Bioenergy Studies 4(1), 78-92

BIOENERGY STUDIES

REVIEW PAPER

Analysis of UniversityStudents' AwarenessTowardsRenewableEnergy in Turkey

Okan DEMİR[1], M. Şevki TERZİOĞLU[2] ,Kadir TERZİOĞLU[3]

[1]Department of AgriculturalEconomics, Faculty of Agriculture, Atatürk University, Erzurum, Turkey

[2] Department of Philosophy, Bilkent University Ankara, Turkey

[3]General Directorate of AgriculturalResearchandPolicies Ankara, Turkey

ArticleHistoryReceived 13 May 2024

Accepted20August 2024

First Online 22August 2024

Corresponding Author

Tel.: +90 05333559349

E-mail: okandemir@atauni.edu.tr

KeyWords

Awareness

RenewableEnergy

Abstract

In today's world, the majority of energy needs are met globally through fossil fuel resources. The environmental pollution, increased global warming, and depletable nature of fossil fuel resources enhance the importance of renewable energy sources. Another issue for our country is the dependency on fossil-based fuels. Especially, foreign dependency poses a significant challenge for sustainable development in our country. Therefore, the importance of renewable energy sources such as biomass energy, hydroelectricity, solar energy, geothermal energy, biofuels, and wind energy is becoming increasingly crucial for both the environment and the development of our country. With this in mind, the "Renewable Energy Awareness Scale" was implemented to assess the awareness of Bilkent University students, one of our country's foremost educational institutions. Developed by Morgil, Seçken, Yücel, ÖzyalçınOskay, Yavuz, and Ural in 2006, this test, after obtaining necessary permissions, was applied as a survey study with 22 direct questions, while other questions were modified to prioritize the biomass issue. The data obtained from the study was analyzed to evaluate the impact on variables such as score type, faculty, department, gender, family education level, age, level of education, and parents' education level. According to the model results of the study, it has been observed that young people, women, individuals admitted to the university based on numerical scores, those in undergraduate education, those with parents having a higher education level, and those who have received training in renewable energy exhibit higher awareness of renewable energy.

Student

Introduction

Energy is an fundamental element forthecontinuation of life. One of thehistoricalmeanings of energy, which is alsodefined as thepowerto do work, is "livingforce" (visviva). Since theexistence of humanity, energydemand has constantlyincreaseddepending on technologicaldevelopments in ordertosustain life andincreaselivingstandards. The ever-increasingenergyneedaroundtheworld, increasingfossilfuelconsumption, andtheincrease in localand global environmentalpollutionraisetheimportance of renewableenergy (Karatepe et al., 2012). Forcenturies, humanity has beenmeetingtheirenergyneedsfromfossilfuels, however in recentyearsrenewableenergy has become an importantalternativetofossilfuelswithitsclean andunlimitedfeatures (Tsantopoulos et al., 2014). Inoppositiontotheexhaustion of non-renewableenergyresources, the main renewableenergyresourcesareare solar energy, windenergy, hydraulicenergy, biomass, geothermalenergyandwaveenergy, areunlimited, clean, economicalandenvironmentallyfriendly (Çelikler, 2013). Renewableenergysourcesareimmenselyimportant in terms of reducingthedependence on foreignenergybyprovidingtheenergyneeds of countrieswiththeirownresourcesandcreating a sustainableecosystembyreducingthedamagecausedbyfossilenergysourcestotheenvironment.

Utilizingenergy is a necessity of the modern ageand an indispensablehumanright. Infact, theadverseimpact on theenvironment, climateandnatureshould be reducedtominimum andthebenefit of societyshould be optimized at allstages of theprocess, startingfromtheresearch, discoveryandevaluation of energyresources, whicharethecommonproperty of thesociety, toproduction, transmission, distributionandsale (MMO, 2022). Althoughrenewableenergyresourceshave a diversepotentialworldwide, whenthetypes of energyconsumedareinvestigated, oilcomesfirst, followedbycoalandnaturalgas. Inthedissemination of 2020 worldprimaryenergysupplytoresources, oiltookthefirstplacewith 171.4 EJ and 29.1 percent of the total supply. Oilwasfollowedbycoalwith 155.8 EJ and 26.5 percentshare, andnaturalgaswith 139.1 EJ and 23.7 percentshare. Renewablesourceswereabletomeet 11.6 percent of theprimaryenergysupplywith 68.3 EJ. Inthe 46 yearsfrom 1973 to 2019, theshare of nuclearenergy in worldprimaryenergyconsumptionincreasedby 456 percent, theshare of renewableenergysourcesby 147 percent, theshare of naturalgasby 44 percent, andcoalby 8.5 percent, whiletheshare of oildecreasedby 34% (Yılmaz, Ş.&Türkyılmaz, O., 2022). Renewableenergyproduction is increasing as a result of thepressureandnecessitycreatedbybothinternationalprotocolsandenvironmentalandclimaticcrisesoccurringaroundtheworld. However, thisincrease is insufficientcomparedtothe

rate of increase in bothrenewableenergypotentialandenergydem and.

According to ETKB data, Turkey's total energy supply in 2020 was 147.17 million TOE. In the share of this supply to resources, petroleum took the first place with 28.6%. Petroleum was followed by coal with a share of 27.7%, natural gas with a share of 27.1%, geothermal, wind, and solar with a share of 9.9%, hydraulics with a share of 4.6%, bioenergy, waste, and other resources with a share of 2.3% (Yılmaz, Ş. &Türkyılmaz, O., 2022). Between 2000 and 2020, the share of oil in Turkey's total energy supply was 13.7%; the share of bioenergy, wood, garbage, and waste was 5.8%; While the share of coal decreased by 1.2%; The share of natural gas increased by 11.3%, the share of geothermal, solar and wind increased by 8.8%, and the share of hydraulics increased by 1.2%. Renewable energy supply in Turkey is above the world supply average. One of Turkey's energy targets is to meet 1/3 of the total energy supply from renewable energy sources in the first years of the "Turkey Century". This target shows that renewable energy investments in Turkey will continue to increase.

Turkey faces a significant energy deficit, primarily relying on foreign energy sources. Over the past two decades, the proportion of total energy production to overall energy supply in Turkey has seen a decline, dropping from 33% to 29.8%. In 1990, the country's foreign dependency in total energy supply stood at 52%, a figure that surged to 67% in 2000, 70% in 2010, and reached a peak of 76% in 2015 (Yılmaz, Ş. &Türkyılmaz, O., 2022). However, recent years have witnessed a positive shift with the rise in solar, wind, and geothermal energy production. As of 2020, Turkey has managed to reduce its foreign energy dependency to 70%.

In nations grappling with a negative energy balance, mitigating drawbacks can be achieved through a combination of demand-side and supply-side policies. On the supply side, securing the utilization of indigenous energy resources, particularly renewable sources, necessitates strategic investments in energy production. Concurrently, enhancing energy efficiency on the demand side becomes imperative. Developing comprehensive policies that encompass both the supply and demand facets requires addressing crucial elements such as social and public energy awareness, behavioral patterns, and consciousness. The promotion of renewable energy awareness, often articulated through terms like green energy, clean energy, and the energy of the future, plays a pivotal role in shaping future energy projections. It underscores the importance of fostering a collective understanding and commitment to sustainable energy practices, influencing the trajectory of energy use in the times ahead.

Numerous studies in the literature explore social approaches and public evaluations of renewable energy, as demonstrated by research conducted by scholars such as Malesios and Arabatzis (2010), Karabulut et al. (2011), Yumurtacı and Keçebaş (2011), Zhai and Williams (2012), Tsantopoulos et al. (2014), Scherhaufer et al. (2017), Sonnberger and Ruddat (2017), Tabi and Wustenhagen (2017), Tampakis et al. (2017), Strazzera and Statzu (2017), Firestone et al. (2018), and Karasmaniki and

Tsantopoulos (2019). These studies serve as noteworthy examples in this research domain. However, the body of literature addressing university students' perspectives on renewable energy resources, their behaviors, and attitudes toward this subject is relatively limited. Despite the wealth of research on societal views, there exists a paucity of studies specifically examining the unique dynamics shaping university students' engagement with renewable energy. (Ahamad and Ariffin, 2018; Karatepe et al., 2012; Ozil et al., 2008; Çoker et al. 2010; Çelikler, 2013; Altuntaş and Turan, 2018).

The objective of this study is to assess the awareness levels of university students in Turkey regarding renewable energy, identify the factors influencing this awareness, and formulate policy recommendations to enhance overall awareness levels.

Methodology

Data

The data for this study were derived from surveys administered to university students in Ankara during the spring semester of 2022-2023. The research universe intentionally focused on universities ranking within the top 10 in Turkey according to the URAP (University Ranking by Academic Performance) ranking. Within this universe, students for the surveys were randomly selected from Hacettepe, Middle East Technical, Ankara, Gazi, and İhsanDoğramacıBilkent Universities in Ankara. The number of surveys conducted was determined using a simple random sampling method.

The surveys were carried out voluntarily during the spring semester of the 2022-2023 academic year, utilizing a mobile application with a secure black code through Google Drive. In total, 438 surveys were administered.

In the survey-based study, data collection employed a 5-point Likert-type scale as outlined by Morgil et al. (2006). Comprising 22 questions, the scale aimed to gauge respondents' awareness of renewable energy. The first segment of the survey focused on these Likert-type questions to assess the participants' understanding of renewable energy concepts. The second part of the survey delved into the socio-demographic characteristics of the students, encompassing factors such as age, gender, education level, university entrance score type, and parents' education level. Responses on the Likert scale were categorized across five levels, ranging from "strongly agree" (5) to "strongly disagree" (1).

Empiricalmethodology

help of Ordered Probit Model estimation. In cases where the dependent variable is categorical or ordinal, ordered logit or probit probability estimators can be used. Maximum Similarity functions are used in both methods. The ordinal probit model is based on the normal probability distribution, while the ordinal logit model is derived from the standardized logistic probability distribution. The feature that distinguishes

Since the attitude determination data towards renewable energy obtained with the Likert scale is categorical and ordinal, one of the most appropriate evaluation methods is ordered probit or logit models (McKelvey and Zavoina1975; Davidson and MacKinnon 2003; Wooldridge 2010). In this study, university students' attitudes towards renewable energy were analyzed with the

the ordinal probit model from the ordinal logit model is the normal distribution of errors. In the ordered probit model, it is assumed that there is a continuous but unobservable latent dependent variable behind the observable, interval and ordered categories (y). The unobservable, latent dependent variable (y*) is explained by the vector of explanatory variables and the error term. It is assumed that the error term has a normal distribution (Greene 2008).

$n = t\text{^}[1 + (0{,}02)(b - 1)] * pq/E\text{^}2$(1)

Intheorderedprobit model, it is assumedthatthere is a continuous but unobservablehiddendependentvariablebehin dtheobservable, intervalandorderedcategories (y). Theunobservable, latentdependentvariable (y*) is explainedbythevector of explanatoryvariablesandtheerrorterm. It is assumedthattheerrorterm has a normal distribution (Greene, 2012).

$Y^* = X'\beta + \varepsilon\varepsilon \sim N[0,1]$(2)

Here, y*; unobservabledependentvariable, x; vector of explanatoryvariables, β; parametervectorto be estimatedand ε; indicatestheerrorterm.

Therelationshipbetweenthedependentvariabl e (y) andtheunobserveddependentvariable (y*) is considered as a function of thethresholdvalues (μj) thattakeseparatevalues accordingtotheconsumersandareestimatedusi ngtheregressioncoefficients (β). Intheresearch, theattitudeslevel of theuniversitystudentswereclassified in fourdifferentsequentialcategories (Y= 0, 1, 2, 3). Accordingtothis; Therelationshipbetweenthedependentvariabl e (y) of the model andtheunobserveddependentvariable (y*) will be as follows (Chen et al., 2002; Greene, 2012).

İf $y^* \leq 0$	*y= 0*	*(3)*
İf $0 < y^* \leq \mu_1$	*y= 1*	*(4)*
İf $\mu_1 < y^* \leq \mu_2$	*y=2*	*(5)*
İf $\mu_2 < y^* \leq \mu_3$	*y=3*	*(6)*
İf $\mu_3 \leq y^*$	*y=4*	*(7)*

The “μ” in theequationarethethresholdvalues thatareestimated in the model and form thelowerandupperlimits of thevalues that y willtake (Greene 2008). The independent variable was recategorized by taking the average scores of the answers given by the university students according to the renewable energy awareness questions. Accordingly, those with an average score of up to 1.4 were considered as a very low level of awareness, those with an average score of 1.5-2.4 were considered as a low level of awareness, those with an average score of 2.5-3.4 were considered as a medium level of awareness, those with an average score of 3.5-4.4 were considered as a high level of awareness, and those with an average score greater than 4.5 were considered as a very high level of awareness.

The ordinal categories of the dependent variable used in the model, “Y=0” very low awareness level, “Y=1” variable low awareness level, “Y=2” variable middle

awareness level, "Y=3" variable high awareness level and "Y=4" variable represents very high awareness level.

In the ordered probit model, the error term is assumed to be normally distributed. Theprobabilitythatstudentswill be in one of the 5 categories of attitude'slevel is as follows: (Greene, 2012; Bozoglu et al., 2016; Bozoglu et al., 2022).

$$\text{Prob}\,(y = 0|x) = \Phi\,(-x'\beta), \quad (8)$$
$$\text{Prob}\,(y = 1|x) = \Phi\,(\mu_1 - x'\beta) - \Phi\,(-x'\beta), \quad (9)$$
$$\text{Prob}\,(y = 2|x) = \Phi\,(\mu_2 - x'\beta) - \Phi\,(\mu_1 - x'\beta), \quad (10)$$
$$\text{Prob}\,(y = 3|x) = \Phi\,(\mu_3 - x'\beta) - \Phi\,(\mu_2 - x'\beta), \quad (11)$$
$$\text{Prob}\,(y = 4|x) = 1 - \Phi\,(\mu_3 - x'\beta) \quad (12)$$

Fortheseprobabilitiesto be positive; Itshould be $0 < \mu1 < \mu2$. $\boldsymbol{\Phi}$denotesthecumulative normal distributionfunction. It is inconvenienttodirectlyinterpretthecoefficients of thevariables of theorderedprobit model estimatedusingthemaximumlikelihoodmethod (Akbay et al. 2007). Since theeffects of explanatoryvariables on probabilitiesdepend on thevalues of explanatoryvariables, theyare not thesameas parameter (β) estimates. It is not clear how tointerpretthecoefficientswithoutadditionalcomputation in theorderedprobit model. Thisrequiresestimatingthemarginaleffects of explanatoryvariables in ordertodeterminetheeffect on probabilities. Themarginaleffects of thevariablesarecalculatedforeachprobability as follows (Greene, 2012).

$$\partial prob(y = 0|x))/\,\partial x = -\emptyset(x\text{^}'\beta)\beta, \quad (13)$$
$$\partial prob(y = 1|x))/\,\partial x = [\emptyset(-x\text{^}'\beta)\beta, -\emptyset(\mu1 - x\text{^}'\beta)\beta], \quad (14)$$
$$\partial prob(y = 2|x))/\,\partial x = [\emptyset(\mu1 - x\text{^}'\beta) - \emptyset(\mu2 - x\text{^}'\beta)]\beta, \quad (15)$$
$$\partial prob(y = 3|x))/\,\partial x = [\emptyset(\mu2 - x\text{^}'\beta) - \emptyset(\mu3 - x\text{^}'\beta)]\beta, \quad (16)$$
$$\partial prob(y = 4|x))/\,\partial x = [\emptyset(\mu3 - x\text{^}'\beta)\beta, \quad (17)$$

The ordered probit model, which is one of the limited dependent variable model types, was estimated using the Limdep Econometric Computer Program.

Results and Discussion

The renewable energy awareness model employed seven independent variables. These variables include age, gender, university entrance score type, mother's education level, father's education level, and whether the participants have received training on renewable energy.

Among the survey participants, 0.46% (2 individuals) demonstrated very low awareness of renewable energy, 6.9% (30 individuals) had low awareness, 9.6% (42) exhibited medium awareness, 18.5% (81 individuals) possessed high awareness, and a substantial majority of 64.6% (283 individuals) displayed very high awareness.

The average age of the survey respondents was 21.4, with a standard error of 2.41. The gender distribution showed that 62.8% (275) were female, while 37.2% (163) were male. Regarding the university entrance score type, respondents were categorized as numerical or other. Those admitted with numerical scores constituted 46.8% (205), while the rest accounted for 53.2% (233).

The education levels of both mothers and fathers were incorporated as categorical variables in the model, with codes ranging from one to six denoting primary school, secondary school, high school, associate degree, undergraduate, and graduate degree. Among the surveyed students' mothers, 8.2% (36 individuals) had completed primary school, 5.3% (23 individuals) had finished secondary school, 27.9% (122 individuals) had a high school education, 7.3% (32 individuals) had an associate degree, 42.0% (184 individuals) had obtained an undergraduate degree, and 9.4% (41 individuals) held graduate degrees. Regarding the subjects' fathers, 2.3% (10 individuals) had a primary school education, 4.3% (19 individuals) had completed secondary school, 18.0% (79 individuals) had a high school education, 11.9% (52 individuals) had an associate degree, 45.9% (201 individuals) had an undergraduate degree, and 17.6% (77 individuals) possessed graduate degrees. The variable indicating whether participants had received training on renewable energy is binary, with 29.2% (128 individuals) reporting that they had undergone such training.

Table 1. Definitions of the model variables

Variable name	Variable definition
AGE	Age (year)
GENDER	Female:0 Male: 1
UNISCORTYP	Maths/science:1 Others:0
EDUCLEV	Graduate: 1 Undergraduate: 0
MOTHEDU	Mother education (categoric)
FATHEDU	Father education (categoric)
RENEREDU	If the student takes about renewableenergy: 1; other: 0

The results of the ordered probit model are presented in Table 3. The chi-square value for the model, assessing renewable energy awareness, is significant at the 0.01 level, standing at 38.96041 with 7 degrees of freedom. The estimated threshold values (Mu) are positively significant at the 0.01 level. The significance of these threshold values indicates the accuracy of the ranking measurement concerning renewable energy awareness. The established ordered probit model comprises a total of 8 independent variables.

According to the model results, there exists a negative relationship between the age of university students and their awareness of renewable energy, with the age variable proving significant at the 1% level. The marginal effect analysis indicates that a 1% increase in a student's age corresponds to a 20.8% increase in the probability of the student having medium-level awareness of renewable energy. The findings suggest that

younger individuals tend to exhibit higher awareness of renewable energy, potentially attributed to innovations in environmental awareness and sensitivity incorporated into secondary education curricula. Additionally, the heightened social sensitivity stemming from climate extremes and environmental disasters related to global climate change may contribute, with young people more likely to access such information through digital social networks. This aligns with the conclusions drawn by Karytsas and Theodoropoulou in 2014, who similarly found that young people tend to have higher awareness of renewable energy.

The gender variable is found to be significant at the 10% level, indicating a negative relationship between renewable energy awareness and gender. In the model, where gender is coded as a binary variable, transitioning from female to male is associated with a decrease in renewable energy awareness. Specifically, the marginal effect results reveal that shifting to male gender increases the likelihood of falling into the low, medium, and high awareness categories while decreasing the probability of being in the very high category. This suggests that women tend to exhibit higher awareness of renewable energy than men. Consistent with these findings, Karatepe et al. (2012) observed in their 2012 study on university students in Turkey that female students had a higher level of awareness about renewable energy resources compared to their male counterparts. However, Çeliker (2013) found no gender-based difference in the renewable energy sensitivities of science teacher candidates in Turkey. In a Greek study by Karytsas and Theodoropoulou (2014), it was determined that gender is an important variable in awareness, with men exhibiting higher awareness levels than women. It's worth noting that the study acknowledged limitations related to the internet-based sample and surveys, suggesting that the gender variable might be influenced by other socio-economic factors. Similarly, Aktamis (2011), in a study on socio-economic factors affecting energy saving and awareness among secondary school students, found a significant relationship between gender and energy awareness, with female students displaying higher awareness than male students. Results from studies conducted in Jordan (Zyadin et al., 2012), Palestine (Assali et al., 2019), and Indonesia (Muslim et al., 2021) also support the trend that female students tend to have higher awareness of renewable energy compared to their male counterparts.

The variable indicating the university entrance score type as numerical, and the binary variable "uniscortyp" compared to others, is significant at the 10% level and exhibits a positive relationship with the level of awareness. In simpler terms, students entering the university with numerical scores tend to have a higher level of renewable energy awareness compared to their counterparts. According to the marginal impact results, the probability of students entering the university with numerical scores falling into the very high category of renewable energy awareness is 8.03%. This aligns with the structure of the university selection examination system in Turkey, where students admitted with numerical scores typically focus on mathematics and science courses, gaining in-depth knowledge in these fields. Recent innovations in pre-university education

curricula, especially in science courses, contribute to heightened awareness of renewable energy among these students. Corroborating this trend, Guven and Sulun (2017), in their study measuring the renewable energy sensitivity and knowledge levels of teacher candidates, found that science teacher candidates exhibited a higher level of renewable energy knowledge compared to those who received social studies education. Additionally, a significant number of students admitted with numerical scores are placed in engineering and health sciences. Engineering education encompasses the study of energy and its various types, fostering increased awareness. Similarly, students in health sciences, including medicine, dentistry, and nursing, gain insights into the environmental degradation caused by fossil fuel use and its associated health issues. This educational exposure creates awareness among health sciences students about renewable energy as a viable alternative to fossil fuel usage.

The model results reveal a negative relationship between the level of education and renewable energy awareness; however, the coefficient is not statistically significant. This indicates that the awareness level of undergraduate students tends to be higher. According to the marginal effect results, being at a graduate level reduces the probability of reaching a very high awareness level by 1.9%. This outcome parallels the trend observed with the age variable. In alignment with the higher awareness levels of younger individuals, the awareness level of undergraduate students is comparatively higher.

There exists a linear and statistically significant relationship between the education levels of both the mother and father and the level of renewable energy awareness, with significance levels of 1% and 5%, respectively. In simpler terms, as the education levels of the mother and father increase, individuals tend to exhibit higher levels of renewable energy awareness. According to the marginal effect results, a 1% increase in the mother's education corresponds to an 8.7% increase in the probability of the individual achieving a very high level of renewable energy awareness, while a similar increase in the father's education yields a 3.9% increase. These findings align with a 2012 study by Karatepe et al., which reported that as the education level of parents rises, the renewable energy awareness of students also increases.

There is a positive relationship between awareness of renewable energy and receiving education on this subject, and the coefficient is significant at the 10% level. According to the marginal effect results, a 1% increase in the probability of receiving education corresponds to an 8.3% increase in the probability of students reaching a very high level of awareness. The purpose of the education individuals receive is to instigate changes in awareness, attitude, and behavior. Studies focusing on energy, particularly renewable energy, have consistently found that individuals who receive training exhibit higher levels of awareness and more positive attitudes compared to those without training. Moreover, the impact of training is identified to be more substantial than other influencing factors (Jamaludin et al., 2020; Polonsky et al., 2012; Brounen and Quigley, 2013).

Table 2: Ordered Probit model results

Variables	Estimatedcoefficient	Marginaleffects				
		Y=0 (verylow)	Y=1 (low)	Y=2 (medium)	Y=3 (high)	Y=4 (veryhigh)
Constant	2.03639*** (0.0000)					
AGE	-0.17904*** (0.0056)	0.00154** (0.0130)	0.01988*** (0.0065)	0.2083** (0.0145)	0.02376** (0.0184)	-0.06601*** (0.0055)
GENDER	-0.24453* (0.0506)	0.00233* (0.0923)	0.02846* (0.0635)	0.02875* (0.0699)	0.03149* (0.0623)	-0.09104* (0.0514)
UNISCORTYP	0.21878* (0.0727)	-0.00187* (0.0883)	-0.02409* (0.0726)	-0.02529* (0.0886)	-0.02904* (0.0921)	0.08030* (0.0701)
EDUCLEV	-0.05375 (0.6422)	0.00046 (0.6433)	0.00597 (0.6424)	0.00625 (0.6437)	0.00713 (0.6439)	-0.01982 (0.6422)
MOTHEDU	0.23788*** (0.0010)	-0.00205*** (0.0046)	-0.02641*** (0.0013)	-0.02767*** (0.0052)	-0.03157*** (0.0078)	0.08770*** (0.0009)
FATHEDU	0.10800** (0.0343)	-0.00093** (0.0491)	-0.01199** (0.0370)	-0.01256** (0.0490)	-0.01433* (0.0565)	0.03982** (0.0343)
RENEREDU	0.23001* (0.0877)	-0.00176* (0.0743)	-0.02385* (0.0711)	-0.02603* (0.0902)	-0.03133 (0.1216)	0.08297* (0.0808)
Mu (01)	1.21745*** (0.0000)					
Mu (02)	1.74458*** (0.0000)					
Mu (03)	2.37225*** (0.0000)					
Log likelihood function		-430.51549				
Restricted log likelihood		-449.99569				
Chi squared [7 d.f.]		38.96041				
Significance level		0.00000				

Not: ***, **, * denote significance levels at 1%, 5%, 10% respectively. The number in parantheses indicate p values.

Conclusionsandpolicyimplications

In this study, the aim was to identify the factors influencing the renewable energy awareness of university students in Turkey and to assess the extent of their impact. The study sample was drawn from universities situated in Ankara and selected from among the top 10 universities in the country. This sample encompasses not only the most accomplished students from various regions of Turkey but also individuals who are likely to emerge as highly successful professionals in their respective fields in the future.

According to the model results of the study, individuals characterized as young, female, admitted to university based on numerical scores, pursuing undergraduate education, with parents possessing higher education levels, and those who have received training on renewable energy exhibit higher levels of awareness regarding renewable energy.

Based on these findings, specific recommendations and policy implications can be articulated. Primarily, within the realm of public planning that prioritizes societal interests, the objective should be to ensure the effective and efficient supply, transmission, and distribution of energy. This approach should aim to minimize adverse impacts on the natural and social environment while maximizing reliance on renewable resources.

To mitigate the adverse impacts of air and environmental pollution on human and societal well-being, and address the challenges posed by the climate crisis, including issues such as droughts, sea level rise, diminishing groundwater levels, forest fires, erratic precipitation, and unexpected floods, it is imperative to take decisive and prompt actions. A key strategy to alleviate the destructive consequences and curtail the escalating temperature rise, targeting a limit of 1.5-2 °C, involves a radical and expeditious reduction in the utilization of fossil fuels for both energy production and consumption. The pivot towards renewable energy sources stands out as the most natural avenue to implement this overarching policy. A crucial component of this approach entails fostering widespread awareness and understanding of renewable energy across all segments of society.

The objective of enhancing awareness and understanding of renewable energy should be a focal point at the governmental policy level. The government is encouraged to orchestrate renewable energy events catering to all segments of society and to undertake awareness-raising initiatives through diverse mediums, including written, visual, and digital platforms.

Renewable energy awareness training should be included in the training curriculum of Public Education Directorates and certificate programs should be organized.

The attainment of renewable energy certificates should be established as a prerequisite for individuals seeking public employment in relevant fields. The awareness and proficiency in renewable energy should play a significant role in shaping employment policies across both public and private enterprises, particularly within the energy sector.

The government should initiate the "Produce Your Own Energy" campaign, encouraging individuals to generate renewable energy, while also providing support for investment expenditures in this field.

Curricula focused on renewable energy, tailored to match their learning abilities, should be implemented for future generations, commencing from kindergarten. Instilling knowledge about renewable energy and its significance will equip the upcoming generation for the intricacies of our globalized world and the ongoing advancements in technology.

Renewable energy subjects should be incorporated into secondary and high school curricula, and both elective and compulsory courses at the university level should be integrated into educational programs. The revision of educational curricula serves as a valuable tool for educational institutions to enhance awareness of renewable energy among students and various groups, fostering the development of innovative strategies to cultivate positive attitudes towards renewable energy. This approach ensures that students acquire a comprehensive understanding of renewable technology before embarking on careers in the environmental field.

Renewable energy should be designated as a priority research area in universities and research institutes, with affirmative action taken in favor of research and development projects in this field.

Research aimed at gauging awareness, attitudes, and knowledge levels regarding renewable energy should be undertaken to assess the perceptions of all segments of society. Additional research is essential to ascertain the percentage of individuals who possess awareness and knowledge about renewable energy issues in all regions of Turkey. The outcomes of such research endeavors will yield a comprehensive understanding of citizens' perspectives, acceptance levels, and attitudes toward renewable energy in Turkey. These studies can assist policymakers and other relevant institutions in evaluating the behavior of diverse social groups, enabling them to formulate strategies accordingly.

Due to the swift pace of technological advancements in the renewable energy sector, it is advisable to conduct more frequent and systematic studies examining the public's attitudes toward the latest developments, policies, and subsidies.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding

This study is supported by United Nations Industrial Development Organization (UNIDO), and General Directorate of Agricultural Research and Policies within the scope of the "Sustainable Use of Biomass to Assist the Development of Turkey's Economy Towards Green Growth " project financed by Global Environmental Fund. We are grateful to TAGEM, UNIDO, and GEF for their contributions and support. We also thank the students who joined in the survey for their contributions.

References

AHAMAD, N.R., ARİFFİN, M., 2018. Assessment of knowledge, attitude and practice towards sustainable consumption among university students in Selangor, Malaysia. https://doi.org/10.1016/j.spc.2018.06.006.

AKBAY, C. TİRYAKİ, G.Y. ve GÜL, A. 2007. Consumer characteristics influencing fast food consumption in Turkey. Food Control, 18, 904-913.

AKTAMİS, H., 2011. Determining energy saving behaviour and energy awareness of secondary school students according to socio-demographic characteristics. Educational Research and Reviews Vol. 6(3), pp. 243-250, March 2011 Available online at http://www.academicjournals.org/ERR ISSN 1990-3839.

ALTUNTAŞ, EÇ., TURAN, SL., 2018. Awareness of secondary school students about renewable energy sources. Renewable Energy, Volume 116, Part A, 2018, Pages 741-748, ISSN 0960-1481, https://doi.org/10.1016/j.renene.2017.09.034.

ASSALİ, A., KHATİB, T., NAJJAR, A., 2019. Renewable energy awareness among future generation of Palestine. Renewable Energy, Volume 136, 2019, Pages 254-263, ISSN 0960-1481, https://doi.org/10.1016/j.renene.2019.01.007.

BOZOĞLU, M., BİLGİC, A., TOPUZ, BK., ARDALİ, Y., 2016. Factors Affecting The Students' Environmental Awareness, Attitudes And Behaviors In Ondokuz Mayis University, Turkey. Fresenius Environmental Bulletin, Volume 25 – No. 4/2016, pages 1243-1257.

BOZOGLU, M., TOPUZ KİLİC, B., BASER, U., SHAHBAZ, P., EROGLU, NA., 2022. Graduate Students' Knowledge Levels on Climate Change in the Departments of Agricultural Economics in Turkey. J. Agr. Sci. Tech. (2022) Vol. 24(5): 1029-1041.

BROUNEN, D., KOK, N., QUİGLEY, JM., 2013. Energy literacy, awareness, and conservation behavior of residential households. *Energy Econ* 38: 42–50.

CHEN K.Z., ALİ M., VEEMAN M.M., UNTERSCHULTZ J. and LE T. 2002. Relative importance rankings for pork attributes byAsian-origin consumers in California:Applying an ordered probit model to a choice- based sample. Journal ofAgricultural and Applied Economics 34(1):67-79.

ÇELİKLER, D., 2013. Awareness about renewable energy of pre-service science teachers in Turkey. Renewable Energy 60 (2013) 343-348.

ÇOKER, B., ÇATLIOĞLU, H., BİRGİN, O., 2010. Conceptions of students about renewable energy sources: a need to teach based on contextual. Procedia - Social and Behavioral Sciences, Volume 2, Issue 2, 2010, Pages 1488-1492, ISSN 1877-0428, https://doi.org/10.1016/j.sbspro.2010.03.223.

DAVİDSON, R., & MACKİNNON, J. G. (2003). Econometric theory and methods. New York: Oxford University Press.

FİRESTONE, J., BİDWELL, D., GARDNER, M., KNAPP, L., 2018. Wind in the sails or choppy seas?: people-place relations, aesthetics and public support for the United States' first offshore wind project. Energy Res.

Soc. Sci. 40, 232–243. https://doi.org/10.1016/j.

GREENE W.H. 2008. Econometric Analysis. Sixth Edition. Pearson Prentice-Hall, Upper Saddle River, New Jersey, 07458.

GREENE W.H. 2012. Econometric Analysis. Seventh Edition. Pearson Prentice-Hall, Upper Saddle River, New Jersey, 07458. ISBN 10:0-13-139538-6.

GUVAN, G., SULUN, Y., 2017. Pre-service teachers' knowledge and awareness about renewable energy. Renewable and Sustainable Energy Reviews. Volume 80, 2017, Pages 663-668, ISSN 1364-0321, https://doi.org/10.1016/j.rser.2017.05.286.

JAMALUDİN, AA., ILHAM, Z., ZULKİFLİ, NEI., MOHTAR, IW.,HALİM-LİM, SA., OHGAKİ, H., ISHİHARA, K., AKİTSU, Y., 2020. Understanding perception andinterpretation of Malaysian university students on renewable energy. AIMS Energy, 2020, 8(6): 1029-1044. doi: 10.3934/energy.2020.6.1029.

KARABULUT, A., GEDİK, E., KEÇEBAS, A., ALKAN MA., 2011. An investigation on renewable energy education at the university level in Turkey. Renewable Energy 2011; 36:1293-7.

KARASMANİKİ, E., TSANTOPOULOS, G., 2019. Exploring future scientists' awareness about and attitudes towards renewable energy sources. Energy Policy 131 (2019) 111–119.

Karatepe, Y., Neşe, S.V., Kecebaş, A., Yumurtaci, M., 2012. The levels of awareness about the renewable energy sources of university students in Turkey. Renew. Energy 44, 174–179. https://doi.org/10.1016/j.renene.2012.01.099.

KARYTSAS, S., THEODOROPOULOU, H., 2014. Socioeconomic and demographic factors that influence publics' awareness on the different forms of renewable energy sources, Renewable Energy, Volume 71, 2014, Pages 480-485, ISSN 0960-1481, https://doi.org/10.1016/j.renene.2014.05.059.

MALESİOS, C., ARABATZİS, G., 2010. Small hydropower stations in Greece: the local people's attitudes in a mountainous prefecture. Renew. Sustain. Energy Rev. 14 (9), 2492–2510. https://doi.org/10.1016/j.rser.2010.07.063.

MORGİL, İ., SECKEN, N., YUCEL, AS., ÖSKAY, ÖÖ., YAVUZ, S., URAL, E., 2006. Developing A Renewable Energy Awareness Scale For Pre-service Chemistry Teachers . Turkish Online Journal of Distance Education, 7(1), 63-74. https://dergipark.org.tr/tr/pub/tojde/issue/16923/176621

MCKELVEY, R. D., & ZAVOİNA, W. A. (1975). Statistical model for the analysis of ordinal level dependent variables. J Math Soc., 4(1), 103–120.

MUSLİM, R., SAPUTRO, H., THAMRİN, AG., 2021. Case study: Vocational student's knowledge and awareness level toward renewable energy in Indonesia. *Open Engineering*, vol. 11, no. 1, 2021, pp. 690-708. https://doi.org/10.1515/eng-2021-0067

OZİL, E., UGURSAL, V.I., AKBULUT, U., OZPİNAR, A., 2008. Renewable energy

and environmental awareness and opinions: a survey of university students in Canada, Romania, and Turkey. Int. J. Green Energy 5 (3), 174–188. https://doi.org/10.1080/.

POLONSKY, MJ., VOCİNO A, GRAU SL, ET AL. 2012. The impact of general and carbon related environmental knowledge on attitudes and behaviour of US consumers. *J Mark Manage* 28: 238–263.

SCHERHAUFER, P., HOLTİNGER, S., SALAK, B., SCHAUPPENLEHNER, T., SCHMİDT, J., 2017. Patterns of acceptance and non-acceptance within energy landscapes: acase study on wind energy expansion in Austria. Energy Policy 109, 863–870. https://doi.org/10.1016/j.

SONNBERGER, M., RUDDAT, M., 2017. Local and socio-political acceptance of wind farms in Germany. Technol. Soc. 51, 56–65. https://doi.org/10.1016/j.techsoc.2017.07.005.

Strazzera, E., Statzu, V., 2017. Fostering photovoltaic technologies in Mediterranean cities: consumers' demand and social acceptance. Renew. Energy 102 (8), 361–371. https://doi.org/10.1016/j.renene.2016.10.056.

TABİ, A., WUSTENHAGEN, R., 2017. Keep it local and fish-friendly: social acceptance of hydropower projects in Switzerland. Renew. Sustain. Energy Rev. 68 (1), 763–773. https://doi.org/10.1016/j.rser.2016.10.006.

TAMPAKİS, S., ARABATZİS, G., TSANTOPOULOS, G., RERRAS, I., 2017. Citizens' views on electricity use, savings and production from renewable energy sources: a case study from a Greek island. Renew. Sustain. Energy Rev. 79, 39–49. https://doi.org/10.

TSANTOPOULOS, G., ARABATZİS, G., TAMPAKİS, S., 2014. Public attitudes towards photovoltaic developments: case study from Greece. Energy Policy 71, 94–106. https://doi.org/10.

WOOLDRİDGE, J. M. (2010). Econometric analysis of cross section and panel data. Cambridge, MA: MIT Press.

YILMAZ, Ş., TÜRKYILMAZ, O., 2022. Dünya'da ve Türkiye'de Birincil Enerji Arzı. Türkiye'nin Enerji Görünümü, TMMOB Makina Mühendisleri Odası Raporu, Yayın No: MMO/731, ANKARA.

YUMURTACI, M., KEÇEBAŞ, A., 2011. Renewable energy and its university level education in Turkey. Energy Education Science and Technology Part B - Social and Educational Studies 2011; 3:143-52.

ZHAİ, P., WİLLİAMS, E.D., 2012. Analyzing consumer acceptance of photovoltaics (PV) using fuzzy logic model. Renew. Energy 41, 350–357. https://doi.org/10.1016/j.

ZYADİN, A., PUHAKKA, A., AHPONEN, P., CRONBERG, T., PELKONEN, P., 2012. School students' knowledge, perceptions, and attitudes toward renewable energy in Jordan. Renewable Energy, Volume 45, 2012, Pages 78-85, ISSN 0960-1481, https://doi.org/10.1016/j.renene.2012.02.002.

Bioenergy Studies 4(1), 78-92

http://doi.org/10.51606/bes.2021.7