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Research Article

Willingness to pay for green energy sources in the United Arab Emirates (UAE)

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Abstract. This study investigates the willingness of customers in the UAE to pay a premium for green energy (GE) sources. Given the huge initial investment required for GE projects, raising capital is often achieved by increasing energy bills or taxes. To explore this issue, the study surveyed 192 small and medium-sized businesses using the contingent valuation method. The results indicate that while most businesses are aware of solar and wind energy sources and the importance of combating climate change, half of them are not willing to compromise their current energy use and do not support an increase in utility bills or taxes to finance GE projects. However, older businesses tend to be more willing to pay a premium for GE compared to younger businesses. Overall, majority of the businesses support a voluntary increase in electricity bills. The findings highlight the crucial role of current electricity bills and knowledge about GE sources in shaping customers' willingness to pay. This study contributes to the literature on energy finance and the contingent valuation method in the context of green energy in the UAE.

Keywords: Contingent valuation; Energy finance; Green energy; UAE; Willingness to pay.

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1. Introduction

The increasing global warming and its impact on climate have prompted many countries to focus on designing sustainable energy policies. Although there are global and national initiatives to mitigate the consequences of climate change, it is not sufficient, and much more needs to be done. The Paris agreement signed by 197 countries in 2016 and ratified by 185 countries so far is a major global initiative taken by global leaders to address the impact of global warming on climate change.† One of the major responses to negative climate change is reducing carbon emission through investment in Green Energy (GE)‡.

The international Energy Agency (IEA, 2020) reports that despite the challenges of the current Covid-19 pandemic, investments in renewable energy projects are expected to grow at 5% annually. Solar energy, wind and hydropower constitute the top three energy projects expected to grow faster in the coming years. A greater share of the growth in GE investment belongs to China, European Union, India and Arab countries such as United Arab Emirates (UAE) (IEA, 2020).

GE technologies are capital-intensive investments and tend to have higher risk (Ghosh and Nanda, 2010; Kalamova, Kaminker, and Johnstone, 2011). The financial sector is expected to mobilize significant funding for investment in GE innovations and efficiency to achieve the global commitment of reducing the global temperature rise to below 2 degrees Celsius (OECD, 2016). The role of developed and sustainable financial markets is paramount in accelerating GE growth and efficiency (McInerney and Bunn, 2019). However, the current trends indicate that, despite its size, the contribution of the financial market in financing GE projects is minimal. One of the major barriers to GE development reported in previous studies is the lack of adequate funding (e.g., De Serres, Murtin, and Nicoletti, 2010; Eleftheriadis and Anagnostopoulou, 2015). In addition, the contribution of the financial actors towards the different energy technologies is disproportionate, where some actors prefer a certain technology to the other, leaving the flow of funding directed to a particular technology (Popp, 2010; Veugelers, 2012; Mazzucato and Semieniuk, 2018). Stirling (2014) and Stern (2015) emphasized that investment in diversified GE technologies enhances the supply and efficiency of the energy system. However, a unidirectional investment towards limited technologies tend to result in higher losses, if the innovations are unsuccessful (Grubler, 2012). Nevertheless, an increasing investment in green bond has been reported recently, a total outstanding investment of $1.45 trillion dollar on GE related projects (The Climate Bonds Initiative, 2018). According to Bloomberg New Energy Finance (BNEF)§, as of September 2019, the total investment in GE projects reached $2.6 trillion. Although a major emphasis has been given to investments in GE technologies, their long-payback period, high risk and huge capital requirements, make GE investments less

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† See https://unfccc.int/sites/default/files/english_paris_agreement.pdf

‡ Energy companies finance their projects using both internal cash flow sources and external public and private sources of funding, including debt capital, equity and grants (Hussain, 2013).

§ Details can be found in the following link. https://www.bloomberg.com/news/articles/2019-09-05/clean-energy-investment-is-set-to-hit-2-6-trillion-this-decade

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appealing to investors (Eleftheriadis and Anagnostopoulou, 2015; OECD, 2016). Investors expect a higher rate of return on GE investments to compensate for the potential higher risk (Jacobsson and Jacobsson, 2012).

Despite its multifaceted advantage, the cost of energy generated from green energy sources are expensive compared to other sources such as coal. These costs are usually borne by households and businesses (Szakály *et al*., 2021). As a result, the supply cost of GE is assumed to have a significant effect on customers' preference in using GE technologies (Bollino, 2009). Bollino (2009) argued that the willingness of consumers to pay (WTP) an additional premium for GE utilities is expected to affect future energy policies and investments in GE technologies. It is argued that as consumers' awareness about the importance of mitigating environmental damages improves, their WTP additional premium on green technologies increases, resulting in lower government subsidies. Greater WTP is also expected to increase access to finance for GE investments. This study aims to assess the WTP for GE technologies in the UAE.

UAE is one of the few countries leading the world in adopting GE technologies. The UAE has abundant renewable energy potential, and it is the first country in the GCC region to take considerable measures to increase the use of GE technologies, with the aim of increasing the share of GE to 24% by 2021 (IRENA, 2019). Therefore, examining consumers' WTP a premium for GE utilities is an important public policy and timely topic.

A growing number of studies focus on consumers' preferences in using different sources of GE (e.g., Batley *et al,* 2001; Ek, 2005; Borchers, Duke and Parsons, 2007; Bollino, 2009; Bujdosó *et al*., 2012; Muhammad *et al*., 2021; Pleeging *et al*., 2021). These studies use surveys to assess customers' WTP, predominantly using a contingent valuation model. For example, Batley *et al.* (2001) identified social status and income level as the determinants of WTP, while Ek (2005) reported that age, income and environmental awareness as the key factors affecting WTP for renewable energy products. In addition, Borchers *et al.* (2007) revealed that the type of GE source also affects customers' WTP. Overall, existing studies report a wide variety of results confirmed by Ma *et al.* (2015) who analyzed 28 empirical studies that focus on the determinants of WTP for renewable energy sources and find a significant variation in the methods used.

Majority of the extant studies on the WTP on GE sources focus on developed countries such as USA, Italy, Netherlands, the United Kingdom, Canada, etc. (Diaz-Rainey and Ashton, 2007; Whitehead and Cherry, 2007; Wiser, 2007; Bollino, 2009; Polinori, 2009; Pleeging *et al*., 2021;). There is no study addressing the consumers' WTP for GE utilities in the UAE. In addition, none of the existing studies addresses the WTP from business entity perspectives. Existent studies on the customers' WTP cannot be generalized as they differ in terms of survey methodology, and country socio-economic and institutional differences. This study investigates customers' WTP for GE sources in the UAE and aims to: (i) explore the customers' awareness on GE technologies (ii) identify the factors that impact customers' WTP for GE sources and (iii) evaluate customers' WTP for GE sources. The study argues that the public preferences about the use of different sources of GE and their pricing will affect future government energy policies and investments in GE projects.

Using a contingent valuation survey (e.g., Mitchell and Carson, 1989), the study assesses the willingness of small and medium enterprises in the UAE to pay a premium for GE technologies. The findings of this study can provide insights into consumers' behavior, enabling policymakers and investors to design effective and efficient policies that encourage the adoption of GE technologies, thereby accelerating the transition to a sustainable energy system.

2. Literature review

The theory of Planned Behavior (Ajzen, 1991) is relevant to understanding WTP for green energy sources. This theory suggests that individuals' attitudes, subjective norms, and perceived behavioral control influence their intention to engage in a particular behavior, such as paying a premium for green energy sources. Attitudes towards green energy sources can be shaped by factors such as environmental concern and knowledge of energy issues, while subjective norms can be influenced by social norms and perceptions of others' behavior. Perceived behavioral control can be influenced by factors such as income, availability of green energy sources, and ease of access.

Following the theory of planned behavior, several studies have investigated the determinants of WTP for green energy sources. For example, a study by Diaz-Rainey and Ashton (2007) and Rowlands, Scott and Parker (2003) found that customers with greater disposable income are more likely to be willing to pay more for green energy sources compared to customers with less disposable income. In addition to income, other factors such as knowledge of energy issues, concern for the environment, and trust in government and energy providers have been found to influence WTP for green energy sources (Bujdosó *et al*., 2012; Abdullah *et al*., 2021). This means that knowledge of green energy and individuals' attitudes towards green energy sources can play a crucial role in shaping their WTP.

Growing research discusses the significance of GE sources in reducing global carbon emissions (e.g., Stirling, 2014; Stern, 2015; Mazzucato and Semieniuk, 2018; Pleeging *et al*., 2021). However, such investments require significant amount of capital and partly, their success depends on the willingness of customers to pay a premium for GE sources, their willingness to invest in GE technologies and ability to adjust their behaviors for the benefit of protecting the environment (Pleeging *et al*., 2021).

Over the last decade, the awareness of people on environmental issues has improved, and as a result, GE use has increased by 3% in 2020 and the share of renewables in the global electricity generation jumped to 29% in 2020 from 27% in 2019 (IEA, 2021). Generally, energy generated from GE sources is more expensive than energy generated from non-GE sources despite their positive environmental and social impacts (Borchers *et al*., 2007). Consequently, return on investment in GE projects is strongly significant in determining the success of GE projects and lack of adequate funding continue to be a major challenge of GE projects.

According to a policy paper of the World Bank (2011), GE projects can be financed using three schemes. (1) direct provision, in which funds are raised using grants, equity contributions or loans from the government; (2) through commercial sources – loans from financial institutions and (3) through a special fund such as GE funds created for the purpose of financing GE projects.

In recent years, there have been several innovations in green energy financing, such as green bonds, green banks, and crowdfunding platforms. These innovative financial products are expected to meet the funding needs for investments in GE (Sachs *et al*., 2019). Investment in GE has increased from USD 619 billion in 2010 to USD 974 billion in 2020, and it's expected to grow to USD 4.34 trillion by 2030 (IEA, 2021). IEA (2021) estimates that 70% of GE investments will need to be carried

out by private developers, consumers, and financiers, and the remaining 30% is to be covered by the public sector.

Despite the increasing popularity of green energy financing, there are still several challenges that need to be addressed. One major challenge is the high upfront costs of green energy projects, which can deter investors and consumers from investing in green energy sources. Lack of standardized metrics for measuring the environmental impact of green energy projects and a mismatch between the time horizon of green energy projects and the investment horizons of investors, have also been identified as challenges to financing green energy projects (Bollino, 2009; Szakály *et al*., 2021).

Government policies and regulations can play a critical role in promoting green energy financing and encouraging consumers to pay for green energy sources. For example, feed-in tariffs and renewable portfolio standards have been used in many countries to incentivize the production and consumption of green energy and several studies have examined the impact of these policies on green energy financing and consumers' willingness to pay for green energy sources (e.g., Sachs *et al*., 2019).

Overall, willingness to pay for green energy sources is influenced by various factors, including attitudes towards the environment, perceived behavioral control, and subjective norms. The theory of planned behavior provides a useful framework for understanding the underlying psychological processes that drive consumers' intentions to pay for environmentally friendly energy sources. The studies reviewed have shown that consumers are generally willing to pay more for green energy sources if they believe that doing so will help to protect the environment and mitigate the negative effects of climate change. In addition, factors such as affordability, accessibility, and perceived effectiveness of green energy sources also play a role in shaping consumers' willingness to pay. Ultimately, promoting the benefits of green energy sources and addressing potential barriers to adoption can help to increase consumers' willingness to pay and support the transition towards a more sustainable energy system.

3. Research Method

3.1. Data source

Assessing the willingness of customers to pay (WTP) a premium for green energy (GE) utilities is crucial in energy research to understand consumers' demand and formulate policies and regulations related to GE investments. This study uses a survey method to investigate the willingness to pay (WTP) for green energy sources among small and medium-sized enterprises (SMEs) in the United Arab Emirates (UAE). The survey was conducted using a questionnaire that was designed based on the contingent valuation method (CV). The questionnaire was distributed to a sample of 192 SMEs in various industries across the UAE.

The sample was selected using a convenient sampling method. The convenient sampling helped to contact willing firms that are located at industrial areas and commercial centers. The representation of various industries in the UAE are also considered when selecting the sample firms.

The questionnaire was designed to collect data on respondents' WTP for green energy sources, as well as their attitudes towards the environment, energy consumption behavior, and socio-demographic characteristics. The WTP question was presented in a hypothetical scenario, where respondents were asked to imagine that they were given the opportunity to purchase green energy sources at a certain price premium over their current electricity bill and respondents were asked to indicate their WTP for various options.

WTP survey instruments are commonly used in energy research to assess consumers' demand and devise policies and regulations on GE investments (Diaz-Rainey and Ashton, 2007; Bollino, 2009; Ntanos *et al*., 2018).

The CV method is widely used in the WTP studies, and it is an important model in evaluating the economic and environmental benefits of improved use of energy (Bollino, 2009; Pleeging *et al*., 2021). The model allows researchers to systematically collect data related to the willingness of consumers to pay for a given program, project, or alternative energy use. The model uses hypothetical scenarios to ask respondents about a given topic (Kwak, Yoo and Kim, 2013).

The study's survey questionnaire comprises of four parts, including demographic characteristics, knowledge about green energy sources, level of electricity consumption, and willingness to pay a premium for GE sources. The WTP survey questionnaires are criticized for their upward response bias, raising the issue of reliability and validity (Diamond and Hausman, 1994). However, previous research suggests that the reliability and validity problem can be overcome if the

Table 1
Respondents' characteristics

Variables		Frequency	Percentage (%)
Gender	Male	176	91.67%
	Female	16	8.33%
Education	Elementary & lower	11	5.74%
	High school	16	8.33%
	Bachelor	113	58.85%
	Masters and above	52	27.08%
Age of enterprises	1 - 5 years	51	26.56%
	5 - 10 years	60	31.25%
	10 - 20 years	68	35.42%
	Over 20 years	13	6.77%
No. of employees	Less than 10	40	20.83%
	10 – 20	32	16.67%
	20-30	39	20.31%
	More than 30	81	42.19%
Type of Business	Wholesale and retail	54	28.13%
	Real-estate and construction	30	15.63%
	Healthcare	25	13.02%
	Manufacturing	13	6.77%
	Transportation	10	5.21%
	Others	60	31.25%

questionnaire is designed, tested, and implemented carefully (e.g., Carson, Flores, and Meade; 2001).

To address the issue of reliability and validity, the study conducted a pilot study of ten respondents to assess the suitability and clarity of the survey questionnaire before conducting the major survey on 192 respondents.

3.2. Sample

Table 1 reports the key characteristics of the study sample respondents. Out of 192 SMEs considered in the sample, 91.67% of them have male managers, while 8.33% of the SMEs are led by females. This finding highlights a potential gender disparity in the leadership of firms.

In terms of educational background, 85.93% of the respondents hold a Bachelor degree or above, while a small percentage of respondents (5.74%) reported having an elementary school or lower qualification. These results suggest that the participating firms have a highly educated workforce, which may have implications for business practices and outcomes.

Regarding the age of the firms, the results indicate that a substantial proportion of the firms are relatively young, with 26.56% being less than five years old. This finding highlights the prevalence of start-up firms in the sample, which may have implications for their operations and strategies. In addition, the sample is predominantly composed of wholesale and retail firms (28.13%), followed by real-estate and construction (15.63%), healthcare (13.02%), and manufacturing (6.77%), Transportation (5.21%) and other types of businesses (31.25%).

Finally, the results suggest that the participating firms vary considerably in terms of their size, with 20.83% having less than 10 employees, 36.98% having between 10 to 30 employees, and 42.19% having more than 30 employees.

3.3. Method of Analysis

The study assesses the customers' willingness to pay (WTP) a premium for GE sources using the contingent valuation method, a model widely used in previous studies (e.g., Diaz-Rainey and Ashton, 2007; Bollino, 2009; Ntanos *et al*., 2018). The WTP survey questionnaire asks respondents their willingness to pay a premium for GE utilities based on given scenarios - green energy and conventional energy sources.

Energy is one of the consumptions for households and firms. This study focuses on small and medium enterprise users and examines their willingness to pay a premium for using GE technologies. The firms will have several goods to consume subject to utility constraints, where 'g' is a proxy for GE consumption and 'x' is the composite goods of the firm.

$$\min e(g, x) \quad (1)$$

Equation (1) is subject to utility constraint:

$$u = u(g, x) \quad (2)$$

Total expenditure of the customer is the expenditure for GE services (g) plus the total other goods expenditure (x).
Equation (1), can be rewritten as

$$E* = f(p_r, p_z, u) \quad (3)$$

The price of the GE utility is 'p_r' , the price for other utilities is 'p_z' and 'u' is an error term for unexplained factors.

The consumer aims to lower the expenditure function in equation (3) while consuming GE services and other goods, subject to utility constraints. The study determines the WTP for GE services by calculating the difference between the two expenditure functions with and without GE services, with the compensating surplus (CS) welfare estimate derived from this difference. The CS estimate represents the amount each UAE SME is willing to pay for GE services.

The new expenditure of the consumer can be determined using the following formula:

$$E* = e\,(p_{r0}, p_z, u) \quad (4)$$

$$E* = e\,(p_{r1}, p_z, u) \quad (5)$$

Where, 'p_{r0}' is the price of the non-GE utility, and 'p_{r1}' indicates the prices for GE utilities. Therefore, the willingness to pay for GE is the difference between two expenditure functions (4) and (5), with $Pr_1 > Pr_0$ and the compensating surplus (CS) welfare estimate can be derived from the following differences:

$$\text{CS}\,(W_0 : W_1) = e\left(Pr_{1,}\, p_z, u_0\right) - e\left(Pr_{1,}\, p_z, u_0\right) \quad (6)$$

This estimate of compensating surplus is a measure of the WTP for GE services. It is the amount each UAE small and medium business is willing to give up and remain at the previous utility level before the change.

The data collected from the survey was analyzed using descriptive statistics and correlation matrix analysis. Descriptive statistics were used to summarize the distribution of WTP values and other variables collected through the survey. Correlation matrix analysis was used to examine the relationships between WTP and the explanatory variables in the study.

The study contributes to the literature on WTP for GE utilities by focusing on SMEs and providing a comprehensive analysis of customers' willingness to pay for green energy sources. The study's results provide valuable insights for policymakers and investors in the energy sector, highlighting the potential market for GE services among SMEs in the UAE. The results of the analysis are presented in the following section.

4. Results and Discussion

4.1. Awareness on green energy sources and use

Table 2 reports the level of awareness of respondents on different sources of green energy (GE). A total of 192 participants were asked to rate their level of awareness on a list of GE sources, including wind, solar, geothermal, hydropower, and biomass. The results revealed that the respondents had better knowledge of wind and solar sources compared to the other sources. Specifically, 67.18% and 69.28% of the respondents rated their awareness of wind and solar sources as average or above, respectively. On the other hand, 66.15%, 68.23%, and 75.0% of the respondents rated their knowledge of geothermal, hydropower, and biomass energy sources as poor or unsure, respectively.

In addition, the respondents were asked if they knew of any government projects on GE. A total of 88.54% of the respondents indicated that they were not aware of any GE project that is undertaken by the government, while only 11.46% of them indicated that they knew of some projects such as the Al Dhafra solar project in Abu Dhabi.

Overall, the findings suggest that there is a need to increase awareness and knowledge of different sources of GE, particularly geothermal, hydropower, and biomass. Moreover, efforts should be made to promote government initiatives and projects on GE to increase public awareness and support.

Table 3 presents the results of respondents' preference for sources of GE. Most of the respondents (84.38%) believe that solar and wind have higher potential in the UAE, which is consistent with their level of awareness reported in Table 2. Specifically, 72.92% of the respondents rated solar as having

Table 2
Knowledge on different types of renewable energy sources

Green energy sources	Level of awareness			
	Poor	Average	Very good	unsure
Wind	19 (9.90%)	101 (52.60%)	28 (14.58%)	44 (22.92%)
Solar	22 (11.46%)	91 (47.40%)	42 (21.88%)	37 (19.27%)
Geothermal	57 (29.69%)	48 (25.00%)	17 (8.85%)	70 (36.46%)
Hydropower	60 (31.25%)	44 (22.92%)	17 (8.85%)	71 (36.98%)
Biomass	69 (35.94%)	34 (17.71%)	14 (7.29%)	75 (39.06%)

Table 3.
Customers' preference on GE sources

Green energy sources	Has high potential in the UAE		Preferred source of green energy	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Wind	22	11.46%	57	29.68%
Solar	140	72.92%	102	53.13%
Geothermal	13	6.77%	23	11.98%
Hydropower	15	7.81%	10	5.21%
Biomass	2	1.04%	0	0%

high potential, while 11.46% rated wind as having high potential. In terms of preference, 53.13% of the respondents preferred solar, while 29.68% preferred wind as their source of green energy.

The results of this study are consistent with several recent studies that have examined people's knowledge and preferences regarding green energy sources. Bujdosó *et al.* (2012) conducted a survey among Hungarian consumers and found that solar and wind energy were the most popular sources of renewable energy. Similarly, Halder *et al.* (2010) conducted a study among Indian consumers and found that solar and wind energy were the most popular sources of renewable energy, followed by biomass and hydropower. Khajepour and Ameri (2020) also found that solar and wind energy were the most preferred sources of renewable energy among Iranian consumers.

Khambalkar *et al.* (2010) conducted a study in India to assess the level of awareness of renewable energy technologies among college students. They found that students had the highest awareness of solar energy, followed by wind energy, hydropower, and biomass. Similarly, Ntanos *et al.* (2018) conducted a study among Greek university students and found that solar and wind energy were the most popular sources of renewable energy, while geothermal energy was the least known source.

Zografakis *et al.* (2010) conducted a study among the general population in Greece and found that solar and wind energy were the most preferred sources of renewable energy, followed by hydropower and biomass. Furthermore, the respondents were asked to rate their awareness on climate change and its impact on the environment. Table 4 reports the level of agreement among respondents on the relationship between climate change and the environment. The results show that most of the respondents (57.29%) agree that industrial pollution has negative impacts on human health and the country's economy, while 45.31% understand the overall consequences of climate change on the environment.

This result is consistent with previous studies that have shown a positive correlation between knowledge about climate change and concern for the environment (Fielding, McDonald, and Louis, 2012; Lee *et al*., 2015). Furthermore, over half of the respondents (52.60%) are willing to make compromises in their current lifestyle for the benefit of the environment and their future wellbeing. However, the respondents were less willing to pay higher prices or accept an increase in taxes to finance GE projects. Most of the respondents (56.25%) disagree or strongly disagree to pay higher prices on their electricity bills, while 57.29% disagree or strongly disagree that taxpayers should pay higher taxes to protect the environment. These results are consistent with previous studies that have found that cost is a significant barrier to the adoption of renewable energy (e.g., Bollino, 2009; Szakály *et al*., 2021).

Overall, these findings suggest that while awareness and concern about climate change and the environment are present among UAE consumers, cost remains a significant barrier to the adoption of renewable energy. Policymakers and industry stakeholders should consider addressing this barrier through measu res such as subsidies or tax incentives to make green energy more affordable and accessible to consumers.

In Table 5, the study reports customers' preferences of using energy efficient technologies and their plan for future use if they are not using one currently. The findings from Table 5 suggest

Table 4
Awareness on climate change and the environment

Attributes	Disagree and strongly disagree	Neutral	Strongly agree & agree
Current changes in the environment are going to be worse.	46 (23.96%)	59 (30.73%)	87 (45.31%)
People should pay higher prices in electricity to protect the environment.	108 (56.25%)	62 (32.29%)	22 (11.46%)
People should pay higher taxes to protect the environment.	110 (57.29%)	70 (36.46%)	12 (6.25%)
Industrial pollution is dangerous for human being.	37 (19.27%)	45 (23.44%)	110 (57.29%)
I am not concerned about climate change because it won't have effect in few years.	73 (38.02%)	89 (42.71%)	30 (15.63%)
I am willing to make compromise in my current lifestyle for the benefit of the environment.	21 (10.94%)	70 (36.46%)	101 (52.60%)

Table 5
Customers' preference on GE sources

Green energy sources	Use energy efficient technology		Plan to use energy efficient technology	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Yes	51	26.56%	91	64.54%
No	141	73.44%	50	35.46%

that there is a significant opportunity for promoting the use of energy efficient technologies in the UAE, as 73.44% of respondents do not currently use such technologies but plan to do so in the future. This is consistent with the results of other studies, which have found that energy efficient technologies are gaining in popularity among consumers (Ntanos *et al.*, 2018). However, the high cost of green energy technologies continues to be a major barrier to their adoption, with 67.14% of respondents in this study citing cost as a reason for not using such technologies.

Moreover, lack of awareness about the benefits and availability of energy efficient technologies is another factor that impedes their use (Ntanos *et al.*, 2018). Increasing public awareness through targeted education campaigns and incentive programs can help overcome this barrier. For instance, Ntanos *et al.* (2018) suggested that energy efficiency awareness campaigns can help build a culture of energy efficiency and encourage greater adoption of energy efficient technologies.

The results also show that a significant percentage of respondents (35.46%) do not plan to use energy efficient techno logies in the future, with cost being the main reason. This result is in line with existing evidence that energy efficient appliances are mostly more expensive than ordinary appliances (e.g., Panzone, 2013; Ntanos *et al.*, 2018). This highlights the need for policymakers and energy companies to work together to address the issue of affordability, such as by providing incentives and subsidies to encourage the adoption of energy efficient technologies.

Overall, the findings suggest that while there is growing awareness of the benefits of green energy technologies among consumers in the UAE, significant barriers remain to their adoption. Addressing these barriers through targeted education campaigns, incentive programs, and subsidies could help accelerate the transition to a more sustainable energy system in the country.

4.2. Customers' willingness to pay.

Table 6 presents insightful information on the willingness of respondents to accept an increase in their utility bills to finance green energy projects. The table shows that most respondents are willing to use energy-efficient and renewable energy appliances to protect the environment, but not all are willing to pay extra for electricity generated from renewable energy sources.

The finding that 64.58% of the respondents agree or strongly agree with using energy-efficient and renewable energy appliances is encouraging for policymakers and businesses. This suggests that the public is open to using more sustainable energy sources and is willing to adopt energy-efficient appliances.

On the other hand, the finding that 50.69% of respondents disagree or strongly disagree with paying more for electricity generated from renewable energy sources poses a challenge for green energy initiatives. It is understandable that some individuals may be hesitant to pay more for electricity generated from renewable sources, as there may be a perception that it is more expensive than traditional energy sources. However, research has shown that over the long term, renewable energy can be more cost-effective than traditional energy sources (BNEF, 2021).

One possible explanation for the lack of willingness to pay more for renewable energy could be the issue of affordability. Therefore, policymakers and businesses should focus on making renewable energy more affordable and accessible for consumers.

Table 7 reports the respondents' willingness to pay a premium on their electricity bills to support investments in GE projects. The results reveal that many respondents (86.46%) are not willing to accept any increase in their electricity bills to support research and development (R&D) in renewable energy. It is noteworthy that a significant proportion of respondents

Table 6
Willingness to use renewable energy sources.

Attributes	Disagree and strongly disagree	Neutral	Strongly agree & agree
I am willing to pay more for electricity generated from renewable energy sources.	105 (50.69%)	39 (20.31%)	48 (25.00%)
Somebody else can pay extra for renewable energy not me.	36 (18.75%)	132 (68.75%)	24 (12.50%)
I am willing to use energy efficient and renewable energy appliances to protect my environment.	13 (6.77%)	55 (28.65%)	124 (64.58%)

Table 7
Willingness to pay premium to support investments in green energy.

Attributes	Yes	No
Willingness to pay a premium to support R & D in renewable energy.	26 (13.54%)	166 (86.46%)
Support of government proposal to increase electricity bills by 5% to invest in green energy projects.	156 (81.25%)	36 (18.75%)
Willing to pay 10% more on electricity bills to have a 10% of your energy source from renewable energy.	87 (45.31%)	105 (54.69%)
Willing to accept a 10% increase in electricity bills, given that use of renewable energy would help you save 5% in energy costs.	80 (41.67%)	112 (58.33%)

(58.33%) are not willing to accept any increase in their electricity bills, even if the use of renewable energy could save them future energy costs. This finding highlights the need for increased education and awareness campaigns to inform consumers about the long-term benefits of investing in renewable energy.

On the other hand, the study found that 81.25% of the respondents are willing to pay a premium if the increase in electricity bills is proposed by the government. This finding is consistent with a report by BNEF (2021), which states that government policies that support renewable energy have been successful in driving its adoption and are likely to be key to achieving decarbonization goals.

The study also sheds light on the maximum percentage increase that respondents are willing to pay to use electricity generated through GE sources. Most of the respondents (75.64%) indicated their willingness to accept an increase of up to 5%, while a smaller proportion (20.31%) are willing to accept up to 10%. This finding suggests that consumers are willing to pay a small premium for renewable energy.

The reasons provided by respondents for their support or opposition to paying a premium for renewable energy are also noteworthy. The findings indicate that 45.31% of the respondents who are willing to pay a premium care about the environment, suggesting that consumers are becoming increasingly environmentally conscious. In addition, the finding that 38.02% of respondents believe that green energy plays an important role in eliminating dependence on oil and gas underscores the importance of renewable energy in achieving energy security and reducing reliance on fossil fuels.

On the other hand, the finding that 50% of those who are unwilling to accept any increase in their electricity bills assert that an increase on the current electricity bills would make their bills unaffordable highlights the need for policies that address the affordability of renewable energy.

4.3. Factors affecting Customers' willingness to pay.

The results from Table 8 suggest that 54.17% and 17.19% of the respondents spend up to 10% and more than 10% of their monthly expenditure on utility bills, respectively. Customers who spend a higher proportion of their monthly expenditure on utility bills may be less willing to accept an increase in their electricity bills, as it may cause a significant financial burden on their household budget. The relatively high percentage (27.60%) of respondents who were unsure about their monthly utility expenditure highlights the importance of improving customer awareness and education about their electricity consumption and billing.

In addition, the results suggest that only a small proportion of the respondents (less than 1%) spend more than 20% of their monthly expenditure on utility bills. This finding may indicate that most of the respondents are financially stable and can afford an increase in their electricity bills if it is necessary to support investments in renewable energy sources. However, further research is needed to investigate the relationship between household income and customers' willingness to pay for utility bills.

Overall, the findings from Table 8 suggest that the current utility expenditure is an important factor that affects customers' willingness to pay for future bills. Improving customer awareness and education about their electricity consumption and billing can help to improve their attitudes towards energy conservation and willingness to pay for energy-efficient appliances, which in turn can support investments in renewable energy sources.

In addition, customers' future price expectations could also affect their willingness to pay. The results from Table 9 show that almost half of the respondents (47.92%) expect an increase in utility prices in the future, which could affect their WTP for utility bills. The expected increase in utility prices could lead to a decrease in customers' willingness to pay for utility bills, as higher prices could result in a decrease in disposable income and an increase in the cost of living.

Nevertheless, 29.17% of the respondents expect utility prices to remain the same. This result may indicate that some customers are satisfied with their current utility bills, and they may be willing to pay for renewable energy investments if the price remains the same.

Interestingly, 7.29% of the respondents expect a decrease in utility prices in the future. This result may suggest that some customers are optimistic about the future of renewable energy, and they believe that the widespread adoption of renewable energy could lead to a decrease in utility prices. However, this finding needs to be interpreted with caution, as a decrease in utility prices may not necessarily lead to an increase in customers' willingness to pay for renewable energy investments.

Overall, the results from Table 9 highlight the importance of price in customers' decision-making process regarding energy consumption and willingness to pay for renewable energy investments. Future research could investigate the factors that influence customers' price expectations and how these expectations affect their willingness to pay for renewable energy investments.

Table 8
Monthly utility bills as a proportion of monthly expenditures

Proportions	Frequency	Percentage (%)
Up to 10%	104	54.17%
10 - 20%	33	17.19%
20 - 30%	1	0.52%
More than 30%	1	0.52%
Unsure	53	27.60%

Table 9
Future utility price expectations

Proportions	Frequency	Percentage (%)
Increases	92	47.92%
Remains the same	56	29.17%
Decreases	14	7.29%
Unsure	30	15.63%

Table 10
Customers' effort to use electricity efficiently.

Items	Make an effort to save energy		Do not make an effort to save energy	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Switch the lights off when not in use	168	87.50%	24	12.50%
Use energy saving light bulbs	149	77.60%	43	22.40%
Use energy saving AC	90	46.88%	102	53.12%
Switch of all lights at the end of the day	141	73.44%	51	26.56%
Never leave electrical equipment on standby mode	107	55.73%	85	44.27%
Close external and internal doors	147	76.56%	45	23.44%

The customers' effort to use electricity efficiently by using several techniques of saving energy could also affect their willingness to pay. Table 10 provides insights into the customers' willingness to use electricity efficiently. Most of the respondents indicated that they make efforts to save energy by switching off lights when not in use, closing doors, and not leaving electrical tools unattended. However, the results also indicate that a significant proportion of the respondents (53.12%) do not make an effort to use energy-efficient air conditioners. This finding is noteworthy given that air conditioning is one of the most energy-intensive appliances in the UAE, and its energy consumption can have a considerable impact on the electricity bill.

The results also show that 22.40% of the respondents reported using energy-saving light bulbs, which is consistent with the findings of previous studies that suggest that the adoption of energy-efficient lighting technologies is one of the most effective ways to reduce electricity consumption.

Overall, the results of Table 10 emphasize the need for policies and programs that promote energy-saving behaviors and the adoption of energy-efficient technologies. For instance, incentives, such as subsidies and tax credits on energy efficient appliances can encourage consumers to purchase these appliances, while public education campaigns can promote the benefits of energy-saving behaviors and encourage their adoption.

The respondents were also asked to rank alternatives of raising funds to finance GE projects. Table 11 presents the respondents' perceptions of alternative sources of funding for financing green energy (GE) projects. The results show that a significant majority of the respondents (71.87%) support the idea of raising funds through voluntary increases in electricity bills, while only a minority (28.13%) agree with increasing the electricity bills of all households and businesses in the UAE to finance GE projects.

The relatively low support for increasing electricity bills for all households and businesses to finance GE projects may reflect concerns about the affordability and fairness of such a policy. Energy affordability is a significant concern for many households, particularly those on low incomes and policies that increase energy costs for all consumers can exacerbate energy poverty and inequality.

Overall, the results of Table 11 suggest that policymakers and energy providers should consider a range of funding mechanisms for GE projects, including voluntary contributions and subsidies, to ensure that the costs of financing these projects are distributed fairly and that consumers are willing to support the transition to renewable energy sources.

Table 12 reports respondents' preference on how funds raised from utility bills should be managed. The results show that 72.40% of the respondents prefer that the funds should be collected and managed by a government entity. However, the International Energy Agency (IEA) predicts that private entities will finance 70% of future green energy investments, while the public sector will only contribute 30%. This suggests that there is a need for a better understanding of the role of private entities in financing green energy projects. On the other hand, 27.60% preferred private energy suppliers to collect the funds. This result is consistent with the literature which highlights the importance of government intervention and support in financing and promoting renewable energy projects (e.g., Abdullah *et al*., 2020).

The preference for government management of the funds can be attributed to several reasons. Firstly, customers may view government entities as more reliable and transparent in managing public funds compared to private companies. Secondly, government entities may have a long-term vision and commitment to promoting renewable energy projects as part of their sustainable development agenda. Thirdly, the government may have access to a broader range of resources and funding options compared to private companies.

On the other hand, those who prefer for private energy suppliers to manage the funds may be due to their perception that private companies may have more expertise and experience in developing and managing renewable energy projects. However, this view may be countered by the concern that private companies may prioritize profit over sustainability, which could result in inadequate investment in GE projects.
Overall, the results from Table 12 suggest that customers prefer the government to manage the funds raised from utility bills for financing GE projects. This preference may be attributed to the perceived reliability, long-term vision and commitment, and access to resources of government entities. However, the minority preference for private energy suppliers to manage the funds may be attributed to the perception of their expertise and experience in managing renewable energy projects.

Table 13 presents the results of a survey that investigated the social influence on customers' willingness to pay for green energy projects. The study found that 62.49% of the respondents indicate that they would be willing to pay more for GE if other businesses were also willing to pay more. This finding suggests that social influence plays a crucial role in shaping customers' decision-making regarding the adoption of green energy. In contrast, 15.63% of the respondents reported that they would be less willing to purchase GE if they knew that other businesses were also purchasing them. This finding suggests that social influence could also have a negative impact on the adoption of green energy. Interestingly, 21.88% of the businesses indicated that they would not be influenced by other businesses when deciding whether to purchase renewable energy. These findings highlight the importance of understanding the role of social influence in shaping customer behavior towards green energy.

The study also investigated customers' willingness to pay for green energy projects through a temporary increase in electricity bills. The results show that over half of the firms

Table 11
Customers' perception on the sources of funds to finance green energy projects.

Alternatives	Rank	
	Frequency	Percentage (%)
The additional money could be raised by increasing the electricity bills of all households and businesses in the UAE.	54	28.13%
The additional money could be raised through a voluntary increase on the electricity bills of only those households and businesses in the UAE who are willing to support the investment in renewable energy.	138	71.87%

Table 12
Customers' preference on who should manage funds for green energy projects.

Alternatives	Rank	
	Frequency	Percentage (%)
Green energy utility bills could be collected by the government and used to help fund the construction of more renewable energy projects.	139	72.40%
Green energy utility bills could be collected by private energy suppliers and used by private companies to invest in more renewable energy projects.	53	27.60%

Table 13
Social influence on consumers' willingness to pay for green energy projects.

Alternatives	Rank	
	Frequency	Percentage (%)
My Business would be more interested in purchasing renewable energy if many other businesses were also purchasing renewable energy.	120	62.49%
My Business would not be affected by the behavior of other businesses when deciding whether to purchase renewable energy.	42	21.88%
My Business would be less interested in purchasing renewable energy if many other businesses were also purchasing renewable energy.	30	15.63%

surveyed in the sample are against an increase in electricity bills to finance GE projects. However, 71.87% of the respondents support raising the funds through a voluntary increase in electricity bills. This finding is consistent with the findings of Borchers et al. (2007) who found a negative relationship between willingness to pay and a non-voluntary green energy program.

The study also found that 81.25% of the respondents would be willing to pay a premium if a government proposed the increase in electricity bills. The businesses that are willing to accept an increase in electricity bills claim that they care about the environment (45.31%) and that GE play a significant role in eliminating the dependence on oil and gas (38.02%). These findings are in line with the results reported in Ntanos et al. (2018).

4.4. Correlation analysis

Table 14 presents the correlation between individual business characteristics and WTP variables related to renewable energy investments in the United Arab Emirates (UAE). The matrix provides information on the correlation between each variable, including the overall WTP score which is calculated by summing up the scores for six WTP measures. The overall WTP score ranges from 0 (indicating not willing to pay) to 10 (indicating strong support for renewable energy investments). Description of the variables included in the correlation matrix is provided as an appendix (Appendix 1).

The correlation analysis indicates a negative and significant relationship between the location of the business and WTP2, which measures the willingness to pay for GE investments through an increase in electricity bills. This implies that businesses located in Abu Dhabi, Dubai, and Sharjah are less willing to pay for renewable energy investments compared to other locations in the UAE. This could be because these locations have huge concentration of industries that consume more energy. Thus, due to concerns about increased energy costs such firms are more likely to oppose an increase in utility bills.

According to Karytsas and Theodoropoulou (2014) socio economic factors such as gender, age, education, occupation etc. have statistically significant effects on the level of awareness about GE sources. Education has a positive impact on improving people's knowledge about GE (Karatepe et al., 2012). Knowledge of the GE sources and the ongoing concern of climate change tend to have a positive impact on businesses' WTP for GE sources (Abdullah et al., 2021).

The results reported in Table 14 indicate that age is negatively and significantly associated with WTP3 and WTP5, implying that older businesses are willing to accept a temporary increase in electricity bills and they believe that it is worth to pay more for GE sources than for non-renewable sources compared to new businesses.

In addition, the correlation matrix shows a positive relationship between WTP scores and individual knowledge about renewable energy (KWLDG), as well as climate change awareness (CLIMATE1 and CLIMATE2), and energy efficiency use (USEffecient). This implies that businesses that have better knowledge on the different types of GE sources also tend to understand the impact of climate change on the environment. Such businesses are likely to use energy efficient appliances to save energy and protect the environment, and they are willing to pay more in the short-term with the expectation of energy savings in the future. Furthermore, businesses that are aware of the impact of climate change on the environment are willing to pay more on their electricity bills to support investment in GE projects. However, they prefer the funds for the projects to be managed by a government entity than a private firm (FUNDMGMT). These findings follow Hansla *et al.* (2008) who depict the positive relationship between greater environmental awareness and the use of GE sources. In addition, Ek (2005) report that greater knowledge in renewable energy sources and

Table 14
Correlation matrix

	LOCATION	AGE	GENDER	EMPLY	WTP1	WTP2	WTP3	WTP4	WTP5	WTP6	WTP
LOCATION	1.000										
AGE	-0.039	1.000									
GENDER	0.075	-0.047	1.000								
EMPLY	0.011	0.264***	0.166**	1.000							
WTP1	-0.113	0.013	0.014	0.037	1.000						
WTP2	-0.221***	-0.092	0.032	-0.109	0.130*	1.000					
WTP3	0.001	-0.172**	-0.002	-0.093	0.383***	-0.112	1.000				
WTP4	-0.121	0.096	0.032	0.087	0.081	0.038	0.099	1.000			
WTP5	0.183**	-0.212***	-0.051	-0.075	-0.128	0.013	0.144*	0.065	1.000		
WTP6	0.213***	0.037	-0.028	0.236***	0.116	0.016	-0.028	-0.114	0.195**	1.000	
WTP	0.100	-0.064	0.051	0.026	0.784***	0.370***	0.483***	0.150*	0.316***	0.437***	1.000

	KWLDG	CLIMATE1	CLIMATE2	USEffecient	BillsNow	FUNDMGMT	PEEREffect
KWLDG	1.000						
CLIMATE1	0.184**	1.000					
CLIMATE2	0.246***	0.105	1.000				
USEffecient	0.265***	0.229***	0.069	1.000			
BillsNow	-0.075	0.188*	-0.079	0.219**	1.000		
FUNDMGMT	0.307***	0.089	0.246***	-0.010	-0.192*	1.000	
PEEReffect	0.239***	0.198**	-0.118	0.090	0.024	0.039	1.000
WTP1	0.100	-0.011	0.538***	-0.100	-0.182*	0.430***	-0.001
WTP2	-0.045	-0.073	0.088	0.021	-0.052	0.340***	0.115
WTP3	0.091	-0.088	0.369***	-0.154**	-0.244**	0.157*	-0.168**
WTP4	0.078	0.066	0.130	0.254***	0.052	-0.057	0.096
WTP5	-0.025	0.004	-0.020	-0.032	0.137	-0.120	-0.056
WTP6	-0.101	0.207***	0.090	-0.138*	0.053	-0.023	0.273***
WTP	0.078	0.022	0.487***	-0.091	-0.024	0.319***	0.092

higher educational status tend to positively influence the WTP of customers.

On the other hand, the negative and significant relationship between *BillsNow* and *WTP3* shows that businesses with higher current electricity bills are not willing to accept even a temporary increase in electricity bills to support R&D on GE. However, the analysis suggests that there is a positive relationship between the willingness to pay for renewable energy investments and the perceived effectiveness of fund management (FUNDMGMT), indicating that businesses with

positive perceptions of fund management are more likely to support renewable energy investments, if the funds are managed by government entity.

Overall, the correlation matrix provides insights into the relationships between individual business characteristics and willingness to pay for renewable energy investments in the UAE. The results suggest that the location of the business, current electricity bills, environmental awareness, and perceptions of fund management are important factors that influence the willingness of businesses to support renewable energy investments. These findings have significant implications for policymakers and investors looking to promote renewable energy investments in the UAE and other regions with similar characteristics.

5. Conclusion

The demand for clean, renewable and efficient energy continues to grow globally and particularly so in the United Arab Emirates (UAE), driven by an increasing global warming. With an aim to achieve zero carbon emissions by 2050, the UAE is investing heavily in green energy technologies. This study aimed to investigate the willingness to pay (WTP) of small and medium-sized businesses in the UAE for different sources of green energy.

The study provides several key findings. First, most businesses in the sample were more knowledgeable about solar and wind energy sources compared to other sources of green energy. Second, only about half of the businesses surveyed were willing to compromise their current energy use for the benefit of the environment, while more than half were against an increase in electricity bills or taxes to finance green energy projects. Third, the results indicate that age, knowledge, and current electricity bills are significant determinants of customers' WTP for green energy sources. Older businesses and those with greater knowledge of green energy sources and climate change concerns were found to be more likely to support an increase in energy bills, while businesses currently paying less for energy bills were more likely to accept an increase in electricity bills to support green energy projects. Fourth, although many businesses were initially opposed to an increase in electricity bills or taxes, the majority were willing to pay more if the funds for green energy were managed by a government entity, or if other businesses supported the increase in energy bills. Lastly, the study found that many businesses do not currently use energy-efficient technologies due to high purchase and maintenance costs and lack of knowledge.

The results of this study have important implications for policymakers, businesses and investors who are interested in promoting the adoption of green energy technologies in the UAE. First and foremost, the findings highlight the need for education and awareness programs to increase knowledge about different sources of green energy, particularly geothermal and biomass. By improving understanding of these technologies, policymakers and businesses can encourage the adoption of a more diversified portfolio of green energy sources, which could help to reduce the risk associated with investing in a single technology.

Second, the study highlights the importance of carefully considering the impact of cost on consumers' willingness to pay for green energy. While a significant proportion of businesses are willing to pay more for green energy if the funds are managed by a government entity or if other businesses also support the increase, more than half of the sampled businesses are against an increase in electricity bills or taxes. Policymakers and investors must, therefore, consider the affordability of green energy for businesses and consumers when developing policies and investment strategies to promote the adoption of green energy.

Third, the study underscores the need for careful management of green energy funds to ensure their effectiveness in promoting the adoption of green energy technologies. The findings suggest that businesses are more willing to pay for green energy if they have confidence in the management of the funds. Policymakers and investors must, therefore, ensure that green energy funds are managed transparently and effectively to maintain the support of businesses and consumers. Overall, the findings of this study indicate that knowledge, education, age, current electricity bills and GE fund management are important factors that influence businesses' willingness to pay for green energy in the UAE. By taking these insights into account, policymakers, businesses, and investors can develop more effective strategies to promote the adoption of green energy. Further research in this area could also provide valuable insights into the potential for promoting green energy adoption in other countries with different levels of pollution, government policies, tax rates, and socio-economic factors. Furthermore, investigating the variation in customers' WTP across countries could provide insight into the influence of government policies, tax rates, and other socio-economic factors on the adoption of GE sources.

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References

Abdullah, W.M.Z.B.W., Zainudin W.N.R.A, Ishak, W.W.M., Sulong, F., Zia Ul-Haq, H. M. (2021) Public Participation of Renewable Energy (PPRED) Model in Malaysia: An Instrument Development. *Int. Journal of Renewable Energy Development*, 10(1), 119 -137. https://doi.org/10.14710/ijred.2021.32311

Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes*, 50, 179-211.

Batley, S., Colbourne, D., Fleming, P. and Urwin, P. (2001). Citizen versus consumer: challenges in the UK green power market. *Energy Policy*, 29(6), 479-487. https://doi.org/10.1016/S0301-4215(00)00142-7

Bloomberg New Energy Finance (BNEF). (2021). New Energy Outlook 2021. Retrieved from https://about.bnef.com/new-energy-outlook/

Bollino, C. A. (2009). The Willingness to Pay for Renewable Energy Sources: The Case of Italy with Socio-demographic Determinants. *The Energy Journal*, 30(2), 81-96. https://www.jstor.org/stable/41323234

Borchers, A., Duke, J., & Parsons, G. (2007). Does willingness to pay for green energy differ by source? *Energy Policy*, 35 (6), 3327-3334. https://doi.org/10.1016/j.enpol.2006.12.009

Bujdosó, Z., Patkós, C., Kovács, T., Radics Z., & Baros, Z. (2012). The Social Aspects and Public Acceptance of Biomass Giving the Example of a Hungarian Region. *Int. Journal of Renewable Energy Development*, 1(2), 39-43. https://doi.org/10.14710/ijred.1.2.39-43

Carson, R. T., Flores, N. E., & Meade, N. F. (2001). Contingent Valuation: Controversies and Evidence. *Environmental and Resources Economics*, 19, 173-210. https://doi.org/10.1023/A:1011128332243

De Serres, A., Murtin, F., & Nicoletti, G. (2010). A framework for assessing green growth policies. OECD economics department

working paper series, *Working paper no. 774*. OECD Publishing, Paris. https://doi.org/10.1787/5kmfj2xvcmkf-en

Diamond, P. A., & Hausman, J. A. (1994). Contingent Valuation: Is Some Number Better than No Number? *Journal of Economic Perspectives*, 8 (4), 45-64. https://doi.org/10.1257/jep.8.4.45

Diaz-Rainey, I., & Ashton, J. (2007). Characteristics of UK consumers' willingness to pay for GE. *Working paper. Social Sciences Research Network*.

Ek, K. (2005). Public and private attitudes towards "green" electricity: the case of Swedish wind power. *Energy Policy*, 33 (13), 1677–1689. https://doi.org/10.1016/j.enpol.2004.02.005

Eleftheriadis, I. M., & Anagnostopoulou, E. G. (2015). Identifying barriers in the diffusion of renewable energy sources. *Energy Policy*, 80, 153–164. https://doi.org/10.1016/j.enpol.2015.01.039

Fielding, K. S., McDonald, R., & Louis, W. R. (2008). Theory of planned behavior, identity, and intentions to engage in environmental activism. *Journal of Environmental Psychology*, 28(4), 318-326. https://doi.org/10.1016/j.jenvp.2008.03.003

Ghosh, S., & Nanda, R. (2010). Venture capital investment in the clean energy sector. Harvard Business School Working Paper No. 11-020. https://www.hbs.edu/faculty/Pages/item.aspx?num=46919

Grubler,A. (2012). Energy transitions research: insights and cautionary tales. *Energy Policy*, 50, 8–16. https://doi.org/10.1016/j.enpol.2012.02.070

Halder, P., Pietarinen, J., Havu-Nuutinen, S., & Pelkonen, P. (2010).Young citizens' knowledge and perceptions of bioenergy and future policy implications. *Energy Policy*, 38(6), 3058–3066. https://doi.org/10.1016/j.enpol.2010.01.046

Hansla, A., Gamble, A., Juliusson, A., & Gärling, T. (2008). Psychological determinants of attitude towards and willingness to pay for green electricity. *Energy Policy*, 36(2), 768–774. https://doi.org/10.1016/j.enpol.2007.10.027

Hussain, M. Z. (2013). Financing renewable energy options for developing financing instruments using public funds. Washington DC, World Bank. https://documents1.worldbank.org/curated/en/196071468331818432/pdf/765560WP0Finan00Box374373B00PUBLIC0.pdf

IAEA (2020). Annual report 2020. International Atomic Energy Agency, 2020. Accessible at https://www.iaea.org/opic/annual-report-2020 .

IEA (2020). Global Energy Review 2020. The impacts of the Covid-19 Crisis on Global Energy Demand and CO2 Emissions, *International Energy Agency*, Paris, France. https://doi.org/10.1787/a60abbf2-en.

IEA (2021). World energy outlook 2021 report, International Energy Agency. Accessible at www.iea.org/weo .

IRENA (2019). GCC Renewable energy Market analysis, Policy paper, International Renewable energy agency. https://www.irena.org/publications/2019/jan/renewable-energy-market-analysis-gcc-2019

Jacobsson, R., & Jacobsson, S. (2012). The emerging funding gap for the European Energy Sector – will the financial sector deliver? *Environmental Innovations and Societal Transitions*, 5, 49–59. https://doi.org/10.1016/j.eist.2012.10.002

Kalamova, M., Kaminker, C., & Johnstone, N. (2011). Sources of finance, investment policies and plant entry in the renewable energy sector, *OECD Environment Working Paper* No. 37. Accessible at http://dx.doi.org/10.1787/5kg7068011hb-en .

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

Karytsas, S., & Theodoropoulou, H. (2014). Socioeconomic and demographic factors that influence publics' awareness on the different forms of renewable energy sources. *Renewable Energy*, 71, 480–485. https://doi.org/10.1016/j.renene.2014.05.059

Khajepour, S., & Ameri, M. (2020). Techno-economic analysis of using three fresnel solar fields coupled to a thermal power plant for different cost of natural gas. *Renewable Energy*, 146, 2243-2254. https://doi.org/10.1016/j.renene.2019.08.075

Khambalkar, V. P., Katkhede, S. S., Dahatonde, S., Korpe, N., & Nage, S. (2010). Renewable energy: An assessment of public awareness. *International Journal of Ambient Energy*, 31(3), 133–142. https://doi.org/10.1080/01430750.2010.9675112

Knapp, L., O'Shaughnessy, E., Heeter, J., Mills, S., & DeCicco, J. M. (2020). Will consumers really pay for green electricity? Comparing stated and revealed preferences for residential programs in the United States. *Energy Research & Social Science*, 65, 101457. https://doi.org/10.1016/j.erss.2020.101457

Kwak, S.-Y., Yoo, S.-H., & Kim, C.-S. (2013). Measuring the Willingness to Pay for Tap Water Quality Improvements: Results of a Contingent Valuation Survey in Pusan. *Water*, 5(4), 1638–1652. https://doi.org/10.3390/w5041638

Ma, C., Rogers, A. A., Kragt, M. E., Zhang, F., Polyakov, M., Gibson, F., Chalak, M., Pandit, R., & Tapsuwan, S. (2015). Consumers' Willingness to pay for renewable energy: A meta-regression analysis. *Resource Energy Economics*, 42, 93-109. https://doi.org/10.1016/j.reseneeco.2015.07.003

Lee, T. M., Markowitz, E. M., Howe, P. D., Ko, C. Y., & Leiserowitz, A. A. (2015). Predictors of public climate change awareness and risk perception around the world. *Nature Climate Change*, 5, 1014-1020. https://doi.org/10.1038/nclimate2728

Mazzucato, M., & Semieniuk, G. (2018). Financing renewable energy: Who is financing what and why it matters. *Technological Forecasting & Social Change*, 127, 8-22. https://doi.org/10.1016/j.techfore.2017.05.021

McInerney, C. & Bunn, D. W. (2019). Expansion of the investor base for the energy transition. *Energy policy*, 129, 1240 – 1244. https://doi.org/10.1016/j.enpol.2019.03.035

Mitchell, R., & Carson, R. (1989). Using Surveys to Value Public Goods: the Contingent Valuation Method, *Natural Resources Journal*, 29(3), 900–902. http://www.jstor.org/stable/24883508 .

Muhammad, I., Shabbir, M. S., Saleem, S., Bilal, K., & Ulucak, R. (2021). Nexus between willingness to pay for renewable energy sources: evidence from Turkey. *Environmental Science and Pollution Research*, 28, 2972–2986. https://doi.org/10.1007/s11356-020-10414-x

Ntanos, S., Kyriakopoulos, G., Chalikias, M., Arabatzis, G., & Skordoulis, M. (2018). Public Perceptions and Willingness to Pay for Renewable Energy: A Case Study from Greece. Sustainability, 10(3), 687. https://doi.org/10.3390/su10030687

OECD (2016). Green Investment Banks: Scaling up Private Investment in Low-Carbon, Climate-Resilient infrastructure, OECD Green Finance and Investment Series, OECD, Paris. https://www.oecd.org/environment/cc/green-investment-banks-9789264245129-en.htm

Panzone, L. A. (2013). Saving money vs investing money: do energy ratings influence consumer demand for energy efficient goods? Energy Economics, 38, 51-63. https://doi.org/10.1016/j.eneco.2013.03.002

Pleeging, E., Van Exel, J., Burger, M. J., & Stavropoulos, S. (2021). Hope for the future and willingness to pay for sustainable energy. *Ecological Economics*, 181, 106900. https://doi.org/10.1016/j.ecolecon.2020.106900

Polinori, P. (2009). Italians, Renewable Energy Sources and EU's Climate Vision, International Association for energy economics forum, 2nd quarter. https://www.iaee.org/en/publications/newsletterdl.aspx?id=64

Popp, D. (2010). Innovation and climate policy. *Annual Review of Resource Economics,* 2, 275-298. https://doi.org/10.1146/annurev.resource.012809.103929

Rowlands, I., Scott, D., & Parker, P. (2003). Consumers and green electricity: profiling potential purchasers. *Business Strategy and the Environment,* 12(1), 36-48. https://doi.org/10.1002/bse.346

Sachs, J. D., Woo, W. T., Yoshino, N., & Taghizadeh-Hesary, F. (2019). Why Is Green Finance Important? ADBI Working Paper 917. Tokyo, Asian Development Bank Institute. https://www.adb.org/publications/why-green-finance-important .

Said, Z., Alshehhi, A., & Mehmood, A. (2018). Predictions of UAE's Renewable Energy Mix in 2030. *Renewable Energy*, 118, 779-789. https://doi.org/10.1016/j.renene.2017.11.075

Sardianou, E., & Genoudi, P. (2013). Which factors affect the willingness of consumers to adopt renewable energies? *Renewable Energy*, 57, 1–4. https://doi.org/10.1016/j.renene.2013.01.031

Sbia, R., Shahbaz, M., & Hamdi, H. (2014). A contribution of foreign direct investment, clean energy, trade openness, carbon emissions and economic growth to energy demand in UAE. *Economic Modelling,* 36, 191–197. https://doi.org/10.1016/j.econmod.2013.09.047

Stern, N. (2015). Why Are We Waiting? The Logic, Urgency, and Promise of Tackling Climate Change, MIT, Press. https://mitpress.mit.edu/9780262529983/why-are-we-waiting/

Stirling, A. (2014). Transforming power: Social science and the politics of energy choices. *Energy Research and Social Science*, 1, 83–95. https://doi.org/10.1016/j.erss.2014.02.001

Szakály, Z., Balogh, P., Kontor, E., Gabnai, Z., & Bai, A. (2021). Attitude toward and Awareness of Renewable Energy Sources: Hungarian Experience and Special Features. Energies, 14 (1), 22. https://doi.org/10.3390/en14010022

The Climate Bonds Initiative (2018). Bonds and Climate Change. The State of the Market 2018. https://www.climatebonds.net/files/reports/cbi_sotm_2018_final_01k-web.pdf

Toufic, M., Daniel, G. S., & Nazli, C. (2011). Renewable energy in Abu Dhabi: opportunities and challenges. *Journal of Energy Engineering*, 137, 169–76. http://dx.doi.org/10.1061/(ASCE)EY.1943-7897.0000042

Veugelers, R. (2012). Which policy instruments to induce clean innovating? *Research Policy*, 41 (10), 1770 – 1778. https://doi.org/10.1016/j.respol.2012.06.012

Whitehead, J. C., & Cherry, T. L. (2007). Willingness to pay for a GE program: A comparison of ex-ante and ex-post hypothetical bias mitigation approaches. *Resource and Energy Economics*, 29(4), 247-261. https://doi.org/10.1016/j.reseneeco.2006.10.001

Wiser, R. H. (2007). Using contingent valuation to explore willingness to pay for renewable energy: A comparison of collective and voluntary payment vehicles. *Ecological Economics*, 62(3-4), 419-432. https://doi.org/10.1016/j.ecolecon.2006.07.003

World Bank (2011). Financing renewable energy options for Developing Financing Instruments using Public Funds", a policy paper. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/196071468331818432/financing-renewable-energy-options-for-developing-financing-instruments-using-public-funds

Zinder, H. A. (2016). Finance Guide for Policy-Makers. Renewable Energy, Green Infrastructure. https://ndcpartnership.org/toolbox/finance-guide-policy-makers-renewable-energy-green-infrastructure

Zografakis, N., Sifaki, E., Pagalou, M., Nikitaki, G., Psarakis, V., & Tsagarakis, K. P. (2010). Assessment of public acceptance and willingness to pay for renewable energy sources in Crete. *Renewable and Sustainable Energy Reviews*, 14(3), 1088–1095. https://doi.org/10.1016/j.rser.2009.11.009

Appendix 1

Description of variables

Variables	Symbol	Variable measure
Location	*LOCATION*	1 if the location of the business is in Abu Dhabi, Dubai or Sharjah, otherwise 0
Age	*AGE*	The number of years since the business is established
Gender	*GENDER*	1 if the owner is male, otherwise 0
Employment	*EMPLY*	1 if the business has more than 10 employees, otherwise 0.
Knowledge	*KNOWLEDGE*	Average knowhow score ranging from 0 (very poor) – 5(Excellent) on a list of different types of green energy sources.
Climate change	*CLIMATE1*	1 if the respondent is aware about a climate change
Climate change perception	*CLIMATE1*	Average score ranging from 0 (strongly disagree) – 5(strongly agree) on a list of questions assessing the perception on the impact of climate change.
Energy efficient use	*USEFFECIENT*	1 if the business uses energy efficient appliances, otherwise 0.
Electricity bills	*BillNow*	1 if the bill per month is up to 1000 AED, 2 if the bill is between 1000 and 3000 AED, 3 if the bill is between 3000 and 8000 AED, 4 if the bill is between 8000 and 15000 AED and 5 if the monthly bill is at least 15,000 AED.
Fund management	*FUNDMGMT*	1 if the business prefers a government, 0 if it prefers a private entity, should manage the funding for renewable energy investment.
Peer effect	*PEEREFFECT*	1 if the business prefers to use green energy sources when other similar businesses are using green energy sources, otherwise 0.
Willingness to pay for green energy sources	*WTP1*	An average score ranging from 0 (strongly disagree) – 5(strongly agree) on three questions measuring the business's willingness to pay more for electricity generated from green sources.
Willingness to contribute to green energy financing	*WTP2*	1 if the business agrees that funding should be raised through raising electricity bills, otherwise 0.
Willing to pay for research and development on green energy	*WTP3*	1 willing to pay a temporary increase in electricity bills to fund research and development on green energy, otherwise 0.
Willingness to support government investment in green energy	*WTP4*	1 willing to accept an increase in electricity bills to support the investment in green energy, otherwise 0.
Worth of paying more for green energy sources	*WTP5*	1 if the business believes that paying more on electricity bills from green energy source is worth, otherwise 0.
Willingness to pay more today for future cost savings	*WTP6*	1 if the business agrees paying more today with the expectation of saving energy costs in the future, otherwise 0.
Overall willingness to pay for green energy sources	*WTP*	The sum of the scores for *WTP1* to *WTP6*, ranging from 0 (neither willing to pay an increase in bills nor willing to support any investment in green energy) and 10 (strongly supports an increase in bills and investment in green energy sources).