SUSTAINABLEELECTRICITY POWERPLANNING

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Public opinion on renewable energy technologies: the Portuguese case

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Abstract: Renewable energy technologies are part of the solution to meet future increasing demand of electricity and decommissioning of power plants in the European Union. In this study, the public opinion on renewable energy technologies was analyzed by means of a survey implemented in Portugal. The survey addresses four technologies: hydro, wind, biomass and solar power. The study has five main research topics: (i) the level of acknowledgement that the Portuguese possess on the technologies under study, (ii) the position of respondents towards new renewable energy projects in the country, (iii) the validity of the NIMBY hypothesis in Portugal while realizing in which technology it is more pronounced, (iv) the perception that the Portuguese hold on Sustainable Development issues, regarding each of the four technologies and (v) the willingness to pay more for the renewables among the Portuguese people. The results suggest that more than 60% of the respondents acknowledge these technologies, being biomass the least known. There is a generally positive attitude towards new projects and this tendency is more pronounced for solar power. NIMBYism is more pronounced in municipalities with biomass, although not felt by the vast majority of their population. Solar power plants are regarded by the Portuguese public as the most desirable technology in terms of economic and environmental aspects, while hydro power is perceived as the technology that can contribute most to local residents' welfare. Willingness to pay is high among those who perceive renewables as increasing the costs of the electricity bills, but few respondents believe that renewables tend to raise costs of the bill.

Nomenclature

NIMBY	Not in My BackYard
H	Sample of respondents living in municipalities with hydro power
NH	Sample of respondents living in municipalities without hydro power
W	Sample of respondents living in municipalities with wind power
NW	Sample of respondents living in municipalities without wind power
B	Sample of respondents living in municipalities with biomass
NB	Sample of respondents living in municipalities without biomass
S	Sample of respondents living in municipalities with solar power plants
NS	Sample of respondents living in municipalities without solar power plants
RET	Renewable Energy Technology

1. INTRODUCTION

Electricity demand projections for 2030 in the European Union (EU) demonstrate the need for the construction of new power plants, due to the substitution of obsolete ones and to the increase of the electricity demand (European Commission, 2009). However, many uncertainties exist in the planning process. The nature of these uncertainties lie both in the costs associated with the technologies and in the prices of primary energy, often imported from geographically unstable areas and subject to even higher increasing demand in the developing world. Planning on the long run becomes then essential, since power plants require the investment of large initial capital sums and operate for long periods.

Planning assumes a variety of time scales and purposes. While the practical guide called roadmap2050 (http://www.roadmap2050.eu/) is directed to a very long-term frame, the policies EU20-20-20, targeted to 2020, define concrete goals: (i) to cut in greenhouse gases (GHG) emissions to at least 20% below the 1990 levels, (ii) to reach 20% of renewables' share in the energy mix and (iii) increase energy efficiency in 20%. Therefore, Renewable Energy Sources (RES) are expected to play a significant role in the electricity generation mix, and policies have been successfully designed in order to do so (Marques and Fuinhas, 2012).

Besides the cost uncertainty, the social and environmental aspects represent also fundamental dimensions to be included in energy decision making process both from the private and public perspectives. The increasing importance of RES on electricity production poses additional challenges for investors and decision makers. From the private investor point of view, ensuring public acceptance is fundamental to minimize the risk of cost over runs or even of failure and cancellation. Frequently, this public acceptance varies according to the technology and is related to local population financial compensations schemes but also to other elements such as local development or job creation. Also, from the public perspective these variables should be taken into consideration when designing sustainable energy scenarios for the next years recognizing electricity as a fundamental driver of social wellbeing and economic competitiveness.

The present study addresses RES in Portugal, so the remainder of this section briefly introduces its past and present situation. The importance of RES for electricity production in Portugal is undeniable and it is then fundamental to analyze the social acceptance of all RES technologies, identifying major sources of concern and geographical patterns.

This paper describes the implementation of a large scale survey aiming to study five main research topics: (i) the level of acknowledgement that the Portuguese possess on the technologies under study, (ii) the position of respondents towards new renewable energy projects in the country, (iii) the validity of the NIMBY hypothesis in Portugal while realizing in which technology it is more pronounced, (iv) the perception that the Portuguese hold on Sustainable Development issues, regarding each of the four technologies and (v) the willingness to pay more for the renewables among the Portuguese people.

1.1 Portuguese electricity system

During 2012, demand of electricity in Portugal was 49 TWh (REN, 2011). As can be seen in Figure 1, the special generation status technologies, an umbrella for subsidized technologies, represent the greatest part of generation, followed by thermal (natural gas and coal) and large hydro. The imports from Spain are higher than exports and represent 16% of total supply. The special generation status include, besides the ones we address in our study (wind, biomass, solar and hydro), some other technologies such as urban waste, biogas and non-renewable cogeneration. In 2012, 74% of special generation status came from renewable energy sources (European Commission, 2011). If we exclude imports, the ratio of produced renewable energy in 2012 amounted to 47%.

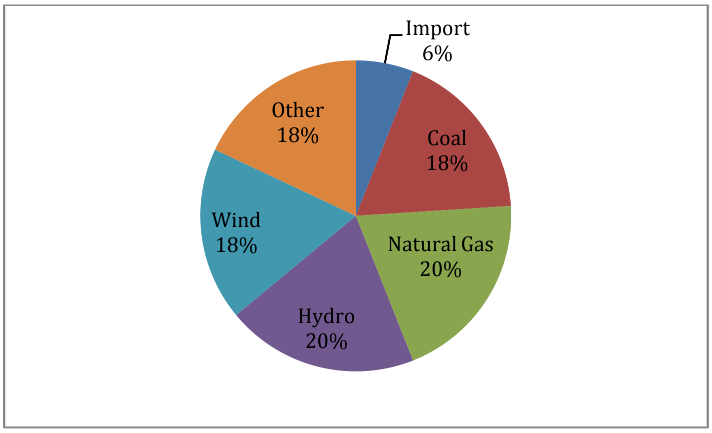

Figure 1: Electricity production shares, by technology, in 2011. Own elaboration from REN (2012a) data.

Figure 2 presents data concerning renewable energy in more detail. Portugal achieved the EU target for RES in 2010, reaching, a share of 39% renewable energy in the electricity sector. The other successful countries achieving these goals were Denmark, Germany, Hungary, Ireland, Lithuania and Poland (European Commission, 2012). In

that year, together, the Member States achieved 12.7% of renewable energy quota, but the goal for 2020 is 20%, so further improvement is still needed.
The evolution of energy produced from RES has been increasing but not steadily. As the most significant part of it is based on hydro power, it is therefore, subject to the profile of the rain (the so-called hydroelectric productivity index) in a given year.

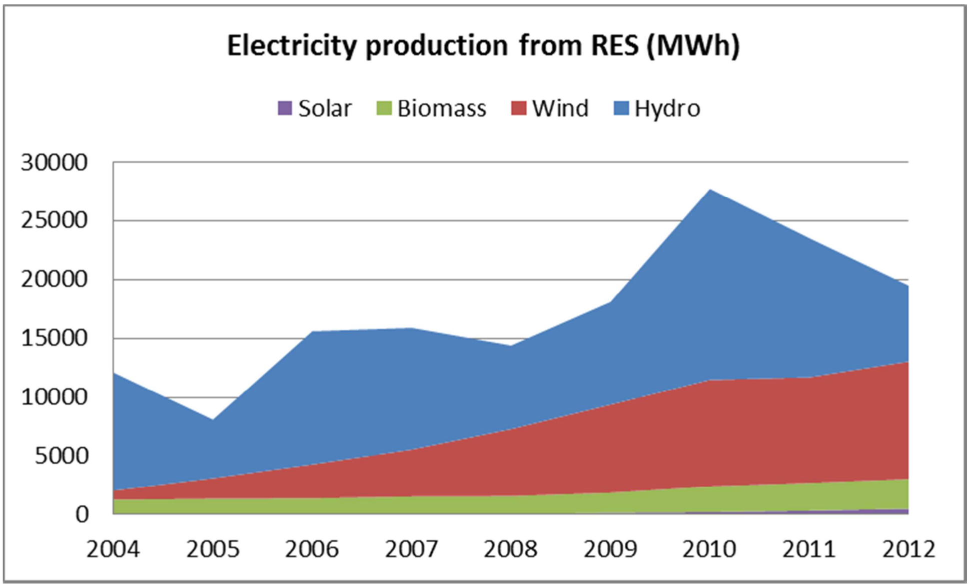

Figure 2: Energy production in Portugal, 2012, using the renewable energy sources addressed in the present study: hydro, wind, biomass and photovoltaics. Own elaboration from DGEG (2011).

Feed-in tariffs are presently the support policy used in Portugal to promote RES for electricity production, given that free market would constrain their use as they are still economically less attractive than the traditional technologies. Among renewable energy technologies, the exception to this rule is hydro power. These plants have been playing a significant role in Portugal since the 50's and are mostly operated outside the feed-in tariff schemes. In the end of 2012, the total installed hydro power in Portugal was 5540 MW (DGEG, 2012). From these, 94.5% of the installed power refers to power plants not included in feed-in tariff schemes (Ordinary Regime Production); only 5.5% of total installed power refer to small units, subject to feed-in tariffs and included in the special generation status (REN, 2012a).

Among the remainder renewable energy sources, the most prominent one is wind power. The first wind farm was built in Portugal in 1992 and since then the growth of the installed wind power has been exponential. At the end of 2012, total wind power achieved 4194 MW (REN, 2012b). According to the Portuguese Renewable Action Plan, this number will increase to 5300 MW in 2020 (DGEG, 2012b).
There exist various types of biomass production, and they can be divided in two types: a first one where the origin of biomass is the forest or agriculture (dedicated production), or a second type where biomass results from the processing of primary biomass, including residues, waste and subproducts (Carneiro and Ferreira, 2012). In some cases, the power plant may generate an amount of heat that is useful for industrial purposes besides the electricity. Currently Portugal has 462 MW of biomass installed power, among which 348 MW exist in cogeneration mode (e2p, 2012).

Installed solar power in Portugal, in 2012, was 360 MW (DGEG, 2012a). Among these, the units that can be considered "solar power plants" or "solar farms" are 17 (besides two in the island of Madeira, not addressed in the present study) and represent 141 MW. Among these units, the largest has 45.8 MW installed (e2p, 2012).

The remainder of the paper is as follows: in section 2 we address the paper design and implementation, in section 3 we present results of the survey sections, in section 4 we present discussion and conclusions.

2. Survey design and implementation

The survey aims at studying the differences of public opinion towards the four technologies (hydro, wind, biomass and solar) between Portuguese regions where they are and are not present. Therefore, four different surveys exist, each to be applied in two samples consisting of distinct regions, totaling eight cases. A hydro power questionnaire delivered in municipalities where hydro power is present is further represented as "H"; the same questionnaire applied to respondents who live in municipalities where hydro power is not present is represented as "NH", the equivalent for wind is "W" and "NW", for biomass "B" and "NB", for solar "S" and "NS".

Given that the study addresses the NIMBY hypothesis, perhaps the best case would be studying the opinion of the respondent and relate it to the distance to a given infrastructure; however this approach would be difficult to implement, given the survey was intended to be handled by telephone. As a result, it was needed to define the delimitations of the "region" size, and in the present study, the geographical unit is the municipality (*"concelho"* in Portuguese). There are 308 of these in Portugal, the population ranging from 451 to 529.485, and areas between 7.9 to 1720.6 km^2.

Information of the Portuguese renewable energy generation infrastructures can be found online, in the http://e2p.inegi.up.pt/ website. This website was used to retrieve a list of municipalities where wind, biomass or solar power plants are present. For the large hydro power plants, the website www.edp.pt was used for the same purpose.

In our study, some municipalities were not consulted for some technologies. In the case of hydro power, the municipalities affected by the 10 power plants expected to be built according to PNBEPH (2011) were left outside. In the "non-hydro", "non-wind" and "non-biomass" cases, only municipalities with less than 20.000 permanent residencies according to the National Institute of Statistics, www.ine.pt, were consulted. This option was taken to avoid inquiring urban districts where these technologies are unlikely to be implemented due to their own urban nature.

The surveys were done during May and June of 2012, and were delivered using CATI (computer assisted telephone interviewing), by a specialist company. The number of surveys to be collected was 381 in each case, which would ensure at least a confidence interval of 95% with a margin of error of 5%. For the calculation of the needed sample size, the following expressions were used:

$$x = z\left({}^{c}/_{100}\right)^{2} r(100 - r)$$

$$n = {N \times x}/{((N-1)E^2 + x)}$$

$$E = \sqrt{\left({(N-n)}/{n(N-1)} \right)}$$

Where z(c/100) is known as the critical value, the positive z value that is at the vertical boundary for the area α/2 in the right tail of the normal distribution, where α is the population standard deviation, equal to 5% (since the confidence interval is 95%) in our case; n is the sample size required, N is the number of permanent residencies for the case study, *r* is 50% (the fraction of responses we are interested in) and E is the margin of error.

2.1 The surveys

Each survey addresses only one technology. The surveys cases N and NH only ask the respondent about hydro power, the N and NW only wind power, and the same goes for all the inquired technologies.

Each survey was divided in six sections. The first section acted as a filter. The questionnaire would count as valid for the respondents that passed on this filter question. When the interviewer read the scales of possible answers, scales were reversed randomly, to avoid biases.

Section I (Filter question)

Have you ever heard of electricity produced in HYDRO DAMS / produced from the WIND, or on WIND FARMS / from BIOMASS, or in FOREST RESIDUE FIRED POWER PLANTS / produced in SOLAR POWER FARMS or SOLAR POWER PLANTS?

Note: Respondents who do not pass the filter question do not proceed to complete the questionnaire.

Section II (NIMBYism)

1: More HYDRO/WIND/BIOMASS/SOLAR power plants should be built in our country.

2: More HYDRO/WIND/BIOMASS/SOLAR power plants should be built in our concelho. (Note: municipality).

3: More HYDRO/WIND/BIOMASS/SOLAR power plants should be built in our freguesia. (Note: subdivision of municipality)

Scale of possible answers: 1 – totally disagree, 2 – tend to disagree, 3 – tend to agree, 4 – totally agree, 5 – doesn't know/doesn't answer. (Note: the order of the scale has been randomized to avoid biases.)

Section III (Perception of costs)

What impact do the dams/wind/biomass/solar power plants have upon the electricity bill, in your opinion?

Scale of possible answers: 1 – lowers extremely the bill, 2 – lowers slightly the bill, 3 – has no impact in the bill, 4 – raises slightly the bill, 5 – raises extremely the bill, 6 – doesn't know/doesn't answer. (Note: the order of the scale has been randomized to avoid biases.)

Section IV (Perception of environmental impact)

What impact do the dams/wind/biomass/solar power plants have upon the environment, in your opinion?

Scale of possible answers: 1 – harm the environment considerably, 2 – harm the environment slightly, 3 – have no environmental impact, 4 – protect the environment slightly, 5 – protect the environment considerably, 6 – doesn't know/doesn't answer. (Note: the order of the scale has been randomized to avoid biases.)

Section V (Perception of social impact in local populations)

What impact do the dams/wind/biomass/solar power plants have upon the populations near which they are built?

Scale of possible answers: 1 – develop considerably the local populations, 2 – develop slightly the local populations, 3 – don't develop nor harm the local populations, 4 – slightly develop the local populations, 5 – greatly develops the local population, 6 – doesn't know/doesn't answer. (Note: the order of the scale has been randomized to avoid biases.)

Section VI (Socio-demographics)

Education degree: *scale of possible answers: 1 – no studies; 2 – 4th degree, 3 – 9th degree, 4 – 12th degree, 5 – university degree*

Gender:

Age:

3 - Results

In this section we begin by characterizing the respondents of the questionnaire, followed by their responses in the questionnaires. We divide this section in five subsections, each addressing one of the five research topics presented earlier. For each we follow the same approach: first we show the numeric results obtained from the responses of the survey regarding the research question, and then we provide statistical significance tests, allowing to identify variables which can explain the results. Results were considered to be statistically significant for p-values lower than 0.05.

Among the 3646 respondents that agreed to take the survey, the minimum age found was 16, the maximum 95.

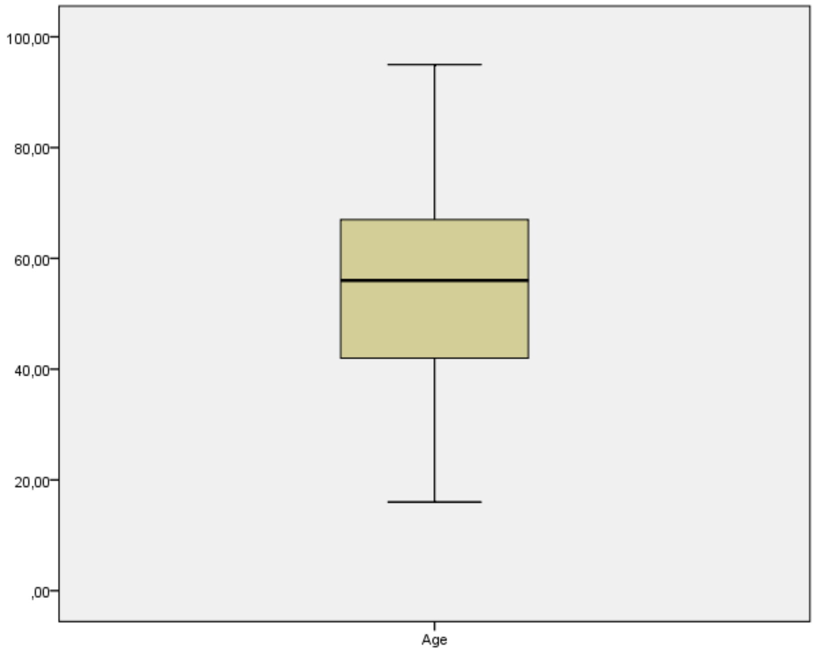

Figure 3: Boxplot containing the information of the survey respondents' age: the mean is 54.27 and standard deviation is 16.8.

A majority of respondents are female, 2346, against 1300 males.

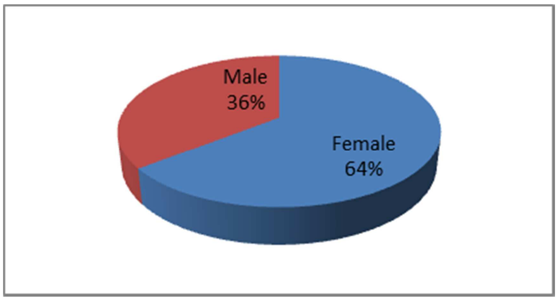

Figure 4: Distribution of respondents according to gender.

The distribution of respondents according to educational level shows that more than half of the respondents (56%) have studied less than 10 years in school, and only 17% went to university.

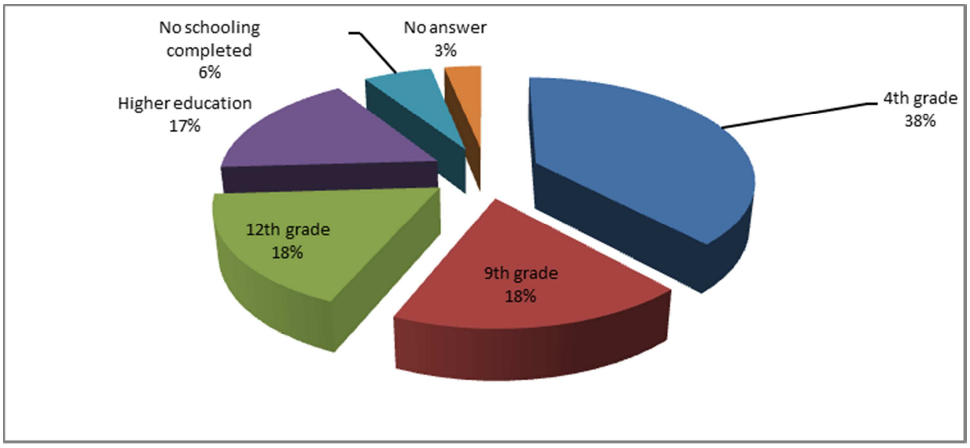

Figure 5: Distribution of respondents according to educational level.

3.1 –Technology acknowledgement

Sixteen per cent of respondents did not acknowledge the technology mentioned in the survey (and therefore did not proceed to complete it to the end). Hydro power is the most acknowledged technology, while biomass remains the least known. Solar power, although being the least contributor to the energy mix as shown in the previous section, remains better known than wind power in the cases where the questionnaire was implemented in municipalities in which they are present. Wind power is the only case in which a technology is more recognized in municipalities where it is not present than in municipalities where it exists, although with a small difference.

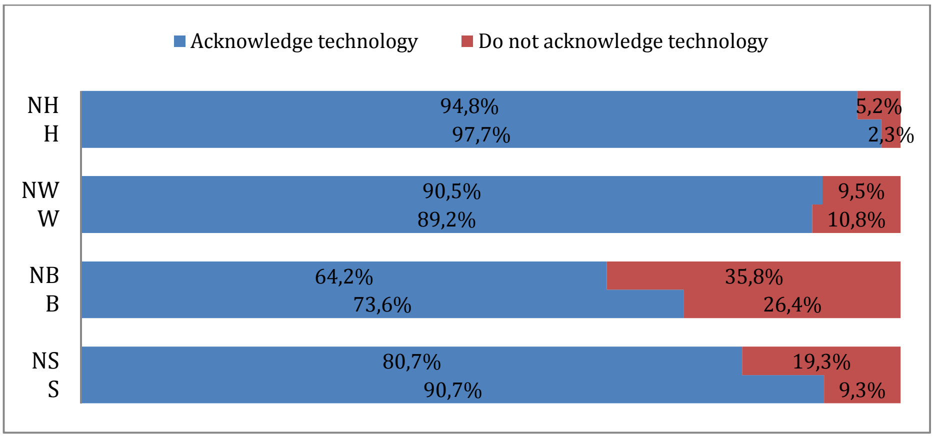

Figure 6: Acknowledgement of technology according to technology. Note there are four different questionnaires applied to respondents who live in a municipality where the technology focused by the questionnaire is present (H, W, B, S) and where it is not present (NH, NW, NB, NS).

Examining the output of the Fisher's exact test it becomes possible to state that residents living in municipalities where the technology is implemented acknowledge the technology significantly more than residents of municipalities where the technology is not implemented, the only exception being wind power (the tendency is the contrary but it is not statistically significant).

Table 1: Statistical test evaluating the influence of acknowledging the technology by being resident in a municipality where the technology is implemented

	Test	p	Statistically significant? (for p<0.05)
Hydro	Fisher's exact test	0.023	**YES**
Wind	Fisher's exact test	0.241	no
Biomass	Fisher's exact test	<0.001	**YES**
Solar	Fisher's exact test	<0.001	**YES**

The values of technology acknowledgement are related to age in Table 1. It can be concluded that the group of respondents that passed the filter have a slightly lower average age than the original group.

Table 2: Age influence on the filter question.

Age	Acknowledge Technology?	
	No	Yes
Mean	65,44	52,65
Maximum	85	90
Minimum	40	16

However, if instead of global results we analyze the statistical significance of age in the filter question, in Table 2, we can conclude that only in three cases (H, NW and NS) the influence of age is statistically significant.

Table 3: Results of the filter question according to age, according to the case.

	Mean age				
Case	**Acknowledges technology**	**Doesn't acknowledge technology**	**Statistically significant? (for levels of p<0.05)**	**Test**	
H	**52.65**	**65,44**	**YES**	**t-test**	**t=2,338**
				df=8,382	**p=0,046**
conclusion:	**younger respondents present more acknowledgement with the technology**				
NH	55.79	61,1	no	t-test	t=1,426
				df=399	p=0,133
W	55.11	59,44	no	t-test	t=1,644
				df=422	p=0,101
NW	**54.17**	**64,3**	**YES**	**t-test**	**t=3.512**
				df=411	**p=<0.001**
conclusion:	**younger respondents present more acknowledgement with the technology**				
B	53.08	52,94	no	t-test	t=-0.82
				df=512	p=0.934
	-				
NB	53.32	53,54	no	t-test	t=0.149
				df=597	p=0.881
	-				
S	56.18	61,53	no	t-test	t=1.897
				df=410	p=0.059
	-				
NS	**50.75**	**58,67**	**YES**	**t-test**	**t=4.199**
				df=465	**p=<0,001**
conclusion:	**younger respondents present more acknowledgement with the technology**				

In table 4 the results of technology acknowledgement are distributed by gender. Using the Fisher’s exact test it becomes evident that only it is possible to state that males acknowledge the technology significantly more than females in the cases of B, NB and NS.

Table 4: Results of the filter question, according to gender.

	Acknowledges technology		Gender		
Case	**Female**	**Male**	**Statistically significant? (for p<0.05)**	**Test**	
H	**97,9%**	**97,4%**	no	Fisher's exact test	p=0,485
			-		
NH	**93,4%**	**97,2%**	no	Fisher's exact test	p=0,08
			-		
W	**89,3%**	**89,1%**	no	Fisher's exact test	p=0,532
			-		
NW	**89,8%**	**93,1%**	no	Fisher's exact test	p=0,177
			-		
B	**66,9%**	**83,8%**	YES	Fisher's exact test	p=~0,00
conclusion:	**males acknowledge better**				
NB	**56,9%**	**75,6%**	YES	Fisher's exact test	p=~0,00
conclusion:	**males acknowledge better**				
S	**89,8%**	**93,8%**	no	Fisher's exact test	p=0,143
NS	**77,4%**	**85,9%**	YES	Fisher's exact test	p=0,014
conclusion:	**males acknowledge better**				

The variable "education" is statistically significant to all of the eight cases. This means that invariably respondents with higher education do acknowledge the technology significantly more than respondents with lower educational degree, according to Wilcoxon-Mann-Whitney test.

Table 5: Results of the filter question according to educational level.

	% that does acknowledge technology					Education		
Case	**No schooling completed**	**4th grade**	**9th grade**	**12th grade**	**Higher education**	**Statistically significant? (for p<0.05)**	**Test**	
H	86,70%	98,60%	98,50%	100,00%	100,00%	YES	Mann-Whitney U	sig=0,002
conclusion:	**More educated respondents acknowledge better the technology**							
NH	78,30%	95,30%	94,70%	100,00%	100,00%	YES	Mann-Whitney U	sig=0,001
conclusion:	**More educated respondents acknowledge better the technology**							
W	84,60%	94,30%	94,80%	96,10%	100,00%	YES	Mann-Whitney U	sig=0,009
conclusion:	**More educated respondents acknowledge better the technology**							
NW	75,00%	90,30%	95,90%	96,80%	98,20%	YES	Mann-Whitney U	sig=0,001
conclusion:	**More educated respondents acknowledge better the technology**							
B	64,00%	67,80%	74,50%	78,00%	80,20%	YES	Mann-Whitney U	sig=0,006
	More educated respondents acknowledge better the technology							
NB	55,60%	57,30%	68,30%	66,40%	72,90%	YES	Mann-Whitney U	sig=0,003
conclusion:	**More educated respondents acknowledge better the technology**							
S	95,20%	89,80%	98,20%	98,60%	100,00%	YES	Mann-Whitney U	sig=0,001
conclusion:	**More educated respondents acknowledge better the technology**							
NS	27,80%	73,10%	87,30%	93,00%	92,60%	YES	Mann-Whitney U	sig=~0,000
conclusion:	**More educated respondents acknowledge better the technology**							

3.2 Willingness to accept new projects

The following plots are the results of the second section in the questionnaires, where the respondent is asked what is his opinion about the implementation of new projects of the technology (H=municipality with hydro, NH=municipality without hydro, W= wind, B=biomass, S=solar) in the country (C), municipality (M) and "freguesia" (F). Respondents retain a better opinion towards new wind and solar power projects, whereas hydro power remains the least supported form of energy.

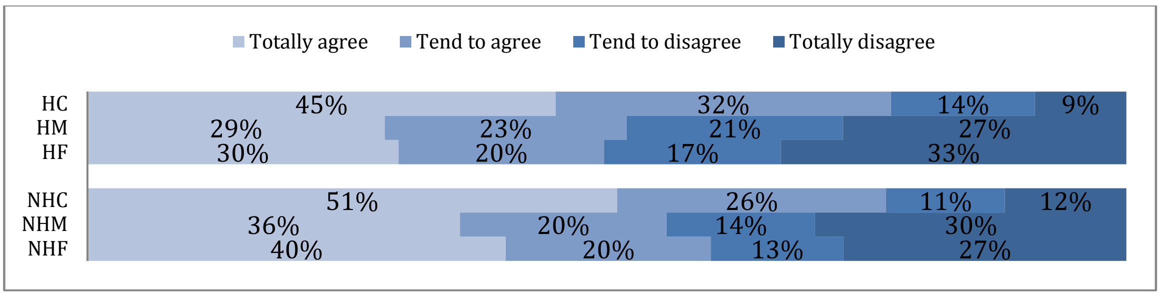

Figure 7: Willingness to accept new hydro power implementation in country (C), municipality (M) or "freguesia" (F).

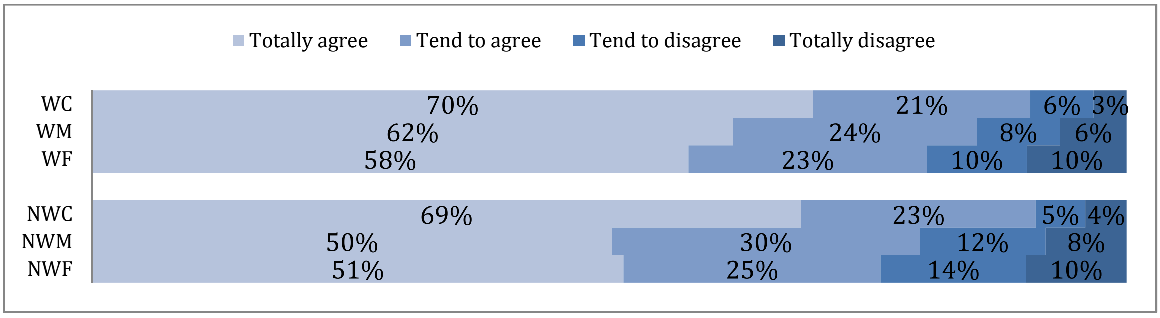

Figure 8: Willingness to accept new wind power implementation in country (C), municipality (M) or "freguesia" (F).

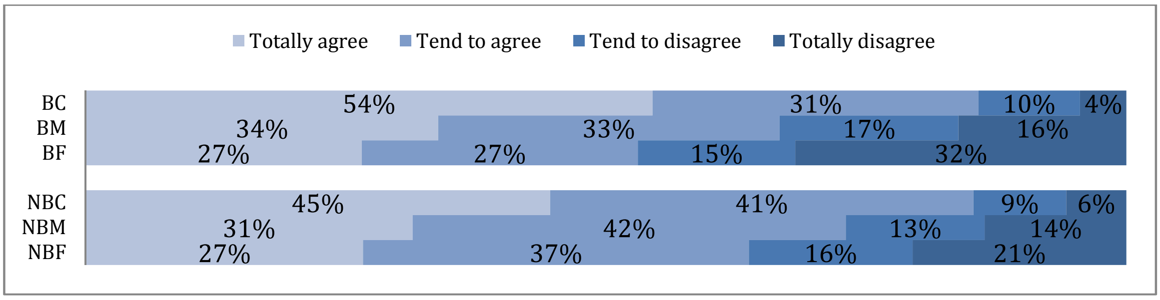

Figure 9: Willingness to accept new biomass project implementation in country (C), municipality (M) or "freguesia" (F).

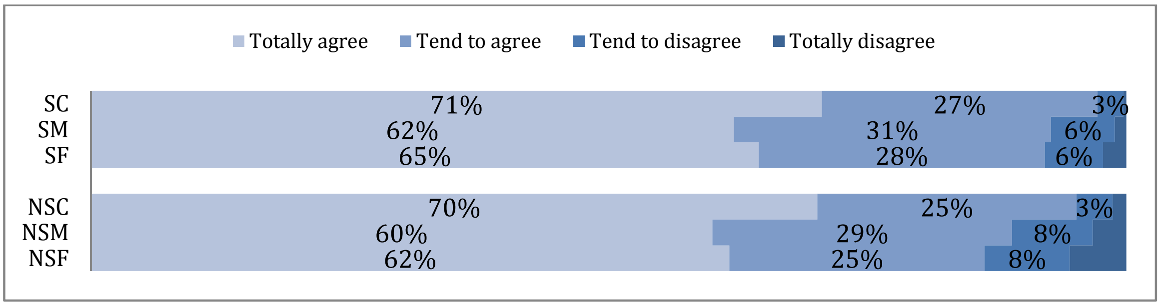

Figure 10: Willingness to accept new solar power implementation in country (C), municipality (M) or "freguesia" (F).

Three major conclusions can be drawn from these results.

Firstly, the attitude of respondents is generally positive towards all renewable energy technologies: the case with least support is that of respondents HF, who live in municipalities with hydro power projects and who are asked whether they would support new hydro power plants in their "freguesia"; if we sum the results of "totally agree" and "tend to agree", this result is 49.7%. So, always more than half of the respondents are favourable to a new RES power plant, whether it is in their "freguesia", municipality or country. Solar power, followed closely by wind power, are the technologies which have the most high acceptance values, either if the projects would be implemented in the country, in the municipality or in the "freguesia". The result with the highest acceptance values is "SC", with 98% of "totally agree" plus "tend to agree".

Secondly, the residents in municipalities where wind and solar power already exist are more supportive (adding the "totally agree" and "tend to agree" results) than residents where these technologies do not exist.

Finally, the respondents which did not express their opinion accounted for 2.5% when asked about new project implementation in the country, 3.1% in the municipality and 3.6% in the “freguesia”. The respondents showing more reluctance to give an opinion were the S case (6.1% did not respond what their opinion was about new projects in country, 6.3% in the municipality and 6.6% in the “freguesia”), followed by NH respondents (5.5% for country, 6.1% for municipality and 5.3% for freguesia). The respondents more willing to respond were invariably the B case (99.7% for country, 99.2% for municipality and 99% for “freguesia”).

In Table 6 we can see that the variable “resident in municipality which has technology” influences significantly the opinion of respondents in four out of twelve cases: HF, WM, BC and BF. However, the tendency is not all for these four cases. Residents who live in municipalities with hydro power are significantly less supportive of new hydro power plants in their “freguesia” than residents without hydro power plants in the municipality. The same happens to residents of municipalies where biomass exists. However, residents in municipalities where biomass exist are more supportive towards new projects in the country than residents in municipalities without biomass Residents that live in municipalities with wind power projects are statistically significantly more supportive towards new projects in municipality than residents in municipalities without wind power..

Table 6: Evaluation of the influence of the variable “respondent lives in a municipality where the technology exists” in the respondent’s acceptance of new projects in the country

		wilcoxon-mann test	Statistically significant? (for p<0.05)
Hydro	country	p=0,350	no
	municipality	p=0,315	no
	freguesia	p=0,004	**Yes, residents in municipalities with hydro power tend to be less supportive towards new projects in “freguesia”**
Wind	country	p=0,775	no
	municipality	**p=0,002**	**Yes, residents in municipalities with wind power tend to be more supportive towards new projects in municipality**
	freguesia	p=0,088	no
Biomass	**country**	**p=0,021**	**Yes, residents in municipalities with biomass tend to be more supportive towards new projects in country**
	municipality	p=0,549	no
	freguesia	**p=0,015**	**Yes, residents in municipalities with biomass tend to be less supportive towards new projects in “freguesia”**
Solar	country	p=0,761	no
	municipality	p=0,349	no
	freguesia	p=0,190	no

The fact that residents in municipalities with biomass present such “contradictory” opinions (higher acceptance for new projects in the country, but more rejection locally) suggests potential NIMBYism effect, which we investigate further in the section 3.3.

3.2.1 Socio-demographic data influence on attitude towards new projects in the country

In order to understand how the socio-demographic data relates to the opinion towards new projects in the country, some statistical significance tests were taken, and are presented in Table 7, Table 8 and Table 9.

From Table 7 we can conclude that the "age" factor is significant in six out of eight cases. However, it is not possible to generalize a linear relationship between age and acceptance, given that acceptance sometimes increase significantly with age (NH, NW, B, NB) but sometimes decreases with age (NS), or divide opinions more radically (in the case of H, where older respondents are divided towards totally accepting and totally rejecting). Results of significance are obtained using ANOVA test. Complementation of the ANOVA results was done using Scheffe and Dunnett's coefficients that indicate which categories present significantly different ages of respondents. This was necessary given that no linear relation exists between age and acceptance, so for example the row "conclusion" indicates which categories present significantly different values between them. As such, when in case H we indicate that "respondents of more extreme groups are significantly older than the moderate categories", three things occur: (i) the age of respondents of "totally agrees" and "totally disagrees" is statistically the same, (ii) the age of respondents who "tend to agree" and "tend to disagree" are statistically the same, and (iii) the respondents of (i) present an age statistically greater than respondents of (ii).

Table 7: Evaluation of the influence of the variable age in the respontent's acceptance of new projects in the country

Case	Statistically significant?	ANOVA test	
H	YES	sig.	~0,000
conclusion:	**Respondents of more extreme groups ("totally agrees" and "totally disagrees") are significantly older than the moderate categories**		
NH	YES	sig.	0,003
conclusion:	**Respondents that "tend to disagree" are significantly younger than respondents that "totally agree"**		
W	no	sig.	0,112
conclusion:	-		
NW	YES	sig.	0,041
conclusion:	**Respondents that "tend to agree" are significantly younger than those that "totally agree"**		
B	YES	sig.	0,001
conclusion:	**Respondents in the category "totally agree" are significantly older than the category "tend to agree"**		
NB	YES	sig.	0,002
conclusion:	**Respondents in the category "totally agree" are significantly older than the category "tend to agree"**		
S	no	sig.	0,316
conclusion:	-		
NS	YES	sig.	0,025
conclusion:	**Respondents who "totally disagree" are significantly older than those who "totally agree" or "tend to agree"**		

Table 8 presents the influence of "gender" in the opinion towards new projects in the country. Only in one case (NB) it proved to be statistically significant, and the tendency is that females are less supportive of biomass projects in the country.

Table 8: Evaluation of the influence of the variable gender in the respontent's acceptance of new projects in the country

Case	Statistically significant?	Chi-square test	
H	No	Pearson chi-square	2,091
		Sig.	0,554
conclusion:	-		
NH	No	Pearson chi-square	0,294
		Sig.	0,961
conclusion:	-		
W	No	Pearson chi-square	4,112
		Sig.	0,25
conclusion:	-		
NW	No	Pearson chi-square	1,087
		Sig.	0,78
conclusion:	-		
B	No	Pearson chi-square	2,448
		Sig.	0,485
conclusion:	-		
NB	YES	Pearson chi-square	10,342
		Sig.	0,016
conclusion:	**Disagreement with new biomass projects is significantly higher among females**		
S	No	Pearson chi-square	2,711
		Sig.	0,438
conclusion:	-		
NS	No	Pearson chi-square	3,398
		Sig.	0,334
conclusion:	-		

Table 9 presents the influence of "education" in the opinion towards new projects in the country. Only three cases are statistically significant, but the tendency among these cases is not the same. On the one hand, lower education is associated with rejecting hydro power projects in the country (both for N and NH respondents), while the case of NS is the opposite, given that more educated respondents are more supportive of solar power plants.

Table 9: Evaluation of the influence of the variable education in the respondent's acceptance of new projects in the country

Case	Statistically significant?	Chi-square test	
H	YES	Pearson chi-square	33,75
		Sig.	0,001
conclusion:	**Respondents with a lower educational degree agree significantly more with new hydro power projects in the country**		
NH	YES	Pearson chi-square	21,162
		Sig.	0,048
conclusion:	**Respondents with a lower educational degree agree significantly more with new hydro power projects in the country**		
W	no	Pearson chi-square	17,129
		Sig.	0,145
conclusion:	-		
NW	no	Pearson chi-square	12,29
		Sig.	0,423
conclusion:	-		
B	no	Pearson chi-square	18,754
		Sig.	0,100
conclusion:	-		
NB	no	Pearson chi-square	10,074
		Sig.	0,610
conclusion:	-		
S	no	Pearson chi-square	12,214
		Sig.	0,429
conclusion:	-		
NS	YES	Pearson chi-square	28,928
		Sig.	0,004
conclusion:	**Respondents with a lower educational degree disagree significantly more with new solar power projects in the country**		

3.3 NIMBYism

Similarly to Jones (2009), in our work we will use the term "NIMBYism" as an attitude of general supporting a technology but rejecting it in the particular case of seeing it implemented near one's "backyard". A new variable "$NIMBY_{aggregate}$" was created.

For each respondent, the computation of this variable is:

$$NIMBY_{aggregate} = NIMBY_{country} - NIMBY_{freguesia}$$

Since the scale of $NIMBY_{country}$ and $NIMBY_{freguesia}$ ranges from 4 (totally agree with new projects) to 1 (totally rejects new projects), so that high values for $NIMBY_{aggregate}$ indicate a high NIMBY attitude, i.e., that the respondent totally supports new projects in the country but rejects them near his backyard. Negative numbers will indicate a PIMBY attitude (please in my backyard, as in Swofford and Slattery (2010)). Note that if a respondent rejects the technology both in the country and in the "freguesia", NIMBYism will be zero for this respondent.

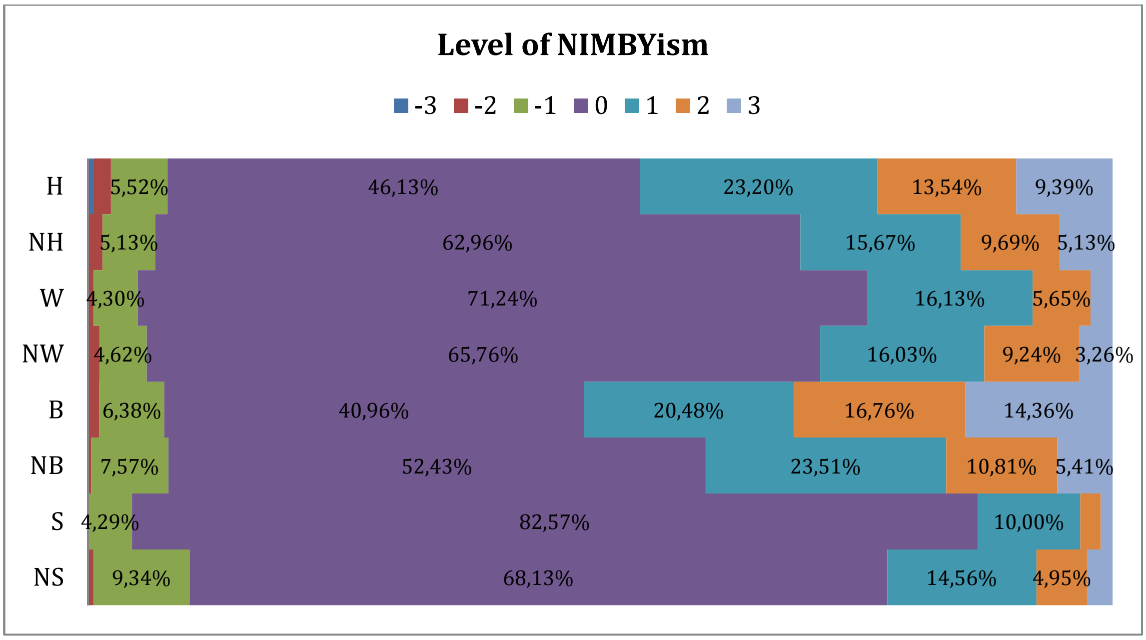

Figure 11: Levels of NIMBYism. The more positive the value, the greater is the difference between acceptance of the technology in the country and the acceptance of technology in the "freguesia".

Some conclusions can be drawn on NIMBYism:

Respondents whose opinion remains the same for new projects on the country or in the freguesia (i.e. $NIMBY_{aggregate} = 0$) vary from 83% in the case of residents in municipalities with solar power plants, to 41% in the case of respondents who live in municipalities with biomass. This suggests that NIMBYism is not, in any case, affecting the vast majority of respondents.

If we count the cases of positive $NIMBY_{aggregate}$ occurrences, NIMBY attitude is leaded by residents in municipalities with biomass (51%), followed by residents in municipalities with hydro power (46%) and municipalities without biomass power plants (40%). As seen in the Figure 11, attitude towards solar power is in every case very positive, and it is the less susceptible technology of generating negative reactions, to residents in municipalities where it exists or not.

According to Table 10 it can be concluded that the "effect of proximity" to the technology can only explain NIMBYism in the cases of hydro power and biomass, in the sense that H presents more NIMBYism than NH, and B more NIMBYism than NB.

Table 10: Evaluation of the influence of the variable "resident lives in a municipality where the technology exists" with NIMBYism attitude. Test: Mann-Whitney U Test. Significance levels for p<0.05.

	Sig.	Statistically significant?	Conclusion
Hydro	**~0,000**	**YES**	**Significantly more NIMBYism in municipalities with the technology**
Wind	0,201	no	-
Biomass	**~0,000**	**YES**	**Significantly more NIMBYism in municipalities with the technology**
Solar	0,240	no	-

- Between residents that have a NIMBY attitude, those who live in municipalities with biomass tend to be more extreme (14.4% cases of $NIMBY_{aggregate} = 3$).

- PIMBY attitude, i.e. $NIMBY_{aggregate} < 0$, is not greater than 10% in any case (9.34% for residents in municipalities with solar power plants), and is not greater than NIMBY attitude in any case.

3.3.1 NIMBYism and socio-demographic

Crossing the socio-demographic data with the NIMBYism perceptions, we obtained Tables 11, 12 and 13. From Table 11 no clear conclusion of between age and NIMBYism can be obtained. To begin with, in the case H, more extreme NIMBYism is statistically associated with older respondents, while in the case NH the tendency is inverted, and people with no NIMBY attitude are statistically older than the slightly NIMBY. NIMBYism in the NS case is significantly more found among older respondents. Only one more case of statistical significance exists, and it is the case of more pronounced NIMBYism according to Table 11, and this case is B: extreme NIMBYism is significantly associated with older respondents.

Table 11: Evaluation of the influence of the variable age in the respondent's NIMBYism attitude.

Case	Statistically significant?	ANOVA test	
H	YES	sig.	0,003
conclusion:	**Respondents with NIMBYism=3 are significantly older than respondents with NIMBYism=1**		
NH	YES	sig.	0,001
conclusion:	**Respondents with NIMBYism=0 are significantly older than respondents with NIMBYism=1**		
W	No	sig.	0,069
conclusion:	-		
NW	No	sig.	0,12
conclusion:	-		
B	YES	sig.	~0,000
conclusion:	**Respondents with NIMBYism=3 are significantly older than respondents with NIMBYism=-1, with NIMBYism=0 and NIMBYism=1**		
NB	No	sig.	0,733
conclusion:	-		
S	No	sig.	0,859
conclusion:	-		
NS	YES	sig.	0,026
conclusion:	**Respondents with NIMBYism=2 are significantly older than respondents with NIMBYism=0**		

The statistical tests of gender influence on NIMBYism bring no conclusion, since no test was statistically significant.

Table 12: Evaluation of the influence of the variable gender in the respondent's NIMBYism attitude.

Case	Statistically significant?	Chi-square test	
H	No	Pearson chi-square	5,585
		Sig.	0,471
conclusion:		-	
NH	No	Pearson chi-square	4,572
		Sig.	0,47
conclusion:		-	
W	No	Pearson chi-square	2,464
		Sig.	0,782
conclusion:		-	
NW	No	Pearson chi-square	4,59
		Sig.	0,468
conclusion:		-	
B	No	Pearson chi-square	3,596
		Sig.	0,609
conclusion:		-	
NB	No	Pearson chi-square	7,107
		Sig.	0,213
conclusion:		-	
S	No	Pearson chi-square	2,849
		Sig.	0,583
conclusion:		-	
NS	No	Pearson chi-square	4,888
		Sig.	0,43
conclusion:		-	

The tests of educational level reveal that only one case is statistically significant, and it is the case B (the case where more NIMBYism exists), the conclusion is that lower education is significantly correlated with high NIMBYism.

Table 13: Evaluation of the influence of the variable educational level in the respondent's NIMBYism attitude.

Case	Statistically significant?	Chi-square test	
H	no	Pearson chi-square	31,59
		Sig.	0,137
conclusion:	-		
NH	no	Pearson chi-square	23,852
		Sig.	0,249
conclusion:	-		
W	no	Pearson chi-square	25,231
		Sig.	0,193
conclusion:	-		
NW	no	Pearson chi-square	20,511
		Sig.	0,426
conclusion:	-		
B	YES	Pearson chi-square	50,334
		Sig.	~0,000
conclusion:	**Lower educational degree contributes to NIMBYism**		
NB	no	Pearson chi-square	9,746
		Sig.	0,973
conclusion:	-		
S	no	Pearson chi-square	13,377
		Sig.	0,645
conclusion:	-		
NS	no	Pearson chi-square	22,946
		Sig.	0,291
conclusion:	-		

3.4.1 – Perception on economy of different technologies

The perception of economic impact of the RET was assessed according to the respondent's perception on bill. The results showed that more pessimistic attitudes (i.e. perception of higher costs) are obtained for hydro and wind power. Among these, the more extreme positions ("greatly raises bill") are the cases of respondents that live in municipalities where the technology is implemented. Biomass is the one that causes a more positive perception of reducing the bill, but solar power is the one that receives the more extreme attitude of greatly reducing it.

Aggregating the results in three categories ("reduces bill", "does not alter bill" and "raises bill"), only three cases exist where respondents perceive the technologies as "raising bill" more than "reducing bill": H, NH and W.

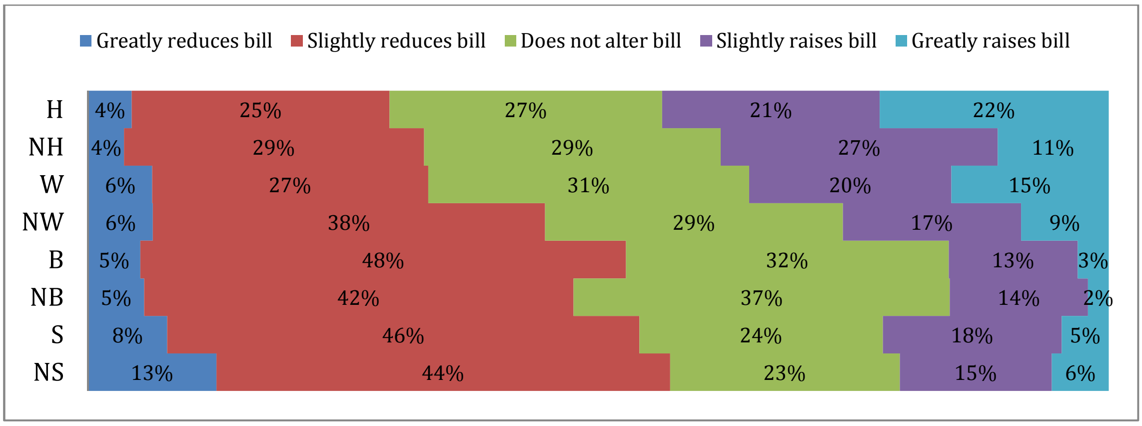

Figure 12: Respondents' perception on technology's contribution to the electricity bill.

A major finding of our study is that the perception that the majority of the Portuguese population holds on the full costs of electricity produced by different sources might be absolutely unrelated to the real market costs . Portuguese are pessimistic about the costs of hydro power, which of the analysed technologies is the only ones that operates outside the subsidized feed-in tariff system. They also perceive wind power as being more expensive than biomass and solar power. Judging from the feed-in tariffs, which are calculated in a way that gives the investor the adequate payback of the investment, plus some rent, solar power is the most expensive (45 c€/kWh), followed by biomass (10.7 c€/kWh) and in last place wind power (7.45c€/kWh) (EREF, 2012). There is, therefore, a total inversion of the perceived costs and the actual costs, if we accept that the feed-in tariff reflects true costs of technologies.

In table 14 it is possible to analyze that the fact that respondents live or not in a municipality where the technology exists only makes a statistical difference in the perception of hydro and wind power respondents. However, while residents in municipalities with hydro power tend to perceive the costs of hydro as contributors to lower the bill, in wind power the tendency is the opposite.

Table 14: Evaluation of the influence of the variable "respondent lives in a municipality where the technology exists" in the respondent's perception of economic impacts of the technology. Significance for $p<0.05$, using the Mann-Whitney U test.

	Sig.	Statistically Significant ?	**Conclusion**
Hydro	0,032	Yes	H residents perceive hydro power as significantly contributor to **lower** prices than NH residents
Wind	0,002	Yes	W residents perceive wind power as significantly contributor to **raise** prices than NH residents
Biomass	0,37	No	-
Solar	0,212	No	-

3.4.1.1 – Statistical significance analysis of socio-demographic data

Crossing the socio-demographic data with the perception of costs, Tables 15, 16 and 17 are generated.

Four cases out of eight have proven that age is statistically significantly correlated with the perception that respondents hold on the impact that the technologies have in the price of the bill. More specifically, in cases H, NW, S and NS, younger respondents perceive the technologies as contributing to lower the bills.

Table 15: Evaluation of the influence of the variable age in the respondent's perception of economic impacts of the technology

Case	Statistically significant?	ANOVA test	
H	YES	sig.	~0,000
conclusion:	Respondents that perceive hydro power as contributing to "slightly reducing bills" or "does not altering bills" are significantly younger than respondents who perceive it as "greatly raising bills"		
NH	no	sig.	0,061
conclusion:	-		
W	no	sig.	0,078
conclusion:	-		
NW	YES	sig.	0,018
conclusion:	Respondents that perceive wind power as "greatly reducing bills" are significantly younger than those who perceive it as "slightly raising the bills"		
B	no	sig.	0,251
conclusion:	-		
NB	no	sig.	0,489
conclusion:	-		
S	YES	sig.	~0,000
conclusion:	Respondents that perceive solar power as "greatly reducing bills" are significantly younger than respondents who perceive "slightly reducing bills", "does not alter bills" and "slightly raising bills".		
NS	YES	sig.	0,007
conclusion:	Respondents that perceive solar power as "greatly reducing bills" are significantly younger than respondents who perceive that solar power "does not alter bills".		

Two cases out of eight have proven that gender is statistically significantly correlated with the perception that respondents hold on the impact that the technologies have in the electricity bill. More specifically, in cases H and S, female respondents significantly perceive the technologies as contributing to lower the bills.

Table 16: Evaluation of the influence of the variable gender in the respondent's perception of economic impacts of the technology

Case	significant?	Chi-square test	
H	YES	Pearson chi-square	11,689
		Sig.	0,02
conclusion:	Males perceive hydro as contributing to raise prices more significantly than females		
NH	No	Pearson chi-square	0,827
		Sig.	0,935
conclusion:	-		
W	No	Pearson chi-square	0,988
		Sig.	0,912
conclusion:	-		
NW	No	Pearson chi-square	6,082
		Sig.	0,193
conclusion:	-		
B	No	Pearson chi-square	3,164
		Sig.	0,531
conclusion:	-		
NB	no	Pearson chi-square	4,064
		Sig.	0,397
conclusion:	-		
S	YES	Pearson chi-square	15,975
		Sig.	0,003
conclusion:	Males perceive solar as contributing to raise prices more significantly than females		
NS	No	Pearson chi-square	7,464
		Sig.	0,113
conclusion:	-		

Three cases out of eight have proven that educational level is statistically significantly correlated with the perception that respondents hold on the impact that the technologies have in the electricity bill. The tendency is the same across the cases H, W and S, where higher educated respondents significantly perceive the technologies as contributing to lower the electricity bills.

Table 17: Evaluation of the influence of the variable education in the respondent's perception of economic impacts of the technology

Case	Statistically significant?	Chi-square test	
H	YES	Pearson chi-square	36,721
		Sig.	0,002
conclusion:	**Lower educational degree is statistically associated with perception of hydro power as increasing bills**		
NH	no	Pearson chi-square	25,278
		Sig.	0,065
conclusion:	-		
W	YES	Pearson chi-square	31,7
		Sig.	0,011
conclusion:	**Lower educational degree is statistically associated with perception of wind power as increasing bills**		
NW	no	Pearson chi-square	17,956
		Sig.	0,326
conclusion:	-		
B	no	Pearson chi-square	20,921
		Sig.	0,182
conclusion:	-		
NB	no	Pearson chi-square	16,425
		Sig.	0,424
conclusion:	-		
S	YES	Pearson chi-square	38,04
		Sig.	0,001
conclusion:	**Higher educational degree is statistically associated with perceptions of solar power as a contributor to lower prices of bills**		
NS	no	Pearson chi-square	18,471
		Sig.	0,297
conclusion:	-		

3.4.2 – Perception on environmental impacts of different technologies

As for the question of environmental impacts, hydro power and biomass are perceived as the most threatening technologies. Solar power is the technology perceived as more environmental friendly, but that perception is more pronounced in municipalities where it is not implemented.

Aggregating the results in three categories ("protects environment", "no impact" and "endangers environment"), there is no single case of respondents perceiving any case as being more protective than endangering towards the environment, although it comes close in the case of residents of solar power municipalities.

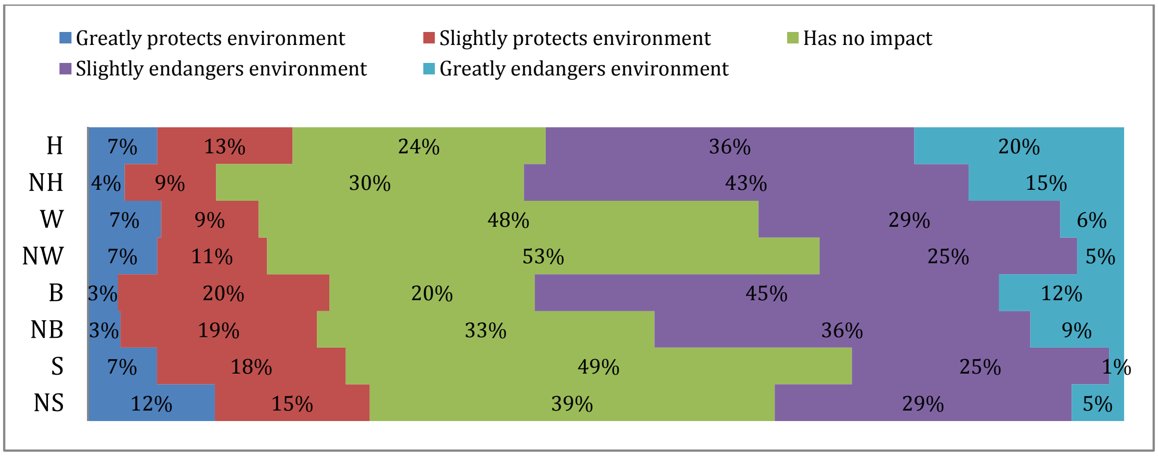

Figure 13: Respondent's perception on technology's environmental impact.

From the results presented in Table 18 it is possible to perceive that the "proximity effect" is only relevant in the case of biomass: respondents that live in municipalities where biomass exists tend to perceive biomass as significantly more threatening to the environment as the comparison group.

Table 18: Evaluation of the influence of the variable "resident lives in municipality where the technology is implemented" in the respondent's perception of environmental impacts of the technology. Significance for $p<0.05$, using the Mann-Whitney U test.

	Sig.	Significant?	**Conclusion**
Hydro	0,684	No	-
Wind	0,178	No	-
Biomass	0,035	Yes	B residents perceive biomass as significantly more threatening to the environment than NB residents
Solar	0,403	No	-

3.4.2.1 – Statistical significance analysis of socio-demographic data

In three cases (NH, S, NS) the age of respondents is statistically significant. However, the significance of age does not mean the same in these three cases: while in NH, younger respondents tend to perceive hydro power as more endangering to the environment than older respondents, in both cases of solar power (S and NS) the tendency is the opposite.

Table 19: Evaluation of the influence of the variable age in the respondent's perception of environmental impacts of the technology

Case	Statistically significant?	ANOVA test	
H	no	sig.	0,054
conclusion:	-		
NH	YES	sig.	0,001
conclusion:	**Respondents who perceive hydro power as "greatly endangering the environment" are significantly younger than respondents who perceive it as having "no impact"**		
W	no	sig.	0,162
conclusion:	-		
NW	no	sig.	0,256
conclusion:	-		
B	no	sig.	0,137
conclusion:	-		
NB	no	sig.	0,661
conclusion:	-		
S	YES	sig.	0,002
conclusion:	**Respondents that perceive solar power as "greatly protecting environment" are significantly younger than respondents who perceive "slightly protecting the environemnt", "has no impact" and "slightly threatens the environment".**		
NS	YES	sig.	0,002
conclusion:	**Respondents that perceive solar power as "slightly protecting the environment" are significantly younger than respondents who perceive that solar power "has no impact".**		

The gender proved to be statistically significant only for respondents who live in municipalities with biomass (B), where females perceive the technology as more threatening to the environment than males.

Table 20: Evaluation of the influence of the variable gender in the respondent's perception of environmental impacts of the technology

Case	significant?	Chi-square test	
H	no	Pearson chi-square	3,622
		Sig.	0,46
conclusion:		-	
NH	no	Pearson chi-square	0,576
		Sig.	0,966
conclusion:		-	
W	no	Pearson chi-square	4,902
		Sig.	0,297
conclusion:		-	
NW	no	Pearson chi-square	1,328
		Sig.	0,857
conclusion:		-	
B	YES	Pearson chi-square	18,267
		Sig.	0,001
conclusion:		**Females perceive biomass as more threatening to the environment**	
NB	no	Pearson chi-square	8,206
		Sig.	0,084
conclusion:		-	
S	no	Pearson chi-square	2,606
		Sig.	0,626
conclusion:		-	
NS	no	Pearson chi-square	3,034
		Sig.	0,552
conclusion:		-	

Only the cases of hydro power the educational degree proved to be statistically significant. In both cases respondents who perceive the technology as threatening to the environment have a statistically higher education degree.

Table 21: Evaluation of the influence of the variable education in the respondent's perception of environmental impacts of the technology

Case	Statistically significant?	Chi-square test	
H	YES	Pearson chi-square Sig.	40,005 0,001
conclusion:	Respondents with higher educational degree significantly perceive hydro power as more threatening technology		
NH	YES	Pearson chi-square Sig.	39,958 0,001
conclusion:	Respondents with higher educational degree significantly perceive hydro power as more threatening technology		
W	no	Pearson chi-square Sig.	15,875 0,462
conclusion:		-	
NW	no	Pearson chi-square Sig.	24,673 0,076
conclusion:		-	
B	no	Pearson chi-square Sig.	9,57 0,888
conclusion:		-	
NB	no	Pearson chi-square Sig.	22,298 0,134
conclusion:		-	
S	no	Pearson chi-square Sig.	19,255 0,256
conclusion:		-	
NS	no	Pearson chi-square Sig.	16,277 0,434
conclusion:		-	

3.4.3 – Perception on social impacts of different technologies

To what concerns the social impacts of the technologies, answers are globally more positive than economic or environmental impacts. More pessimistic opinions ("greatly harms local population") represent, at most, 7% for H respondents. However, it is also 20% H respondents who support the vision that hydro power "greatly develops local population".

The optimistic view ("greatly develops local population") presents less support in the case of NB, with only 3% of respondents.

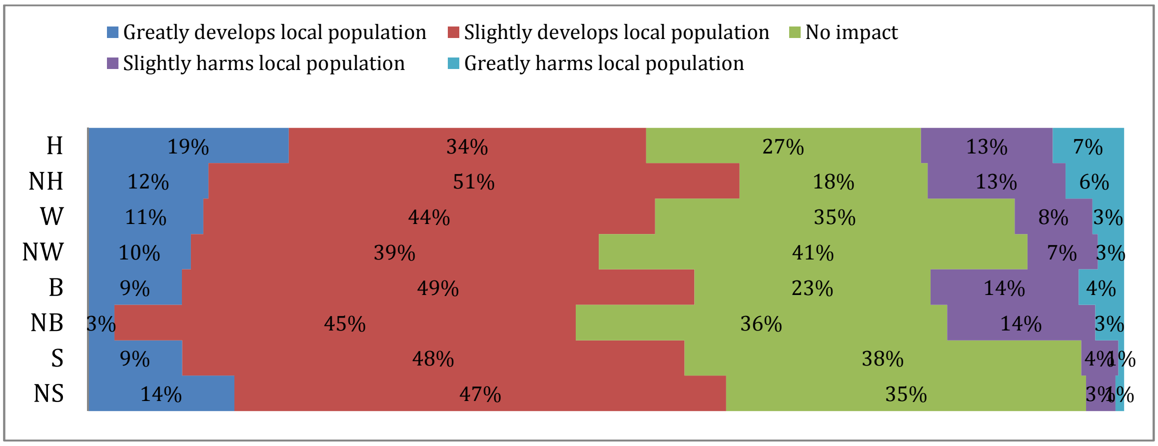

Figure 14: Respondent's perception on technology's social impact.

Regarding no responses in the last section of the questionnaire: respondents that live in municipalities where the technology is not implemented were always more inclined to give a "no answer" than respondents that live in municipalities where the technology is implemented, the only exception being the case of perception of costs of biomass. The biggest difference between no response rates was in the hydro power technology: "H" respondents were always more willing to respond, and their rates of no response were always lower than half of "NH" respondents. The highest no response rate was 18% in the cost perception of hydro power.

In Table 22 the statistically significance for social perception indicates that the proximity effect only affects the biomass surveys. The residents in biomass municipalities tend to perceive this technology as a contributor to develop local populations significantly more than NB respondents.

Table 22: Evaluation of the influence of the variable "resident lives in a municipality where the technology is implemented" in the respondent's perception of social impacts of the technology. Significance for $p<0.05$, using the Mann-Whitney U test.

	Sig.	Significant?	**Conclusion**
Hydro	0,651	No	-
Wind	0,282	No	-
Biomass	0,005	Yes	B residents perceive biomass as contributor to develop local populations significantly more than NB residents
Solar	0,097	No	-

3.4.3.1 – Statistical significance analysis of socio-demographic data

In five cases the age proved to be statistically significant in the social impacts perception. For the cases of hydro power (H and NH) and biomass (B), the perception that these projects benefit local populations increase significantly with the age. On the other hand, both cases of solar power (S and NS) have the opposite tendency, where significantly younger respondents believe that solar power develop the local communities.

Table 23: Evaluation of the influence of the variable age in the respondent's perception of social impacts of the technology

Case	Statistically significant?	ANOVA test	
H	YES	sig.	0,001
conclusion:	**Respondents who perceive hydro power as "greatly developing local populations" are significantly older than respondents who perceive it as "slightly developing local populations"**		
NH	YES	sig.	0,01
conclusion:	**Respondents who perceive hydro power as "greatly developing the local population" are significantly older than respondents who perceive it as having "no impact"**		
W	no	sig.	0,35
conclusion:	-		
NW	no	sig.	0,735
conclusion:	-		
B	YES	sig.	0,009
conclusion:	**Respondents who perceive biomass as having "no impact" are significantly younger than respondents who perceive it as "slightly developing local populations"**		
NB	no	sig.	0,131
conclusion:	-		
S	YES	sig.	0,004
conclusion:	**Respondents who perceive solar power as "greatly contributing to develop local population" are significantly younger than respondents who perceive it as "slightly developing local populations" and "slightly harms local population"**		
NS	YES	sig.	0,002
conclusion:	**Respondents that perceive solar power as "greatly developing local communities" are significantly younger than respondents who perceive that solar power "slightly develops local populationst" or brings "no impact"**		

The gender is significantly correlated with the social impacts perception only in two cases (NH and NS), with females being significantly more pessimistic than males.

Table 24: Evaluation of the influence of the variable gender in the respondent's perception of social impacts of the technology

Case	Statistically significant?	Chi-square test	
H	No	Pearson chi-square Sig.	5,66 0,226
conclusion:	-		
NH	YES	Pearson chi-square Sig.	14,136 0,007
conclusion:	**Males perceive hydro power as having more potential to develop local populations, significantly more than females**		
W	no	Pearson chi-square Sig.	19,064 0,265
conclusion:	-		
NW	No	Pearson chi-square Sig.	5,941 0,204
conclusion:	-		
B	no	Pearson chi-square Sig.	2,982 0,561
conclusion:	-		
NB	no	Pearson chi-square Sig.	9,046 0,06
conclusion:	-		
S	no	Pearson chi-square Sig.	3,081 0,544
conclusion:	-		
NS	YES	Pearson chi-square Sig.	10,289 0,036
conclusion:	**Females perceive solar power as having threatening to the development of local populations, significantly more than males**		

The tendency is the same across the four statistically significant cases (H, NB, S, NS): higher education degree is frequently related to a positiveperception of development of local communities.

Table 25: Evaluation of the influence of the variable education in the respondent's perception of social impacts of the technology

Case	Statistically significant?	Chi-square test	
H	YES	Pearson chi-square Sig.	28,924 0,024
conclusion:	**Respondents that perceive hydro power as "slightly developing local populations" have a significantly higher educational degree than those who perceive it as "slightly harming" the local population**		
NH	no	Pearson chi-square Sig.	15,836 0,464
conclusion:	-		
W	no	Pearson chi-square Sig.	15,875 0,462
conclusion:	-		
NW	no	Pearson chi-square Sig.	22,707 0,122
conclusion:	-		
B	no	Pearson chi-square Sig.	17,322 0,365
conclusion:	-		
NB	YES	Pearson chi-square Sig.	35,194 0,004
conclusion:	**Respondents that perceive biomass as "greatly harming local populations" possess a significantly lower level of education than the other categories**		
S	no	Pearson chi-square Sig.	35,189 0,004
conclusion:	**The higher the educational degree, the higher is the perception that solar power brings development to local populations**		
NS	no	Pearson chi-square Sig.	37,574 0,002
conclusion:	**The lower the educational degree, the higher is the perception that solar power harms local populations**		

We now present a brief resume of the influence of how the socio-demographic data (age, gender and education) and the fact of living in a municipality where the technology is present affect the acceptance of technologies in the country, the NIMBYism and the perception of economic, environmental and social impacts.

Table 26: Quantification of statistically significant results performed in section 3.

	Number of statistically significant tests			
	Municipality has technology	Age	Gender	Education
Acceptance of new projects in the country	1	6	1	3
NIMBYism	2	4	0	1
Perception economic impact	2	4	2	3
Perception environmental impact	1	3	2	2
Perception social impact	1	5	2	4
Total	7	22	7	13

3.4.4 - Influence of Sustainable Development perceptions on NIMBYism and acceptance of new projects in the country

The data obtained in sections 3.3 and 3.4 from the questionnaire are now crossed, in order to perceive whether the public acceptance of technologies is influenced by Sustainable Development questions. Statistical significance testes were done using Kendall's tau b, given that both variables to study are ordinal.

Starting with perception of costs, all the eight cases proved to be statistically significant correlated with the acceptance of the technologies in the country. The tendency across the eight cases is the same: respondents who perceive the technology as a contributor to lower the electricity bill agree with new projects of the technologies in the country.

Table 27: Evaluating the significance that perception of costs has in the acceptance of projects in the country

Case	Statistically significant?	Kendall's tau b	
H	YES	Approx Tau b Sig.	-3,579 ~0,000
conclusion:	**High acceptance of hydro power in the country is significantly correlated with perception of hydro power as a contributor to reducing bills**		
NH	YES	Approx Tau b Sig.	-3,69 ~0,000
conclusion:	**High acceptance of hydro power in the country is significantly correlated with perception of hydro power as a contributor to reducing bills**		
W	YES	Approx Tau b Sig.	25,231 ~0,000
conclusion:	**High acceptance of wind power in the country is significantly correlated with perception of wind power as a contributor to reducing bills**		
NW	YES	Approx Tau b Sig.	-6,61 ~0,000
conclusion:	**High acceptance of wind power in the country is significantly correlated with perception of wind power as a contributor to reducing bills**		
B	YES	Approx Tau b Sig.	-4,345 ~0,000
conclusion:	**High acceptance of biomass in the country is significantly correlated with perception of biomass as a contributor to reducing bills**		
NB	YES	Approx Tau b Sig.	-3,889 ~0,000
conclusion:	**High acceptance of biomass in the country is significantly correlated with perception of biomass as a contributor to reducing bills**		
S	YES	Approx Tau b Sig.	-2,838 0,005
conclusion:	**High acceptance of solar power in the country is significantly correlated with perception of solar power as a contributor to reducing bills**		
NS	YES	Approx Tau b Sig.	-2,749 0,006
conclusion:	**High acceptance of solar power in the country is significantly correlated with perception of solar power as a contributor to reducing bills**		

However, NIMBYism is only correlated with perception of costs in one case, W, where the higher the level of NIMBYism is associated with the perception of wind power as a source that contributes to raise the electricity bill. However, given that if a power plant is built it will have an impact in the bill, regardless of where it is built, it was expected that the cost of the bill would not be a reason to increase NIMBYism.

Table 28: Evaluating the significance that perception of costs has in the NIMBYism attitude

Case	Statistically significant?	Kendall's tau b	
H	no	Approx Tau b	0,977
		Sig.	0,328
conclusion:		-	
NH	no	Approx Tau b	1,151
		Sig.	0,25
conclusion:		-	
W	YES	Approx Tau b	2,817
		Sig.	0,005
conclusion:	**NIMBYism is associated with perception of wind power as a contributor to raise the bills**		
NW	no	Approx Tau b	-9,96
		Sig.	0,319
conclusion:		-	
B	no	Approx Tau b	1,299
		Sig.	0,194
conclusion:		-	
NB	no	Approx Tau b	1,405
		Sig.	0,16
conclusion:		-	
S	no	Approx Tau b	-0,263
		Sig.	0,793
conclusion:		-	
NS	no	Approx Tau b	0,631
		Sig.	0,528
conclusion:		-	

From all the cases of Table 29 we can conclude that a positive attitude towards new RES power plants is significantly correlated with a positive view on environmental aspects of the technologies.

Table 29: Evaluating the significance that perception of environmental impact has in the acceptance of projects in the country

Case	Statistically significant?	Kendall's tau b	
H	YES	Approx Tau b	-5,985
		Sig.	~0,000
conclusion:	**High acceptance of hydro power in the country is significantly correlated with perception of hydro power as having a good impact in the environment**		
NH	YES	Approx Tau b	-8,022
		Sig.	~0,000
conclusion:	**High acceptance of hydro power in the country is significantly correlated with perception of hydro power as having a good impact in the environment**		
W	YES	Approx Tau b	-4,328
		Sig.	~0,000
conclusion:	**High acceptance of wind power in the country is significantly correlated with perception of wind power as having a good impact in the environment**		
NW	YES	Approx Tau b	-2,79
		Sig.	0,005
conclusion:	**High acceptance of wind power in the country is significantly correlated with perception of wind power as having a good impact in the environment**		
B	YES	Approx Tau b	-4,98
		Sig.	~0,000
conclusion:	**High acceptance of biomass in the country is significantly correlated with perception of biomass as having a good impact in the environment**		
NB	YES	Approx Tau b	-3,518
		Sig.	~0,000
conclusion:	**High acceptance of biomass in the country is significantly correlated with perception of biomass as having a good impact in the environment**		
S	YES	Approx Tau b	-3,908
		Sig.	~0,000
conclusion:	**High acceptance of solar power in the country is significantly correlated with perception of solar power as having a good impact in the environment**		
NS	YES	Approx Tau b	-2,334
		Sig.	0,02
conclusion:	**High acceptance of solar power in the country is significantly correlated with perception of solar power as having a good impact in the environment**		

From Table 30 we can conclude that NIMBYism is only correlated with perception of costs in one case, NB, where the higher the level of NIMBYism is associated with the perception of biomass power as a source with negative environmental impact.

Table 30: Evaluating the significance that perception of environmental impact has in the NIMBYism attitude.

Case	Statistically significant?	Kendall's tau b	
H	no	Approx Tau b	1,259
		Sig.	0,208
conclusion:	-		
NH	no	Approx Tau b	0,231
		Sig.	0,817
conclusion:	-		
W	no	Approx Tau b	1,505
		Sig.	0,132
conclusion:	-		
NW	no	Approx Tau b	1,559
		Sig.	0,119
conclusion:	-		
B	no	Approx Tau b	0,707
		Sig.	0,48
conclusion:	-		
NB	YES	Approx Tau b	3,872
		Sig.	~0,000
conclusion:	**NIMBYism is significantly correlated with a negative perception of biomass' environmental impact**		
S	no	Approx Tau b	1,317
		Sig.	0,188
conclusion:	-		
NS	no	Approx Tau b	0,633
		Sig.	0,527
conclusion:	-		

From Table 31 we can conclude that all the cases are statistically significant, in the same direction. Respondents who perceive the technologies as contributors to the development of local communities present also a positive attitude towards new RES projects.

Table 31: Evaluating the significance that perception of social impact has in the NIMBYism attitude.

Case	Statistically significant?	Kendall's tau b	
H	YES	Approx Tau b Sig.	-5,431 ~0,000
conclusion:	**High acceptance of hydro power in the country is significantly correlated with perception of hydro power as developing local communities**		
NH	YES	Approx Tau b Sig.	-10,38 ~0,000
conclusion:	**High acceptance of hydro power in the country is significantly correlated with perception of hydro power as developing local communities**		
W	YES	Approx Tau b Sig.	-5,558 ~0,000
conclusion:	**High acceptance of wind power in the country is significantly correlated with perception of wind power as developing local communities**		
NW	YES	Approx Tau b Sig.	-4,062 ~0,000
conclusion:	**High acceptance of wind power in the country is significantly correlated with perception of wind power as developing local communities**		
B	YES	Approx Tau b Sig.	-4,745 ~0,000
conclusion:	**High acceptance of biomass in the country is significantly correlated with perception of biomass as developing local communities**		
NB	YES	Approx Tau b Sig.	-4,611 ~0,000
conclusion:	**High acceptance of biomass in the country is significantly correlated with perception of biomass as developing local communities**		
S	YES	Approx Tau b Sig.	-3,908 ~0,000
conclusion:	**High acceptance of solar power in the country is significantly correlated with perception of solar power as developing local communities**		
NS	YES	Approx Tau b Sig.	-2,754 0,006
conclusion:	**High acceptance of solar power in the country is significantly correlated with perception of solar power as developing local communities**		

From Table 32 we can conclude that NIMBYism is significantly correlated with four cases (H, NH, W and NS). The tendency is the same: respondents who perceive the technology as harmful to the development of local communities are significantly NIMBY.

Table 32: Evaluating the significance that perception of social impact has in the NIMBYism

Case	Statistically significant?	Kendall's tau b	
H	YES	Approx Tau b	2,23
		Sig.	0,026
conclusion:	Perceiving hydro power as harmful to local the development of local populations is significantly correlated with NIMBYism		
NH	YES	Approx Tau b	2,439
		Sig.	0,015
conclusion:	Perceiving hydro power as harmful to local the development of local populations is significantly correlated with NIMBYism		
W	YES	Approx Tau b	3,118
		Sig.	0,002
conclusion:	Perceiving wind power as harmful to local the development of local populations is significantly correlated with NIMBYism		
NW	no	Approx Tau b	-0,647
		Sig.	0,518
conclusion:	-		
B	no	Approx Tau b	0,048
		Sig.	0,961
conclusion:	-		
NB	no	Approx Tau b	1,557
		Sig.	0,119
conclusion:	-		
S	no	Approx Tau b	-0,461
		Sig.	0,645
conclusion:	-		
NS	YES	Approx Tau b	2,291
		Sig.	0,022
conclusion:	Perceiving solar power as harmful to local the development of local populations is significantly correlated with NIMBYism		

Note, however, that the case with most NIMBYism is B, and in its case no significant correlation was found with economic, environmental or social impact perceptions.

3.5 – Willingness to Pay (WTP)

Some studies present in the literature address the question “willingness to pay” (WTP). Since the renewables are generally more expensive than the traditional sources, schemes such as feed-in tariffs are created to compensate them The cost of these support schemes are usually passed to the consumers, requiring that these would pay a higher price for the electricity bill.

The Eurobarometer (European Commission, 2006) clearly asked whether respondents would be willing to pay 5%, 10%, 25% more than the present electricity bill; the majority of the Portuguese respondents (59%) would not be willing to pay more. In our study, while we didn’t directly asked the respondents their willingness to pay , it is possible to articulate two questions (section 2 “opinion about new power plants in the country” and section 3 “perception of costs”) and deduct which respondents are willing to pay more for renewables, although not on concrete values like the Eurobarometer. Crossing the tables of the respondents that agree with new projects in the country (“totally agree” + “tend to agree”), with the respondents that perceive the technologies increasing the prices (“greatly increases bill” + “slightly increases bill”) we obtained the results shown on Table 33.

Table 33: Willingness to pay (WTP).

	A: Perceives technology as contributing to higher prices	B: Agrees with new projects in the country	WTP: Responded both A and B	WTP/A
H	43,8%	77,3%	27,3%	62,4%
NH	38,0%	76,9%	20,2%	53,2%
W	35,2%	90,7%	23,6%	67,1%
NW	26,0%	91,2%	15,7%	60,5%
B	15,7%	85,8%	10,2%	65,4%
NB	15,6%	85,3%	10,5%	67,5%
S	22,1%	97,2%	16,5%	74,7%
NS	20,5%	95,2%	15,5%	75,7%

Results suggest that, in line with the Eurobarometer (European Commission, 2006), it is a minority of the respondents that agree with new projects and simultaneously are aware that they will increase the electricity bill, most concretely 17.2% of the total respondents. This minority ranges from 27.3% in municipalities with hydro power to 10.2% in municipalities with biomass. Putting in order the technologies, from preferred to least preferred, according to WTP: hydro, wind, solar, biomass.

Of course, like said previously, it is also only a minority of the respondents that appear to be aware that wind, biomass and solar power plants are subsidized (i.e. their real costs are above the average of the electricity bill). Still, it is interesting to note that a large part of the respondents (53% to 76%) who perceive the technology as more expensive, still agree with its implementation: the last column of this table shows how many, among those who perceive the technology as contributing to higher prices, still accept to pay more for it.

3.5.1 – Analyzing the causes for WTP

In the cases of hydro and wind power, living in a municipality where the technology exists influences statistically significantly the willingness to pay in a positive way.

Table 34: Influence of the variable “resident in a municipality where the technology exists” on willingness to pay (WTP), using Fisher’s Exact Test (significance for $p<0.05$).

Technology	Sig.	Conclusion
Hydro	0,027	**Municipalities where hydro power exists have statistically more respondents willing to pay**
Wind	0,008	**Municipalities where wind power exists have statistically more respondents willing to pay**
Biomass	0,529	-
Solar	0,383	-

Age proved to be significant only in the case H, where willingness to pay is more evident for older respondents.

Table 35: Influence of age on willingness to pay (WTP).

Case	Statistically significant?	t-test	
H	YES	t	-4,242
		Sig.	~0,000
conclusion:	Older respondents are more willing to pay		
NH	no	t	-1,882
		Sig.	0,061
conclusion:	-		
W	no	t	-0,932
		Sig.	0,055
conclusion:	-		
NW	no	t	-1,643
		Sig.	0,101
conclusion:	-		
B	no	t	-1,382
		Sig.	0,168
conclusion:	-		
NB	no	t	0,384
		Sig.	0,702
conclusion:	-		
S	no	t	0,262
		Sig.	0,793
conclusion:	-		
NS	no	t	-1,264
		Sig.	0,207
conclusion:	-		

Gender is statistically significant in two cases, B and NS, with different meanings: in the former, females are more willing to pay, while in the latter this willingness is more evident for males.

Table 36: Influence of gender on willingness to pay (WTP).

Case	Statistically significant?	Fisher's exact test	
H	no	Sig.	0,352
conclusion:	-		
NH	no	Sig.	0,174
conclusion:	-		
W	no	Sig.	0,337
conclusion:	-		
NW	no	Sig.	0,101
conclusion:	-		
B	YES	Sig.	0,043
conclusion:	**Females are more willing to pay**		
NB	no	Sig.	0,175
conclusion:	-		
S	no	Sig.	0,145
conclusion:	-		
NS	YES	Sig.	~0,000
conclusion:	**Males are more willing to pay**		

Education is significant in two cases, H and B, where respondents with a lower educational degree are more willing to pay.

Table 37: Influence of educational level on willingness to pay (WTP).

Case	Statistically significant?	Chi-square	
H	YES	Pearson chi-square Sig.	16,599 0,002
conclusion:	**Respondents with lower educational degree are more willing to pay**		
NH	no	Pearson chi-square Sig.	6,735 0,151
conclusion:	-		
W	no	Pearson chi-square Sig.	6,347 0,175
conclusion:	-		
NW	no	Pearson chi-square Sig.	-6,616 0,158
conclusion:	-		
B	YES	Pearson chi-square Sig.	12,399 0,015
conclusion:	**Respondents with lower educational degree are more willing to pay**		
NB	no	Pearson chi-square Sig.	3,337 0,503
conclusion:	-		
S	no	Pearson chi-square Sig.	2,594 0,628
conclusion:	-		
NS	no	Pearson chi-square Sig.	1,871 0,759
conclusion:	-		

4 – Discussion and conclusions

Surveys addressing the public opinion on four renewable energy technologies (hydro, wind, biomass and solar) were implemented in Portugal. The five objectives were (i) to study the public acknowledgement with the technologies, (ii) to analyze the position of respondents towards new renewable energy projects in the country, (iii) to understand to what extent is the NIMBYism phenomenon existing in Portugal, (iv) to frame the perception that the Portuguese hold on Sustainable Development issues, regarding each of the four technologies and (v) to study if willingness to pay more for RET's is a reality among the Portuguese.

The results obtained do not always differ much in cases where technology is already present and where it is not present, with the exception being biomass. It is possible that proximity to the power plant becomes more influent for smaller distances. In our case we based our geographical area roughly in literature results, (50 miles in (Greenberg, 2009) and (Ansolabehere, 2007)), which in Portugal can be roughly the size of municipality "concelho". Other intrinsic problem in our survey could be the size of some power plants: some of them are small enough that the population might not be aware of their existence. For example, the largest Portuguese solar power plant is 45.8 MW with an area of 250 ha, and the smallest has only 0.4 MW installed power, 625 times smaller than the former; in biomass the biggest is 95 MW and the smallest 0.3 MW. Other difficulty in our survey was the task of formulating a question that addresses each of the three pillars of Sustainable Development. In order to avoid a long questionnaire that would imply a larger absence of responses, only three questions were included in this section. It would have certainly been needed more than one question for each pillar to obtain a better perception of the respondents' opinion, since the pillar "economy" is more than the cost of the electricity bill, and the pillar "social", besides not being still fully understood, certainly means more than local issues (Ribeiro et al., 2011).

The Portuguese are fairly acquainted with renewable energy technologies. Hydro power, due to its historical importance, is acquainted by almost all respondents. Solar power, however the least contributor to the total amount of produced electricity, is more known than biomass. Outside municipalities where it is not present solar power is still acknowledged by 64.2% of respondents. Residents in municipalities with biomass power plants acknowledge this technology significantly more than residents outside these municipalities. Males acknowledge this technology statistically significantly more than women. Higher educational level is significantly correlated with being acquainted with biomass.

Zografakis (2010) evaluated the acknowledgement of technologies, and also concluded that, among the four technologies in our study, biomass is the least known, with 59% (our case was 74% in municipalities with biomass, and 64% for the control group). In their case, however, solar power is the most known technology, while in ours it was hydro power. It is clear that technology awareness depends certainly on the geographical area covered by the survey; for example the island of Crete addressed in Zografakis (2010) has more wind and solar power than hydro power and it is reflected in the acknowledgement shown by the respondents.

Public attitude towards new projects of the RES technologies in the country is generally positive. Solar power leads the preferences with 97% of acceptance, while hydro power ranks last place with 77%. Analyzing deeper the causes for the case with least acceptance (hydro power), using statistical significance tests, it is possible to conclude that the attitude towards hydro power projects in the country is more negative when (i) the lower is the respondents' educational degree, (ii) the higher are the perceived costs of the technology (iii) the worse are the perceived environmental impacts of the technology and (iv) the worse is the perception of how hydro power contributes to the development of local communities.

The Eurobarometer (European Commission, 2012) emphasizes that the Portuguese believe that "the goal of achieving 20% of renewable energy in the EU is reasonable": while this number is 57% for the EU average citizen, it is 59% for the Portuguese ones. Our results are in line with the Eurobarometer 2012, since the Portuguese showed a generally supportive attitude towards more renewable energy projects. As shown in section 3.2, the case showing least acceptance for "building new projects in country" is NH, and even this one still shows 77% of positive attitudes.

Cicia (2012) concluded that preferences among Italians are towards wind and solar. In their study, biomass shows very low levels of acceptance (70% of respondents are against the use of biomass for generating electricity), against our results, that were only 14% to 15%.

Kaldellis (2013) studied the perceptions of Greeks towards new RET's projects, and a similar conclusion is the favorable opinion towards photovoltaics. The levels of acceptance in their work were: wind, photovoltaics and hydro projects with 63%, 83% and 67%, respectively, whereas we obtained 91.5%, 96.5% and 77%.

It is obvious that acceptance of projects depends much on the location. To our knowledge no studies have been done in Portugal concerning either NIMBYism or acceptance of RET's.

The survey also asked what would be the attitude towards new power plants near respondent's residence, as a mean to evaluate a "distance factor". This distance factor has been called NIMBYism in the literature. Given that 41% to 83% of population doesn't change their position towards a new power plant far away or near their residence, we can conclude that NIMBYism isn't definitely an attitude shared by the majority. Solar power remains the technology causing less NIMBY reactions, with only 13% of respondents showing a better opinion towards the technology in the country than near their residence. However, 51.6% of the residents in municipalities with biomass show NIMBYism . Among them, 14.1% are extreme NIMBYists that totally support the technology in the country but totally reject it if implemented in respondent's "freguesia". The second highest NIMBYism values are obtained in municipalities with hydro power (46.1%). Statistical significance tests proved that both biomass and hydro cases present more NIMBYism than comparison groups (i.e. NB and NH cases, sampled in municipalities where the technology does not exist). Other tests show that the extreme NIMBYists are statistically older. In the case of biomass, lower education is statistically correlated with higher NIMBYism. In the case of NB, the worse is the perception of its environmental impacts, the higher is the NIMBYism. In both H and NH, the less optimistic views towards local communities' development due to hydro power are statistically correlated with NIMBYism.

Similarly to Jones (2009), we addressed NIMBYism between a group affected by wind power and a comparison group. In their case, NIMBYism was found to be more present in the W than the NW group in a statistical significant way; our case, on the contrary, shows less NIMBYism in W than NW, although not statistically significant difference.

Upreti (2004) concluded that biomass as an “industrial-scale” tends be seen by local residents as a threat to the environment. Although this was also the conclusion for our questionnaires in regions where no biomass exists, we found no relation between the environment perception of residents in municipalities with biomass and NIMBYism.

Regarding the perception of technologies’ impact on the bill of electricity, the major finding is that the respondents appear unaware of the “true costs” of technologies. Assuming that feed-in tariffs reflect real costs of technologies, the public opinion perceives the costs of the RET in the reverse order: solar power as cheaper, followed by biomass, wind and hydro as most expensive. Only 21 to 22% perceive solar power as raising prices, while the figures for hydro power range from 38 to 44%. Optimism towards the RET prices is significantly shown by younger respondents in four cases (H, NW, S and NS), by females (H and S) and higher educated respondents (H, W and S). For all the eight cases, acceptance of new RET projects in the country increases significantly with the perception of RET’s as contributing to lower prices, to protect the environment and to develop local communities.

The worst environmental impact is attributed to hydro power, while wind and solar power are seen as the least threatening. All technologies are seen more as contributing than harming local populations’ development. The cases where more harm is perceived are biomass and hydro. In these cases, the perception of a positive social impact increases with age, and for H and NB this perception increases with higher educational degree.

A major conclusion is that NIMBYism in the most extreme case, B, could not be explained under economic, environmental or social impacts perception.

Among the socio-demographic data (age, gender and education), it is the age variable the one that can, in a greater amount of tests, explain the evaluation of acceptance of new projects in the country, NIMBYism and perception of economic, environmental and social impacts.
Only a minority of respondents is willing to pay more for renewables: this number ranges from 10.2% to 27.3% depending on the technology. Ordering the technologies from the highest to the lowest preferences according to willingness to pay, the obtained results were hydro, wind, solar, biomass. Municipalities with hydro and wind power have significantly more respondents willing to pay for these technologies. Surprisingly, no statistical significance was found in the relation of a positive perception of environmental impacts of any renewable energy technology and willingness to pay for it, contrarily to Bang et al. (2000). Willingness to pay increases significantly with age (in the case of H), and decreases with an increasing educational level (cases B and NS).

However, the majority of respondents perceive technologies as contributing to lower prices. Among those who perceive the technologies as contributing to raise the electricity bill, willingness to pay ranges from 53.2% (NH) to 75.7% (NS).

Willingness to pay for a specific project location, in Scotland, was handled by Hanley and Nevin (1999). Their study concluded that residents willingness to pay for hydro power was the highest oned, followed by a wind farm, and lastly by biomass. This is exactly the order perceived by the respondents in our study.

Gracia et al. (2012) also concluded from their Spanish study that it is a minority of respondents that are willing to pay more for renewables. However, the order of preferences differs from our study, given that solar power is favored in their case, more than wind and biomass.

Zografakis et al. (2010) did a study in the Greek island of Crete, and concluded that larger willingness to pay was presented by respondents with higher family income. In our case, we did not ask family income, but instead we asked educational level. If we accept that higher education is correlated with higher family income, our results are opposed to Zografakis et al. (2010): the statistical tests on our data proved that only in two cases there is a significant correlation between educational level and willingness to pay, and this happens in biomass and hydro power, where less educated respondents show more willingness to pay.

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