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Investigating the importance of motivations and barriers related to microgeneration uptake in the UK

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HIGHLIGHTS

- Research on factors affecting adoption of microgeneration technologies in the UK.
- Home resale value is the largest concern amongst microgeneration rejecters.
- Availability of reliable information remains a significant barrier for considerers.
- Increasing awareness of household energy self-sufficiency would boost uptake.
- Green Deal may have a limited impact on capital cost and home-resale barriers.

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ABSTRACT

Microgeneration technologies such as solar photovoltaics, solar thermal, wind and heat pumps may be able to contribute to meeting UK climate change and energy security targets, but their contribution to UK domestic energy supply remains low. This research uses a best-worst scaling survey of microgeneration adopters, considerers and rejecters ($n = 291$) to determine the relative importance of different motivations and barriers in microgeneration (non) adoption decisions. The most important motivations are earning money from installation, increasing household energy independence and protecting against future high energy costs. Results indicate that the introduction of Feed-in Tariffs has clearly encouraged a new, more financially-motivated, group to install. Financial factors are the most important barriers and of most importance to rejecters is the prospect of losing money if they moved home. The Green Deal was introduced to reduce this barrier, but may instead exacerbate the problem as potential homebuyers are put off purchasing a home with an attached Green Deal debt. The difficulty in finding trustworthy information on microgeneration is also a major obstacle to adoption, particularly for considerers, despite efforts by the government and microgeneration interest groups to reduce this barrier. Self-sufficiency in energy is a more important motivation for those considering or having rejected installation than for adopters. Provision of accessible information and greater emphasis on household self-sufficiency in energy could help improve the uptake.

1. Introduction

Microgeneration is the generation of electricity and/or heat from a low carbon source [1] at a scale suitable for households. For example, the UK government limits microgeneration capacity to 50 kW for electricity and 45 kW for heat. The microgeneration technologies include solar photovoltaic (PV), micro-wind, micro-hydro, micro-CHP, fuel cells, solar thermal and heat pumps (air, water and ground source).

The UK government aims to increase uptake in microgeneration in order to meet climate change and renewable energy targets [2] and to improve energy security [3]. A number of incentive schemes have been implemented since 2010 and uptake has increased in particular for solar PV: from approximately 5000 installations in 2010–400,000 in July 2013 and the total number of microgeneration installations was 520,000 [4,5].

However, the overall contribution of microgeneration in the domestic sector remains low, accounting for ~0.2% of the total energy supplied to households [4]. Significant barriers to wider

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adoption exist that must be overcome if microgeneration is to contribute to UK climate change and energy security targets, such as high capital costs.

Recent research into the consumer perceptions of microgeneration has identified many motivations and barriers in the adoption decision (as discussed in Section 3), but their relative importance remains unknown. Therefore, this research provides new understanding and knowledge of the relative importance of various motivations and barriers and how this relative importance varies between those who adopt and those who reject microgeneration. This understanding allows recommendations to be made to policymakers and the microgeneration industry that would help increase the uptake. For these purposes, we use a sample comprising existing adopters, those who are considering installing and those who have rejected it. The specific aims of the research are to:

- identify the motivations and barriers associated with the consumer decision whether to install a microgeneration system;
- elicit the relative importance of these motivations and barriers and any differences between adopters, considerers and rejecters;
- identify the differentiating factors between those who adopt and those who reject installing a microgeneration system; and
- identify improvements that could be made in policy and within the microgeneration industry and to identify population segments that would be most affected by them.

In the next section, the paper describes the background to this research in terms of recent policies that have impacted on microgeneration uptake and Section 3 gives an overview of recent research into the factors affecting consumer adoption. This is followed in Section 4 by a description of the methodology. Results are presented in Section 5 and a discussion which relates the research findings to microgeneration policy appears in Section 6. Conclusions are drawn in Section 7, including recommendations for both policy makers and microgeneration suppliers.

2. UK microgeneration policy

A number of policies have been recently implemented to remove financial barriers to microgeneration uptake: the Feed-in Tariff (FIT) [2], Renewable Heat Incentive (RHI) [6] and more recently the Green Deal [7]. The Microgeneration Strategy [3] also included a number of measures to remove non-financial barriers. These policy measures and their impact on uptake are described briefly below.

2.1. Feed-in tariffs

The FIT scheme was introduced in April 2010 and offers a fixed payment to households for every unit of energy they generate by approved, electricity-generating microgeneration installations; this is paid for by the household's electricity supplier. Depending on the technology, the tariffs were designed to give an annual return on investment of 5% [8] with the payments guaranteed for 20–25 years.

Since the implementation of FITs, the global solar PV market has grown significantly, leading to a fall in UK installation costs by approximately 50% by 2012 [4]. Over the same period, there was a 15% increase in the UK electricity price, further reducing payback times. In October 2011, the UK Government launched an emergency tariff review and proposed reducing the tariff for small solar PV by half, to 21 p/kWh [9]. The short notice period given for the tariff change, approximately 6 weeks, caused much concern within the industry due to the expected rush to install before the deadline and the subsequent industry redundancies after this period [10]. A group of microgeneration suppliers contested this change at the UK Supreme Court and the tariff change was temporarily rescinded until April 2012 [10]. As predicted, there was a spike in the number of installations before, and a sharp drop in installations observed after the cut (see Fig. 1). The process by which the tariff rate was changed may also have caused a degree of uncertainty or scepticism amongst potential adopters, adding to the barriers to adoption.

2.2. Renewable heat incentive

Renewable Heat Incentive (RHI) is an equivalent incentive to the FIT scheme but for heat generators. However, the RHI is still not available for the domestic sector – after many delays, it is expected to be implemented in Spring 2014 [11,12]. While awaiting the RHI, the Renewable Heat Premium Payment (RHPP) has been offering a small grant since August 2011: £300 for solar thermal systems (which typically costs £5000 to install), £850 for air source heat pumps (costing £6000–10,000), £950 for biomass boilers (£5000–£12,000) and £1250 for ground source heat pumps (£9000–£17,000). These grants have doubled for each technology since May 2013 [13,14]. However, households that are connected to the central gas grid, which represent 85% of the UK housing stock [15], are only eligible for a solar thermal system grant. This limits the potential uptake of the scheme, reflected in the fact that since the initiation of the grant, only 9000 new microgeneration systems have been installed [16,17].

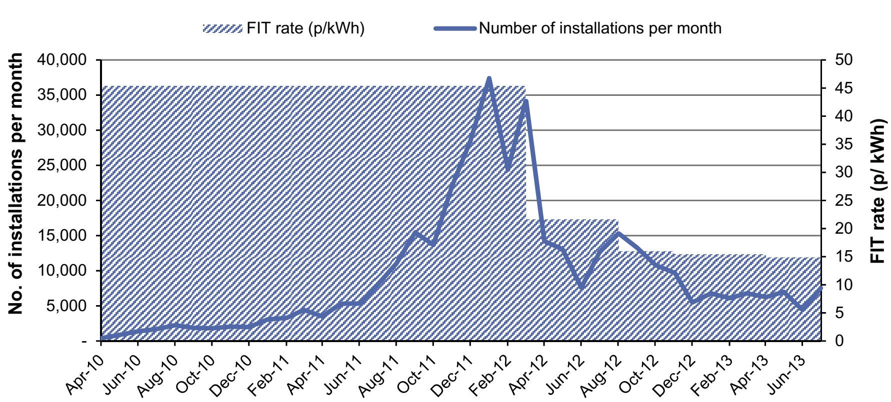


Fig. 1. Feed-in Tariff (FIT) payment rates and the number of installations per month for solar PV retrofit installations of less than 4 kW capacity [modified from [4,5].

2.3. Green Deal

The Green Deal, implemented in Jan 2013, facilitates loans for the capital cost of various energy efficiency measures for residences and businesses. The loans are paid back at a fixed rate with estimated fuel bill savings resulting from the improvements and are automatically added to the property's energy bill [18]. Energy improvements such as insulation, double glazing and some forms of microgeneration can be installed by accredited installers, paid for with a loan from an accredited private loan company. Loan interest rates are 7–9% and the repayment term is 10–25 years. The improvement work must be recommended by an accredited home energy assessor and the Green Deal stipulates that the loan is permitted only if the monthly repayments are lower than the predicted fuel bill savings [7].

Thus, the Green Deal seeks to address the capital cost barrier and eliminate the risk of not recouping the investment as the repayment is offset against fuel bill savings. However, since the Green Deal began, uptake has been slow. The number of preliminary household assessments reached 38,000 by mid-June 2013, but very few households subsequently applied for Green Deal finance (245 applications by June 2013) and none had been implemented [19].

2.4. Microgeneration strategy

The Microgeneration Strategy [3] was published in 2011 and suggests pathways for the microgeneration industry to reduce a number of non-financial barriers to greater uptake. Such barriers are concerns about performance and durability and the availability of trustworthy information and advice. In particular, the strategy outlined the task of the Microgeneration Certification Scheme (MCS) to ensure that technological and installation standards were met. The MCS is an accreditation scheme for installers and technologies, which aims to ensure that any installed product meets the required set of standards [3]. In order for a household to receive any of the incentives described above, the microgeneration technology and installer must be accredited.

3. Existing research on the motivations and barriers affecting adoption

Previous research has identified a number of motivations and barriers that affect adoption of microgeneration, including finance, environmental concerns, self-sufficiency, uncertainty and trust, inconvenience and impact on residence. These are reviewed briefly next, as a way of introduction to the research carried out in this work. For a more comprehensive review, see Balcombe et al. [4].

3.1. Finance

Capital cost has repeatedly been found to be the main barrier to installing microgeneration [e.g. 20,21–24]. For many people, the capital cost is either unaffordable [22] or they cannot earn enough money from the installation to warrant the investment [25]. However, the introduction of the FITs has improved payback time and the significant increase in solar PV uptake suggests that the changing financial landscape has further motivated people to adopt. There is also concern that the installation will have a negative impact on the home value: the resale value of the home would either not increase proportionally with the capital investment, or would put off potential homebuyers such that the home value decreases. Currently, there is limited research into the effects of microgeneration on house resale value [26–28].

3.2. Environmental concerns

Many people are motivated to install by the desire to improve the environment [24,29]. However, a number of studies suggest that there is little desire from households to pay extra for this environmental improvement [24,30–32]. Households may be motivated by the environmental motive to consider installing, but the decision is more often based on financial or other factors than environmental benefit [31,33,34]. One other environment-related motivation to install is to demonstrate environmental commitment to others via technologies which are visible outside the property, such as solar panels or wind turbines [35,36].

3.3. Self-sufficiency

The motivation to increase the household's self-sufficiency in energy or independence from the central electricity grid is also important to potential adopters [36–38]. The recent increases in energy prices have also contributed to a desire to protect against future price rises [39]. Guarding against power cuts [39] may also be a motivation but no UK study has considered this within their research. Recent concerns raised by the UK gas and electricity regulatory body Ofgem (Office of Gas and Electricity Markets) regarding the tightening margins between the quantity of electricity supply and demand within the next two years [40] suggest that this motivation may become more important as the risk of power cuts increases.

3.4. Uncertainty and trust

There are also barriers to adoption relating to uncertainty over technological performance of a microgeneration system [35,41–43] and the suitability of their home [3]. Fuelling this uncertainty has been the perceived lack of reliable or trustworthy information [20,44]. Consumers are often unaware of information and advice centres [3,42] and there is also a lack of trust in suppliers and installers [3], with numerous examples shared online of poor installation experiences [e.g. 45] or aggressive product-selling [32,46].

3.5. Inconvenience

Installing a microgeneration system often involves major modifications to the household heating or electricity system [22,47]. There may also be a change in day-to-day use of the heating/electricity system, with different technologies requiring different modes of operation, space requirement (e.g. heat pumps, biomass) or frequent refuelling (biomass boilers) [22]. Other barriers include a change in maintenance requirements and complexity of the system [48].

3.6. Impact on residence

There is a space requirement associated with retrofitting households with some technologies and is a particularly significant barrier for smaller households. The zero-carbon homes initiative [49] eliminates this barrier for new-build homes: by 2016 homes must either have a microgeneration installation or be connected to a district renewable energy system in order to comply [50]. However, the barrier for the 25 million existing UK homes remains. There is also an aesthetic impact on the house by installing a microgeneration system and concerns are often raised about neighbour disapproval [27,42].

3.7. Differing perceptions across the UK population

The various motivations and barriers described above may impact upon a household's adoption decision, but the extent to which they impact upon the decision varies considerably across the population. Although adoption is highest amongst 45–65 year olds [29,42,51,52], awareness is higher for under 45-year-olds and they more frequently consider installing [53] but less frequently install [42]. The correlating factors with age that affect uptake may be the level of available income for investment, house size or likelihood of moving house [52,54]. A number of studies also find that there is greater adoption amongst those with higher income and a higher level of education [25,54–57]. A higher income may somewhat mitigate the capital cost barrier, but the causality between adoption and education is less clear.

4. Methodology

While the studies discussed in the previous section have identified a number of factors that affect the adoption decision, they did little to identify how important they are in the adoption decision. This is the focus of the present research which aims to identify the relative importance of consumer motivations and barriers associated with the adoption decision and to identify relative differences between adopters, considerers and rejecters across population segments. The aim is also to suggest improvements in policy and within the microgeneration industry that could help to increase uptake.

4.1. Questionnaire design and data collection

To achieve the above aims, an online survey of adopters, considerers and rejecters has been carried out using the questionnaire developed as part of this research. To help design the questionnaire, first a comprehensive list of motivations and barriers was identified through a literature review detailed in Balcombe et al. [4] and summarised in Section 3. Semi-structured telephone interviews were then undertaken with a sample of 12 adopters, considerers and rejecters to refine the list of motivations and barriers. The interviews lasted approximately 20 min and participants were asked to describe their interest in microgeneration: what motivated them, what put them off and any background information related to these factors. While these topics were followed broadly, the open nature of semi-structured interviews also allowed for new topics to be discussed, depending on what the interviewees said. As a result, eight motivations and 14 barriers were identified and included in the survey; these are listed in Table 1. The survey was carried out using the best-worst scaling (BWS) method to help elicit the relative importance of the motivations and barriers in the adoption decision; BWS is described further below.

The survey was carried out online between October 2012 and March 2013. Recruitment was undertaken via advertisements placed on a number of websites and microgeneration forums, as well as to approximately 20 renewable energy showrooms in the UK. Leaflets were also distributed in neighbourhoods where one or more property had installed a solar panel – as these were visible from the outside the property, they indicated clearly the adopters. Based on the previous research, it was also possible that other neighbours might be considerers, motivated by their adopter-neighbours [58,59].

Respondents were asked which of the following statements applied to them: I have bought a microgeneration system (adopters); I am currently thinking about buying a microgeneration system (considerers); and I have thought about it and decided not to buy a microgeneration system at this time (rejecters). They were then asked to complete the BWS survey, which is described in the next section. The full questionnaire can be found in Supplementary material.

In total, 291 respondents completed the survey with a relatively even split between adopters ($n = 113$), considerers ($n = 87$) and rejecters ($n = 91$). Their characteristics are discussed in Section 5.

4.2. Best-worst scaling

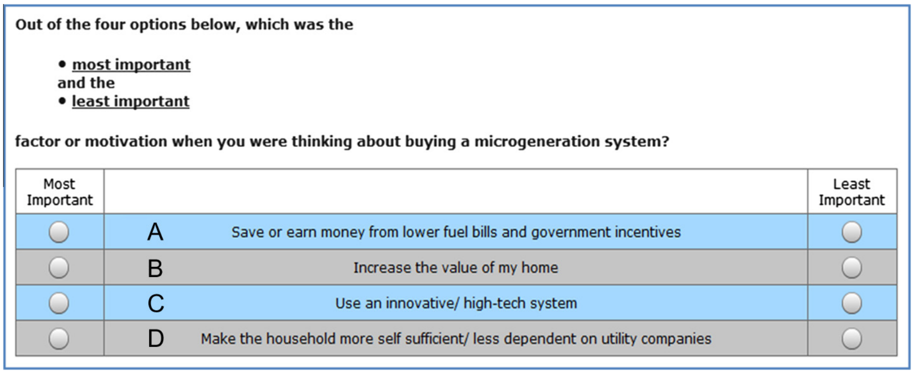
BWS is a survey method in which respondents are asked repeatedly to select the best and worst options (in this case motivations and barriers) within a set. They make repeated pairs of best/worst choices, each set with a different combination of options shown. The choices are analysed to reveal the relative importance or preference associated with the options, based on random utility theory (see Section 4.3) and the assumption that the frequency of selection of an item as best or worst indicates the strength of preference for that item [60,61].

Fig. 2 shows an example of a choice task used within the survey. For items A, B, C and D, the selection of A as best and B as worst suggests that A > (C & D) > B, providing preference orderings on 5 of the 6 possible pairwise comparisons [62]. Repeated choice tasks with differing motivations or barriers allow an estimate of the probability that, given a certain set of motivations, item x will be selected as best and item y as worst, from which the relative importance of each item can be inferred.

Respondents were asked to complete five choice tasks for motivations, each comprising four motivations, and seven choice tasks for barriers, each consisting of five barriers. The total number of times each motivation and barrier should appear for each respondent (the number of items per choice set multiplied by the number

Table 1
Motivations and barriers considered in the survey.

Motivations	Barriers
1. Save or earn money from lower fuel bills and government incentives	1. Costs too much to buy/install
2. Help improve the environment	2. Cannot earn enough/save enough money
3. Protect against future higher energy costs	3. Home/location not suitable
4. Make the household more self-sufficient/less dependent on utility companies	4. Lose money if I moved home
5. Use an innovative/high-tech system	5. High maintenance costs
6. Protect the household against power cuts	6. System performance or reliability not good enough
7. Increase the value of my home	7. Energy not available when I need it
8. Show my environmental commitment to others	8. Environmental benefits too small
	9. Take up too much space
	10. Hassle of installation
	11. Would not look good
	12. Neighbour disapproval/annoyance
	13. Disruption or hassle of operation
	14. Hard to find trustworthy information/ advice


Out of the four options below, which was the

- most important

and the

- least important

factor or motivation when you were thinking about buying a microgeneration system?

Most Important			Least Important
○	A	Save or earn money from lower fuel bills and government incentives	○
○	B	Increase the value of my home	○
○	C	Use an innovative/ high-tech system	○
○	D	Make the household more self sufficient/ less dependent on utility companies	○

Fig. 2. An example subset of motivations taken from the best-worst scaling survey.

of choice sets, divided by the number of items) should normally be approximately three, in order to produce statistically significant results [63]. Preliminary testing of the survey suggested that 12 choice sets were acceptable without resulting in respondent fatigue. The number of items per choice set is typically four or five and a study by Orme [63] on the internal validity of such BWS experiments suggests that there is little advantage in more than five items per set. Thus, the survey was designed such that each motivation and barrier appears approximately the same number of times for all respondents across all the choice sets: an average of 2.5 times per person.

As far as we are aware, this is the first time BWS has been used to elicit consumer perceptions of microgeneration. Other studies have used open ended interviews with qualitative analysis [36,64], closed format questions or rating scales with descriptive statistical [e.g. 29,41,42,65] or regression analysis [55]; environmental valuation economic studies have used choice experiments [22,32] and the contingent valuation method [24,66]. The BWS methodology was selected over other methods for its suitability for eliciting importance values over large sets of independent items. Asking respondents to rank items over large sets has been shown to prompt greater likelihood of anomalous choice behaviour, hence the desire to reduce the cognitive load via small sets. The cognitive load is further reduced by only asking respondents to make judgements at the extreme (best/worst) rather than ranking all items shown [67]. BWS also forces the respondent to discriminate between the different items by having to select a best and worst option, thus respondents cannot simply rate each item as of 'middling' importance, as is the case with agreement scale methods (e.g. Likert scales). Additionally, there is no scale use bias associated with the method as respondents do not explicitly rate each motivation and barrier on an absolute scale which is vulnerable to systematic differences in respondents tendency to (not) use certain portions of the scale. BWS also avoids differences in interpretation of terms such as "very" and "quite" often used as labels in such rating scales. Finally, the random utility models estimated on BWS data yield ratio-scaled importance scores, rather than just a rank order, which provide more information and help to understand the results better.

4.3. Data analysis

As mentioned earlier, random utility theory has been used to reveal the relative importance of preferences. The importance of each motivation and barrier is expressed as follows [60]:

$$U_x = I_x + \varepsilon_x \quad (1)$$

where U_x is the relative importance of motivation or barrier x, I_x is the systematic element of importance (the importance level measured within the study) and ε_x is the unobserved error component, which accounts for internal inconsistencies in the choices. I_x is estimated by making an assumption regarding the error terms which are independent and identically distributed (iid), i.e. they all have the same probability distribution.

The best-worst choice tasks are used to estimate the probability of each motivation or barrier being selected as best or worst, given a certain subset of motivations or barriers. Probabilities for the different pairs within the subset are then transformed into relative importance values using the multinomial logit (MNL) rule [68]:

$$P(xy|C) = \frac{e^{I_x - I_y}}{\sum_1^K e^{I_j - I_k}} \quad (2)$$

where $P(xy|C)$ is the probability that item (motivation or barrier) x is selected as best and item y is selected as worst within subset C; j and k are two of the non-selected items in subset C and K is the total number of pairs of items in subset C. A relative importance value U_x is estimated for every motivation and barrier except one, which is the reference value by which to measure the relative importance of the other items. In this study, the reference motivation was *Show my environmental commitment to others* and the reference barrier was *Hard to find trustworthy information/advice*.

A Hierarchical Bayes (HB) model was used to estimate individual-level importance scores. Individual-level importance scores allow us to analyse the variation of importance scores across the sample, which is an advantage over an aggregate MNL model (which yields average importance scores over the whole sample). The survey was designed and data collected and analysed using Sawtooth software: Maxdiff and CBC Hierarchical Bayes [69]. The HB model is hierarchical as it is an iterative operation between two distinct levels of parameter estimation [70]. On the lower level, individual-level MNL scores are estimated from each individual's choice sets. However, there is not enough survey data to fully estimate each parameter for each individual as this would require more choice sets for each respondent potentially resulting in a greater respondent drop-out rate. In order to fill in these information gaps, importance values and covariances are taken from a set of normal distributions from the whole sample: this is the upper level [71]. The new estimate for the individual-level scores then allows a new estimate for the upper-level mean importance scores and covariance matrix. The number of iterations carried out is specified (20,000 in this model) and the importance scores are estimated by taking the average values over the iterations (after a 'burn-in' period of 10,000 iterations to negate the influence of starting values of importance scores and the covariance matrix).

A number of covariates are used in the model in order to improve estimates of the upper-level normal distribution of importance values. If a covariate has a significant effect on the model the different covariate values significantly alter the prediction of the

Table 2
A summary of the characteristics of the sample, showing the breakdown for adopters, considerers and rejecters.

Variable	Total		Adopters		Considerers		Rejecters	
	Mean	Standard error	Mean	Standard error	Mean	Standard error	Mean	Standard error
Which technology have you installed/considered?	*n* = 291		*n* = 113		*n* = 87		*n* = 91	
Solar PV	0.85	0.021	0.85	0.034	0.84	0.040	0.86	0.037
Solar thermal	0.44	0.029	0.27	0.042	0.58	0.053	0.52	0.053
Micro-wind	0.18	0.023	0.062	0.023	0.30	0.049	0.22	0.044
GSHP[a]	0.17	0.022	0.027	0.015	0.26	0.048	0.24	0.045
ASHP[b]	0.13	0.020	0.12	0.030	0.20	0.043	0.088	0.030
Biomass	0.13	0.020	0.062	0.023	0.23	0.045	0.11	0.033
Micro-CHP	0.048	0.013	0	0	0.10	0.033	0.055	0.024
Micro-hydro	0.024	0.009	0.018	0.012	0.057	0.025	0	0
Income	*n* = 282		*n* = 106		*n* = 86		*n* = 90	
<£20,000	0.25	0.026	0.24	0.04	0.28	0.049	0.24	0.046
£20,000–£30,000	0.17	0.022	0.16	0.036	0.22	0.045	0.13	0.036
£30,000–£40,000	0.15	0.021	0.11	0.031	0.16	0.040	0.17	0.040
£40,000–£50,000	0.12	0.020	0.11	0.031	0.14	0.038	0.12	0.035
£50,000–£60,000	0.071	0.015	0.094	0.029	0.035	0.020	0.078	0.028
£60,000–£80,000	0.10	0.018	0.10	0.030	0.058	0.025	0.14	0.037
£80,000–£100,000	0.050	0.013	0.066	0.024	0.047	0.023	0.033	0.019
>£100,000	0.085	0.017	0.11	0.031	0.058	0.025	0.078	0.028
Gender	*n* = 289		*n* = 111		*n* = 87		*n* = 91	
1 = Male, 0 = Female	0.79	0.024	0.83	0.036	0.77	0.045	0.77	0.044
Age	*n* = 264		*n* = 102		*n* = 78		*n* = 84	
Years	53.9	0.771	55	1.04	51.2	1.56	54.9	1.46
Occupation[c]	*n* = 281		*n* = 108		*n* = 85		*n* = 88	
Employed	0.59	0.029	0.59	0.048	0.58	0.054	0.61	0.052
Retired	0.27	0.026	0.31	0.045	0.20	0.044	0.27	0.048
Student	0.032	0.011	0	0	0.071	0.028	0.034	0.019
Unemployed	0.11	0.018	0.093	0.028	0.15	0.039	0.080	0.029
Education[d]	*n* = 291		*n* = 113		*n* = 87		*n* = 91	
Bachelor's degree (or equiv)	0.59	0.029	0.66	0.045	0.49	0.054	0.60	0.052
Master's degree (or equiv)	0.31	0.027	0.35	0.045	0.24	0.046	0.33	0.050

[a] Ground source heat pump.
[b] Air source heat pump.
[c] Nine types of occupation were considered but only the types for which correlation was found are shown.
[d] Eight education groups were considered but only the groups for which correlation was found are shown.

importance weights. Each of the 10,000 HB iterations produces an estimate of the effect of the covariate and this may be either positive (i.e. a change in the covariate from the reference value increases the importance weight) or negative (decreases the importance weight). The covariate effect is significant if over 95% of the iterations are either positive or negative [71].

5. Results

The sample characteristics are given in Table 2 for the total sample and the three sub-groups: adopters, considerers and rejecters. Mean responses are given alongside the standard error of the mean as a measure of the average variance within the group. Further detail in the responses can be found in the Appendix.

The demographic of the aggregate sample was similar to that of a typical adopter [4,29,42,51,52]. In comparison to the UK 2011 Census data, the sample was older (54 compared to 48 years old[1]), educated to a higher level (60% had a Bachelor's degree or higher, compared to 27% in England and Wales) and wealthier (median income £30,000–£40,000 versus the UK average £26,500) [72]. Whilst there is little difference between the adopter and rejecter groups, considerers are far closer to the national average with a lower income (median of £20,000–£30,000), age (51 years old) and level of education than the rest of the sample (although still twice that of the national average).

It is important to note that these three groups are not static or necessarily homogeneous in their preferences. Adopters are an aggregated group who have installed different technologies at different times and perhaps for different reasons. Fig. 3 shows the distribution of the year of installation or rejection across the sample of adopters and rejecters indicating that over 75% of adopters had installed since the FITs were introduced in 2010. Fig. 4 reflects the proportion of the whole sample that considered/installed each technology. The vast majority of adopters have installed a solar PV system. Some have installed solar thermal (25%, normally in addition to a solar PV system) but very few other technologies have been installed, which is consistent with the current number of installations of different microgeneration technologies in the UK [4].

The following sections detail the survey results for the motivation for and barriers to installing microgeneration in the UK.

5.1. Motivations for installing microgeneration

As described in Section 4.3, choice models were estimated using an HB technique to elicit importance values for motivations and barriers, the results of which are given in Table 3. The values shown are the measure of relative importance given to each motivation, whereby the sum of importance values for each group always equals 100. The sample was treated in aggregate (adopters, considerers and rejecters together) as all groups were presented

[1] This figure is derived from the 2011 Census statistics [72] and considering only those aged 18 or over.

Table 3
Estimates from the Hierarchical Bayes model of relative importance of each motivation and barrier for adopters, considerers and rejecters, with the standard error of the mean as a measure of variance.[a]

	Adopters		Considerers		Rejecters	
	Mean	Standard error	Mean	Standard error	Mean	Standard error
Motivations						
Make the household more self-sufficient/less dependent on utility companies	23.6	1.04	27.7	0.93	26.3	0.82
Save or earn money from lower fuel bills and government incentives	22.7	0.87	21.0	1.21	25.0	0.85
Protect against future higher energy costs	24.1	0.76	23.1	1.04	26.5	0.64
Help improve the environment	16.6	1.10	15.2	1.43	11.2	1.23
Increase the value of my home	3.7	0.64	2.3	0.55	3.0	0.62
Use an innovative/high-tech system	2.7	0.42	2.7	0.63	1.2	0.38
Show my environmental commitment to others	5.0	0.89	3.5	0.95	2.0	0.61
Protect the household against power cuts	1.5	0.43	4.5	0.74	4.7	0.78
Root Likelihood	*0.73*	*0.01*	*0.71*	*0.01*	*0.76*	*0.01*
Barriers						
Costs too much to buy/install	14.5	0.64	18.3	0.55	15.5	0.71
Hard to find trustworthy information	11.9	0.70	13.2	0.84	8.1	0.80
System performance or reliability	10.6	0.52	10.5	0.65	8.9	0.61
Cannot earn enough/save enough money	9.4	0.60	12.1	0.77	12.1	0.78
Lose money if I moved home	11.4	1.90	5.5	1.25	18.6	2.96
Home/location not suitable	8.5	0.81	6.0	0.76	8.1	0.94
Energy not available when I need it	8.1	0.65	8.6	0.67	6.9	0.59
Hassle of installation	6.6	0.63	5.0	0.63	4.7	0.63
High maintenance costs	4.9	0.35	8.1	0.54	4.7	0.42
Environmental benefits too small	4.7	0.42	4.1	0.52	5.1	0.65
Disruption or hassle of operation	4.8	0.48	4.4	0.52	2.8	0.37
Take up too much space	1.8	0.25	1.6	0.29	2.6	0.41
Would not look good	1.3	0.30	1.6	0.43	0.9	0.25
Neighbour disapproval/annoyance	1.5	0.37	1.1	0.29	1.0	0.27
Root Likelihood	*0.55*	*0.01*	*0.57*	*0.01*	*0.57*	*0.01*

[a] Individual importance scores were transformed, rescaled and averaged across each adopter, consider and rejecter group. For each respondent, the raw scores were first zero-centred (a mean score of zero across the set of parameters) by subtracting the mean value from each parameter. Each parameter was transformed using the equation $\frac{e^{U_i}}{e^{U_i}+a-1}$, where U_i is the zero-centred importance score and a is the number of items in each set (4 for motivations, 5 for barriers) [63]. Finally, the parameters were rescaled such that the summation of the parameters equals 100.

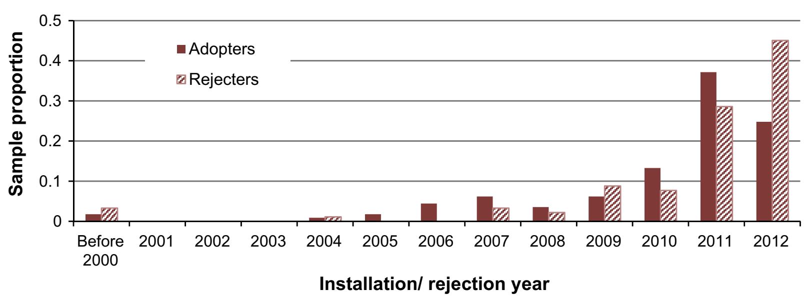


Fig. 3. The year of installation for the sample of adopters and the year of rejection for the sample of rejecters.

with the same motivations and barriers to adoption, in order to elicit importance scores for each respondent, as shown in Table 3. The individual level scores, as well as individual root likelihood (RLH) estimates[2] [73,74], were then averaged over the adopter, considerer and rejecter groups to give average group scores. Fig. 5 illustrates these importance scores of each motivation for each adopter, considerer and rejecter group. The error bars on each estimate represent the standard error of the mean importance scores (shown in Table 3). The model fit of the HB models (0.71–0.76 for motivation models and 0.55–0.57 for barrier models) was judged acceptable [74].

The covariates used for the estimation of models on motivations were: adopters, considerers and rejecters (3 groups); income (8 groups; see Table 2); age (continuous); level of education (3 groups: no Bachelor's degree, Bachelor's degree, Master's degree or equivalent); and technology adopted/considered/rejected (4 binary groups[3] (yes/no): solar PV, solar thermal, wind and ground source heat pumps). These covariates were found to significantly affect importance estimates and notable differences are described below.

As shown in Fig. 5, four motivations are found to be consistently more important than the others, of which three relate to finance and independence from power companies: saving or earning money from the installation, increasing household independence and to protect against future high energy costs. The fourth top motivation, desire to help improve the environment, is

[2] The root likelihood is a measure of model fit, defined as the geometric mean of the probabilities of each respondent selecting each choice that they did, given the estimated model. The maximum theoretical RLH value (a perfect model fit) is 1, whilst a minimum value (with no model fit, called the null RLH) equates to the reciprocal of the number of items per choice task [73]. A rule of thumb for acceptance of the model is a RLH that is double the null RLH value: 0.5 for motivations [4 items per choice set: $(1/4) * 2 = 0.5$] and 0.4 for barriers [5 items per choice set: $(1/5) * 2 = 0.5$] [74].

[3] All technologies were tested as covariates during the analysis but only solar PV, solar thermal, wind and ground source heat pumps had a significant impact on the parameter estimations.

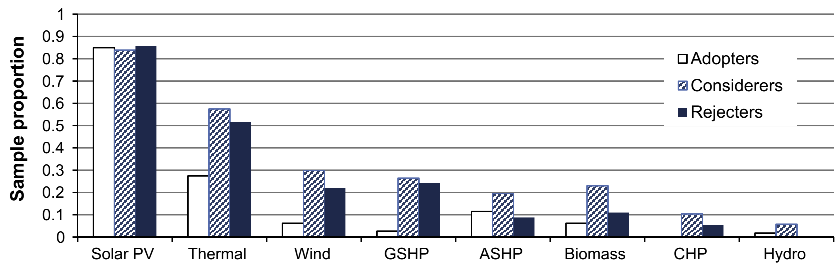


Fig. 4. The proportion of adopters, considerers and rejecters who have installed or considered each technology.

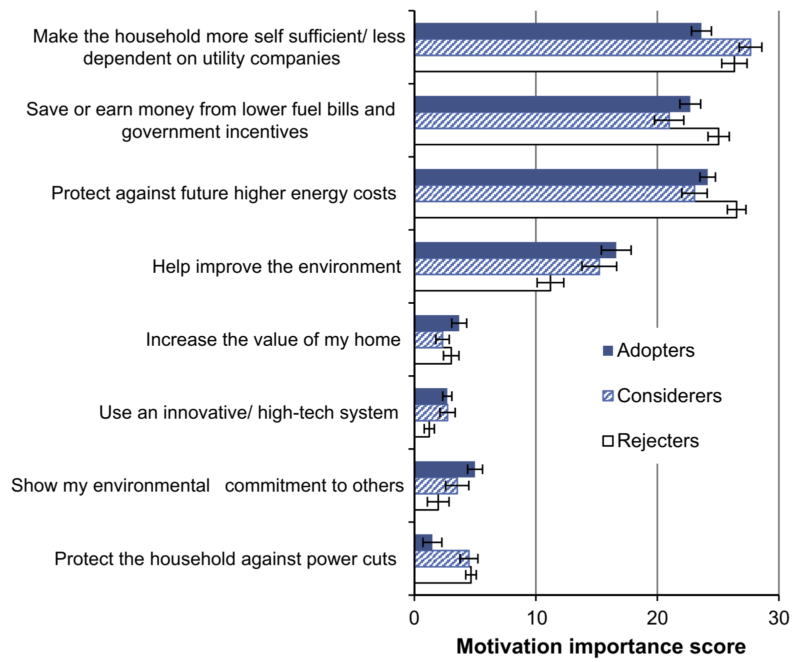


Fig. 5. Hierarchical Bayes estimation of the relative importance of motivations for installing microgeneration for adopters, considerers and rejecters.

consistently below these financial motivations, but its relative importance to them is variable across the three groups. For rejecters saving money from lower fuel bills is 2.3 times as important a motivation as improving the environment, but for adopters and considerers, it is only 1.4 times as important.

The rest of the motivations matter little relative to the top four factors, yet there are notable differences among the groups. Protection against power cuts is far more significant an issue for considers and rejecters than for adopters. Saving money from lower fuel bills is 15 times more important than such protection for adopters, but only 5 times more so for considerers and rejecters.

Adopters are more motivated by the desire to show their environmental commitment to others, relative to both financial and pure environmental motivations. Hence improving the environment is only 3.3 times more important than showing that commitment to others for adopters, whilst for considerers and rejecters it is 4.3 and 5.6 times more important. Saving or earning money is 4.5 times more important than exhibiting environmental commitment for adopters whilst for rejecters it is 12.5 times more important (see Fig. 5).

Considerers are less motivated to earn money from the installation, relative to the other motivations, than rejecters and adopters. Considerers have a lower income than adopters and rejecters and the inclusion of income group as a covariate in the model shows that lower income groups (in particular household incomes of <£20,000 and £30,000–£40,000) are also 16–21 times less motivated to save or earn money from the installation; this is discussed further in Section 6.1.

Another group significantly less motivated by earning money from the installation are adopters who installed prior to 2010, the year in which FITs were introduced. These results are shown in Fig. 6 which illustrates the differences in motivation importance scores between adopters before 2010 ($n = 28$) and from 2010 onwards ($n = 85$). Saving or earning money was 1.7 times more important than improving the environment for later adopters, but 1.4 times less important for earlier adopters. Therefore, the introduction of FITs has created a new group of adopters who exhibit much greater financial motivations to install.

Adopters who installed prior to 2010 were also significantly more motivated by showing their environmental commitment to others. This motivation was twice as important compared to those who installed since 2010. The motivation to increase the value of their home was twice as important for the post-FIT adopters, although still relatively unimportant in the adoption decision (5 times less important than the top most important motivations; see Fig. 6).

5.2. Barriers to installing microgeneration

There is a much greater variation of importance values across the different barriers than motivations, as illustrated in Fig. 7 which shows the relative importance of each barrier to the sample

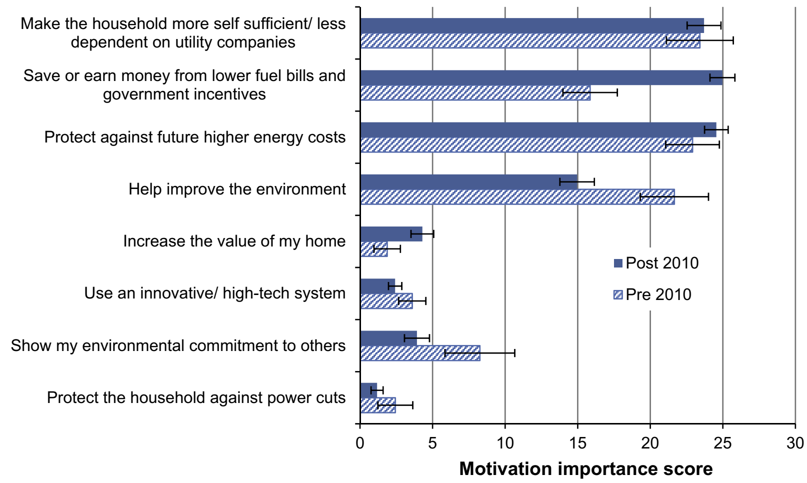


Fig. 6. Motivation importance scores for pre- and post-2010 adopters.

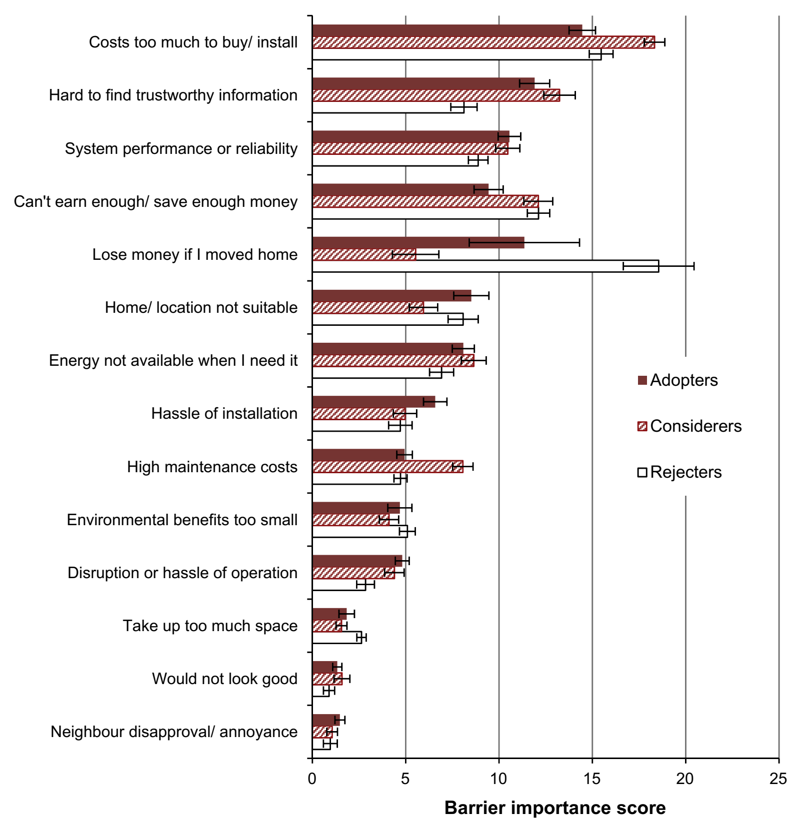


Fig. 7. Hierarchical Bayes estimation of the relative importance of barriers to installing microgeneration for adopters, considerers and rejecters.

sub-groups. The covariates used for the estimation of barriers were: adopters, considerers and rejecters (3 groups); income (8 groups; see Table 2); age (continuous); likelihood of moving home within five years (5 groups: very likely, fairly likely, no idea, fairly unlikely and very unlikely); and technology adopted/considered/rejected (6 binary variables (yes/no): solar PV, solar thermal, wind, ASHP, biomass and CHP).

Financial barriers (high capital costs, not earning or saving enough money and the risk of losing money if moved home) were found to be the most important. For adopters and considerers, the most important barrier was the high capital cost, which was 50% more important than not earning enough money from the installation. Surprisingly, the largest barrier for rejecters was the prospect of losing money if they moved home, 60% more important than for adopters and 3 times more important than for considerers. The difficulty in finding trustworthy information is also a significant barrier for most and is approximately as important as not earning or saving enough money from the installation for considerers, 1.3 times more important for adopters and 1.5 times less important for rejecters. Aspects of particularly little importance for all groups were that the system would not look good and concerns about neighbour disapproval and were between 10 and 17 times less important than the capital cost barrier.

Both considerers and rejecters are significantly more put off by not saving/earning enough money than adopters: this barrier was 30% more important for considerers and rejecters than for

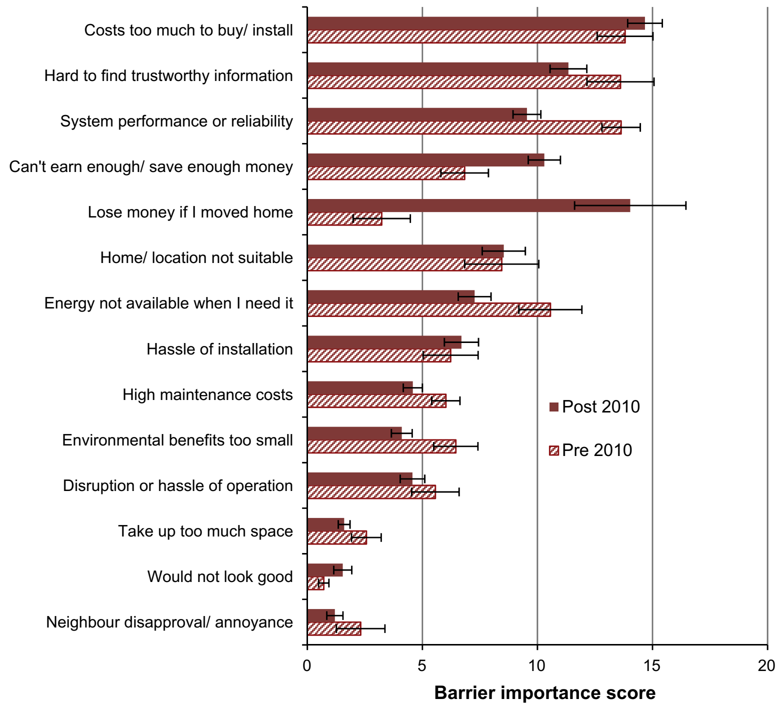


Fig. 8. Barrier importance scores for pre- and post 2010 adopters.

adopters. This implies that the FITs and other financial incentives, whilst having increased uptake, have not removed these barriers from the installation decision.

Using income categories as covariates within the model shows that the two lowest income groups (<£20,000 and £20,000–£30,000) are 20–25% more put off by the capital cost barrier.

Another group who were significantly put off by the risk of losing money if they moved home are post-2010 adopters (Fig. 8). Relative to the most important barrier to both pre- and post-2010 adopters – high capital cost – losing money if they moved home was 4.3 times less important for pre-2010 adopters, whereas for post-2010 adopters the two barriers are of equal importance. The latter group were 4 times more put off by potentially losing money if they moved home than those who installed prior to 2010 (see Fig. 8). More recent adopters were also far more put off by not earning or saving enough money from the installation. This is perhaps synonymous with their greater motivation to save or earn money, described in Section 5.1.

Adopters who installed before 2010 were far more concerned about system performance, energy availability and had more difficulty in finding trustworthy information. Relative to the capital cost barrier, system performance and the information barrier were approximately as important for the pre-2010 adopters, but 1.3 and 1.5 times less important for the post 2010 adopters, respectively. The problems in purchasing the system, described by adopters within the survey and during the telephone interviews, often concerned uncertainty about the potential system performance because of a lack of accessible or trustworthy information.

6. Discussion

Having summarised and discussed some of the key findings on motivations and barriers, we now discuss the impact of past and current policies, as well as our findings' implications for future policy and the microgeneration industry.

6.1. Motivations for installing microgeneration

The results of the survey for motivations show that improving the environment is a far greater motivation for adopters than rejecters (see Fig. 5). Previous research has found the environmental motive to be an initiator to investigate installing rather than being a decisive factor in the decision (see Section 3.2). However, this study clearly identifies it as a differentiating factor between those who adopt and those who reject.

The FIT scheme has significantly increased the earning potential of electricity-generating technologies, encouraging a new, more financially-motivated, consumer group to install. As this becomes the main motivation for some to install, other financial investment products become the competition for microgeneration systems rather than other electricity sources. Such investment products include bank saving accounts, stocks, shares, bonds and property investment [8]. However, during the period 2010–2012, Bank of England interest rates were 0.5% [75], which in turn meant that savings accounts had low interest rates. Similarly, the property market [76] and the stock markets were more volatile during the economic downturn. At the same time, the rate of return on a solar PV investment reached approximately 10%[4] [8]. Thus, aside from perhaps an early mortgage repayment, solar PV represented a preferable financial investment for many. Therefore, regardless of any other motivations for installing microgeneration, solar panels may have been chosen mainly for their investment potential.

In 2013, however, the UK financial landscape started to change. Although interest rates remained low, economic growth and house prices began to increase [76]. This suggests other assets may start

[4] This figure was estimated from [6], based on the old tariff of 43.3 p/kWh. The new tariff of 21 p/kWh gives a 4.5% annual return on investment. Payments for electricity exported to the grid are not included in the estimate because the total contribution of export payments is small (~3% of income from solar PV). Although this contribution has increased with the increase of export payments from 3 to 4.5 p/kWh, their contribution is still small.

to compete financially more strongly with microgeneration installations.

Alongside the impacts of any improvement on rates of return on other investments, FIT rates were reduced in 2012 (roughly by a half) so that the FIT return fell to less than half of what it was previously for solar PV: ~4.5% [8,77]. Consequently, this consumer segment (households who regard microgeneration primarily as a financial investment) may be lost unless the financial landscape changes again or the appeal of microgeneration increases. For example, rejecters are most motivated to protect against future high energy costs and to make the household more self-sufficient in terms of energy provision (see Fig. 5) so that uptake by this group may increase if these aspects improved. For instance, self-sufficiency from solar PV can be maximised using battery storage. However, this represents an additional upfront cost, which is already an important barrier to installing microgeneration (see Section 5.2). Additionally, the FIT incentives offer a sell-back price for generated electricity of 5 p/kWh, further reducing the financial viability of battery storage. Therefore, without any incentives, the uptake of batteries will remain low, in turn reducing the potential of microgeneration to benefit from the self-sufficiency motivation and by implication, from protection of future increases in energy prices. Recognising this as an issue, the German government implemented a scheme in May 2013 offering capital grants for 30% of the installation cost and low-interest loans for the remainder of the cost to increase the uptake of battery storage [78]. A similar scheme could be introduced by the UK government, following the successful implementation of the FITs, which were also imported from Germany.

A further action that would help with the uptake of energy storage is provision of clear, impartial information on batteries and their potential to improve self-sufficiency and flexibility of electricity use as well as their financial viability in conjunction with microgeneration systems. Currently, there is a lack of such information, particularly as the incentives landscape and the related financial benefits are very complex, including the FIT scheme and the Green Deal. This is compounded by the complexity of electricity pricing and numerous deals offered by grid electricity providers which are very confusing to the consumer [79]. Providing simple and clear guidance to consumers on the benefits of battery storage should therefore be a priority for suppliers and installers, in a similar manner in which FITs were promoted [e.g. 80,81].

Compared to rejecters, considerers were significantly less motivated by earning money from the installation, although this is still important in the decision (see Fig. 5). Perhaps as this group has a lower income, they expect lower financial gains relative to the higher-income groups. Considerers are thus likely to be less motivated by the FIT incentives than adopters and rejecters. Therefore, instead of FITs which offer higher gains but require a high initial investment, the Green Deal may be more appealing as it lowers the initial investment whilst resulting in lower financial gains (due to the payback of the loan). The potential effectiveness of the Green Deal is discussed further in the following section.

6.2. Barriers to installing microgeneration

The results of the survey indicate that, in spite of the numerous financial incentives, the largest barriers are still high capital costs, not earning enough money and the risk of losing money if they moved home (see Fig. 7). The latter, the largest barrier for rejecters, has appeared on some specialist websites [82,83] with a particular concern being 'rent a roof' schemes [84,85], where solar panels are owned by a third party. This is viewed as a risk to potential home-buyers as well as mortgage lenders. However, this barrier has received very little attention in the academic literature with findings on the effect of solar PV on resale value being conflicting and inconclusive: two studies on house sales in the USA find that house prices increase approximately proportionally with the capital investment of solar PV [26,27], whereas one study in Oxford, UK, finds a negligible difference in house price between those with solar panels and those households without [28].

The UK government has attempted to address the capital cost and house resale value barriers with the introduction of the Green Deal. The risk of losing money if moving home is reduced by the Green Deal loan as there is no risk associated with an initial outlay. However, concern has been raised that the fixed loan repayments, which stays with the home rather than the original occupants, will put off prospective house buyers resulting in a lower house price [86,87]. If the house-buyers were lower energy users than the previous occupants, the monthly repayment (which is fixed at the start of the term) could be greater than the savings from the improvement measures, saddling the house-buyers with an additional bill [88]. A survey conducted by Which? of 2000 UK residences found that half the sample of potential house buyers would want the loan to be paid off prior to purchasing [86]. One fifth of the sample said they would be put off purchasing a property if it had a Green Deal attached to it. Thus, the Green Deal may indeed exacerbate the risk of losing out financially if an adopter moved home prior to the end of the payback.

The high interest loan rate of 7–9% has also been criticised for making the deal unappealing to homeowners [89–91]. A number of improvements to the Green Deal have been suggested by the UK Green Building Council, including to reduce the loan interest rates and to reduce council tax for homes that meet certain energy efficiency requirements [89]. These would both further incentivise the Green Deal agreement, as well as providing on-going financial incentives for house-buyers considering purchasing a home with an attached Green Deal.

Other barriers to adoption, particularly for pre-FIT adopters, were system performance and energy availability concerns, as well as the difficulty in finding trustworthy information. These barriers were less of a concern for more recent adopters, as well as rejecters, which may be due to the improvement measures put in place since 2010. The Microgeneration Certification Scheme provides standards for installation and there are significant quantities of technological and performance-related information from the Department of Energy and Climate Change (DECC), the Energy Saving Trust (EST), MCS and other interest groups.

In 2011, it was reported in the Microgeneration Strategy document that [3, page 38, paragraph 4.2].

"Currently, most householders ... struggle to identify accurate, unbiased information. In the absence of a widely recognised source of impartial advice, anecdotal evidence of previous grant programmes suggests that investment decisions could be taken based on inadequate information or even influenced by mis-selling."

Despite the efforts to address this (by DECC, MCS, EST, etc.) finding trustworthy information was the second-most important barrier faced by considerers. The barrier was 10% more important than earning/saving enough money, 25% more important than system performance and over twice as great as the barrier posed by fear of losing money if they moved home. Clearly there remains a considerable gap between the government's intention to provide reliable information to those considering microgeneration adoption, and the experience of these considerers. Addressing this may be one of most effective and inexpensive means of lowering barriers to greater microgeneration uptake.

6.3. FITs and the experience of adoption

In order to investigate adopters' experiences of their microgeneration system, they were asked "If you knew what you know now at the time of deciding to install, would you do it again?"

(see Supplementary material). The results indicate that 90% of adopters would either probably or definitely buy again knowing what they knew post-installation. However, many solar PV adopters also experienced problems with installing. As described in Section 2.1, the solar PV FIT rate change in 2012 brought about a rush to install before the payments on new installations reduced. Several respondents reported that this rush was the cause of poor quality installation.

A high proportion of considerers and rejecters have also been affected by the cuts to the solar PV FIT rates in 2012. Many were concerned that, if they were to adopt, their FIT payment may be changed. This is a false concern: FIT rate reductions only affect systems installed after the reduction date and FIT rates remain constant once the installation is registered. This misinterpretation may be due to the complicated nature of the tariffs and the uncertainty caused by the speed and scale of the changes to the FIT rates. The regulation regarding FIT rate degression began in 2010 as a simple annual percentage reduction, but has since been amended to include various caveats: 'corridors', 'triggers' and 'emergency adjustments', which are controlled by DECC [92]. In order to increase consumer confidence in the incentives, the regulation framework must be stable, consistent [20] and transparent. The relationship between changing the FIT rates and installation costs should be made available and updated regularly so that consumers can make informed decisions related to the return on their investment.

Adopters were also asked "Would you do anything differently now in terms of technology, installation or using the system?" Notably, six out of the seven wind turbine adopters said they would do something different, with four of these saying they would not install a wind turbine at all. The main problem experienced by wind turbine adopters was the performance, or lack of wind to generate from, suggesting they have been installed in an unsuitable location. Similarly, analysis of the effect of the covariates used within the HB model shows that those who installed or considered wind turbines, as well as air source heat pumps and biomass, were more concerned about system performance than those who installed or considered other technologies. Those who installed or considered a wind turbine viewed a lack of system performance as equally important as the capital cost barrier, compared to the sample average figure of 63% of the importance of capital cost.

The MCS issues sets of standards for the design and installation of microgeneration systems, in order to ensure installations operate as designed [93]. As the sample of wind installations in this study is small ($n = 7$), further investigation into the experiences of wind turbine adopters is required in order to assess the effectiveness of the MCS accreditation in this instance. It has been widely documented that the number of suitable locations for small scale wind installations is very limited in the UK [94]. Poorly performing installations cause a bad public perception as well as not contributing to the household, let alone UK climate change and energy security targets.

7. Conclusions

This paper has used best-worst scaling to explore the relative importance of the motivations and barriers associated with adoption of microgeneration. Of the motivations investigated, three were consistently the most important: saving or earning money from the installation, increasing household independence and protecting against future energy costs. Half as important in the decision was the desire to help improve the environment. However, this motivation is far stronger for adopters than rejecters, suggesting it to be a key differentiating factor between those who decide to install and those who do not.

Financial barriers dominate the adoption decision: high capital costs, not earning or saving enough money and the risk of losing money if they moved home were very important to all groups. Considerers also found the difficulty in obtaining reliable information very important, 10% more so than not earning or saving enough money from the installation. The microgeneration strategy, the Microgeneration Certification Scheme and the Energy Savings Trust have all highlighted this barrier and attempted to provide reliable information in response, but despite this the barrier remains a significant one and must be addressed further. Greater provision of impartial and more transparent information and advice may represent the most cost-effective action to help increase microgeneration uptake.

There are differences in the experience of adoption across technologies, most notably with wind turbine owners, who often experienced operational problems such as a lack of wind. The Microgeneration Certification Scheme is aimed at ensuring a certain level of product and installation quality to avoid miss-selling. Further work is needed to examine the success of the scheme in ensuring acceptable wind turbine performances.

The introduction of the feed-in Tariffs (FITs) has increased uptake by enabling a more financially-motivated group to install. However, the halving of solar PV FITs in 2012 reduced uptake significantly and is likely to have impacted most upon the financially-motivated consumer group. The sudden tariff cut also caused a rush to install prior to its implementation, to which many adopters attributed poor quality installations. Additionally, the complicated nature of the FIT degression mechanism has decreased consumer confidence and caused a misinterpretation of the incentives, with many fearing that if they were to install, their FIT rate might change. In order to prevent such negative consequences of tariff degression in the future, the mechanism to regulate FIT degression must be simpler, more transparent and regularly updated, allowing a more informed consumer decision.

If the uptake figures since the FIT rate reduction are to be improved, other motivations, such as the desire for energy self-sufficiency, should be focused on and publicised more clearly. Rejecters in particular are highly motivated to be self-sufficient or independent from utility companies and to protect against future energy cost increases. The recent concern over the risk of an imminent 'energy gap' within the next two years may further add to households' motivation to be self-sufficient and to guard against power cuts. In order to increase uptake, the government and microgeneration industry should focus on promoting and detailing the benefits of microgeneration in relation to these aspects, or improving them by increasing the availability of energy when required. For example, microgeneration suppliers could promote the use of battery storage with solar PV and highlight the potential benefits with respect to self-sufficiency. An incentive scheme similar to the recent German capital grant scheme for battery storage would increase uptake, albeit at an additional government (and taxpayers') cost. However, further research is required to determine the economic and environmental impacts of battery storage.

The Green Deal is intended to deal with the installation-cost barrier and the risk of losing money if moving home by providing a capital cost loan. This may appeal to considerers who have a lower income and are less motivated by earning money from incentives as well as rejecters who are most put off by the risk of losing money if they moved home – one of the largest barriers identified in this research. However, the high loan interest rates and the risk of encountering problems if the home was sold whilst the loan is still being repaid significantly limit the consumer appeal for the scheme, as demonstrated by the very low uptake rates of the scheme. The Green Deal would be more appealing if loan interest rates were more competitive and the potential negative effect of Green Deal finance on house sale prices should be investigated

Table A1
Summary of answers by adopters.

Variable	Participants	Mean	Standard error
Do you own the system?			
1 = Yes, 0 = No	113	0.956	0.019
Installation year			
Before 2000	113	0.018	0.012
2004	113	0.009	0.009
2005	113	0.018	0.012
2006	113	0.044	0.019
2007	113	0.062	0.023
2008	113	0.035	0.017
2009	113	0.062	0.023
2010	113	0.13	0.032
2011	113	0.37	0.046
2012	113	0.25	0.041
Those installed since FITs have been available (2010)	113	0.75	0.041
Do/Have you received incentives for the system?			
No	113	0.28	0.043
Feed-in tariffs	113	0.65	0.045
ROCs (Renewable Obligation Certificates)	113	0.018	0.012
Grant (e.g. from the Low Carbon Buildings Programme)	113	0.088	0.027
Other (please describe briefly)	113	0.11	0.029
If you knew what you do now at the time of deciding to install, would you do it again?			
Definitely would	113	0.71	0.043
Probably would	113	0.19	0.037
Not sure	113	0.027	0.015
Probably not	113	0.035	0.017
Definitely not	113	0.035	0.017
Would you do anything differently?			
Nothing	113	0.42	0.047
Do not know	113	0.062	0.023
Yes I would change something...	113	0.52	0.047
Did you encounter any problems during the decision/installation/operation of the system?			
No problems	113	0.58	0.047
Problem or difficulty when buying it	113	0.11	0.029
Problem or difficulty with installing it	113	0.14	0.033
Problem or difficulty whilst using it	113	0.19	0.037
Any other problem or difficulty	113	0.20	0.038

Table A2
Summary of answers by considerers and rejecters.

Variable	Considerers			Rejecters		
	Participants	Mean	Standard error	Participants	Mean	Standard error
What year did you decide not to install?						
Before 2000	N/A	N/A	N/A	91	0.033	0.019
2004	N/A	N/A	N/A	91	0.011	0.011
2007	N/A	N/A	N/A	91	0.033	0.019
2008	N/A	N/A	N/A	91	0.022	0.015
2009	N/A	N/A	N/A	91	0.088	0.03
2010	N/A	N/A	N/A	91	0.077	0.028
2011	N/A	N/A	N/A	91	0.286	0.048
2012	N/A	N/A	N/A	91	0.451	0.052
What stage of consideration have you got to?						
Initial investigation	87	0.63	0.052	91	0.65	0.05
I have talked others who have installed	87	0.32	0.05	91	0.37	0.051
I have been to see a system in action	87	0.17	0.041	91	0.13	0.036
I received professional advice	87	0.18	0.042	91	0.24	0.045
I received a quote from supplier/installer	87	0.33	0.051	91	0.44	0.052
Other information	87	0.10	0.033	91	0.15	0.038
How likely are you to install?						
Almost definitely will	87	0.14	0.037	N/A	N/A	N/A
Pretty likely	87	0.33	0.051	N/A	N/A	N/A
Perhaps	87	0.45	0.054	N/A	N/A	N/A
Pretty unlikely	87	0.069	0.027	N/A	N/A	N/A
Almost definitely would not	87	0.011	0.011	N/A	N/A	N/A
Are you familiar with the recent cuts to the solar PV FITs?						
Yes	77	0.67	0.054	69	0.73	0.054
Vaguely	77	0.23	0.049	69	0.20	0.049
No	77	0.091	0.033	69	0.072	0.031

(*continued on next page*)

Table A2 (*continued*)

Variable	Considerers			Rejecters		
	Participants	Mean	Standard error	Participants	Mean	Standard error
Have these cuts put you off installing a system?						
Made no difference	70	0.3	0.055	64	0.33	0.059
Put me off a little	70	0.49	0.06	64	0.28	0.057
Put me off a lot	70	0.21	0.049	64	0.19	0.049
Put me off completely	N/A	N/A	N/A	64	0.20	0.051
If the cuts have put you off, why?						
The changes make it less financially beneficial	70	0.6	0.059	64	0.44	0.063
If I bought a system I would be worried about future tariff rates changing	70	0.4	0.059	64	0.44	0.063
The change had not happened when I considered installing	N/A	N/A	N/A	64	0.17	0.048
Other...	70	0.37	0.058	64	0.36	0.06

further. If a negative effect is identified, the barrier could be reduced by lowering council tax rates for Green Deal homes or energy efficient homes in general as is the case with vehicle tax.

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Appendix A

(See Tables A1 and A2).

Appendix B. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.apenergy.2014.05.047.

References

[1] HM Government. Energy act, 2004. Crown Copyright: London; 2004. <www.legislation.gov.uk/ukpga/2004/20/contents>.

[2] HM Government. The UK renewable energy strategy, DECC, Editor 2009. Crown Copyright: London; 2009.

[3] HM Government. Microgeneration strategy, DECC, Editor 2011. Crown Copyright: London; 2011.

[4] Balcombe P, Rigby D, Azapagic A. Motivations and barriers associated with adopting microgeneration energy technologies in the UK. Renew Sustain Energy Rev 2013;22:655–66.

[5] DECC. Monthly central feed-in tariff register, in microsoft excel, July_2013_Monthly_Central_Feed-in_Tariff_Register_Statistics.xls, Editor 2013. DECC: London; 2013. <www.gov.uk/government/statistical-data-sets/monthly-central-feed-in-tariff-register-statistics>

[6] DECC. Renewable heat incentive, department of energy and climate change, Editor 2011. Crown Copyright: London; 2011. <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48041/1387-renewable-heat-incentive.pdf>.

[7] DECC. The green deal- a summary of the government's proposals, department of energy and climate change, Editor 2010, Crown Copyright: London; 2010. <www.gov.uk/government/uploads/system/uploads/attachment_data/file/47978/1010-green-deal-summary-proposals.pdf>.

[8] DECC. Feed-in tariffs scheme: consultation on comprehensive review phase 1 – tariffs for solar PV, DECC, Editor 2011. Crown copyright 2011: London; 2011. <www.gov.uk/government/uploads/system/uploads/attachment_data/file/42834/3416-fits-IA-solar-pv-draft.pdf>.

[9] DECC. Feed-in tariffs scheme: summary of responses to the fast-track consultation and government response, department of energy & climate change, Editor 2011. Crown Copyright 2011: London; 2011.

[10] Debenham C. Legal battle over solar feed-in tariff ends in defeat for DECC. YouGen Blog 2013; 2013. <www.yougen.co.uk/blog-entry/1883/Legal+battle+over+solar+feed-in+tariff+ends+in+defeat+for+DECC/> [cited 14.09.13].

[11] Nichols W. Green heat industry hits out at renewable heat incentive delay; 2011. <www.guardian.co.uk/environment/2011/jan/21/renewable-heat-incentive-delay?INTCMP=SRCH> [cited 10.10.12].

[12] Nichols W. Green heating scheme delayed again until spring 2014. Guardian environment network 2013; 2013. <www.guardian.co.uk/environment/2013/mar/27/green-heating-scheme-delayed-again-rhi> [cited 27.05.13].

[13] Energy Saving Trust. choosing a renewable technology. Generating energy 2013; 2013. <www.energysavingtrust.org.uk/Generating-energy/Choosing-a-renewable-technology> [cited 08.07.13].

[14] Energy Saving Trust. Renewable heat premium payment phase 2 generating energy 2013; 2013. <www.energysavingtrust.org.uk/Generating-energy/Getting-money-back/Renewable-Heat-Premium-Payment-Phase-2> [cited 29.06.2013].

[15] OFT. Off-grid energy: an oft market study, office of fair trading, Editor 2011. Crown Copyright: London; 2011. <www.oft.gov.uk/shared_oft/market-studies/off-grid/OFT1380.pdf>.

[16] Energy Saving Trust. renewable heat premium payment scheme: regional statistics as at phase 1 closure, 2012. Energy Saving Trust: London; 2012. <www.energysavingtrust.org.uk/Publications2/Generating-energy/Regional-statistics-for-the-Renewable-Heat-Premium-Payment-scheme>.

[17] Energy Saving Trust. Renewable heat premium payment scheme phase 2 statistics as at 18 February 2013. Energy Saving Trust: London; 2013. <www.energysavingtrust.org.uk/Publications2/Generating-energy/RHPP-Phase-Two-web-stats>.

[18] Dowson M et al. Domestic UK retrofit challenge: barriers, incentives and current performance leading into the green deal. Energy Policy 2012;50:294–305.

[19] DECC. Statistical release: experimental statistics. Domestic green deal and energy company obligation in Great Britain, Monthly report March 2013, DECC, Editor 2013. Crown Copyright: London; 2013. <www.gov.uk/government/uploads/system/uploads/attachment_data/file/230138/Statistical_Release_-_Green_Deal_and_Energy_Company_Obligation_in_Great_Britain_-_20_August_2013.pdf>.

[20] Allen SR, Hammond GP, McManus MC. Prospects for and barriers to domestic micro-generation: a United Kingdom perspective. Appl Energy 2008;85(6):528–44.

[21] Element Energy. Potential for microgeneration. Study and analysis, Energy saving trust. Editor 2005: London; 2005. <www.berr.gov.uk/files/file27558.pdf>.

[22] Scarpa R, Willis K. Willingness-to-pay for renewable energy: primary and discretionary choice of British households' for micro-generation technologies. Energy Econ 2010;32(1):129–36.

[23] Bergman N, Eyre N. What role for microgeneration in a shift to a low carbon domestic energy sector in the UK? Energy Efficiency 2011;4(3):335–53.

[24] Claudy MC, Michelsen C, O'Driscoll A. The diffusion of microgeneration technologies – assessing the influence of perceived product characteristics on home owners' willingness to pay. Energy Policy 2011;39(3):1459–69.

[25] Claudy MC et al. Consumer awareness in the adoption of microgeneration technologies: an empirical investigation in the Republic of Ireland. Renew Sustain Energy Rev 2010;14(7):2154–60.

[26] Dastrup SR et al. Understanding the solar home price premium: electricity generation and "green" social status. Eur Econ Rev 2012;56(5):961–73.

[27] Hoen B et al. An analysis of the effects of residential photovoltaic energy systems on home sales prices in California, Ernest Orlando Lawrence Berkeley National Laboratory, Editor 2011. Environmental Energy Technologies Division: Orlando; 2011. <eetd.lbl.gov/ea/emp/reports/lbnl-4476e.pdf>.

[28] Morris-Marsham C. Do solar PV and solar thermal installations affect the price and saleability of domestic properties in Oxford. In: Bartlett school of graduate studies, 2010. UCL: London; 2010. p. 63. <www.oxford.gov.uk/Direct/SolarValueStudyFinalReport.pdf>.

[29] Leenheer J, de Nooij M, Sheikh O. Own power: motives of having electricity without the energy company. Energy Policy 2011;39(9):5621–9.

[30] Walters R, Walsh PR. Examining the financial performance of micro-generation wind projects and the subsidy effect of feed-in tariffs for urban locations in the United Kingdom. Energy Policy 2011;39(9):5167–81.

[31] Wimberly J. Banking the green: customer incentives for EE and renewable. In: EcoAlign; 2008. <www.ecoalign.com/news/releases/banking-green-role-customer-incentives-energy-efficiency-and-renewable-energy>.

[32] Yamaguchi Y et al. Prediction of photovoltaic and solar water heater diffusion and evaluation of promotion policies on the basis of consumers' choices. Appl Energy 2013;102:1148–59.
[33] Hack S. International experiences with the promotion of solar water heaters (SWH) at household-level, deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Editor 2006: Mexico, City; 2006. <www.conuee.gob.mx/work/sites/CONAE/resources/LocalContent/6942/1/IEPSWH.pdf>.
[34] Claudy MC, Peterson M, O'Driscoll A. Understanding the attitude-behavior gap for renewable energy systems using behavioral reasoning theory. J Macromark 2013:1–15. jmk.sagepub.com/content/early/2013/04/11/0276146713481605.full.pdf+html.
[35] Caird S, Roy R. Adoption and use of household microgeneration heat technologies. Low Carbon Econ 2010;1(2):61–70.
[36] Palm J, Tengvard M. Motives for and barriers to household adoption of small-scale production of electricity: examples from Sweden. Sustain: Sci Practice Policy 2011;7(1):6–15.
[37] Jager W. Stimulating the diffusion of photovoltaic systems: a behavioural perspective. Energy Policy 2006;34(14):1935–43.
[38] Bergman N et al. UK microgeneration. Part I: policy and behavioural aspects. Proc Inst Civ Eng: Energy 2009;162(1):23–36.
[39] Praetorius B et al. Technological innovation systems for microgeneration in the UK and Germany – a functional analysis. Technol Anal Strateg Manage 2010;22(6):745–64.
[40] Ofgem. Electrical capacity assessment report 2013. In: Report to the secretary of state, Ofgem, Editor 2013. Energy Market Monitoring and Analysis: London; 2013. <www.ofgem.gov.uk/ofgem-publications/75232/electricity-capacity-assessment-report-2013.pdf>.
[41] Brook Lyndhurst Ltd, MORI, and Upstream, Attitudes to renewable energy in London: public and stakeholder opinion and the scope for progress, London Renewables and DTI, Editors. 2003: London; 2003. <legacy.london.gov.uk/mayor/environment/energy/docs/renewable_attitudes.pdf>.
[42] Ellison G. Renewable energy survey 2004 draft summary report of findings, London Assembly, Editor 2004. ORC International: London; 2004. <legacy.london.gov.uk/assembly/reports/environment/power_survey_orc.pdf>.
[43] Zahedi A. A review of drivers, benefits, and challenges in integrating renewable energy sources into electricity grid. Renew Sustain Energy Rev 2011;15(9):4775–9.
[44] Mahapatra K et al. Business models for full service energy renovation of single-family houses in Nordic countries. Appl Energy 2013;112:1558–65.
[45] Taylor P. Sorting out a solar PV cowboy's mess. Guest Blog 2013; 2013. <www.solarpowerportal.co.uk/guest_blog/sorting_out_a_solar_pv_cowboys_mess_2356>. [cited 10.06.13].
[46] Lonsdale S. Eco living: Beware the 'solar-panel cowboys' Property 2013; 2013. <www.telegraph.co.uk/property/9724311/Eco-living-Beware-the-solar-panel-cowboys.html> [cited 10.06.13].
[47] Wee H-M et al. Renewable energy supply chains, performance, application barriers, and strategies for further development. Renew Sustain Energy Rev 2012;16(8):5451–65.
[48] Element Energy. The growth potential for microgeneration in England, Wales and Scotland, BERR. Editor 2008: London; 2008. p. 12.
[49] HM Government. Energy white paper: meeting the energy challenge, DTI, Editor 2007, Crown Copyright: London; 2007. <webarchive.nationalarchives.gov.uk/20121205174605/http:/www.decc.gov.uk/assets/decc/publications/white_paper_07/file39387.pdf>.
[50] McLeod RS, Hopfe CJ, Rezgui Y. An investigation into recent proposals for a revised definition of zero carbon homes in the UK. Energy Policy 2012;46:25–35.
[51] GfK NOP Social Research. Renewable energy awareness and attitudes research, DTI. Editor 2006: London; 2006. <webarchive.nationalarchives.gov.uk/+/http://www.dti.gov.uk/files/file29360.pdf>.
[52] Willis K et al. Renewable energy adoption in an ageing population: heterogeneity in preferences for micro-generation technology adoption. Energy Policy 2011;39(10):6021–9.
[53] Consumer Focus. Keeping FiT consumers' attitudes and experiences of microgeneration, energy saving trust and DECC, Editors. 2011: London; 2011. <http://www.consumerfocus.org.uk/files/2012/04/Keeping-FiT.pdf>.
[54] Mahapatra K, Gustavsson L. Influencing Swedish homeowners to adopt district heating system. Appl Energy 2009;86(2):144–54.
[55] Fischer C, Sauter R. Governance for industrial transformation. In: Human dimensions of, global environmental change. Berlin; 2003.
[56] Keirstead J. Behavioural responses to photovoltaic systems in the UK domestic sector. Energy Policy 2007;35(8):4128–41.
[57] Bergman N, Jardine C. Power from the people. In: Domestic microgeneration and the low carbon buildings programme, ECI Research Report No 34, Editor 2009;2009. <www.eci.ox.ac.uk/publications/downloads/bergmanjardine09powerpeople.pdf>.
[58] Bollinger B, Gillingham K. Peer effects in the diffusion of solar photovoltaic panels. Mark Sci 2012;31(6):900–12.
[59] Müller S, Rode J. The adoption of photovoltaic systems in Wiesbaden, Germany. Econ Innov New Technol 2013;22(5):519–35.
[60] Louviere J et al. An introduction to the application of (case 1) best–worst scaling in marketing research. Int J Res Mark 2013;30(3):292–303.
[61] Finn A, Louviere JJ. Determining the appropriate response to evidence of public concern: the case of food safety. J Public Policy Mark 1992;11(2):12–25.
[62] Software Sawtooth. The MaxDiff system technical paper in technical paper series. Utah: Sawtooth Software Inc.; 2013.
[63] Orme B. Accuracy of HB Estimation in MaxDiff experiments, in research paper series, I. Sawtooth Software, Editor 2005: Sequim, WA 98382; 2005. <www.sawtoothsoftware.com/download/techpap/maxdacc.pdf>.
[64] Warren P. Uptake of Micro-generation among small organisations in the camden climate change alliance, in Geography2010, Durham University: Durham; 2010. <http://etheses.dur.ac.uk/764/>.
[65] Curry TE et al. A survey of public attitudes towards energy & environment in Great Britain, 2005, Massachusetts Institute of Technology, Laboratory for Energy and the Environment; 2005. <http://www.stanford.edu/~kcarmel/CC_BehavChange_Course/readings/Additional%20Resources/Sample%20Intervention%20Docs/Surveys/mit.pdf>.
[66] Baskaran R, Managi S, Bendig M. A public perspective on the adoption of microgeneration technologies in New Zealand: a multivariate probit approach. Energy Policy 2013;58:177–88.
[67] Vermeulen B, Goos P, Vandebroek M. Obtaining more information from conjoint experiments by best–worst choices. Comput Stat Data Anal 2010;54(6):1426–33.
[68] Marti J. A best–worst scaling survey of adolescents' level of concern for health and non-health consequences of smoking. Soc Sci Med 2012;75(1):87–97.
[69] Sawtooth Software Inc. All Products, 2013 11 Nov 2013; 2013. <http://www.sawtoothsoftware.com/products/all-products>.
[70] Sawtooth Software. CVA/HB technical paper. In: Technical paper series 2003: Sequim, WA 98382; 2003.
[71] Orme B, Howell J. Application of covariates within Sawtooth Software's CBC/HB program: theory and practical example. In: Research paper series, 2009, Sawtooth Software Inc.: Sequim, WA 98382; 2009.
[72] Office for National Statistics. Neighbourhood statistics-census 2011 data; 2013. <neighbourhood.statistics.gov.uk/dissemination/instanceSelection.do?JSAllowed=true&Function=&%24ph=60_61&CurrentPageId=61&step=2&datasetFamilyId=2514&instanceSelection=132828&Next.x=14&Next.y=18> [cited 20.04.13].
[73] Sawtooth Software. Max Diff utilities calculation with CBC HB V5.2.8 Sawtooth Software User Forum 2013; 2013. <www.sawtoothsoftware.com/forum/3084/max-diff-utilities-calculation-with-cbc-hb-v5-2-8> [cited 10.06.13].
[74] Sawtooth Software. The CBC/HB system for hierarchical bayes estimation version 5.0 Technical Paper. In: Technical paper series, 2009: Sequim; 2009.
[75] Bank of England. Changes in bank rate, minimum lending rate, minimum band 1 dealing rate, repo rate and official bank rate, 2013, Bank of England: London; 2013. <www.bankofengland.co.uk/statistics/Documents/rates/baserate.pdf>.
[76] House Price Crash. Nationwide average house prices adjusted for inflation; 2013. <www.housepricecrash.co.uk/indices-nationwide-national-inflati on.php> [cited 08.07.13].
[77] DECC. Feed-in tariffs scheme. Government response to consultation on comprehensive review phase 2A: solar PV cost control, DECC, Editor 2012, Crown Copyright: London; 2012.
[78] Clean Technica. Germany's energy storage incentive to start May 1; 2013. <cleantechnica.com/2013/04/17/germanys-energy-storage-incentive-to-start-may-1/> [cited 01.08.13].
[79] DECC. Electricity market reform: policy overview department of energy and climate change, Editor 2012, Crown Copyright: London; 2012. <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65634/7090-electricity-market-reform-policy-overview-.pdf>.
[80] NHBC Foundation. Introduction to feed-in tariffs, BRE, Editor 2011, IHS BRE Press: 2011. <http://www.nhbcfoundation.org/Researchpublications/IntroductiontoFeedinTariffsNF23/tabid/437/Default.aspx>.
[81] Energy Saving Trust. Generating your own energy – an overview of what's available. 2012 July 2012; <www.energysavingtrust.org.uk/Generate-your-own-energy/Overview-of-what-s-available>.
[82] Brignall M. How solar panels can dim mortgage prospects. The guardian; 2012. <http://www.guardian.co.uk/money/2012/mar/23/solar-panels-dim-mortgage-prospects> [14.01.13].
[83] Debenham C. Do solar panels affect house sales? YouGen Ltd; 2010. <http://www.yougen.co.uk/blog-entry/1546/Do+solar+panels+affect+house+sales'3F/> [cited 19.12.12].
[84] Lambert S. House hunters warned against buying homes with free solar panels fitted. This is money; 2012. <http://www.thisismoney.co.uk/money/mortgageshome/article-2130985/RICS-warns-house-hunters-buying-homes-free-solar-panels-fitted.html> [cited 20.05.13].
[85] Rowley E. Renting out roof to solar power firms could make your home harder to sell, surveyors warn. The telegraph; 2011. <http://www.telegraph.co.uk/finance/newsbysector/energy/8856365/Renting-out-roof-to-solar-power-firms-could-make-your-home-harder-to-sell-surveyors-warn.html> [cited 14.01.13].
[86] Bachelor L. Green deal debt may have to be repaid before property sold; 2013. <www.guardian.co.uk/money/2013/may/19/green-deal-debt-repaid> [cited 31.05.13].
[87] Newman C. Is the Green Deal right for me? YouGen Blog 2013; 2013. <www.yougen.co.uk/blog-entry/2117/Is+the+Green+Deal+right+for+me'3F/> [cited 30.05.13].
[88] Booth AT, Choudhary R. Decision making under uncertainty in the retrofit analysis of the UK housing stock: implications for the Green Deal. Energy Build 2013;64:292–308.
[89] King P et al. Open letter Re: ensuring success for the green deal and the retrofit agenda 26 June 2013, DECC, Editor 2013, UK Green Building Council:

London; 2013. <www.google.co.uk/url?sa=t&rct=j&q= &esrc=s&frm=1&source =web&cd =1&ved=0CCwQFjAA&url=http%3A%2F%2F www.ukgbc.o rg%2Fs ystem%2Ffiles%2Fprivate%2Fd ocuments%2F13062 6%2520Green%2520 Deal%2520 open %2520letter%2520-% 2520Ed%2520Davey. pdf&ei=ag14UoaKI 4bR0QW-p4HQCw&usg=AF QjCNF_fnV91HmTZRj26poq nLfz8FimOw& bvm=bv.55819444, d.d2k>.

[90] Carrington D. Cavity wall insulations crash by 97% following green deal introduction; 2013. <www.guardian.co.uk/environment/2013/may/29/cavity-wall-insulations-crash-green-deal> [cited 31.05.13].

[91] Hickman L. Older and disabled people 'put off' energy efficiency schemes; 2013. <www.guardian.co.uk/environment/2013/may/02/older-disabled-people-put-off-energy-efficiency> [cited 31.05.13].

[92] Feed-in Tariffs ltd. Feed-in tariffs. Contingent degression: corridors, triggers and levels 2013; 2013. <http://www.fitariffs.co.uk/eligible/levels/contingent/>. [05.09.13].

[93] DECC, Requirements for contractors undertaking the supply, design, installation, set to work commissioning and handover of micro and small wind turbine systems, in Microgeneration Installation Standard, 2008, DECC: London.

[94] Energy Saving Trust, Location, location, location. Domestic small-scale wind field trial report, 2009: London.