ j.trd.2022.103215.
- Liu, X., Han, L., Wu, S., Meng, Y., Yue, C. and Liang, S.Y., 2022. Influence of blade curvature characteristics on energy consumption in machining process. *The International Journal of Advanced Manufacturing Technology*, 121(3-4), pp.1867-1885. https://doi.org/10.1007/s00170-022-09420-9.
- Liu, X., Wang, Q., Wei, H.-H., Chi, H.-L., Ma, Y. and Jian, I.Y., 2020. Psychological and Demographic Factors Affecting Household Energy-Saving Intentions: A TPB-Based Study in Northwest China. *Sustainability*, 12(3), no. art.836. https://doi.org/10.3390/ su12030836.
- Liu, Y., Wang, P., Luo, X., Zhang, M., Zhao, T., Yang, Y., Sun, Y., Liu, X. and Liu, J., 2022. Analysis of flexible energy use behavior of rural residents based on two-stage questionnaire: A case study in Xi'an, China. *Energy and Buildings*, 269, no. art.112246. https://doi.org/10.1016/j.enbuild.2022.112246.
- Madeira, R.N., Silva, A., Santos, C., Teixeira, B., Romão, T., Dias, E. and Correia, N., 2011. LEY!: persuasive pervasive gaming on domestic energy consumption-awareness. In: *Proceedings of the 8th International Conference on Advances in Computer Entertainment Technology*. Lisbon Portugal: ACM. pp.1-2. https://doi.org/10.1145/ 2071423.2071512.
- Maryasin, O.Yu. and Lukashov, A.I., 2022. Optimizing the Daily Energy Consumption of an Enterprise. In: A.A. Radionov and V.R. Gasiyarov, eds. Advances in Automation III. Cham: Springer International Publishing. pp.370-382. https://doi.org/10.1007/978-3-030-94202-1\_35.
- Mohseni, S., Baghizadeh, K. and Pahl, J., 2022. Evaluating Barriers and Drivers to Sustainable Food Supply Chains. *Mathematical Problems in Engineering*, 2022, pp.1-24. https://doi.org/10.1155/2022/4486132.

- Mufutau Opeyemi, B., 2021. Path to sustainable energy consumption: The possibility of substituting renewable energy for non-renewable energy. *Energy*, 228, no. art.120519. https://doi.org/10.1016/j.energy.2021.120519.
- Mujeed, S., Li, S., Jabeen, M., Nassani, A.A., Askar, S.E., Zaman, K., Abro, M.M.Q., Sriyanto and Jambari, H., 2021. Technowomen: Women's Autonomy and Its Impact on Environmental Quality. *Sustainability*, 13(4), no. art.1611. https://doi.org/10.3390/ su13041611.
- National Energy Regulatory Authority, 2022. *Measures to reduce energy consumption*. [pdf] Available at: <www.anre.ro> [Accessed 08 June 2023].
- OECD, 2020. *Electricity generation by source*. [pdf] Available at: <a href="https://www.iea.org/data-and-statistics/charts/electricity-generation-by-source-oecd-2000-2020">https://www.iea.org/data-and-statistics/charts/electricity-generation-by-source-oecd-2000-2020</a>> [Accessed 20 November 2022].
- Osuntuyi, B.V. and Lean, H.H., 2023. Moderating Impacts of Education Levels in the Energy–Growth–Environment Nexus. *Sustainability*, 15(3), no. art.2659. https://doi.org/ 10.3390/su15032659.
- Pata, U.K., Yilanci, V., Zhang, Q. and Shah, S.A.R., 2022. Does financial development promote renewable energy consumption in the USA? Evidence from the Fourier-wavelet quantile causality test. *Renewable Energy*, 196, pp.432-443. https://doi.org/10.1016/j.renene.2022.07.008.
- Qiu, W., Bian, Y., Irfan, M. and Li, Y., 2022. Optimization path of green credit to energy consumption structure: A symbiotic development perspective of resource-based and non-resource-based industries. *Energy & Environment*, https://doi.org/10.1177/ 0958305X221120258.
- Romanach, L., Hall, N. and Meikle, S., 2017. Energy consumption in an ageing population: exploring energy use and behaviour of low-income older Australians. *Energy Procedia*, 121, pp.246-253. https://doi.org/10.1016/j.egypro.2017.08.024.
- Senjawati, M.I., Susanti, L., Zadry, H.R. and Fithri, P., 2018. Gender Influence on the Household Electrical Energy Consumption Behavior. *MATEC Web of Conferences*, 248, no. art.03001. https://doi.org/10.1051/matecconf/201824803001.
- Shah, T.M., Khan, A.H., Nicholls, C., Sohoo, I. and Otterpohl, R., 2023. Using Landfill Sites and Marginal Lands for Socio-Economically Sustainable Biomass Production through Cultivation of Non-Food Energy Crops: An Analysis Focused on South Asia and Europe. Sustainability, 15(6), no. art.4923. https://doi.org/10.3390/su15064923.
- Smal, T. and Wieprow, J., 2023. Energy Security in the Context of Global Energy Crisis: Economic and Financial Conditions. *Energies*, 16(4), no. art.1605. https://doi.org/10.3390/ en16041605.
- Stanisic, T., Milicevic, S. and Krstic, B., 2022. Natural Resources in Function of Sustainable and Competitive Tourism Development of the EU Countries. *Problemy Ekorozwoju*, 17(1), pp.64-70. https://doi.org/10.35784/pe.2022.1.06.
- Streimikiene, D., Kyriakopoulos, G., Lekavicius, V. and Pazeraite, A., 2022. How to support sustainable energy consumption in households? *Acta Montanistica Slovaca*, (27), pp.479-490. https://doi.org/10.46544/AMS.v27i2.15.
- Surahman, U., Hartono, D., Setyowati, E. and Jurizat, A., 2022. Investigation on household energy consumption of urban residential buildings in major cities of Indonesia during COVID-19 pandemic. *Energy and Buildings*, 261, no. art.111956. https://doi.org/ 10.1016/j.enbuild.2022.111956.

AE

- Tan, C., Xu, Y., Dai, C., Li, B. and Ullah, S. 2022. Financial integration and renewable energy consumption in China: do education and digital economy development matter?, *Environmental Science And Pollution Research*, 30(5), pp.12944-12952. https://doi.org/10.1007/s11356-022-22852-w.
- Tang, C.-S., Kogid, M., Alin, J. and Dollery, B., 2022. Modelling Sectoral Energy Consumption in Malaysia: Assessing the Asymmetric Effects. *Sustainability*, 14(3), no. art.1816. https://doi.org/10.3390/su14031816.
- Tian, S., Ren, W., Deng, Q., Zou, S. and Li, Y., 2022. A Predictive Energy Consumption Scheduling Algorithm for Multiprocessor Heterogeneous System. *IEEE Transactions on Green Communications and Networking*, 6(2), pp.979-991. https://doi.org/10.1109/ TGCN.2021.3131323.
- Tyc, A., 2020, The European Union and Japan's Economic Partnership Agreement: labour provisions under the 'Trade and Sustainable Development' Chapter, *Juridical Tribune Tribuna Juridica*, 10 (special), pp. 20-31.
- Tyurina, Y., Frumina, S., Demidova, S., Kairbekuly, A. and Kakaulina, M., 2023. Estimation of Tax Expenditures Stimulating the Energy Sector Development and the Use of Alternative Energy Sources in OECD Countries. *Energies*, 16(6), no. art.2652. https://doi.org/10.3390/en16062652.
- Wang, S., Xie, Z. and Wu, R., 2020. Examining the effects of education level inequality on energy consumption: Evidence from Guangdong Province. *Journal of Environmental Management*, 269, no. art.110761. DOI 10.1016/j.icarus.2020.110761
- Zakari, A., Tawiah, V., Khan, I., Alvarado, R. and Li, G., 2022. Ensuring sustainable consumption and production pattern in Africa: Evidence from green energy perspectives. *Energy Policy*, 169, no. art.113183. https://doi.org/10.1016/j.enpol.2022.113183.
- Zhang, Z., Jin, G., Hu, Y., He, N. and Niu, J., 2022. Performance Management of Natural Resources: A Systematic Review and Conceptual Framework for China. *Water*, 14(20), no. art.3338. https://doi.org/10.3390/w14203338.
- Zhou, Y., Wang, X., Dong, R.K., Pu, R. and Yue, X.-G., 2022. Natural resources commodity prices volatility: Evidence from COVID-19 for the US economy. *Resources Policy*, 78, no. art.102895. https://doi.org/10.1016/j.resourpol.2022.102895.
- Zhu, P. and Lin, B., 2022. Do the elderly consume more energy? Evidence from the retirement policy in urban China. *Energy Policy*, 165, no. art.112928. https://doi.org/10.1016/j.enpol.2022.112928.