Working Paper 2: Community Energy Initiatives Project

Title: An empirical study of public beliefs about community renewable energy projects in England and Wales

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June 2007

Abstract
Increased deployment of renewable energy technologies has led to UK Government programmes supporting community initiatives. Despite a lack of empirical research, policy-makers have assumed beneficial project outcomes. More widely, there is a need to deepen conceptual understanding of public acceptance of renewable energy technologies. To address these issues, data were collected from 208 individuals at six community renewable energy projects in rural locations in England and Wales. Results support policy assumptions about positive outcomes, but revealed how they varied across places, and generally impacted more upon beliefs about renewable energy than climate change. The structure of public beliefs was characterised by distinct, inter-related facets of process and outcome, each with different levels, and the facets were positively associated with acceptance. Individuals were differently positioned in relation to this structure, falling into two clusters. While process beliefs were positively associated with acceptance for both clusters, measures of community environmental beliefs and norms, derived from Value-Belief-Norm theory (Stern, Dietz, Abel, Guagnano and Kalof, 1999), were significant only for one. The implications of the study are discussed for Value-Belief-Norm theory, social research on renewable energy technologies, and UK energy policy.

Introduction:
To respond to the threat of climate change, the UK Government, like many governments around the world, has committed to reducing greenhouse gas emissions and increasing the deployment of renewable energy technologies. UK policy aims to achieve a 60% cut in emissions by 2050, in comparison to 1990 levels, along with increasing the proportion of electricity generated from renewable resources: 10% by 2010 and 20% by 2020 (Department of Trade and Industry (DTI), 2003). Such targets necessitate that technologies that generate electricity from wind, sun, biomass and ocean sources, become commonplace, rather than 'alternative', as is currently the case. But in the future, energy generation is not only likely to be less reliant upon fossil-fuels, it is also likely to be smaller-scale (Anderson, Shackley, Mander & Bows, 2005), reflecting a more decentralised or distributed energy system (e.g. Greenpeace, 2005).

Decentralised energy systems have important social and psychological as well as technical, economic and environmental implications (Devine-Wright, 2006). For example, communities are more likely to be implicated in the process of developing small-scale (i.e. less than 5 megawatt) solar, wind, hydro and bio-energy technologies, where before large-scale technical systems (Hughes, 1983) were developed by the state or by private utilities, with minimal levels of public participation. Indeed, some actors in the UK energy arena have made normative declarations stating that communities *should* be more deeply engaged with energy demand and supply, as a result of concerns about climate change. For example, the Royal Commission on Environment and Pollution (RCEP), 2000) recommended that: *"Every community should review its impacts on the environment in terms of demands for energy, and the ways in which they should be met"* (page 7). UK policy makers also implicate communities in relation to potential outcomes of distributed energy: *'A 'distributed energy' system, using these technologies could radically change the way we meet our energy needs in the long-term. Heat and electricity can be created locally from renewable resources. And a more community-based energy system could lead to greater awareness of energy issues, driving a change in social attitudes and, in turn, more efficient use of our energy resources* (DTI, 2006; pp. 14-15).

This rhetorical focus upon communities as energy actors is not novel. What is new is its adoption by central government as an element of energy policy, manifest in publicly funded support programmes providing capital grants, advice and support to communities wishing to develop renewable energy projects. This adoption is, in part, driven by policy makers' concerns about the impacts of public resistance upon energy policy targets (Walker, Hunter, Devine-Wright, Evans and Hunter, forthcoming). Despite general public acceptance of renewable energy in the UK (McGowan and Sauter, 2005), the local development of technologies such as wind turbines and biomass plant have been controversial (Toke, 2005; Upham and Shackley, 2005; Warren, Lumsden, O'Dowd and Birnie, 2005). This has led to an interest in the concept of public acceptance, regarded as a key issue for renewable energy research (Ekins, 2004), and often conceived as NIMBYism (Not In my Back Yard, e.g. Wolsink, 2000).

Policy makers' assumptions about the positive outcomes of community renewable energy projects are explicitly social-psychological: that they may raise levels of awareness, engender more positive 'social attitudes', and perhaps increase levels of community cohesion. However, there is little empirical evidence to support such claims. Although there is now a growing body of social research on public beliefs about renewable energy technologies, little of this has focused upon contexts of community-based projects. Instead, research has focused upon individual's beliefs about renewable energy at a general level, typically through large-scale opinion polls (e.g. Eurobarometer, 2006) or about public responses to utility-led developments in a particular location, typically through smaller-scale case studies, often of wind farms (e.g. Warren et al, 2005).

This body of research has produced some consistent findings, suggesting that public beliefs about renewable energy technologies are often complex and multi-faceted (Devine-Wright, 2005a), linked to a range of contextual, psychological and personal factors (Devine-Wright, forthcoming) including technology type and scale (e.g. Lee,

Wren and Hickman, 1989), spatial proximity (Hubner and Meinjder, 2005), the potential for local involvement and benefit (Krohn and Damberg, 1999; Toke, 2005?), beliefs about local impacts (Upham and Shackley, 2006; Devine-Wright, 2005b) and the perceived fairness of the planning process (e.g. Zoellner & Schweizer-Rees, 2005). Conceptually, there is an emerging consensus, at least amongst academics, that NIMBYism is a deficient basis to explain public acceptance or resistance to energy technologies (Devine-Wright, 2005a; Warren et al., 2005; Wolsink, 2006; Owens and Driffil, 2006). However, there is, as yet, little in the way of alternative, coherent conceptual frameworks proposed to replace the NIMBY concept and to guide research. As a recent study concluded, '*there is a need to develop a research agenda for understanding the role of subjectivity in wind energy debate'* (Ellis et al., 2006, page 22).

This empirical study aimed to contribute to this goal by improving understanding of public acceptance, and of the outcomes when renewable energy technologies are developed in a community context. Public acceptance was investigated in two ways. Firstly, structural aspects of public beliefs about community renewable energy were investigated, using methodological tools such as multidimensional scaling and factor analysis to reveal underlying facets (i.e. mutually exclusive categories that are "the building blocks of any theory", Canter, 1997, page 14). This structural approach is consistent with psychological research on place (e.g. Canter, 1997), and research informed by social representations theory (e.g. Devine-Wright, H., 1999; Castro and Lima, 2001), which has examined the multi-dimensional structure of belief systems (e.g. environmental worldviews – Castro and Lima, 2001), and how individuals are positioned in relation to that structure. Content elements were drawn from analysis of policy discourse, media reports and previous literature on renewable energy and technology acceptance, including beliefs about project outcomes (e.g. greater personal awareness of renewable energy and climate change, project impact on social cohesion), beliefs about equity and fairness in how projects were planned and developed (Zoellner and Schweizer-Ries, 2005), and aspects of risk perceptions, such as certainty of outcome, trust and personal involvement (Slovic, 1999).

Secondly, the study investigated to what degree particular social and environmental psychological processes might explain public acceptance. Since community based projects typically do not deliver financial benefits directly to local residents, the study investigated the role of altruistic environmental beliefs and norms to explain public acceptance. Value-Belief-Norm theory (VBN, Stern, Dietz, Abel, Guagnano and Kalof, 1999) is a theory based upon Schwartz's Norm Activation Model (Schwartz, 1977), which posits that values, environmental worldview (as measured by the New Ecological Paradigm, Dunlap and Van Liere, 2000), beliefs (awareness of consequences and ascription of responsibility) and norms (feelings of moral obligation) explain environmentally significant behaviour. VBN theory has been empirically shown to explain several types of environmentally significant behaviour identified by Stern (2000), including 'low commitment environmental citizenship', such as acceptance of policies raising energy prices in the Netherlands (Steg, Dreijerink and Abrahamse, 2005). Arguably, this form of acceptance is more akin to an evaluative belief than a behaviour, and was taken to suggest that, in this study, VBN theory could be conceived as providing

a useful basis for explaining levels of public acceptance of community renewable energy projects. Since UK policy discourse (cf. RCEP, 2000) implicates communities *per se*, the study differed from, and was conceived to extend, previous VBN research by conceiving constructs such as environmental beliefs and norms at personal *and* community levels of analysis.

The focus upon community suggested that social as well as environmental psychological processes may be important in understanding public acceptance. As Stern (2005) noted, despite a tendency towards reductionism in environmental psychological research, '*for some environmental problems, unorganized collections of individuals, such as local communities, can be important actors*' (page 3). Previous research has indicated how social factors, such as membership of groups, can be important in shaping pro-environmental beliefs and behaviour (Olli, Grenstad and Wollbaek, 2001). In parallel, research on place has explored social or communal aspects of affective and existential ties between individuals and valued locations (Hummon, 1992), linking issues of place, social identification and sense of community (Kim and Kaplan, 2004). In this study, public acceptance of community renewable energy projects was conceived to relate to the process of social identification (Twigger-Ross, Bonaiuto and Breakwell, 2003), that is feelings of belonging and pride in the local community, but in a way that was mindful of the complex and problematic nature of the concept of 'community', and its relative neglect in both social (Howarth, 2001) and environmental psychology (Stern, 2005).

Research questions:

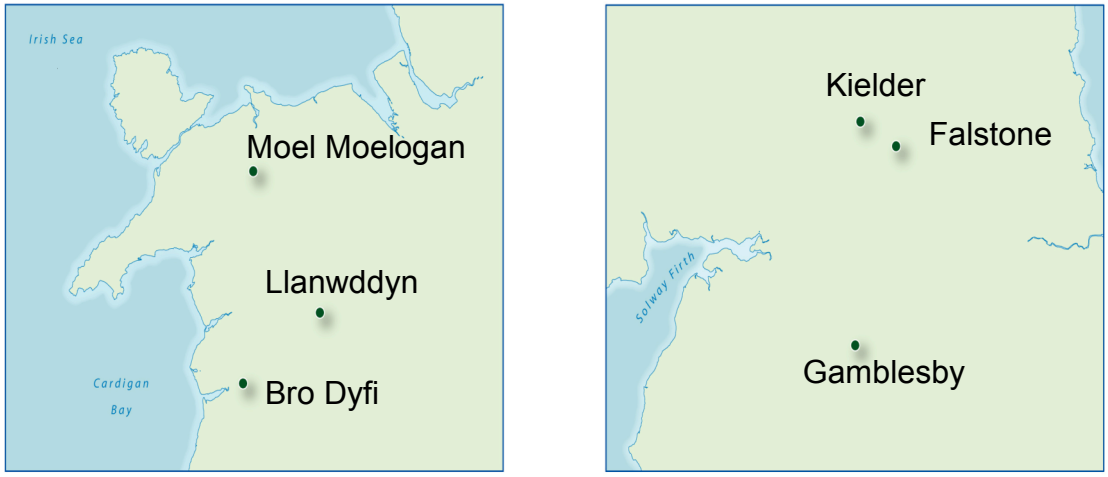
1. What is the structure of public beliefs about community renewable energy projects? How are individuals positioned in relation to this structure?
2. To what extent are projects accepted by local residents, and perceived to result in higher levels of personal awareness and more positive attitudes towards climate change and renewable energy technologies?
3. To what extent are levels of public acceptance explained by social identification, and environmental beliefs and norms at both personal and community levels of analysis?

Method:

Research context

Arising from qualitative interviews with national and regional stakeholders reported elsewhere (cf. Walker et al., forthcoming), and scrutiny of a database of over 500 UK community renewable energy projects devised as part of the research project, data was collected in six small-scale, rural settlements where community renewable energy projects had been successfully implemented, three in Wales (Llanwyddn, Moel Moelogan and Bro Dyfi) and three in the North of England (Kielder, Falstone and Gamblesby) between June and September 2005 (see figures 1 and 2). The rationale for collecting data in two 'regional' areas of the UK was to enable the identification of wider political and institutional factors shaping the emergence of the projects, reflecting the interdisciplinary nature of the project as a whole.

Figure 1: Locations of community energy projects in Wales and North England



The projects were intended to reflect a variety of renewable resources (wind, solar, geothermal energy and biomass), technologies for heat and power generation (wind turbines, solar panels, ground source heat pumps and wood boilers), scales of development (from single building scale, through local heat networks to a grid-connected wind farm), spatial location and institutional structure, yet were intended to be similar in having successfully installed renewable technology, and reported high levels of community involvement or beneficial outcomes in each place, as indicated by materials produced by the project organisers. The project at Moel Moelogan was distinctive in having been recognised as a 'best practice' example of community renewable energy (Sustainable Development Commission, 2005). Key aspects of each project are summarised in table 1.

Table 1: Key aspects of the six community renewable energy projects

Location	Technology context	Institutions	Funding	Responses
Llanwyddn	Biomass district heating network linking school and community centre plus 19 local houses	Public-private partnership	£375,000	34/100
Moel Moelogan	3 grid connected 1.3MW wind turbines (phase 1), later increased to 11 (phase 2)	3 local farmers	£2.6 million	51/150
Bro Dyfi	One 75kW wind turbine, grid connected	Committee-co-operative	£83,555	32/100
Kielder	Biomass district heating network linking school, youth hostel, 6 houses, workshop and castle	Public sector, local council	£630,000	38/135
Falstone	Solar photovoltaic panel and biomass boiler in village shop, tea rooms and visitor centre	Public sector partnership	£250,000	26/100
Gamblesby	Ground source heat pump for renovation project on village hall	Village hall committee	£42,100	27/ 91

Data collection and analytic strategy
Interviews and questionnaires were used to collect data in each location. Interviews were conducted with local stakeholders and individuals involved in instigating, supporting and opposing the projects. Questionnaires were distributed to local residents, the data from which forms the main basis of this paper. Surveys with covering letters (translated into the Welsh language for Welsh case studies) were delivered by project researchers to each house in the village or target area, except in the case of Gamblesby, when due to researcher illness, surveys were part-delivered and part-posted to local residents.

The survey was designed with a mixture of open-ended and closed (both binary and likert-type 1-5) response formats to questions. Sections of the survey addressed: socio-demographic details, project involvement; beliefs about the project; environmental beliefs and worldviews, and social identification with the community. Specifically, 20 items were intended to capture project beliefs, and were based upon policy documents (DTI, 2006) and academic literature (e.g. Slovic, 1999, Zoellner and Schweizer-Ries, 2005), concerning issues such as enhanced awareness, trust, certainty of outcome, control over decisions taken and fairness. Due to space limitations, values were not measured; however, environmental worldview was measured using a10 item 'New Ecological Paradigm' scale (Dunlap and VanLiere, 2000) and climate change-related environmental beliefs were measured using 6 items about awareness of consequences, ascription of responsibility and moral norms at both personal and community levels of analysis, drawn from Stern and colleagues' Value-Belief-Norm theory (1999). Social identity, contextualised in the respondent's relation to the local community, was measured using 4 items concerning belonging, pride, communication and participation, drawing on previous work by Bonaiuto, Breakwell and Cano (1996). For measures of project beliefs, NEP, environmental beliefs, norms and social identification, respondents rated their level of agreement with each statement on a scale from 1 to 5, representing 'strongly disagree' to 'strongly agree'.

Sample:
Of 676 distributed, 208 completed questionnaires were returned, representing an overall response rate of 31%, which varied little across the six places. The sample consisted of 95 males and 107 females (with six missing values). The age profile indicated a predominantly older sample, with few respondents aged under 35 (approx 10%), most respondents aged over 55 years (47%), and 28% of respondents indicating that they were 'retired'. Length of residence in the locality averaged 24 years and ranged from 6 months to 80 years; the majority were owner-occupiers (75%) and lived in detached homes (55%). In terms of national identification, the most common labels used by participants were Welsh (30%), English (35%) and British (28%). Across the six projects, there was little variation in age or gender profiles in comparison to the sample overall.

Devising quantitative measures:
Principle components factor analysis (PCA), using oblique rotation, was used to create scale measures from items intended to measure New Ecological Paradigm (NEP), environmental beliefs and norms, and social identification. For NEP items, PCA

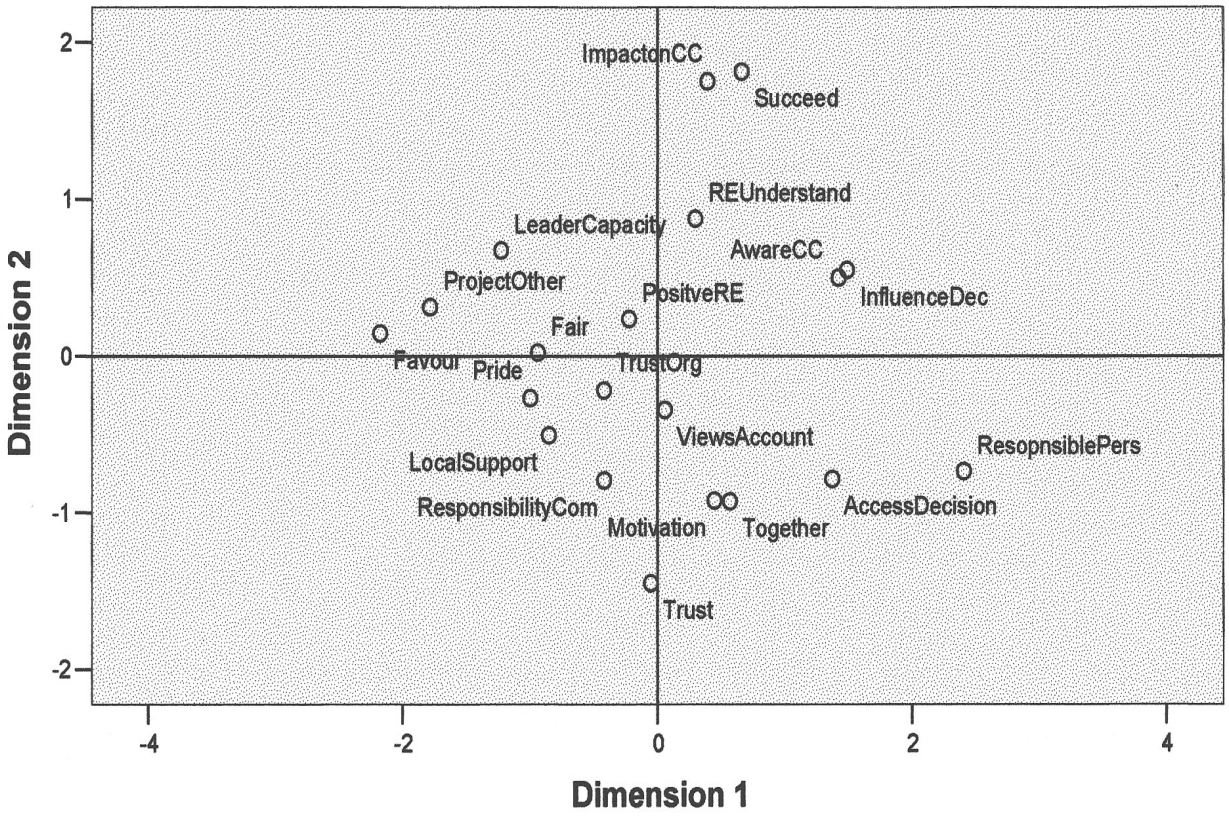
produced a two-factor solution, explaining 48% of variance. An additive scale of 5 items concerning pro-science and technology beliefs ('dominant social paradigm' or DSP) had an alpha reliability of 0.76; a second scale of 5 items reflecting concern for nature ('new ecological paradigm' or NEP) had an alpha reliability of 0.61. The two-factor structure for this scale replicates previous applications of the NEP items (e.g. Wall, Devine-Wright and Mill, forthcoming). For environmental beliefs and norms, a PCA was undertaken on the six items, producing a two-factor solution with 3 items at the personal level consequences, responsibility and moral norms (alpha 0.77) and 3 items at the community level (alpha 0.72). In each case, items capturing normative beliefs loaded highest on each factor. Finally, PCA produced a single factor social identity scale, consisting of the four items, with an alpha reliability of 0.78. Specific items used in each scale are listed in full in appendix 1.

Results:

1. Investigating the structure of beliefs about community renewable energy projects

Two multivariate statistical approaches were used to investigate the structure of beliefs about community renewable energy projects. Firstly, multi-dimensional scaling (MDS) was conducted for all respondents on the 20 items capturing public beliefs about the projects, using ALSCAL in the software package SPSS (Statistical Package for the Social Sciences). This method uses a squared Euclidean distance algorithm to calculate the relative similarity of all items collectively, and reflects this in 2 dimensional and 3 dimensional plots (see figure 2). For illustrative purposes, a 2-D plot is used to illustrate the structure of the items (stress value = .24, squared correlation = .704).

Figure 2: ALSCAL 2-dimensional plot of 20 items capturing public beliefs about community renewable energy projects for all respondents



Interpretation of the plots suggested a curvilinear shape, with items capturing acceptance at the left apex ('I am in favour of the project', and 'I think that projects like this should also happen in other places'); items capturing beliefs about project outcomes towards the top of the plot (both in relation to climate change, and personal level outcomes concerning increased awareness and more positive attitudes); and items concerning beliefs about the process of project development towards the bottom of the plot (local support, community responsibility, personal access to decision making etc.).

Building upon the MDS, bivariate correlation was performed on the two items at the left apex, to investigate their strength of association and suitability for further use as a measure of public acceptance. The correlation was positive and significant ($r = 0.82$, $n=186$, $p = .000$). To further elaborate the structure of public beliefs about the projects, principle components factor analysis, using oblique rotation, was conducted on the remaining 18 items. This produced a four-factor structure, explaining 65% of the variance. The items are summarised in table 2.

Table 2: Factor structure of public beliefs about community renewable energy

Item	Factor 1	Factor 2	Factor 3	Factor 4
The community as a whole has responsibility for the success of the project	.882			
The project has only gone ahead because of local community support and involvement	.839			
I feel a sense of trust in the project organisers	.826			
The project has helped bring the community together	.790			
I feel a sense of pride in the project	.737			
I think the setting up and development of the project has been carried out in a fair and open way	.645			
The committee leaders have the capacity to drive the project forward	.576			
I do not feel a sense of trust in the organisations involved (recoded)	.416			
I am more aware of climate change as a result of this project		-.917		
I understand more about renewable energy as a result of this project		-.634		(.326)
I feel more positive about renewable energy as a result of this project	(.485)	-.622		
I feel that the project will not have an impact on climate change			.755	
When I first heard about the project, I was unsure it would succeed			.715	
I was motivated to become involved in the project				.722
I had access to decision making concerning the project				.711

I had no ability to influence decisions made regarding the project (recoded)				.651
I feel personally responsible for the project				.543
I feel that my views about the project have been taken into account				.527
Total variance explained	45%	8%	6%	6%
Cronbach's alpha reliability estimate	0.915 (181)	0.828 (189)	n/a	.808 (181)

The factors suggest process (collective and personal, factors 1 and 4) and outcome (personal and climate-related, factors 2 and 3) facets of public beliefs about community renewable energy. In particular, items referring to 'whole community responsibility' for project success, changed levels of 'personal awareness of climate change', 'certainty of climatic impacts' and 'motivation for personal involvement' loaded highest on each factor. To create scale measures from factor items, Cronbach's alpha reliability estimates were computed, indicating acceptable reliability levels (i.e. over 0.7, Cortina, 1993) for the measures of 'whole community responsibility', 'personal awareness outcomes' and 'personal involvement'. Bivariate correlation for the final 2 item factor (climate outcomes) was low, although statistically significant (Pearson's r = 0.189, n=183, p = .010) and therefore these items were not considered sufficiently reliable for use in subsequent analyses.

Bivariate correlations were performed for the measures of acceptance, process and outcome, which indicated that acceptance was positively associated with beliefs about process: community responsibility for the project (Pearson's r = 0.788, n = 186, p = .000) and personal involvement (r = .477, n = 186, p = .000); and outcomes: personal awareness levels (r = .444, n = 184, p = .000).

2. Describing levels of acceptance and beliefs about positive personal outcomes

For the sample overall, the mean level of acceptance was above the mid-point (3.64, on a scale from 1 to 5), indicating generally positive levels of acceptance across the projects. To investigate whether acceptance differed between the projects, 1-way analysis of variance was performed. This showed a significant difference by place ($F(5) = 12.49$; p = .000). Post-hoc Scheffe tests indicated significantly lower mean acceptance levels at Moel Moelogan in comparison to all other places (p = .005) save Falstone; and significantly higher mean levels at Gamblesby in comparison to Moel Moelogan (p = .000) and Falstone (p = .027). Descriptive data, summarised in table 3, also indicate that acceptance at Moel Moelogan was the least consensual, and most polarised, (standard deviation = 1.27).

Table 3: Descriptive data for project acceptance and project outcomes by place

	Public acceptance mean (n) sd	Better understanding of renewables	More positive about renewables	More aware of climate change
Sample overall	3.64 (186) 1.16	3.16 (191) 1.11	3.12 (190) 1.10	2.70 (189) 1.00
Llanwyddn	3.90 (25) 0.89	3.00 (31) 1.00	3.23 (31) 1.06	2.74 (31) 0.89
Moel Moelogan	2.79 (49) 1.27	3.17 (48) 1.15	2.71 (48) 1.15	2.67 (48) 1.03
Bro Dyfi	4.13 (24) 0.81	2.75 (24) 1.07	3.21 (24) 1.22	2.43 (23) 0.84
Kielder	3.85 (37) 0.83	2.97 (37) 0.99	3.14 (37) 0.79	2.65 (37) 0.95
Falstone	3.46 (25) 1.01	3.28 (25) 0.89	2.88 (25) 0.97	2.64 (25) 0.86
Gamblesby	4.48 (26) 0.97	3.92 (26) 1.23	3.88 (25) 1.13	3.08 (25) 1.32

To illustrate project outcomes in terms of awareness, understanding and positive beliefs, mean scores for each item and for each project are displayed in table 2. Instead of using the 3 item outcome factor scale, which bundled together climate and renewable energy-related beliefs, data for each separate item is displayed in the table. The descriptive data indicate that respondents reported weak, yet positive impacts in relation to levels of awareness and beliefs about renewable energy, with mean scores generally around or above the mid-point of the scale, and a consistent finding of positive outcomes at Gamblesby. In contrast, respondents tended to disagree that the projects raised awareness of climate change, with all mean scores, save Gamblesby, below the mid-point of the scale.

3. Investigating the positioning of individuals in relation to the structure of public beliefs

To investigate the positioning of individuals in relation to beliefs about community renewable energy projects, a combination of multivariate statistical tools were used. Firstly, MDS was performed by case, using a similar SPSS ALSCAL squared Euclidean distance estimate to that used to investigate project-related items. Since the plot suggested a 2 cluster structure, a K-means cluster analysis was performed seeking 2 clusters of cases. The analysis produced cluster 'A' consisting of 95 cases and cluster 'B' consisting of 82 cases (with 31 cases of missing data), whose mean scores were significantly different for all 18 public beliefs items at a $p<.005$ level. Analysis by socio-demographic and socio-economic variables indicated that the clusters were not characterised by differences in age, gender, length of local residence, type of home (detached house or terraced), tenure (owner-occupier, tenant etc.) and national identification.

The clusters differed in project acceptance: independent groups t-test analysis showed significant differences ($t(175) = -10.229$; $p = .000$). Members of cluster B were significantly more in favour of community renewable energy than cluster A (cluster A mean = 3.02; cluster B mean = 4.41). Furthermore, standard deviations indicated less variability within cluster B (sd = 0.56) in comparison to cluster A (sd = 1.12). Secondly, the clusters were not equally distributed across the 6 places (chi square = 28.47; df = 5; p

= .000). While the proportion of respondents at Llanwyddn and Kielder was relatively equal for each cluster (56/44 and 54/46 respectively), the majority of respondents at Moel Moelogan and Falstone were members of cluster A (77/23 and 60/40 respectively) in contrast to Bro Dyfi (65/35) and Gamblesby (87/13), where members of cluster B were more prevalent.

To assess whether individuals differed in relation to the facets of process and outcome, discriminant function analysis was performed using the 3 reliable scale measures created from the PCA. This produced a significant canonical correlation of 0.784; Wilks lambda of 0.385; chi square = 65.789; df = 3; p = .000. The clusters differed significantly on each scale measure with cluster A having lower mean levels of agreement concerning whole community responsibility for project success ($F(1, 175) = 229.96$, p = .000), positive personal outcomes ($F(1, 175) = 87.85$, p = .000) and levels of personal involvement ($F(1, 175) = 135.53$, p = .000) in comparison to individuals in cluster B (see table 4).

Table 4: Mean differences between sample clusters for scale measures

Scale measures	Cluster A mean (standard deviation)	Cluster B mean (standard deviation)
Project Acceptance	3.02 (1.12)	4.41 (.56)
Whole community responsibility	2.41 (.63)	3.82 (.59)
Personal outcomes	2.48 (.77)	3.55 (.74)
Personal involvement	2.19 (.58)	3.29 (.68)
Personal climate norms/beliefs	3.62 (.62)	4.03 (.73)
Community climate norms/beliefs	3.78 (.60)	4.03 (.79)
Social identification	3.53 (.67)	3.81 (.73)

To assess whether individuals in each cluster differed in relation to NEP, VBN and social identification measures, discriminant function analysis was performed, which produced a canonical correlation of 0.359; Wilks lambda of 0.871; chi square = 22.44; df = 5; p = .000. Analysis indicated significant differences for mean environmental belief and norm levels (personal level $F(1,165) = 14.72$, p = .000, and collective level $F(1, 165) = 5.25$, p = .023) and social identification ($F(1, 165) = 6.70$, p = .01) but not for measures of environmental worldview (see table 4). Descriptive data indicated that individuals in cluster B reported consistently higher levels of community belonging and climate-related beliefs and norms, both at personal and community levels, in comparison to cluster A.

To explore whether acceptance was related with environmental and social processes, bivariate correlations were performed for each cluster separately. For cluster A, there was no significant association between acceptance and measures of NEP, environmental beliefs and social identification; association was only significant for one facet of public beliefs, the process facet of 'whole community responsibility' (Pearson's $r = 0.716$, n = 95, p = .000). By contrast, levels of acceptance for cluster B correlated significantly with process and outcome measures, environmental beliefs and norms at personal and community levels, social identification and DSP (correlation with NEP approached significance: p = .077; see appendix 2). The relatively low bivariate correlation between

the two community level variables: whole community responsibility for project success and community climate-related beliefs and norms (Pearson r = 0.216, n = 82, p = .051) indicated that multi-collinearity (correlation above 0.8; Howitt and Cramer, 2003) was not apparent.

Arising from the differences between the correlation matrices, stepwise multiple regression analysis was conducted solely with individuals from cluster B, to investigate the relative importance of the different variables in explaining acceptance of community renewable energy, using two measures of NEP, personal and community level VBN scales, social identification and three project belief scales as independent variables. Results indicated that an adjusted 44% of the variance in acceptance was directly explained by two variables: beliefs about whole community responsibility for project success (standardised Beta = .57, p = .000) and environmental beliefs and norms at the community level (Beta = +.29, p = .002). Further regression analyses indicated that an adjusted 37% of the variance in whole community responsibility was directly explained by two variables: beliefs about personal involvement in the project (Beta = .45, p = .000) and social identification with the community (Beta = .37, p = .000); while an adjusted 60% of the variance in personal level environmental norms, as expected from Stern et al. (1999), was explained by acceptance of the new ecological paradigm (Beta = .48, p = .000) as well as community level beliefs and norms (Beta = .41, p = .000). Interestingly, the analysis indicated that personal level beliefs and norms directly explained only community level beliefs and norms (Beta = .50, p = .000) and not measures of project related beliefs, or acceptance of community renewable energy.

Discussion:

This study aimed to deepen our understanding of public beliefs about community renewable energy projects, as well as wider issues of public acceptance. The use of a combined methodological approach of MDS and factor analysis enabled the empirical identification of discrete facets (Canter, 1985) or categories of public beliefs, clustering items related to acceptance, process and outcome. The results suggest that acceptance can be conceptualised as involving both positive support for the local project, akin to a general overall evaluation, with a belief that such projects should be replicated in other places. This combination of local and non-local beliefs is distinctive from the conventional NIMBY (not in my backyard) position, where development is opposed locally but accepted elsewhere, which has often been used to explain public beliefs about renewable energy technologies (Wolsink, 2000). It suggests consistency between beliefs about technology siting, both positive and negative, with opponents resisting a given technology, locally and elsewhere, and vice versa for supporters, as has also been empirically shown in studies of utility-led, larger scale renewable energy developments (e.g. Warren et al., 2005).

In examining the structure of public beliefs, the study extended conceptual understanding by identifying outcome and process facets. Conceptually, this suggests that acceptance can be considered as separate from, but embedded within beliefs about outcome and process in developing community based renewable energy technologies. Positive

correlations between the facets and acceptance indicate that developments believed to be characterised by communal involvement and responsibility, individual access to decision-making, and positive personal outcomes, are more strongly supported by local people. Future research can examine whether this structure also characterises public beliefs about utility-led renewable energy developments, for example where positive outcomes at personal and communal levels may outweigh the relative importance of communal involvement, if such involvement is less expected in that development context.

The results suggest that the outcome and process facets can be further sub-divided, for example outcome beliefs operating at personal and global levels; and process operating at community and personal levels. The presence of discrete facets and sub-facets is indicative of the complexity of public beliefs about renewable energy technologies, and suggests a basis for integrating separate strands of research focusing upon beliefs about planning and decision-making (e.g. Zoellner and Schweizer-Ries, 2005), extent of community involvement (e.g. Krohn and Damborg, 1999), as well as project impacts (e.g. Upham and Shackley, 2006). The items used in this study are unlikely to be exhaustive, particularly as they were necessarily generic in terms of technology type. Other facets or sub-facets may emerge from future research (e.g. local, regional or national levels to 'outcomes' in addition to the personal and global levels identified here). However, the empirical identification of process and outcome facets suggests organising principles that offer the potential to guide future research on public beliefs about, and behavioural responses to, a variety of renewable energy developments that are small or large scale; community based, utility or state-led; and involving a range of technologies.

The study also sheds light on policy makers' assumptions about the outcomes of community projects (cf. DTI, 2006). The results suggest two specific findings. Firstly, whilst the results support assumptions that such projects can have a positive impact upon beliefs about renewable energy, they also indicate that these vary substantially by place, and was most clearly indicated at Gamblesby in this study. In essence, positive outcomes are possible but by no means necessarily the result of adopting a community based approach to renewable energy development. Secondly, the results suggest that these community renewable energy projects had little impact upon respondents' awareness of climate change. Although UK energy policy is, in part, driven by concerns about global-level environmental problems, at the local level, the research suggests that community energy projects are more strongly embedded in temporally and spatially more immediate needs, such as replacing an outdated primary school boiler (Llanywddn), refurbishing a dilapidated village hall (Gamblesby), or providing an alternative income stream for local farmers (Moel Moelogan) (Walker et al, forthcoming).

Results indicate that, as is often assumed, levels of public acceptance of community renewable energy was generally high, with a mean for the total sample above the mid-point (3.64 on a scale from 1 to 5). However, this masks considerable diversity across places. Acceptance was both lower and less consensual at the Moel Moelogan windfarm, despite its national recognition as a best practice exemplar (SDC, 2005). In contrast, respondents in Gamblesby reported highest levels of acceptance. This diversity suggests that 'place' matters in understanding public beliefs about environmental issues, as

previously declared by Stern (2005), mindful of the role of both contextual and psychological influences. Contextual factors related to community renewable energy projects include the nature of the organisation or collection of individuals leading the project; the type and scale of technologies deployed; ways in which projects evolve over time and the history of local social relations, particularly whether boundaries are perceived to exist between 'incomers' and others previously resident in that place.

Indication of the importance of local social relations emerged from different aspects of the analyses. Factor analysis indicated that items about community responsibility explained the most variance (45%) in project beliefs. Linking this to acceptance, further analyses indicated that, whilst individuals disagreed over the relative levels of community responsibility in their local projects, they shared a significant and positive association between acceptance and communal involvement, as indicated by correlational and regression analyses. This suggests that, regardless of cluster or place, the process facet of communal responsibility seems to be the key indicator of project acceptance by local people.

The results also suggest that environmental beliefs and norms, stemming from Value-Belief-Norm theory (Stern et al, 1999), help to explain how some individuals are positioned in relation to the structure of beliefs about community renewable energy. Since beliefs about community level climate action were significantly and positively associated with project acceptance for members of cluster B, this suggests that, although the projects seemed to rarely result in an increased awareness of climate change, pre-existing climate related norms can be important in predisposing certain individuals to support community projects.

This result informs our understanding of the role of environmental beliefs and norms beyond the individual level of analysis. In Stern and colleagues empirical work (1999), ascription of responsibility for environmental problems is operationalised at a number of different levels, implicating supra-individual collectivities such as business organisations and national governments. This study extends this multi-level focus through adding the community level of analysis, and suggests that future research would benefit from systematic empirical investigation of how multiple levels, from personal through community to national and international organisations, are implicated in whether and how individuals choose to take action (or not), both as individuals (private sphere behaviours, cf. Stern, 2000) and/or as members of collectivities such as communities, in relation to climate change and renewable energy. The facets identified in the structure of beliefs about community renewable energy support such a view, given the empirical distinction between outcome beliefs at personal and climatic levels, and process beliefs at personal and community levels.

The study has a number of limitations, including the use of single item VBN measures, and the absence of measures of value. Research in small rural settlements resulted in relatively small sample sizes within each place; and the measurement of project outcomes through *post hoc* self-report measures of change in awareness and beliefs would be improved by future research with a longitudinal design that could establish *a priori* levels

of awareness, and use these as a baseline to track change through time as projects evolve. This approach might indicate that levels of awareness and positive beliefs may not change as a result of community energy projects since they may have already been relatively high amongst local people, as a result of specific contextual factors. Finally, since community projects may be more grounded in local rather than global issues, operationalisation of VBN in terms of local social, economic and environmental problems may help explain how individuals that were members of cluster A are positioned in relation to project acceptance.

To conclude, this study aimed to deepen our understanding of public beliefs about community renewable energy projects. Through adopting a structural approach, the study suggests facets referring to process and outcomes that may prove to be useful organising principles to integrate previous research findings and guide future empirical research. Both acceptance and outcomes, whilst generally positive, varied across the projects, indicating that 'place', and by implication, contextual factors are important alongside psychological factors in explaining how individuals are positioned in relation to the structure of public beliefs. The study suggests that investigating the interplay between different levels of analysis, particularly in the case of VBN theory constructs (Stern et al., 1999), would deepen our understanding of how individuals are positioned, yet also emphasises that global impacts may be relatively unimportant in comparison to local impacts in explaining public acceptance of community renewable energy projects.

Acknowledgements:

The authors would like to acknowledge the support of the Economic and Social Research Council under the Sustainable Technologies Research Programme (grant number RES-338-25-0010), and the helpful comments of Dr. Hannah Devine-Wright.

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Appendix 1: Scale measures

a. Environmental worldview

Dominant social paradigm:
Science will help us live without conservation of species
Making changes to the natural environment rarely causes serious problems
Humans were created to rule over nature
There are no limits to growth for nations like the UK
Technology will solve many environmental problems

New ecological paradigm:
The earth is like a spaceship with limited room and resources
The balance of nature is delicate and easily upset
Exploitation of resources should be stopped
One of the most important reasons for conservation is to preserve wild areas
Plants and animals do not exist primarily for human use

b. Climate related beliefs and norms at personal and collective levels

Personal level items:
I feel a personal obligation to do whatever I can to prevent climate change
I feel it's my personal responsibility to prevent climate change
In general, I think that climate change will be a very serious problem for me and my family

Collective level items:
Local communities should not take action to prevent climate change (recoded)
Local communities have some responsibility to prevent climate change
Climate change is not a serious threat to my community* (recoded)

c. Social identification:

I feel a sense of belonging with the community
I feel a sense of pride in the community
I feel that I can participate fully in community activities
I feel that I cannot communicate my own needs within the community effectively (recoded)

Appendix 2: Bivariate correlation matrix for cluster B respondents (Pearson, 2 tailed)

	Acceptance	*Collective response*	*Personal outcomes*	*Personal involve*	*NEP*	*DSP*	*Social identific*	*Personal beliefs*	*Collective beliefs*
Acceptance	1								
Collective responsibility	.619 .000 82	1							
Personal outcomes	.291 .008 82	.306 .005 82	1						
Personal involvement	.401 .000 82	.514 .000 82	.393 .000 82	1					
NEP	.197 .077 82	-.043 .700 81	-.032 .775 81	-.004 .972 81	1				
DSP	-.401 .000 82	-.213 .055 82	.155 .163 82	-.066 .554 82	-.423 .000 82	1			
Social identification	.231 .042 78	.428 .000 78	.179 .117 78	.159 .163 78	-.042 .717 78	-.074 .521 78	1		
Personal beliefs, norms	.335 .002 81	.171 .128 81	.025 .825 81	.181 .106 81	.696 .000 81	-.461 .000 81	-.014 .905 78	1	
Collective beliefs, norms	.384 .000 82	.216 .051 82	-.018 .874 82	.230 .038 82	.550 .000 81	-.573 .000 82	-.047 .683 78	.654 .000 81	1