Citizens' Preferences on Nuclear and Renewable Energy Sources: Evidence from Turkey[1]

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ABSTRACT

Based on data from a face-to-face survey of 2,422 residents from urban Turkey, this paper presents an analysis of citizens' preferences in Turkey on nuclear and renewable energy sources. Findings indicate that opposition to nuclear power was strong, and only a small number of respondents endorsed it by listing it in their top two choices. Conversely, almost two-thirds of the sample endorsed investment in renewable energy sources (such as wind and solar), and only a small minority was opposed to it. Econometric analyses revealed that knowledge of the climate change problem was a common factor that explained endorsement of both nuclear and renewables. Yet, high levels of concern for the environment and a negative perception regarding its future differentiated the endorsers of renewables from those of nuclear energy. Endorsers of nuclear energy were found to be males who were knowledgeable about climate change and engaged in environmental issues, but less concerned about the environment, and optimistic about its future. Nuclear opponents, on the other hand, were found to be concerned about the environment, pessimistic about its future, and not fully relying on technology.

Keywords: energy preferences; environmental conflicts; environmental concern

1. Introduction

Fossil fuels, such as oil, coal and natural gas, play a dominant role in meeting the global energy demand today, contributing to more than 80 percent of the world's primary energy supply. However, fossil fuels are finite, unevenly distributed among countries, and mostly situated in unstable regions of the world, which all give rise to serious energy security concerns. A further and increasing unease about fossil fuels is that they are important sources of greenhouse gas emissions (IEA, 2009). These have led policy-makers all around the world to search for alternative energy sources.

Two main alternatives prevail in the current global energy debate: Nuclear and renewable energy, both of which draw support and opposition due to various reasons. Renewables, defined as energy sources "derived from natural processes that are replenished constantly" (IEA, 2002) include wind, solar, small-scale hydro, geothermal, biomass, tide and wave energy, and are promoted as being clean and endless.[2] Nuclear power, on the other hand, perceived with the connotations of "modernization" and "technological advancement," is seen as a reliable, low-carbon and efficient energy source.

Citizens' preferences for different energy sources have come to play an increasingly central role in decisions about energy investments to be undertaken in the regions or the countries they live in—even sometimes in their neighboring countries (Pidgeon et al., 2008; Visschers et al., 2009). The public resistance that escalated dramatically after the recent Fukushima accident, for instance, means that governments in a number of developed countries are no longer free to easily opt for nuclear energy. Germany is one such case where strong public pressure in favor of a nuclear phase-out, backed by the political pressure of the anti-nuclear Green Party, has forced the

current government to reverse traditional German national policies on nuclear energy (Adam, 2011; Poumadere et al., 2011). The impact of citizens' preferences on energy policies extends, albeit to a lesser degree, to developing countries as well. Strong local resistance in India, for example, led to the withdrawal of the World Bank from funding the Sardar Sarovar Dam project (Dwivedi, 1999).

Based on data from a face-to-face survey of 2,422 residents randomly drawn from urban Turkey, this paper presents an analysis of citizens' preferences on nuclear and renewable energy sources. Turkey is a fast-growing middle-income country and, with a continually increasing population of 74 million, is in great need of and has large potential for new energy investments. Turkey currently has no nuclear power plants and the use of renewable energy is limited, but both alternatives are on the immediate energy policy agenda and are being actively debated (Kaygusuz and Arsel, 2005).

With nuclear and renewable energy still untapped in the country, the setting of the survey study provides a laboratory environment for understanding the interplay between citizens' energy preferences and policy formation and adoption in the context of a developing country. It is well known that nuclear accidents hold strong sway over public opinion in their immediate aftermath, and negative views on nuclear energy are strongly exacerbated during that time (Pidgeon et al., 2008; Rosa and Clark, 1999). The survey on which this study is based was carried out before the Fukushima nuclear accident, in the second half of 2007; thus respondents' answers are free of the Fukushima effect. The previous nuclear accident that strongly affected public opinion in Turkey was the Chernobyl disaster of 1986, in nearby Ukraine. This study was conducted over 20 years after the Chernobyl accident, making it more

likely that any references to the accident are shaped by thoughtful calculation rather than impulsive emotional reaction. Given that, to the best of our knowledge, there is no comprehensive study investigating citizens' energy preferences for the case of Turkey, the results presented in this paper establish the first reference point for the country and open the way for future studies. In addition to reporting the levels of endorsement and opposition for nuclear and renewable energy, as distant as possible from a nuclear disaster effect, the study also investigates the determinants of citizens' preferences on these two energy sources, thus providing additional inputs to the relevant literature.

Another important feature of the survey that this study draws on was that energy and environmental issues constituted the focus of the survey, rather than being an additional, small module of a general public opinion survey. That is, it was a hypothesis-driven dedicated survey about energy and environmental policy that aimed to uncover energy preferences and examine the underlying factors that may explain these preferences. To this end, the questionnaire used presented respondents with a full set of energy investment alternatives, consisting of nuclear, renewables, coal, natural gas, and large-scale hydropower.[3]

The paper first describes the answers for the full set of alternatives, and then focuses exclusively on preferences for nuclear and renewable energy. A set of explanatory variables were conjectured at the research design stage to be correlates of energy preferences: In addition to standard questions about socioeconomic characteristics, the questionnaire also probed respondents' knowledge, values, attitudes, concern and behavior regarding energy and environmental issues. The paper examines

associations between preferences for nuclear and renewable energy and these variables.

More specifically, the objective of the paper is to answer the following questions:

- What can be said about the preferences for and against nuclear and renewable energy among a set of feasible energy alternatives for Turkey? To what extent are nuclear and renewable energy investments endorsed?
- What is the association between knowledge of climate change and preferences for nuclear and renewable energy?
- What are the associated environmental values, attitudes, concerns and behavior? In particular, how do environmental optimism, economy-orientation, full reliance on technology, environmental concern, and engagement in environmental issues affect preferences for renewable and nuclear energy?

One of the main findings indicated that opposition to nuclear energy was strong, and only a small number endorsed nuclear energy by listing it in their top two choices. Conversely, almost two-thirds of the sample endorsed investment in renewable energy sources (such as wind and solar), and only a small minority was opposed to it. Econometric analyses revealed that knowledge of the climate change problem was a common factor that explained the endorsement of both nuclear and renewable energy. Yet high levels of concern for the environment and a negative perception regarding its future differentiated the endorsers of renewable energy from those of nuclear energy. Endorsers of nuclear energy were found to be males who were knowledgeable about climate change and engaged in environmental issues, but less concerned about the environment and optimistic about its future. Nuclear opponents,

on the other hand, were found to be concerned about the environment, pessimistic about its future, and not fully relying on technology.

The plan for the rest of the paper is as follows. Section 2 provides an overview of the general debate regarding nuclear versus renewable energy, and background information on energy issues and concerns in Turkey. Section 3 reviews the empirical literature on energy preferences. Section 4 presents the design of the survey instrument and explains the sampling method employed. Section 5 presents descriptive statistics for various questions of the survey to provide an overall view of the data obtained. The econometric model and analyses are then presented in Section 6. The last section discusses the results and concludes the paper.

2. Context

Global climate change and energy security concerns constitute the two central issues in today's energy policies. As highlighted in the recent *World Energy Outlook 2010* (IEA, 2010, p.3), "it will be governments, and how they respond to the twin challenges of climate change and energy security, that will shape the future of energy in the longer term." In fact, these two concerns are often used to justify two distinct energy proposals: A greater reliance on renewables, and an expansion of nuclear energy. The *World Energy Outlook 2009* (IEA, 2009, p.7) points out that "a low-carbon energy revolution" is required in order to achieve climate change mitigation. Whether this can be achieved through increased reliance on renewable sources or on nuclear energy is being widely debated by different stakeholders, such as policy-makers, investors, scientists, NGOs, and the general public.

The European Renewable Energy Council report, *Rethinking 2050*, for instance, points to a vision for Europe that would involve a "100% renewable energy future by the year 2050" (EREC, 2010, p. 6). Relying on a number of scientific studies, the report argues that this is not only technologically feasible, but is indeed the only sustainable alternative. In a similar vein, Jacobson and Delucchi (2011) indicate that it would be feasible to restructure the worldwide supply of energy to include only wind, water, and sunlight by 2050, to deal with problems of climate change, pollution, and energy security. The authors argue that barriers to such an ambitious plan are not technological or economic, but political and social.

A trajectory for energy supply based only on renewable sources is very often criticized by nuclear advocates as being too optimistic, even mere wishful thinking. Critics of renewables claim that efficient electricity storage is an important problem, and therefore, energy produced by renewable sources on an intermittent basis could not replace fossil fuels until the storage problem is solved (Heal, 2009). They also assert that in most cases, renewable energy requires large investment costs, bringing about a funding problem (Painuly, 2001). In addition, there has been local resistance to wind farms in several places, which has often been associated with environment-related problems of renewables—such as noise, visual pollution, and potential harm to migrating birds. In such cases, resistance to specific wind farm projects has often been understood in terms of "not-in-my-backyard" (NIMBY) attitudes (see, e.g., Krohn and Damborg, 1999). However, recent studies demonstrate that there is not enough empirical evidence for the NIMBY argument (Devine-Wright, 2005; Wolsink, 2000), suggesting that the concept is too imprecise and fails to capture the complexity that underlies the resistance (Kempton et al., 2005; Wolsink, 2007).

Given the revived worldwide interest in nuclear energy, nuclear supporters were anticipating a nuclear renaissance in the near future—before the 2011 Fukushima accident. The International Atomic Energy Agency's 2008 projections included a "high scenario" of 100 percent increase in nuclear energy capacity by 2030. These projections were based on the fact that 24 countries with nuclear power plants were reconsidering their phase-out decisions in 2008 (e.g. Germany and Sweden) and were inclined to encourage new nuclear energy investments, while about 20 countries without nuclear power plants (including Turkey) were considering the nuclear alternative in their future plans (IAEA, 2008a).

As mentioned earlier, energy security seems to be one of the main arguments policy-makers use to promote further nuclear energy development. In the US, for instance, it is feared that oil flow from the unstable regions of the world will be disrupted, bringing on severe consequences for the US economy. Energy security concerns further extend to Europe, a continent highly dependent on the natural gas imported from or through Russia (Joskow and Parsons, 2009). Interestingly, James Lovelock, a pioneering environmentalist and one of the founders of Greenpeace, supported the nuclear option by arguing that in the presence of climate change, "[w]e have no time to experiment with visionary energy sources; civilization is in imminent danger and has to use nuclear—the one safe, available, energy source—now or suffer the pain soon to be inflicted by our outraged planet" (*The Independent*, 24 May 2004). Finally, an MIT Energy Initiative report on the cost of electricity generated from nuclear power plants is optimistic: "[i]n deregulated markets, nuclear power is not now cost-competitive with coal and natural gas. However, plausible reductions by industry in capital cost, operation and maintenance costs and construction time could

reduce the gap. Carbon emission credits, if enacted by government, can give nuclear power a cost advantage" (Deutch et al., 2009, p. 6).

In contrast, opposition to nuclear energy mainly relates to the risk of a nuclear accident, as experienced recently in Fukushima, and to long-term waste disposal problems—both of which have severe consequences for the environment and more generally for the survival of humankind. Joskow and Parsons (2009, p. 48) observe that for a "nuclear renaissance" to be possible, not only should the cost of nuclear energy be competitive with fossil fuels (which may be facilitated, for instance, by imposing a charge on carbon emissions), but significant progress should also be achieved in terms of nuclear waste and safety so that public acceptance may be enhanced. In this regard, the Fukushima nuclear accident, and the resulting extremely high levels of radioactive emissions (7 on the INES scale),[4] was probably a turning point. The post-Fukushima atmosphere has clearly challenged governments planning to rely more on nuclear energy. Public pressure has urged them to reconsider their nuclear expansion plans. Within a couple of months after Fukushima, the German Parliament voted with an overwhelming majority to phase-out nuclear plants by 2022; Belgium's energy minister initiated a discussion on nuclear power; and Japan expressed the need to reduce dependence on nuclear energy and increase reliance on renewables.

In parallel with these developments in the world, a public debate on energy alternatives emerged in Turkey among the business community, environmental NGOs, and the general public. Governments and the public have always paid great attention to energy issues in Turkey, given the critical role of energy in maintaining economic growth and Turkey's current reliance on imports (Kaygusuz and Arsel,

2005). To meet increasing energy demand,[5] the current government has been focusing on the largely untapped energy alternatives, nuclear and renewable energy (MENR, 2010a). Although the potential for renewable energy sources is high, this has been only minimally utilized to date.[6] Consequently, the current government has set installed capacity targets as 20,000 MW for wind power and 600 MW for geothermal by 2023. As for nuclear energy, despite several attempts by previous governments dating back to the 1970s, there are still no nuclear power plants in Turkey. Recently, in 2010, the construction of one nuclear power station on the Mediterranean coast at Akkuyu was contracted to Rosatom, the Russian state-owned atomic energy corporation, but construction has yet to commence. A second nuclear plant is planned at Sinop, a small city on the Black Sea, for which the government has initiated negotiations with Japan, South Korea, and China (*Milliyet*, 10 April 2012). The Akkuyu project, if materialized, will be the first nuclear power plant on a state's sovereign land owned and operated by another state (Şahin, 2011). The government's projections show that nuclear energy will meet 5 percent of the domestic electricity supply of Turkey by 2023 (MENR, 2010a). The current government's focus on these two sources can again be explained by concerns on energy security and rapidly increasing greenhouse gas emissions: Currently, Turkey's rate of dependence on foreign energy supply is at 73 percent (MENR, 2010b), while greenhouse gas emissions went up by 119 percent from 1990 to 2007— the highest increase among 41 Annex-1 countries of the Kyoto Protocol (UNFCCC, 2009).

In this setting, there is a very heated ongoing public debate in Turkey on current energy policies, especially with regard to nuclear energy. The bilateral nuclear cooperation agreement with Russia was signed without much prior discussion at the

public level. This exacerbated the existing unease about nuclear energy, and seems to have given further impetus to resistance against nuclear power plant construction initiatives (*Radikal*, 14 May 2010). While the government has been trying to underplay its significance in an effort to push for nuclear plans, the 2011 Fukushima accident seems to have further strengthened the opposition movement (Şahin, 2011).

Despite the importance of this mainly anecdotal evidence, there is no systematic study on the extent and nature of resistance to nuclear energy in Turkey at the national level, and on how the general public perceives various energy alternatives. While opinion polls and studies on citizens' energy preferences have been conducted extensively and repeatedly in Europe and the US, similar studies do not exist in Turkey. The following section will provide a review of empirical studies that investigate citizens' energy preferences, mostly in Europe and the US. It is hoped that the evidence presented in this paper on the case of Turkey will contribute to filling a gap in the growing literature on energy preferences in contexts other than the EU and the US.

3. Literature on Citizens' Energy Preferences

Public opinion on energy sources began to influence energy policy formation and implementation in the early 1970s. Until then, governmental energy policies were largely treated as a technical issue outside the sphere of public discussion. With the first severe oil crisis in 1973, however, energy policies gradually became a public concern, especially in the US, and opinion polls and surveys measuring citizens' energy preferences gained importance.

Looking at the US case, public opposition to the construction of new nuclear power plants was around 20 percent in the mid-1970s. This climbed to more than 60 percent in the early 1980s, mainly due to Three Mile Island accident as well as the concerns caused by the military nuclear build-up during the Cold War (Rosa and Dunlap, 1994). A public opinion poll conducted just after the Chernobyl accident in 1986 revealed that 69 percent of US respondents opposed the construction of new nuclear power plants. Opposition continued at around 50-60 percent until the 2000s, while support was significantly lower at 30-40 percent (Bolsen and Cook, 2008). More recent surveys conducted in the pre-Fukushima period found an increase in nuclear support, with support and opposition almost at an equal split (Ansolabehere, 2007; Greenberg, 2009; Greenberg and Truelove, 2011). Greenberg and Truelove (2011), for instance, report that in a 2009 survey, 48 percent of the US public favored more reliance on nuclear, while 46 percent favored a decreased reliance.

In Europe, while the general level of nuclear support was not very different to that in the US, there were important cross-country variations among the 27 EU member states (European Commission, 2008; IAEA, 2008b). In *Special Eurobarometer 2008*, while Europeans on average expressed nearly identical levels of support (44%) and opposition (45%) towards nuclear energy, these percentages varied strongly between 7 percent and 64 percent across countries (European Commission, 2008). According to the report, the citizens of most EU countries that have operational nuclear power plants (such as the Czech Republic, Lithuania and Hungary) expressed support above the EU-average, while support remained well below the average in countries with no nuclear power plants (such as Austria, Cyprus and Greece), indicating a positive association between nuclear support and the existence of nuclear power plants in a country.

Most EU countries witnessed a positive change in attitudes towards nuclear energy between 2005 and 2008 (European Commission, 2006, 2008), and there are claims that rising concerns about climate change have played an important role in this (European Commision, 2008; Visschers et al., 2009). Yet, as Pidgeon et al. (2008) point out, nuclear accidents have a major impact on support and opposition levels in both Europe and the US. Van der Pligt (1992), for instance, reported an increase in opposition in the UK from an initial level of 68 percent to 80 percent immediately after the Chernobyl disaster. In fact, Visschers et al. (2009) argue, following Midden and Verplanken (1990), that opinions of supporters are more easily affected by negative information and thus less stable than that of opponents.

As opposed to the long-standing interest in nuclear energy, polling organizations did not pay much attention to public opinion on renewables until recently (Bolsen and Cook, 2008; Farhar, 1994). The latest surveys consistently found that support for renewables is very high, at about 80-90 percent both in Europe and the US (Corner et al., 2011; European Commission, 2006; Greenberg, 2009; Pidgeon et al., 2008; Poortinga et al., 2006). As several studies have repeatedly demonstrated, the tendency to prefer renewables over other energy sources is high as well (McGowan and Sauter, 2005; Pidgeon et al., 2008). Within the context of more cooperation on energy issues among EU members, a recent European Parliament Barometer conducted in EU-27 countries in 2010 (European Commission, 2011a) found that, on average, 29 percent of Europeans considered energy price stability as the highest priority, with the development of renewables following at a close second, with 27 percent. Yet, there is considerable cross-country variation within the EU-27 with respect to these findings as well. The percentage of respondents who gave highest

priority to renewables varied between 12 percent (Lithuania) and 53 percent (Denmark).

Commenting on the large number of energy surveys, Greenberg (2009) states that public opinion polls, in general, do not focus on the determinants of energy preferences, and underlines the need of hypothesis-driven surveys for a more complete and thorough analysis of public preferences. However, studies using hypothesis-driven surveys usually produced mixed findings with respect to socio-demographic factors (Ansolabehere and Konisky, 2009). Ek (2005), for instance, showed that age and income were negatively related with support for wind power in Sweden, while Greenberg (2009) found that these variables were insignificant correlates of renewable support in the US. Similarly, Ansolabehere and Konisky (2009) demonstrated that income was insignificant in explaining opposition to wind power in the US, but Firestone and Kempton (2007) found that opponents to an offshore wind power project in Nantucket Sound, the US, were likely to be wealthier. With regard to nuclear energy, within the US context, Webber (1982) found that nuclear opposition was positively related to age and education, and negatively to income. Ansolabehere and Konisky's (2009) results pointed to a negative relationship between nuclear opposition and age, while education was not a significant determinant. Greenberg and Truelove (2011) characterized those respondents who favored increased reliance on nuclear while acknowledging the possibility of a serious accident as "acknowledged risk takers," and demonstrated that this group was likely to comprise affluent, educated white males. Gender seems to be the exception among other demographic and socioeconomic variables, since it appears to affect energy preferences in the same way across different studies. Women are found to be less likely to support and more likely to oppose (or to be

undecided about) nuclear energy (Ansolabehere and Konisky, 2009; Corner et al., 2011; Greenberg, 2009; Kasperson et al., 1980; Webber, 1982).

The literature on energy preferences has recently begun to relate energy preferences to various indicators of environmental values and attitudes as well. As potential predictors of energy preferences, such studies consider environmental concern; environmental activism; trust in nuclear power plant operators and inspecting authorities; risk perceptions with regard to climate change, energy security, and power plant accidents; and optimism regarding the current and future state of the environment (see, e.g., Corner et al., 2011; Greenberg, 2009; Pidgeon et al., 2008; Spence et al., 2010; Visschers et al., 2009).

While pro-environmental values have been shown to be negatively associated with nuclear support (Corner et al., 2011), environmental concern was found to have a positive impact on renewable support, and a negative one on nuclear (Spence et al., 2010). When respondents were asked whether the local environment would be better or not in the next 25 years, this potential predictor was not found to have any effect on renewable or nuclear preferences; support for renewables was found to be linked to whether respondents characterized themselves as being actively involved in environmental issues (Greenberg, 2009). Trust in the management of energy facilities and nuclear-related authorities have been shown to be a significant predictor of nuclear preferences as well (Ansolabehere and Konisky, 2009; Greenberg, 2009; Greenberg and Truelove, 2011; Visschers et al., 2011; Whitfield et al., 2009). Risk perceptions of respondents have been shown to lead to decreased nuclear support and/or increased nuclear opposition in various studies (Ansolabehere and Konisky, 2009; De Groot and Steg, 2010; Greenberg and Truelove, 2011; Tanaka, 2004;

Whitfield et al., 2009). The close relation of risk perceptions with deeply-seated values about technology has also been underlined in several studies (see, e.g., Barke et al., 1998; Finucane et al., 2000).

Attitudes towards climate change and the role they play in the context of energy preferences have also been investigated recently. Spence et al. (2010), for instance, considered climate change as an independent variable and found that "involvement" in climate change—measured as having strong opinions about climate change and being bothered about—was a positive predictor of both nuclear and renewable support. Other studies tried to capture the impact of framing nuclear power as a means of dealing with climate change (Bickerstaff et al., 2008; Corner et al., 2011; Pidgeon et al., 2008; Visschers et al., 2011). One important finding in this respect was that nuclear power was only very reluctantly accepted when presented as a contribution to climate change mitigation (Pidgeon et al., 2008). On the other hand, Bickerstaff et al. (2008) provided qualitative evidence that most respondents in their focus group tended to reject or at least question a risk-risk trade-off between radioactive waste and climate change.

Findings seem to vary across geographical, cultural, and political contexts, as well as due to different sets of survey questions and wordings. Moreover, studies also differ in terms of the set of energy alternatives presented to respondents: While some focus on only one specific energy option, others include a full set of relevant energy alternatives and compare different energy sources with respect to their significant determinants. The latter is a better strategy, since otherwise it may remain unclear whether respondents' opinions reflect the characteristics of the specific power plants

in question or the attitudes towards the construction of *any* energy facility in general (Ansolabehere and Konisky, 2009; Visschers et al., 2009).

4. Research Design

The analyses in this paper make use of survey data from a research project that aimed to measure the willingness to pay for climate change in urban Turkey (Zenginobuz et al., 2008).[7] The questionnaire was administered in 26 cities, one chosen randomly from each of the NUTS II level[8] regions, from July 4 to August 21, 2007. A professional research company administered the questionnaires to respondents through face-to-face interviews.[9] A total of 2,422 households were drawn from urban Turkey using the random stratified sampling method.[10] Since the unit of analysis was the household, respondents from each household were determined again randomly among those aged 18 years and above. If the selected person was unavailable at the time of visit, an appointment was made and the household was visited a second time; if the person was still unavailable, then a new household was selected randomly. Response rate was 86 percent (approximately one-third of the non-responses were from unoccupied residences). Cooperation rate was 88 percent (rejections consisted of respondents who could not be reached, and those who were reached but either declined to participate or decided to withdraw during the interview).[11]

The energy module of the questionnaire, which this study analyzes, probed respondents' energy preferences. The first part asked about opposition to energy investment alternatives (Table 1).

Table 1: Energy module – Questions on opposition to energy investment alternatives

Are there any energy alternatives that the country shouldn't invest in? *(Multiple answers possible)* Coal □ Natural gas □ Dams □ Renewables (such as wind, solar) □ Nuclear □ What is the most important reason for this? *(Open-ended question asked for each alternative chosen by the respondent)*

The second part was about the type of energy investments that should receive priority in the country. More specifically, respondents were given the same set of energy investment options, and asked to name the energy investment alternatives they believed should receive the highest and the second highest priority (Table 2). Listing nuclear energy among the top two alternatives was then defined as "endorsement of nuclear energy," and the same thing for renewables was defined as "endorsement of renewable energy". An open-ended question asked for the main underlying reason of these choices. For those respondents who indicated renewable energy sources as their first or second choice, a follow-up question checked whether respondents would still endorse renewable energy in the case of a 25 percent rise in electricity bills.[12]

Table 2: Energy module - Questions on prioritizing energy investment alternatives

Q: Which type of these energy investment alternatives should receive the highest priority? And the second highest priority? *("1" for the first alternative, "2" for the second alternative)* Coal □ Natural gas □ Dams □ Renewables (such as wind, solar) □ Nuclear □ Q: What is the most important reason for this? *(Open-ended question asked for each alternative chosen by the respondent)* *(Only for those who selected renewables as a first or second choice:)* Q: Would you still support renewable energy, such as wind and solar, if you knew that your power came from renewable energy power plants and your electricity bill would be 25 percent higher as a result? Yes □ No □

Other modules of the survey contained questions on socioeconomic characteristics of respondents, as well as questions that probed respondents' environmental knowledge, values, attitudes, concerns, and behavior. Using those as possible correlates, data gathered from the energy module were used to measure and explain citizens' energy preferences for and against renewable and nuclear energy in urban Turkey.

5. Descriptive Results

Renewable energy sources, such as wind and solar, were endorsed by a large majority of respondents: 70.2 percent ranked renewable energy sources as their first or second choice, and this rate dropped only to 60.4 percent when asked whether they would still support renewable energy sources if this lead to a 25 percent increase in their electricity bills. In addition, renewable sources were opposed the least (4%). As noted above, the general public does not yet have much experience with sources such as wind and solar energy. Consequently, the high level of endorsement and the low level of opposition may be due to positive media coverage for wind and solar in recent years (see, e.g., *Hürriyet*, 16 April 2006; *Radikal*, 8 February 2007).

The picture is quite different for nuclear energy: There was strong opposition to nuclear power (62.5%), and only little endorsement (7.2%). The high level of opposition seems to be related to two facts: First, Turkey does not have any operational nuclear power plants, the presence of which tended to increase the average level of support in most European countries (European Commission, 2008). Second, the 1986 Chernobyl disaster was geographically nearby and affected Turkey, especially the Black Sea Region—known for tea and hazelnut production. Right after the accident, Turkish authorities tried to cover-up the effects of radioactive fallout in Turkey.[13] However, in later years, scientific evidence showed that the tea and nut

crops from the affected region were indeed contaminated, and incidence of cancer cases in the region significantly increased. The severe decline in trust towards public authorities due to this incident has been well documented (Şahin, 2011), and the way government officials handled the Chernobyl accident and its aftereffects on Turkey may still have a negative impact on the mindset and disposition of citizens towards nuclear energy.

Table 3 presents the descriptive results for energy preferences in more detail. Coal is clearly the most opposed alternative (82.9%). This comes as no surprise, since urban citizens especially suffered from extreme air pollution for decades due to low quality coal used for heating. The heavy reliance on coal for heating in urban regions ended about 10 years ago, when natural gas began to replace it. This likely explains the moderate level of natural gas endorsement as well (37.3%). Hydropower was also highly endorsed (65.2%); this is most likely related to the fact that large dams have been seen as an important sign of modern Turkey "catching-up" with the rest of the developed world since the 1950s (Kaygusuz and Arsel, 2005).

Table 3. Opposition to and endorsement of energy investment alternatives

	Opposition[+]		**Endorsement**[+]	
	Number of respondents	%	Number of respondents	%
Coal	1855	82.9	86	3.6
Natural gas	394	17.6	881	37.3
Dams	135	6.0	1539	65.2
Renewables	90	4.0	1414	60.4[++]
Nuclear	1399	62.5	170	7.2

[+] Percentages do not add up to 100% since respondents were instructed to select as many alternatives as they wished to oppose, and rank their first and second choices for energy investment. Endorsement is then composed of first and second ranked choices.

[++] After checking for robustness of endorsement in case of a 25% increase in electricity bills due to renewables such as wind and solar energy.

Open-ended questions were used to probe the underlying reason for opposing or endorsing each type of energy source. When asked about the main reason they endorsed renewables, a large number of respondents indicated these were "clean" and "harmless." A small share mentioned their climate change concerns, while another small group pointed to the country's high potential in terms of renewables. Opponents based their position on the perceived "ineffectiveness/inefficiency" of renewables, and a significant number of opponents stated that there is "no need at all for renewables." These together might be considered as reflecting opponents' concerns with the intermittent nature of renewables such as wind and solar energy. As expected, the main reason that was given for opposing nuclear power was the perceived "harm for humans" and its "dangers and risks," while the main reason of nuclear endorsement was related to its perceived "efficiency," "cheapness," and "cleanness," presumably since nuclear power plants do not emit local air pollutants such as SO_x, NO_x and other particulate matter.

Table 4 presents the sample's socioeconomic characteristics, which conform to census data compiled by the Turkish Statistical Institute, along with data on how answers to questions on environmental knowledge (climate change knowledge), concern, values and attitudes (environmental optimism, full reliance on technology, economy-orientation), and behavior (engagement in environmental issues) were distributed in the sample.

The descriptive statistics reveal that knowledge of climate change is quite low. This is not surprising, given that the media did not cover climate change much until very recently in Turkey. Perhaps also not surprisingly, the extent to which people are engaged in environmental issues in terms of being a member of an environmental

NGO, joining petition campaigns for nature preservation, and individually appealing for nature protection, is also low. Low membership in environmental NGOs most probably results from a weak civil society, which was severely constricted during the authoritarian military regimes that interrupted the democratic process three times since 1960 (Adem, 2005). In particular, during military rule in the 1980-to-1983 period, membership in any organization of political kind was either extremely restricted or banned outright. This further contributed to weakening of participation in civil initiatives. When asked to name the environmental organizations they were members of, half of the environmentally engaged respondents named a national NGO specialized in forestation rather than more political environmental organizations. This could be said to illustrate the extent to which civil initiatives are avoided for fear of persecution.

When respondents were presented with six major problems of the country, namely, corruption, poverty, restrictions of freedom of speech, unemployment, environmental degradation, and the Kurdish conflict, about one-fifth ranked environmental degradation as one of the two most important problems in Turkey. Answers to the question on expectations regarding changes in the quality of the environment in the next decade reveal clearly that a very large percentage of the sample (63.3%) is pessimistic about the future state of the environment. Turkey's environmental problems, both local and national, have been accelerating since the 1970s due to high rates of industrialization, urbanization, and tourism, which must have contributed to the public's pessimistic view of the future of the environment (Adaman and Arsel, 2010, 2012f). On the other hand, note that 30.6 percent of the respondents believed that technological solutions could resolve all environmental problems. This is not surprising given the dominant modernist discourse of governments in the last

decades that glorifies technological advancement (Kaygusuz and Arsel, 2005). While 16.9 percent of the respondents stated that environmental issues/targets were more important than economic ones, 60.2 percent indicated they were equally important, and 22.9 percent believed that economic objectives had priority, even at the expense of environmental problems. Since in answering this type of questions respondents are typically inclined to state that both options are equally important to them, this last percentage may be seen as a considerable amount. This finding seems to be in line with the strong economic-growth orientation of a developing country such as Turkey.

Table 4. Various descriptive statistics

Gender (%)	Male	Female					
	49.7	50.3					
Age (%)	18-24	25-34	35-44	45-54	55+		
	23.1	27.6	20.2	15	14.1		
Education (%)	No diploma	Primary	Secondary	University			
	8	49	32	12			
Household wealth (%)	Personal Computer	Car	Credit Card	Internet access	Dishwasher	Holiday abroad	
	38.1	30.1	43.8	28.4	41.9	6.6	
Knowledge of climate change	Do you know which gases cause the climate change problem? *(% of respondents who said **Yes** and then gave the **right** answer)*						28.8
	Have you heard about the Kyoto Protocol? *(% of respondents who correctly stated what the Kyoto Protocol is about)*						5.2
Engagement in environmental issues	In the last 5 years, did you participate in any signature campaigns to protect nature? *(% of respondents who said **Yes**)*						12.4
	did you write any individual petitions to protect nature? *(% of respondents who said **Yes**)*						3.7
	did you apply for membership in an environmentalist group/NGO? *(% of respondents who said **Yes**)*						2.2
Environmental concern	Which are the two most important problems of the country?					First priority	Second priority
	Corruption					13.7	9.8
	Poverty					17.2	20.5

	Restrictions of Freedom of Speech	4.0	4.3
	Unemployment	44.9	24.9
	Environmental Degradation	6.9	14.6
	Kurdish conflict	10.0	15.7
	Other	3.1	3.8
Environmental optimism	How do you think environmental quality will be in Turkey in the coming 10 years? *(%)*		
	Environment in Turkey will be **worse** in 10 years		63.3
	Environment in Turkey will be the **same** in 10 years		12.4
	Environment in Turkey will be **better** in 10 years		24.3
Full reliance on technology	Do you believe that all environmental problems can be solved by technological advancement? *(% of respondents who said **Yes**)*		30.6
Economy-orientation	Do you believe that economic issues/targets matter more than environmental issues/targets in a country? Or do you believe that environmental issues/targets are more important? Or are they equally important?		
	Economic issues/targets matter more than environmental ones		22.9
	Environmental issues/targets are more important		16.9
	Economic and environmental issues are equally important		60.2

6. Econometric Analysis

Four separate binary logit models were used to estimate four qualitative dependent variables; namely, endorsement of renewable energy, endorsement of nuclear energy, opposition to renewable energy, and opposition to nuclear energy. Table 5 provides a list of dependent and independent variables used in the models estimated, together with a brief description of each variable.

As explanatory variables, a set of independent variables in line with the literature was used to explain energy preferences for and against nuclear and renewable energy. The independent variables fall in two different categories: Socioeconomic variables on the one side, and environmental knowledge, values, attitudes, concern, and behavior on the other. The variables in the latter group captured different dimensions of respondents' characteristics with regard to environment and

technology, which is confirmed by the relatively small sample correlations among them (see Appendix A).

Table 5: Description of dependent and independent variables

Dependent Variable	**Description**
Endorsement of renewables	Takes the value 1 if respondent's first or second best alternative is renewables, 0 otherwise
Endorsement of nuclear	Takes the value 1 if respondent's first or second best alternative is nuclear, 0 otherwise
Renewable opposition	Takes the value 1 if respondent selected renewables as an alternative that the country should not invest in
Nuclear opposition	Takes the value 1 if respondent selected nuclear as an alternative that the country should not invest in
Independent Variable	**Description**
Gender	Male, Female
Age	Between 18-82
Education	Categorized as no diploma, primary education, secondary education, or university education
Household wealth	Measured by ownership of a number of items (factor loadings[+] of possessing a credit card, personal computer, internet access, mobile phone, fridge, washing machine, a dishwasher, LCD TV, car, vacation house, and the possibility of taking a holiday in a foreign country); a higher value corresponds to a higher level of household wealth
Region of residence	Categorized as the NUTS-I regions of Turkey (Istanbul, Western Marmara, Aegean, Eastern Marmara, Western Anatolia, Mediterranean, Central Anatolia, Western Black Sea, Eastern Black Sea, Northeastern Anatolia, Central Eastern Anatolia and Southeastern Anatolia)
Knowledge of climate change	Factor loadings based on items regarding knowledge of the Kyoto Protocol, and knowledge of the primary gas that causes global climate change; a higher value corresponds to a higher level of climate change knowledge
Engagement in environmental issues	Factor loadings of participation in a signature campaign to protect nature, writing individual petition to help prevent the destruction of the nature, and membership in an environmentalist group/NGO; a higher value corresponds to higher level of engagement in environmental issues
Environmental concern	Dummy variable taking the value 1 if a respondent identifies environmental problems as one of the two most important problems of the country, 0 otherwise

Environmental optimism	Respondent's expectations on how the environment in Turkey will look like in 10 years compared to today; on a scale between 1 to 5, 1 indicating much worse and 5 indicating much better
Full reliance on technology	Respondent's view on whether it is possible to solve all environmental problems through technological advancement; 0 indicating No, 1 indicating Yes
Economy orientation	Dummy variable taking the value 1 if a respondent agrees with the statement that "Economic objectives of the country are more important than environmental ones," 0 otherwise

[+]Household wealth, knowledge of climate change and engagement in environmental issues are composite variables, constructed using Principal Component Analysis (PCA). In case of household wealth, for instance, factor loadings are estimated for each individual depending on the ownership of a credit card, personal computer, internet access, mobile phone, fridge, washing machine, dishwasher, LCD TV, car, vacation house, and the possibility of taking a holiday in a foreign country. PCA then provided scores for each individual having a standard normal distribution with a mean of zero.

Some studies have used trust in the government and/or the nuclear authority as a potential predictor of energy preferences (see, e.g., Corner et al., 2011; Greenberg, 2009; Spence et al., 2010). This study does not include trust as an explanatory variable since, when the survey was conducted in 2007, it was unclear which institution would be responsible for the construction and operation of the first nuclear power plant in Turkey in case the project was to go ahead.[14] As a separate issue, full reliance on technology, a variable that captures those who believe that all environmental problems can be solved with technology, may be seen as a proxy for respondents' perception of risk. Risk perception is a characteristic that conflates different aspects of individual preferences and is in general difficult to measure.

Results of the Econometric Analysis

The results of the logistic regressions presented in Table 6 indicate the determinants of the preferences for or against renewable and nuclear energy. Based on these results, we discuss below the similarities and differences between the determinants of endorsement of nuclear and renewable energy, and significant characteristics of those who oppose these two energy alternatives.

Table 6. Results of binary logit regressions[+, ++]

	Endorsement of Renewables		Endorsement of Nuclear		Opposition to Nuclear		Opposition to Renewables[+++]	
	Coefficient	Odds ratio	Coefficient	Odds ratio	Coefficient	Odds ratio	Coefficient	Odds ratio
Age	0.002	1.002	-0.006	0.994	0.004	1.004	-0.027**	0.974
Household wealth	0.048	1.049	-0.046	0.955	-0.008	0.992	0.03	1.031
Gender (female)	0.136	1.145	-0.484**	0.616	-0.077	0.926	-0.493*	0.611
Primary school	0.870***	2.387	-0.192	0.825	0.014	1.015	0.216	1.241
Secondary school	0.932***	2.539	-0.021	0.980	0.174	1.190	0.204	1.227
University	1.158***	3.183	0.299	1.348	0.418	1.520	1.53	4.618
Knowledge of climate change	0.366***	1.442	0.621***	1.861	0.033	1.033	-1.515***	0.220
Engagement in environmental issues	-0.1	0.905	0.303**	1.354	-0.024	0.976	-0.193	0.825
Environmental optimism	-0.125***	0.883	0.196**	1.216	-0.195***	0.823	0.378***	1.459
Full reliance on technology	-0.059	0.943	0.211	1.235	-0.245**	0.783	0.525*	1.691
Environmental concern	0.285**	1.330	-0.498**	0.608	0.252**	1.286	-0.605	0.546
Economy-oriented	-0.388***	0.679	-0.134	0.875	-0.106	0.899	0.765***	2.149
Knowledge*Concern	0.837**	2.309	-0.137	0.872	-0.311	0.733	-1.233	0.291
Aegean	0.025	1.025	0.056	1.058	-0.071	0.932	-1.042**	0.353
Western Marmara	-0.226	0.798	0.58	1.786	-0.113	0.893	0.054	1.056
Eastern Marmara	-0.076	0.927	-0.182	0.834	0.167	1.182	-0.959*	0.383
Western Anatolia	0.002	1.002	-0.149	0.862	-0.353*	0.702	-1.001**	0.368
Mediterranean	0.05	1.051	0.021	1.021	-0.189	0.828	-1.136**	0.321
Central Anatolia	0.143	1.154	0.640*	1.897	-0.433*	0.649	-2.193**	0.112
Western Black Sea	-0.115	0.891	-0.412	0.662	0.258	1.294	-1.440*	0.237
Eastern Black See	-0.151	0.860	0.155	1.167	-0.442	0.643	-0.971	0.379
Northeastern Ana.	0.255	1.291	-0.199	0.820	0.455	1.576	-	-
Central Eastern Ana.	-0.119	0.888	-0.133	0.875	-0.024	0.976	-	-
Southeastern Ana.	0.337	1.401	-1.041**	0.353	-0.262	0.769	-2.892***	0.055
Constant	-0.208		-2.490***		0.973**		-3.200**	
Number of observations	1773		1790		1713		1590	
LR Chi-Square	85.74		61.34		58.14		97.5	
P-value	0.000		0.000		0.000		0.000	
Pseudo R-Square[++++] (Mc Fadden's)	0.036		0.064		0.026		0.184	

[+] Significance at 10 percent, 5 percent, and 1 percent are denoted by *, ** and ***, respectively.

[++] For each dependent variable, we ran a constrained model with socioeconomic variables and then added other independent variables one-by-one in order to check for endogeneity. This revealed that our results are robust to endogeneity problem.

[+++] In case of opposition to renewables, Northeastern Anatolia and Central Eastern Anatolia regions drop out from the analysis due to perfect prediction.

[++++] Even though the reported pseudo R-squares are small, each model is significant at the $p<0.001$ level. Recall that the aim of the study was not to come up with a complete model of energy preferences, but to search the way a given set of dimensions relate to them. At any rate, the measure used in the analysis, McFadden's pseudo R-square provides a rather conservative figure. Furthermore, several variables used in the study are discrete, in which case small pseudo R-squares are not unexpected.

A common ground for the endorsers of nuclear and renewables: The results show that knowledge of the climate change problem is a significant determinant of both renewable and nuclear endorsement. That is, being more knowledgeable about climate change increases the probability of endorsement of both nuclear energy and renewables. This finding is perhaps not surprising since the media, scientific publications, and some environmental NGOs view these two energy alternatives as possible solutions to the climate change problem. Therefore, individuals who are aware of global warming usually position themselves in one of these two camps.

Points of divergence for the endorsers of nuclear and renewable energy: Though endorsers of nuclear and renewable energy are both knowledgeable about the climate change problem, they differ in two important aspects: Degree of concern for the environment, and perceptions about the future of the environment. While environmental concern is a significantly positive predictor of renewable endorsement, the relationship between environmental concern and nuclear endorsement is also significant but negative. That is, being strongly concerned about the environment increases the probability of endorsing renewables but decreases the likelihood of endorsing nuclear power. Moreover, optimism about the future of the environment is a significantly positive determinant of nuclear endorsement, while the relationship between optimism about the future of the environment and renewable

endorsement is also statistically significant but negative. That is, individuals who are optimistic about the future of the environment are more likely to endorse nuclear energy, and those who are pessimistic are more likely to endorse renewables.

Further characteristics of endorsers of renewables: These results presented above on the differences between endorsers of nuclear and renewable sources are further enhanced by the positive and statistically significant "knowledge-environmental concern" interaction term. That is, individuals who are knowledgeable about the climate change problem and at the same time concerned about the environment are likely to favor the endorsement of renewable energy investments. In addition, those who are not prioritizing economic objectives over environmental ones and those with higher levels of education are found to endorse renewable resources as well.

Further characteristics of endorsers of nuclear energy: The analysis shows that males rather than females are likely to endorse nuclear energy investments. In addition, those who are more engaged in environmental issues, that is, those who participate in signature campaigns to protect nature, write individual petitions regarding an environmental issue, and/or have membership in an environmental group/NGO, are more likely to express a strongly favorable opinion towards nuclear energy investments in Turkey. A relevant point in interpreting this relationship is that perhaps, as also observed in some Western countries, certain environmental NGOs in Turkey prefer not to take any position on nuclear energy, and even a few provide support to this energy source. Given the fact that there is no significant relationship between engaging in environmental issues and endorsing renewables, the endorsers of nuclear power might gain the upper hand in the public debate on renewable versus nuclear energy.

Characteristics of opponents of renewables: As already mentioned, the percentage of those opposed to renewables constituted a rather small group (4%) in the sample. The statistically significant negative relationship between opposition to renewables and knowledge of climate change implies that one of the correlates of opposition to renewables is the lack of knowledge about climate change. Other significant determinants of opposition to renewable energy are full reliance on technology, and optimism about the future of the environment. The former finding might sound surprising, but responses given to open-ended questions revealed that most opponents' expressed reasoning is related to the perceived "inefficiency/ineffectiveness" of renewables. That is, those who believe in technology as being capable of solving all environmental problems were found to be opposing renewables, largely on the ground that they generate electricity on an intermittent basis. They may indeed be presuming that environmental problems associated with more efficient and reliable energy sources can be successfully addressed with technology. The analysis also shows that there exists a significantly positive relationship between opposing renewable energy and giving priority to economic objectives of the country over its environmental objectives. Again, this result seems to be in line with the answers opponents of renewables gave to open-ended questions: A non-negligible share of opponents stated that any investment in renewable energy was a waste of scarce resources that could be used for more efficient energy production investments. It was also interesting to see that opponents of renewables were likely to be males rather than females.

Characteristics of opponents of nuclear energy: Unlike other groups, the opponents of nuclear energy cannot be characterized in terms of their level of knowledge concerning climate change, but their opposition seems rather to be related to several

attitudinal factors. Opponents of nuclear energy were found to be more likely to be concerned about the environment, pessimistic about the future state of the environment and not fully relying on technology.

7. Discussion and Conclusions

This paper presented an analysis that aimed to understand citizens' preferences regarding renewable and nuclear energy in Turkey, as well as the factors shaping them. Almost two-thirds of the sample endorsed investment in renewable energy sources such as wind and solar, and only a small minority expressed opposition to them. Renewable energy sources seem to have a favorable green image so far in Turkey. However, this favorable image was formed without the presence of a significant amount of actual installed capacity in renewable energy. If renewables get a boost, it may become a source of local conflicts in the future—as has been the case in some instances in Europe and the US (Gamboa and Munda, 2007). Given that the public in Turkey has had limited experience with renewable energy, the prospect for such conflicts is yet to be seen. In this respect, a proper institutional design will surely facilitate renewable energy development and overcome such potential conflicts.

On the other hand, there was a high level of nuclear opposition in Turkey, and the recent nuclear accident in Fukushima is likely to increase relevant reported figures. Moreover, how construction of the first nuclear power plant, if completed in 2019 as planned by government authorities, will affect preferences for nuclear and renewable energy is another important question for future investigation. In this context, it is important to underline that our study is a first in Turkey on energy preferences, and as such establishes a reference point for similar studies in the future.

Knowledge of the climate change problem seems to be the common factor in determining endorsement of both renewable and nuclear energy. Yet, a high level of concern for the environment and pessimism regarding its future differentiate the endorsers of renewables from those of nuclear energy. Endorsers of nuclear energy were found to be males who were knowledgeable about the climate change problem and engaged in environmental issues, but less concerned about the environment in general and optimistic about its future. Nuclear opponents, in contrast, were found to be concerned about the environment, pessimistic about its future, and not fully relying on technology.

The relation between knowledge of climate change and nuclear support, in many instances, leads experts and policymakers to jump to the conclusion that all people who are more aware of the climate change problem will readily support nuclear energy. The evidence obtained from the case of Turkey demonstrates that knowledge of climate change may also trigger endorsement of renewable energy sources. The findings further imply that concern for the environment does not always go hand in hand with a favorable opinion towards nuclear power. Rather, respondents concerned about the environment seem to distance themselves from nuclear energy, presumably due to its potential harm to the environment and human health. The positive association between environmental optimism and nuclear endorsement is also interesting. This implies that any worsening of environmental indicators and exacerbation of environmental conflicts in Turkey might lead to more environmental pessimism, which in turn would further weaken endorsement of nuclear energy.[15]

Our results also suggest that disagreements within society over alternative energy investments are complex in nature. As in many other environmental conflicts, the

complexity arises from differences in environmental values and attitudes. People may oppose economic and technical rationality arguments put forward in favor of nuclear energy on purely value-laden grounds, a finding already well-publicized in the environmental conflicts literature (e.g., Martinez-Alier, 2009; Muradian et al., 2003). Our results that bring forward the importance of attitudes towards technology, and of perceptions regarding the future of the environment for preferences over renewable and nuclear, provide further support for this view.

The question that Turkey currently faces is whether the plans for the construction of nuclear power plants will actually materialize. As a result of its modernist and growth-seeking orientation, the state in Turkey has historically opted for policies that aimed to boost industrial and economic growth, regardless of environmental costs they may bring about (Adaman and Arsel, 2010, 2012f; Algan and Mengi, 2005; Kılıçoğlu, 2005). Traditionally, there has been very little room in Turkey, if any, for discussion and deliberation at the public level regarding major industrial initiatives, and this has also been the case for plans on nuclear energy. Strong popular anti-nuclear sentiments—which this study also uncovers and documents—and in some cases local and national protests by activists have so far been completely ignored. Just one month after Fukushima, the Turkish government passed a decree to exclude nuclear power projects from environmental impact assessment—a move aimed at clearing barriers that may impede their implementation (Şahin, 2011). There seems to be an effort on the part of government authorities to impose a particular view and value system regarding the environment, without meaningful public deliberation.[16]

Lack of public participation in such an important policy undertaking that involves serious risks for current as well as future generations, points to a legitimacy problem

(Muradian et al., 2003). Whether the strong nuclear opposition we have uncovered in this study will be transformed into collective nuclear resistance in Turkey remains to be seen. That may turn out to be a critical factor in drawing the public's attention to this legitimacy problem and, if it materializes, may force the policy makers to reconsider the overall energy policy for the country.

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Footnotes

[1] This paper is based on a survey carried out as part of the research project entitled, "Measuring Households' Willingness to Pay for CO_2 Emissions in Turkey" that was supported by The Scientific and Technological Research Council of Turkey (TÜBİTAK), Project No:105K234, 2006-2008. Therefore, we would like to gratefully acknowledge the financial support of TÜBİTAK. We would also like to thank

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[2] Though there is no full consensus, the recent tendency is not to count large-scale hydropower among renewable energy sources due to associated dramatic environmental and social costs (see, e.g., International Rivers Network, 2003; Alhassan, 2009).

[3] For the survey questionnaire, see Zenginobuz et al. (2008).

[4] The International Nuclear and Radiological Event Scale. Level 7 is the highest level on the International Atomic Energy Agency Scale based on the total release of radioactivity.

[5] Over the last decade, the rate of increase in primary energy demand in Turkey has been the highest among all OECD countries, and projections indicate an annual increase of 4 percent until 2020 (MENR, 2011).

[6] For example, out of an estimated potential installed capacity of 53 GW for wind power, as of late 2009 only 803 MW were being utilized (MENR, 2011).

[7] A separate module of this survey investigated urban households' willingness to pay for CO_2 emission reductions. Findings for that module have subsequently been published in Adaman et al. (2011).

[8] NUTS stands for *Nomenclature d'Unités Territoriales Statistiques* in French (the Nomenclature of Territorial Units for Statistics). It was developed by Eurostat to serve as a single, coherent classification system to divide the European Union's territory for regional statistics. According to NUTS, Turkey is comprised of 12 NUTS I level regions, and 26 NUTS II level regions.

[9] The company employed 18 supervisors and 120 interviewers, who received a full-day training about the specificities of the survey from the research team.

[10] The urban population consists of those living in the province and district centers (defined administratively and usually corresponding to settlements with a population more than 5,000), and amounted to 75 percent of the population as of 2008 (TURKSTAT, 2009). Our study was confined only to the urban population since the share of the electricity consumption is almost negligible in the rural areas of Turkey. The total sample size was distributed to 26 NUTS II regions according to their

urban population sizes. From each region, one city was chosen randomly according to the probability-proportional-to-size (PPS) sampling method (in which the selection probability for each city is set to be proportional to its population). From each city, in addition to the center district, two more districts were randomly chosen (PPS). Then, from each of the three districts, neighborhoods were randomly chosen (PPS). The number of questionnaires that were pre-assigned to each neighborhood was set as 12. This was followed by a random choice of six streets per each neighborhood. Finally, two households were selected randomly from each street. No systematic reasons were detected for rejections. Given the probability sampling method used, our sample of size 2422 represents urban Turkey with a margin of error of 1.9 percent at a 95 percent confidence level (calculated using the standard margin of error formula [Miller and Miller, 2003])

[11] The fact that households were presented an official letter from a prestigious public university stating the scientific nature of the survey helped reduce the rejection rate.

[12] The follow-up questions in the pilot study undertaken prior to the actual survey revealed that a significant number of respondents who indicated endorsement of renewable energy sources were under the impression that renewable energy sources, such as wind and solar, were practically free to utilize, and this played a role in their preferences. This observation in the pilot study was in line with the findings of Ansolabehere (2007) for US respondents, and the follow-up question with 25% rise in the electricity bill was included in the actual survey to eliminate this misperception.

[13] For example, the then Minister of Industry drank tea in front of the media to dispel the rising rumors about radioactive contamination on tea leaves, and the then Prime Minister stated that a small amount of radiation was in fact good for health.

[14] Since the variation in trust values to different public institutions in Turkey is very high (see, e.g., Adaman et al., 2009), without specifying which institution in particular will be in charge of constructing and operating the nuclear power plants, the answers received could have been misleading. As a matter of fact, the contract signed with Russia gives full control and responsibility for construction and the operation of the Akkuyu nuclear power plant (including the disposal of nuclear waste) to the Russian state-owned company. As of yet it is not clear to what extent, if any,

the Turkish government as well as Turkish regulatory agencies will have control over the power plant.

[15] Some evidence that environmental indicators are, in fact, worsening may be found in the following documents: EPI, 2012; *Ntvmsnbc*, 8 February 2012; Şekercioğlu et al., 2011.

[16] In a recent statement, the Prime Minister compared the risk of driving a car or using an LPG stove with that of a nuclear power plant as follows: "There is always a risk. Does this mean that we shouldn't use LPG stove in our homes or drive a car?" (*Milliyet*, 27 March 2011).

APPENDIX

APPENDIX A: Correlation Matrix of Independent Variables

	Age	HH-wealth	Female	Educa-tion	Knowledge of climate change	Engage-ment in env issues	Env. optimism	Full reliance on techn.	Env. concern	Economy-orientation
Age	1.000									
HH-wealth	-0.069	1.000								
Female	-0.045	-0.019	1.000							
Education	-0.346	0.348	-0.029	1.000						
Knowledge of climate change	-0.070	0.174	-0.036	0.305	1.000					
Engagement in env issues	0.007	0.124	-0.011	0.140	0.126	1.000				
Env. optimism	-0.058	-0.076	-0.034	-0.054	-0.045	-0.052	1.000			
Full reliance on technology	0.101	-0.025	-0.042	-0.118	-0.057	0.024	0.097	1.000		
Env. concern	0.025	0.073	0.006	-0.028	0.002	0.043	-0.048	0.014	1.000	
Economy-orientation	0.012	-0.010	-0.031	-0.030	-0.041	0.003	0.068	0.078	-0.087	1.000

APPENDIX B: Hausman Tests for IIA Assumption

Omitted	Chi-Square	Df	p-value	Evidence
Coal	-0.474	56	1.000	for Ho
Natural gas	1.153	56	1.000	for Ho
Dams	1.527	57	1.000	for Ho
Renewables	33.311	56	0.993	for Ho
Nuclear	-0.533	54	1.000	for Ho

H_0: Energy investment alternatives are independent of each other.