Environmental Energy and Economic Research 2021 5(3): S017
DOI 10.22097/eeer.2021.277525.1189

Research Article

Energy Literacy and Energy-related Financial Literacy in Iran: Case of Northwestern Academic Community

Davoud Hamidi Razi, Reza RanjPour [*], Mohammad Ali Motafakker Azad

University of Tabriz, Tabriz, Iran

Received: 22 January 2021 /April: 10 May 2021

Abstract:
Empowering citizens is the most effective way in order to make effective decisions to speed up energy conservation in residential sector. The aim of this study is to investigate the impact of economic and financial literacy on energy literacy and energy awareness in the north west of Iran. The study population consisted of employees and professors of universities in the three provinces of East Azerbaijan, West Azerbaijan and Ardabil that were completed and analyzed 500 questionnaires after sampling. According to the results of Logit model, economic and financial literacy had a significant and positive effect on energy literacy index (selection of heating systems A and B) and energy awareness (energy bills or costs awareness) and the result was confirmed in all the estimation models for three carriers. As the area of the house's infrastructure area increases, energy literacy increases. Education and age have a negative and positive effect on energy awareness, respectively. The results suggest that investing in promoting energy-related economic and financial literacy for citizens to stimulate energy savings.
Keywords: Energy Literacy, Energy Awareness, Economic Literacy, Energy Conservation, Discrete Models.

Introduction

In Iranian economy, both residential and transport sector have the highest share in the final consumption of energy (Iran's Energy Balance Sheet, 2018). The high share of Tertiary sector in energy consumption along with the high energy intensity index indicates the great potential of energy saving in Iranian economy (Mohammadi et al., 2019). Iranian policymakers are currently making priority to manage the energy consumption with price related policies and increasing the market price of energy carriers. Experiences have shown that pricing policies not only are ineffective enough but also leads unrest and social protests. The weakness of institutional and economic infrastructure, the existence of a structured inflation and a constant depreciation are some of the key elements that make price related policies ineffective in Iran. Therefore, it is necessary to use cost-effective policies that stimulate reforms in the energy consumption pattern. One of the most effective non-tariff strategies to stimulate energy savings is to promote energy literacy and awareness of citizens to choose energy efficient appliances (Brounen et al. 2013; Ameli and Brandt, 2015; Van den Broek et al., 2019;

[*] Corresponding author E-mail: reza.ranjpour@gmail.com

Akroush et al., 2019). The lack of interest and inclination to choose and use energy-efficient equipment is often referred as the energy efficiency gap. According to the literature, energy efficiency gap due to behavioral and structural (market) failures prevent economic agents to opt energy-efficient equipment, even if they believe that that equipment is effective in terms of cost (Broberg and Kazukauskas, 2015). Structural barriers result from the actions of public and private organizations, and are usually beyond the control of the individual energy end user but behavioral barriers are problems that characterize the end-user's decision-marking relating to energy consumption (Hirst and Brown, 1990).

According to economic assumptions, in order to choose between two similar energy-consuming devices, a rational consumer must solve an optimization problem for selecting a device that minimizes the sum of purchase prices and the present value of future energy costs. In addition to the numerical skill, this optimization requires knowledge about the prices of equipment, intensity (frequency of use of means), and present and future of price energy carriers. Consumers incur two types of "information" and "optimization" costs (Conlisk, 1988). Therefore, in order to perform optimization, the consumer must collect the information required and then process this information in effective way.

Taking into account the above mentioned statement, one of the essential prerequisites for rational decision-making in choosing between multiple energy-efficient appliances and effective energy consumption is energy literacy. According to existing literature, energy literacy is defined as a comprehensive concept that has cognitive, emotional, and behavioral dimensions (DeWaters and Powers, 2011). DeWaters and Powers (2011) define energy literacy thus includes (1) knowledge about energy production and consumption as well as its impact on the environment and society, (2) attitudes and values towards energy saving and (3) change in behavior and action in order to saving energy. It will also be more interested in saving energy if citizens know how to consume energy and its cost (Scott, 1997). many factors including age, gender, income level affect the energy literacy of citizens, which have been studied and measured by many empirical studies (DeWaters and Powers, 2011; Cotton et al. 2015). One of the important variables recently considered is economic and financial literacy. Economic literacy affects energy conservation both directly and indirectly. This is also considered by the concept of "Financial related energy Literacy" (Brounen et al. 2013; Sovacool and Blyth, 2015; Van den Broek, 2019).

In this paper, energy literacy, energy awareness and economic (financial) literacy were measured through the survey approach and questionnaire. In order to measure energy literacy, such as Brounen et al. (2013), the question of calculating the final price of alternative heating systems was asked from respondents. This question has been designed to assess whether the respondents are willing and able to make a trade-off between long-term savings from a more expensive heating system with the short-term benefits of buying a cheaper, less efficient model that is associated with higher energy consumption. In order to measure energy awareness, questions were asked about household's energy expenditure (monthly energy cost). Also, Lusardi and Mitchell (2011) have provided a credible basis for assessing the level of economic (financial) literacy which in research researchers has use it. The main contribution (or innovation) of this study is econometrically modeling of energy literacy, energy awareness and energy-related financial literacy in the Iranian economy. The concept of energy-related financial literacy in Iran has received less attention and there is a lot of research work to be done in this area.

The rest of this paper is organized as follows: the next section is literature review. The third section describes the research methodology and data. The empirical findings have been studied in the fourth section. This section contains descriptive and econometrical evidences. The fifth section is devoted to the conclusion and recommendations for researcher and policymakers.

Literature review

In the economic literature, econometric models used to predict consumer behavior have limiting assumptions, and over-reliance on these models can lead to erroneous statistical and policy implications (Kahneman, 2003; Shleifer, 2012). In this regard, the emergence of a new branch of economics called behavioral economics and cognitive economics that questions the purely consumer rationality increase the need to pay attention to other factors influencing consumer behavior such as beliefs, preconceptions, heuristics and culture (Andor and Fels, 2018; Mohammadzadeh et al. 2017). Consumer behavior is complex and rarely adheres to conventional (classical) economic assumptions. According to empirical literature, people are routinely deviated from the "rational choice" model of human behavior. In this regard, many studies show that consumer behaviors and choices are largely stimulated by cognitive biases, heuristics, and other "predictably irrational" tendencies (Frederiks et al. 2015). Generally, there are two questions about consumer response to energy carrier price changes:

1) How does information beyond a price enter into consumer awareness?

2) How does awareness of price levels affect people's behavior?

Considering each of the above mentioned questions can assist the researchers and policy makers to find the optimal portfolio of policies to modify the energy consumption pattern. One of the key factors beyond the price of energy carriers that affect Citizens energy consumption behavior is their energy awareness and literacy (Brounen et al. 2013; Ameli and Brandt, 2015; Van den Broek et al., 2019; Akroush et al., 2019). Energy literacy is a broad term that includes content knowledge as well as a citizen's understanding of energy that includes emotional and behavioral aspect (DeWaters and Powers, 2013). In the evaluation of energy literacy, three areas of cognitive (knowledge, cognitive skills), emotional (attitude, values, personal responsibility), and behavioral attitudes are generally considered. The "cognitive domain" is divided into the level of knowledge, abilities, and mental skills. The cognitive domain is concerned with processes such as knowing, recognizing, and understanding, thinking, reasoning and judging. According to education theory, when the instructor is concerned about solving a problem with the student, his or her concern is with the cognitive domain. Therefore, in teaching the concepts of energy management training, energy conservation optimization strategies such as insulation calculation, optimization for choosing between two energy consuming devices, boiler thermal analysis, and analysis of information collected from energy audits are related to cognitive domain (DeWaters and Powers, 2013; Martins et al. 2020). In the cognitive section, one of the important questions to ask about how to calculate the cost of two energy goods A and B is:

"Imagine you own a home and your heating system is defective. To replace it, you have two choices. Model A is priced at 3000 USD and monthly bills are 100 USD and Model B is slightly more expensive and costs 5000 USD but monthly bills are 80 USD. Suppose the shelf life of both models is 15 years. Which heating system do you prefer?"

The purpose of this question is to measure the ability of respondents to calculate the cost and how to trade-off between short-term and long-term benefits of choosing energy-efficient appliances. It is worth noting that in some studies the question is referred to as "energy-related financial literacy" (Brounen et al. 2013; Blasch et al. 2017). Energy awareness is also one of the issues that have been in the focus of empirical studies. It is known as awareness of energy and the amount of monthly energy consumption and its cost. In general, citizens will be more interested in saving conservation if they are aware of how energy is consumed and how much it costs (Scott, 1997).

According to empirical studies, many factors such as age, sex, income level, etc. have impact on citizens' energy literacy and awareness. One of the variables that have recently been taken into consideration and its impact on energy literacy is "economic and financial

literacy" (Blasch et al. 2017; Brounen et al. 2013). How information beyond energy (carriers) prices affects the pattern of consumption of citizens is very diverse and complex; one of them is the level of economic literacy of citizens. Economic literacy includes things like how citizens perceive concepts such as scarcity, savings, understanding and interpretation of relative prices, how citizens perceive and analyze macroeconomic data, and so on (Chytilova, 2017; Jappelli, 2010). In empirical economic studies, economic literacy has also been considered financial literacy, but economic literacy is much broader than financial literacy. Financial literacy encompasses concepts such as financial awareness, knowledge of financial products and financial institutions, or concepts such as financial skills such as the ability to calculate compound interest rates and overall financial ability in money management and financial planning (Dianati Dilami and Hanifezadeh, 2015). Lusardi and Mitchell (2011) state: "*While it is important to assess how people are financially literate and what their characteristics are, it is also in practice to research how people process economic information and how they make informed decisions about their family finances is difficult*". Therefore measuring financial literacy alone is not a quantitative issue. Financial literacy questions often seek to test people's understanding of the three basic fundamentals of "compound interest", "inflation" and "risk avoidance". The first two requires numerical literacy, while the third requires familiarity with the concepts of equity and mutual funds (Lusardi and Mitchell, 2011). Although the usefulness of questions of financial literacy has been at least controversial in their own concepts, it has provided a useful basis for comparison across countries. Promoting economic and financial literacy helps citizens understand the concepts of scarcity, savings, how to optimize between commodities, and interdisciplinary optimization, and empower citizens to make wise decisions in all matters including energy production and consumption. Most countries today are sensitive to any weaknesses in understanding the concepts and skills of economic decision-making and analysis and are preparing programs to tackle them from elementary to university through formal and informal programs (Lusardi and Mitchell, 2011; Chytilova, 2017).

There are rich and growing literature on energy literacy and energy-related financial literacy (Hassan et al. 2009; Nair et al. 2010; Kalmi and Trotta, 2017; Trotta, 2018; Mola et al. 2018; Pelenur, 2018; Martins et al. 2021). Brent and Ward (2018) investigated the effect of the relationship between financial literacy and energy efficiency. By designing an online survey of 1385 people in Australia (Melbourne) and using discrete models and mixed logit estimators, they found that the financial literacy makes choices more consistent with standard consumer preferences, and low financial literacy reduces the willingness to invest in energy efficiency. Also, Blash et al. (2017) examined the interaction between the limited rationality of consumers, the level of energy literacy and investment literacy, and how energy information is displayed on household energy appliances and equipment among samples 583, 877 and 1996 Families from three important urban areas of Switzerland. For this purpose, they used a two-way model and estimator of probit. According to the results: 1) The necessary condition for achieving maximum energy efficiency is rational decision-making, 2) Consumers with limited rationality, when buying energy devices, use non-standard revelations and patterns, 3) the high level of energy literacy and investment literacy leads to rational decision-making. Brounen et al. (2013) used a detailed survey of 1,721 Dutch households to measure awareness and conservation behavior in energy consumption. According to results energy literacy and awareness among residential households is low. Also, 40 percent of the sample does not appropriately evaluate investment decisions in energy efficient equipment. Boogen et al. (2021) analyzed the level of efficiency in the use of electricity in the European residential sector relying on a cross-sectional data set comprised of 1375 households located in Italy, the Netherlands, and Switzerland and observed in 2016. They also linked energy efficiency to energy-related financial literacy. Their results showed

that while energy-relevant knowledge per se does not play a significant role, stronger cognitive abilities are associated with higher levels of energy efficiency. Martins et al. (2021) evaluated energy literacy levels, considering the entire dimension (attitudes, intentions and behavior), and investigated for the determinants of these levels. After distributing a questionnaire to the university community in Portugal, they confirmed that good levels of energy literacy, despite moderate levels of energy and financial knowledge. Also, Gender seems to be a determinant of all energy literacy dimensions, and financial knowledge has a positive and significant impact on energy knowledge.

Trotta (2018) investigated the socio-demographic, dwelling, and environmental factors that have the strongest influence on the daily energy-saving behaviours, the adoption of energy efficient appliances and the energy efficient retrofit investments made by British households. To this end, he applied nonlinear principal components analysis (NLPCA), ordinary least squares (OLS) regression, and probit models. The results show different household profiles with specific features driving daily energy-saving behaviours and energy efficiency investments. Environmental variables are a good predictor of both energy-saving behaviours and investment in energy efficient appliances but not of energy efficient retrofit measures. Results of income and dwelling type variables with regard to energy-saving behaviours and energy efficient retrofit investments significantly diverge; in addition, interesting patterns emerge with respect to the respondents' age, sex, and marital status. Cotton et al. (2015) investigated students' energy literacy at a UK university, and recommends ways in which it can be enhanced using a behaviour change model. This research utilised a mixed-methods approach including an online survey (with 1,136 responses) and focus groups. The results identified strengths and weaknesses in students' energy literacy, and noted the relative influence of formal and informal curricula. The potential for aligning these curricula is highlighted through the 4Es model of enable, engage, exemplify and encourage. In another study, Martins et al. (2020) by using Principal Component Analysis (PCA) created an energy literacy index, as well as the indices for each of the energy literacy dimensions (Knowledge, attitude, and behavior). They also investigated which factors influence energy literacy levels among Portuguese university members. The results obtained showed the influence of gender in energy literacy, verifying that, although women have less knowledge, they demonstrate a more positive attitude and more correct behavior. Reis et al. (2021) assessed the influence of end users' literacy (including proficiency on energy-related topics, numeracy, and graphical literacy), the decision style, and the way electricity tariffs information is framed, on the willingness to adopt time-differentiated tariffs (TDT). To this end, an exploratory online survey was conducted between March and May 2018 to a convenience sample of 340 Portuguese university students who, although not being representative of the whole population, are illustrative of the next generation of more literate energy end users. Results highlighted the role of energy literacy as a crucial factor in facilitating the readability and understandability of TDT information and in encouraging end users to adopt TDT schemes. The different dimensions of energy literacy showed to influence the results differently as worse numeracy and graphical literacy levels were correlated with a lower willingness to adopt TDT. Results also revealed the relevance of the framing effect in the end users' willingness to enroll in TDT and socio-demographic parameters (as age and housing) emerged as relevant factors influencing the willingness to adopt such pricing schemes. These results convey further information for the design of more effective energy policies aiming to promote end users' energy literacy and empowering them to make more informed decisions.

Inside Iran, few studies have focused on energy literacy and energy-related financial literacy, and most of these issues have been discussed in the context of environmental literacy. Bahrami (2020) analyzed the content of the first-grade students' textbooks in terms of the amount of their attention to the topic of energy in Iran. The indicators were used to

analyze the content of the textbooks are based on the Powers and De Waters (2013) definition of energy literacy. The results of data analysis show that the environmental issues and the importance of energy in the individual and social life of the people have not been paid much attention. Ghaemi et al. (2014) investigated the level of environmental literacy of government employees in order to select the most appropriate education method. It was found that government employees have a positive attitude and proenvironment but in terms of their cognitive and environmental behavior level is low. The research demonstrated that selftraining packages in the form of audio–video materials are the most appropriate technology for training on environment for government employees. Also, Zainali et al. (2016) investigated energy literacy training in order to operationalize environmental behavior among female high school students in Maragheh. The results showed that 21.9% of students have low energy literacy, 68.9% have moderate energy literacy and 9.1% have good energy literacy. The data also show that there is a significant and positive relationship between energy literacy and energy saving and environmental protection. According to this study, the higher the level of energy literacy among students, leads to energy savings and environmental behavior. Naderi et al. (2017) in their study examined the status of energy literacy among the region 19 citizens of Tehran and its relationship with cultural consumption. The findings of their research shows that the energy literacy rate among respondents in cognitive dimension is low, and this rate (energy literacy) in behavioral and effectiveness dimensions are relatively high. Also, there is correlation between energy literacy (efficiency, behavioral and cognitive dimension) and cultural consumption. Hamidi Razi et al. (2020) have investigated the status of energy literacy (in three dimension of cognitive, emotional and behavioral) in the northwest of Iran by Tobit estimator. The results showed that financial and economic literacy has a positive and significant effect on two cognitive and emotional dimensions of energy literacy, while carrying insignificant effect on its behavioral dimension. Therefore, the hypothesis of the energy efficiency gap is confirmed among the statistical sample of the study. As it mentioned, the main contribution of this study is econometrically modeling of energy awareness and energy-related financial literacy in the Iranian economy. In this research, the Logit estimator is used and in addition to energy-related financial literacy, energy bill awareness is also modeled.

Data and methodology

Statistical population and Sampling

The main approach of this research is questionnaire survey. In this study, DeWaters and Powers (2013) basic energy literacy questionnaires and Lusardi and Mitchell (2011) Economic and Financial Literacy Questionnaire were localized and validated by energy and economic experts (10 energy experts at the Institute of International Energy Studies and 10 economic experts) approved. The reliability of the questionnaire was also assessed by Cronbach's alpha (0.84) indicating that the questionnaire has acceptable reliability. The statistical population of this study includes all staff and professors working in state and private universities which are located in provinces of East Azerbaijan, West Azerbaijan and Ardabil. This statistical population has been selected for 3 reasons: 1) the focus of this study is on heads of households and parents; ultimately, these pay the cost of energy bills and make the final decision about choosing energy-efficient appliances. Also, the parents have more influence over other family members. 2) The type of questions asked in the questionnaire was such that the academic community had a better participation in the pre-test than other people. 3) In this study, we had a regional view and tried to achieve an acceptable estimate of energy literacy and its determinants in the northwestern region of the country. This idea was

reinforced by the fact that according to some empirical studies, regional energy policy-making is more efficient than centralism and unit policy-making (Seif and Hamidi Razi, 2017).

The study population consisted of approximately 7540 employees and professors. According to the Cochran formula, 500 people based on the formula of Cochran sampling and a multi - stage cluster sampling method were selected. It is noteworthy that the pilot study was initially carried out using 60 questionnaires (6 for each university and 10 for each university) where the variance of the studied trait (energy literacy) was estimated to be 0.32 and then by incorporating it into the formula Cochrane was obtained below sample size:

$$\mathrm{n} = \frac{Nt^2s^2}{Nd^2+t^2s^2} = \frac{7540\times1.96^2\times0.32}{[(7540\times0.05^2)+(1.96^2\times0.32)]} \cong 462 \approx 500 \quad (1)$$

As can be seen, the estimated sample size of the Cochran formula was 462, which was increased to 500 by the researchers to increase the accuracy of the research. As mentioned, multi-stage cluster sampling was used in this study and the number of questionnaires distributed in each university was calculated by multiplying the weight (ratio of the statistical population of each university to the total statistical population of that university) at 500.

Econometric model

By adjusting the models used in the studies of Blash et al. (2017) and Brunen et al. (2013), the following econometric models is used in this research to model the effects of factors affecting energy literacy and energy awareness:

$$EL_i = \alpha_i+\beta_1 FL_i + \beta_2 D_i \ +\varepsilon_i \quad (2)$$

$$EA_i = \alpha_i+\beta_1 FL_i + \beta_2 D_i \ +\varepsilon_i \quad (3)$$

Where i represents the respondents to the questionnaire (i = 1, 2, 3 ,…, 500), EA_i is energy awareness indicator for each respondent divided into two groups of 0 and 1 (0 indicates no awareness of energy costs and 1 indicates awareness of energy costs for three carriers (electricity, natural gas and gasoline). FL_i is financial and economic literacy index for each respondent between 0 and 1, calculated from the ratio of the number of correct questions to the total economic and financial literacy questions (in percentages between 0 and 100). D_i is the vector variables include age, sex, education, house area, house worship and income level. Also $\boldsymbol{\varepsilon_i}$ indicates the disruption component for modeling the shocks and the effect of the variables are not included in the model.

According to the type and quality of dependent variables, in this research, the logit estimator is used to model and extract the coefficients. In statistics, the logistic model (or logit model) is used to model the probability of a certain class or event existing such as pass/fail or win/lose (Cramer, 2003).

Empirical results

Descriptive statistics and preliminary analysis

About 500 respondents answered the questionnaire which 36% were women and 64% were men. Other details of context variables include:

- 14% are 18-29 years old, 46% are 39-30 years old, 31% are 40-49 years old, 8% are 59-50 years old and 1% is 60 years old or older.
- 6% have primary school diploma, 29% have bachelor's degree, 34% have master's degree and 30% have PhD (almost 1% did not answer).
- 10% of respondents have a house area (or apartment) of less than 80 square meters, 49%

with a home area of 80 to 120 square meters, 34% have a home area 120 to 200 square meters, and 7 percent have a home area (or apartment) of more than 200 square meters.

- 31% of respondents own private villa, 47% live in their own apartments, 16% live in rental housing, 3% live in rental housing (only deposit), 1% live in complex (free state complex for state employees), 1% live in free housing, 1% have other options.
- 11% of respondents have one room, 57% have two rooms, 27% have three rooms and 4% have more than 4 rooms. 1% either do not have a room or did not answer the question.
- 5% of respondents to the questionnaire, earn less than one million two hundred thousand Tomans, the income of 20% is one million and two hundred to two million Tomans, the wage of 34% respondents is between 2 million Toman to 3 million Tomans and 41% earn more than 3 million Toman.

According to the results, the mean energy literacy index among the respondents was 0.69. So it can be said that 69% of respondents' answers to choosing a heating system, were correct. As mentioned before, energy awareness in this study was measured by informing citizens to the cost of the bills of the three carriers of electricity, gas and petroleum. According to the results of energy awareness indicator for carrier's electricity, gas and petroleum are 72%, 73% and 73% respectively (Table 1).

Table 1. Descriptive statistics of energy literacy and awareness

Varies	Frequency	Mean	Standard deviation	Minimum	Maximum
Energy Literacy Index (Heating System Selection)	500	0.69	0.46	0	1
Energy Cost Awareness (Electricity)	500	0.72	0.45	0	1
Energy Cost Awareness (Natural gas)	500	0.73	0.44	0	1
Energy Cost Awareness (Gasoline)	500	0.73	0.45	0	1
Economic and Financial Literacy	500	0.48	0.26	0	1

Results demonstrate that the energy awareness was higher among respondents and particularly men were more aware of energy costs and bills than women.

Figure 1 shows the distribution of respondents in terms of economic and financial literacy questions. As observed among the respondents (staff and university professors), the concept of inflation and the exchange rate are well understood. Respondents for the question related to macroeconomic data analysis have the least performance. In this question, they were asked to guess the average annual per capita share of Iranian citizens in oil revenues, which only 26% of respondents responded correctly and the rest (74%) selected wrong answer and or I don't know option. in response to risk avoidance (stock exchange and securities)only 37% of respondents were correct. The average economic and financial literacy index for men is higher than for women.

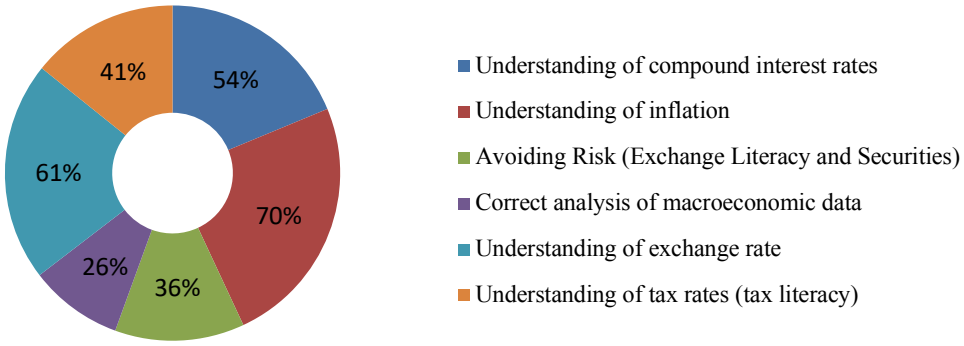

Figure 1. Distribution of respondents in terms of economic and financial literacy questions.

In terms of the sample and statistical population (university staff and professors) who are well educated and often have university education, the economic and financial level is low. The analysis of macroeconomic data proves that the citizens of the statistical sample of the research generally have experiential assumptions that they rely on them when making decisions rather than calculating and assessment. Therefore, some of the citizens' economic assumptions are biased and far from reality.

Model Estimation Results

The variables of energy literacy and energy awareness in this study considered as dummy variables (zero or one). Logistic estimator was used to determine the extent of the influence of explanatory variables on the survey data. In the Logit model, the coefficients are interpreted as Odds Ratio and some transformations must be made to achieve the final effects (Williams, 2012).

Energy Literacy Model (Heating System Selection)

Table 2 represents the results of estimation for the dependent variable of energy literacy (selection of heating systems A and B). It is clear that, economic and financial literacy has a positive and significant effect on energy literacy in all estimated models, and as economic and financial literacy increases, the probability of correct answer to the question of heating system's selection increases. Also, in the main model, the area of the house has a positive and significant impact on energy literacy, and by increasing the area of the house, citizens have correctly calculated the cost of heating systems. This conclusion is in line with the studies of Blasch et al. (2017) and Brounen et al. (2013), in which financial (and economic literacy) leads to the correct calculation of the final cost. Also, the positive effect of financial literacy on energy literacy and in contrast to the insignificant effect of education level on energy literacy indicates that formal education does not necessarily lead to improved decision making and energy literacy.

Table 2. Regression results, Energy Literacy (Logit Model)

	Overall	**Among Tenants**	**Among owners**
FL	1.87 [0.47]***	1.58 [0.87]*	2.09[0.56]***
Y	-0.14 [0.13]	-0.53 [0.27]*	-0.02 [0.14]
Sex (Male=1 and Female= 0)	-0.31 [0.24]	-0.97* [0.50]	-0.13 [0.27]
Age	0.07 [0.13]	0.93 [0.34]***	-0.10 [0.14]
Edu	0.09 [0.12]	0.25 [0.25]	0.04 [0.14]
House Area	0.37 [0.14]**	0.65 [0.32]**	0.31 [0.17]*
House Ownership (1-0)	-0.03 [0.25]	-	-
Constant	-0.95 [0.73]	-2.50 [1.47]*	-0.73 [0.86]
F (7, 483)	3.91 (0.000)***	2.48 (0.028)**	3.42 (0.003)***
goodness-of-fit test (Hosmer-Lemeshow)	0.96 (0.472)	0.67 (0.730)	0.70 (0.7130)
Pseudo R^2	0.051	0.135	0.048

Note: Standard errors are in brackets [], and p-values are in parentheses (). Significance at the 0.10, 0.05, and 0.01 levels are indicated by *, **, and ***.

In addition to financial literacy, the house area has positive and significant effect on energy literacy and increases the likelihood of a correct answer to the question of choosing a heating system. But the house ownership has no significant effect on the choice of heating system and energy literacy. Also, Income and sex has no significant effect on energy literacy. To investigate further, the experimental model was estimated separately for the two groups of

tenants and landlords. The results of the effect of economic and financial literacy and the area of the home are similar to the general model. Among renters with rising household incomes, the probability of correct answering the energy literacy question is reducing. Among the tenants, being a male has a negative impact on energy literacy and as citizen's age increases, the probability of correct answering the question of energy literacy increases as well. It is noticeable that the F-test of the overall significance and the Goodness of fit test are desirable and confirm the results.

Energy Awareness Model

Table 3 presents the results of the econometric model for the dependent variable, energy bill awareness through the Logit estimator for the energy carriers (electricity, natural gas and gasoline). In all three estimation models, with increasing economic and financial literacy the likelihood of energy bill awareness increases. As a result, respondents who perceive the basic concepts of economics correctly and have economic cost-benefit rationale are more likely to have higher energy awareness and better performance in energy cost management. By getting older, citizens are more likely to become energy conscious. In other words, as people become older, their sensitivity to energy costs increases. The variable of gender and being male have a significant positive impact on the likelihood of knowing the cost of natural gas and gasoline, however, it does not have a significant effect on the probability of monthly electricity bills awareness. As the level of education increases, the likelihood of energy awareness of electricity goes down and its effect on the likelihood of energy bill awareness of natural gas and petroleum is insignificant. According to the predictions, house ownership has a significant and positive impact on energy bill awareness of electricity and natural gas. Therefore, with the increase in residential house ownership rates, the likelihood of awareness of electricity and petroleum costs increases.

Table 3. Regression Results, Energy Bill Awareness (Logit estimator)

	Electricity	**Natural gas**	**Gasoline**
FL	2.06 [0.45]***	1.76 [0.46]***	2.86[0.51] ***
Y	-0.14 [0.13]	-0.13 [0.13]	0.13[0.13]
Sex (Male=1 and Female= 0)	0.37 [0.25]	0.62 [0.24]**	0.58 [0.24]**
Age	0.53 [0.16]***	0.55 [0.16]***	0.55 [0.15]***
Edu	- 0.30 [0.13]**	- 0.17 [0.13]	- 0.14 [0.13]
House Area	0.17 [0.15]	0.11 [0.15]	0.21 [0.16]
House Ownership (1-0)	0.75 [0.26]***	0.80 [0.26]***	0.26 [0.27]
Constant	-0.17 [0.84]	-0.92 [0.82]	-2.16 [0.79]***
F (7, 483)	7.31 (0.000)	7.49 (0.000)	9.13 (0.000)
Hosmer-Lemeshow goodness-of-fit test	0.73 (0.685)	0.32 (0.967)	0.87 (0.5507)
Pseudo R^2	0.096	0.104	0.1407

Note: Standard errors are in brackets [], and p-values are in parentheses (). Significance atthe0.10, 0.05, and 0.01 levels are indicated by *, **, and ***.

In the logistic model, the coefficients are interpreted as probability of success (here, the energy bill awareness), and it is not possible to interpret the coefficients as classical regression. In order to achieve the final coefficients, some conversions must have to be done. Table 4 shows the final coefficients for the energy awareness model. It is obvious that, no change in the significance of the coefficients has occurred, and only the final mean coefficients have varied which need to be interpreted.

Table 4. Marginal effects results

	Energy Literacy (heating system)	Energy Awareness (Electricity)	Energy Awareness (Natural gas)	Energy Awareness (Gasoline)
FL	0.377***	0.366 ***	0.307 ***	0.476***
Y	-0.029	-0.024	-0.022	0.022
Sex (Male=1 and Female= 0)	-0.063	0.065	0.108 **	0.096 **
Age	0.014	0.095 ***	0.096 ***	0.092 ***
Edu	0.019	-0.054 **	-0.029	-0.023
House Area	0.074 **	0.031	0.020	0.036
House Ownership (1-0)	-0.006	0.133 ***	0.139 ***	0.044

Note: Standard errors are in brackets [], and p-values are in parentheses (). Significance at the 0.10, 0.05, and 0.01 levels are indicated by *, **, and ***.

According to the table 4, by increasing one unit of economic and financial literacy index, the energy literacy and energy awareness (for electricity, gas and gasoline) indices will increase by 0.377, 0.366, 0.307 and 0.476, respectively. Therefore, increasing economic and financial literacy has a greater effect on energy awareness of petroleum than electricity and gas. According to the results of econometric models, it can be said that promoting economic and financial literacy empowers citizens to make efficient decisions in terms of choosing energy-efficient appliances and thus saving energy. Other results which are derived from estimations prove that citizens, who have economic knowledge and are familiar with concepts of cost-effectiveness analysis, are more about energy-conscious. This issue is in the case of gasoline, electricity and natural gas, respectively. The importance of this matter is in the order of petroleum, electricity and natural gas respectively. On the other hand, the negative impact of education level proves that the mere reliance on academic degrees will neither stimulate energy savings and nor increase energy literacy.

Discussion and Conclusion

As a matter of fact, energy decisions are made by consumers decisions about the amount of energy consumed, the location of the energy purchased and the type of energy consumed. Therefore, it is essential that these decisions should be made with the maximum knowledge and information in terms of energy and related issues. In spite of the fact that standard (classical) models of education are a valid tool for promoting energy awareness and literacy, recently with the development of behavioral and cognitive economics models, energy literacy can be enhanced through non-standard and “Predictably Irrational” methods (Blash et al. Et al., 2017; Mohammadzadeh et al., 1986).

In this research in the framework of survey data, by using the questionnaire, the impact of economic (and financial) literacy on energy literacy and energy awareness beside assessing of “energy literacy”, “energy awareness” and “economic and financial literacy” was examined. The validity of the questionnaire was confirmed not only by experts in the field of energy optimization and university professors but also through Cronbach's alpha at 0.84 at 1% level. The study population consisted of staffs and professors of universities in the three provinces of east Azerbaijan, west Azerbaijan and Ardabil which 500 questionnaires after sampling have been analyzed. According to the results, energy literacy index (calculating final price of heating systems) was evaluated 0.69 on average (between 0-1). Also, Energy awareness indices (energy bills awareness) for three carries electricity, natural gas and petroleum were evaluated 0.72, 0.73 and 0.73, respectively (ranging from 0-1). The index of economic and financial literacy among staff and professors of Northwestern universities was 48%. Although

in the theory of economic literacy, the concept of inflation has been noticed immensely, in general the performance of economic literacy index is not eye-catching. The main purpose of this study is to investigate the factors which affecting energy literacy and awareness with emphasis on the effect of economic and financial literacy.

According to logistic estimation, economic literacy has a significant and positive effect on energy literacy and energy awareness at 1% level. Thus it can be said that citizens who think economically and logically (cost-benefit) and also understand the basic concepts of economics correctly and practically, calculate the expense of energy-efficient appliances correctly and are more aware of their energy costs. This conclusion is in line with the studies of Blasch et al. (2017) and Brounen et al. (2013), in which financial (and economic literacy) leads to the correct calculation of the final cost. Also, the positive effect of financial literacy on energy literacy and in contrast to the insignificant effect of education level on energy literacy indicates that formal education does not necessarily lead to improved decision making and energy literacy. The house area has a positive impact on energy literacy (heating system selection). In contrast, the impact of ownership on energy literacy is not significant. Education level has an insignificant impact on energy literacy but significant positive impact on energy bill awareness.

The results of this study have a direct relationship with the Iranian targeted subsidy plan and energy conservation polices. There is ample evidence that confirm that promoting economic and financial literacy has a positive and significant effect on energy literacy and energy awareness, and thereby stimulating energy savings. Consequently, it is fundamental to focus on enhancing economic and financial literacy in order to improve citizens' decision-making efficiency and reform their energy consumption patterns. Also, government intervention and investment to improve the economic and financial literacy of citizens is an important recommendation of the proponents of the behavioral economics approach in this area, because for various reasons, citizens are biased in financial and economic decisions and do not act optimally. The insignificant impact of income on energy literacy and energy awareness, as well as the positive impact of home area infrastructure on energy literacy, requires that increasing block tariffs be taken into consideration more than ever. With increasing block tariffs, the rate per unit of energy increases as the volume of consumption increases. Consumers face a low rate up to the first block of consumption and pay a higher price up to the limit of the second block, and so on until the highest block of consumption. By implementing this policy, while observing the justice index of citizens who consume more energy (above the average level of society), they will realize the rising cost of energy and will make long-term decisions.

Acknowledgment

This research was granted by Iranian Fuel Conservation Company (IFCO) under contract number 1106-3007. The authors would like to thank the IFCO and all the scholars who participated in this study.

References

Akroush, M. N., Zuriekat, M. I., Al Jabali, H. I., and Asfour, N. A. (2019). Determinants of purchasing intentions of energy-efficient products: The roles of energy awareness and perceived benefits. International Journal of Energy Sector Management, 13(1), 128-148.

Allcott, H. (2011). Social norms and energy conservation. Journal of public Economics, 95(9-10), 1082-1095.

Ameli, N., and Brandt, N. (2015). Determinants of households' investment in energy efficiency and renewables: evidence from the OECD survey on household environmental behaviour and attitudes. Environmental Research Letters, 10(4), 044015.

Andor, M. A., and Fels, K. M. (2018). Behavioral Economics and Energy Conservation–A Systematic Review of Non-price Interventions and Their Causal Effects. Ecological Economics, 148, 178-210.

Bahrami, S. (2020). Energy Literacy in the Science Textbooks of the First-High-School. Iranian Journal of Energy, 22(4), 69-90.

Blasch, J., Filippini, M., and Kumar, N. (2017). Boundedly rational consumers, energy and investment literacy, and the display of information on household appliances. Resource and Energy Economics. 56, 39-58.

Boogen, N., Cattaneo, C., Filippini, M., and Obrist, A. (2021). Energy efficiency and the role of energy-related financial literacy: evidence from the European residential sector. Energy Efficiency, 14(4), 1-17.

Broberg, T., and Kazukauskas, A. (2015). Inefficiencies in residential use of energy—a critical overview of literature and energy efficiency policies in the EU. International Review of Environmental and Resource Economics, 8(2), 225-279.

Brounen, D., Kok, N., and Quigley, J. M. (2013). Energy literacy, awareness, and conservation behavior of residential households. Energy Economics, 38, 42-50.

Chytilova, H. (2017). Economic literacy and money illusion: An experimental perspective (Vol. 9). Taylor & Francis.

Conlisk, J. (1988). Optimization cost. Journal of Economic Behavior & Organization, 9(3), 213-228.

Cotton, D. R., Miller, W., Winter, J., Bailey, I., and Sterling, S. (2015). Developing students' energy literacy in higher education. International Journal of Sustainability in Higher Education, 16(4), 456-473.

Cramer, J. S. (2003). Logit Models from Economics and Other Fields. Cambridge: Cambridge University Press.

DeWaters, J. E., and Powers, S. E. (2011). Energy literacy of secondary students in New York State (USA): A measure of knowledge, affect, and behavior. Energy policy, 39(3), 1699-1710.

DeWaters, J., and Powers, S. (2013). Establishing measurement criteria for an energy literacy questionnaire. The Journal of Environmental Education, 44(1), 38-55.

Dianati Dilami, Z., and Hanifezadeh, M. (2015). Financial Literacy Level of Tehran Households and its Determinant Factors. Financial Knowledge of Securities Analysis, 8(26), 115-139.

Frederiks, E. R., Stenner, K., and Hobman, E. V. (2015). Household energy use: Applying behavioural economics to understand consumer decision-making and behaviour. Renewable and Sustainable Energy Reviews, 41, 1385-1394.

Ghaemi, A., Ghaemi, P., and Shobeiri, S.M. (2014). Level of environmental literacy of government employees in order to select the most appropriate education method, Environmental Sciences, 12(2), 43-54.

Hamidi Razi, D., Ranjpour, R., and Motafakker-Azad, M. A. (2020). Energy Literacy: Case of Iran's Northwestern Academic Community. Journal of Energy Planning and Policy Research, 5(17), 141-184.

Hassan, M. G., Hirst, R., Siemieniuch, C., and Zobaa, A. F. (2009). The impact of energy awareness on energy efficiency. International Journal of Sustainable Engineering, 2(4), 284-297.

Hirst, E., and Brown, M. (1990). Closing the efficiency gap: barriers to the efficient use of energy. Resources, Conservation and Recycling, 3(4), 267-281.

Jappelli, T. (2010). Economic literacy: An international comparison. The Economic Journal, 120(548), F429-F451.

Kahneman, D. (2003). Maps of Bounded Rationality: Psychology for Behavioral Economics. American Economic Review, 93(5), 1449-1475.

Kahneman, D. (2011). Thinking, Fast and Slow, Farrar, Straus and Giroux, ISBN 978-0374275631.

Kahneman, D., Slovic, P., and Tversky, A. (1982). Judgment under Uncertainty: Heuristics and Biases. New York: Cambridge University Press.

Kalmi, P., Trotta, G., and Kazukauskas, A. (2017). The Role of Energy Literacy as a Component of Financial Literacy: Survey-based evidence from Finland. Heading Towards Sustainable Energy Systems: Evolution or Revolution.

Kumar, N. (2019). A model-based clustering approach for analyzing energy-related financial literacy and its determinants. Available at SSRN 3328468.

Lee, L. S., Lee, Y. F., Altschuld, J. W., and Pan, Y. J. (2015). Energy literacy: Evaluating knowledge,

affect, and behavior of students in Taiwan. Energy Policy, 76, 98-106.
Lusardi, A., and Mitchell, O. S. (2011). Financial literacy and retirement planning in the United States. Journal of Pension Economics & Finance, 10(4), 509-525.
Lusardi, A., and Mitchell, O. S. (2011). Financial literacy around the world: an overview. Journal of pension economics & finance, 10(4), 497-508.
Martins, A., Madaleno, M., and Dias, M. F. (2020). Energy literacy assessment among Portuguese university members: Knowledge, attitude, and behavior. Energy Reports, 6, 243-249.
Martins, A., Madaleno, M., and Dias, M. F. (2020). Energy literacy: What is out there to know?. Energy Reports, 6, 454-459.
Martins, A., Madaleno, M., and Ferreira Dias, M. (2020). Financial Knowledge's Role in Portuguese Energy Literacy. Energies, 13(13), 3412.
Mills, B., Schleich, J. (2012). Residential energy-efficient technology adoption, energy conservation, knowledge, and attitudes: an analysis of European countries. Energy Policy 49, 616–628.
Ministry of Energy (2018). Four Decades of Energy Balance, Macro and Energy Planning Bureau, available at: http://pep.moe.gov.ir
Mohammadi, S., Emami Meibodi, A., Javan, A., and Fakehi, A. (2019). Simulation of Iran's Energy Balance and Designing Supply and Demand Management Scenarios for 2042 Using LEAP. Iranian Energy Economics, 8(29), 103-129.
Mohammadzadeh, P., Beheshti, M., and Akbari, A. (2017). Cognitive economics as a new approach in explaining consumer economic behaviors. Journal of Economic Research (Tahghighat-E-Eghtesadi), 52(1), 1-33.
Mola, S., Fathi-Azar, E., Adib, Y., and Namdar, A. (2018). Energy Literacy: Review of Knowledge , Attitude , and Behavior of Middle School Students in the City of Orumiyeh. Environmental Education and Sustainable Development, 6(4), 91-102.
Naderi, A., Shir-Ali, E., and Shahbazi, M. (2017). A Study of Energy Literacy Status among the Region 19 Citizens of Tehran and its Relationship with Cultural Consumption. Quarterly of Social Studies and Research in Iran, 6(3), 391-408.
Nair, G., Gustavsson, L., and Mahapatra, K. (2010). Factors influencing energy efficiency investments in existing Swedish residential buildings. Energy Policy 38(6), 2956–2963.
Pelenur, M. (2018). Household energy use: a study investigating viewpoints towards energy efficiency technologies and behaviour. Energy Efficiency, 11(7), 1825-1846.
Reis, I. F., Lopes, M. A., and Antunes, C. H. (2021). Energy literacy: an overlooked concept to end users' adoption of time-differentiated tariffs. Energy Efficiency, 14(4), 1-28.
Scott, S. (1997). Household energy efficiency in Ireland: A replication study of ownership of energy saving terms. Energy Economics, 19, 187-208.
Seif, A. M,. and Hamidi Razi, D. (2017). Identification of Factors that Influence Iran's Provincial Energy Intensity Index: A Spatial Dynamic Panel Data Approach. QEER. 13 (53), 61-103.
Shleifer, A. (2012). Psychologists at the Gate: A Review of Daniel Kahneman's Thinking, Fast and Slow. Journal of Economic Literature, 50(4), 1–12.
Sovacool, B. K., and Blyth, P. L. (2015). Energy and environmental attitudes in the green state of Denmark: implications for energy democracy, low carbon transitions, and energy literacy. Environmental Science & Policy, 54, 304-315.
Trotta, G. (2018). Factors affecting energy-saving behaviours and energy efficiency investments in British households. Energy Policy, 114, 529-539.
U.S. Department of Energy (2017), Energy Literacy: Essential Principles for Energy Education, https://www.energy.gov/sites/prod/files/2017/07/f35/Energy_Literacy.pdf
Van den Broek, K. L. (2019). Household energy literacy: A critical review and a conceptual typology. Energy Research & Social Science, 57, 101256.
Van den broek, K. L., and Walker, I. (2019). Heuristics in energy judgments tasks. Journal of Environmental Psychology, 62, 95-104.
Van den broek, K. L., Walker, I., and Klöckner, C. A. (2019). Drivers of energy saving behaviour: The relative influence of intentional, normative, situational and habitual processes. Energy Policy, 132, 811-819.
Zainali, S., Shobeire, M., and Larijani, M. (2016). Energy literacy training to operationalize environmental behavior. IJE, 18 (4), 133-140.