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Valuing the preferences for micro-generation of renewables by households

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ABSTRACT

We study the valuation of preferences for small scale initiatives in renewable electricity generation. We analyse the results of a stated choice experiment among 507 respondents in The Netherlands and provide valuations of characteristics of small scale initiatives. Respondents prefer installing the capacity in small to medium sized groups and their preferred location for the generation capacity is at sea, followed by their own roofs. People that already consume green electricity, as well as those that have indicated to be willing to generate energy locally, are less price sensitive than others. Our results suggest that there is ample scope for expanding the role of micro-generation.

1. Introduction

The EU (European Union) has set a target to reduce EU greenhouse gas emissions with 20% below 1990 levels in 2020 and increase the share of renewable energy sources in electricity generation to 20% [9]. These targets provide a challenge for many countries, and need to be tackled on all levels; producers; large users and small users. Our focus here is on the latter level.

Local and small scale initiatives in renewable electricity generation have long been neglected, both in policy and in academia. Small users could potentially play an important role in generating renewable however. Several studies (e.g. Refs. [2,13,26,27,31]) have established that households do indeed have a positive willingness to pay for renewable electricity. Recent qualitative work [10,33] suggests that deliberation and cooperation with local authorities and other local representatives was highly valued by respondents. This provides opportunities to move away from top-down policies towards more involvement of local communities [12].

The involvement and initiative of local communities may be an efficient way of increasing the share of renewable production in electricity generation, as it requires a minimum amount of government intervention and administrative burden. Moreover, local generation of electricity requires a lower level of costly transport capacity. It is therefore important for policy makers to understand the preferences of potential small scale producers of green electricity, both to assess the potential contribution of this option as well as to identify what drives its success.

We add to the literature by explicitly taking into account small scale private initiative in the generation of renewable electricity. This may either relate to local domestic micro-generation (e.g. photovoltaic cells placed on the roofs of houses) or to individual or neighbourhood initiatives to invest in renewable energy generation elsewhere. We conduct a stated choice experiment focussing on important characteristics related to these initiatives, such as location, group size, initiator, participation and costs.

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Several authors address issues that are relevant to the local and small scale nature of private initiatives in this respect [25]. identify barriers for adopting renewable electricity, such as investment costs and production efficiency, hindrance of grid companies and regulation, finding a place to locate a wind turbine without risking relations with neighbours, the installation technology and process and the production results. More involvement of local people could lead to increased acceptance and understanding of renewable energy [24] and would lead to installation of own, micro renewable energy production in their own home [10].

The remainder of the paper is organised as follows. Section 2 outlines the framework and methodology, followed by a discussion of the data in Section 3. Section 4 presents the empirical results and their implications. The final section contains our conclusions.

2. Framework and methodology

2.1. Attributes of micro generation

The word 'micro-generation' clearly relates to the scale of production. The nature of micro-generation requires us to take a few more attributes into account. As we stated earlier, one of the advantages of micro-generation is that it requires a lower level of transmission capacity. This implies that micro generation is local, i.e. electricity is generated close to the place where it is used. Given our focus on households, this would mean that generating capacity is placed on roofs or in a street. Moreover, our focus on households also implies that they, either individually or in cooperation, take the initiative. Based on these considerations, we define 'pure micro-generation' as small-scale, local and initiated by individuals or neighbourhoods. Obviously, hybrid forms (such as medium-scale local generation initiated by neighbourhoods) may also exist and still have some of the advantages of micro generation.

By identifying the willingness to pay for the attributes mentioned above, we provide an indication of the potential of micro generation, both in pure and hybrid forms. Moreover, we identify the willingness to pay for participations, since this is identified by several authors [10,24,33] as a positive influence.

2.2. Stated choice experiments

Choice experiments confront respondents with multiple questions in the following form: Do you prefer A or B, where A and B are described by the level of the characteristics of a good or service. It is assumed that individuals derive utility from the characteristics of the good rather than from the good itself, implying that a change in one of the characteristics can result in a discrete switch from one good to the other.

The major strength of choice experiments over contingent valuation, is that they provide more information on respondents preferences on specific characteristics. The relative importance of the attributes included in the choice experiment can be found via the marginal rate of substitution for each included attribute, where the marginal rate of substitution for any attribute relative to the monetary attribute provides an indication of the willingness to pay for this specific attribute.[1] This is often more useful from a management or policy perspective.

The characteristics theory of value is consistent with micro-economic theory on consumer choice, although the analysis of the relation between the decision to consume and the utility derived from the consumption begins one step earlier in the decision making process of the consumer. The individual simultaneously chooses to consume a specific amount of the good that corresponds with the quantities of the characteristics provided by the good and which in turn maximise his/her utility. Therefore, to make the choice paradigm empirically operational, random utility theory [22] needs to be involved.

Choices for a renewable electricity generation scenario, as assessed in a choice experiment, are discrete choices. Discrete choices are generally analysed using logit or probit models. When a respondent is able to choose between more than two options, the MNL (Multinomial Logit Model) is commonly used. MNL models are however limited as they require the IIA (independence from irrelevant alternatives) property. This means that 'addition or subtraction of any option from the choice set will not affect relative probability of individual *i* choosing any other option'. A generalisation of the MNL model is the MMNL (mixed multinomial logit model) [23], which does not require the IIA assumption. The difference between the MNL and the MMNL is that the parameters of the latter are allowed to vary over individuals.

In the estimations performed on choice modelling experiments, the estimated parameters do not have a direct interpretation, but the rate at which the respondents are willing to trade-off between attributes can be calculated. When a monetary value is included as an attribute in the choice experiment, the willingness to trade off between attributes can interpreted as the implicit price (or willingness to pay) for attribute *k*. The implicit price is equivalent to the marginal willingness to pay for a level of the attribute as compared to the status quo level of that similar attribute. In this choice experiment with these model specifications, preferences of different characteristics for renewable electricity generation rather than a preference for renewable electricity generation per se can be estimated.

2.3. Survey design and sample selection

To avoid bias problems, a survey question must be constructed in such a way that 1) the answers given by respondent are viewed as having a potential influence on actual actions of the agent and 2) the respondent cares about the outcomes of his/her choices on actions performed by the agent.

Question formats should be *incentive compatible*, meaning that all participants fare best when they respond truthfully. Empirical evidence has shown that such questions predict actual behaviour quite close [6].

2.4. Choice experiment; attributes

Based on a brief literature survey of choice experiments on wind energy and renewable electricity generation in general (e.g. Refs. [1,4,13,27], as well as interviews with participants of renewable energy generating collectives, we derived a list of about 20 possible attributes. We reduced this number to 5 to keep the choice experiment manageable.[2] The attributes aim to capture attitudes towards environmental and visual impacts from renewable electricity generation are the *location* and the *size* of the renewable source. Other attributes included, aimed to capture attitudes towards institutional factors are *initiative* and *participation*. Furthermore, *additional costs per year* are included as an attribute. The levels of the attributes are chosen based on the literature as discussed earlier and common sense. For each attribute, one of the options is chosen as the base case, so that the valuations found in

[1] Or the willingness to accept if the attribute provides a disutility.

[2] One of the characteristics we choose not to differentiate between is the type of generation (e.g. solar versus wind), as this is not the main focus of our study and has been analysed extensively by others (e.g. [4,13,27]).