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Article

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**ADOPTION OF VOLUNTARY MEASURES FOR REDUCING ELECTRICITY
CONSUMPTION IN THE REPowerEU PLAN CONTEXT:
A ROMANIAN CONSUMER PERSPECTIVE**

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Abstract

Reducing energy consumption has important implications for the sustainable development of society, but this consideration has become more stringent in the actual geopolitical context. Following the strategic directions established by the European Green Pact and "NextGenerationEU", a concrete action of the European Commission was the elaboration of the REPowerEU Plan, which aims to make Europe independent from Russian fossil fuels before 2030 and transition to green energy. In this context, in order to know the attitude, behaviour and future intentions of Romanian consumers toward voluntary measures aimed at reducing energy consumption, quantitative marketing research was carried out, in which data collected through a questionnaire led to the identification of new factors that can influence energy saving behaviour: the level of information of household consumers and the level of perceived importance, compared to voluntary measures to reduce electricity consumption. Although the research results cannot be extrapolated to the level of the entire Romanian population, but only to certain segments, the authors consider the association of consumption behaviour with two important factors, which have not been analysed in the scientific literature so far, to be a success. This analysis is necessary to understand, improve, and align the actions of domestic consumers with the strategic plans of the European Union for the implementation of measures to reduce energy consumption.

Keywords: Voluntary measures, residential consumer, reduction in electricity consumption, energy savings behaviour, REPowerEU plan, green energy, sustainability.

JEL Classification: F02, F64, M30, Q49

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Introduction

In the last decades, reducing the consumption of non-renewable resources and the transition to the green economy is a global concern and at the same time a source of intense debates in the political, economic and social environments. The new paradigms highlight the need to correlate economic growth at the state level with sustainable consumption behaviour, based on social responsibility and care for future generations (Rahman and Velayutam, 2020). Current growth strategies are based on a way of thinking adapted to rational consumption (Zhao et al., 2021), aiming at leading to a global economy based on climate neutrality and sustainable development.

Electricity and energy consumption have become essential in many areas of modern society. With the development of new transport technologies or heating closed spaces (e.g., electric vehicles and heat pumps), consumption demand has reached unprecedented limits (EEA, 2022). From an energy perspective, regardless of whether it is about residential or non-residential consumers, global, regional, and subsidiarily national policies are increasingly aimed at drawing viable levers and adopting solutions to the unprecedented situations that govern the contemporary world, including environmental problems, resource scarcity, and political conflicts.

Recent international events – the COVID-19 pandemic, but especially the invasion of Ukraine by the Russian Federation – have created new effects, among the most serious, on the energy sector (Zakeri et al., 2022). The current energy crisis has placed security and access to electricity at the top of the European policy agenda for 2023. In response to the current context, the European Parliament (EP) adopted on 14 February 2023, in a plenary session in Strasbourg, the REPowerEU plan, intended for the financing of projects in the field of energy, for the period 2023-2026, with a view to the rapid reduction of dependence on fossil fuels in Russia and the transition to green energy (European Commission, 2023). The energy crisis in Europe presents two fundamental aspects: on the one hand, the insufficient capacity to produce and supply energy to all categories of consumers and, on the other hand, the dramatic increase in energy prices, mainly as a result of the high costs of importing fossil fuels from regions other than the traditional ones (Russia). Replacing fossil fuels with "cleaner" forms of energy will reduce the EU's greenhouse gas emissions as well as its dependence on Russia.

The strategic directions of REPowerEU aim at the transition of the EU member states from an energy system largely centred on non-renewable resources to an ecological system that supports economic growth policies and climate neutrality, up to the horizon of the 2050s. A strategic objective to achieve the proposed goal and, at the same time, to prevent an energy collapse in the period immediately following the suspension of Russian imports of fossil fuels, it is the redefining of the position of household consumers in relation to energy consumption, by promoting voluntary measures aimed at saving energy and transitioning to green energy.

This paper aims to know the attitude, current behaviour, and future intentions of Romanian consumers toward voluntary measures to reduce electricity consumption, in the context of REPowerEU, preventing an energy collapse in the period immediately following the suspension of Russian fossil fuel imports. By selecting a set of measures proposed or applied by various countries in the world (France, Belgium, Norway, Sweden, Germany, Canada, Italy, USA, etc.), aimed at reducing energy consumption at the individual household level

and appreciated by us as being representative, we tested the behaviour of the sample of respondents and interpreted the association relationships between certain factors and phenomena. The authors' intention was to analyse the behaviour of domestic consumers in Romania in relation to the recent RePowerEU recommendations and regulations, as well as to estimate their willingness to actively participate in the transition to green energy.

Given the fact that the RePowerUE Plan was adopted on February 14, 2023, we consider that our research is up-to-date and can contribute to the knowledge of the current attitude of Romanian consumers towards the adoption of energy-saving measures. Our work makes an important contribution to the current state of knowledge, from the perspective of factors that can influence electricity-saving behaviour and that can, in turn, be determined by public information and education campaigns. Thus, the research identifies two interconnected factors that can contribute to increasing interest in adopting measures to reduce electricity consumption by residential consumers: the level of information that conditions the degree of awareness and the level of perceived importance. The level of information positively influences the level of importance perceived by the population with respect to the reduction of electricity consumption, the latter having a significant impact on the change in consumption behaviour. Most previous research has identified influences of sociodemographic factors, psychological factors, attitudes, and values regarding environmental protection (Abrahamse et al., 2007; Alibeli and Johnson, 2009; Yue, Long and Chen, 2013; Yang and Zhao, 2016; Hong et al., 2019), not clearly highlighting the impact of the level of information and the importance perceived by consumers, on energy saving behavior at the household level. The results of the research can be used in subsequent scientific studies, to make comparisons over time, to measure the willingness of consumers to change some habits in a certain period of time, or to evaluate the contribution to the climate neutrality agreed upon by the European Green Pact. They can also be included in a cluster of statistical data with the aim of formulating new policies and directions useful in achieving the objectives of RePowerUE.

The paper is structured as follows: in the first section, the theme of the article is presented, familiarising the reader with the key concepts integrated into the body of the work, its purpose, and content. Section 2 summarises the most important ideas and results of the studied scientific literature which highlighted the importance of the proposed theme and were the basis for formulating the specialised questions in the paper's questionnaire; Section 3 describes the research methodology, respectively, starting from the purpose, the objectives of the research and the sampling technique were defined, the description of the structure of the questionnaire and the variables introduced in the analysis was made; Section 4 presents the main results of the research, evaluating the consistency and reliability of some questions that are the subject of our theme; in the paper, assessments were made regarding the measures taken so far by the respondents to improve the efficiency of energy consumption at the residential level, the importance of the degree of information regarding the need to reduce energy consumption, in the context of the crisis, on different socio-demographic categories was tested, the willingness of the population in the sample to adopt new measures to avoid the prolongation of the energy crisis, and the transition to the green economy was analysed (mounting of solar panels and finding alternative sources of current, thermal insulation of the home, use of smart energy devices, purchase of electrical appliances with a green label, etc.). Section 5 is intended to provide conclusions in terms of the results obtained and some considerations regarding future research directions. From our research, the conclusion was drawn that the level of information of citizens regarding the policies promoted for the

adoption of voluntary measures to reduce energy consumption, as well as the awareness of the importance of energy saving, are determining factors in shaping consumption behaviour.

1. Review of the scientific literature

1.1. The importance of the RePowerEU strategy in the context of the current energy crisis

The scientific literature and practice of the last years place an increasing emphasis on the need to promote on a large scale the transition to a sustainable energy system that limits climate change caused by the effects of the large-scale use of non-renewable and intensely polluting natural resources (Azevedo, Morgan and Lave, 2011).

At the global level, energy use and primary energy demand have increased over time (Bertoldi, 2022), determined by population and economic growth and in particular the need and desire for additional services and devices such as cars, television, smartphones, computers, Internet, and more living space per capita (Olkuski et al., 2021; Ellsworth-Krebs, 2023). Individual nations must strike a balance between the three main aspects of the "energy trilemma", as defined by Oliver Wyman and the World Energy Council (WEC, 2019): affordability and access, energy security, and environmental sustainability. Social justice is becoming more often acknowledged as a fourth crucial component (Bridge et al., 2018; Kuzemko et al., 2022) and energy justice is an equitable balance between the three dimensions of the Energy Trilemma (Heffron, McCauley and Sovacool, 2015). There are essentially two parties: those who claim that the current policy solutions will significantly speed up Europe's transition to clean energy (Osička and Černoch, 2022; Tollefson, 2022) and others, arguing that any quickening of clean energy, in particular renewable electricity, in Europe could further exacerbate difficulties related to supply chains and potential global resource superpowers (Kuzemko et al., 2022). The start of the Russo-Ukrainian war has important implications for the regional and global energy sector, as follows:

- Effects on energy markets: record high prices of natural gas and, implicitly, record high electricity prices (Tollefson, 2022)- between February 2021 and 2022, the price of natural gas rose from 20 to 80 €/MWh, with surges as high as 180 €/MWh, raising electricity prices too (Osička and Černoch, 2022; Ghisellini, Passaro and Ulgiati, 2023).
- Disruption of global energy supply with considerable effects on economic patterns over a long time (Cui et al., 2023).
- Slowing economic growth caused by rising energy prices (Yagi and Managi, 2023).

"RePowerEU", the strategy adopted in February 2023, constitutes a strong foundation for the transformation of Europe's energy system into an ecological system independent of Russia, which aims to strengthen economic growth, limit the effects of fossil fuel dependence, and steer Europe towards the path of climate neutrality, until the year 2050 (European Parliament, 2022). REPowerEU also includes an EU save energy plan that outlines short- and long-term measures to reduce energy use. Further measures include a reduction in electricity use proposed in September 2022 as part of the intervention to bring down energy prices (Consilium Europa, 2022). EU ministers agreed on a non-binding goal to reduce overall electricity demand by at least 10% until 31 March 2023 and on a mandatory target to reduce electricity consumption by 5% at peak hours.

Understanding and changing the behaviour of household energy consumption are effective ways to improve energy efficiency and promote energy conservation in this context. Household energy consumption accounts for a significant portion of total energy consumption worldwide. According to Zhou and Yang (2016), in some European countries, household energy consumption represents approximately 30% of total energy consumption.

Although the terms "electricity" and "energy" are frequently used interchangeably, it is critical to recognise that electricity is only one component of total energy consumption (Romero-Jordán and del Río, 2022). Households play an important role in overall energy demand and specifically in electricity demand. The residential sector could be an important driver of energy efficiency and savings, with considerable implications for the sustainable development of society (Guo et al., 2018).

According to Eurostat (2023), the residential sector represented 27.4% of the final energy consumption. By consumption destinations, the situation is as follows (Figure no.1):

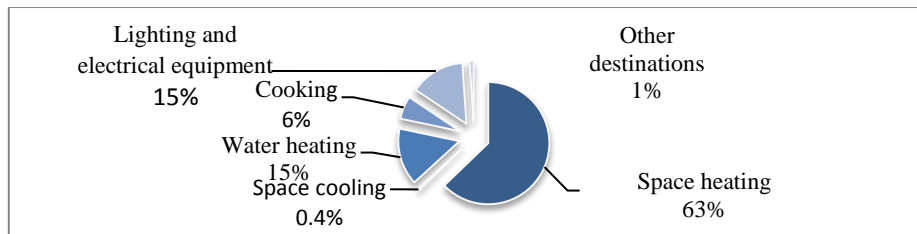


Figure no. 1. Distribution of energy consumption in the residential sector

Source: Eurostat processing (online data code: nrg_d_hhq)

1.2 The role of information level and perceived importance at the behavioural level

All measures aiming to reduce energy consumption must be based on understanding the essence of the concept of energy-saving behaviour and its drivers. Energy-saving behaviours may be defined as the behaviours through which people try to reduce overall energy use (Sweeney et al., 2013), and, as a consequence, electricity savings behaviours involve all the choices and actions made by consumers that aim to minimise their home electricity consumption (Innocent, Francois-Lecompte and Roudaut, 2020). Energy-saving actions, including electricity, can refer to:

- Curtailment behaviours, which save energy through reduced use.

Efficiency behaviours, which can be classified as low investment measures – replacing incandescent lamps with compact fluorescent lamps – and high investment measures – save energy by buying more efficient appliances, and installing insulation (Nair, Gustavsson and Mahapatra, 2010).

- Better maintenance of appliances to improve their performance and efficiency (Ölander and Thøgersen, 1995).

- Electricity savings behaviours everyday eco-gestures in various domains, such as heating, cooking, lighting, and electrical appliances (Innocent, Francois-Lecompte and Roudaut, 2020).

Fujimi, Kajitani and Chang (2016) discovered that electricity-saving behaviors that require little effort and cause little discomfort can become new habits or lifestyles that promote long-term energy conservation. One of the main problems to solve is how to keep consumers interested in energy-related issues and increase their awareness while creating long-lasting behavioural changes (Vassileva and Campillo, 2014). According to research results (Sweeney et al., 2013), motivations to engage in energy-saving behaviours differ across individuals, including cost, environment, and information. In the case of low-income households, the main impediment to investing in more energy-efficient products and adopting energy-efficient lifestyles is economic or related to a lack of interest (Cayla, Maizi and Marchand, 2011; Vassileva and Campillo, 2014). Larger energy savings can be achieved when specific information is provided with increased frequency (Aydin, Brounen and Kok, 2018).

Changing individual behaviour to reduce electricity consumption takes a lot of time and effort and is affected by problems such as potential inertia and motivation (Lazaric and Toumi, 2022). These problems are related to the predilection for energy-efficient equipment policies rather than behavioural actions that improve individual-level abilities (Marechal and Holzemer, 2015; Buckley, 2020). In the case of European households, the lack of awareness of daily energy consumption and poor information about their electricity use determine the lack of knowledge on how to act on this problem (Belaïd and Joumni, 2020; Buckley, 2020).

2. Research methodology

The scope of the investigation was to discover the attitude, current behaviour, and future intentions of Romanian consumers related to voluntary measures to reduce electricity consumption, in the context of REPowerEU. The following research objectives and subsequent questions were examined:

- **O1:** Assessing the level of awareness about the energy crisis and the need to reduce electricity consumption. Does the level of information significantly influence the adoption of voluntary measures to reduce electricity consumption?
- **O2:** Identifying changes in consumption behaviour, in relation to the intensification of national and European discussions regarding the energy crisis.

The source of the data involved in this research is represented by the responses obtained following the development of a questionnaire distributed through the Google Forms platform. A number of 902 individuals provided answers to the 22 questions designed to identify a possible pattern of consumers with respect to electricity and their potential willingness to adopt some measures to reduce electricity consumption in the context of the REPowerEU Plan.

The questionnaire was addressed to students, teaching staff, and non-teaching staff from some universities in Romania, as well as employees of some private companies and state institutions, between January and February 2023. The response rate to the questionnaire was of approximately 53%, and the questionnaire was sent to a total of 1,700 respondents. The approach to data collection was that of the statistical survey. Data collection was performed using stratified random non-proportional sampling, with strata determined by age and income variables. Therefore, three age groups and three income groups were established,

resulting in nine strata. Simple random sampling was used to determine the respondents within each stratum.

The structured questionnaire contains sections including 22 questions, 20 closed and 2 open. The Likert scale and semantic differential were used. The questions were classified as follows:

- 7 questions regarding the socio-demographic distribution: age, sex, education level, income level, family size, marital status, occupational status
- 4 supporting questions in shaping the attitude regarding the reduction of energy consumption: assessment of the degree of awareness, knowledge/interest in the actions undertaken at the European level, and considerations regarding the price increase as a solution to reducing the energy crisis.
- 3 questions regarding the sources of electricity: the number of electronic devices, the method of heating the home, the electricity provider
- 8 questions regarding general consumption behavior: frequency of use of electrical devices and the possibility of opting out, purchase behavior and introduction of consumption reduction practices, and considerations regarding the perceived importance of voluntary measures to reduce electricity.

In table no. 1 the variables used in the Results and Discussion section are presented. Their statistical description will be carried out before their use in the study of respondents' behaviour.

Table no. 1. Description of the variables introduced in the analysis

Variable	Coding	Question type and answers
Gender	GENDER	Dichotomous
Age	AGE	Ordinal – Six-level scale
Income	INCOME	Ordinal – Six-level scale
The latest education level	EDUCATION	Nominal – Four-level scale
Information (through news) on the need to reduce consumption	INF_RED	Nominal – <i>Yes, No, I don't remember</i>
The importance given to measures for consumption reduction	IMP_RED	Ordinal – Scale 1-5
Energy label verification level	Q8	Ordinal – Scale 1-5
Willingness to initiate voluntary measures to reduce consumption	Q11, with sub-items Q11A-Q11D	Ordinal – Scale 1-5 (1-totally disagree; 5-totally agree)
The degree of importance perceived for certain consumption reduction measures	Q12, with sub-items Q12A-Q12K	Ordinal – Scale 1-5
Integrated consumption reduction measures	Q13, cu sub-itemi Q13A-Q13D	Dichotomous – <i>Yes, No</i>

Considering the structure of the questionnaire and the two objectives previously stated, the methodological approach consists in testing the significance (chi-square, ANOVA),

correlation analysis, and analogical methods of graphical representation of the data. The statistical description of the variables was carried out before each step was exposed in the construction of the objective argumentation. At the same time, we also considered it useful to aggregate certain sub-items to construct some variables that describe the overall effect. Consequently, a distinct methodological step consists of evaluating the consistency and reliability of the newly constructed variables, with the help of Cronbach's Alpha coefficient (1951), whose calculation relationship is shown in equation (1). In general, the threshold of 0.7 is considered an indication of consistently performed measurements.

$$\alpha = \frac{N * \overline{cov}}{\overline{var} + (N - 1) * \overline{cov}} \quad (1)$$

where:

N - represents the number of items included in the analysis.

(cov)⁻ - represents the average covariance of the items included in the analysis.

(var)⁻ - represents the average variance of the items included in the analysis.

3. Results and discussion.

Following the data pre-processing stages, 865 valid questionnaires were obtained from 902 completed questionnaires, with the following social structure of the respondents:

- 35% men and 65% women
- 74,79% of the respondents belong to the 18-25 age group, 7% to the 26-35 age group, 6,58% to the 36-45 age group, 9,36% to the 46-55 age group, and the difference to other categories.
- 80% of the respondents are single.
- 81.4% of the respondents are students, while 41% are employed (with a percentage of the two categories overlapping).
- 40% of respondents have completed higher education (bachelor's degree, master's degree, doctorate).
- The size of the family varies, and most of the respondents come from families of 2-4 members.
- 47% of the respondents have a declared monthly net income of less than 2000 RON, while 26% of them are in the 2001-4000 RON category.

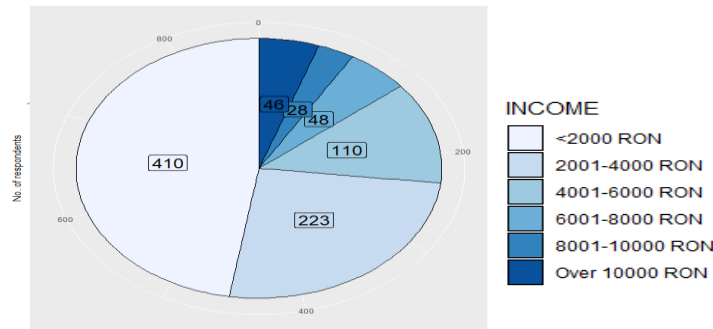


Figure no. 2. Distribution of income

Analysing the answers of the 865 people interviewed, it is found that, for most, the need to reduce electricity consumption is a current issue. Approximately 90.2% of the respondents stated that in the last six months they had heard / saw news that draws attention to the importance of reducing electricity consumption. At the same time, it is noted that, for the most part, respondents consider it very important to adopt measures to reduce energy consumption at the individual or household level (approximately 64.9% of the individuals surveyed). Regarding the recent European approach aimed at adopting measures to reduce gross electricity consumption by 10% and electricity consumption by 5% during peak hours, respondents have only limited knowledge. Only 7.7% of the respondents stated that they recognise these initiatives to a great extent, while 37.8% mention that they are informed to a small extent about these initiatives.

From the point of view of the electrical appliances present in the households of the respondents, a high frequency of appearance of classic electrical appliances, such as the freezer and refrigerator, the television, the washing machine, or the vacuum cleaner, can be found. Laptops and computers are also essential devices in Romanian households. More than 750 respondents out of a total of 875 say that they own such equipment. Somewhat less common household appliances are the dishwasher, the electric cooker, the coffee maker, or the espresso machine. Next, the analysis will be related to the research objectives, using various descriptive metrics and statistical methods to test significance.

In the study of the first objective, descriptive statistics were used for both supporting questions in the modeling of the consumption attitude (Table 2). The mean, median, standard deviation, the number of respondents who answered positively or with the maximum value on the scale (MAX_Resp), and the number of respondents who answered negatively or with the minimum value on the scale (MIN_Resp) were used. The variable INF_RED measures how informed the respondents consider themselves in the current economic context, and the variable IMP_RED evaluates the degree of importance they give to the energy situation. In this regard, 775 people believe that they have seen/ followed the news about the energy crisis, while 355 of them attach great importance to the implementation of measures to reduce consumption.

Table no. 2. Descriptive Statistics

ATTITUDINAL	Media	Mediana	STD_DEV	MAX_Resp	MIN_Resp
INF_RED	1.86	2	0.45	775	48
IMP_RED	3.91	4	1.15	355	42

To know the influence of the level of information on the adoption of voluntary measures to reduce electricity consumption, a three-stage procedure was approached, by performing an ANOVA test, bivariate analysis of correspondences, and studying the correlation matrix. Thus, the first step will be ANOVA analysis, used to determine the degree to which certain groups are significantly different. For the current question, we divide the respondents into two groups, depending on the level of information on the need to adopt voluntary measures to reduce consumption.

- **N1** – The uninformed group - those who do not know or have not heard news about the energy crisis recently – INFO_RED = 0 or 1.
- **N2** – The informed group - those who have heard news about this topic – INFO_RED = 2.

These groups will be analysed in relation to the degree of importance perceived by the respondents, to see if the level of information really determines the intensification of the perception regarding the necessity of action to reduce consumption. A methodological note is that the size of the two segments is different, the first group having 86 respondents, while the second 779, so the statistical results may be altered by this aspect.

Table no. 3. ANOVA test

Groups	Number	Sum	Average	Variance		
N1	86	314	3.651163	1.759234		
N2	779	3064	3.933248	1.268032		
Variation	SS	df	MS	Fstat	P-value	Fcrit
Between Groups	6.16282	1	6.16282	4.681529	0.030762	3.852257
Within Groups	1136.06	863	1.31641			
Total	1142.22	864				

According to the results (Table no. 3), we can see that the value of $F_{crit} < F_{stat}$, which means that we can reject the null hypothesis and accept the alternative hypothesis, so there will be significant differences between the two groups. Since the ANOVA analysis only illustrates that there are differences, but not their type, we can see from the average indicator that the importance given to this topic by N2, the informed group, will be higher (Table 4).

Table no. 4. Mean differentiated by groups

Groups	Average
N1	3.65
N2	3.93

Therefore, we can affirm that **the level of information positively influences the level of importance perceived by the population regarding the reduction of electricity consumption.**

Having established this aspect, we continue with a bivariate analysis of the correspondences, as well as with the study of the correlation between some variables. The items of the Q11 and Q12 scales were developed based on scales to evaluate electricity-saving behaviour, used in previous research (Boomsma et al., 2019; Krupnova et al., 2022). The component of adopting some voluntary measures to reduce electricity at the residential level was analysed, the scales being completed by the authors with items made according to the provisions of European legislation and the directions for implementing energy-saving behaviour. As a first step, we will study the relationship between the level of importance given to this topic (IMP_RED) and the willingness to initiate voluntary measures to reduce consumption (Q11), respectively, the degree of perceived importance (Q12).

As previously mentioned, involving two questions with multiple sub-items, the first step will be to develop the Cronbach alpha coefficient for both cases. The results of the statistical test illustrate good internal consistency, so we can conclude that the two variables can be used in the subsequent analytical process (Table no. 5).

Table no. 5. Cronbach's alpha coefficient estimation results

Variable	Question	Cronbach's Alpha
Willingness to initiate voluntary measures to reduce consumption	Q11	0.78
The degree of importance perceived for certain consumption reduction measures	Q12	0.89

In the following, the main descriptive statistics for questions Q11 and Q12 will be presented, respectively, the mean and the standard deviation, as well as indicators of the distribution: the coefficient of asymmetry and skewness (Table no. 6).

Table no. 6. Questions Q11 and Q12

	Sub-item	Mean	Standard deviation	Asymmetry	Skewness
Q11A	Minimising household energy consumption between 8:00 a.m. - 1:00 p.m. and 6:00 p.m. - 8:00 p.m.	2.83	1.33	0.13 (left)	-1.07 (platykurtic)
Q11B	Disconnecting electrical equipment from the source when not in use	3.62	1.44	-0.61 (right)	-1 (platykurtic)
Q11C	Limiting room lighting to a single bulb	3.52	1.41	-0.54 (right)	-1.02 (platykurtic)
Q11D	Replacement of large electrical appliances with small ones exactly adapted to current needs	3.15	1.36	-0.16 (right)	-1.11 (platykurtic)
Q12A	Bringing ready-to-use equipment out of standby	3.43	1.33	-0.36 (right)	-0.97 (platykurtic)
Q12B	Full use of washing and cooking machines	3.82	1.27	-0.79 (right)	-0.46 (platykurtic)
Q12C	Use of sunlight during the day. by removing the blinds	4.19	1.21	-1.42 (right)	0.93 (leptokurtic)
Q12D	Closing devices when not in use (TV, laptop, radio, Internet, console, espresso machine, coffee maker, etc.)	4.18	1.17	-1.35 (right)	0.85 (leptokurtic)
Q12E	Unplugging power supplies from outlets when not in use	3.53	1.44	-0.49 (right)	-1.1 (platykurtic)

	Sub-item	Mean	Standard deviation	Asymmetry	Skewness
Q12F	Replacement of light bulbs with long-lasting and economical lamps	4.04	1.21	-1.06 (right)	0.07 (mezokurtic)
Q12G	Using programmes that save electricity for washing clothes and/or dishes	3.72	1.23	-0.7 (right)	-0.44 (platykurtic)
Q12H	Abandoning sources of artificial drying of laundry/dishes	3.8	1.35	-0.77 (right)	-0.66 (platykurtic)
Q12I	Giving up the use of several household appliances with the same destination and creating common spaces for use	3.39	1.38	-0.38 (right)	-1.05 (platykurtic)
Q12J	Closing internet access on devices when they are not in use	2.93	1.48	0.03 (symmetric)	-1.37 (platykurtic)
Q12K	Maintaining, in the cold season, an average room temperature of 19 degrees Celsius.	2.76	1.42	0.19 (left)	-1.21 (platykurtic)

After the statistical analysis, a correlation analysis was performed based on the matrices (Figure 3). Positive direct coefficients are observed both between the perceived general degree of importance (IMP_RED) and the willingness to initiate measures to reduce consumption (Q11), as well as between this general level and the specific importance given to individual saving measures (Q12). Therefore, we can say that this perception will positively influence energy behaviour.

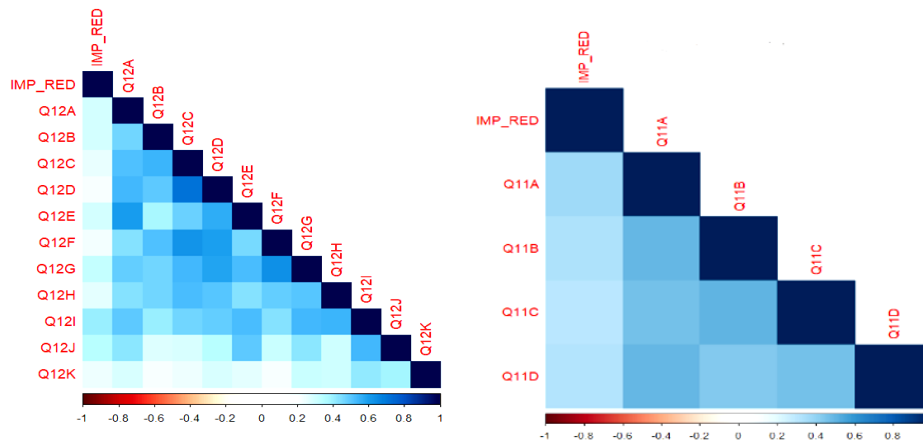


Figure no. 3. Correlation matrix – IMP_RED and voluntary availability (Q11) IMP_RED and perceived importance for certain measures (Q12)

The next stage aims to test the association between the level of information and the adoption of voluntary measures to reduce electricity consumption. Thus, we performed a bivariate correspondence analysis, applied in turn to the variables considered relevant for this purpose.

According to the results highlighted (Table no. 7), it is noted that the level of information of the respondents regarding the need to adopt measures to reduce electricity consumption directly and significantly influences their willingness to reduce individual electricity consumption (or at the household level), as well as the extent to which individuals appreciate that they could ensure a reduction in consumption. These aspects are confirmed by obtaining

significance thresholds (*p-value*) below 5% in the case of verifying the associated hypotheses.

Consumers' intention to implement energy-saving initiatives, as well as the extent to which they estimate that they can achieve savings, is influenced by respondents' beliefs and awareness that these actions are important. It can be stated that **the level of importance perceived by the population is significant in initiating change in consumer behaviour**, and this can be achieved through massive information campaigns, with an emphasis on the impact and direct consequences of inaction.

Table no. 7. Testing the relationship between the degree of information and the availability of applying voluntary measures to save electricity

Hypothesis tested	The chi-square statistic	p-value
Information from the media about the need to reduce electricity consumption influences the willingness to voluntarily reduce electricity consumption.	621.03	0.000
Knowledge of the European approach to the adoption of measures to reduce electricity consumption influences the availability of voluntary reduction of electricity consumption.	537.12	0.721
Media information about the need to reduce electricity consumption influences the extent to which respondents estimate that they could reduce individual electricity consumption.	428.01	0.021
The belief in the importance of adopting measures to reduce consumption influences the willingness to voluntarily reduce electricity consumption.	592.74	0.000
The belief in the importance of adopting measures to reduce consumption influences the extent to which respondents estimate that they could reduce individual electricity consumption.	608.23	0.041

To achieve the second objective, we used the Q13 scale, developed based on items used in previous research (Rahbar and Abdul Wahid, 2011; Testa, Cosic, and Iraldo, 2016; Never et al., 2022), in order to identify the component that involves financial investments in energy saving behaviour. The responses to the Q13 scale in the questionnaire indicated four types of action, described statistically (Table no. 8) and from the point of view of results (Figure no. 4).

Table no. 8. Question Q13, integrated consumption reduction measures

	Sub-item	Mean	Standard deviation	Assymetry	Skewness
Q13A	Installation of solar panels	0.12	0.32	2.37 (right)	3.64 (leptokurtic)
Q13B	Purchasing smart devices	0.29	0.45	0.95 (right)	-1.1 (platykurtic)
Q13C	The purchase of electrical equipment with the A+ energy label	0.51	0.5	-0.03 (symmetric)	-2 (platykurtic)
Q13D	Thermal insulation of the home	0.49	0.5	0.04 (symmetric)	-2 (platykurtic)

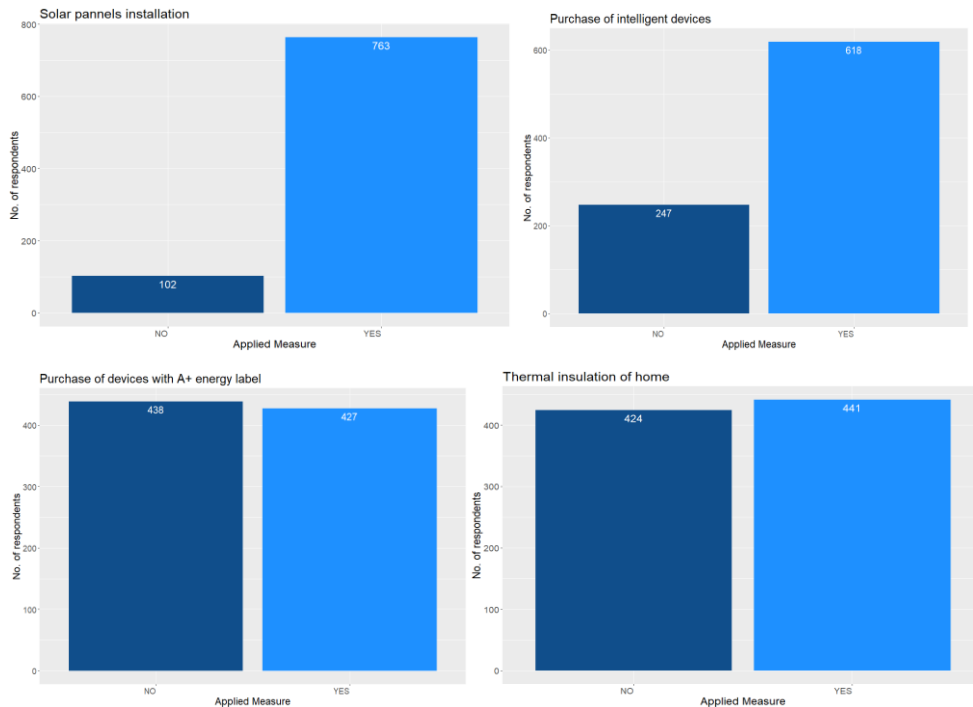


Figure no. 4. Measures applied to reduce consumption (Q13)

Therefore, it is observed that the most frequent actions taken will be those related to thermal insulation in the home or the purchase of class A electronic devices (where approximately half of the respondents are found). In addition to the last aspect, item 8 of the questionnaire refers to the degree of verification of the energy label (Table no. 9), at the time of a new purchase, it is observed that 357 respondents check this aspect with maximum frequency, representing a first ecological habit that has entered consumption behaviour and which has the direct consequence of reducing electricity consumption (Figure no. 5).

Table no. 9. Question Q8 - integrated consumption reduction measures

	Sub-item	Mean	Standard deviation	Assymetry	Skewness
Q8	Energy label verification level	3.6	1.44	-0.53 (right)_	-1.1 (platykurtic)

Regarding the observed behaviour, in the following, we will illustrate the degree to which measures to reduce consumption are implementable, taking into account two criteria: the willingness to initiate measures (Q11) and the level of perceived importance (Q12). The conclusions are that disconnecting household appliances from the source and limiting lighting when the space is not inhabited represent actions that the respondents believe they will undertake easily in the future, an aspect also found in the analysis of the level of importance of other measures with a similar message.

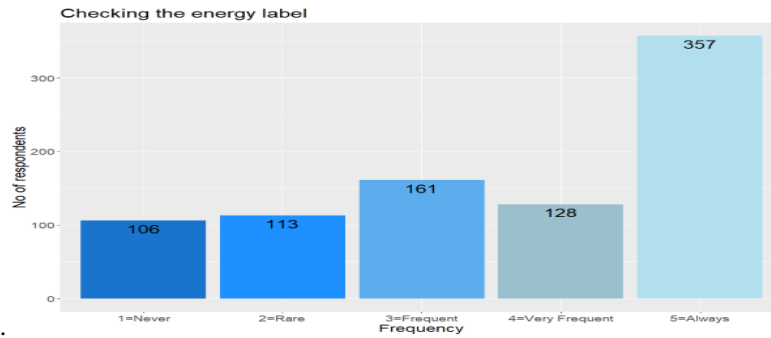


Figure no. 5. Energy label verification level

From the analysis of the research results, the main conclusions regarding consumption behaviour at the residential level are shown in Figure no. 6:

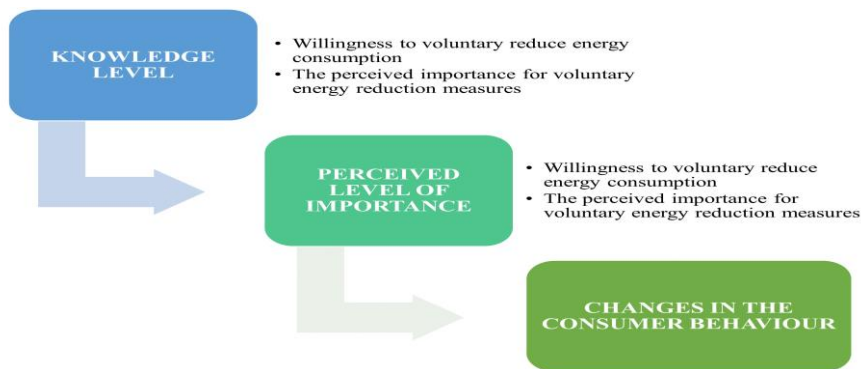


Figure no. 6. Description of factors affecting consumption behavior

The first valuable observation is that the level of information will positively influence the level of importance perceived by the population; in other words, the more connected citizens are to the topic of reducing consumption (by listening to and searching for news on the topic), the more they will understand the seriousness of the context and the urgent need to implement mitigation measures. Massive information campaigns that focus on the direct consequences of inaction will be crucial to the success of the REPowerEU plan. Following the logical course, the second conclusion illustrates that the level of perceived importance will be significant for the adoption of new voluntary measures, for the more optimistic estimate of the potential for consumption reduction, and finally for the change in consumption behaviour. This change in behavior will take shape through the introduction of voluntary ecological practices, such as: checking the energy label, thermal insulation of the home, or purchasing electronic devices of the A energy class.

The usefulness of the results obtained from the processing in the Python and R environments resides in both the qualitative and numerical multiple-choice questionnaire questions. The preliminary hypotheses tested with specific methods proved to be correct in the vast majority.

Conclusions

Approximately one third of the annual energy consumption in Europe belongs to domestic consumers. The RePowerEU strategic directives highlight the fact that any social, economic, or ecological approach that can prevent an acute energy crisis or have beneficial effects on the European energy policy in the coming years, constitutes an example of good practices for the transition to the green economy. Although there is no special chapter that makes an exact reference to the need to change the behaviour of household energy consumers over time, the new strategic plan suggests that the competent institutions in each EU member state must act in the direction of informing and supporting citizens regarding the more efficient solutions for the production, management, and consumption of energy. Voluntary measures have the quality of recommendations that, systematically applied over time, can change states and form habits.

The study carried out by the authors, with the objective of knowing the attitude, behaviour, and future intentions of Romanian consumers in relation to voluntary measures aimed at reducing energy consumption, was based on the processing, through descriptive statistics and structural analysis, of the information collected from the market. The analysis of the results led to the formulation of three relevant conclusions for the socio-economic context and for the discussions initiated by the REPowerEU plan. The first conclusion of the research, appreciated as an original contribution of the authors to scientific literature, refers to the essential role of information in the population's awareness of the importance of reducing electricity consumption. As a result, information campaigns on policies to promote energy consumption according to sustainable criteria could contribute considerably to increasing the level of knowledge about how individual consumers can support savings actions through measures that will lead to behavioural changes.

The second original conclusion derived from the research reveals that the degree of importance given by the sample population to the adoption of measures to reduce electricity consumption significantly influences consumer behaviour. Evidence in this regard is represented by the third conclusion of the investigation, namely determining the use of voluntary ecological practices in the purchasing behaviour of electrical household equipment, the most frequent being the check of the energy label. An increase in quality of life is associated with a wider access of the population to services and consumer goods.

The study showed that saving energy by completely or partially renouncing some of these benefits is not a solution. However, there is an almost unanimous willingness on the part of the responding household consumers to implement some voluntary measures regarding the reduction of electricity consumption: thermal insulation of buildings, the purchase of electrical equipment and appliances with a low consumption index, the reduction of energy consumption during peak hours, the installation of intelligent systems for heating, ventilation, and air conditioning, cutting off the power supply to household appliances when they are not used as intended, installing thermostats to control the temperature in the room, using intelligent lighting systems, participating in climate neutrality, orienting towards some alternative sources of energy (solar panels, wind energy, thermal energy, etc.). Therefore, we can conclude that the main factors that lead to the actual change in consumer behaviour will be the level of information and the level of importance perceived by the respondents, these being the defining factors for the success of any national and regional initiative. Such an analysis and association of consumption practices at the household level (approaches regarding home insulation, use of alternative sources of electricity, consumption control, etc.)

with the characteristics of purchasing behavior, with the level of information and the importance given by citizens to the policies of transition to green energy have not yet been realised in the scientific literature. Through this research, we have managed to develop new ideas and generate new research niches.

A future direction of research may consider the analysis of behavioural changes, under the influence of new factors. To increase the precision of the results, the sample will include a larger number of respondents and the sample structure can be diversified. Another direction of research will aim to answer the following question: Can the success of the adoption of voluntary measures to reduce household electrical energy consumption be associated with the level of purchasing power existing in Romania and with policies regarding increases in electricity prices?

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