Investors’ preferences for wind energy policy: results of a web-based survey using conjoint measurement technique

Emanuela Menichetti*

Institute for Economy and the Environment, ‘IWOe–HSG’
University of St. Gallen, Tigerbergstrasse 2, 9000 St. Gallen, Suisse

Abstract - Policy targets and measures have been set by several countries around the world to support the deployment of renewable energy technologies. Renewable energy policies play a crucial role in reducing the risk associated to an investment decision, by providing a stable framework and decreasing market uncertainty. However, the relationship between policies and investment flows is not straightforward. Sometimes even ambitious policy targets have not been able to catalyze the needed investments. Even worse, the policy framework is also seen to represent a potential risk factor per se. As most markets for clean energy technologies are being regulated under policy schemes, understanding how investors perceive the renewable energy policy risk is of particular importance. The aim of this paper is to shed some light on the investors’ preferences for renewable energy policies, with a specific focus on onshore wind technology. The paper presents the results of a web-survey conducted with a large set of European investors. Respondents were asked to compare a number of alternative policy options to support an on-shore wind project located in Europe. The alternatives proposed differed in terms of type of policy scheme implemented, level of support, duration of support, length of the administrative process and degree of social acceptance. The combination of policy attributes and attribute levels lead to a total number of 14 trade-off choices that investors had to compare. The respondents’ choices were then analysed using the adaptive conjoint analysis technique. The results of the conjoint analysis demonstrate that differences in policy design contribute to influence the likelihood to invest in onshore wind. In particular, investors in renewable energy policy seem to show a certain risk aversion, therefore looking for certainty and continuity of support measures. The main results of the survey are presented and conclusions and recommendations for both policy makers and practitioners are provided.

Key words: Adaptive conjoint analysis (ACA) - Investments - Renewable energy policy.

1. INTRODUCTION

Policy targets and measures have been set by several countries around the world to support the deployment of renewable energy technologies. Policies play a crucial role in reducing the risk associated to an investment decision, by providing a stable framework and reducing market uncertainty.

However, the relationship between policies and investment flows is not straightforward. Sometimes even ambitious policy targets have not been able to catalyze the needed investments. Even worse, the policy framework is also seen to represent a potential risk factor per se.

As most markets for clean energy technologies are being regulated under policy schemes, understanding how investors perceive the renewable energy policy risk is of particular importance.

* emanuela.menichettis@unisg.ch
This paper presents the results of a web-based survey conducted with a sample of European investors using adaptive conjoint analysis (ACA) technique. After setting the context for this research, the article introduces the methodological aspects related to the questionnaire survey preparation and administration.

The main results are presented and discussed, and conclusions and recommendations for both policy makers and practitioners are derived.

2. INVESTMENTS IN RENEWABLE ENERGY TECHNOLOGIES

Investments in renewable energy technologies have increased rapidly over the last decade. According to analysts, between 2002 and 2009 a cumulated amount of more than USD 650 billion should have flown in the green energy [1, 2].

In the year 2008, for the first time new power generation investment in renewable energy was greater than investment in fossil fuels [2].

Although the sector was affected by the consequences of the recent financial crisis, it reacted quite rapidly and investments in 2009 show only a moderate drop compared to the previous two years [3]. Among the various renewable energy technologies, wind continues to attract the highest share of new investments year after year, thus confirming its status of mature and reliable technology.

According to the Global Wind Energy Council [4], despite the economic downturn world’s total wind power generation capacity grew by over 30% in 2009. This positive trend is triggered by the spectacular growth recorded in the European Union, USA and China.

As far as the EU countries are concerned, new generation capacity in 2009 reached over 10 GW, with an annual average market growth of 23% over the last fifteen years [5]. Wind installations represented 39% of total generating capacity added in the EU in 2009, more than any other generating technologies.

Investment in EU wind farms in 2009 totalled €13 billion. The onshore wind power sector attracted €11.5 billion during 2009, while the offshore wind power sector accounted for approximately €1.5 billion.

The main drivers which are stimulating investments in the market are, on the one hand, the significant cost reductions achieved by the technology and, on the other, the favourable energy policies set by many countries around the world as a means to fight climate change and accelerate economic recovery.

However, achieving the transition towards low carbon economies requires substantial additional efforts to scale up investments. The International Energy Agency (IEA) estimates that a cumulated investment of USD 3.2 trillion (€ 2.2 trillion) is required over the next 40 years in order to achieve the target of 12% of global electricity from wind power by 2050, as depicted in its BLUE Map scenario [6].

Meeting this goal requires increased mobilization from both public and private actors. The role of policy makers is to provide market operators with the right signals in order for them to commit more capital.

This requires a better understanding of the relationship between policies and investments. A short analysis is provided in the next paragraph.
3. INVESTORS’ PREFERENCES FOR RENEWABLE ENERGY POLICIES

In the current energy markets, policies play a crucial role in determining the success of a renewable energy project. Therefore the willingness to invest on a renewable energy technology will be strongly influenced by the agents’ preferences and perceptions over different policy schemes.

Several studies have assessed the effectiveness of renewable energy policies in Europe. A major result of these analyses is that despite recent improvements and acceleration of renewable energy deployment, progress is uneven across countries and in most EU Member States support systems are still not designed and implemented in an appropriate way [7].

In several cases, growth of renewables is limited because investments are accompanied by high risks due to uncertainties associated with the policy instruments, including non-economic barriers. These are represented by administrative hurdles, obstacles to grid access, lack of information and training and social acceptance issues.

The IEA identifies five key principles for effective renewable energy policies [8]. The two highest priorities in the short term are to remove non-economic barriers and to establish a predictable and transparent support framework in order to attract investments. Other experts confirm that that clear and appropriate long-term policy signals are essential to help investors integrate climate change considerations into decision-making processes and reallocate capital to low-carbon technologies [9].

Indeed, it seems that the main barrier to investments in greenhouse gas mitigation technologies is not the lack of capital, but rather the lack of appropriate policy package to attract it [10]. This suggests that effective policies should satisfy certain design principles in order to ensure that project risk is reduced thus stimulating investments.

The response of business to policy risk is important to determine the effectiveness of policies. Therefore understanding the decision making process underlying investments in renewable energy technologies and how different policy characteristics influence the likelihood to invest seems to be a research priority.

4. THE SURVEY

In order to understand investors’ policy preferences, a survey was conducted with a sample of EU professionals. Investors were asked to choose among different attributes and levels of a hypothetical policy framework for to support an onshore wind project in Europe.

In order to reduce the possible influence of unobserved factors and to allow for a fair comparison among attributes, some characteristics of the project such as the availability of wind resource and the project size were set by the researchers and fully disclosed. The survey was conducted online using adaptive conjoint analysis methodology and was completed by 60 respondents.

4.1 Adaptive conjoint analysis (ACA)

Conjoint analysis is a methodological tool that allows to study consumer preferences among multattribute alternatives in a wide variety of product and service contexts [11]. The term “conjoint” derives from the idea that buyers evaluate an overall product or service based on its multiple conjoint attributes – also called features.
Assuming that a product can be defined as a vector in a multidimensional attribute space, and that the evaluation of the product is based on its attribute levels, it becomes theoretically possible to relate preference to attributes [12].

Conjoint analysis assumes that a consumer assigns a utility value to each level of each attribute and makes his or her final decision based on the total utility values across attributes for a given choice set [13]. Applied consumer research focuses on determining the contributed portion (part-worth utility) of each attribute level to the dependent variable [14].

Conjoint analysis has been extensively used in applied psychology, as well as in marketing research. Over the years, the methodology has acquired popularity also in other academic disciplines and among practitioners.

In management literature, it has been adopted to analyse investment decision making processes of different types of entrepreneurs and venture capitalists [15-18], as well as to investigate strategic thinking of top managers. The use of conjoint analysis for assessing investors’ perceptions of renewable energy policy is still relatively new.

Among the various conjoint measurement techniques ACA was selected as the most suitable approach under the scope of the present study since it retains the following main features: a) it collects preference data in a computer-interactive mode, therefore increasing the respondent’s interest and involvement with the task, and b) it allows to customize the interview so that respondents are asked in detail only those attributes of greatest relevance. The term adaptive refers to the fact that the computer-administered interview is customized for each respondent.

At each step previous answers are used to decide which question to ask next, to obtain the most information about the respondent’s preferences. The respondent’s part worths are continually re-estimated as the interview progresses, and each question is chosen to provide the most additional information, given what is already known about the respondent’s values.

4.2 The research design

The conjoint analysis design was elaborated following the procedure suggested by [19]. More specifically, an orthogonal matrix has been developed, which allowed to screen and reduce the number of attribute and levels in order to keep the number of product concepts to a manageable size. After a pre-test with a limited sample of investors, five different policy attributes were retained. These are displayed in Table 1, together with the corresponding attribute levels.

**Table 1**: Attributes and attribute levels of renewable energy policies selected under the present research

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Type of renewable energy support scheme</td>
<td>1. Tax incentives / investment grants</td>
</tr>
<tr>
<td></td>
<td>2. Tenders schemes</td>
</tr>
<tr>
<td></td>
<td>3. Feed-in tariffs</td>
</tr>
<tr>
<td></td>
<td>4. Tradable Green Certificates / Renewable Portfolio Standard</td>
</tr>
<tr>
<td>2. Level of the incentive (the premium paid per kWh produced and sold)</td>
<td>1. 100 €/MWh</td>
</tr>
<tr>
<td></td>
<td>2. 75 €/MWh</td>
</tr>
<tr>
<td></td>
<td>3. 50 €/MWh</td>
</tr>
<tr>
<td></td>
<td>4. 25 €/MWh</td>
</tr>
<tr>
<td>3. Duration of the support (number of years)</td>
<td>1. Unchanged for less than 10 years</td>
</tr>
</tbody>
</table>
The combination of attributes and levels led to a total number of 14 trade-offs choices to be answered by investors. The survey proceeds as follows: first, a series of ‘importance questions’ are asked by the software, where the highest and lowest level of each attribute are compared. Then, a series of ‘pairs questions’ are generated, where trade decisions are proposed.

Examples of such choice tasks are displayed in Fig. 1.

Fig. 1: Examples of choice task

4.3 Descriptive statistics

Half of the respondents are venture capital or private equity funds, thus operating in the early stages of the technology innovation chain. Banks, pension funds, hedge funds, infrastructure funds and other categories of investors being involved in late stage project development represent 15% of the sample.

Family-run business, personal investment funds and other private companies account for 10%, and project developers and engineering companies sum up to 17%.

The remainder (8%) is represented by companies which have provided no indication regarding their profile in the corresponding demographic section of the questionnaire. About two thirds of respondents currently invest in renewables. Renewables represent at least 10% of the portfolio for over 70% of respondents, while 27% of respondents invest only in renewables.

† The number of trade-off questions is determined according to the following formula: 3*(N – n - 1) – N, where N = total number of levels, n = total number of attributes.
Solar photovoltaic’s and wind onshore are the two most represented technologies, being in the investment portfolios of 57 % and 47 % of the respondents, respectively. Biomass, solar thermal and concentrated solar power follow, while tidal and wave are the least represented technologies (accounting for only 5 % of the portfolio).

The average investor’s experience in the renewable energy market is not particularly high. In fact, less than one third of respondents have more than 5 years of experience with renewables, and only than 10 % have more than 10 years of experience.

The majority of the sample has less than 5 years of experience (45 %) or not experience at all. This result is not surprising; if we consider that the renewable energy market has started experiencing considerable growth only quite recently and still represent a limited fraction of the global energy market. Despite the lack of specific expertise in the field, respondents seem to have overall a quite robust experience in financial markets; indeed, the majority of the sample (83 %) is older than 30 years, and 27 % of respondents are older than 40 years.

Over one third investors have a multidisciplinary background. More than one fourth Economics and Business Administration while 22 % has studied Engineering. The remainder is split amongst finance (18 %), and law balance, it is worth signalling that almost all respondents are men.

The most relevant sources for informing the investment decision in the renewable energy market are due diligence and technical reports. Respondents closely follow what the well known, high profile investors in the sector are doing as an additional source to influence their decision.

Finally, investors seem to have a quite positive attitude regarding the potential to be reached by renewable energy technologies in Europe: over 80 % of respondents believe that the EU can achieve a penetration rate of renewables of 20 % by 2050, and more than 40 % deem that a share of 50 % is achievable.

5. MAIN RESULTS

The results of the analysis indicate that the sample is composed of rather risk-averse investors who seek to maximize their return over a relatively short time horizon. Indeed, the most relevant policy attribute is the level of incentive, which on average receives over 25 % of preferences.

The type of policy scheme is ranked second in terms of importance, being assigned over 21% of preferences. The third important element of policies according to the investigated sample is the duration of the financial support given to the renewable energy project. This seems to be almost equally important as the type of policy scheme, since it receives about 21 % of preferences from the respondents.

The length of the administrative process is ranked fourth, receiving 18 % of preferences. The least important policy attribute for the sample is the overall degree of acceptance toward the renewable energy technology manifested by the main stakeholders in the hypothetical policy framework described in the survey. In fact, social acceptance receives slightly more than 14 % of preferences.
Additional details are provided in Table 2, which shows the part worth utilities. Part worth utilities describe the contribution of the various attribute levels to the overall utility, thus allowing to understand how the change in a variable level affects the investor’s preferences for a certain policy framework. Part worth utility results are normalized using the Zero-centered differentials (diffs in the following) method.

The diffs method rescales utilities so that for each individual the sum of the utility differences between the worst and the best level of each attribute is equal to the number of attributes times 100 [20]. This normalizes the data so that each respondent has equal impact when computing the population average.

This additional information reveals that significant differences exist also within each attribute. Starting from the most important policy attribute, i.e. the level of support granted to the renewable energy project, one can see that a premium incentive of 100 €/MWh is two and half time more desirable than a premium incentive of 75 €/MWh (60.21 against 23.60). This confirms the finding that the sample is composed of agents who look for the highest return of their investment.

Table 2: Importance of attribute levels and standard deviations (N = 60)

<table>
<thead>
<tr>
<th>Policy attributes</th>
<th>Part worth utilities</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level of the support</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 €/MWh premium</td>
<td>60.21</td>
<td>10.11</td>
</tr>
<tr>
<td>75 €/MWh premium</td>
<td>23.60</td>
<td>7.33</td>
</tr>
<tr>
<td>50 €/MWh premium</td>
<td>-17.91</td>
<td>4.17</td>
</tr>
<tr>
<td>25 €/MWh premium</td>
<td>-65.91</td>
<td>15.67</td>
</tr>
<tr>
<td><strong>RE support scheme</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed-in tariffs</td>
<td>57.35</td>
<td>13.98</td>
</tr>
<tr>
<td>TGC/RPS</td>
<td>14.57</td>
<td>4.72</td>
</tr>
<tr>
<td>Tender schemes</td>
<td>-21.85</td>
<td>6.63</td>
</tr>
<tr>
<td>Tax incentive/Invest.grants</td>
<td>-50.06</td>
<td>8.22</td>
</tr>
<tr>
<td><strong>Duration of the support</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than 20 years</td>
<td>51.21</td>
<td>10.20</td>
</tr>
<tr>
<td>10-20 years</td>
<td>2.13</td>
<td>5.10</td>
</tr>
</tbody>
</table>
Less than 10 years  -53.35  10.32

<table>
<thead>
<tr>
<th>Length on the administrative process</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 6 months</td>
<td>44.45</td>
<td>10.73</td>
</tr>
<tr>
<td>6 – 12 months</td>
<td>1.49</td>
<td>4.36</td>
</tr>
<tr>
<td>&gt; 12 months</td>
<td>-45.93</td>
<td>11.58</td>
</tr>
</tbody>
</table>

Social acceptance

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>35.77</td>
</tr>
<tr>
<td>Low</td>
<td>-35.77</td>
</tr>
</tbody>
</table>

It is worth highlighting that the negative values associated to some attribute levels do not imply that these options are not desirable per se. In fact, by applying the Zero-centered diffs method, the utilities have been re-scaled to an arbitrary additive constant to sum 0 within each attribute. As a consequence, a negative value of part worth utilities does not mean that the particular attribute level is unattractive in absolute terms, but only that it is less preferred than an alternative option showing a higher part worth utility value. In other terms, while positive values indicate an increase in the utility, negative values indicate a decrease in utility for the observed respondent.

Regarding the type of renewable energy support scheme, feed-in tariffs are by far the most preferred instrument, with an average utility of 57.35. The utility value associated to feed-in tariffs is almost 4 times higher than the one assigned to more market-based support mechanisms as tradable green certificates or the renewable portfolio standard, which receive an individual utility of 14.57. This finding is in line with a previous research conducted by [21], where feed-in tariffs were found to be the most favored renewable energy support scheme by a group of European and US venture capital and private equity investors.

It is also to add that currently feed-in tariffs are the most diffused support instrument in the EU, with 20 countries out of 27 having in place feed-in tariff as either a partial or exclusive way to support renewable [22]. Although all renewable energy support scheme options were described in detail in the survey in order to induce a perfectly informed choice, one cannot exclude that the very high ranking assigned by investors to feed-in tariffs might have been - at least partly - influenced by the popularity of this instrument compared to less familiar alternatives.

In their turn, tradable green certificates have been presented as the most effective and cost-efficient means to stimulate renewable electricity production [23]. More recently however, their popularity has started going down. This is reflected in the more reduced number of countries currently adopting this scheme in the EU (among them: the United Kingdom, Sweden, Belgium and Italy).

Tender schemes for renewables, as applied for example in Denmark and France, are ranked third, with a utility value of -21.85. Finally, fiscal measures like tax incentives of investment grants receive by far the lowest utility value amongst the proposed options (-50.06). Again, this result might be partly explained by a certain lack of confidence with this instrument by the surveyed investors. In fact, this type of support scheme is currently in place only in a very limited set of EU Member States, like Finland and Malta, which were outside the scope of the survey.

In terms of the duration of the support granted to the renewable energy project, investors show a high interest for a long-term support: an incentive paid for more than 20 years is strongly preferred over an incentive paid for a 10 to 20 years timeframe.
(51.21 compared to 2.13, respectively). A time horizon shorter than 10 years receives a very negative score (-53.35), meaning that in order to embark in a renewable energy investment, agents ask policy makers to guarantee a financial support to the project over a minimum timeframe of 10 years.

It is interesting to note that the range of variation for the duration of support is similar to that observed for the type of policy scheme, meaning that not only these two policy attributes seem to be almost equally important, but that also the difference between the most preferred and the least preferred attribute level show a similar pattern.

As far as the duration of the administrative process is concerned, investors look for a smooth framework allowing to get the necessary authorizations and permits in a relatively short timeframe. A quick administrative process (less than 6 months) receives an average individual utility of 44.45, a medium process (6-12 months) records an individual utility of 1.49 while a slow administrative process (requiring more than 12 months) is assigned an individual utility of -45.93.

This can be interpreted as a percentage change in choice probability: if all other elements of the policy framework remain constant, the likelihood that an investor prefers a given policy framework increases by approximately 50% if the administrative process is shortened from more than 12 months to 6-12 months.

The relatively lower importance assigned by the surveyed investors to the duration of the administrative process compared to other policy attributes can be explained by the following factors: i) first, the heterogeneity of the sample analyzed; and ii) the different geographical contexts where these investors operate.

As for the first factor, it is to presume that the length of the administrative and authorization process is a serious issue of concern for project developers, whereas this is certainly not an issue for other category of investors like for example insurance companies, banks or venture capital funds.

Regarding the second factor, previous studies have already pointed out that administrative hurdles represent a barrier to renewable energy investments in some EU countries like for example Italy and Greece, while they are less of an issue in other countries like Germany or France.

In order to assess these influences, a deeper analysis has been conducted per category of investors. This has revealed that actually no significant difference can be perceived in the share of preferences for the administrative framework amongst the various subgroups of companies analysed. Results suggest that the geographical location where the investor operates might rather explain the different values assigned to attribute levels by similar companies.

With respect to the last policy attribute analyzed, a higher social acceptance is obviously preferred to a more resilient framework for renewable energy investments. Nevertheless, the social acceptance component is less relevant compared to the other policy attributes previously analyzed. This finding can be interpreted in several ways. One explanation could be that investors believe that addressing social acceptance issues is a task to be carried out by policy makers, not by private operators.
This is tantamount to saying that investors look for adequately designed top down policies that take into account all relevant barriers that might hamper the diffusion of renewable energy technologies, including social acceptance.

Another possible explanation is that investors believe that onshore wind technology is not a disputed technology. Therefore they tend to assign a relatively lower importance value to social acceptance simply because they do not perceive a strong opposition to this renewable energy technology in the EU community.

Finally, it is worth remembering that a large majority of the surveyed sample is represented by venture capital and private equity firms, which operate in the early stage of the project value chain. These actors typically invest in technology assets, but do not physically build renewable energy projects. Therefore they are less concerned by social acceptance issues than other investors’ typologies like for example project developers and utilities.

In order to account for the variation on these perceptions according to the different profiles of investors, a cluster analysis has been conducted, which revealed how social acceptance issues seem to be particularly relevant for specific categories of investors like Infrastructure funds, project developers and banks, whereas venture capitalists and private equity firms do not seem to be concerned. This finding seems to suggest that those investors who need to interact more closely with public authorities and citizens are also more concerned by public acceptance issues.

6. CONCLUSIONS

The research presented had the purpose to assess investors’ attitudes toward renewable energy policies. Since renewable energy markets are regulated under several policy schemes, understanding which policy characteristics influence the most the likelihood to invest in a renewable energy project by reducing the perceived risk associated to the investment can provide useful insights to decision makers, and help them design more effective policy instruments to support the deployment of renewable.

To achieve this goal, ACA was used as a tool to investigate investors’ preferences over renewable energy policy characteristics.

The results of the survey conducted with 60 European investors reveal that investors are primarily driven by total remuneration opportunities. Therefore reasonably high levels of the premium incentive should be given to wind projects in order to ensure that investments will be undertaken. Feed-in tariffs seem to be the most favored policy instruments.

Investors also ask for continuity of support, over a timeframe longer than 20 years. Other aspects like the administrative process and social acceptance seem to represent less of an issue for the sample analyzed. However, the sample segmentation has revealed that some differences can be observed across the various categories. This finding suggests that policy makers should design targeted policies which take into account the specific needs and concerns expressed by different categories of operators.

The study is not exempt from limitations. In particular, the sample analysed is too small to allow generalizations. In addition, the study was restricted to the EU region therefore results might be different in other empirical contexts, due to different policy...
frameworks in place. In order to capture these differences and get a better understanding of investors’ behaviors, it would be interesting to conduct similar surveys in other countries outside the EU, like for example Algeria. This would provide relevant insights for national and international investors, as well as for policy makers.

REFERENCES


