


## Article

# Public Attitudes toward Renewable Energy in Croatia

Sunčana Slijepčević \*  and Željka Kordej-De Villa

The Institute of Economics, Zagreb, 10000 Zagreb, Croatia; zkordej@eizg.hr

\* Correspondence: sslijepcevic@eizg.hr

**Abstract:** Renewable energy sources (RES) play a key role in achieving the European Union's energy and climate objectives. As a member of the European Union, Croatia has committed to adopting European Directive 2009/28/EC, a directive on promoting the use of RES. Croatia shows good potential for the use of different types of RES. In the period 2009–2019, the share of renewable energy in energy consumption increased from 23.6 to 28.5 percent. The Croatian energy strategy aims to increase the national share of renewable energy to at least 32 percent by 2030. Acceptance and public support are essential for renewable energy to be introduced into energy policy and particularly to encourage renewable energy implementation in the residential sector. The purpose of the paper is to explore the public perception of renewable energy and citizens' willingness to pay for the use of RES. Data were collected through a 2021 survey of citizens 18 years and older. The survey results show a low level of implementation of RES technology in the residential sector; more than 80 percent of respondents did not use any sources of renewable energy in their households. Results related to respondents' knowledge of different sources of renewable energy suggest they have the most knowledge of solar, wind, and hydropower energy. Respondents believe that combating climate change, reducing dependency on energy imports, reducing environmental impacts, and improving health are the most important benefits of RES implementation. The survey reveals general support for RES among respondents; almost 89 percent of them would purchase renewable energy from local suppliers. In addition, 79 percent of survey participants were willing to pay for the introduction of RES technology into their households. The research shows that environmental concerns are the primary reason for citizens' higher willingness to pay for RES.

**Keywords:** renewable energy; economic impacts; environmental impact; citizens; green economy; knowledge; behavior; households; willingness to pay; survey



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## 1. Introduction

The greenhouse effect is the main cause of atmospheric temperature increases on earth [1]. Greenhouse gases can be produced naturally; however, human activities are the most important contributor to greenhouse gas emissions and global warming. The Kyoto Protocol of 1997 and the Paris Agreement of 2015 were introduced under the auspices of the United Nations Framework Convention on Climate Change and aimed to reduce human impacts on the climate. The Paris Agreement is a legally binding international treaty adopted by 196 parties. Its main goal is to strengthen the global response to climate change by keeping the global temperature rise in check. Article 2 of The Paris Agreement states its goal is “to hold the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels”. In furtherance of this goal, the agreement provides financial, technology, and capacity-building support for the most vulnerable countries [2].

The European Union (EU) is one of the major international actors on climate policy [3,4]. To find solutions to the climate problems, the EU formulated a long-term Strategy [5] for achieving net-zero greenhouse gas emissions by 2050, and it is seen as the European contribution to fulfilling the Paris Agreement temperature objectives.

Renewable energy sources (RES) will play a key role in achieving the EU's energy and climate objectives. According to Directive 2009/28/EC [6], "energy from renewable sources means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases." There is scientific and general political understanding that the consumption of fossil fuels must be eliminated to mitigate and stop climate change. RES are available within the EU and are cost-competitive with fossil fuels. Across the EU, the share of renewable energy in gross final energy consumption has increased in recent years from 12.6 percent in 2009 to 18.8 percent in 2019 [7]. The five EU countries with the largest share of their energy coming from RES (based on 2019 Eurostat data) are Sweden (56.4 percent), Finland (43.1 percent), Latvia (41 percent), Denmark (37.2 percent), and Austria (33.6 percent). In Croatia, the share of RES in gross final energy consumption has increased from 23.6 percent in 2009 to 28.5 percent in 2019 [7].

The literature review shows that there are various dimensions of analysis of RES, including its socioeconomic, environmental, and technical aspects. It is beyond the scope of this paper to present literature in the technical field, so we present here a review of a brief selection of the most recent relevant literature analyzing the socioeconomic and environmental benefits of RES.

There is a growing body of literature that addresses the importance of RES in the energy transition to climate-neutral societies [8–13]. The numerous economic benefits of RES implementation are one of the main strands of recent research. Job creation, new manufacturing opportunities, and the positive contribution of RES to economic growth are in the focus of the literature examining its economic impact [14–21]. Numerous studies explore the complex relations between renewable energy and sustainable development goals, as well as the impact of development level (measured by the Human Development Index) on energy consumption [22–26]. Research on environmental impact and quality of life is mostly focused on local and regional sustainability impacts [27–31]. The introduction of RES into energy policy requires informed citizens, public awareness, and willingness to pay (WTP) for or support RES projects and is one of the most well-researched RES topics [32–39]. Recently, citizen-financed energy communities have become the focus of European research [40–43].

Croatian researchers have also contributed to the literature on the economic impacts of RES. There is research on specific renewable sources and barriers for their wider introduction, such as wind energy [44–47], solar energy [48], and biomass [49], as well as research into the economic impacts of RES in general [50,51]. The profitability and market-related aspects of RES projects are also analyzed in various studies [45,46,52–54]. So far, the research on attitudes and knowledge of energy topics in Croatia has mainly addressed general issues related to the production and consumption of traditional energy sources, while renewable energy has received much less attention [55].

In reviewing the literature, we identified just one survey in Croatia on knowledge and attitudes towards RES and WTP for renewable energy. The research was performed in 2003 and published in 2004 [55,56]. The survey included self-assessment questions and an objective test [56], and questions on WTP for electricity from RES [55]. The aim of this paper is to investigate the situation in Croatia related to RES implementation in the residential sector, as well as citizens' perceptions of the economic and environmental effects of RES and their WTP for greater consumption of RES in Croatia.

Social acceptance and public support are prerequisites for the introduction of RES into energy policy [57], so research results may be useful for further energy planning.

The paper is structured as follows. The EU and Croatian legal and policy context, as well as the renewable energy sector in Croatia from 2009–2019, are introduced in Section 2. The methodology of research and data sources are presented in Section 3, and the results of the survey are discussed in Section 4. Finally, Section 5 presents the conclusions and suggestions for further research.

## 2. Renewable Energy—EU and Croatian Context

### 2.1. EU and Croatian Legal and Policy Context

To mitigate the climate change process, in December 2019, the EU adopted a European Green Deal [58]. This new development strategy aims to transform the EU into a resource-efficient and competitive economy where economic growth is decoupled from resource use, and there are no net emissions of greenhouse gases by 2050.

The EU policy related to increasing RES in the energy mix of EU members is based on Directive 2009/28/EU European Commission [6]. The RES share in direct gross consumption at the EU level should amount to at least 20 percent in 2020. The revised Renewable Energy Directive (2018/2001/EU) [59] entered into force in December 2018 as part of the Clean Energy for all Europeans package, which sets out a very ambitious decarbonization plan [5]. The revised Renewable Energy Directive also introduced the concept of energy communities in the form of citizen and renewable energy communities. The main goal of these recent policy documents is to facilitate energy transition, which requires an economic and social transformation that encompasses all economic sectors.

EU member states are required to formulate long-term national strategies for greenhouse gas emissions reduction to achieve emissions reduction targets under the Paris Agreement [2]; the overall goal is “to improve the quality of life of citizens, protect the environment and provide for jobs and growth” [5] (p. 6). The Renewable Energy Directive sets rules for the EU to achieve its 32 percent renewables target by 2030. It also includes new provisions to enable citizens to play an active role in the implementation of renewable energy communities.

In July 2021, the Commission proposed a further revision as part of the package to deliver on the European Green Deal [58]. The goal of the revision is to reduce greenhouse gas emissions by 55 percent by 2030, and the proposed overall RES target is increased to 40 percent. By 2040, EU countries are expected to achieve 100 percent of their energy supply from RES. Although meeting the 2030 goals seem likely, the 2040 objective looks uncertain due to significant financial barriers. To assist the less successful EU members in their energy transition, in September 2020, the Commission established the Modernization Fund [60]. The Just Transition Mechanism is intended to provide financial support and technical assistance to those countries that are most affected by the transition towards a green economy. According to the plan, at least EUR 65–75 billion must be mobilized over the period 2021–2027 to support the implementation of the EU Green Deal [58].

As a member of the EU, Croatia has committed to the European climate-energy package, which also includes Directive 2009/28/EC [6]. By accepting the Directive, Croatia has accepted increasing its share of RES in energy consumption and production.

Here we briefly present the most relevant policy documents dealing with RES and climate change. The Energy Strategy of the Republic of Croatia until 2030 and with a view to 2050 [61] foresees a much higher share of RES in energy production, higher energy efficiency, and a reduction in greenhouse gas emissions. In the period up to 2030, the plan is to increase the share of RES in consumption to at least 32 percent with a potential increase of up to 36.4 percent, while by 2050, this share should be 65 percent. The national renewable energy action plan [62] further elaborates objectives for specific types of RES. In addition to the energy strategy and national action plan, the Low-Carbon Development Strategy of the Republic of Croatia until 2030 with a view to 2050 [63] defines the framework of the energy transition, which will result in economic growth with less energy consumption. In all scenarios, the energy share from RES increases. In the period until 2030, the expected share of energy from RES is 36.6 percent, which is higher than the EU target. This will allow the use of additional mechanisms from the amended regulations guaranteeing the origin of electricity [64], such as the possibility of exporting green energy certificates for energy from renewable sources. The increase in the energy share from RES is a consequence of increases in the share of electricity consumption and production of electricity from RES and a decrease in total energy consumption. In the period until 2040, the expected energy share from RES, depending on the scenario, increases from 44.1 to 45.8 percent, while in

the period until 2050, the expected energy share from RES increases from 53.2 percent to 65.6 percent [63].

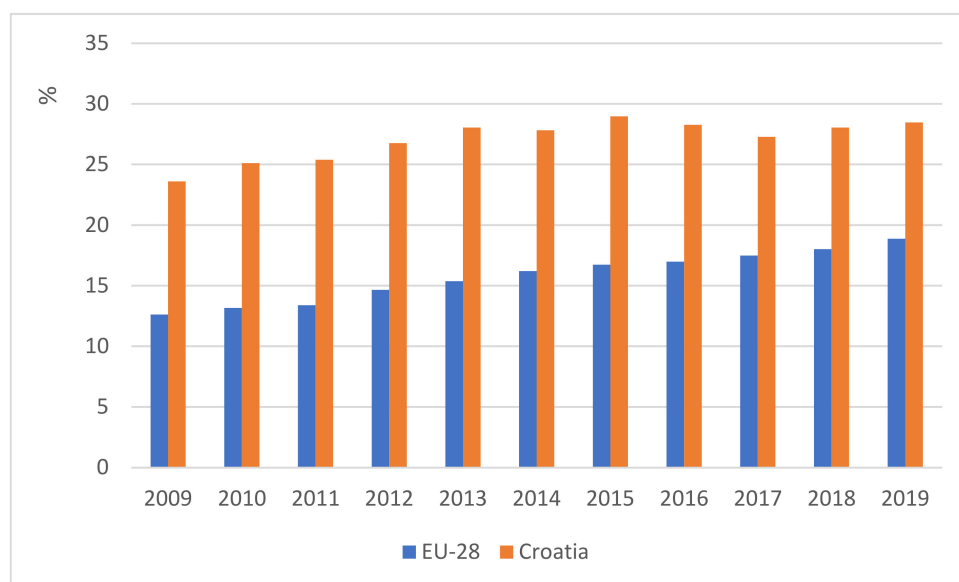
Croatia's Integrated National Energy and Climate Plan for the period 2021–2030 [65] furthers the objectives of the Energy Union and contributes to the achievement of the Sustainable Development Goals.

The national Energy Strategy sets out the legislative and institutional framework for the RES sector. In addition to the Act on Energy [66], Act on Electrical Energy Market [67], and Act on Renewable Energy Sources and High-Efficiency Cogeneration [68], there are many by-laws that regulate the production, distribution, and financial issues related to RES. While the Ministry of Economy and Sustainable Development is responsible for the development and sustainability of the entire energy sector, the Croatian Energy Market Operator (HROTE) is responsible for the organization of the gas and electrical energy markets. Local (regional) authorities can also establish agencies for monitoring, planning, and fostering energy efficiency as well as for the development of RES on their territories.

## 2.2. Renewable Energy Sector in Croatia in 2009–2019

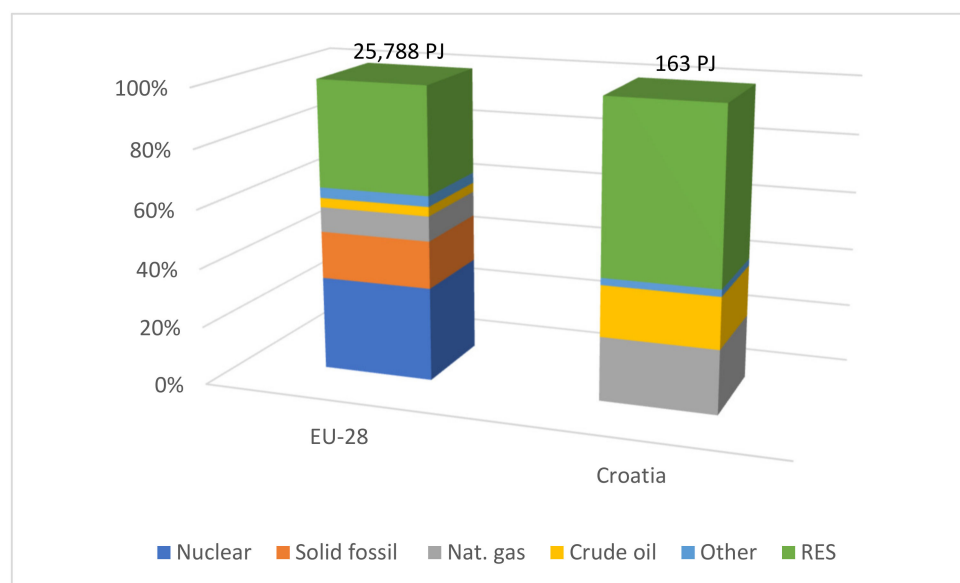
RES has an important role in the achievement of energy-strategy objectives. There are several satisfactory natural possibilities for the use of RES in Croatia for all types of resources—sun, wind, water potential, and input for biomass and biogas. To describe the situation in Croatia, we use three indicators: the share of energy from RES in the gross final energy consumption, the share in the total primary energy production, and the structure of RES use in electricity generation.

As presented in Figure 1, in the period 2009–2019, the share of RES in consumption has grown both in the EU-28 and in Croatia. In the EU-28, the share grew from 12.6 percent in 2009 to 18.9 percent in 2019. In Croatia, the share of RES in consumption increased from 23.6 percent in 2009 to 28.5 percent in 2019.



**Figure 1.** Overall share of energy from RES for EU-28 and Croatia, 2009–2019. Source: Authors' elaboration based on [7].

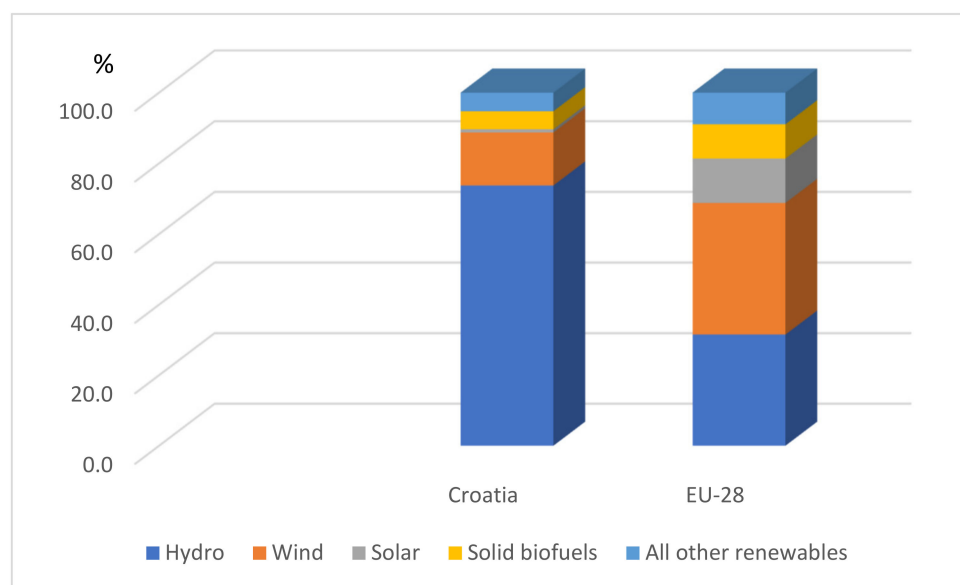
Figure 2 presents production of primary energy in Croatia and EU. In the period 2009–2019, the production of primary energy in the EU decreased 7.9 percent (from 28,011 PJ in 2009 to 25,788 PJ in 2019). Such development could be explained by growing energy efficiency and efforts to decarbonize the economy and energy sector. The most substantial share in total primary energy production in the EU in 2019 was RES, with 36.5 percent.



**Figure 2.** Production of primary energy in Croatia and EU in 2019. Source: Authors' elaboration based on [7].

In the period 2009–2019 in Croatia, primary energy production decreased from 208 PJ to 163 PJ. The RES share in total primary production in 2019 was much higher in Croatia than in the EU and amounted to almost 59 percent [7].

The electricity generation by RES is presented in Figure 3. In 2019 in Croatia, 73.7 percent of electricity was generated by hydropower, 15 percent was generated by wind, while solid biofuels and all other renewables participated with 5.1 and 5.3 percent, respectively. In electricity generation, solar power participated with less than 1 percent. In the EU-28, the structure is different. Hydropower contributes to electricity generation with 31.5 percent, wind power with 37.3, solar with 12.6, solid biofuels with 9.7, and all other renewables with 9 percent.



**Figure 3.** Electricity generation from RES in 2019. Source: Authors' elaboration based on [7].

### 3. Methods

Data for this research were collected through a survey of citizens older than 18 years. The questionnaire consisted of two parts. The first part of the questionnaire consists of



questions about the respondent's socio-demographic characteristics and their knowledge of RES. The second part consists of questions that measure the citizens' attitudes to renewable energy and their WTP for the use of renewable energy. More concretely, the questions reveal respondents' knowledge of RES and its use, attitudes on economic and other impacts of RES, WTP for the use of renewable energy, and their participation in the fight against climate change. In the questionnaire we used the 5-point Likert scale. According to Mattel and Jacoby [69] there are no significant differences in the proportion of the scale used between questionnaires with different number of scale points. The list of all questions is presented in the Table A1 in the Appendix A.

The question related to knowledge about RES reflects respondents' subjective evaluation of their knowledge about the different RES sources. The most widely used renewable sources in Croatia are wind power, solar power, hydropower, geothermal energy, and biomass. Therefore, we select these sources for self-assessment, although European Directive 2009/28/EC includes additional sources (aerothermal, ocean energy, landfill gas, sewage treatment plant gas, and biogases).

Six questions in the survey elicit respondents' views on the environmental, economic, and health impacts of the use of renewable energy and enable us to analyze their awareness of the importance of increasing the use of renewable energy. The respondents were asked to rate the influence of renewable energy on economic growth, job creation, air and water pollution, dependence on energy imports, and household expenditure on energy and health.

The survey also explored respondents' WTP for energy from renewable sources in the household and asked what monthly amount in increased electricity charges the respondent would agree to if the energy came from renewable sources. To be able to analyze the differences in respondents' WTP for the use of renewable energy, the survey also included questions concerning the respondents' current behavior in combating climate change and their willingness to change their behavior. Thus, respondents were asked if they were taking measures to combat climate change. The respondent's willingness to change behavior is considered greater if they would buy energy from renewable sources in the hypothetical situation that a local supplier offers them the opportunity to purchase 100 percent renewable energy, and if they would, with a subsidy, install a solar panel or other renewable energy technology in the yard or roof of the house or multi-family building in which they live.

The findings in the literature show that socio-demographic factors can influence citizens' awareness of climate change and their pro-environmental behavior [70–73]. However, there is no clear picture of the relationship between support for RES and different socio-demographic variables. One study reveals [74] that in the United Kingdom, older respondents show lower support for RES, while Australian research found that support is stronger among younger respondents [75]. Results of some Norwegian national studies show that the level of support is higher in younger and older cohorts [32]. The analysis of Dlamini et al. (2021) shows that employment status is a predictor of environmental attitudes. Socio-demographic factors can have a significant impact on citizens' attitudes and increase awareness of climate change. Since the opinions in the literature are inconclusive about the factors that have this influence, we included in the survey questions about the age, gender, level of education, employment status, and place of residence of respondents. Climate change has a different impact on RES in different parts of Croatia, and the most significant impact is expected on RES in the Adriatic region [76]. Therefore, we included the region as an additional variable in the analysis of differences in attitudes.

After the development of the questionnaire and prior to conducting the final survey, we conducted a pilot test with a sample of ten respondents to test the clarity of the questions and identify possible problems and ambiguities encountered while completing the survey. The final survey was conducted in 2021. A total of over 3500 surveys were sent by email, and the response rate was 13.4 percent. As noticed in the literature, the response rate to surveys depends on many factors and, despite the development of internet technology, the

response rate for email surveys is usually lower than for those conducted by telephone or through personal interviews or using paper surveys [77,78]. Due to the many factors that influence the response rate, there is no unique response rate considered generally acceptable as the threshold; surveys with a low response rate are also able to accurately reflect attitudes in the population [79,80]. The survey was conducted using the LimeSurvey tool [81], which collects anonymous responses. In addition to descriptive statistics, we conducted independent sample t-tests and chi-squared tests. We applied the chi-squared tests to estimate the differences in respondents' willingness to pay for use of renewable energy in their households according to the different variables from the survey which reflect the respondents' attitudes on the benefits of RES, as well as their willingness to change their behavior and use renewable energy. The mean differences according to gender, employment status, type of residence facility, use of RES, and combating climate change were tested using t-tests. Therefore, we statistically tested the existence of mean differences in willingness to pay for renewable energy between male and female respondents, employed respondents and those with other employment status, those living in houses and those living in multi-family houses, respondents who use RES and those who do not use RES, and respondents who are actively involved in combating climate change and those who are not. The results were analyzed using the statistical program SPSS Statistics 23.

#### 4. Results

The distribution of respondents is set out in Table 1 and shows that 46.7 percent of the respondents are from Continental Croatia, 28.6 percent from Adriatic Croatia, and the rest from the city of Zagreb. Most respondents have a tertiary education, while 13.7 percent have at least a secondary education and 14.1 percent have a post-graduate education. Over half of the respondents are females, and most of the respondents are employed.

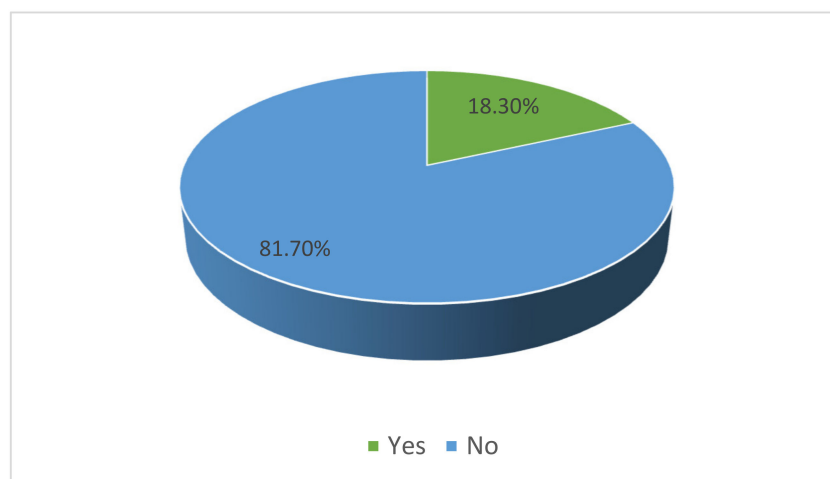
**Table 1.** Distribution of sample,  $N = 473$ .

Distribution of Sample, Percent		
Region	Adriatic Croatia	28.6
	Continental Croatia	46.7
	City of Zagreb	24.7
Gender	Female	67.3
	Male	32.7
Age	18–29	18.1
	30–39	19.8
	40–49	25.4
	50–59	24.4
	60+	12.3
Education	Secondary education or lower	13.7
	Tertiary education	66.6
	Post-graduate education	14.1
Employment status	Employed	80.3
	Student	11.4
	Other	5.9
Type of residence facility	Multi-family building	38.0
	House	62.0

Source: authors' research.

Over 80 percent of respondents do not use any RES in their households (Figure 4), indicating a low level of RES-technology use in households in Croatia. For comparison, a

Greek study indicates that in Greece, around 40 percent of households do not use RES [82]. The Piekut research [83] compares the household sector RES consumption in absolute terms across EU countries and shows that Croatia is in 14th place in terms of RES consumption in 2019. However, along with Portugal, Lithuania, and Slovenia, it is also one of the countries where RES consumption in the residential sector is decreasing.



**Figure 4.** Use of RES technology in the households. Source: authors' research.

Table 2 presents respondents' self-evaluation of their knowledge of RES. The results indicate that citizens have the highest level of knowledge about solar, wind, and hydropower energy. Thus, 56.7 percent of respondents estimate that they have at least a good knowledge about solar energy, while 43.0 percent of respondents say the same for wind power energy and geothermal energy. The self-evaluated level of knowledge about geothermal energy and biomass is much lower. Of the respondents, 15.4 percent admit that they have no knowledge of biomass, and 11.2 percent say they have no knowledge of geothermal energy; this is consistent with 2004 findings for Croatia [56]. Compared to the results of the survey conducted in Greece [82], Croatian citizens estimate a lower level of knowledge about solar power energy, similar to that for wind power and a higher level of knowledge of hydropower, geothermal energy, and biomass. In the Greek survey [82], there is no category for people who declare they have no knowledge of RES, but there is a large number of citizens in both countries who rate their knowledge about geothermal energy and biomass as poor.

**Table 2.** Knowledge of respondents about RES.

	Nothing at All	Poor	Average	Good	Excellent
Wind power	2.8	12.3	41.9	32.2	10.8
Solar power	1.1	7.8	34.5	41.4	15.3
Hydropower	4.1	20.4	32.5	31.5	11.5
Geothermal energy	11.2	35.6	27.4	19.4	8.3
Biomass	15.4	32.0	26.8	17.5	8.2

Source: authors' research.

Table 3 shows respondents' attitudes toward the impacts of RES. The respondents see the main benefit of using renewable energy as fighting against climate change, reducing the dependency on energy imports, reducing air and water pollution, and improving health. In addition, most of the respondents see the benefit of using renewable energy in encouraging economic growth. However, according to respondents, renewable energy cause greater benefits to society than to their household. Thus, more than half of the respondents believe



that the use of renewable energy in their households will not lead to a reduction in their energy expenditure.

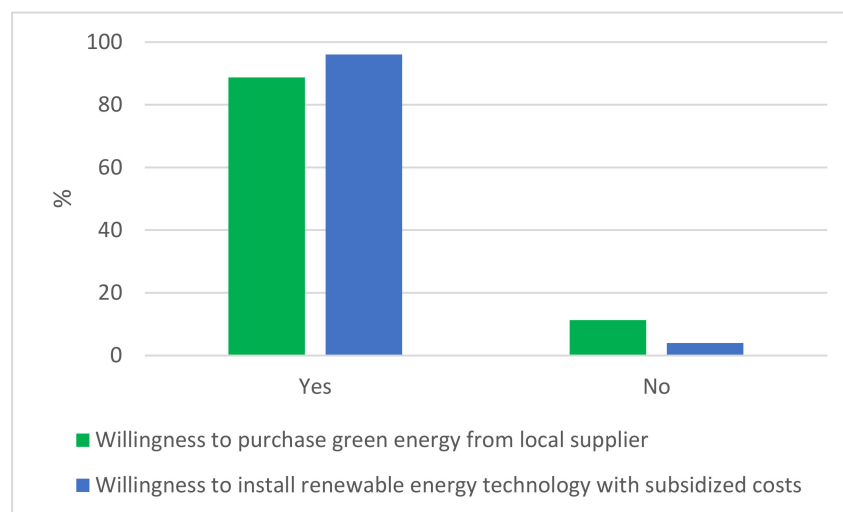
**Table 3.** Impacts of RES.

	Mean	Std. Deviation
Economic growth	4.51	1.05
Job creation	3.75	1.29
Value of reduced air and water pollution	4.67	0.95
Reducing the dependence on energy imports	4.61	1.04
Reducing household energy expenses	2.36	1.62
Fighting against climate change	4.67	0.97
Health benefits	4.61	0.94

Source: authors' research.

Results of the survey are consistent with research presented in [27–29], where the benefits of RES were the variable considered essential in determining perceptions of RES implementation and their impact on life quality. Additionally, results from case studies in Germany [84] indicate that its economic benefits are the most important factor for public acceptance of RES.

Data depicted in Figure 5 show the high level of willingness among respondents to purchase green energy or install renewable energy technology. Of respondents, 88.7 percent would purchase green energy if local suppliers offered them energy from renewable sources, and 96 percent would be interested in installing renewable energy technology in their households if the investment were subsidized.



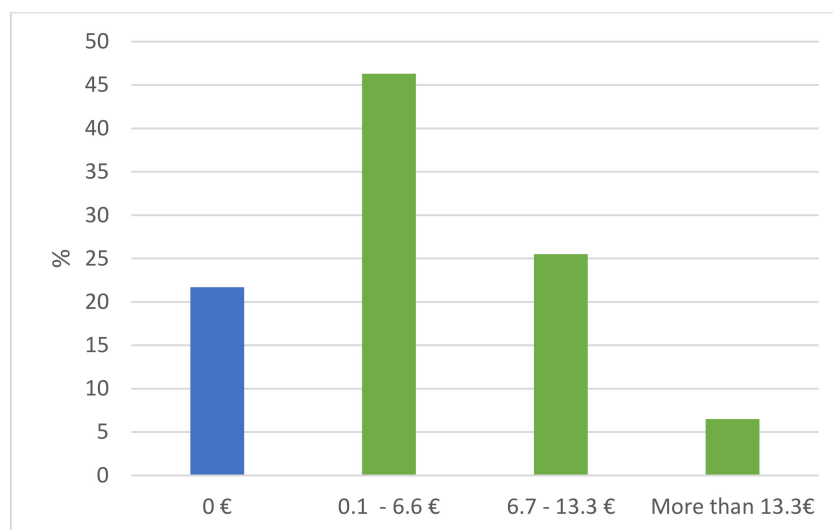
**Figure 5.** Willingness to purchase green energy or install renewable energy technology. Source: Authors' research.

Results of the survey shows that most of the respondents are willing to pay more for the introduction or expansion of RES technology in their households; 79 percent stated that they would be willing to pay more for the use of RES technology in households (Figure 6).

The results of the survey show that 46.3 percent of the respondents would be willing to pay an additional EUR 0.1 to 6.6 every month to use greener energy in their households. One-quarter of respondents would be willing to pay between EUR 6 and 13 per month more in electricity bills to be able to use renewable energy in the household, and 6.5 percent of respondents would be willing to increase their electricity spending by more than EUR 13.3 per month. Such results show a WTP for greener energy by households in Croatia. The result for Greece [82] shows a WTP higher amounts for green energy, but the Greek

survey was conducted only in the capital, and the Croatian research covered the whole territory of the Republic of Croatia.

To identify which factors determine the different levels of citizens' WTP for the use of RES technologies in the household, we performed chi-square and t-tests, as presented in Table 4.



**Figure 6.** Willingness to pay for renewable energy technology in household per month. Note: amounts are recalculated from HRK to EUR according to Croatian National Bank exchange rate for 2020: 1 EUR = 7.53308 HRK. Source: Authors' research.

**Table 4.** Willingness to pay for the use of renewable energy.

Indicator	Category	Willing to Pay, %	Unwilling to Pay, %	Pearson Chi-Squared Test/t-Test	p-Value
Fighting against climate change	Yes	84.3	15.7	5.540	0.000
	No	59.0	41.0		
Region	Adriatic Croatia	77.5	22.5	6.062	0.048
	Continental Croatia	83.2	16.8		
	City of Zagreb	71.0	29.0		
Benefits for climate change	No benefits	20.0	80.0	46.976	0.000
	Neutral	64.5	35.5		
	Benefits	82.4	17.6		
Benefits for households	No benefits	22.6	77.4	65.843	0.000
	Neutral	75.5	24.5		
	Benefits	85.4	14.6		
Benefits for local unit	No benefits	29.2	70.8	43.262	0.000
	Neutral	71.0	29.0		
	Benefits	84.2	15.8		
Age	18–29	87.1	12.9	5.167	0.075
	30–64	75.9	24.1		
	65+	86.4	13.6		
Gender	Female	83.5	16.5	3.673	0.000
	Male	68.1	31.9		
Willingness to purchase green energy from local supplier	Yes	84.0	26.0	8.300	0.000
	No	35.4	64.6		
Willingness to install renewable energy technology with subsidized costs	Yes	79.5	20.5	2.619	0.009
	No	47.1	52.9		

Source: Authors' research.

Survey results show that the WTP for the use of renewable energy is related to respondents' environmental concerns. People who are engaged in measures to fight against climate change or see the benefits of RES for improving the environment are more willing to pay extra for the use of renewable energy in their households. There is also a great tendency to change behavior. People who would be willing to change their behavior and buy 100 percent renewable energy from a local supplier are those who would be willing to pay more money for green energy. If they can get a subsidy, they would also be willing to introduce renewable energy technology into their own household.

According to the survey results, greater WTP for renewable energy is associated with age and gender. The results suggest that females exhibit higher WTP for the use of RES in households than males; 83.5 percent of females and 68.1 percent of males are willing to pay higher electricity bills if the energy that they purchase comes from RES. This is consistent with research that women are more concerned with environmental issues [32–34,75,84–86].

Interestingly, younger people (younger than 30 years) and people older than 65 years are the two groups most likely to pay more for RES. Over 91 percent of retired persons and 85.0 percent of students stated that they would be willing to pay higher electricity bills if the energy that they purchased were from RES. Unemployed people show the least WTP higher electricity bills.

The results of the survey indicate that the WTP for renewable energy is the highest in Continental Croatia, where 83.2 percent of respondents said they would be willing to pay higher electricity bills if the energy came from RES. In Adriatic Croatia, 77.5 percent of respondents were similarly willing, which is a result of the region's warmer climate. The city of Zagreb had the fewest number of respondents willing to allocate more money for the use of RES; only 71.0 percent of respondents indicated a willingness to do so. The results of German research [84] indicate that the level of trust has a positive effect on the willingness to participate in local community energy projects. Citizens of Zagreb show a lower level of trust in the urban authority adopting measures for the benefit of citizens in the field of energy and climate policy. Only 24 percent of respondents believe that the city of Zagreb will take such measures, which explains the low WTP for the use of RES in Croatia.

The results indicate that a greater WTP is not affected by an individual's residence type and that it does not matter whether they live in a single-family house or in a multi-family building. Also, there are no statistically significant differences in the WTP for green energy in households with different levels of education or employment status.

## 5. Conclusions

In this paper, we explore the public perception about renewable energy and citizens' WTP for the use of RES. The survey shows that there is general support for renewable energy among respondents, and almost 89 percent would purchase renewable energy from local suppliers. In addition, most of the survey participants declared that they would be willing to pay more for the introduction of RES technology into their households. Citizens are legitimate actors for urging energy transition. The low levels of involvement by citizens in renewable energy projects is a common issue across all EU states. Therefore, the results of this research are important because they indicate the possibility of greater active involvement of citizens in the implementation of renewable energy projects in households and/or at the local level. These results could be especially useful for the countries that plan to strengthen the role of renewable energy communities.

The survey results show that according to the respondents' own self-assessment, they have different levels of knowledge about the various RES. The respondents have the highest level of knowledge about solar energy, while almost half of the respondents are not very familiar with geothermal energy and biomass. Better RES education and information campaigns would be important factors for encouraging the use of RES among citizens.

The awareness among citizens about the environmental benefits of RES is high. Many citizens see the positive impacts of the use of RES for encouraging economic growth.

However, many do not see RES having any impact on job creation. Also, most feel that RES will have a negative impact on their household budget by increasing energy bills or increasing investment costs.

The survey indicates the two main reasons for citizens' interest in RES are primarily related to environmental concerns. Citizens who are concerned with environmental issues show more positive attitudes towards the acceptance of RES in their households. It is revealed that citizens who are actively involved and implement measures aimed to combat climate change are those who are more oriented toward the use of renewable energy and are willing to pay additionally for the use of renewable energy. Also, those citizens who are aware of the environmental benefits of renewable energy or see certain economic benefits for their household or local government are more willing to pay for renewable energy.

Although universally representative views cannot be drawn from this paper, the results could be useful for planning future energy and climate projects related to renewable energy. Energy transition requires economic and technological, but also socio-political transformation. Social acceptance of renewable energy is a prerequisite for the introduction of renewable energy technologies, so further research related to socio-political, community, and market acceptance is needed.

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## Appendix A

**Table A1.** Survey questions and variables.

Variable	Question/Statement	Values in the Survey
Gender	Gender	1—Female, 2—Male
Age	Age	Open question
Education	Highest education level	1—Secondary education or lower, 2—Tertiary education, 3—Post-graduate education
County	County of residence	1—Bjelovar-Bilogora County, 2—Brod-Posavina County, 3—Dubrovnik-Neretva County, 4—Istria County, 5—Karlovac County, 6—Koprivnica-Križevci County, 7—Krapinska-Zagorje County, 8—Lika-Senj County, 9—Međimurje County, 10—Osijek-Baranja County, 11—Požega-Slavonia County, 12—Primorje-Gorski Kotar County, 13—Sisak-Moslavina County, 14—Split-Dalmatia County, 15—Šibenik-Knin County, 16—Varaždin County, 17—Virovitica-Podravina County, 18—Vukovar-Srijem County, 19—Zadar County, 20—Zagreb County, 21—City of Zagreb

Table A1. Cont.

Variable	Question/Statement	Values in the Survey
Employment	Employment status	1—Employed, 2—Student, 3—Other (retired, unemployed)
Type of residence facility	Please indicate the type of residence facility in which are you currently living	1—House, 2—Apartment in the house, 3—Multi-family building
Knowledge about renewable energy sources (RES)	Please estimate the level of your knowledge about RES: wind power	1—Nothing at all, 2—Poor, 3—Average, 4—Good, 5—Excellent
	Please estimate the level of your knowledge about RES: solar power	
	Please estimate the level of your knowledge about RES: hydropower	
	Please estimate the level of your knowledge about RES: geothermal energy	
	Please estimate the level of your knowledge about RES: biomass	
Use of RES	Do you use any RES in your household	1—Yes, 2—No
Combating climate change	Are you taking measures and actions to mitigate/combat climate change?	1—Yes, 2—No
Impacts of RES	Please indicate to what extent do you agree with the following statement: Increased use of RES has a positive impact on economic development	1—Strongly disagree, 2—Disagree, 3—Neutral, 4—Agree, 5—Strongly agree
	Please indicate to what extent you agree with the following statement: Increased use of RES leads to increased employment	
	Please indicate to what extent you agree with the following statement: Increased use of RES has the effect of reducing air/water pollution	
	Please indicate to what extent you agree with the following statement: Increased use of RES is reducing Croatia's dependence on energy imports	
	Please indicate to what extent you agree with the following statement: Increasing the use of RES affects the increase in energy costs in the household	
	Please indicate to what extent you agree with the following statement: Increased use of RES has the effect of mitigating climate change	
	Please indicate to what extent you agree with the following statement: Increased use of RES has a positive effect on health	
	Please indicate to what extent you agree with the following statement: The economic benefits of introducing RES in households are great	
	Please indicate to what extent you agree with the following statement: The economic benefits of introducing RES for the municipality/city in which I live are great	

Table A1. Cont.

Variable	Question/Statement	Values in the Survey
Willingness to pay	How much extra would you be willing to pay to buy electricity from renewable sources?	1—EUR 0, 2—from EUR 0.1 to 6.6, 3—from EUR 6.7 to 13.3, 4—more than EUR 13.3. Amounts are recalculated from HRK to EUR according to the Croatian National Bank exchange rate for 2020: 1 EUR = 7.53308 HRK
Willingness to purchase green energy from local supplier	If your local electricity supplier offered clean, renewable energy, would you buy it?	1—Yes, 2—No
Willingness to install renewable energy technology with subsidized costs	If there was a possibility of subsidizing RES, would you decide to install a solar panel or other renewable energy sources in the yard or on the roof of the house or building in which you live?	1—Yes, 2—No
Trust in local government	Please indicate to what extent you agree with each of the following statements: I have confidence that the municipality/city in which I live takes measures for the benefit of citizens in the field of energy and climate policy	1—Strongly disagree, 2—Disagree, 3—Neutral, 4—Agree, 5—Strongly agree

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