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How do you like wind farms? Understanding people's preferences about new energy landscapes with choice experiments

This study aims at understanding people's preferences about wind energy in order to foster the installation of new power plants in Italy. The application of a choice experiment allowed the willingness to pay to be estimated for the following attributes: wind turbines position, turbine height, number of turbines per wind farm and minimum distance of the farm from houses/coast. According to our results the majority of people perceive wind energy positively and prefer offshore wind farms. People recognise the importance of preserving landscape and think that wind turbines do not improve its beauty. In this respect the installation of new wind farms can be considered a second-best solution in terms of landscape preservation, but a first-best solution if other aspects are taken into account.

Keywords: *Choice experiment, Wind energy, Landscape externalities, Italy, Renewable energy, Internet survey*

JEL: *H23,Q01,Q20,Q51,Q56,O13*

1. Introduction

Directive 2009/28/EC (23rd April 2009, also known as the "20–20–20 European Directive") prescribes the adoption of measures to foster the production of energy from renewable resources. The aim of the Directive is to have 20% of gross energy consumption in the EU supported by renewables and 10% of cars using biofuel by 2020. This is an ambitious target and wind energy has an important role to play in this.

In Italy, the consumption of energy from renewables was 8.9% of the total gross consumption of energy in 2009[1], while the objective imposed by the EU Directive for Italy is 17%. More specifically wind energy accounts for the 9% of the total energy produced from renewables in Italy (71% hydroelectric, 11% biomasses and waste, 8% geothermic, 1% solar photovoltaic) in 2009[2].

Despite its advantages in terms of "clean" energy production, wind energy has been widely criticised especially for its impact on landscape. The main negative externalities generated by wind farms on landscape can be summarised as visual impacts, noise and biodiversity losses (bird deaths). Among these 3 sources of disturbance, the visual impact is the most important given that technology

[1] Source: GSE (2012).
[2] Source: ISTAT (2009).

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improvements have reduced noise and bird collisions depend on the location of the wind farms (migratory routes etc.). The determinants of the visual impact are their location, their size, the height of the turbines and distance from reachable viewpoints.

These externalities are often the core of opposition[3] towards the creation of wind farms by residents and interest groups (environmental associations like WWF, Greenpeace etc.). Given the problems regarding public perception of wind energy plants a better understanding of people's preferences in terms of wind farm characteristics would help to mitigate opposition to their construction and therefore lead to a greater rate of success in the spreading of this technology. Furthermore, when dealing with landscape impact evaluation the European Landscape Convention fosters people's participation given that in art. 1 it defines landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors".

In most cases landscape is not rival and not excludable[4] and therefore enters the category of pure public goods. This implies that when dealing with the visual externalities of wind farms affecting landscape we are in the context of market failures: the impacts on landscape of the wind farms are not internalised by market transactions. In order to quantify these externalities in monetary terms economists have developed a set of tools called non-market valuation techniques. Non-market valuation techniques include two main families of methodologies: revealed preference (RP) techniques and stated preferences (SP) techniques. RP include hedonic pricing, the travel cost method and averting behaviour, while SP include contingent valuation (CV) and choice experiments (CE). An advantage of SP techniques is that they allow for the valuation of both use and non-use values. This characteristic results as being particularly important in landscape externalities valuation because non-use values (e.g. option values, bequest values) might play an important role and need to be considered. In this study CE has been applied for the detailed information it offers in terms of the marginal rate of substitution of every characteristic of the analysed good/policy[5].

While there are several studies that applied choice experiments (CE) to investigate preferences for different mixes of renewables in the energy market (Roe et al., 2001; Bergmann et al., 2006; Borchers et al., 2007; Navrud and Bråten, 2007; Longo et al., 2008; Scarpa and Willis, 2010; Aravena et al., 2012; Menegaki, 2012; Zoric´ and Hrovatin, 2012; Cicia et al., 2012) only a few (Ladenburg and Dubgaard, 2007; Krueger et al., 2011; Landry et al., 2012; Dimitropoulos and Konto-

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[3] Warren et al. (2005, see Table 2, p. 857) present a synthesis of the main arguments deployed to oppose wind farm development. The authors quote as the main source of debate and opposition the transformation of natural landscape into what could be defined according to Pasqualetti (2011) as "energy landscape".

[4] In some circumstances landscape can be subject to certain degrees of rivalry (e.g. in cases of recreational congestion), while it is difficult (but yet possible) that it is excludable. Nevertheless in the majority of cases it is not excludable and not rival.

[5] Further details about this choice are given in section 3.

leon, 2009; Meyerhoff et al., 2010; Strazzera et al., 2012; Ek, 2002; Aravena et al., 2006) evaluated the impact of wind turbines with CE focusing on preferences about wind turbines location[6]. Only two studies (Cicia et al., 2012; Strazzera et al., 2012) applied CE to wind power in Italy but neither looked specifically at the preferences for the location of new wind farms considering possible installations both onshore and offshore. Strazzera et al. (2012) focused on a case study in Sardinia and did not consider the option of offshore wind farms while Cicia et al. (2012) studied the preferences of consumers in choosing non-fossil energy sources (wind, solar, agriculture biomass, nuclear) in their energy contract. As far as we know, this is the first research that investigates people's preferences for wind farms in terms of location and structure of new installations in Italy. Furthermore our study considers the minimum distance (both from houses and coastline depending on the location - inland or offshore) attribute in conjunction with the location attribute. Krueger et al. (2011) considered these attributes in conjunction but only for offshore wind farms, given that in their study the location attribute referred to different positions offshore of the Delaware Shoreline (USA).

This study aims at understanding people's preferences about wind energy in order to foster the installation of new wind farms in Italy to accomplish the EU Commission Renewable Energy Roadmap. The study is based on a web survey structured in order to understand respondents' knowledge of renewable energy, energy market liberalization, and wind energy landscape impact perception. Particular focus is placed on studying preferences for the location of new wind farms (onshore or offshore) and their configuration in terms of visibility (number of turbines, height of turbines and minimum distance from houses or coast). A CE has been applied to derive the benefits, in monetary terms, for the different wind farms configurations according to people's preferences. Data have been analysed using a Random Parameter Logit (RPL) model.

The rest of the paper is structured as follows. Section 2 presents a review of previous studies that applied CE considering wind farms location among the attributes. Section 3 focuses on the methodological background, experimental design and survey characteristics. Results are presented in section 4 and discussed in section 5.

2. Previous applications of Choice Experiments to wind power externalities

Ladenburg (2009) provided a good summary of the literature concerning the application of both Contingent Valuation (CV) and CE with regard to offshore

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[6] Despite applying CE, A´ lvarez-Farizo and Hanley (2002) considered the case study of a new wind farm to be built in La Plana (north Spain) but they considered a generic impact on landscape among the included attributes. According to their results all attributes considered (impact on flora, impact on cliffs and impact on landscape) are significant and people are more concerned on the impact on flora and habitat than on landscape.

wind farms. Strazzera et al. (2012, see Table A1, p. 11) updated the Ladenburg (2009) review to 2012 considering only CE studies. The review presented in this article focuses on the studies that applied CE: CV studies (see for example Nomura and Akai, 2004; McCartney, 2006) are not so relevant within the context of this research given the difficulties in comparing the monetary results obtained from these two methodologies.

Among the CE studies that considered wind farms location preferences, some are specifically targeted to offshore wind farms (Ladenburg and Dubgaard, 2007; Krueger et al., 2011; Landry et al., 2012), others to onshore wind farms (Dimitropoulos and Kontoleon, 2009; Meyerhoff et al., 2010; Strazzera et al., 2012) and only a few authors (Ek, 2002; Aravena et al., 2006) consider both options.

2.1 Preferences for offshore wind farms location

Ladenburg and Dubgaard (2007) did one of the first studies specifically targeted at the elicitation of the WTP for reducing the landscape externalities of offshore wind farms. The survey administered covers future offshore wind farms in Denmark. The attributes considered are: distance from the shore, number of turbines per wind farm, number of offshore wind farms and the yearly cost per household to implement the policy. Respondents showed a mean WTP of 146, 96 and 122 €/household/year for moving the turbines to 12, 18 and 50 Km respectively (the base level is 8 Km). These value vary when considering subgroups of people. In particular people who see wind turbines from their residence or holiday homes have a higher WTP while young people (age < 30) seem insensitive to visual disamenities, showing a WTP close to zero. Interestingly, the marginal WTP and therefore the marginal damage of the turbines view drops for distances greater than 18 Km.

Krueger et al. (2011) analysed preferences for offshore wind farms at different distances from the coast placed off the Delaware Shoreline (USA). The authors found that WTP increases up to 6 miles (about 9.6 Km) of distance and then starts decreasing. More precisely the WTP[7] of inland residents was \$19, \$9, \$1 and 0 per household for turbines located at 0.9, 3.6, 6, and 9 miles offshore. The WTP for the same distances but considering residents living near the ocean was much higher \$80, \$69, \$35, and \$27.

Landry et al. (2012) combined travel cost and choice experiments to understand the impacts of offshore wind farms on coastal tourism. They used a phone survey for the travel cost data collection and an internet survey for the CE. Data were collected from residents of the north-eastern coastal counties in North Carolina (USA). The authors found that placing wind turbines 1 mile from the coast has a negative effect and implies a compensating variation per beach visitor of \$55 or \$105 depending on the model applied. The effect of placing the turbines at 4

[7] WTP values are expressed as \$/household/year.

miles from the coast or from the sounds did not result as statistically significant. The authors concluded that the installation of wind turbines far away from the coast/estuary will have no effect on recreation and tourism in the studied region.

2.2 Preferences for inland wind farms locations

Dimitropoulos and Kontoleon (2009) concentrated on the valuation of the factors that influence social acceptance of wind farms. In particular they considered not only the physical attributes (number of turbines and height) of the wind farms but also the governance characteristics of the project planning (involvement of local municipalities and representatives) and the conservation status of the installation area (whether it was part of the Natura 2000[8] protection scheme). For their CE study, the authors collected 212 questionnaires from residents on the islands of Naxos and Skyros (Greece). Data were analysed applying RPL models both to the pooled sample and to the two distinct areas considered in a separate way. The focus was on the willingness to accept a compensation rather than on WTP for installing renewables. The authors concluded that governance and siting attributes had more weight in determining people choices than the physical attributes. Local communities involvement resulted as being one of the key factors to avoid local opposition. Furthermore the analysis of the two groups of respondents (for example with regard to tourism) showed a great variability of opinions suggesting that generalisation of the results should be done cautiously.

Meyerhoff et al. (2010) analysed the externalities of onshore wind turbines in two regions of Germany. The authors applied CE and considered the following attributes: size of wind farms, maximum height of turbines, impact on red kite population, minimum distance from residential areas, monthly surcharge to power bill. A latent class model (LCM) was applied for data analysis finding 3 classes of preferences: advocates, moderates, opponents. The authors did not manage to characterise the sources of heterogeneity with socio-economic characteristics. The results highlight how the most important attributes (those with a greater WTP) are the impact on the red kite population and minimum distance from residential areas. The height of turbines did not result as significant in the data analysis. Interestingly the majority of respondents declared that they are not disturbed by wind turbines.

Strazzera et al. (2012) applied CE to investigate the social acceptability of a new wind farm in south-west Sardinia (Italy). The authors focused particularly on the visibility of the wind farm from the seaside. They considered only inland locations (either close to the coast, with different degrees of visibility from the coast – well visible, not well visible, not visible) or in proximity to historical sites. The choice of considering only inland locations was due to the fact that, being based on a real case study, the location of the wind turbines was constrained by the

[8] For more information about Natura 2000 see http://goo.gl/ffTJz.

considered project. Along with common CE analyses (Multinomial Logit – MNL, Random Parameters Logit – RPL) the authors combined the results of a principal component analysis on qualitative questions based on a Likert scale as determinants, among other socio- economic variables, of class membership probability in a LCM. They defined their approach as a "Latent class model with psychometric variables". According to the results of the MNL model they found that the visibility of the wind turbines from the beach is the most critical factor. The LCM analysis showed that about 25% of the sample are strong opponents to the project regardless of the amount of compensation offered. It should be noted that monetary values have been calculated as willingness to accept: this choice introduces some difficulties in comparing the estimates with other studies that elicited willingness to pay (WTP).

2.3 Preferences for wind farms location considering onshore and offshore option simultaneously

Ek (2002) analysed the preferences of Swedish consumers with regard to wind farms noise, size, height (taller or shorter than 60 m), location (mountains, offshore, onshore) and price (change of electricity cost per kWh). The author conducted a postal survey collecting 488 usable questionnaires for the CE. According to the results, Swedish households prefer wind farms offshore rather than onshore and even worse on mountains. Turbine height and noise did not result as significant, while small wind farms are preferred to large plants unless they are sited offshore.

Aravena et al. (2006) took as case study the implementation of new wind farms in Chile. The authors designed a CE considering the following attributes: project location (offshore, along the coast, inland and on the mountains), the total area covered (300, 500 or 800 football pitches), the percentage of birds hurt or killed per year (1, 3 or 5) and the price vector (expressed as monthly bill surcharge). Despite the fact that the study was more concerned with the effect of the inclusion/exclusion and differentiation of the levels of the cost attribute, in the CE version that considered the WTP people preferred wind farms offshore with a minimum impact on bird species.

3. Material and methods

3.1 Choice experiments

This study applies the choice experiment (CE) methodology (Batsell and Louviere, 1991; Hensher, 1994; Louviere, 1988a,b, 1991; Louviere and Hensher, 1982). CE has been widely applied in the last decade for valuation purposes like transport studies, environmental valuation, marketing, agribusiness and health. Among non-market valuation techniques CE is part, along with Contingent Valuation

(CV), of the stated preference methods. With respect to CV, CE allows not only a welfare measure to be derived for the good/service as a whole, but also provides further insights to understand to what measure the single characteristics of the good/service influence the probability of choosing it. In fact CE is based on Random Utility Models (RUMs) (Luce, 1959; Manski, 1977; McFadden, 1974; Thurstone, 1927; Yellott, 1977), which assume that utility is derived from the properties/characteristics of goods/services rather than directly from the goods themselves. The good/service characteristics (referred to as "attributes" in CE) are therefore the determinants of the good/service utility.

In practice, the good/service examined is split into its key characteristics, or ″attributes″. Each attribute can assume different ″levels″. To make things clearer it is useful to give an example. If the good being investigated is a smartphone, its attributes might be the size of display (SOD), the type of connectivity and cost. The levels of the attribute SOD could be 3″, 4″, 5″; those of the attribute connectivity 3G, 4G and those of cost 100 €, 200 € and 400 €. As can be seen attribute levels can be qualitative or quantitative. With a procedure called experimental design, the number of all possible combinations of attributes and levels are reduced. In this way the researcher is able to present a reasonable number of treatment combinations (or choice profiles) to the respondents. Treatment combinations are usually grouped into ″choice sets″ so that the respondents choose between a minimum of 2 treatments combinations. To make the choice task more realistic, a further choice option is often added to the choice set: the *status quo* - in the case of policy - or ″none of these″ - in the case of goods - option.

In this way the researcher derives the probability of a person n choosing alternative i (where *alternative* is synonymous of *choice option*) among a set of possible alternatives in a choice set.

If the utility derived from a person n for the *i-th* good i is defined as:

$$U_{ni} = V_{ni} + \varepsilon_{ni} \quad (1)$$

Where V is the observable part of utility, and ε the unobservable one.

It is then possible to specify the probability of choosing alternative i over another alternative j as (Train, 2009):

$$P_i = Prob(U_i > U_j \forall j \neq i) \quad (2)$$

$$= Prob(\varepsilon_{ni} - \varepsilon_{nj} > V_{nj} - V_{ni} \forall j \neq i) \quad (3)$$

$$= \int_{\varepsilon} I(\varepsilon_{ni} - \varepsilon_{nj} > V_{nj} - V_{ni} \forall j \neq i)\, \mathrm{f}(\varepsilon_n) \mathrm{d}\varepsilon_n \quad (4)$$

Where f(ε*n*) is the density of the unobserved portion of utility and the indicator function $I(\cdot)$ assumes the following values:

$$I(\cdot) = \begin{cases} 1 & \text{if } i \text{ is chosen} \\ 0 & \text{if } i \text{ is not chosen} \end{cases} \tag{5}$$

Looking at equation 2, it is straightforward to note that what determines the probability of choice of an individual between two alternatives *i* and *j* is their difference in utility, given that utility is an ordinal measure. Equation 4 is a multidimensional integral and its solution depends on the assumption about the distribution of the density function $f(\varepsilon n)$. In this study the Mixed Logit[9] model (Train, 2009) has been applied and the integral in equation 4 does not take a closed form: it can be calculated only with approximation methods. RPL models have the advantage of taking into consideration respondents taste heterogeneity. Nevertheless these are not the only models that consider such aspect. Latent class models (LCM) (Greene and Hensher, 2003) are another option when heterogeneity matters. RPL models take into account taste heterogeneity in a continuous fashion, considering it random with a specific density function. It is up to the researcher to identify which parameters of the utility function should be treated as random and to make strong assumptions imposing the distribution of their density function (normal, lognormal, triangular, uniform). Latent class models can be considered a semiparametric variant of MNL models (Greene and Hensher, 2003), in which the probability of choosing a specific option is conditional on both the attributes bundle and the individual belonging to a specific group of people with common taste characteristics.

Data analysis can be performed with both commercial (NLogit®R[10], Stata®R[11]) or open source (R Core Team, 2012; Croissant, 2011; Bierlaire, 2003) software. The interested reader can find more details on the econometric specifications of the different CE models in Hensher et al. (2005) and Train (2009).

Welfare measures are derived by looking at the marginal rate of substitution between non-monetary attributes and the monetary attribute included in the indirect utility function (IUF). Therefore, the consumer surplus can be calculated within the context of discrete choice models such as the relative Hicksian compensating variation (Hoyos, 2010). When dealing with additive IUFs, the formula for calculating WTP becomes:

$$WTP_j = -\frac{\partial U / \partial x_j}{\partial U_j / \partial p} = -\frac{\partial \beta_j}{\partial \beta_p} \tag{6}$$

Where *j* is the *j-th* attribute, *U* is the indirect utility function and *p* is the price attribute.

[9] Also known as Random Parameter Logit (RPL).
[10] http://www.limdep.com/
[11] http://www.stata.com/

3.2 Experimental design

An unlabelled choice experiment was opted for, and given the purpose of the study, the design of the choice experiment took into consideration 5 attributes: wind turbines position (offshore, plain, mountain/hills), turbine height, number of turbines per wind farm, minimum distance of the wind farm from houses and the yearly increase per household of the electricity bill in order to create the new wind farms. The description of each attribute was accompanied by an icon for each of its levels in order to ease the choice task process (see Figure 1). The attributes and their levels are presented in more detail in Table 1.

Other attributes were taken into consideration, such as the wind turbine rotor (vertical or horizontal) and the impact of the wind turbines on birds. The former was discharged after an enquiry to the European Wind Energy Association (EWEA) on the effective usage of horizontal turbines on large-scale plants. EWEA confirmed that big turbines mainly use vertical rotors, so the shape of the turbine has not been taken into consideration. With regard to impact on the avifauna, recent publications have highlighted that this is minimum (Farfa´n et al., 2009). Furthermore, as highlighted by Barrios and Rodr´ıguez (2004) the impact of wind farms should be considered case by case taking into consideration the presence of migrating birds etc. It was therefore decided to focus on the five attributes discussed above testing them and their presentation in a focus group.

The full factorial of the attributes and levels was reduced to a fractional factorial orthogonal design with SPSS®R software as suggested by Hensher et al. (2005). This process led to 16 choice profiles (Table 1), grouped into 8 choice tasks with 3 choice options each (2 choice profiles plus the no-choice option). Figure 2 shows a choice task as presented to the respondents. The design was not blocked and therefore each respondent tackled 8 choice tasks.

3.3 The internet survey

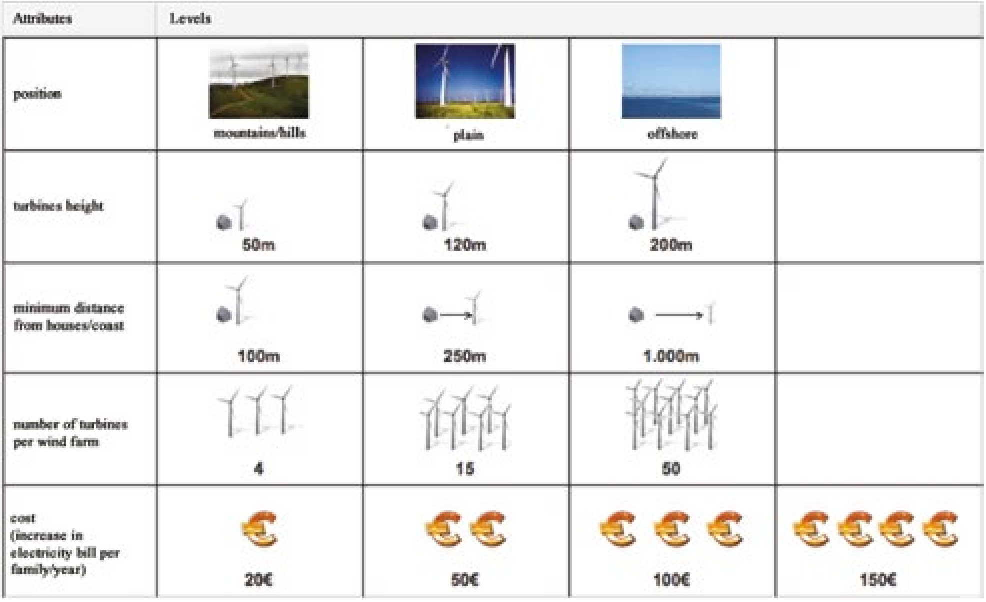
The questionnaire was administered to the respondents via web. The application handling the survey and data collection was custom developed in order to provide a smooth user experience and resemble a paper questionnaire.

From a technical viewpoint the web survey relied on open source languages like PHP[12], Javascript and MySQL[13] as database. We opted for an open access format of the questionnaire, namely no credentials were asked in order to participate in the survey and whoever had the link to the application could answer. In order to prevent multiple answers by the same respondents we recorded their IP address, completion time and we made use of cookies.

The questionnaire was divided into 7 sections. The questions in the first sec-

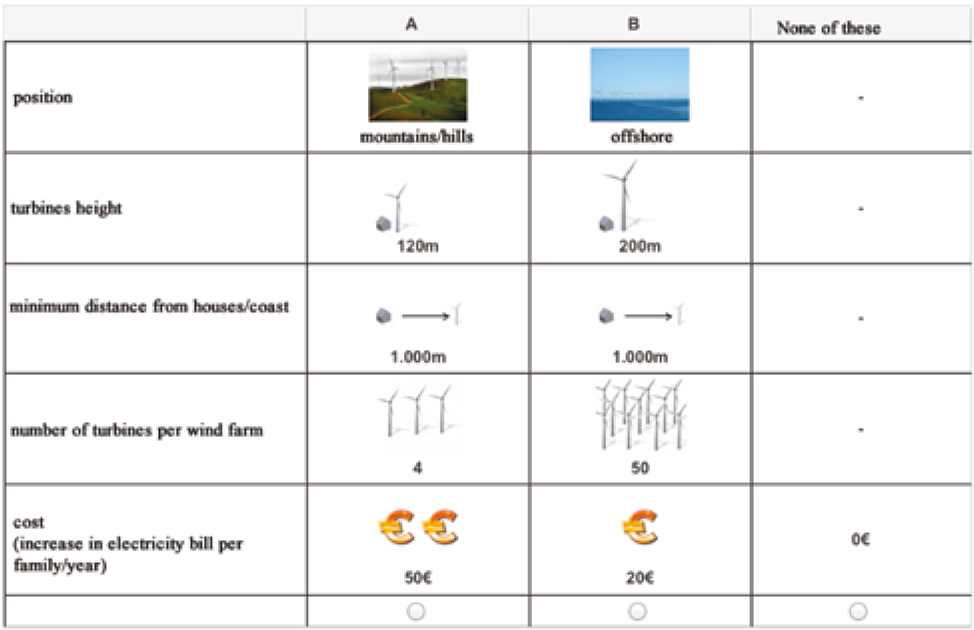
[12] See http://www.php.net/
[13] See http://www.mysql.com/

Figure 1. CE attributes and levels.



Attributes	Levels			
position	mountains/hills	plain	offshore	
turbines height	50m	120m	200m	
minimum distance from houses/coast	100m	250m	1.000m	
number of turbines per wind farm	4	15	50	
cost (increase in electricity bill per family/year)	20€	50€	100€	150€

Figure 2. One of the 8 choice tasks.



	A	B	None of these
position	mountains/hills	offshore	-
turbines height	120m	200m	-
minimum distance from houses/coast	1.000m	1.000m	-
number of turbines per wind farm	4	50	-
cost (increase in electricity bill per family/year)	50€	20€	0€
	○	○	○

Table 1. CE design.

Choice task	Choice profile	Position	Height (m)	Distance (m)	N. turbines	Cost*
1	1	plain	120	250	15	20
	2	plain	50	1000	4	100
	3	none	0	-	0	0
2	4	mountain/hills	120	1000	4	50
	5	offshore	200	1000	50	20
	6	none	0	-	0	0
3	7	mountain/hills	50	100	4	20
	8	mountain/hills	50	250	50	150
	9	none	0	-	0	0
4	10	offshore	50	250	4	100
	11	mountain/hills	200	100	15	100
	12	none	0	-	0	0
5	13	mountain/hills	200	250	4	50
	14	plain	200	100	4	150
	15	none	0	-	0	0
6	16	offshore	50	100	15	50
	17	plain	50	100	50	50
	18	none	0	-	0	0
7	19	mountain/hills	50	1000	15	150
	20	offshore	120	100	4	150
	21	none	0	-	0	0
8	22	mountain/hills	50	100	4	20
	23	mountain/hills	120	100	50	100
	24	none	0	-	0	0

* €/year per household.

tion were targeted at understanding the respondent’s knowledge of different renewables, his opinion on them and knowledge about the liberalisation of the energy market. Section two was specifically devoted to the respondent’s knowledge of wind energy and his opinions on it. The third section introduced the choice task showing 9 images of potential wind turbines in different locations and illustrating the policy scenario. Section four was dedicated to the choice experiment. In the fifth section some control questions were asked about the level of understanding and certainty about the choice experiment answers. Respondents were also asked what they thought about the choice experiments attributes to understand whether some attributes dominated the others or whether they were considered in conjunction. Sections seven and eight asked socio recreational and socio-economic questions respectively.

Before publishing the survey online 2 rounds of tests took place: first the recruited respondents were asked to complete the survey being watched by a member of our staff in order to see how people were coping with the task. During this phase people could ask about problems encountered or other issues. Once the main potential interface problems had been corrected, a second test was performed leaving people to answer the survey by themselves and asking for feedback at the end. When the questionnaire tests had been completed the questionnaire was published online.

3.4 Sample selection

Given the open access nature of the internet questionnaire respondents were invited to respond to our survey through paid advertising[14] on two internet channels: Google AdWords[15] and Facebook Advertising[16]. The text of the advertising was quite generic ("The future of Italian energy: have your say!") in order to avoid participation biases due to the over-representation of specific interest groups (i.e. renewables' advocates, nuclear energy advocates etc.). We targeted the advertising campaign at Italian residents. Respondents were not rewarded with monetary incentives. A further channel of questionnaire promotion was the involvement of consumers' protection organisations asking them to drive the attention of their members posting a link to the survey on their newsletters.

4. Results

389 completed questionnaires were collected in 2011. 383 completed and suitable questionnaires were analysed (6 questionnaires were rejected out of 389, given that 6 respondents declared that they do not live in Italy) providing 3064 choice observations[17].

The sample mean age is 35.3 years (min 20, max 66) (Table 2), the majority are men (63.7%) and 48.6% of people have a bachelor degree while 40.7% completed high school and 8.4% have a M.Sc. or Ph.D.

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[14] For paid advertising we mean the publication in the above mentioned channels of a text announcement redirecting the viewer to the internet domain hosting the questionnaire once the link in the advertising text was clicked. Paid advertising was managed using a mixed strategy between pay-per-click and pay-per-view, were for the first the advertiser pays a fixed amount every time the announcement gets clicked, while for the second a fixed amount is paid for a given stock of visualisations of the announcement.

[15] See http://www.google.com/ads/ for further details.

[16] See https://www.facebook.com/advertising for further details.

[17] This figure is given by the 8 choices made by each of the 383 respondents (383*8 = 3064).

With regard to the geographical location of residence 57.2% of people live on the plain, 18.3% on hilly terrain, 8.6% on the mountains, 7.6% on the coast, 7.6% in the countryside and the remaining 0.8% close to a lake.

The majority of the sample spend their holidays at the sea side (78.1%) and/or on the mountains (53.3%) while preferences are inverted for shorter trips during the weekend (mountains 65% and/or the seaside 45%).

The declared rate of membership to environmental associations (16.7%) is in line with national statistics.

Table 2. Age categories of sample (min 20, max 66, median 33).

Age category	Frequency	Percent	Census 2011 (%)*
18 - 24	54	14.10	8.32
25 - 44	248	64.75	31.45
45 - 60	73	19.06	27.34
> 60	8	2.09	32.89
Total	383	100	100

* see ISTAT (2011).

4.1 Knowledge about renewables

Among different energy sources, wind energy is known by the majority of the sample and is considered renewable by 99.5% (Table 3).

Looking with more precision at people's knowledge about wind energy, 85.9% of the sample have seen a wind turbine and 33.7% have been close enough to hear the noise of its rotor. Only 6% of the sample can see a wind turbine from the windows of their house, while 22.7% declared to have seen wind turbines at least once from the windows of their holiday home/hotel.

4.2 Perceptions of wind energy and its impact

94.5% of the sample have a positive opinion with regard to wind energy (Table 5) and 92.1% consider its growing diffusion positively (Table 6). Furthermore, according to respondents, wind energy should be second only to solar energy in terms of investment policies in future years (Table 4).

With regard to a general impact on tourism, 83% of the respondents declared that they would be willing to spend their holidays in a house/hotel with wind turbines visible from the windows (Table 7). A permanent view of wind turbines has a greater impact: in fact only 67.7% of people would be keen to buy a house with this characteristic (Table 8).

Table 3. Which of the following energy sources are renewable?

	Yes	No	Don't know	Sum
biomasses	64.8	23.8	11.5	100
coal	2.9	94.3	2.9	100
natural gas	9.1	85.6	5.2	100
petrol	0.5	98.7	0.8	100
nuclear	11.2	82.2	6.5	100
photovoltaic	98.4	0.8	0.8	100
hydroelectric	89.0	6.3	4.7	100
wind energy	99.5	0.3	0.3	100

Table 4. On which of the following energy sources should Italy invest more in the future?

	Nothing	A little	Reasonable	A lot	A great deal	Sum
hydrogen	9.9	17.5	24.5	27.9	20.1	100
biomasses	6.8	21.4	31.9	24.3	15.7	100
coal	58.0	35.5	5.2	1.0	0.3	100
natural gas	18.0	45.4	27.7	6.0	2.9	100
petrol	63.7	30.8	5.0	0.3	0.3	100
nuclear	59.5	18.5	12.8	4.2	5.0	100
solar (thermo/photovoltaic)	0.8	1.3	8.1	26.6	63.2	100
hydroelectric	1.6	6.8	25.8	27.9	37.9	100
wind energy	1.3	2.6	11.2	31.9	53.0	100

Table 5. How do you consider wind energy?

	Frequency	Percent
very negative	1	0.3
negative	6	1.6
indifferent	9	2.3
positive	201	52.5
very positive	161	42.0
don't know	5	1.3
Total	383	100

Table 6. What do you think about the growth of wind energy?

	Frequency	Percent
very negative	4	1.0
negative	10	2.6
indifferent	9	2.3
positive	171	44.6
very positive	182	47.5
don't know	7	1.8
Total	383	100

Table 7. Would you spend your holidays in a place close to a wind farm with wind turbines visible from the windows of your house/hotel?

	Frequency	Percent
yes	318	83.0
no	24	6.3
don't know	41	10.7
Total	383	100

Table 8. Would you buy a house with wind turbines visible from windows?

	Frequency	Percent
yes	258	67.4
no	55	14.4
don't know	70	18.3
Total	383	100

Data reported in Table 9 provide quite interesting insights into people's opinion about wind energy. First of all 65% of the sample do not consider the fact that birds and other species could suffer a negative impact from the installation of wind turbines a great problem, while 19.1% quite agree with this opinion.

Nearly 50% of people do not think that wind turbines are a source of noise pollution.

With regard to the housing market, 37.4% think that wind turbines will not affect the price of nearby houses, while 33.2% are quite in line with this belief and 21.9% disagree.

75% of people do not feel that wind turbines improve landscape beauty, at the same time 61.9% think that their landscape impact is negligible if compared with the environmental and health impacts of traditional fossil fuel power plants.

The majority of the sample (94%) are in favour of public incentives to foster renewables and this figure keeps good for specific subsidies to wind farms development (87.7%).

4.3 Electricity bill and preferences on electricity market offers

Despite the liberalisation of the electricity market, 80% of the sample have the old monopolist company (Enel) as energy supplier. 52.2% of people do not know whether their electricity contract contemplates renewables as energy source, while 21.1% chose to go for green electricity contracts and 26.6% did not. The main reasons for not choosing an energy supply contract that considers renewables are that people did not know they have the possibility of choosing their energy supplier (20.8%), they do not know what is meant by green energy (20%), they did not know they have the possibility of choosing to buy green energy in their contract (35.6%), they find it too expensive (20%).

A quite considerable proportion of the sample (71%) knows the yearly amount of their electricity bill. Among those who know their domestic electricity costs, 33% of people spend up to 300 €/year, 30% between 300 € and 500 € and only 10.2% more than 1000 €/year.

Table 9. There are positive and negative aspects related to wind energy. How much do you agree with the following statements? (data are reported in percentages on the basis of 383 observations). Some of these questions were inspired by Ek (2002)

	Strongly disagree	Disagree	Quite agree	Agree	Strongly agree	Don't know	Sum
Wind energy does not damage the environment	6.5	19.1	27.2	23.0	22.2	2.1	100
Wind energy is a source of noise nuisance	10.7	38.9	21.1	6.8	1.0	21.4	100
Wind energy is an expensive energy source	19.6	39.4	15.9	3.4	1.6	20.1	100
Wind turbines improve landscape beauty	43.6	32.1	17.2	3.1	1.8	2.1	100
Wind energy is not very reliable due to wind inconstancy	25.6	43.6	16.2	5.7	2.9	6.0	100
The impact (collision and noise) of wind turbines on birds and other species is of great concern	23.0	42.0	19.1	9.4	3.7	2.9	100
Wind energy is renewable (it is not exhaustible because it relies on wind)	1.3	1.0	11.5	21.1	63.7	1.3	100
The development of wind farms will reduce adjacent real estate values	8.9	28.5	33.2	12.0	9.9	7.6	100
The landscape impact of wind energy is negligible if compared to that on health and the environment of other fossil sources	3.7	9.9	22.5	22.7	39.2	2.1	100

4.4 Choice experiment results: RPL model

Data were dummy coded[18] and analysed using Nlogit®R software. We applied a Random Parameter Logit model to overcome the limitations of MNL models[19]. Random parameters were selected looking at the significance of the standard deviation of their distribution and after some investigation we found that the only

[18] An alternative approach would have been to use effects coding (Hensher et al., 2005, p. 119). A problem that might arise using dummy coding (Bech and Gyrd-Hansen, 2005) is that the base level of an attribute, namely the utility of the excluded dummy in the utility function, might get confounded with the utility grand mean.

[19] In particular MNL models are subject to the independence from irrelevant alternative assumption (IIA), which is rarely satisfied.

significant random parameter was position ″offshore″. The latter was assumed to be normally distributed. According to our analysis the attribute position ″offshore″ was the only attribute for which the tastes of respondents varied significantly. RPL model results along with WTP estimates are reported in Table 10 and 11.

Table 10. Yearly electricity bill as declared by the sample.

	Frequency	Percent	Valid Percent
I have no idea	108.00	28.20	
0 – 50 €	3	0.78	1.09
50 – 100 €	11	2.87	4.00
100 – 300 €	78	20.37	28.36
300e – 500 €	84	21.93	30.55
500e – 1000 €	71	18.54	25.82
> 1000 €	28	7.31	10.18
Total	383	100	100

All attributes are significant taking a 90% confidence level apart from "height 200 m", "position mountain/hills" and the number of wind turbines (when 15). The sign of the cost attribute is negative as expected. With regard to the relative importance of the utility of attributes, respondents show the highest WTP for building new wind farms offshore and at the maximum distance from houses (1 Km in our case).

The negative sign of the ASC for the status quo option (do nothing) implies that people are keen on fostering the implementation of policies in favour of the installation of new wind farms.

With regard to the location (base level "plain") of new wind farms people show a mean WTP of 96 € for offshore location.

People have a disutility from taller wind turbines, probably connected with their greater visibility. In fact in order to avoid the use of wind turbines 120 m high (with respect to 50 m) people are willing to pay nearly 30 €.

With regard to the ″distance from houses/coast″ attribute, WTP grows with distance testifying that the lower the potential visual impact of the new wind farms the higher people's utility. In fact people are willing to pay nearly 47 € for moving wind farms from a minimum distance of 100 m to 250 m and 78 € for moving them to 1,000 m. It should be noted that, as expected, the increase in WTP is not directly proportional to the increase in distance, showing a decreasing marginal utility.

People seem to prefer bigger wind farms, namely with a larger number of wind turbines per unit. The WTP expressed for having 50 turbines per wind farm with respect to 4 is 13 €.

Table 11. Choice experiment results.

Variable	Coeff.[a]	Std.Error	t-value	p-value	WTP[b]	Sign.[c]
ASC	-1.370	0.14	-9.86	0.00		***
Position_mountain/hills	0.149	0.10	1.43	0.15		
Position_offshore[d]	1.182	0.15	7.93	0.00	96.50	***
Height_120M	-0.360	0.09	-3.90	0.00	-29.40	***
Height_200M	0.029	0.10	0.29	0.77		
Distance_250M	0.577	0.07	7.74	0.00	47.10	***
Distance_1000M	0.956	0.12	7.77	0.00	78.00	***
N.turbines_4	-0.162	0.09	-1.85	0.06	-13.30	.
N.turbines_15	0.063	0.10	0.66	0.51		
Cost	-0.012	0.00	-16.12	0.00		***
Derived standard deviations of random parameter distributions						
Position_offshore	1.90	0.15	12.40	0.00		***

[a] McFadden Pseudo R-squared = 0.208; LL = -2666.742; Halton draws = 400.

[b] €/year per household of electricity bill increase.

[c] Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1.

[d] Random parameter assumed normally distributed.

4.5 Choice experiment control questions

After the section relative to the CE choice tasks, respondents had to answer a set of questions related to their difficulties in the CE and on the importance given to the different attributes while responding. Attribute attendance is an important aspect in order to understand the quality of the data collected and the reliability of the monetary estimates (Scarpa et al., 2013).

The majority of the sample (58%) did not find the choice tasks particularly difficult. The difficulties found by the rest of the sample were mainly due to the fact that they found several attributes equally important, they found that there were too many variables to take into consideration and finally because they do not think that consumers should pay in order to have a clean environment.

The position on the territory has been the most important factor in choosing for 25% of the respondents followed by the yearly increase in the electricity bill (23.8%), minimum distance from houses (21.1%), number of turbines on each wind farm (9.4%) and height of the turbines (1.3%). Some respondents (18.8%) did not have a most important attribute but based their choice on different attributes in each scenario.

91.9% of the sample declared to have considered the different attributes in conjunction while choosing.

5. Discussion and conclusions

The results obtained show that the Italian sample considered has a positive perception of wind energy. The qualitative analysis of responses gave interesting insights into some common problems associated with wind power implementation like landscape impact, NIMBY (Not In My Back Yard) effect of plants location, effect on house prices and tourism. According to our results people recognise that wind energy has a negative impact on landscape. At the same time this impact results as negligible when compared to the environmental and health side effects of traditional fossil fuel power plants. Looking at the NIMBY effect, people are less concerned about a temporary view of wind turbines during holidays, while a permanent view of wind turbines from windows decreases the likelihood of people buying such a house.

What clearly emerges is how the landscape impact of wind turbines should be minimised. This can be derived from the result that people prefer to limit wind turbines visibility in terms of both location (offshore) and distance from viewpoints. At the same time they prefer wind farms with a consistent number of wind turbines (50): this could be interpreted in two ways. First a need to concentrate the impacts and second the willingness to increase power generation per power plant. CE results allowed a ranking to be made of the attributes that people judge more critical in determining the landscape impact of wind farms. Looking at the relative importance of the attributes considered, location (offshore) lies in top position, followed by the minimum distance (1,000 m) from houses/coast, the height of turbines (120 m) and their number per wind farm (50). Interestingly, the CE ranking of preferences about the relative importance of attributes has been confirmed by a direct question on this topic made in the control questions section of the questionnaire.

It is possible to say that Italian preferences with regard to wind farms do not differ critically from those found in other geographical contexts. This is an important result of this study given the characteristics of the Italian peninsula in terms of length of coastline and cultural heritage. With regard to size, Navrud and Bråten (2007) found that people prefer a few large wind farms rather than several small ones in Norway. Looking at wind farms location, offshore wind farms resulted as the preferred solution in Sweden (Ek, 2002) and Chile (Aravena et al., 2006), while a nonlinear relationship between distance from the coast and WTP was found in Denmark (Ladenburg and Dubgaard, 2007) and USA (Krueger et al., 2011; Landry et al., 2012).

The WTP expressed in order to implement the installation of new wind power plants shows how there is a considerable consumer surplus that should help in implementing public policies or boost the energy supply from the private sector by setting a new trend in favour of renewables. Policies aiming at fostering the green energy markets should therefore exploit the consumer surplus for green sources. Renewables have recently been heavily subsidised, but once incentives end, liberalisation of the electricity market could take advantage of renewables offering "green electricity" packages. Once the demand side is keen on this product diversification, companies could take advantage of the consumer surplus in order to finance new green plants installations. In this sense a parallel can be drawn with the "ethical banking" (EB) sector. What we can term "ethical energy contracts" is based on the assumption that customers are willing to pay some extra money in order to use green energy, as in the EB context they forego a certain rate of return on their investments to be sure that they are used in financing socially and ethically correct projects and firms. Therefore the presented results can be very useful in fostering renewables from the supply side.

Two aspects should be considered with caution in generalising our results. First, our sample cannot be considered representative of the Italian population especially with respect to age (Table 2). The sample considered has a lower mean age than the Italian population and therefore the results obtained should be interpreted as the expectations of younger people rather than those of the overall Italian population. This is both an effect of how people were recruited for the survey and of the choice to opt for a web-survey, where elder people are less likely to be reached. Second, this is a general survey on a hypothetical national scenario. Therefore site-specific assessments are needed in order to take into account the peculiarities of different contexts like the presence of historical sites, birds' migratory routes, important tourist attractions etc. In this respect CE WTP estimates could be used as input in further modelling as shown by Drechsler et al. (2011). These authors used the CE results presented in Meyerhoff et al. (2010) as input in order to derive the social cost function of the installation of new wind farms[20]. Moreover, the conclusions drawn on tourism impact and house prices should be validated by further research on real case studies applying different methodologies like the travel cost method for tourism and hedonic pricing for house prices in the Italian context. Looking at other analyses, Landry et al. (2012) applied the travel cost method and found that tourism on the North Carolina (US) coast is not particularly affected by the presence of offshore wind farms. Hoen et al. (2009) found little evidence of the impact of wind turbines proximity on property values in the USA. These authors applied a multi-site hedonic pricing analysis.

This research confirms how landscape perception is an evolving concept. People recognise the importance of preserving landscape and think that wind tur-

[20] The social cost function includes production and externalities costs and is minimised under the constraint of an exogenous energy production target. Energy production depends on the location of turbines and more precisely on the frequency distribution of wind speeds observed at the location and altitude of the wind farm. Potential locations are found with GIS software while optimal locations are found combining geographical data in order to maximise energy production and CE data for the minimisation of the social costs.

bines do not improve its beauty, but at the same time are aware that preservation does not always mean lack of action. In this respect the installation of new wind farms can be considered a second-best solution in terms of landscape preservation, but a first-best solution if other aspects are taken into account, such as for example the reduction of the landscape, health and environmental impacts of traditional power plants. In fact wind energy is a substitute for other sources of energy production. This does not mean that the installation of wind turbines should be a priority without compromises, but rather that they might gain a good degree of acceptance if their location is chosen in order to minimise their impacts. It is therefore important to take people’s opinions into consideration when implementing wind energy plants, trying to choose their location in order to minimise their visibility and landscape impact without compromising their efficiency.

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