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What you give is what you get: Willingness to pay for green energy

Jana Hojnik [a, *], Mitja Ruzzier [a], Stephanie Fabri [b], Alenka Lena Klopčič [c]

[a] Faculty of Management, University of Primorska, Cankarjeva 5, 6000, Koper, Slovenia
[b] Faculty of Economics, Management and Accountancy, University of Malta, Msida MSD, 2080, Malta
[c] Montel Energetika.NET Ltd, Krasnja 63, 1225, Lukovica, Slovenia

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ABSTRACT

Renewable energy has become an important objective especially for fighting climate change and improving energy security. This study has employed two methods for data analysis (i.e., regression analysis and fuzzy-set Qualitative Comparative Analysis) in order to seize the complexity of the phenomenon and explore antecedents of willingness to pay for green energy. The results derived from fuzzy-set Qualitative Comparative Analysis indicate that knowledge and/or social norms and moral obligations are present in all configurations when we have high willingness to pay for green energy. Furthermore, we conducted linear regression analysis, which revealed that acceptance of green energy, social norms and moral obligations and knowledge about green energy exert a significant positive impact on willingness to pay for green energy and, thus, work as drivers of willingness to pay for green energy. We have also examined the differences among socio-demographic characteristics of consumers (e.g., gender, education, income, and age) related to their environmental concern, consumers' commitment, acceptance of green energy, perceived risk, social norms and moral obligations, knowledge about green energy, and consumers' willingness to pay for green energy. Use of different methods allowed us to better understand the issue pertaining to antecedents of willingness to pay for green energy.

1. Introduction

Energy is central to nearly every major challenge and opportunity the world faces today – be it for jobs, security, climate change, food production or increasing incomes; access to energy for all is essential [1]. Sustainable development goals thus emphasize that focusing on universal access to energy, increased energy efficiency and the increased use of renewable energy through new economic and job opportunities is crucial in order to create and provide more sustainable and inclusive communities and resilience to environmental issues like climate change [1]. Global energy needs have become an extremely important concern for all economies and the primary sources include fossil fuels such as oil, coal and natural gas; all of which contribute over 80% of the global energy supply. Since they emit greenhouse gases, their eventual effects on climate change especially in regard to threats to the environment and human health have become a matter of urgent concern [2]. Renewable energy sources diminish greenhouse emissions and are thus extremely important and one of the crucial strategies to follow sustainability. Renewable or green energy is produced from solar, hydro (water), biomass, wind, and geothermal energy sources, while non-renewable or conventional energy is often fossil- or nuclear-based energy [3]. In response to the environmental and economic threats posed by fossil fuels, countries need to transition from their consumption of non-renewable energy to an increased consumption of renewable energy [4]. Transitioning to clean energy production is challenging, however, a necessary response to the current climate crisis [5].

Promoting renewable energy sources (RES) has become an important policy objective of the EU in fighting climate change and improving energy security which should be achieved by reducing greenhouse gas emissions and dependence on energy imports, respectively [6]. In turn, this is envisaged to open up new opportunities for economic growth through innovation and lead to a sustainable and competitive energy policy [6]. In our research we followed the definition of renewable energy, provided by Dogan and Muhammad, who defined renewable energy as energy harnessed from green electricity sources such as hydroelectric power, wind, tide, solar and biomass power systems [2].

* Corresponding author.
E-mail addresses: jana.hojnik@fm-kp.si (J. Hojnik), mitja.ruzzier@fm-kp.si (M. Ruzzier), stephanie.fabri@um.edu.mt (S. Fabri), alenka-lena.klopcic@energetika.net (A.L. Klopčič).

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The liberalization of the energy markets has boosted the development of new marketing strategies, aiming to increase consumers' activity in the market and to satisfy current climate change policies [7]. With the growing deployment of renewable energy sources as distributed generation, citizens are therefore taking on new roles [8], investing in these sources and becoming active participants in the market [9], that is, 'prosumers' [10]. Additionally, as the share of renewables in the market increases, producers also become increasingly effective political actors [11].

The current EU energy policy aims to strike a balance between sustainable development, competitiveness, and secure supply [12]. It therefore sets out specific target shares of renewables (RES) for member states, which researchers [13,14] see as a promising path for the transition to a low-carbon energy future. Wanting to provide a support mechanism for RES, some countries introduced a system of Guarantees of Origin (GO) or Green Certificates (GC), which functioned well until the first serious crisis in the RES industry in 2012, which led to a drop in certificate value [15,16]. The poor liquidity of GO markets and the volatile certificate prices are also discussed by Hulshof et al. [17].

While some researchers [18,19] see RES as a way to enhance energy security or as an answer to the growing pressure of energy scarcity, especially in relation to fossil fuels [20] and environmental degradation [21], others [22] see them as an opportunity to create new jobs and increase economic well-being, specifically in the countryside [23], and some [24] argue that the large-scale deployment of RES also stimulates technological change.

Furthermore, some authors, such as Nesta et al. [25], find that RES policies are quite effective in fostering green innovation (providing that the countries already have a liberalized energy market), whereas according to Horbach and Rammer [26] and Kalkbrenner et al. [27], the proximity of the RES generation and the strategic commitment of a particular region to "green issues" also play a role. This means that local authorities and government institutions will most likely keep playing a key role in the RES boom, while energy companies, including multinationals, will increasingly need to comply with their guidelines [28,29].

Moreover, when discussing RES, many authors note the vital importance of demand-side flexibility [30], as well as the need to reduce the imbalance between contracted supply and actual demand and the related costs [31]. The imbalances created by increased integration of RES in the energy markets is also discussed by Simshauser [32], whereas Cepeda and Finon [33] note that we need policies that will prevent market distortion caused by renewables, specifically by wind power. Kloppenburg and Boekelo [34], for example, find that the energy platforms which are emerging in response to the energy transition, offer a decentralized, digitally enabled exchange of energy from distributed sources. However, the uncertainties produced by these platforms and their tendency to privatize energy provisioning could slow down the transition to sustainable energy systems, the two researchers note, calling for responsible design of the energy grids of the future, which will include microgrids [35] and smart grids [36]. Additionally, many authors warn of possible outages [37] and the volatility of RES [38,39] adding that we will have to combine RES with battery systems [40–42] and grid support services [43]. The control reserve market will therefore become increasingly important [44], specifically in terms of demand flexibility [45]. Meanwhile, as argued by Akizu et al. [46], in addition to being renewable, energy will also have to be equitable in the future.

In our paper we focus on willingness to pay for green energy, based on consumers – we aim to explore and better understand what drives consumers' willingness to pay for green energy and how demographic characteristics influence the antecedents of willingness to pay for green energy and as well willingness to pay for green energy itself, irrespectively of their economic status they belong to (lower/middle class). According to the value-belief-norm (VBN) theory, environmental behaviors are driven by moral obligations (i.e., personal moral norm) in order to protect cherished objects, beings or states [47]. Moreover, Stern [47] stresses that personal moral norms are the main basis for individuals' general predispositions to pro-environmental action. Likewise, Lin and Syrgabayeva [3] stress that future research should include also social norms and social pressure, since their role may be essential in adoption of innovation and likewise green energy. When orientating towards consumers, we need to take into account that willingness to pay for green energy plays a central role in directing appropriate policy for the country to realize its ambitious renewable energy targets [2]. Since the European electricity market is liberalized and consumers can easily switch their electricity supplier according to their preferences, we aim to explore which factors influence willingness to pay for green energy and to provide findings that will help policy makers and utility companies understand consumers and their attitude towards paying for green energy. As stressed by Olanrewaju et al. [4] countries need to transform the use of non-renewable energy to increased consumption of green energy. Response to the environmental and economic threats posed by fossil fuels largely depends also on consumers, who can contribute actively by adoption of green energy. Therefore, considering the importance of consumers' role when aiming as a country to pave the way towards more sustainable future, we aim to explore which attitudes affect consumers' willingness to pay for green energy. Sangroya and Kumar (2017) [48] stressed that it is not only the financial aspect that leads consumers to decide on adoption of green energy – consumers are also driven by emotional and social considerations. Likewise, Lin and Syrgabayeva [3] emphasize that environmental concern should be positively related to consumers' pro-environmental behaviors – the intention to use renewable energy. Previous research revealed that environmental concern/conscience, knowledge and attitude towards green energy significantly and positively affect willingness to pay for green energy and thus offer support to willingness to pay for green energy [2,3]. However, the majority of research is focused on adoption of green energy (intention) rather willingness to pay for it, or research on what determines consumers to pay more (a premium price) for green energy [3], while many research works explore or focus on consumers' values as determinants of willingness to pay for green energy [48] and personal values as determinants of public support for renewable energy policies [5] or use a sample of students (only one generation of consumers) [49].

Researchers stress [5] that transition to clean energy is challenging, but a necessary response to the current climate crisis. Renewable energy for domestic consumption has been identified as a key strategy towards sustainability by national, European and international policy makers [50]. Empirical research that aims to understand the determinants behind consumers' willingness to pay for green energy are thus essential, since they can offer findings and inform national and European relevant stakeholders about the social acceptability of green energy, which will help design more efficient policies and meet national, European and international targets. This research intends to bridge the existing gap of understanding the determinants behind the consumers' willingness to pay for green energy by investigating the willingness to pay for green energy based on a sample of Slovenian consumers. We address the following research question: Do environmental concern, consumers' commitment, acceptance of green energy, perceived risk, social norms and moral obligations, and knowledge about green energy lead to consumers' willingness to pay for green energy?

The findings of this study will be beneficial to electricity suppliers, governments, stakeholders and policy makers since they will uncover the determinants of willingness to pay for green energy and as well demonstrate the differences among socio-demographic groups (e.g., gender, education, income, and age). In this way it will enable them to design or establish enabling environment for green energy in Slovenia or any other country similar to Slovenia, which will spur its adoption among consumers. However, in order to do so, it requires to be aware of, and acquire, knowledge of the determining factors that affect the green energy consumption and also find afterwards the right mix of policies, incentives and stakeholder partnership at national and regional levels.

An added value of this paper is the use of mix-methods, in our case fuzzy set Qualitative Comparative Analysis and regression analysis, since we combined the inductive and deductive ways of thinking and explored the topic from both ways. The method is being recommended as a result of the complex relations involved in analyzing willingness to pay for renewable energy goods and services. We believe that use of both methods adds to more profound understanding of this topic.

This paper takes the following structural form. Section 2 dedicates to the background of renewable energy and Green deal for a climate-neutral Europe, while Section 3 reviews the relevant existing literature and provides basis for the hypotheses development. Furthermore, Section 4 explains the research methodology followed by results and the discussion presented in Section 5. Conclusions including implications, limitations and future research directions are discussed in Section 6.

2. The background of renewable energy and green deal for a climate-neutral Europe

In 2018, the share of RES in the EU's gross final energy consumption reached 18%, which is 0.5% points more than in 2017 and more than double the share of 2004 [51]. Twelve member states – including Slovenia's neighbor Croatia – have already reached their national binding targets for 2020, whereas Slovenia was among the countries furthest from their targets in 2018. The EU aimed to achieve at least a 20% share of RES in gross final energy consumption by 2020 and a 32% share by 2030 (pertaining to entire EU). Each EU member state has its own target for 2020. National targets take into account their different starting points, renewable energy potential, and economic performance. In 2018, 21 EU member states increased their share of RES compared to 2017. Sweden had the highest share by far (54.6%), followed by Finland (41.2%), Latvia (40.3%), Denmark (36.1%), and Austria (33.4%). At the opposite end of the scale, the lowest share of renewables was registered in the Netherlands (7.4%).

Slovenia's aim was to achieve a 25% RES share in gross final energy consumption by 2020, however, it missed its objective by 3.9% points and became one of the five states that were the furthest away from their national targets, along with France, Ireland, United Kingdom, and the Netherlands. According to Eurostat [51], Slovenia reached a 21.1% share of RES in gross final energy consumption in 2018, whereas its goal was to reach a 25% share by 2020.

Slovenia is currently in the process of adopting a comprehensive National Energy and Climate Plan (NECP) – a strategic action document that sets out the targets, policies, and measures for 2030 (with an outlook until 2040), consistent with the five dimensions of the energy union [52]:

1. Decarburization (greenhouse gas (GHG) emissions and RES),
2. Energy efficiency,
3. Energy security,
4. Internal market,
5. Research, innovation, and competitiveness.

According to the NECP [52], Slovenia must achieve the indicative target of a 27% share of RES in final energy consumption, whereas the accompanying environmental report proposes the following additional measures to increase the use of RES: carrying out a vulnerability and acceptability study to help identify optimal and non-conflicting locations for energy facilities, improving legislation, introducing incentives for better network integration, and demand-response [52].

The most ambitious targets are set for the building sector where RES are expected to account for two thirds of the energy consumption (i.e., the share of RES in the final consumption of energy products, excluding power and district heating). Additionally, at least a 30% RES share is to be achieved in industry, a 43% share in power generation, a 41% share in heating and cooling, and a 21% share in transport, with biofuels taking up at least 11% [52].

Incidentally, the European Commission recommends that Slovenia achieve a 37% RES share by 2030 [53]. The government of the Republic of Slovenia is obligated to adopt the NECP by the end of February, with the first updates following in 2023.

At the end of 2019, 4470 households in Slovenia had solar-powered self-supply devices installed, 17 households had devices that use a hydro power source, and two households had wind-powered devices, the Slovenian Energy Agency stated for the purpose of this contribution.[1]

On December 11, 2019, the European Commission presented the European Green Deal, outlining a roadmap of measures aimed at making Europe the first climate-neutral continent by 2050. Since the transition to a sustainable economy calls for significant investment efforts in all sectors, it also introduced the Sustainable Europe Investment Plan, which presents an important element of financing the green transition, aimed at enabling a socially just realization of the goal of achieving climate neutrality by 2050. A key tool to ensure this is the Just Transition Mechanism, which was developed to assist the most affected regions. The mechanism will consist of three main sources of financing, including the Just Transition Fund, which will receive EUR 7.5 billion of fresh EU funds to encourage up to EUR 50 billion in investment [54].

3. Hypotheses development

Over the past two decades, European retail markets for electricity have changed fundamentally, and market deregulation has occurred in most countries; that means that consumers have also started to choose the type of supplier they want on the market [55]. In Slovenia this law came into life in year 2007. However, due to its ability to reduce environmental damage, more attention and significance across the globe have been given to green energy. Notwithstanding, researchers [48] pinpoint that for complete acceptance of green energy, government regulations on their own are not enough; the willingness to use green energy and contribute to the wellbeing of the environment should spring from consumers. Since consumers have their role in consumption energy and other goods and are also able to change their energy supplier freely, we aimed to explore the determinants of consumers' willingness to pay for green energy. Soon and Ahmad [56] conducted a meta-analysis on the willingness to pay for renewable energy use and found that increasing numbers of households are willing to pay for renewable energy sources use.

Results of survey conducted in a Shanghai region (China)

[1] Source: The Energy Agency of the Republic of Slovenia – for the purpose of this contribution.

indicate that there is a high level of interest and very positive attitudes towards green energy among the respondents – the respondents expressed environmental concerns and many of them mentioned environmental protection and sustainability as the benefits of green energy compared to standard energy [57]. Dogan and Muhammad [2] found that self-perceived environmental conscience is positively and significantly associated to willingness to pay for green energy, which means that a higher level of perceived environmental conscience positively contributes to the willingness to pay for renewable energy. To the best of our knowledge, the only research conducted on a sample of Slovenian consumers has focused on willingness to participate in green electricity programs and has revealed that environmental awareness, age, household income, and education play the most important roles in explaining household attitudes to green electricity programs [6]. Furthermore, Lin and Syrgabayeva [3] stress that literature suggests positive association between consumers' environmental concern, attitude and renewable energy purchase. Likewise, has found positive and significant effect of environmental concern and relative advantages of renewable energy on adoption of renewable energy on a sample of generation Y from Malaysia [49]. On the contrary, Phillips et al. [5], explored how projected electricity prices and personal values influence public support for a 50% renewable energy target (RET) in Australia, and thus predicted that a stronger commitment to the environment and collective good (prioritizing self-transcendent values) would render people less sensitive to increased electricity prices than those with low self-transcendence values, however this hypothesis was not supported. Based on the aforementioned research findings we postulate the following hypotheses:

Hypothesis 1. There is a positive relationship between consumers' environmental concern and willingness to pay for green energy.

Hypothesis 2. There is a positive relationship between consumers' commitment and willingness to pay for green energy.

It seems that small and simple steps that many people take for the environment in everyday life can function as a level for changes that are more important for environmental sustainability [58]. Thøgersen and Noblet [58] found that people who are more actively engaged in doing small and simple things for the environment in their everyday life, are more likely to accept an expansion of wind power than people who are less engaged in everyday “green” activities. The findings of this research give support to the action based learning approach, which aims to promote important pro-environmental actions reflected as support for or acceptance of environmental policy – it involves promotion of simple and easy behaviors as entry points for more radical steps towards sustainability, referred to as “catalytic” or “wedge” behaviors [58: 854]. Consequently, Thøgersen and Noblet [58] stress that promoting everyday “green” behaviors may prepare the grounds for increasing acceptance of more far-reaching changes in the population, such as an expansion of wind power in their case. Moreover, consumers with considerable belief in their responsibility to protect the environment perceive environment-friendly products favorably and are significantly willing to pay more for them [3]. Green consumers, furthermore, hold positive attitudes to the environmental effect of green electricity because the perceived consumer effectiveness (i.e., individual's beliefs/attitudes about his/her influences on the outcomes through performing a certain behavior) has a positive effect and may also contribute to predict environmentally friendly behavior (i.e., buying green electricity) [59]. Thus, we propose the following hypothesis:

Hypothesis 3. There is a positive relationship between acceptance of green energy and willingness to pay for green energy.

The SWOT analysis on renewable energy sources (RES) conducted by Menegaki [60] expose as threats delays in energy market deregulation, delays in reaching targets, uneven and insufficient exploitation by various EU countries, insufficient institutional capacities and insufficient information dissemination. From the point of consumers, the seen threats of green energy are pertaining to possible instability of renewable energy supply, and unexpected additional costs in the future [59]. However, the main strengths of renewable energy sources are that RES are sustainable (because of decarbonization of the economic growth produced by them), secure (refrain from geopolitical risks), safe (no accident risk, e.g., an oil spill) and they can be largely supplied even in rural remote areas [60]. Yang et al. [59] have found that green consumers are not concerned about the supply stability from a 100% renewable energy supply, and they are not worried about possible price increases. While the results of research conducted by Paravantis et al. [50] on a sample of Western Greece revealed that willingness to pay for actual energy consumption out of renewable energy is correlated to obstacles of renewable energy (e.g., mainly information on new technologies, environmental awareness, and financial incentives) and a sense of measures to address renewable energy obstacles (mainly licensing and legislation). In addition, Phillips et al. [5] stressed that people who value positive collective and environmental outcomes will not necessarily support an energy policy that broadly aligns with their values if they perceive the personal financial costs linked to the policies to be too high, which means that presence of barriers can prevent even the most well-intentioned people from acting in a manner consistent with their values. Based on previous research findings, we posit that:

Hypothesis 4. There is a relationship between perceived risk about green energy and willingness to pay for green energy.

Value-belief-norm theory argues that moral obligations (i.e., personal moral norm) drives environmental behaviors in way that we protect cherished objects, beings or states and as such play the major role as the basis for individuals' general predispositions to pro-environmental action [47]. The research results of Lin and Syrgabayeva [3] suggest that consumers with considerable belief in their responsibility to protect the environment perceive environment-friendly products favorably and are willing to pay more for them. Which means that consumers' responsibility toward social and community welfare is important in the uptake of environmental behavior – consumers who consider themselves environmentalists and feel to have the responsibility to protect the environment exhibit favorable attitudes toward renewable energy use [3]. In addition, Yang et al. [59] found that green consumers feel a moral obligation to contribute to the expansion of renewable energy, and they are practicing environmental behavior in their daily lives. Based on a sample from U.S.A., Arpan et al. [61] found that personal moral norms had a positive association with willingness to pay, and this relationship was quite strong. Moreover, the results of research conducted in Australia by Phillips et al. [5] revealed that respondents with stronger self-transcendent values and weaker self-enhancement values expressed stronger support for the 50% renewable energy target, which is in line with the more general view that self-transcenders (i.e., who value “bigger-than-self” outcomes) are more receptive to pro-environmental initiatives than self-enhancers (i.e., who value personal outcomes related to wealth and power). In addition, the results of the study conducted in India reveals that it is not only the financial aspects that lead consumers to decide on adoption of green energy; consumers are also driven by emotional and social considerations [48]. Based on the abovementioned, we posit the following hypothesis:

Hypothesis 5. There is a positive relationship between social norms and moral obligations and willingness to pay for green energy.

A person's knowledge of renewable energy sources directly influences his/her intentions/beliefs because a highly knowledgeable person would be able to form a substantially coherent and strong opinion and stance (i.e., beliefs and attitudes) [3]. The study conducted by Lin and Syrgabayeva [3] based on a sample of Kazakhstan consumers, identified the following constructs: environmental concern, knowledge, belief, and attitude toward renewable power to influence their willingness to pay a premium price for renewable energy. Researchers suggest that consumer knowledge concerning renewable energy drives the connection between consumers' sense of social responsibility and attitude toward such energy and as a consequence this relationship enhances consumers' willingness to pay more for renewable energy [3]. Paravantis et al. [50] found that willingness to pay for hypothetical renewable energy projects in Western Greece can also depend on having a sense of the potential impacts of renewable energy, while willingness to pay for actual energy consumption out of renewable energy is correlated to level of awareness of different types of renewable energy as well as obstacles and measures to their further development. Hence, the last research hypothesis is presented as follows:

Hypothesis 6. There is a positive relationship between knowledge about green energy and willingness to pay for green energy.

4. Materials and methods

In this section we present Sample and Measures (4.1), The complex relations between the determining factors and willingness to pay for renewable energy (4.2), Calibrations (4.3), and Data analysis by using Fuzzy-set Qualitative Comparative Analysis (fsQCA) (4.4).

4.1. Sample and Measures

The main aim of this study was to examine the relationship between environmental concern, consumers' commitment, acceptance of green energy, perceived risk, social norm and moral obligations, and knowledge about green energy and willingness to pay for green energy. The data was collected between July 14 and July 20, 2017 by using an online survey. In order to collect the data, the questionnaire had been sent to 9927 random e-mail addresses of people aged 18 or older. We addressed only consumers living in Slovenia, therefore, the questionnaire was sent out in the Slovenian language. The data collection resulted in 705 questionnaires fully completed. Therefore, a total of 705 useable responses were used in further analysis for testing the proposed conceptual model.

The design of the questions was based on already-existing measures, which we adapted to some extent. All scales were measured with several items, by adopting a seven-point Likert scale ranging from 1-strongly disagree to 7-strongly agree. The exact measures with names of all constructs used in this research and items pertaining to each of them are shown in Table 3. In this study, we measured seven constructs in total, which are as follows: consumers' environmental concern, consumers' commitment, acceptance of green energy, perceived risk, social norms and moral obligations, knowledge about green energy, and willingness to pay for green energy. The construct pertaining to the consumers' environmental concern was measured with five items adopted and adapted from Thøgersen and Noblet [58], while consumers' commitment was measured by four items adopted from Maniatis [62]. Furthermore, we used three items adapted from Thøgersen and Noblet [58] to measure consumers' acceptance of green energy, two items for measuring perceived risk related to green energy, which was adapted from Yang et al. [59]. Social norms and moral obligations were measured by four items and adapted from Yang et al. [59], while knowledge about green energy has been measured by six items, all adapted from Lin and Syrgabayeva [3]. Lastly, we used three items adapted from Prakash and Pathak [63] to measure consumers' willingness to pay for green energy.

Concerning the sample's demographic characteristics (see Table 1), the sample comprises 351 males (49.8%) and 354 females (50.2%). With regard to the age of respondents, 109 respondents (15.5%) had between 18 and 34 years, 118 (16.7%) between 35 and 44 years, 145 (20.6%) between 45 and 54 years, 147 (20.9%) between 55 and 64 years, and 179 respondents (25.4%) were 65 years old and above. Education level of respondents shows that 481 completed elementary high school, seven respondents completed only elementary school, 190 own a bachelor's degree, and 26 respondents acquired a higher educational degree (e.g., specialization, MBA, master's degree, or Ph.D.).

4.2. The complex relations between the determining factors and willingness to pay for renewable energy

The above hypotheses in Section 3 are mainly derived from studies that adopt linear methods to assess the elements that determine the willingness to pay (WTP). While in most instances, the relationship between the factors and WTP is clear-cut, in the case of risk, past research has found conflicting results between risk and WTP using linear methods. This highlights the fact that the understanding of what constitutes WTP may involve complex interactions such as endogeneity, nonlinearity, equifinality and asymmetric relations. This would imply that an approach that allows for these complexities would be required.

The factors leading to WTP may involve endogenous relationship, that is, there is likely to be an overlap among the determining factors, which factors occur concurrently. Given that the factors are based on cognitive constructs, this endogeneity is expected as with such constructs it is difficult to assess them individually as a result of the overlaps in the cognitive process [64]. For example, environmental concern may lead and be positively linked to knowledge about renewable energy, attitude toward renewable energy [3]. Consumers who consider themselves environmentalists and feel the responsibility to protect the environment are those exhibiting favorable attitudes toward renewable energy use, moreover, environmental concern is in literature recognized as predecessor of environmental knowledge, belief and willingness to pay [3].

These endogenous relations are likely to be more complex when assuming the relation between the determinants and WTP is likely to be nonlinear and based on equifinality. This is because different individuals are likely to have a blend of different levels of cognitive factors with respect to the WTP. This implies that there are multiple combinations which may be associated with high levels of WTP. Thus, assessing these factors individually could lead to over or under estimation of the factors with respect to WTP. For instance, Dogan and Muhammad [2] found that higher level of perceived environmental conscience positively contributes to the willingness to pay for renewable energy, likewise Zorić and Hrovatin [6] found that environmental awareness is positively related to the WTP for green electricity.

In line with previous evidence, asymmetric presence formation in WTP is not uncommon [65]. Thus, in line with the complexities mentioned in this section, we cannot rule out the potential for asymmetric relations among the constructs.

Previous literature has focused on a linear understanding of WTP, leading to the development of clear-cut hypothesis. However, we also feel that this understanding should be taken to another level to allow for the analysis of the potential complexities involved

Table 1
Sample characteristics.

Sample characteristics		Frequency	Percentage (%)
Gender	Male	351	49.8
	Female	354	50.2
Age	18–34 years	109	15.5
	35–44 years	118	16.7
	45–54 years	145	20.6
	55–64 years	147	20.9
	65 years and above	179	25.4
Education	Elementary school	7	1.1
	High school	481	68.3
	Bachelor's degree	190	26.9
	Specialization, MBA, master's degree, or Ph.D	26	3.7

Table 2
Descriptive statistics and calibrations.

Variable	Statistical Distributions				Calibration		
	Max.	Mean	Min.	Std. Dev.	Full-Membership	Cross-Over	Non-Membership
WTP	7	3.36	1	1.61	7	3.5	1
Environmental concern	7	5.51	1	1.23	7	5.2	1
Consumers' commitment	7	5.71	1	1.15	7	5.3	1
Acceptance	7	6.09	1	1.19	7	5.7	1
Perceived risk	7	4.36	1	1.73	7	4	1
Social norms & moral obligations	7	5.13	1	1.29	7	5	1
Knowledge	7	4.91	1	1.36	7	4.7	1

Table 3
Measurement model.

Latent variables and their measurement items		Cronbach's Alpha
Consumers' environmental concern	We are approaching the limit of the number of people the earth can support.	0.842
	If things continue on their present course, we will soon experience an ecological catastrophe.	
	The earth is like a spaceship with very limited room and resources.	
	I am concerned about the effect of global warming.	
	I am concerned about air quality.	
Consumers' commitment	Environmental protection	0.828
	Wastage reduction	
Please rate your commitment to:	Cost reduction	
	Health benefits	
Acceptance of green energy	Green energy is something positive.	0.944
	Green energy is a good solution for environmental problems.	
	I would encourage development of green energy.	
Perceived risk	I am worried that the 100% renewable energy supply will be unstable, because wind and sun are not available at all times.	0.707
	I am worried that green electricity can bring some unexpected additional costs in the future.	
Social norms and moral obligations	Most of my friends and acquaintances important to me think that it is a good idea to obtain green electricity.	0.848
	Members of my family think that my decision to obtain green electricity is great.	
	I personally want to do my share of contributing to the expansion of renewable energy generation.	
	I am obligated to use green electricity for future generations.	
Knowledge about green energy	I am familiar with renewable energy sources.	0.933
	I am familiar with wind-generated electricity.	
	I am familiar with hydro-generated electricity.	
	I am familiar with solar-generated electricity.	
	I am familiar with biomass-generated electricity.	
	I have some knowledge about renewable energy.	
Willingness to pay for green energy	It is acceptable for me to pay more money for electricity that is generated from renewable energy sources.	0.862
	I feel proud to have green energy in my house though it is more costly than conventionally generated energy.	
	I would be willing to spend more money in order to buy green energy.	

Note: * p-values are significant at the 0.05 level.

including endogeneity, nonlinearity, equifinality, and asymmetric relations. These elements cannot be assessed through linear models as such models allow for the analysis of the constructs individually with respect to WTP, keeping the remaining constructs constant. As explained by Fiss [66], in order to allow for the analysis of complex relations, one has to endorse configurational thinking, in particular approaches based on set-theoretic methods.

Set-theoretic methods allow for the analysis of factors that are endogenous, nonlinear, equifinal, and asymmetric in nature. In addition, in cases where relationship through linear regression methods are inconclusive or unclear, such methods are important because they allow for inductive reasoning, as data is analyzed "by case" and not "by variable" [67]. |This type of analysis leads to the analysis of different conditions, and allows researchers to examine conditions by type with regards to necessary, sufficient, or neither of the two [66]. Necessary conditions are conditions that have to be present for the outcome to be present, while sufficient conditions are conditions that are associated with an outcome, but they are one of various other conditions [68].

In addition to regression analysis, this section adopts set-theoretic methods based on the fuzzy-set approach, rather than the crisp-set approach. Compared to the crisp-set approach, fuzzy-set approach allows for a more detailed examination of the configurations as they do not only indicate whether a variable is part of the set or not, but they also indicate the extent by which a variable is part of the set [66,69,70].

In order to assess the hypothesis, and in line with previous research, the study adopts a linear method using regression analysis to assess the impact of the analyzed constructs on WTP. In addition to this method, the study aims to assess the potential complexities of the constructs using fuzzy-set Qualitative Comparative Analysis (fsQCA). Thus, we shall compare the linear and configurational approach in order to understand whether there are any variations in the outcomes, and/or whether the adoption of the two methods provides a deeper understanding of the WTP phenomenon.

4.3. Calibrations

In order to be able to conduct the fsQCA analysis, one has to calibrate the variables (Table 2). The calibration process entails the conversion of the variables to a scale between 0 and 1, indicating the relevance of a variable to a set. A value of 0 implies that the variable is completely out of the set, while 1 implies that the variable is completely within the set, an 0.5 value represents the cross over point, that is, a variable is neither in nor out of the set [67].

In line with other studies, the Calibrations illustrated in the table below are determined by using the theoretical understanding of the variable together with the statistical distribution [66]. Before confirming the calibration points, various options have been analyzed by varying the calibration levels to ensure that the solutions are robust.

4.4. Data analysis by using fuzzy-set Qualitative Comparative Analysis (fsQCA)

After completing the calibration process, we proceed by analyzing the necessary and sufficient conditions by conducting a necessary and sufficiency analysis, respectively. These have been conducted for high and low WTP outcomes in order to assess the asymmetric relations. The software package used is fsQCA 2.0 [71,72].

The sufficiency analysis shows various configurations that are associated with an outcome [67]. The analysis involves four main steps. In the first step we develop a truth table which is based on a data matrix illustrating the different combinations associated with a specific outcome. The table is based on 2^k rows, where k is the number of conditions used in the analysis (in total six). Following this step, the analysis of subset relations takes place where the data is checked for consistency, that is the proportion of cases associated with a specific outcome. The consistency ranges between zero and 1, whereby 0 implies no empirical correspondence and 1 implies a very close empirical correspondence [71,72].

After confirming that the cases have a good level of consistency, we implement the Quine-McCluskey algorithm by employing Boolean algebra. This is a process which simplifies the cases into combinations. The robustness of these combinations is assessed through the coverage, that is the extent by which an outcome is explained by a condition, similar to the R^2 in linear regression [66,73].

The fourth step involves the assessment of the conditions. The complex solutions are based on six conditions and therefore 64 (2^6) potential combinations for both high and low WTP. The frequency threshold of the study was 1 case per solution for both outcomes, encompassing 99% of the sample, beyond the 80% threshold [67,72]. The consistency values for high and low WTP were 0.819 and 0.968, respectively. As outlined in the calibrations section, a number of solutions were analyzed to make sure that the results are robust, and they do not vary with slight changes in calibrations.

Following the sufficiency conditions, we analyze the necessary conditions for both outcomes. A condition is necessary if it has to be present for the outcome to be present. These conditions will be analyzed for the high and low presence of each individual variable with respect to the two outcomes. For a variable to be necessary, the consistency level has to be at least 0.90, and coverage level has to be at least 0.80 [67,74].

5. Results and discussion pertaining to regression analysis

In this study, we measured seven constructs in total, which are following: consumers' environmental concern, consumers' commitment, acceptance of green energy, perceived risk, social norms and moral obligations, knowledge about green energy and willingness to pay for green energy. The exact measures with names of all constructs and pertaining items, followed by values of Cronbach's alpha are reported Table 3.

For the purposes of testing our hypotheses, we have first conducted exploratory factor analysis for each construct used in this research in order to test whether we can combine the items of each into one factor (the extraction method used was Maximum Likelihood, rotation Direct Oblimin).

The first conducted exploratory factor analysis has shown that all five items have one common factor – consumers' environmental concern. The value of the Kaiser-Meyer-Olkin measure for sampling adequacy was 0.834, and Bartlett's test of sphericity showed statistically significant value (chi-square = 1376,459; df = 10; p = 0.000), meaning that the correlation matrix has significant correlations. The communality index showed good communalities for all items (above the threshold of 0.2), with the lowest one 0.431 – "We are approaching the limit of the number of people the earth can support." Variance explained is 52.62%. Results of exploratory factor analysis for consumers' commitment showed that the value of the Kaiser-Meyer-Olkin measure for sampling adequacy was 0.764, which suggests the existence of high enough correlations between variables for suitable use of factor analysis. In addition, Bartlett's test of sphericity has statistically significant value (chi-square = 1284.242; df = 6; p = 0.000) and has shown that the correlation matrix has significant correlations. The communality index showed good communalities for all four items (all above the threshold of 0.2). Moreover, exploratory factor analysis has extracted only one single factor, consisting of four items, which explains 58.76% of total variance. Results of the exploratory factor analysis for acceptance of green energy extracted one factor as well, comprising three items and explaining 85.28% of the total variance. The Kaiser-Meyer-Olkin measure for sampling adequacy (KMO = 0.765) and Bartlett's test of sphericity (chi-square = 2018.483; df = 3; p = 0.000) showed good results, the lowest item communality was 0.797 ("Green energy is a good solution for environmental problems"). Furthermore, we have not conducted the exploratory factor analysis for construct Perceived risk, since it has only two items, however, we retained it in the analysis, since it is crucial to this research. We conducted an exploratory factor analysis for Social norms and moral obligations. The resulting exploratory factor analysis extracted just a single factor, consisting of four items, which explains 58.28% of total variance. The Kaiser-Meyer-Olkin measure for sampling adequacy (KMO = 0.722) and Bartlett's test of sphericity (chi-square = 1389.721; df = 6; p = 0.000) showed good results, with communalities higher than 0.40. Results of exploratory factor analysis for knowledge about green energy showed that the value of the Kaiser-Meyer-Olkin measure for sampling adequacy was 0.918, which suggests the existence of high enough correlations between variables for suitable use of factor analysis. In addition, Bartlett's test of sphericity has statistically significant value (chi-square = 3403.34; df = 15; p = 0.000) and has shown that the correlation matrix has significant correlations. The communality index showed good communalities for all six items (all above 0.50). Moreover, exploratory factor analysis has extracted only one single factor, consisting of six items, which explains 70.53% of total variance. Lastly, results of exploratory factor analysis for willingness to pay for green energy showed that the value of the Kaiser-Meyer-Olkin measure for sampling adequacy was 0.679, which suggests the existence of high enough correlations between variables for suitable use of factor analysis. In addition, Bartlett's test of sphericity has statistically significant value (chi-square = 1239.655; df = 3; p = 0.000) and has shown that the correlation matrix has significant correlations. The communality index showed good communalities for all three items (all above the threshold of 0.4) and exploratory factor analysis has extracted only one single factor, consisting of three items, which explains 70.71% of total variance.

In order to explore the relationship between predicted determinants of willingness to pay for green energy (i.e., environmental concern, consumers' commitment, acceptance of green energy, perceived risk, social norm & moral obligations, and knowledge about green energy) and willingness to pay for green energy as dependent variable, we have conducted linear regression analysis.

Table 4 illustrates the relationship between determinants of willingness to pay for green energy (environmental concern, consumers' commitment, acceptance of green energy, perceived risk, social norm & moral obligations, and knowledge about green energy) and willingness to pay for green energy as dependent variable. The results show that the tested model is statistically significant (sig = 0.000; F = 35.009). Table 4 illustrates the results of regression analysis. The results indicate that acceptance of green energy, social norms and moral obligations and knowledge about green energy exert a significant positive impact on willingness to pay for green energy and, therefore, work as drivers of willingness to pay for green energy. On the other hand, we have not found any support for consumers' environmental concern, consumers' commitment and perceived risk; it seems that none of these exert statistically significant effect on willingness to pay for green energy.

Table 5 demonstrates the results of mean differences by socio-demographic groups. We can see that regarding gender, there were significant statistical differences between women and men consumers only for consumers' environmental concern, consumers' environmental commitment and knowledge about green energy. We can see that women consumers are more concerned about the environment and as well express greater environmental commitment than men consumers. While related to the knowledge about green energy, we can see that men consumers express to have more knowledge about green energy than women consumers. Our findings are in line with findings of other researchers [3], who found that men have considerable knowledge of renewable energy, while women show higher concern for the environment than men. In addition, Dogan and Muhammad [2] have found women to have a negative relationship with willingness to pay for green energy, while we have not found any significant difference among women and men related to willingness to pay for green energy.

When pertaining to age, we found significant differences for consumers' environmental concern, consumers' environmental commitment, perceived risk and willingness to pay for green energy. In more detail, consumers of age 65 years and over are the ones who express to have the greatest environmental concern, followed by the ones of age between 45 and 54 years, while consumers of age between 18 and 34 years seem to have the lowest environmental concern in the sample. Regarding the consumers' environmental commitment, the results show that consumers of age 55–64 years have the highest environmental commitment, while again, the consumers of age range 18–34 years express the lowest environmental commitment. Perceived risk about green energy is the highest in age group 55–64 years and the lowest perceived risk about green energy is in age group of 18–34 years. The age group 18–34 years is the one that is the most willing to pay for green energy, while consumers of age group 45–54 years are the least willing to pay for green energy. Our findings are somewhat consistent with the findings of Lin and Syrgabayeva [3], who found that young consumers aged "18 to 24" had the highest score on willingness to pay more for renewable energy. Researchers [2,6] have found that age has a negative relationship with willingness to pay for green energy, which is somewhat similar to our results, since we found significant differences among different age groups, however, the least keen to pay for green energy were the ones of age group from 45 to 54 years, followed by the ones from 55 to 64 years. Somewhat similar results were found also by Paravantis et al. [50], who found that willingness to pay for actual energy consumption out of renewable energy is correlated to age, since a typical green consumer is younger, more educated, and wealthier.

When it comes to education, the results indicate that there are significant differences only for consumers' environmental commitment. In more detail, consumers with elementary or high schooling express the highest environmental commitment, while consumers with specialization, MBA or Ph.D. express the highest environmental commitment. Researchers [2] have found that education has a negative relationship with willingness to pay for green energy, Paravantis et al. [50] found that a typical green

Table 4
Coefficients for results of the linear regression analysis for the dependent variable willingness to pay for green energy.

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	−2,364E-16	0.033		0.000	1.000
Consumers' environmental concern	−0.017	0.038	−0.017	−0.449	0.654
Consumers' commitment	−0.052	0.039	−0.052	−1.350	0.178
Acceptance of green energy	0.120	0.045	0.120	2.665	***0.008****
Perceived risk	−0.027	0.034	−0.027	−0.793	0.428
Social norms and moral obligations	0.335	0.045	0.335	7.436	***0.000****
Knowledge about green energy	0.170	0.035	0.170	4.815	***0.000****

Note: Dependent variable: willingness to pay for green energy, *p < 0.05.

Table 5
Mean differences by socio-demographic groups.

Demographics	Consumers' environmental concern		Consumers' environmental commitment		Acceptance of green energy		Perceived risk		Social norms and moral obligations		Knowledge about green energy		Willingness to pay for green energy	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Gender														
Women	5.59	1.16	5.86	1.12	6.14	1.10	4.20	1.62	5.07	1.31	4.65	1.31	3.29	1.59
Men	5.29	1.31	5.53	1.18	6.06	1.21	4.31	1.73	5.18	1.26	5.02	1.32	3.42	1.58
F ratio Sig.	**10.059*** **(0.002)**		**13.847*** **(0.000)**		0.866 (0.352)		0.702 (0.402)		1.395 (0.238)		**14.225*** **(0.000)**		1.178 (0.278)	
Age														
18–34 years	5.08	1.15	5.14	1.12	6.01	1.14	3.57	1.67	4.85	1.30	4.96	1.40	3.71	1.51
35–44 years	5.45	1.14	5.46	1.30	5.97	1.14	4.03	1.50	5.10	1.27	4.72	1.06	3.61	1.49
45–54 years	5.60	1.19	5.78	1.04	6.18	1.13	4.27	1.62	5.25	1.13	4.80	1.33	3.08	1.50
55–64 years	5.38	1.41	6.01	1.10	6.04	1.25	4.65	1.86	5.16	1.46	4.79	1.40	3.15	1.73
65 years and more	5.63	1.17	5.89	0.99	6.25	1.04	4.50	1.52	5.25	1.15	4.92	1.34	3.39	1.54
F ratio Sig.	**4.178*** **(0.002)**		**12.736*** **(0.000)**		1.638 (0.163)		**8.406*** **(0.000)**		2.060 (0.084)		0.716 (0.581)		**3.949*** **(0.004)**	
Education														
Elementary or high school	5.42	1.27	5.79	1.11	6.11	1.12	4.32	1.61	5.18	1.25	4.77	1.31	3.28	1.57
Bachelor's degree	5.51	1.14	5.51	1.22	6.13	1.12	4.12	1.77	5.02	1.29	5.00	1.30	3.55	1.60
Specialization, MBA, Ph.D.	5.31	1.49	5.35	1.42	5.66	1.90	4.03	2.06	4.80	1.82	4.89	1.71	3.34	1.68
F ratio Sig.	0.454 (0.635)		**5.135*** **(0.006)**		1.978 (0.139)		1.208 (0.299)		2.066 (0.127)		2.111 (0.122)		2.022 (0.133)	
Income (net per month)														
Less than €500	5.31	1.50	5.57	1.32	6.15	1.10	4.30	1.68	5.17	1.25	4.69	1.29	3.02	1.47
€500-750	5.46	1.17	5.87	1.09	6.14	1.08	4.03	1.55	5.25	1.24	4.72	1.28	3.18	1.50
€750-1000	5.47	1.30	5.61	1.27	6.14	1.12	4.48	1.69	5.09	1.30	4.81	1.37	3.41	1.61
€1000-1250	5.54	1.06	5.79	0.95	6.00	1.20	4.42	1.71	5.03	1.36	4.71	1.36	3.28	1.61
€1250-1500	5.50	1.21	5.87	0.98	6.08	1.13	4.32	1.84	5.36	1.09	5.12	1.14	3.72	1.65
€1500-2000	5.53	1.24	5.55	1.17	6.00	1.24	3.70	1.77	5.00	1.12	4.91	1.20	3.93	1.33
More than €2000	4.96	1.91	5.34	1.44	5.62	2.07	3.70	2.13	5.17	2.05	5.77	1.62	4.81	2.11
F ratio Sig.	0.723 (0.653)		1.758 (0.093)		0.683 (0.687)		1.868 (0.072)		1.190 (0.306)		**2.339*** **(0.023)**		**4.312*** **(0.000)**	

Note: M = mean value; SD = standard deviation, *$p < 0.05$.

consumer is more educated, while we have not found significant difference in willingness to pay among groups with different education.

Lastly, when pertaining to income (measured net per month), we can observe from Table 5 that there are significant differences in knowledge about green energy and willingness to pay for green energy. In more detail, consumers that earn more than €2000 net per month express higher level of knowledge about green energy, while consumers with less than €500 net per month express the lowest level of knowledge about green energy. Regarding willingness to pay for green energy, consumers with more than €2000 net per month express the highest willingness to pay for green energy, while the ones with less than €500 the lowest willingness to pay for green energy. Researchers [6,50,75] found that income influences willingness to pay for green energy. Also findings of Yoo and Kwak [76] indicate that higher income increases the probability to buy green energy in line with our results, since we can observe that with higher income also higher willingness to pay for green energy is expressed.

6. Results and discussion pertaining to the fuzzy set Qualitative Comparative Analysis

In this section we present first the necessity conditions (6.1), followed by Sufficiency conditions results (6.2).

6.1. Necessity conditions

Table 6 below highlights the consistency and coverage levels, which are used to identify whether a condition is necessary or not. None of the conditions, on their own are deemed necessary for the outcomes.

6.2. Sufficiency conditions results

Table 7 highlights the seven configurations of the sufficiency analysis. The symbols in the Table are defined as follows -" illustrates the presence of a condition, and "" illustrates the low presence of a condition, following notations used by other similar studies (e.g., Refs. [77,78]). In addition, the blank spaces show indifference towards the outcome.

The results show four configurations for high WTP (Configurations 1–4) and three for low WTP (Configurations 5–7). The results show that the relationship between the conditions and WTP is complex based on nonlinearity, equifinality, and asymmetric relations.

Nonlinearity implies that two variables can be positively related in one configuration (e.g., norms and knowledge in Configuration 4), or negatively related in another (e.g., norms and knowledge in Configuration 2). This challenges the notion of linearity which is typically assumed when assessing such relations, There is evidently the presence of equifinality. That is, there are multiple ways of achieving high WTP and low WTP. In addition, the results clearly highlight asymmetric associations. This means that configurations associated with low WTP are not the exact inverse of configurations associated with high WTP. In fact, for example, environmental concern is high in Configuration 2 and Configuration 5. In linear regression methods we assume that if environmental concern is positively related with high WTP, then low environmental concern is associated with low WTP. Through these configurations we are seeing that the relationship is more complex.

Overall, these complexities indicate that by looking at individual variables in isolation as we do under linear regression methods, one might get misleading results. High WTP is definitely not necessarily associated with the high presence of variables all at once.

When zooming into the associations, overall, the results for high WTP show that knowledge and/or norms are present in all configurations. This implies that individuals need a good understanding through their values or knowledge about the environment in order to be able to commit to higher prices associated with environmental wellbeing. Without this knowledge, the individuals cannot appreciate the environment and are unlikely to be willing to pay for a better environment. This outcome is further confirmed by the fact that in low WTP, norms and knowledge are low. Individuals may feel they are concerned or committed towards the environment but without the required values or knowledge they would not be able to appreciate it enough to have a high WTP.

The results also indicate that high WTP is associated with low perceived risk. The presence of environmental concern, consumer commitment, and acceptance is important for high WTP when any one of these three elements is accompanied by knowledge and/or social norms and obligations. The results for high WTP show that it is not the case that these three variables have to be highly present concurrently.

The results are valid for both high and low WTP given that the consistency levels exceed the threshold of 0.75. The sufficiency analysis also provides an indication of the level of coverage through two indicators namely raw and unique coverage. "Raw coverage indicates how much of the membership in the outcome is covered by the membership in a single path; the unique coverage instead indicates how much a single path uniquely covers" [79] (p. 139). The levels of coverage are adequate. There is no threshold level for the coverage.

The following section will outline the discussion based on the results outlined in this section.

Table 6
Necessity analysis.

Variable	HighWTP		Low WTP	
	Consistency	Coverage	Consistency	Coverage
High environmental concern	0.866	0.596	0.754	0.65
Low environmental concern	0.491	0.615	0.531	0.832
High consumer commitment	0.894	0.585	0.789	0.647
Low consumer commitment	0.461	0.636	0.434	0.854
High acceptance	0.933	0.573	0.789	0.606
Low acceptane	0.359	0.576	0.444	0.892
High perceived risk	0.71	0.556	0.732	0.717
Low perceived risk	0.639	0.656	0.547	0.703
High social norms and moral obligations	0.881	0.667	0.67	0.636
Low social norms and moral obligations	0.518	0.557	0.649	0.873
High knowledge	0.839	0.638	0.693	0.66
Low knowledge	0.552	0.589	0.62	0.828

Table 7
Sufficiency analysis.

	High WTP				Low WTP		
Permutation	1	2	3	4	5	6	7
Environmental concern		●			●		
Consumers' commitment				●			●
Acceptance	●		●				
Perceived risk						●	
Social norms & moral obligations	●		●	●			
Knowledge		●	●	●			
Consistency	0.86	0.86	0.867	0.887	0.976	0.978	0.984
Raw Coverage	0.302	0.289	0.336	0.227	0.243	0.224	0.204
Unique Coverage	0.038	0.001	0.033	0.005	0.035	0.02	0.021
Overall Solution Consistency	**0.819**				**0.968**		
Overall Solution Coverage	**0.399**				**0.288**		

7. Conclusions

This study has employed two methods for data analysis (i.e., regression analysis and fuzzy-set Qualitative Comparative Analysis) in order to seize the complexity of the phenomenon and offer a more precise and profound understanding of conditions, antecedents of willingness to pay for green energy.

The results derived from fuzzy-set Qualitative Comparative Analysis indicate that knowledge and/or social norms and moral obligations are present in all configurations when we have high willingness to pay for green energy. That means that consumers with knowledge about green energy and social norms and moral obligations express higher willingness to pay for green energy. This outcome is further confirmed by the fact that when we have low willingness to pay for green energy, both social norms and moral obligations and knowledge about green energy are low. This is in line with prior research, which emphasized the role and importance of knowledge about green energy, social norms and personal moral norms, which are the main basis for individuals' general predispositions to pro-environmental action and their role may be essential in adoption and willingness to pay for green energy [3,47]. The results also indicate that high WTP is associated with low perceived risk. The presence of environmental concern, consumer commitment, and acceptance is important for high WTP when any one of these three elements is accompanied by knowledge and/or social norms and obligations.

Furthermore, we conducted linear regression analysis, which also confirms the crucial role of social norms and moral obligations and knowledge about green energy for willingness to pay for green energy and is thus in line with the results of fuzzy set Qualitative Comparative Analysis. Linear regression analysis revealed that acceptance of green energy, social norms and moral obligations and knowledge about green energy exert a significant positive impact on willingness to pay for green energy and thus work as drivers of willingness to pay for green energy. According to findings of Sangroya and Kumar [48], who focused on consumers' values, it is not only the financial aspects that lead consumers to decide on adoption of green energy; consumers are also driven by emotional and social considerations. This is in line with our findings, since social norms and moral obligations and further acceptance of green energy and knowledge about it affect consumers' willingness to pay for green energy. Which means that policy makers should form green energy initiatives that incite pro-environmental behavior and also marketing campaigns that evoke consumers' sense of responsibility for our environment. In this way they become more willing to pay for green energy and proactively pay for green energy with or without subsidies. It is worth mentioning that in Slovenia, there is no state subsidy to the end-consumers if they shift over to renewable energy source. Policy makers, electricity firms and other relevant stakeholders should invest in educating and raising awareness about green energy among consumers and with environmentally educative campaigns try to persuade consumers to pay for green energy. Since social norms and moral obligations and knowledge about green energy are strong determinants of willingness to pay for green energy, more effort as stated should be invested in education campaigns. As suggested by Sangroya and Kumar [48], policy makers should tend to formulate pro-green energy programs and mass messages that appeal to consumers' sense of responsibility to voluntarily adopt green energy without having to rely on financial incentives. The delivered messages about green energy should clearly and comprehensively convey the ability and importance of green energy to reduce the adverse effects of greenhouse gas emissions and fight climate change while reinforcing and empowering consumers to take one step closer to change and benefit our environment. Financial incentives should still take place, since the majority of consumers is in favor of green energy, but not all of them can afford it. Pro-active willingness to pay for green energy can surely be spurred by level of knowledge about green energy and its acceptance. As abovementioned, also social norms and moral obligations affect consumers' willingness to pay for green energy. However, consumers that lack resources, be they financial or intellectual, need to be educated and also empowered not only educationally, but also financially. Policy makers and electricity firm managers have the potential and ability to persuade consumers to adopt renewable energy and beforehand enhance the knowledge on renewable energy [3].

Furthermore, when pertaining to the socio-demographic characteristics of consumers, we can observe that women consumers have higher levels of environmental concern and environmental commitment, while men consumers have higher level of knowledge about green energy. Younger consumers (from 18 to 34 years) seem to have lower level of environmental concern and also environmental commitment, however, they have also the lowest level of perceived risk related to green energy and are more likely to pay for green energy than the rest of population seized in this study. Education seems not to be the decisive factor regarding the research issue explored in our study, however it seems that the most environmentally committed consumers are the ones with elementary or high school. Knowledge about green energy and willingness to pay for it seem to grow with the consumers' income. That means that income could be a determinant, which will decide whether consumers will have the knowledge and the willingness to pay for green energy.

Each and every research has its own limitations and ours is not an exception. However, the limitations of this study, may serve as avenues for future research. We have used rather large sample of consumers and as well employed not only regression analysis, but also fuzzy set to deepen our understanding of the discussed research issue. This study has been based on a sample of Slovenian consumers and should be replicated also in other countries to see the differences and similarities in consumers' behavior. We believe that the results of the study pertaining regression analysis complement and add value to the ones from the fuzzy set and bring more understanding of not just how, but also which behavior/determinant influences and links with willingness to pay for green energy. Use of both research methods/analyses contributes to this study and brings additional insights in this research topic. The results of this study can be generalized to other countries (especially in European Union), which are somewhat similar in their consumers' mentality and economy to Slovenia. We still need to take into account that consumers and their attitude, which is comprised in the research, are sensitive to change and are subjective. A longitudinal research, which would follow the consumers through years could additionally benefit the results of this research. In addition, future research could as well address and focus on regionally dependent studies, since the mentality between different regions strongly differs.

Our findings present several important implications for the policy makers, energy regulators, utility companies and as well as information on how to design effective mechanisms to induce adoption of green energy among consumers. Despite that this research is conducted on a sample of Slovenian consumers, the findings can be still generalized to countries with similar characteristics as Slovenia (economy, green energy potential, etc.). Slovenia's objective is to pursue sustainability and continuously increase adoption of green energy, by 2030 its goal is to achieve a 37% share of RES in gross final energy consumption [53]. Based on the acquired findings we may tailor strategies to target consumers with specific relevant characteristics and also socio-demographics. However, all the effort and marketing should not be oriented only towards the consumers that are already aware, environmentally concerned and responsible, but should raise awareness of the ones that do not own these attributes and, moreover, are not able to afford green energy. The green energy should not be the privilege of educated and wealthy people, but become a reality for all.

Credit author statement

All authors have revised the final version of the manuscript and agreed to submit it in journal Energy Policy. In more details, the corresponding author dr Hojnik and dr Fabri were taking care of methodology and results with discussion and reviewing. Dr Ruzzier provided the funds for research (data collection) and as such was responsible for funding acquisition, and has as well reviewed the manuscript. Dr Hojnik has covered all sections (conceptualization, methodology, validation, formal analysis, investigation, writing, visualization and supervision) of the manuscript and research. Ms Klopčič has been involved in writing and reviewing the manuscript.

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Declaration of competing interest

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

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