Energy transition and willingness to pay for renewable energy: The case of environmental students

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Abstract. Examining willingness-to-pay (WTP) for renewable energy sources (RES) as well as views on energy topics can enable policymakers to design effective measures for facilitating the transition from fossil fuels to a renewable-based energy system. The aim of this study was to investigate environmental students’ willingness-to-pay for renewables and their views on various energy topics. Results showed that respondents preferred renewable-based electricity production to conventional energy production while solar energy emerged as the most preferred renewable type. In addition, most respondents were willing to pay for renewable energy but would pay relatively low sums of money per month. Moreover, respondents were divided over whether new lignite plants should be constructed in Greece. Finally, social media and special websites were the most favored media of daily information.

1. Introduction

Since the ratification of the Kyoto Protocol, many European countries established strict policies to decrease greenhouse carbon emissions in order to achieve their emissions reduction objectives. The most common path that member states follow to meet these objectives is by increasing the share of renewable energy in their national energy mix. Future targets of emissions reduction are anticipated to be particularly challenging as in a press release in September 2020, the European Commission proposed a 55% decrease in emissions by the year 2030 compared to the levels recorded in 1990. Greece has reduced significantly its greenhouse gas emissions and analysts have attributed this reduction to the deployment of renewable energy sources (in alignment with Laws 2009/28/EC and 3851/2010) as well as to the reduced energy consumption due to the economic crisis in the previous years [1]. In order to comply with the Integrated Emission Directive 2010/75/EU, Greece has announced a large-scale decommissioning plan which will, in essence, lead to the closure of lignite plants. At the moment, Public Power Corporation (PPC), the country’s major energy producer, ensures energy efficiency through large-scale energy projects including 34 major thermal and hydroelectric power plants and three solar parks of the interconnected power grid of the mainland, as well as the 61 autonomous power plants on Greek islands [2].

The European energy market has been liberalized meaning that it has become free and subject to competition; consumers can choose any energy provider they prefer. Moreover, the market liberalization implies that the diffusion of renewable energy depends, at least to some extent, on consumers who will either choose or reject renewable tariffs and contracts [3]. It is worth mentioning that any additional costs in energy transition make it less friendly to the public. In this regard, insights

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into individuals’ willingness-to-pay for renewable energy and their views on energy topics are of the utmost significance and can be used to promote renewable energy [4]. In other words, if policymakers are aware of the so-called consumer surplus (the divergence between the paid price and the willing-to-pay price), they can design marketing strategies to promote renewable energy as a product that can be purchased but also estimate the correct size of subsidies.

Most research works have focused on analyzing the willingness-to-pay of consumers or citizens while there is a scarcity of research focusing on the WTP of university students. However, university students will soon be financially independent and will face a variety of energy options [4]. Moreover, it is interesting to examine whether students majoring in disciplines related to the environment are willing to pay for renewables. Hence, the aim of this paper is to investigate willingness-to-pay for renewable energy, perceptions of renewable and non-renewable energy sources as well as the effect of information sources on energy views among undergraduate students majoring in the Department of Forestry and Management of the Natural Resources, in the Democritus University of Thrace. It should be noted that the energy habits [5] of students are not examined here.

2. Methodology
The research instrument was a structured questionnaire developed for the study after a literature review. A pilot study was performed on a limited scale leading to minor corrections in the wording of a few items. Multistage random sampling method was performed to select the required number of respondents and a representative sample of 214 undergraduate environmental students completed the questionnaire. The gathered data were scrutinized using the Statistical Package for the Social Sciences (SPSS) and various statistical tests were performed including descriptive statistics and the non-parametric Friedman test.

3. Results
In this section, the study results are presented. Subsection 3.1 describes respondents’ sociodemographic characteristics and Subsection 3.2 examines their preference for various energy types, including both renewable and non-renewable types. Subsection 3.3 examines their opinion on the construction of new lignite plants and finally Subsection 3.4 analyzes their willingness-to-pay for renewable energy.

3.1. Respondents’ socio-demographic characteristics
Information on respondents’ socio-demographic characteristics was first collected. As Figure 1 shows, in the sample, male respondents outnumbered their female peers by about seven percentage units.

![Figure 1. Respondents’ gender (%).](image-url)
Undergraduate studies at the Department of Forestry and Management of the Environment and Natural Resources have a duration of five academic years. In this study, students of all academic years were invited to participate. As shown in Figure 2, the percentages of fourth- and fifth-year undergraduates were higher than those of second- and third-year undergraduates.

![Figure 2. Respondents’ year of study.](image)

Information on respondents’ family background was collected. As Figure 3 shows, considerable shares of fathers were public (26.6%) and private employees (22%). Similarly, 24.8% of mothers were employed in the public sector and another 21.5% in the private sector. Only as few as 4.2% of fathers and 7.5% were not employed. Interestingly, significantly lower percentages of parents reported having retired.

![Figure 3. Students’ parents’ occupation.](image)

In terms of respondents’ family background, another variable that was examined was parents’ education level. According to Figure 4, a substantial share of fathers (36.9%) and mothers (45.3%) had completed higher education (university graduates). Meanwhile, lower percentages of parents reported having attended just compulsory education (pre-school and primary school).
3.2. Respondents’ preference for energy types
Next, respondents assessed different energy production technologies based on which types they prefer to be developed in Greece. Responses were ranked using the non-parametric Friedman test. According to results shown in Figure 5, solar energy received the highest ranking (mean rank 7.53), followed by wind energy (mean rank 6.92) and hydropower (mean rank 6.37). However, coal- and lignite-based electricity production technologies obtained the lowest rankings with mean ranks of 3.13 and 3.01, respectively.

3.3. Respondents’ opinion on the construction of new lignite plants
Respondents’ were then asked whether their agreed with the construction of new lignite plants in regions where large deposits have been discovered. As it appears in Figure 6, the highest share of undergraduates (43%) was somewhat confused about the construction of new lignite plants as they neither agreed nor disagreed. In addition, the percentage of respondents who agreed (29.4%) was
slightly higher than the percentage of students who disagreed (27.5%) to construct new lignite plants in regions with notable lignite resources.

Information sources often affect how individuals regard environmental issues. In this study, in order to examine the effect of information sources on students’ views on the construction of new lignite plants, the non-parametric Friedman test was applied. In Table 1, it can be seen that students who agreed with the construction of lignite plants, used mostly social media for their daily information. However, students who disagreed with the construction of lignite plants used mostly special websites. Moreover, university textbooks were ranked in the fifth position in the category of those who disagreed with the construction, in the sixth position for those who neither agreed nor disagreed and in the seventh position for those who expressed their agreement with the construction.

**Figure 6.** Percentages of students’ agreement with the construction of new lignite plants.

| mean rank | strongly disagree | neither agree nor disagree | strongly agree |
|-----------|-------------------|----------------------------|---------------|
| family and friends | 5.78 | 5.98 | 5.11 |
| national television networks | 4.50 | 5.46 | 4.97 |
| local radio networks | 3.80 | 4.36 | 5.02 |
| national newspapers | 3.20 | 3.23 | 3.52 |
| local newspapers | 2.70 | 3.05 | 3.02 |
| news websites | 5.77 | 5.32 | 5.67 |
| special websites | 6.97 | 5.96 | 6.31 |

**Table 1.** Results of the non-parametric Friedman test for ranking information sources.
3.4. Respondents’ willingness to pay for renewable energy sources

Respondents were also asked to state the amount of money they are willing to pay every month in order to reduce lignite-based electricity production and to increase the share of RES in the national energy mix. As shown in Table 2, 41.1% of students would pay up to 10 Euros per month and 24.8% would pay up to 20 Euros per month. However, an appreciable share of respondents (by 21.5%) was unwilling to pay any money for renewables. Moreover, relatively lower percentages of students were willing to pay higher amounts of money. In specific, only 9.3% would pay up to 40 Euros and as few as 3.3% would pay more than 50 Euros a month.

| Information sources                  | Not willing to pay | Up to 10 € monthly | Up to 20 € monthly | Up to 40 € a month | 50 € or more a month |
|--------------------------------------|--------------------|--------------------|--------------------|--------------------|----------------------|
| Family and friends                   | 46                 | 88                 | 53                 | 20                 | 7                    |
| National television and radio networks| 5.30               | 5.02               | 4.27               | 3.30               | 2.93                 |
| Local television and radio networks  |                    |                    |                    |                    |                      |
| National newspapers                  |                    |                    |                    |                    |                      |
| Local newspapers                     |                    |                    |                    |                    |                      |
| News websites                        |                    |                    |                    |                    |                      |
| Special websites                     |                    |                    |                    |                    |                      |
| Social media                         |                    |                    |                    |                    |                      |
| University textbooks                 |                    |                    |                    |                    |                      |

Students’ willingness-to-pay was analyzed using the non-parametric Friedman test. Here, it was sought to examine the effect of information sources that students used for their daily information on their willingness-to-pay. Results in Table 3 show that there is substantial differentiation between students’ willingness-to-pay. In specific, students who were willing to pay for RES used social media (mean rank 6.69), special websites (mean rank 6.36) and resorted to their family/friends (mean rank 5.77) to a higher degree than students who were not willing to pay. Students who were unwilling to pay for RES used mostly social media (mean rank 7.57), special websites (mean rank 6.20) and news websites (mean rank 5.61).

| Information sources                  | Mean rank |
|--------------------------------------|-----------|
| Family and friends                   | 5.30      |
| National television and radio networks| 5.02      |
| Local television and radio networks  | 4.27      |
| National newspapers                  | 3.30      |
| Local newspapers                     | 3.00      |
| News websites                        | 5.61      |
| Special websites                     | 6.20      |
| Social media                         | 7.57      |
| University textbooks                 | 4.73      |

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Table 2. Frequency and percentages of students’ willingness to pay for RES.

| Frequency | Percentage (%) |
|-----------|----------------|
| Not willing to pay | 21.5 |
| Up to 10 € monthly     | 41.1 |
| Up to 20 € monthly     | 24.8 |
| Up to 40 € a month     | 9.3  |
| 50 € or more a month   | 3.3  |
| Total                 | 100.0 |

Table 3. Results of the non-parametric Friedman test for information sources.
4. Conclusions
This paper presents the findings from a study that focused explicitly on undergraduate environmental students because these are the future environmental experts who will address important issues such as energy transition. The purpose was to examine students’ willingness-to-pay for renewables, their perception of renewable and non-renewable energy sources as well as the effect of information sources on their views. Results suggest that the majority of students were willing to pay for RES, but they preferred lower sums of money. Although students as future energy consumers can be expected to pay for RES, it is necessary to ensure that there are some more affordable options of tariffs and contracts. In this way, more individuals could pay for renewables thereby supporting the diffusion of renewable energy.

Another interesting finding was respondents’ clear preference for developing renewable-based generation technologies rather than conventional ones. In specific, solar energy followed by wind energy and hydropower were the most preferred renewable energy types. These findings are consistent with the study of Gareiou et al. [6] who examined views on renewable energy among the citizens of Athens. Likewise, citizens in the Greek capital perceived that solar energy and wind energy were environmental friendly. Moreover, our respondents were asked whether they agreed with the construction of new lignite plants – a rather controversial issue especially in a time that Greece is bound to implement the decarbonisation of its energy system. This controversy was reflected on students’ responses with almost similar shares of students agreeing and disagreeing with the construction of new lignite plants. However, environmental students need to be more opinionated about crucial issues such as lignite phase-out and thus parties involved in curriculum design need to provide environmental students with more information on this topic to enable them to form solid opinions.

Students’ use of information sources was also examined and it was found that students who agreed with the construction of new lignite plants used mostly social media for their daily information whereas students who disagreed used mostly special websites, and students who were undecided used social media. Therefore, social media followed by special websites emerged as the most influential information sources. Finally, a limitation of this study was that the sample is by no means representative of the Greek society but it only represents the students majoring in the Department of Forestry and Management of the Environment and Natural Resources. Therefore, conclusions cannot be applied to higher social layers nor other social groups.

To conclude, it is critically important to raise awareness about renewable energy through systematic and targeted campaigns, focusing not only on general problems, such as climate change, but also on site-specific issues, such as the decommissioning of lignite plants and the transition to renewable-based electricity technologies. It is of great significance that policy makers and other parties involved in the energy sector to know how much individuals are willing to pay for renewable energies and which information sources are mostly used so that the relevant information reaches them.

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