

ATTITUDES OF GREEK UNIVERSITY STUDENTS TOWARDS ENERGY AND THE ENVIRONMENT

CHARISIOU N.D.
GOULA M.A.*

Laboratory of Alternative Fuels and Environmental Catalysis (LAFEC)
Pollution Control Technologies Department (PCT)
Technological Educational Institute of Western Macedonia (TEI WM)

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*to whom all correspondence should be addressed:

e-mail: mgoula@kozani.teikoze.gr

ABSTRACT

This paper summarises the results of a survey carried out amongst the student population of one of the largest Greek Technological Educational Institutes. It explores attitudes toward the environment in general and then, more specifically, toward global warming and global warming-mitigation technologies. It also explores student understanding of sources of carbon dioxide and climate change-mitigation technologies, such as carbon dioxide capture and storage (CCS). Further, it analyses responses to questions about willingness of respondents to pay to solve global warming. The data was collected in October and November of 2011 using a structured questionnaire which was first formulated in English and then translated into Greek. The analysis was performed using the statistical package SPSS v17.0 and focused on descriptive statistics, in order to compare the average ratings for the different statements.

The present study concludes that university students in Greece are overwhelmingly positively disposed towards the environment with the majority of respondents believing that protecting the environment should have priority over economic considerations. Students also view the effects of global warming as serious enough to warrant action and state their belief that the current generation should meet its own needs without compromising the ability of future generations to meet their own. Moreover, the majority of the participants are against the development of nuclear energy, favoring RES (solar wind and bioenergy), and energy conservation technologies. However, the study has also identified a lack of understanding in regards to sources of carbon dioxide. The majority of the respondents do not seem to know that oceans act as sinks of CO₂ emissions or that the housing stock is a significant contributor to this problem.

Keywords: survey, environment, global warming, climate change, university students, Greece

1. Introduction

As is well documented, the unprecedented development that the world has experienced since the 1950's has been based upon our insatiable appetite for energy. Although the benefits are obvious, the environmental problems emanating from the use of fossil fuels are of such grave importance that they are increasingly moving towards the top of the international political and economic agenda. Prominent amongst these are the results that anthropogenic greenhouse gas (GHGs) emissions have on the planet's climate. The 2007 Intergovernmental Panel on Climate Change (IPCC) scientific assessment stated with "very high confidence" that humans are having an effect on the climate (IPCC, 2007). The finite nature of the resource is also a cause of anxiety, as is the insecurity surrounding the reliability of

future energy supplies. The latter is especially prevalent since the terrorist attacks on American soil and the emergence of Asia as a rival center for energy demand. The issue of 'resource nationalism', through the use of National Oil Companies (NOC) has been a matter of bitter debate in the congress of the United States of America (USA). As these were not enough, the majority of oil producing countries are characterized by political instability, while few, are outright hostile towards the 'West'. The recent tragedy in Fukushima, Japan has also highlighted the advantage that Renewable Energy Systems (RESs) have over nuclear energy, namely that of safety. The global strategy to reduce dependence on fossil resources is based on reducing energy consumption, by applying energy savings programs focused on energy demand reduction and energy efficiency in the transportation, industrial and domestic sectors, and by developing and promoting RESs.

Arguably, the European Union (EU) has been one of the most vocal advocates of the need to adopt and implement global schemes that will help reduce GHG emissions, and a driving force behind the conception of the Kyoto Protocol. The development of RES is a core component in the strategies adopted by the EU Member States (MS) to achieve their respective commitments. However, a careful examination of the available data reveals that implementation is still lagging far behind the ideals espoused by policy/ decision makers. Excluding hydro power plants, the share of RES electricity production in 2008, in TWh, was a meager 5.9% (Table 1). The lion's share is in biomass and wind produced electricity, while geothermal, photovoltaics and tidal/wave have not as yet captured a significant share of the market (Figure 1). Further, RES production in EU MS is characterized by great discrepancies. For example in 2010, Germany and Spain were the largest wind power producers, together accounting for 56.5% of installed capacity (Figure 2) (EWEA, 2012). It is worth noting that over 75% of the total off shore wind energy capacity had been installed in the UK and Denmark (KPMG, 2010). Even greater are the discrepancies in electricity produced by photovoltaics, with Germany dominating, with 86% of the EU total. The failure of the Mediterranean countries to develop this recourse cannot but be noted. A greater variety of MS have developed biomass produced electricity schemes with Germany (19%), Finland (14%), the UK (14%) and Sweden (11%) as frontrunners. Geothermal and tidal/ wave electricity are almost solely produced by Italy and France respectively (Coenraads *et al.*, 2008; Ruska and Kiviluoma, 2011).

Table 1. EU RES electricity production in TWh in 2008

RES Technology	TWh	Share of RES excluding Hydro (%)
Total Biomass	102,1	44,9
Total Hydro	352	
Photovoltaics	1,5	0,7
Solar thermal electricity	0	0,0
Tide & Wave	0,5	0,2
Geothermal electricity	5,4	2,4
Total Wind	118	51,9
Total RES	579,5	
RES share of total production (%)	14,9	
Total excluding all hydro	227,5	
RES share of total production	5,9	
Total electricity produced (RES, Conventional sources and Nuclear)	3,879	

Source: Ruska and Kiviluoma, 2011

In Greece, electricity is mainly produced by the use of brown coal (lignite). The utilization of RES begun with the introduction of Law 2773 (1999), which adopted the European directive 1996/92/EC on the liberalization of the electricity markets. As is the case with many EU MS, wind has developed

significantly better than other RES (70% of total installed capacity), while PV has only started developing since 2007 (Kambezidis *et al.*, 2011). Arguably, RES development in Greece is lagging far behind its EU partners (excluding large hydro, only 2.6% of electricity was produced by RES), especially if comparisons are made with the EU-17 (6.2%).

As a truism, a promising avenue for equipping members of society with the necessary tools for identifying potential solutions to environmental problems can be found in environmental education, as it can produce an environmentally literate citizenry able to actively address relevant challenges and problems. Thus, the investigation of knowledge, perceptions and attitudes, among students of the tertiary sector, that concerns various aspects of environmental issues are of high importance. Such an investigation may reveal the success (or otherwise) of current educational programmes and equip decision makers with the necessary data for the formulation of future policies.

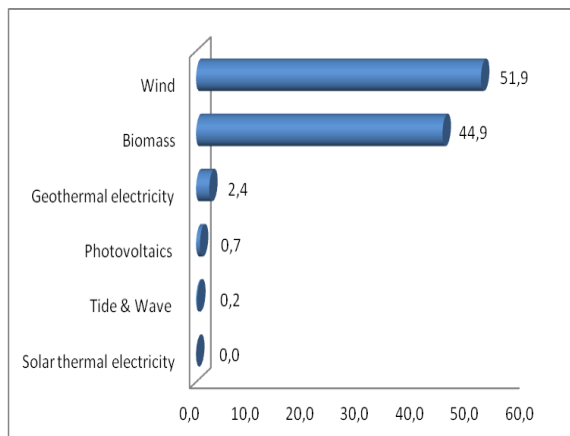


Figure 1. Share (%) of EU RES production (2008)

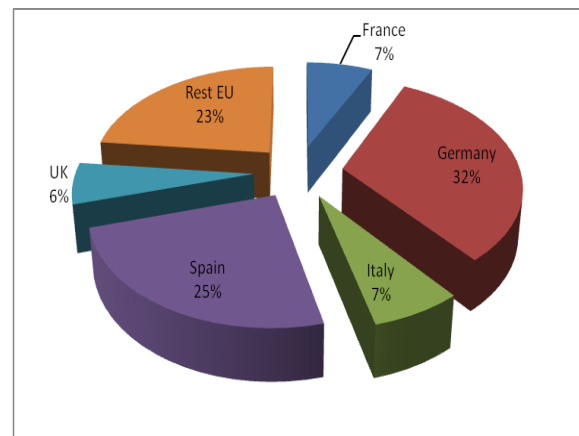


Figure 2. Production of wind energy among EU MS (2010)

This paper summarises the results of a survey carried out amongst the student population of one of the largest Greek Technological Educational Institutes. It explores attitudes toward the environment in general and then, more specifically, toward global warming and global warming-mitigation technologies. It also explores student understanding of sources of carbon dioxide and climate change-mitigation technologies, such as carbon dioxide capture and storage (CCS). Further, it analyses responses to questions about willingness of respondents to pay to solve global warming.

2. Materials and methods

2.1 Questionnaire design

The data was collected using a structured questionnaire, which consisted of 28 questions. The questionnaire borrowed heavily from a similar study carried out in the UK (Curry *et al.*, 2005), but other studies were also consulted (Gossling *et al.*, 2005; BERR, 2008; Halder *et al.*, 2010; Qu *et al.*, 2011). It was decided to subdivide it into the five following sections:

- i. Socio-demographic information (questions 1-12 & 25)
- ii. Attitudes towards environmental issues (questions 13-16 & 27-28)
- iii. Attitudes towards global warming (questions 17-21)
- iv. Understanding of carbon dioxide sources (questions 22-23)
- v. Willingness to pay (question 24)

The questionnaire was first formulated in English and then translated into Greek. Before the study was conducted the opinions of five experts were sought. Their respective fields of expertise are:

Environmental catalysis, Wind energy development, Biofuels production, LCA in bioenergy systems and Waste management. Based on the experts recommendations small revisions were made.

2.2 Data collection

The survey was conducted in October and November of 2011 at the Technological Educational Institute of Western Macedonia (TEIWM), one of the largest regional Technological Universities in Greece, with 18 departments (providing an equal number of undergraduate courses) and a student population that approaches the 22,000 mark (Table 2). TEIWM is spread over five campuses, which are located in the cities of Kozani, Florina, Kastoria, Ptolemaida and Grevena. The main campus is located in the city of Kozani, which hosts the School of Technological Applications and the School of Management and the Economy, with a total of eight departments. Florina hosts the School of Agricultural Technology with a further three departments. Due to time constrains, no surveys were carried out in the remaining campuses.

Table 2. Information on TEIWM

Host city	School/ Department	Numb. of stud.	Numb. of staff ¹	Numb. respond. (% of sample)	Contribution of envir. courses to the curriculum
Kozani	School of Technological Applications				
	Pollution Control Technologies	1028	8 (6)	39 (9.4)	Extreme
	Mechanical Engineering	1472	12 (12)	76 (18.4)	Low
	Electrical Engineering	1861	11 (11)	59 (14.3)	Low
	Industrial Design	1473	6 (5)	47 (11.4)	None
	Geo-technology and the Environment	1319	10 (3)	20 (4.8)	Moderate
	Geniko (General) ²	0	11 (10)	-	-
	School of Management and the Economy				
	Accounting	1622	7 (6)	4 (1.0)	None
	Business Management	1686	6 (7)	97 (23.4)	None
Monetary and Economic Studies	1091	9 (4)	20 (4.8)	None	
Florina	School of Agricultural Technology				
	Plant Production	1473	7 (4)		None
	Animal Production	864	3 (4)		None
	Agricultural Products, Marketing and Quality Control	1010	7 (4)	50 (12.1)	None
Kastoria	Kastoria Campus				
	International Trade	1505	6 (4)		None
	Public Relations and Communication	2624	3 (9)		None
	Computer science	1202	7 (11)		None
Grevena	Grevena Campus				
	Computing Applications in Management and the Economy	964	4 (7)		None
	Business Computing	242	0 (3)		None
	Logistics Management	47	0 (1)		None
Ptol. ³	Ptolemaida Campus				
	MidWifery	203	0 (14)		None
Totals		21686	117 (125)	414	

Note: ¹Non permanent members of staff (adjunct) in parenthesis, ²The Geniko department's role is confined to the teaching of basic courses in the first two years of study (e.g., mathematics, chemistry and computers), ³Ptolemais

Two out of the five departments at the School of Technological Applications are wholly (Pollution Control Technologies) or partially (Geo-technology and the Environment) oriented towards environmental studies, however relevant courses (such as Renewable Energy Systems) are taught at another two departments (Mechanical Engineering and Electrical Engineering). A close inspection of the curriculum of the departments belonging to the School of Management and the Economy revealed that environmentally related courses are absent. Surprisingly, given the nature of modern agricultural studies, this was also the case with the departments belonging to the School of Agricultural Technology. The questionnaires were delivered to students in the classrooms. The purpose of the questionnaire was explained, while it was made clear that taking part in the survey was not obligatory. Few declined the opportunity to participate.

Some information regarding the region that TEIWM is located is also necessary, as within Greece, West Macedonia is perceived as suffering from severe environmental degradation. Although no comparable studies exist, it can be expected that this perception may have an influence on the respondents' attitudes towards energy and the environment. West Macedonia is located in the northwest of Greece on the borders of Albania and the Former Yugoslavic Republic of Macedonia (FYROM). The region is mountainous, and geographically isolated. It is classified as a NUTS 2 region, with a per capita income (GDP) of 75% of the EU average (Eurostat, 2008). Currently, unemployment stands at 24.3%, the highest in Greece (EL.STAT., 2011). Lignite extraction for power production has led to heavy industrialization and the region hosts the largest Greek electricity power production units, which contribute to 50% of the total electricity production of the country (EL.STAT., 2011). This rapid and unplanned industrialization process has resulted in significant environmental problems and the overreliance of the local economy on the energy sector. It is worth noting that the plumes emanating from the power plants are visible from both the Kozani and Florina campuses.

2.3 Data analysis

The analysis was performed using the statistical package SPSS v17.0 and focused on descriptive statistics, in order to compare the average ratings for the different statements.

3. Results and discussion

A total of 414 questionnaires were delivered to students in their classrooms. Most participants were male (67.2%). In terms of age, 61.3% were between 18-21, 26.9% between 21-24 and 7.7% between 24-27. The vast majority stated their nationality as Greek (94.4%), while 56.2% classified their place of origin as urban and 43.5% as rural.

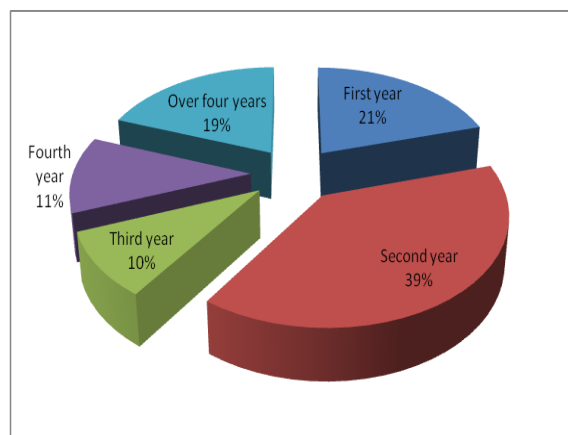


Figure 3. Questionnaire participants by year of study

Most students live on relatively low or modest incomes (for the purposes of the present study, a student's income includes all possible sources, such as money received from parents, employment,

grants, etc), with 23.6% on less than 300€ per month, 24.1% between 301-400€ and 15.8% between 401-500€. Very few stated that they have an income greater than 1000€ (2.2%), while 20.7% did not wish to divulge that information. Less than a third (28.3%) are employed either in full or part time capacity (30.2% and 69.8% respectively). Most live alone in rented flats (61.1%), with student halls (11.5%), and at home with parents (9.8%) the next highest. For the majority of the respondents the rent paid is between 150-250€ (57.6%), while those in student halls or at home with their parents, live rent free. A breakdown of the respondents by department attended is presented in Table 2 above. Information on the year of study of the participants is presented in Figure 3. It should be noted that all degrees provided by TEIWM are four year courses however, as is common in Greece, a large proportion of students exceeds this time.

A number of questions exploring the attitudes of the respondents towards environmental issues required the choosing of priorities from a given list. For example, in question 13, respondents were asked to choose the three most important issues that Greece is currently facing, from the twenty-four listed in Table 3.

Unsurprisingly for a country caught in the throngs of an economic crisis, unemployment, the economy and tax evasion were all listed among the top four (the issue of tax evasion is currently attracting significant attention in the mass media). The environment was listed as the 10th most important concern. Throughout this study, the 10% of respondents who included the environment in their top three are considered “concerned about the environment”. The survey included a question that explored specific environmental concerns. Participants were asked to select the first and second most important environmental concern facing Greece today. Figure 4 includes both responses. As can be seen, the top three responses were water and soil pollution (35%), the destruction of ecosystems (30%) and global warming (22%). Figure 5 shows the responses to a question that asked participants to choose their preference between protecting the environment and protecting the economy. Encouragingly, the largest percentage of respondents selected a response that said both are important but, given the choice, the environment should take precedence over the economy. No major differences were observed between gender or place of origin. In terms of subject studied, 92% of the respondents at the Pollution Control Technologies (PCT) believe that highest priority should be given to protecting the environment, even if it hurts the economy. In contrast, only 7% of those studying Accounting and 9% of those studying Agricultural Products, Marketing and Quality Control (APMQC) gave a similar answer.

Table 3. Most important issues facing Greece

Issue	Listed amongst top 3 (%)	Issue	Listed amongst top 3 (%)
Unemployment	55	Income inequality	6
Education	37	Foreign policy	5
Economy	34	Welfare state	3
Tax evasion	28	Terrorism	3
Asylum seekers	24	Keeping the euro	3
Poverty	20	Racism	3
Health care	15	Inflation	1
Crime	14	AIDS	1
Budget deficit	11	Stock market	1
Environment	10	Family values	1
European Union	7	Social exclusion	1
Drugs	6	Aging population	1

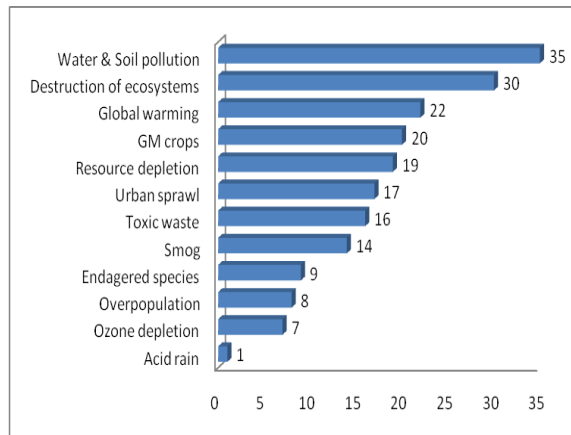


Figure 4. Most important environmental concerns (%)

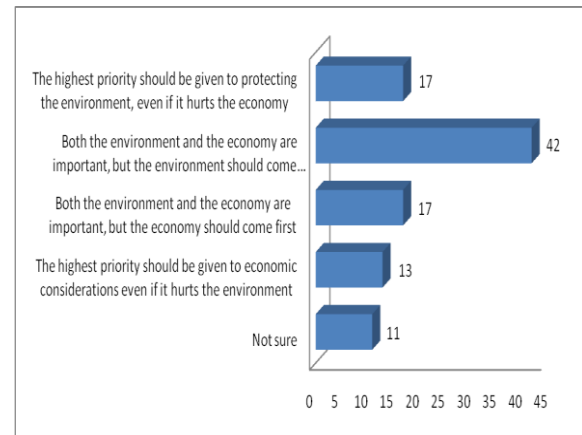


Figure 5. Tradeoffs between the environment and the economy

Although the vast majority of the respondents understand that the operations of automobiles and factories increase CO₂ emissions, surprisingly, only 73% provided the correct answer in regards to coal burning power plants. Even less (44%), identified home heating as a contributor to CO₂ emissions however, this may be attributed to the fact that buildings in the Kozani and Florina cities are heated up by the steam that results from the power plants operating in the area, thus technically, the 24% that stated that homes have no effect are also correct. Only 12% of the participants understood that nuclear power stations do neither increase nor decrease CO₂. Furthermore, respondents were, in varying degrees, unsure about the effects of farming, trees and oceans (Table 4).

Table 4. Understanding the sources of carbon dioxide

Technology or practice	Increases CO ₂ (%)	CA ¹	Decreases CO ₂ (%)	CA ¹	No Effects (%)	CA ¹	Not sure (%)
Automobiles	90	✓	3		3		4
Factories	91	✓	6		1		3
Coal burning power plants	73	✓	7		3		16
Home heating	44	✓	4		24		27
Nuclear power stations	58		10		12	✓	19
Farming	11	✓	25		52	✓	12
Trees	6		56	✓	34		5
Oceans	5		37	✓	48		10
Windmills	5		26	✓	52	✓	17

Note¹: CA denotes Correct Answer

The core premise of sustainable development was addressed by asking the participants to respond on whether they believed the present generation has an obligation towards safeguarding the needs of the future generations. 75% responded positively, while 18% where not sure (Figure 6). Again, no major differences were observed between gender or place of origin. In terms of subject studied, 98% of the respondents at the PCT and 87% of those at Accounting replied positively, while this dropped to 52%, 57% and 61% for those at Mechanical, Electrical and APMQC departments respectively.

A number of survey questions explored general attitudes toward global warming. The majority of the respondents (75%) believe that action to tackle the effects of global warming is necessary, with 2/3 of those advocating immediate action. Only 16% of the respondents believe that more research is necessary before any action is taken (Figure 7). In terms of likely means to combat global warming, it is interesting to note that over a quarter of the respondents (27%) believe that although global warming is a problem, Greece will not do anything about it. This may be attributed to current events in the country,

where the worsening economic situation has led a large number of the populace to doubt the effectiveness of governmental institutions. Nonetheless, 40% of the participants believe that we will have to change our lifestyles and reduce energy consumption, while a significant proportion (18%) placed their faith in academic/ research institutes, believing that researchers will develop the necessary tools to combat this issue (Figure 8).

The survey asked respondents to select the technologies they would consider using to address global warming. Each technology was followed by a definition to provide the respondents with information about what they were selecting. The highest preferences included solar, wind and biomass energy, energy efficient cars and appliances and carbon sequestration. Nuclear energy scored lowest, with 61% being against its development (Figure 9).

The survey also asked respondents to state how much they were willing to pay to address the issue of global warming. Again, it is believed that Greece’s economic climate had a large influence on the participants’ responses with only 19% willing to pay more than 20€ per month (Figure 10).

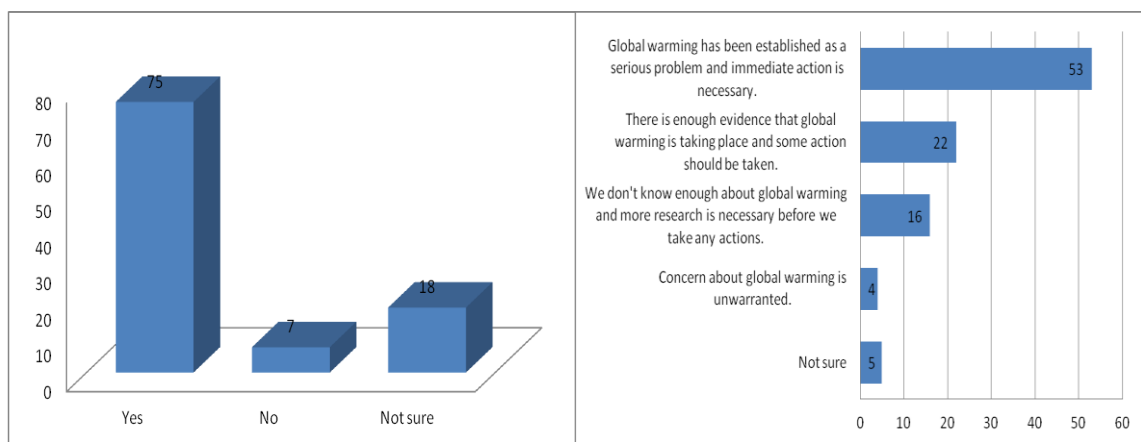


Figure 6. Belief in the obligation towards the needs of future generations (%)

Figure 7. Opinions about global warming (%)

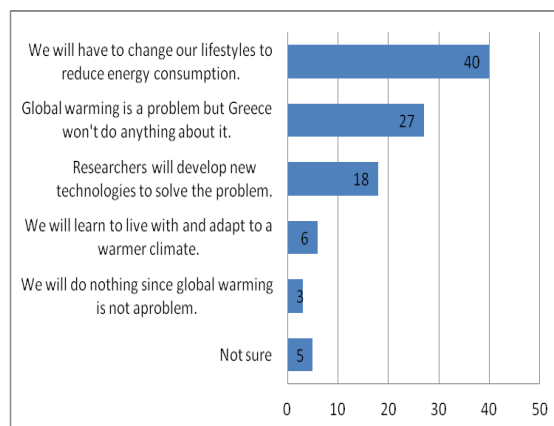


Figure 8. Likely response to global warming (%)

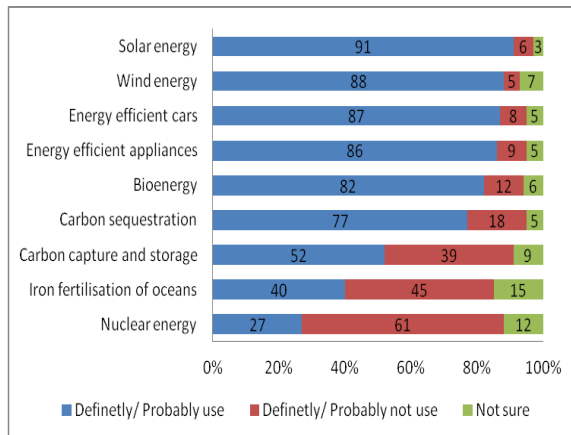


Figure 9. Technological preferences to address global warming

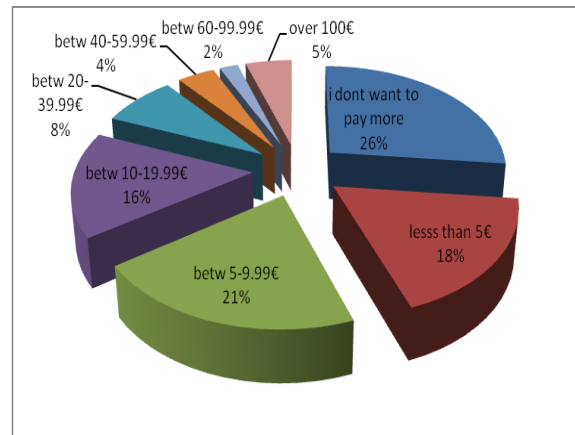


Figure 10. Willingness to pay

4. Conclusions

The present study concludes that university students in Greece are overwhelmingly positively disposed towards the environment. It should be noted that most of the students that participated in the survey, study courses that are unrelated to the environment. Thus, despite the fact that the country is currently undergoing a period of harsh austerity measures, with unemployment reaching almost 45% for those below the age of 35, the majority of respondents believe that protecting the environment should have priority over economic considerations. Furthermore, they consider that the possible effects of global warming are serious enough to warrant action and state their belief that the current generation should meet its own needs without compromising the ability of future generations to meet their own. Moreover, a significant number accept that a change in lifestyle patterns is necessary in order to reduce our energy consumption. Interestingly, the majority of the participants are against the development of nuclear energy, favoring RES (solar wind and bioenergy), and energy conservation technologies. However, environmental/ educational policy and decision makers should probably ponder over the likely understanding of the younger generation in regards to sources of carbon dioxide. The majority of the respondents do not seem to know that oceans act as sinks of CO₂ emissions or that the housing stock is a significant contributor to this problem. This lack of understanding in issues related to GHGs has also been observed by Ikonmidis *et. al.* (2012) who concluded that Greek prospective primary teachers show serious misconceptions in understanding causes, consequences and possible remediation strategies. Further work should include the crossing of the different demographic characteristics obtained in the first section of the questionnaire, in order to investigate possible explanatory variables. The variables need considering include age, gender, area of origin (rural/urban), study subject and background. Comparisons with similar surveys carried out in different countries will also prove useful.

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