PUBLIC UNDERSTANDING OF, AND ATTITUDES TO, LOCAL HYBRID ENERGY SYSTEMS

a study across rural Britain

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Contents list

List of Tables

List of Figures

Acronyms and notes

AD	Anaerobic Digestion – *a renewable energy process whereby bacteria breaks down organic material in the absence of air, yielding a biogas containing methane*.
Big (6)six	Generally taken to mean Britain's six largest energy companies to supply gas and electricity to homes and businesses. Alphabetically at the time of publication of publication: British Gas, EDF energy, E.ON, npower, Scottish Power and SSE.
BURD	Bridging the Urban Rural Divide
CARES	Community and Renewable Energy Scheme – *A Scottish loan initiative launched in 2011 to support the development of locally-owned renewable energy projects which provide wider community benefits.*
CCN	Community Composting Network
CES	Community Energy Strategy – *a government initiative launched in January 2014.*
CIC	Community Interest Company
CHP	Combined Heat and Power – *integrates the production of usable heat and power (electricity), into one single, highly efficient process.*
CoRE	Community Renewable Energy
DECC	Department for Energy and Climate Change
Defra	Department for Food and Rural Affairs
EIS	Enterprise Investment Scheme - *a series of UK tax reliefs launched in 1994 to help small businesses.*
EPC	Energy Performance Certificate – *first introduced in England and Wales in 2007 as part of the Home Information Pack used in house sales. It tells a potential buyer how energy efficient a building is and gives it a rating from A (very efficient) to G (inefficient).*
EPSRC	Engineering and Physical Sciences Research Council
ESCo	Energy Supply Company
FiT	Feed in Tariffs - *a government initiative introduced in 2010 that applies to small-scale (i.e. households) generation of electricity which pays a fixed sum for eligible technologies.*
LED	Light-emitting diode - *usually used to describe energy efficient light bulbs.*
LPG	Liquid (or Liquefied) Petroleum Gas – *often referred to as propane or butane gas.*
PV	Photovoltaic – *A method of converting solar energy into direct-current electricity using semiconducting materials and solar panels to capture solar energy.*
RCUK	Research Councils UK
RE	Renewable Energy - *is generally defined as energy that comes from resources which are naturally replenished on a human timescale such as sunlight, wind, rain, tides, waves and geothermal heat.*
RHEES	Rural Hybrid Energy Enterprise Systems

RHI	Renewable Heat Incentive – *a UK government backed initiative introduced in 2011 to provide long-term financial support for renewable heat generation.*
RSPB	Royal Society for the Protection of Birds
SCARF	Save Cash and Reduce Fuel – *a Scottish social enterprise initiative established to make a practical difference to people living in fuel poverty.*
SMEs	Small and Medium Enterprises
WP	Work Package
WRAP	Waste Resources Action Programme - an independent not-for-profit UK organisation established in 2000 that helps businesses reduce waste, develop sustainable products and use resources in a more efficient way.

Definitions

Air Source Heat Pump	A heat producing system that transfers heat from outside to inside a building or vice versa using a heat pump.
Biogas	A mixture of different *gases* produced by the breakdown of *organic matter* in the absence of some *oxygen.*
Biomass	Biological material derived from living, or recently living, organisms. Usually taken to mean plant material but can also be animal or vegetable.
Climate Change	Refers to a change in the statistical distribution of *weather* patterns that lasts for an extended period of time (i.e. decades). Many factors can affect climate change, including variation in solar activity and more recently some human activity is thought, by some, to be accelerating the process.
Energy Literacy	An individual's understanding of current energy terms and debates.
Energy Security	The link between national security and the availability of natural resources for energy consumption.
Fossil Fuel	*Fuels* formed by natural processes such as *anaerobic decomposition* of buried dead *organisms*, which contain a high percentage of carbon.
Green Deal	A government initiative launched in 2012 to help householders make energy-saving improvements to their home and find the best way to pay for them.
Ground Source Heat Pump	A system that draws in heat from the ground, rather than from the air.
Hybrid Renewable Energy System	A heating system consisting of one renewable and one conventional energy source, or more than one renewable with or without a conventional energy source, that works in standalone or grid connected mode.
Solar Thermal Panels	Photovoltaic panels on a roof used for heating a domestic water system.

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Executive summary

Introduction

This report presents the findings from work package two of the Rural Hybrid Energy Enterprise Systems (RHEES) research project. Funded by the Engineering and Physical Sciences Research Council (EPSRC), RHEES was a three-year research project commissioned in 2012. It consisted of nine work packages that encompassed a range of disciplines including science, technology and social science. Led by the University of Nottingham it was a consortium of six UK universities. Work package two was led by a research team based at Bishop Grosseteste University in Lincoln. RHEES also had a parallel project running in India funded by the Indian Department of Science and Technology (DST) which was led by the Indian Institute of Science (IIS) in Bangalore, with mirroring work packages.

The overarching objective of the project was focussed on bridging the urban rural divide (BURD) in terms of renewable energy production in the community by:

- making rural living a more sustainable option in the UK and India;
- utilising new end-user focused approaches to enable the development of community hybrid systems to tackle energy and fuel poverty; and,
- increasing local employment opportunities and add livelihood value from associated benefits such as low cost transport, fuel, organic fertilisers and compostable sale products.

The specific aims of the UK work package two were to assess:

- the current values attached to bio-resources and rural hybrid energy;
- current and future energy needs and priorities;
- perceptions of the acceptability and viability of community rural hybrid energy sources, systems and schemes;
- public engagement with, and knowledge and experience of, rural hybrid energy; and,
- energy literacy levels amongst householders.

The renewable energy context

Since the Earth Summit in Rio de Janeiro in 1992, the need for sustainable development and a reduction in carbon dioxide emission levels worldwide has become an increasingly important and urgent issue to be addressed if we are to have 'viable futures'[2] and avoid disruptive environmental events resulting from climate change. The current agreement on emissions reduction, in place since the Kyoto Protocol of 1997, expires in 2020 and at the end of 2015 the United Nations Climate Change Conference (COP21) will meet in an attempt to secure legally binding universal agreement on climate change through emission reduction thereafter.

[2] Devine-Wright, P. (2008). Reconsidering public acceptance of renewable energy technologies: a critical review. In T. Jamasb, M. Grubb and M. G. Pollitt (Eds). Delivering a Low Carbon Electricity System: Technologies, 40 Economics and Policy, Cambridge University Press. New York: Cambridge University Press, pp.443-461.

The continuing need to reduce carbon emissions has driven the desire to develop new ways of producing energy. This, along with increasing public and government concerns about the rising cost of energy, has resulted in a shift away from using established forms of energy such as coal, gas and oil to more sustainable, cleaner and renewable energies for example, wind, solar, biomass and anaerobic digestion processes. It is in this context that the Rural Hybrid Energy Enterprise Systems (RHEES) research project was established.

The UK Government has committed to an 80 percent energy reduction by 2050. To this end, there have been a number of government initiatives and incentives intended to encourage the take up of renewable alternatives across society including the commercial and public sector, households and communities. Specific examples include the Feed in Tariff scheme for photovoltaics and the Green Deal. On a community level in 2014 the government issued their Community Energy Strategy.
In addition to the above, those living in rural areas (estimated to be around 20 percent of the UK population) are assumed to face additional energy challenges. For example, in terms of obtaining a reliable energy supply, (many communities have no access to the national grid for gas), and the likelihood of above average fuel consumption, (i.e. the need to run a private vehicle in the absence of public transport), leading to significantly higher energy costs. Older rural residents are deemed to be disadvantaged still further, resulting in high levels of fuel poverty in rural areas. Work package two aimed to investigate some of these issues.

Research design

Work package two took a mixed methods approach which involved household surveys, interviews and observations. Data collection occurred between October 2013 and July 2014. The three case study sites of Lincolnshire, Derbyshire Higher Peak and Easter Ross were selected from within the two rural regions of Britain originally identified in the RHEES research proposal; the East Midlands and Northern Scotland. Work package two further identified eight rural settlements to be investigated; three each in Lincolnshire and Derbyshire Higher Peak and two in Easter Ross, all with resident populations of under 10,000.

There were four main aspects to data collection:

- a stratified postal survey to 6,000 households of which there were 747 valid returns (a response rate of 12.5%);
- face to face interviews with 97 householders;
- face to face interviews with seven stakeholders; and,
- one focus group consisting of 10 residents in the Lincolnshire area interested in issues, or active in the area, of renewal energy.

In addition, a small scoping study was conducted into the status of (community) anaerobic digesters in the UK at the time of the research. Whilst a key focus for RHEES scientific and technical packages it appeared to be absent in the social science sphere and we aimed to investigate why this might be.

Key findings

- *There is a disjuncture in terms of energy literacy between awareness and knowledge, and understanding.* This study found a marked difference between individuals' awareness of renewable

technologies and current debates surrounding related issues and their actual understanding of how such technologies operate, their benefits and their possible challenges.

- *There is a need for better and more trustworthy information*. If government is to engage the general public in future renewable energy initiatives there needs to be better, more accessible and trustworthy information on what is available, what is expected of individual householders and communities and how the general public can contribute.
- *'Communities' is a contentious and undefined term.* It is clear from this study that the term 'community' renewable energy means different things to different people. It would be helpful to either have one workable definition that all adhere to or to take into consideration, and acknowledge, the various definitions when discussing what is and what is not, a community renewable energy technology or initiative.
- *Community hybrid energy systems did, at least in principle, appeal to householders.* This study found the concept of generating energy using community hybrid systems was attractive to many householders. However, the majority had concerns as to how it would work in practice and who in a community would be responsible for taking it forward.
- *There is a social stigma attached to fuel poverty.* The data would suggest this is especially true amongst the elderly.
- *Householders were keen to ensure their homes were as energy efficient as possible*. Those most pro-active in this area were home owners. Those in rented accommodation relied on their landlords to install the majority of energy efficient improvements. This was most likely to occur with social rather than private landlords. Those in older properties found it difficult and expensive to make their home more energy efficient. The main driver for making such improvements was financial.
- *There was little awareness amongst householders of government energy saving initiatives.* Those that were aware of government initiatives found the eligibility criteria difficult and complex to understand.
- *There was an openness towards alternative styles of energy efficient homes.* Interviewees, regardless of age, were generally interested in new ways of constructing and designing homes that reduced carbon emissions. However, many pointed out numerous perceived difficulties with such innovative concepts including gaining planning permission or getting a mortgage on non-traditional properties. Being too old or not well enough to meet the physical demands required to run some of the proposed energy producing systems, i.e. an anaerobic digester or a wood burner, built into new designs were also of concern.
- *Many interviewees were pro-development of renewable alternative energies.* There also appears to be a shift in public opinion regarding the acceptability of nuclear power as a way forward. There was a lot of support for hydro and tidal energy.
- *It was too early in the use of community anaerobic digestion systems to make a full and proper assessment of whether or not they have the potential to be a viable renewable energy at community level.* However, there does appear to be some evidence that anaerobic digestion per se could potentially play a part in a future hybrid energy system. Many interviewees saw its immediate use on a farm scale with the associated ready access to fuel stock.

Recommendations

To policymakers and government:

- Establish a simple understandable definition of 'community renewable energy' to stimulate debate both locally and regionally.
- Lead future public campaigns to raise awareness of the need to reduce carbon emissions and the possibilities of using renewable energy, highlighting the potential consequences of inaction as a society for society.
- Monitor the impact of renewable energy on rural communities especially in terms of increased economic activity, age profiling, opportunities to participate in or set up community projects, wider community benefits and improved energy literacy levels.
- The Government should consider giving discounts on renewable energy new builds.

To Educators - all stages:

- Trial the energy literacy matrix presented in the full report.
- Be willing to engage in the renewable energy and climate change debates in both formal and non-formal contexts.
- Establish a community education programme to raise awareness and address renewable energy initiatives, including Anaerobic Digestion issues. This will also help develop a more sustainable energy sector.

To the renewable energy sector:

- Engage more with the general public, especially householders. Provide greater levels of support, particularly in terms of offering expertise and sharing knowledge and information, to communities that would like to take renewable energy technologies forward.

To other stakeholders:

- Mortgage lenders should broaden their offers and/or soften eligibility criteria to include properties that have elements of alternative energy systems or design.
- All new builds should carefully consider renewable energy options as a matter of course.
- Landlords should take a greater share of responsibility in terms of ensuring their rented properties are as energy efficient as possible.

Section A: Introduction

Work package two (WP2) 'community engagement' was one of nine work packages commissioned as part of the three-year (2012 – 2015) Rural Hybrid Energy Enterprise Systems (RHEES) research project funded by the Engineering and Physical Sciences Research Council (EPSRC), Research Council UK (RCUK). Led by the University of Nottingham, this multidiscipline project (five of the work packages were scientific / technical whilst four, including WP2, had a social science focus) was a consortium of six UK universities, most of which were based in the East Midlands. WP2 sat with Bishop Grosseteste University in Lincolnshire. The project also had a parallel project running in India funded by the Indian Department of Science and Technology (DST), led by the India Institute of Science (IIS) in Bangalore, with mirroring work packages.

The overarching objective of the project focussed on bridging the urban rural divide (BURD) in terms of renewable energy production in the community by:

- making rural living a sustainable option in the UK and India;
- utilising new end-user focused approaches to enable the development of community hybrid systems to tackle energy and fuel poverty; and,
- increasing local employment opportunities and add livelihood value from associated benefits such as low cost transport, fuel, organic fertilisers and compostable sale products.

Active community participation was a key element of the research, particularly in the Indian context.

The specific aims of the UK WP2 were to assess:

- the current values attached to bio-resources and rural hybrid energy (RHE);
- current and future energy needs and priorities;
- perceptions of the acceptability and viability of community RHE sources, systems and schemes;
- public engagement with, and knowledge and experience of, RHE; and,
- energy literacy levels amongst householders.

For this work package, as with others, there was a particular focus on older rural residents (i.e. pensioners).

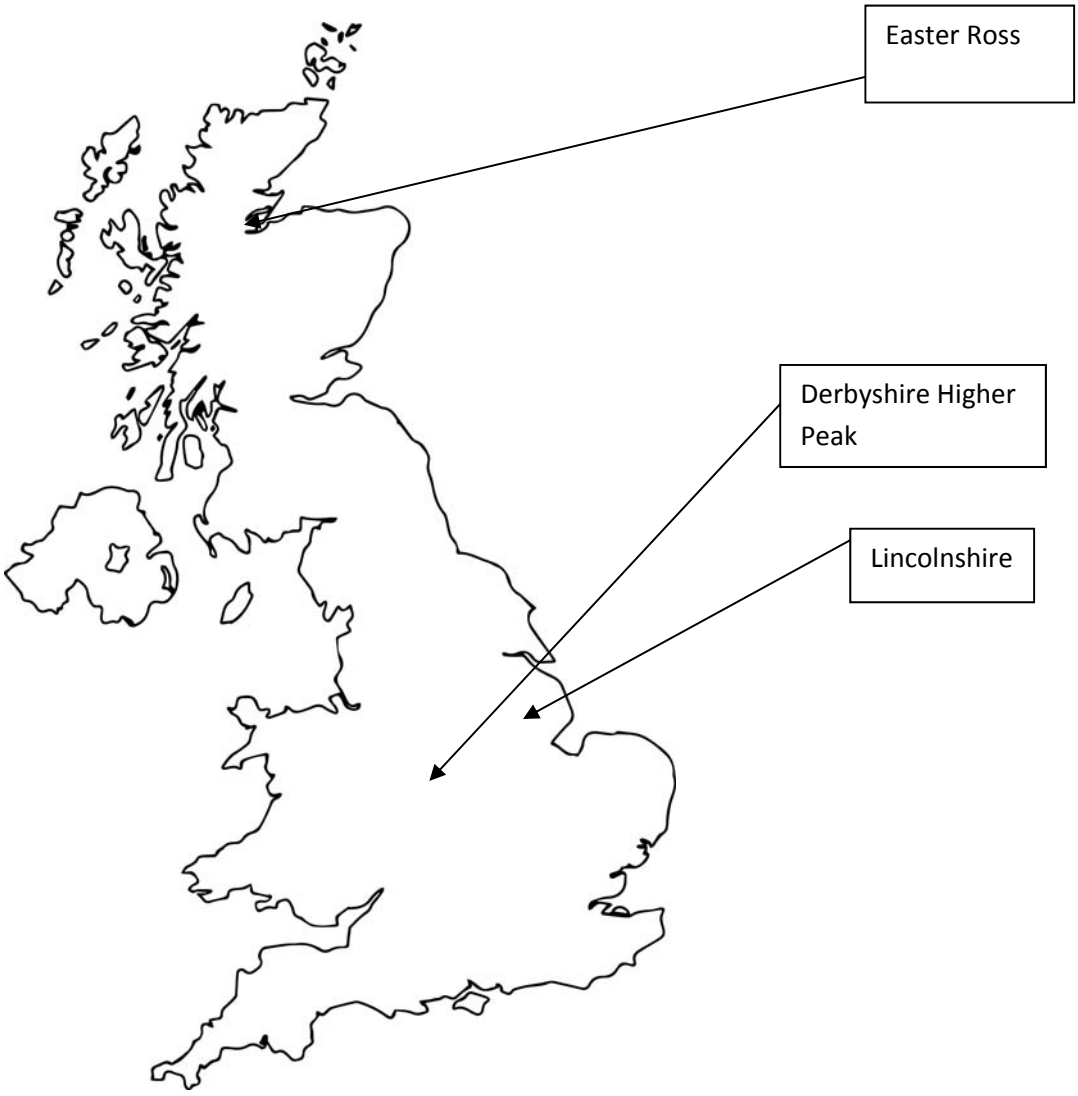
The initial bid identified two rural regions in Britain where work packages would concentrate their research; the East Midlands and Northern Scotland. Due to the size of these two areas WP2 narrowed the initially proposed regions down to three smaller areas, Lincolnshire (Lincs) and the Derbyshire Higher Peaks (DHP) both in the East Midlands of England and Easter Ross (ER) in Northern Scotland. WP2 further identified within them eight rural settlements (three in both Lincs and DHP and two in ER) all with populations of under 10,000. These eight small rural market towns and villages are subsequently referred to as L1, 2 and 3, DHP 1, 2 and 3 and ER1 and 2 and are profiled below.

Overview of the case study sites

All the study sites were either situated in, or adjacent to, tourist gateways. L1 is adjacent to the Lincolnshire Wolds and is an area of outstanding national beauty, DHP1 is at the edge of the Derbyshire High Peak

District and E2 is on one of the main routes into the highlands. Figure 1 shows the location of the three case study sites.

Figure 1: Map showing the location of the case study sites



The rural-urban classification within the 2011 census[3] recognised all the East Midland study areas as either "Rural town and fringe" or "Rural village and dispersed". Both ER1 and ER2 come under the Scottish

[3] 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/248666/Rural-Urban_Classification_leaflet__Sept_2013_.pdf

Government rural-urban classification[4] of 2013-2014 as Code 4: "Remote Small Towns" or "Settlements of between 3,000 and 10,000 people and with a drive time between 30 and 60 minutes to a Settlement of 10,000 or more". Details of the rural-urban classification and population numbers for each of the eight case study settlements can be found in Table 1 below.

Table 1: Urban/rural classification of, and population figures for, the eight case study settlements

Study area	Rural-Urban Classification	Census population	Estimated number of houses	Estimated number of fuel poor households	Proportion of fuel poor households
L1	Rural town & fringe	6,651	3,353	599	17.9%
L2	Rural village & dispersed	4,671	2,954	493	16.7%
DHP1	Rural town & fringe/ Rural village & dispersed	8,653	4,004	920	23%
DHP2	Rural village & dispersed	1,178	799	235	29.4%
DHP3	Rural village & dispersed	642	515	225	43.7%
E1	Remote small town	5,186	n/a*	n/a*	n/a*
E2	Remote small town	5,026	n/a*	n/a*	n/a*

*There is no equivalent data for the Scottish case study areas due to the way in which their data is organised.

The census data for each study area is based on lower super output areas (LSOA). Lower layer LSOAs which are geographic areas designed to have a population of between 1,000 and 3,000 in the 2011 census for England and Wales. If all or part of a LSOA is within a study area its statistics have been included. The Scottish 2011 census was analysed on a different basis[5].

E1 has a significant recent industrial history with two large local authority housing areas built during the height of the work to establish the North Sea oil industry in the early 1970s. However, the oil industry has moved on from its initial construction phase and the two LSOA codes in question are now in the top 15% of the Scottish Index of Multiple Deprivation. Index of Multiple Deprivation scores and rankings also varied considerably across the English case study sites. The two LSOA's within study area L1 showed the highest multiple deprivation index scores and overall rankings indicated significant pockets of poverty. The total estimated number of houses, as shown in Table 1, are drawn from a calculation of fuel poor households[6]. This proportion varied considerably across the LSOA's within each of the English study areas. The percentages ranged from 12.9% in parts of L2 to 43.7% in parts of DHP3. Overall the data indicated that out of 11,925 households across the study area 2,472 (or 20.7%) were likely to be within the 10% definition of fuel poverty.

[4] http://www.scotland.gov.uk/Topics/Statistics/About/Methodology/UrbanRuralClassification
[5] http://www.scrol.gov.uk
[6] DECC: 2012 sub-regional fuel poverty data: 10% indicator https://www.gov.uk/government/collections/fuel-poverty-sub-regional-statistics

Table 2 details the age distribution[7] of the population within the case study areas. It shows that across all eight settlements the largest adult age group was 46-64 years of age with the smallest group being those aged 18-24. In general, those living in ER were most likely to be younger (between the ages of 25 and 64). Approximately one-third of the Lincolnshire and DHP populations were 'older residents' over the age of 64.

Table 2: Age distribution across the eight case study settlements (adults only)

Age	L1	L2	DHP1	DHP2	DHP3	ER1	ER2
18-24	9%	7%	9%	5%	6%	11%	11%
25-45	28%	26%	27%	18%	24%	35%	35%
46-64	29%	38%	38%	37%	42%	38%	33%
65-74	17%	16%	14%	22%	16%	9%	12%
74+	17%	13%	12%	18%	12%	7%	9%

Report structure

This report is divided into four further sections. Section B details the research design. Section C presents the research findings. Section D investigates living with Anaerobic Digestion and Section E sums up the overall findings and makes a series of recommendations to a range of stakeholders including policy makers, educators and those working in the renewable energy industry.

Section B: Research design

Each of the nine UK work packages took a different, autonomous, approach to achieve their specific aims and objectives. WP2 took a mixed methods approach, therefore the findings presented in this report are based on both quantitative (survey) and qualitative (interview and observational) data collected from across the three chosen case study sites between October 2013 and July 2014.

Quantitative data: household survey

In total 6,000 household surveys (see Appendix A) were administered by post across the three case study areas (2,000 each). The aim of the survey was to achieve as wide a response as possible in two ways. Firstly, in terms of household type. For example the properties age and style, i.e. a bungalow, flat, terraced house, etc. Secondly, household composition, i.e. age of residents, their gender, number of occupants, employment status, etc. This would enable the research team to obtain a broad picture of householder's experience and knowledge of, and attitudes towards, renewable energies in different domestic settings.

A technique known as '*Random Stratified Sampling*'[8], was employed. Our sample was *stratified* in the sense that the households surveyed were drawn specifically and only from the eight identified settlements within

[7] Age distribution data for Lincs and DHP is based on the 2011 Census data http://www.nomisweb.co.uk/census/2011/wd501ew and the 2001 census data for ER http://www.gro-scotland.gov.uk/census/censushm/scotcen2/reports-and-data/scotcen8.html

[8] Chen, L., Manion L. and Morrision, K. (2011), Research Methods in Education, 7th Edition, Routledge, Oxon.

the three case study areas. Our sample was also *stratified* in that the aim was to achieve a spread of household types across each settlement by selecting as many residential streets as possible and ideally at least one household from every street; thereby enabling sampling across the full breadth of each settlement. Our sample was *random* in that households receiving a postal survey on each street were selected arbitrarily. The number of addresses selected per street was generally proportionate to its length. For example, on a street with over 100 addresses 30 or 40 households were surveyed, whereas for a street with only ten addresses just three or four households were selected.

In total, 747 valid surveys were returned, giving an overall response rate of 12.5%. As Table 3 details, the greatest percentage return came from Lincs (15.5%); the case study site nearest to the lead institution for WP2, Bishop Grosseteste University based in the city of Lincoln.

Table 3: Survey returns

Survey data	Lincs	DHP	ER	Total
Number of surveys sent	2000	2000	2000	6000
Number of surveys returned	310	246	191	747
% returned	15.5	12	10	12.5

There were approximately an equal number of male and female survey respondents (372 / 364 or 50% and 49% respectfully with 11 or 1% of respondents not stating their gender). The majority of respondents were married (57%) with 13% divorcees and 12% widowed. Over one-third (38%) were aged between 46 and 64. There were the same percentage of respondents aged 65-74 as there were over 75 (25%). Therefore, half of all respondents were over 64 years of age. This is in line with one of the projects key aims; to focus specifically on rural pensioners. There were very few younger respondents; just 1%. A breakdown of survey returns by area and age can be found in Table 4.

Table 4: Percentage distribution of survey returns by age

Age	Lincs	DHP	ER	Total
18-24	1.9%	0.8%	1%	1%
25-45	8.4%	6.9%	10.5%	8%
46-64	30%	43.5%	44%	38%
65-74	19.4%	26.4%	31.9%	25%
75+	37.4%	19.9%	12%	25%
No Answer	2.9%	2.4%	0.5%	2%

In terms of employment status, (Table 5) just over one-quarter (27%) of survey respondents were in full-time work. Respondents recorded as retired were the largest group across all three case study areas.

Table 5: Employment status of survey respondents

Employment status	Lincs	DHP	ER	Average across the three sites
Self employed	8.1%	12.2%	4.2%	8%
Full-time working	29.4%	22%	29.3%	27%
Part-time working	5.2%	10.2%	13.6%	9%
Student	1%	1.2%	1%	1%
Seeking work	2.3%	1.2%	1%	2%
Not seeking work	3.9%	4.1%	2.6%	4%
Retired	46.1%	51.6%	48.7%	49%

Note: A minority of survey respondents entered more than one employment status category with 'retired' and 'part time' working being the most common.

The level of owner occupation (Table 6) was high across all three study areas with the vast majority of survey respondents owning their own home (82%). At the margins there were some indications of difference in the level of rented activity amongst the remaining 18%. For example, the ER sample had the highest proportion of local authority tenants. This probably underestimates the proportion of the population living in such accommodation. The Lincs sample had the highest combined proportion (14.9%) living in private or housing association properties. Nearly a third (29%) of respondents lived in a bungalow; possibly reflecting the age distribution of survey respondents.

Table 6: Housing type of survey respondents

Tenancy	Lincs	DHP	ER	Average across the three sites
Owner occupied	79.7%	87.8%	79.1%	82%
Tenanted property of a private landlord	9.7%	5.7%	4.7%	7%
Tenanted property of a housing association	5.2%	0.4%	2.1%	3%
Tenanted property of the local authority	2.3%	5.3%	11.0%	5%
No answer	3.2%	0.8%	3.1%	2%

The housing stock of the survey respondents was generally older than 25 years (Table 7). Just 5% of respondents lived in a new home (less than ten years old) whilst half of all respondents lived in houses that were 26-75 years old. This figure was particularly high for ER (65.4%). However, ER respondents were least likely (7.9%) to reside in older homes (over 75 years old) whilst respondents living in DHP were most likely (32.1%) to be living in an older property.

The estimates of housing age recorded from the survey returns showed the Lincs case study sites tended to have the highest proportion of houses below 25 years of age whilst the DHP study areas had the highest proportion of houses estimated to be over 75 years old. There was a small proportion of recently built houses in both the Lincs and DHP sites. Table 7 details housing age by the survey returns.

Table 7: Housing age by survey responses

Housing age	Lincs	DHP	ER	Average across the three sites
10 years or less	4.8%	1.6%	9.9%	5%
11 - 25 years	29.0%	12.2%	13.6%	20%
26 - 75 years	40.6%	50.8%	65.4%	50%
75+ years	19.0%	32.1%	7.9%	20%
Don't know	6.5%	3.2%	3.2%	5%

Over half (58%) of all survey respondents had lived at their current address for 11 years or more (Table 8). The Lincs survey respondents seemed the most dynamic having the highest percentage across the three sites that had lived at their current address for less than 5 years. The ER sample showed the highest percentage of resident at the same address for over 25 years. Coincidentally, 56% of survey respondents stated they had family links in the local area; those with the least local family ties were survey respondents living in Lincs (51.3%).

Table 8: Duration at current address for survey respondents

Duration at address	Lincs	DHP	ER	Average across the three sites
1-5 years	27.7%	21.1%	13.6%	22%
6-10 years	16.5%	18.3%	21.5%	18%
11-25 years	33.5%	28%	26.7%	30%
25+ years	19%	31.3%	37.2%	28%
No Answer	3.2%	1.2%	1%	2%

The household survey therefore sought to collect a range of data pertaining to both the householder and their housing type (as detailed above) to enable an exploration of renewable energy attitudes, knowledge and experiences in relation to such factors. In addition, qualitative data from household interviews was used to explore these issues further.

Qualitative data: interviews

The qualitative data consisted of: 97 household interviews (some of which had two adults present, giving a total of 115 individuals participating in interviews); one focus group (comprising ten participants from the Lincs case study area); and seven stakeholder interviews. Interview schedules for householders and the focus group can be found in Appendix B.[9] Interviewees were selected predominantly[10] from a pool of 165 household survey respondents who offered themselves for interview at the end of the postal survey

[9] Interview schedules for the seven stakeholders were designed on an individual basis to reflect their area of knowledge and expertise.

described above. The 97 household interviewees were therefore a sub-set of the survey respondents. A breakdown of the number of interviews by case study area and type can be found in the Table 9.

Table 9: Number of interviews per case study area

Number of:	Lincs	DHP	ER	Average across the three sites
Households offering to be interviewed	80	43	42	**165**
Households actually interviewed	47	27	23	**97**
Individuals interviewed	54	33	28	**115**
Stakeholders interviewed	2	1	4	**7**

As might be expected, the further away the data collection was conducted from the location of the University where WP2 was based (i.e. Lincolnshire) the lower the public response rate. This resulted in fewer survey returns and subsequently less interviews being conducted in DHP and ER than in Lincs.

Table 10: Gender and age of interviewees compared to survey respondents

Household interviewees	Lincs	DHP	ER	Interviewee average across the three sites	Survey average across the three sites
Gender:					
Male	45%	76%	83%	64%	50%
Female	55%	24%	17%	36%	49%
Age:					
18-64	36.2%	51.9%	34.8%	40.9%	50%
65+	63.8%	48.1%	65.2%	50.1%	50%

As Table 10 shows the proportion of men interviewed in DHP and ER was significantly higher compared to Lincs and with the overall profile of the survey respondents. Table 8 also shows that the Lincs and ER interviewees were generally older than the full survey population with nearly two-thirds of those interviewed being over the age of 64. The DHP age split was similar to the overall sample but several interviewees had retired below the age of 65.

[10] There was one household interviewee that was not a survey respondent but a result of attempts to set up a focus group in the Lincolnshire case study are.

Table 11: Tenure of interviewees compared to survey respondents

Tenure for Household Interviewees	Lincs	DHP	ER	Interviewee average across the three sites	Survey average across the three sites
An owner occupied property	78.7%	77.8%	82.6%	79.4%	82%
A tenanted property of a private landlord	10.6%	7.4%	0.0%	7.2%	7%
A tenanted property of a housing association	4.3%	3.7%	0.0%	3.1%	3%
A tenanted property of the local authority	2.1%	7.4%	13.0%	6.2%	5%

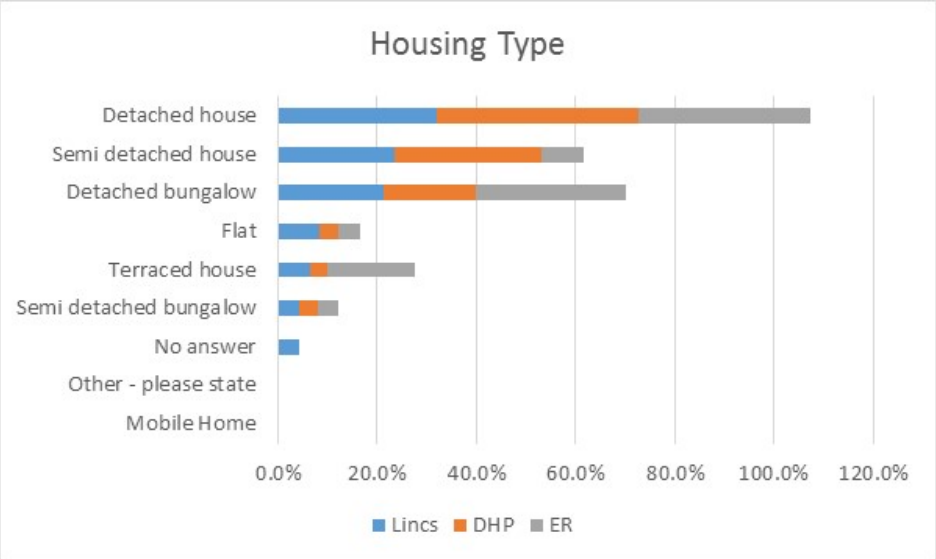
The nature of household tenure was similar between the interviewee households and the overall survey respondents (Table 11). Owner occupation dominated (circa 80%) whilst private or public sector landlords were the next largest category in Lincs and ER respectively.

Table 12: Housing type of Interviewees

Housing type	Semi-detached house	Detached house	Terraced house	Flat	Semi-detached bungalow	Detached bungalow	No answer
Survey	23%	28%	12%	5%	5%	24%	2%
Interview households	21.6%	35.1%	8.2%	6.2%	4.1%	0.0%	2.1%

Household type (Table 12) was broadly similar for both the survey respondents and the household interviewees. The exception was the lack of detached bungalows amongst the interview sample. However, as Figure 2 shows there was some variation across the study areas with ER having the largest representation of both terraced houses (17.4%) and detached bungalows (30.4%). The single largest category of household type was detached houses.

Figure 2: Housing type of interviewees by study area



Across all three case study sites the largest proportion of the housing stock was 26 – 75 years old (Table 13). However, ER had the highest proportion of the newest houses; 10 years old or less.

Table 13: Housing age of interviewee households compared to survey respondents

Housing age	Lincs	DHP	ER	Interviewee average across the three sites	Survey average across the three sites
10 years or less	2.1%	3.7%	21.7%	7.2%	5%
11-25 years	25.5%	11.1%	8.7%	17.5%	20%
26-75 years	38.3%	51.9%	47.8%	44.3%	50%
75+ years	27.7%	26.6%	17.4%	17.4%	20%
No answer	6.4%	3.7%	4.3%	5.2%	5%

Table 14 shows the gender breakdown of those interviewed across the eight settlements within the three case study areas.

Table 14: Gender numbers and balances of interviewees within the three case study areas

	Lincs (n=54)				DHP (n=33)				ER (n=28)		
	L1	**L2**	**L3**	**Total**	**DHP1**	**DHP2**	**DHP3**	**Total**	**ER1**	**ER2**	**Total**
Male	17	9	4	30 (55%)	19	3	0	21 (66%)	8	12	20 (71%)
Female	13	10	1	24 (45%)	8	2	1	11 (34%)	4	4	8 (29%)

The vast majority of the qualitative data was collected via face-to-face interviews. In addition there were three phone interviews; two with householders and one with a stakeholder. All interviews were audio recorded and later transcribed. It should be noted that in presenting the findings from the interviews (Section C) figures are based on 97 not 115 representing the views, opinions, knowledge and experience of households rather than individuals.

Section C: Findings

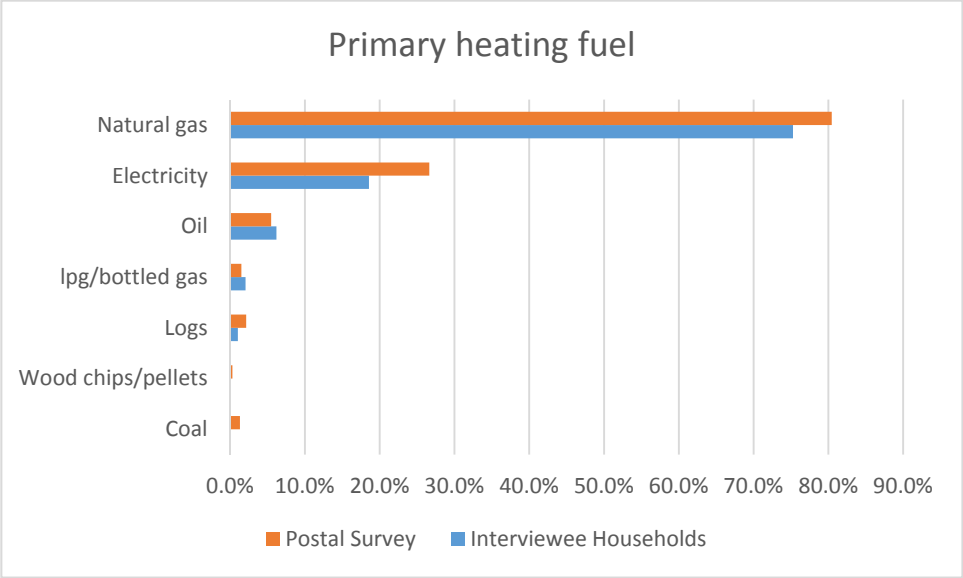
Drawing on both the qualitative and quantitative data sets, (i.e. the survey responses, the household and stakeholders interviews and the focus group) this section presents the findings of WP2 under four broad themes. The first theme considers household energy needs, usage, priorities and recent energy efficiency measures made to the home. The second explores attitudes towards different types of energy efficient houses. The third looks at the energy literacy of interviewees in terms of their knowledge and understanding of wider contemporary energy debates. Finally, theme four is concerned with interviewees' attitudes towards, and willingness to engage with, future local rural hybrid energy systems and their perceived benefits and challenges.

1) Current household energy use

a) Household energy sources and spend

Both survey respondents and interviewees were asked about the primary sources of energy used for heating the home (Figure 3). In both cases the majority used gas followed by electricity supplied from the national grid. Uptake of group buying schemes was low at 2.4% of the survey responses.

Figure 3: Overall primary heating source for interviewees and survey responses



There were two notable exceptions where interviewees were not connected to the mains gas supply; the five interviewees living in L3, and one interviewee living just outside the boundary of PD1. Four of the five interviewees living in L3 used oil instead of gas whilst the remaining two off-grid interviewees used bottled gas. In addition, two of the L3 interviewees belonged to a local (different) group buying energy scheme in an attempt to purchase their oil as cheaply as possible. The survey responses showed that oil was a more popular option than bottled gas for those off-grid. It was particularly favoured in ER with 12.6% of ER survey respondents reporting using bottled gas as their primary heating fuel source. In the overall survey the percentage of respondents in a group buying schemes was very low (2.4%) and there was no consistent link within the interviewee households between being a member of a group buying scheme and using oil. Table 15 shows primary heating sources according to survey responses by area.

Table 15: Primary heating fuel sources of survey respondents by case study area

Primary heating fuel	Lincs	DHP	ER	Average across the three sites
Natural gas	83.2%	91.9%	61.3%	80.5%
lpg/bottled gas	1.9%	1.6%	0.5%	1.5%
Oil	4.5%	1.2%	12.6%	5.5%
Coal	1.0%	1.2%	2.1%	1.3%
Logs	1.6%	2.8%	2.1%	2.1%
Wood chips/pellets	0.3%	0.4%	0.0%	0.3%
Electricity	25.2%	22.0%	35.1%	26.6%

Several (18%) interviewees had supplementary forms of energy such as wood burners (14%) and photovoltaic (11%); some had both. The latter was far higher than the overall percentage of survey respondents where just 5% stated they owned photovoltaic. After gas and electricity the use of logs was the most popular secondary sources of fuel for survey respondents as a whole (9.5%) but least preferred by those in Lincs where only 5.5% took this fuel option compared to 16.7% in DHP and 15.7% in ER.

Whilst interviewees were asked about their household energy spend the results across the study were so diverse and dependent upon a multitude of factors such as, size and age of house, type of energy used, number of occupants, whether the interviewee was retired or not, how many months a year they spent at the house, and so on, that it was not possible to establish a meaningful average spend figure. However, according to this information we were able to ascertain that energy bills were, on average, lowest for interviewees living in Lincs and highest for those living in the ER case study area.

There appeared to be no difference in the breadth of energy spend across the sites with the exception of L3 which was noticeably higher than in the other seven case study settlements. This can largely be attributed to the fact that there is no mains gas supply to the village and therefore residents are more likely to use oil; at the time of the research a more expensive form of energy even when purchased as a group rather than individually. The rising cost of oil was also noted by one of the focus group participants who lived in an outlying village near L1, which also had no mains gas supply. Whilst there were only five interviewees in L3, this does perhaps provide some further anecdotal support for other evidence that those living in rural areas and off the national gas grid are at a disadvantage to others and are likely to spend more than the national average[11] on their household energy bills.

The majority of interviewees paid their household fuel bills by direct debit with many having a dual fuel bill.

[11] https://www.gov.uk/government/...data/.../uk_housing_fact_file_2012.pdf

b) Household transport

Interviewees were asked about household transportation. This was felt to be particularly important to explore given the rural nature of the case study areas.

Table 16: Number of vehicles per interviewee household

Number of vehicles	Lincs (n=47)			DHP (n=27)			ER (N=23)		Total
	L1	L2	L3	PD1	PD2	PD3	ER1	ER2	All areas
0	6	1	0	2	0	0	2	2	13
1	12	8	0	13	3	1	4	4	45
2	6	4	5	4	1	1	2	4	27
3	2	3	0	2	0	0	0	1	8
***Other**	0	0	0	0	0	0	2	2	4
Total	26	16	5	21	4	2	10	13	**97**

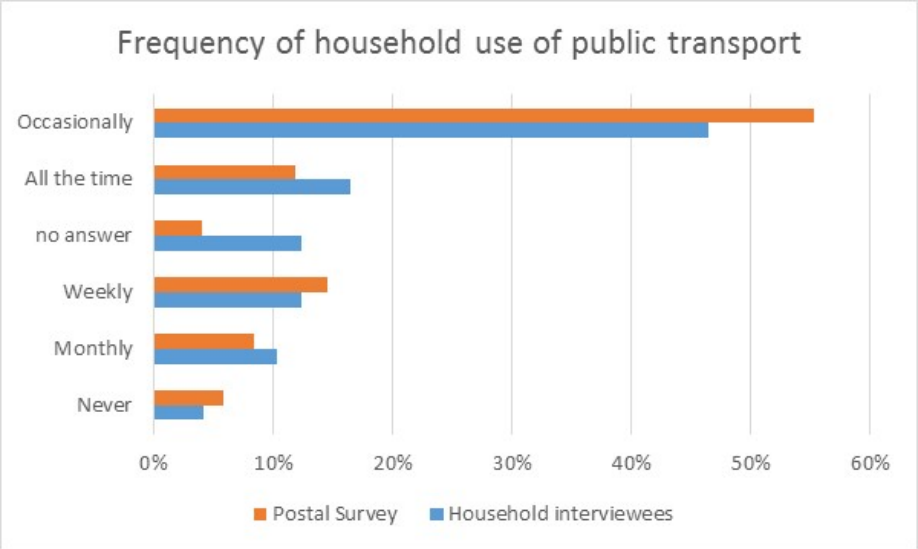
*Includes a fleet of company cars and a mix of cars, bikes and campervans

As Table 16 shows, interviewees were most likely to have one car (46%) with just over a quarter owning two cars. Analysis of the 2011 National Census data indicates an average of 1.42 vehicles per household within Lincolnshire whilst the detail suggests that over 51% of rural households have more than two cars each. The interviewee data in this study indicated that as a percentage, those living in Lincs were more likely to own two cars (32%) followed by those in ER (26%) with the lowest household two-car ownership being in PD (22%). All five interviewees in L3 had two cars; one of the smallest case study settlements providing further anecdotal evidence that those living in small rural communities are likely to spend more on fuel than those in larger rural settlements with better access to public transport.

Very few interviewees (just 13%) did not own a car. Interviewees were more likely *not* to own a car if they lived in ER (17%). with the majority (all but one) of those without a car in Lincs living in L1, the largest of the three settlements where interviewees had access to regular and frequent public transport. L1 also had sufficient facilities to service the local community. There were two main reasons why interviewees did not run a car: ill health and never having held a driving license. Three (23%) of the non-car owners regularly used public transport but two (15% and both in Lincs) reported this to be somewhat limiting. One interviewee (also residing in Lincs) used a skateboard in the summer to get around.

The instance of public transport usage was much lower amongst the interview sample (3%) than for the full survey respondents where 12% stated they used public transport all of the time, 15% weekly and just 6% never (Figure 4).

Figure 4: Frequency of household use of public transport for interviewees and survey respondents



Interviewees were also asked how much, on average, they spent on fuel to run vehicles. This was felt to be important due to the rural locations of the villages. As with energy spend in the home, the amount interviewees spent on vehicle fuel per month varied greatly from £30 to £600 depending on how many vehicles they ran, their type and usage. The overall average spend on fuel per month for interviewees was £137.33. The average monthly spend was lowest for those living in ER (£117) and highest for those living in Lincs (£155). On average, interviewees in Lincs and DHP households reported spending more on vehicle fuel than they did on household energy bills.

The highest fuel spend was reported where vehicles were used to commute to work. This was particularly evident for one interviewee in L3 who had a 108 mile daily compute which was estimated to cost approximately £400 a month for the one car. The household also ran a second car. This interviewee's commute largely accounted for the greater than average travel costs for the Lincs case study area.

Whilst several interviewees reported owning cars that were energy efficient, economical with low emissions, just one specially stated that their car were a hybrid.

c) Consumption patterns

Interviewees were asked if their overall consumption (rather than their spend) on energy had changed recently. Of those who answered this question (90%) 25% reported their consumption had gone up, 41% that it had gone down and 33% that it had remained the same. For Lincs and DHP consumption was more likely to have decreased whilst it was more likely to have remained the same for interviewees living in ER.

Reasons given for *increased* consumption included: working at home; having a new baby in the house; a growing family; illness; and retirement. One interviewee (ER1) commented '*it's great retiring but you need the heating on all the time'.* The latter was also picked up by the focus group participants as reasons why energy consumption was on the rise. Reasons stated for a *reduction* in consumption were that: fewer people now lived in the house; they had moved to a smaller and/or newer property; they had installed a wood burner; they had undertaken home improvements to make the property more energy efficient –

some as part of government initiatives but the majority not - or they had replaced old appliances with newer, more energy efficient ones. Several interviewees had reduce vehicle mileage upon retirement. Some were simply more aware of the rising cost of energy and had consciously become more frugal with their energy consumption. Where consumption remained static, it was generally because there had been no recent changes in the interviewees' circumstances. The age, and in most cases the size, of the property did not seem to be major factors in whether or not energy consumption had changed; social factors (e.g. retirement, illness, a new baby or children leaving home) appeared to be more influential.

d) Prioritisation

Interviewees were asked if they needed to prioritise household energy use. Many felt this was not currently necessary with just over half of those interviewed (56%) reporting that they could afford their household fuel bills. However, this did not mean that they were not aware of how much energy they used or that they did not try to make energy savings where possible. Nor did it mean that they would not have to prioritise their energy use in the future. However, 40% of all interviewees said that they *did* have to make choices regarding their energy usage. The main priority for this group of interviewee was heating their home, (92%) especially in winter. One interviewee commented that heating the home was not an option and that he was '*not concerned about the cost, it has to be done*' (PD2) another interviewee observed that without her heating she would be dead. The remaining interviewees prioritised spending on vehicle fuel. Those living in DHP were least likely to prioritise energy use (74%) whilst those in Lincolnshire were most likely to have to make energy choices (47%).

Interviewees used a number of measures to save energy to try and reduce the size of their household bills including: using off-peak tariffs such as Economy 7; putting on more clothing, specifically an extra jumper; keeping room thermostats down at a constant temperature; changing to energy efficient light bulbs; switching off lights and not leaving appliances on stand-by; cooking in bulk and freezing meals; only washing full loads and cycling, walking or using public transport more frequently. One interviewee sometimes showered at the gym rather than at home. Generally prioritisation meant making small changes and being aware of energy usage.

Across the interview sample age did not appear to be a major factor in energy prioritisation; roughly the same percentage of retired interviewees and those of working age said they prioritised as those who said they did not.

e) Views on the cost of energy

The cost of energy evoked particularly strong reactions from interviewees in Lincs; perhaps not surprisingly given the timing of the interviews which took place in the autumn of 2013. At that time many of the larger energy companies (known as the Big six) announced above inflation energy price increases just ahead of the winter. Following this announcement the Big six were summoned to appear in front of the Energy and Climate Change Parliamentary Select Committee on 29th October 2013 to account for the proposed increases[12]. In addition, in September 2013 the opposition leader, Ed Miliband, promised to freeze energy bills for 20 months if they were to win the next election[13]. In short, the cost of energy, especially to

[12] http://www.parliament.uk/business/committees/committees-a-z/commons-select/energy-and-climate-change-committee/news/energy-prices/ for full details

[13] http://www.bbc.co.uk/news/uk-politics-24213366

households, was a high-profile contentious issue at the time the research was conducted in Lincs. It was prevalent in the media and a political hot potato. Several (nine) Lincs interviewees, unprompted, talked about the Big six behaving as a cartel enabling them to fix energy prices. However, by the time the interviews were conducted in DHP and ER in June and July of 2014, this was much less of an issue with just three interviewees mentioning energy Cartels. The winter had been milder than expected and the media were pre-occupied with other matters. As a result it was noticeable that the public rhetoric sounding this issue amongst DHP and ER interviewees, whilst still evident, was not as strong.

Just over two-thirds of all interviewees felt energy prices were too high. However, just under one-third felt that although energy was expensive, it was probably set at a fair price. Just one interviewee (Lincs) felt the cost of energy was too cheap. Interviewees living in ER – an energy producing region of the country - were most likely to comment that the price of energy was fair whilst those living in DHP were most likely to feel energy was too expensive.

Those who thought the price was too high described the cost of energy in strong language using such terms as 'extortionate', 'disgusting', 'ridiculous', 'shocking', 'terrible', 'appalling', 'frightening', 'overpriced', and 'a rip off'. One commented '*they have got us over a barrel*' (Lincs). Interviewees felt energy companies put profit and shareholders first, customers second. As one interviewee in ER pointed out, *'the profiteering of companies is huge'*. They also felt that the pricing structure was too complicated with very few understanding how gas bills particularly are calculated. Green subsidies also came up as an issue for a small number of interviewees. A few felt that there should be some sort of assistance for the elderly and poor. Several interviewees would like to see the energy companies' renationalisation. However, most were resigned to paying increasingly higher prices for their energy which would become harder for them to afford. Subsequently, many of those who did not currently prioritise felt they might have to do so in the future.

Almost all interviewees (92%) felt that energy supply to the home was an essential service. However, several did make the distinction between household energy supplies being essential but not necessarily a 'right'. One interviewee (Lincs) commented *'energy is a want for some but a need for others*'. Another (ER) stated, '*it's not a God-given right to have electricity on demand'*.

Electricity was generally viewed as the 'universal' energy. Water, along with food, was also considered as essential to survival. Interviewees found it difficult to envisage how society today, with its increasing automation and reliance on digital technology, could operate effectively without electricity. One interviewee, a serving member of the armed forces, did suggest that electricity could be produced using individual or community generators.

f) Recent household energy efficient improvements

The study was interested in energy efficient levels of, and improvements to, the home. Survey respondents were asked if they had a range of different types of household insulation. The majority stated they had double glazing, full loft insulation and cavity wall insulation (Table 17).

Table 17: Household insulation by survey responses

Household insulation	Lincs	DHP	ER	Average across the three sites
Cavity wall insulation	73.2%	55.3%	46.1%	60%
Additional draft proofing to doors and windows	34.5%	36.2%	31.9%	34%
External wall insulation	15.2%	16.3%	21.5%	17%
Fully insulated loft	87.1%	87.0%	83.8%	86%
Double glazing	89.7%	93.1%	91.6%	91%

Nearly two-thirds (64%) of all interviewees reported making one or more energy efficiency improvement to their home in recent years. The most common were installing: (or thickening) loft insulation (31%), - the most popular improvement; a new boiler (18%); double glazing or replacing / upgrading windows (15%); cavity wall insulation (13%) and installing a new central heating system (3%). Other improvements included installing energy efficient light bulbs, filling voids between floors, fitting radiator thermostats and converting a room or conservatory. Frequently, where improvements had been made, interviewees had made several. In terms of non-traditional renewable energy efficient improvements 14% had installed wood burners and 11% Photovoltaic (PV). Those living in DHP were most likely to have PV whilst those living in Lincs were least likely to have installed them. Given that there were twice as many interviewees in Lincs as there were in DHP and ER, this indicated an extremely low take up of solar energy in Lincs.

The remaining third of interviewees, (36%), had not made any recent energy efficiency improvements. There were two main reasons reported for this. Firstly interviewees felt it unnecessary, often because they lived in a relatively new home or one that had been extensively modernised prior to them moving in or it had been purpose built / redesigned for their own specifications. For example, one interviewee (Lincs) had recently moved into a brand new conversion incorporating the highest and latest specifications in relation to energy efficiency including maximising passive solar gain into the design of the house. The second reason given by interviewees was that they were not able to make energy efficiency improvements themselves because they were living in rented accommodation. However, five interviewees (a third) living in rented accommodation, with both local authority and private landlords, did report their landlord had recently made at least one energy efficiency improvement to the property. Those living in rented accommodation were therefore least likely to be able to make home energy efficiently improvements. This limitation was also flagged up in the survey responses.

Several interviewees, (19%), all of which were home owners, planned further improvements in the foreseeable future, usually dependent upon finances. Future improvements planned included loft insulation (4%, all in Lincs), double glazing (5%) and PV (7%). Therefore PV was the most likely future householder improvement to be considered at the time of the interviews. In addition, several interviewees had considered installing PV but discounted them for one or more of the following reasons. Either they were too expensive, in terms of the initial cost. Or the reduced government Feed in Tariff (FiT) rate meant the payback period was too long; especially for older interviewees. Or they were seen as unsightly. Or the interviewee was unsure if they would be staying in the property long-term. Or they were deemed simply not suitable for their particular property, especially relevant to those living in older houses. As one survey respondent stated: *"Renewable energy i.e. solar panels, are very expensive to buy in the first place and take*

a long time for that outlay to be returned via saving money and energy bills." Motivation for installing PV was overwhelmingly economic rather than principled.

g) Take up and knowledge of government energy saving initiatives

At the time of the study there was a plethora of domestic government initiatives around renewable energies. We were interested to explore levels of awareness, and take up of, such initiatives as well as information sources used.

As Table 18 shows, FiTs and Energy Switching schemes were the most recognised domestic government initiatives across all three study areas (55.8% and 42.4% respectfully) amongst survey respondents. However, at least a quarter of survey respondents claimed not to have heard of any of the listed government initiatives. The survey took account of some Scottish Government initiatives and here Home Energy Scotland scored almost as highly (46.6%) as Energy Switching schemes.

Table 18: Awareness of government's domestic renewable energy initiatives amongst survey respondents

Awareness of domestic energy initiatives	Lincs	DHP	ER	Survey average across the three sites **
Feed in Tariffs (FiTs)	34.8%	36.6%	40.3%	36.8%
Renewable Heat Incentive	16.8%	15.0%	17.8%	16.5%
The Green Deal and The Energy Company Initiative	22.9%	24.0%	24.1%	23.6%
The Renewable Heat Premium	3.9%	4.1%	N/A	4.0%
Energy switching schemes	51.3%	49.6%	38.7%	47.5%
The Government Cash Back Scheme	26.5%	20.3%	N/A	23.7%
Community and Renewable Energy Scheme (CARES)*			14.1%	14.1%
Home Energy Scotland*			46.6%	46.6%
Save Cash and Reduce Fuel (SCARF)*			7.3%	7.3%
None of the above	24.2%	30.5%	26.2%	26.8%

Notes: **Scottish Government schemes only / ** % of total count N/A data not collected*

The theme of government initiatives was further explored with interviewees. However, the majority of interviewees had not heard of, or taken up, any government energy saving initiatives. Whilst several interviewees said they had taken up government initiatives it became evident during interview that most were some time ago and centred predominantly on loft or cavity wall insulation.

Several interviewees had considered taking up one or more of the governments energy efficient schemes, mainly Green Deal and FiTs, but had subsequently discounted them due to one of the following factors: the initial cost and/or payback time, both of which mainly pertained to the installation of PV; the initiative under consideration was unsuitable for their property; on investigation they found they were not eligible or they were unable to ascertain their eligibility reporting the criteria too complex; they were living in rented

accommodation; or improvements were not actually needed. Similar reasons were also given by survey respondents, particularly the up-front cost of initiatives verses pay-back time.

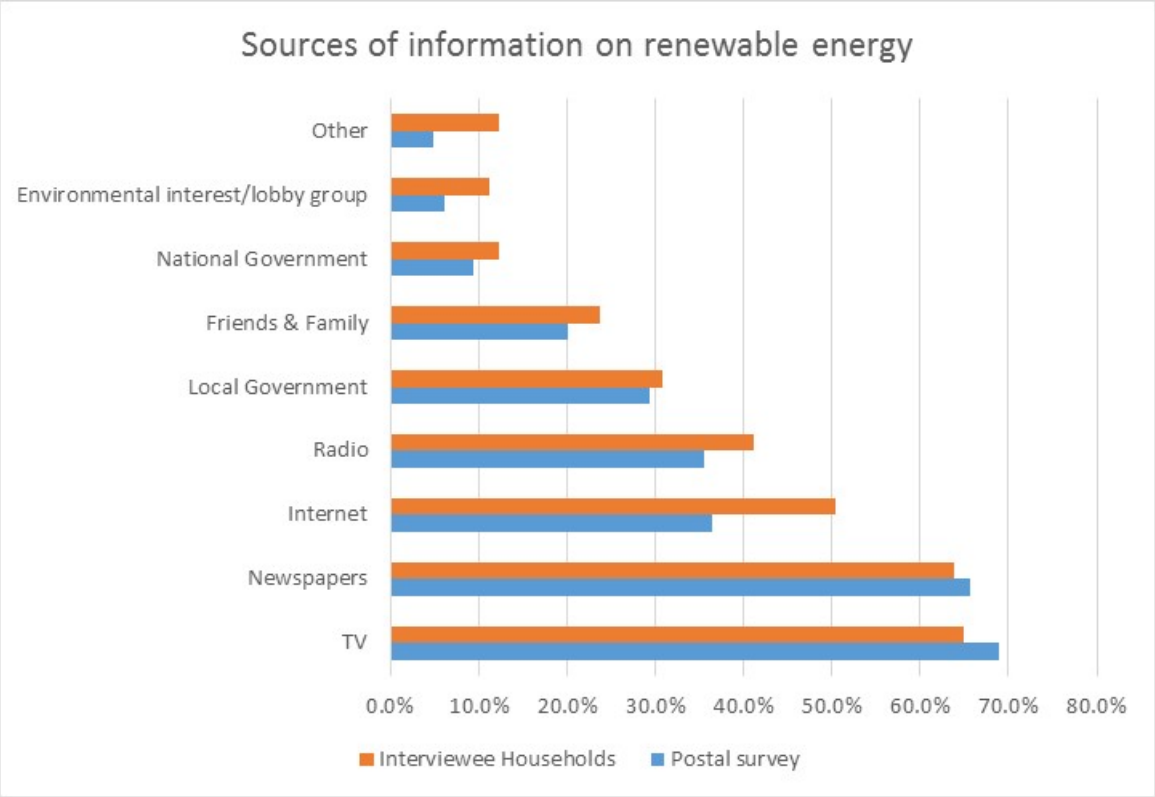
Only a handful of interviewees (16%) stated that they would consider taking up government energy efficiency initiatives in the future, and all stated that a key driver for doing so would be to save them money on household energy bills. The need for energy efficiency to be cost effective was also highlighted in the survey responses. For a small number of interviewees, group buying or bulk energy schemes were felt worthy of future consideration.

One of the main barriers to individual householders engaging with RE and government initiatives in this area was the cost of taking up initiatives. It was a repeated theme in the interviews and mirrored in the comments received on the survey returns. One survey respondent (ER3) commented, '*when you're on a low income you can't invest in anything (quite alienating)'* another (PD1) stated, '*due to low income I am unable to purchase many of the renewable energy resources available'.* This then poses a particular barrier for those trying to redress or level out the disadvantages that already exist for the rural poor and elderly and one which the policymakers need to consider carefully when designing future energy initiatives.

Overall, it would appear there was very little awareness, let alone understanding or knowledge, of current government initiatives amongst the interviewees. Therefore, this could be seen as an area where energy literacy levels amongst the interviewees was low, perhaps due to a lack of simple information on available initiatives. The open responses to the survey also suggested there is a need for more and better information relating to all areas of renewable energy. One respondent commented '*I have accessed free schemes when I have been aware of them'* implying that awareness raising is an important issue to be considered when encouraging take-up of such schemes.

This raised the question of where householders obtain their information on renewable energies per se, not just government initiatives. Details of where survey respondents source their information are shown in Figure 5.

Figure 5: Sources of information on renewable energy technology issues for interviewees and survey respondents



The sources of information quoted by the interviewees and survey respondents, although broadly similar, did show some differences. The dominant pathways for information recognised by both groups were the mainstream media of television, newspapers, the internet and radio. The interviewees made significantly more use of the internet (51%) compared to the overall survey response (37%). They also quoted the "other" category more frequently. In this instance the "other" category often reflected their professional competence or experience. There was a trend for the interviewees to use a wider range of information outside of television and newspapers.

Local Government was quoted as a more frequent source of information (circa 40% across postal and interviewees) than National Government (circa 11% across the two samples). This perhaps reflects the challenge for having the message source correctly identified in the mainstream media.

2) Views on different types of energy efficient homes

We were interested in the views, attitudes and opinions of interviewees towards houses with different energy ratings. This aspect of the research was not included in the survey therefore findings presented in this section come exclusively from the interview data. Interviewees were shown (or, in the case of the telephone interviews, described) four different energy rated properties. The first property (Figure 6) was an old limestone cottage with thick walls and an energy rating of EPC-E.

Figure 6: Limestone Cottage EPC-E

The second (Figure 7) was a house made of straw bales built in Lincolnshire by the local authority with a carbon rating of EPC - A.

Figure 7: Straw Bale house, Lincolnshire EPC-A

The third (Figure 8) was an ultralow carbon eco house, part of the Lammas project in Wales, built very close to a pond.

Figure 8: Eco-House, Lammas project – Ultra low carbon

The fourth (Figure 9) was a wood-clad carbon neutral EPC A/B rated house with large windows and both solar electricity and thermal heating panels on the roof.

Figure 9: Wood-clad, carbon-neutral, EPC-A/B

Many interviewees were aware that new types of energy efficient homes were being designed and built, if only experimental, from watching such programmes as Grand Designs.

In principle most interviewees, regardless of age, were open to the idea of living in a non-traditional energy efficient home. Many recognised particular energy features built into the house designs. The most popular choice amongst interviewees was the carbon neutral wood-clad house, followed by the ultralow carbon eco house. Third choice was the straw bale house with the limestone cottage favoured least.

Whilst the Limestone cottage was probably viewed overall as the most aesthetically appealing, and recognised as a house that had stood the test of time and would be cool in the summer, it was not necessarily a house interviewees would choose to live in. Only a handful of interviewees sited this as their preferred choice out of the four options. Many recognised the difficulties and expense of making such a house energy efficient on any level and especially of keeping it warm in the winter.

Aesthetically the straw bale house appealed to interviewees the least; although not everyone was averse to its appearance. In general interviewees did not particularly like its small windows or 'boxy' appearance; calling it '*bland'*, *unattractive*, '*institutional'* and reminiscent of a 1950s council house or at best '*functional'*. One interviewee (ER) wondered why local authority houses were not designed better commenting, '*don't local authority architects have any imagination or flare*?' Appearance aside, many were not against living in a house made of straw per se recognising its insulating properties and applauding the utilisation of a waste product. However, interviewees did raise a number of concerns, the main one being the potential fire risk. Many understood straw to be a volatile material. Its durability, unpredictability and difficulties of securing a mortgage on such a property were further issues. Many had heard about the house, some through the local authorities' magazine (Lincs), some had visited the village where it was located (Lincs) and others had seen it on the television, notably Grand Designs (27% across all case studies). Whilst some described it as '*excellent'*, '*brilliant'*, an '*amazing idea'* with one couple actually having considered buying or building such a house, many felt there was a lot that could go wrong with it.

Interviewees generally liked the concept of the eco house. Some found it attractive, although again others did not. One interviewee refereed to it as a house for '*trolls'* and many described it as a '*hobbits'* home. Other descriptors included '*ramshackled'* and '*quaint'*. One interviewee described it as '*possibly a step too far'* (Lincs). However, once again concerns outweighed the potential energy efficient benefits. Interviewees were concerned that the roof (which was covered in mud and grass) might slip or that it would encourage mice. The location of the eco house was also seen as problematic with many fearing it had a high risk of flooding because of its proximity to the pond. Another concern was obtaining planning permission to build such a house. Some commented that the Eco house would be out of place on a conventional housing estate and one interviewee felt it was '*more of a project than somewhere to actually live*', (Lincs). These concerns highlight the importance of finding appropriate locations and settings for such alternative homes. One of the main issues with the eco house was that some interviewees felt they were too old to live in such a radically different house; but many said they would have considered it when younger.

The carbon neutral wood-clad house was the most popular of the four options with many interviewees stating they would choose to live in this one over the other three. Several described it as '*fantastic'* or '*brilliant'*. Interviewees particularly liked its big windows which gave lots of natural light. However, PV were viewed by some as ugly and inefficient. There were concerns over how the wood cladding would perform long-term in the damp British climate and again the potential for fire risk was mentioned. Whilst overall it came out as the preferred option not everyone found it aesthetically pleasing with one interviewee calling it '*exceptionally ug*ly' and others describing it as '*square'* or '*boxy'*.

Overall, interviewees welcomed attempts to incorporate energy efficient technologies into new houses. It raised the question for many as to the role and responsibility of developers involved with new builds to incorporate such technology into homes where they can. The point about new builds, along with the issue of obtaining mortgages on non-conventional properties, highlights that it is not just public opinion and attitudes that need to change if society as a whole is to move forward with the energy efficiency agenda but also those of industry, commercial organisations, such as banks and developers, and those financing building projects, (i.e. property developers).

3) Energy literacy: knowledge and understanding of the wider energy debates

WP2 were interested to explore householders understanding and knowledge of current energy and climate change debates and some of the associated key terms, or what might described as their 'energy literacy' levels. We found that 'awareness' and 'understanding' and 'knowledge' do not necessarily go hand in hand. In some areas many of our participants – both survey respondents and interviewees – appeared to have a reasonable level of *awareness* concerning a particular aspect of renewable energy terminology and associated debates. However, on further investigation (follow-up questions or cross-referencing of survey responses) it became clear that their actual *knowledge* and *understanding* of the concepts was not at the same level.

In light of this we devised an 'Energy Literacy Matrix' (see Figure 10) to help identify where energy literacy mismatches lie. It is envisaged that policymakers, the scientific community, adult practitioners and other interested stakeholders might utilise the matrix to help close any gaps and in so doing facilitate better public engagement with the renewable energy agenda in the future. Here the matrix is used to indicate the energy literacy levels of interviewees by case study area but it can be adapted and applied to any group of people or even to individuals. In the latter instance the percentage could be calculated using a simple renewable energy questionnaire that tests an individual's awareness, knowledge and understanding levels. It also has the potential to be used both as a framework to measure the success of any future communication strategies (particularly those that are government-led) and as a learning assessment tool to help adult practitioners, and even learners themselves, measure the effectiveness of interventions aimed at improving energy literacy levels. This could be achieved by using the questionnaire tool before and after an intervention or awareness raising campaign.

The energy literacy matrix presented as Figure 10 has been completed (using italic text) with the findings from the interviews from this section of the report to illustrate how it might work; at least in the initial stages of assessing energy literacy.

Figure 10: Literacy matrix showing energy literacy levels for all interviewees across all three case study areas established during conversations

	Knowledge & Understanding →					
Awareness ↓		**Very low** (<10%)	**Low** (11-30%)	**Moderate** (31-55%)	**High** (56-84%)	**Very high** (85+%)
	Very low (<10%)	*-New fuel poverty definition* *-Hybrid cars* *-Hybrid household systems*				
	Low (11-30%)	-Green Deal -Cash Back				
	Moderate (31-55%)	*-Hybridity* *-Community AD* -AD / -FiTS		*-Energy security* *-AD systems* *- Biomass / fuels*		
	High (56-84%)	-wave or tidal	-Solar -Wind		*-Food v food*	
	Very high (85+%)	*-Fracking*	*-Old Fuel poverty definition*			*- Fuel poverty*

The underlined text in the literacy matrix (Figure 10) shows where awareness of concepts for the survey respondents lay. However, the literacy matrix is limited in this respect since the survey data alone demonstrates one-way responses to questions. Interview data - presented later - allows for a two-way response in which awareness of concepts can be cross-checked with a participant's knowledge and understanding through further questions and discussions. Therefore, we would suggest that survey data alone provides an overly simplistic view of energy literacy levels amongst the general population and is more suited to educational settings where issues can be more explored fully.

The remainder of this section looks first the survey data results for attitudes towards, and experiences of, climate change. It then goes on to present the findings of the interview data which explored the key energy debates specifically fuel poverty, food versus food, energy security and views on fracking.

a) Attitudes towards and experience of climate change

One of the key survey questions explored householder's attitudes towards and experience of climate change and the surrounding debates. The results for the full survey responses are presented in Figure 11.

Figure 11: Opinions and beliefs concerning climate change for survey respondents

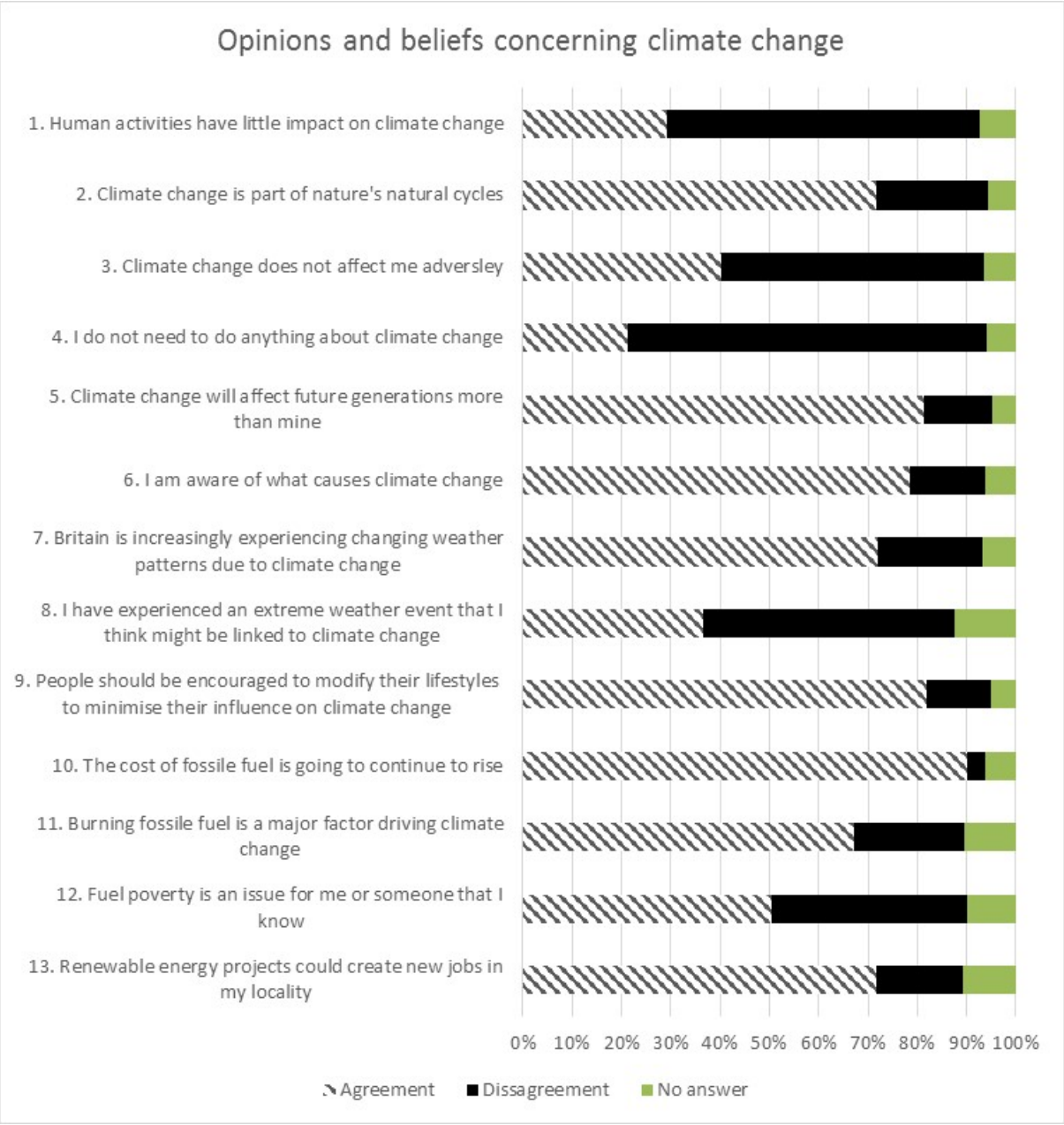
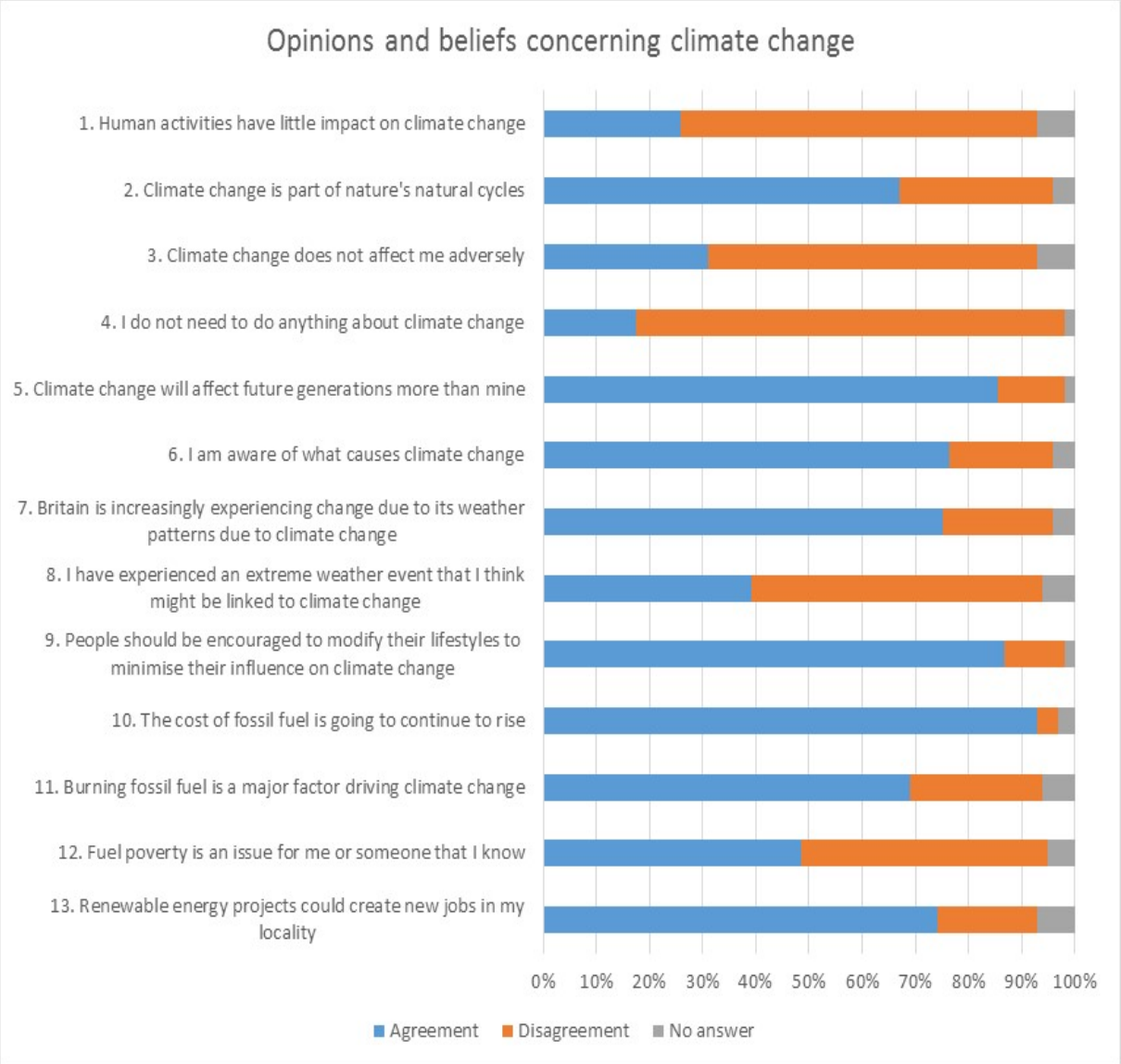


Figure 12 shows the opinions and beliefs concerning climate change for the interviewees using their survey data responses.

Figure 12: Opinions and beliefs concerning climate change amongst interviewees



Figures 11 and 12 show high totals across the shaded cells of the table which indicate a strong awareness of the overall issues around changing climate. The exception was the response to statement eight concerning the direct effects of climate change on personal experience where there was a measure of disagreement. This is also reflected in the level of 'no answers' indicated in the Figure 11. Overall, the segmentation of the response types appears to be relatively consistent for both the whole survey respondents (n=747) and the sub-set of household interviewees (n=97).

There appears to be an underlying perception that climate change is for the future and a disconnection with the need to take action now. Hence, there are large agreements amongst survey respondents with statements that put the impact further into the future or in the hands of others. For example in their responses to statements five ('Climate change will affect future generations more than mine') and nine ('People should be encouraged to modify their lifestyles to minimise their influence on climate change').

b) Attitudes towards, and habits of, recycling household waste

Survey respondents were asked about their recycling of household waste. Many were actively and regularly recycling a range of different household wastes with the most popular being paper, plastics and cardboard, glass and cans and garden waste. These items were recycled by over 90% of survey respondents. Ink cartridges (40.7%), food waste (56.1%) and batteries 64.4%) were the least likely waste items to be recycled. The full results for household waste recycling for survey respondents can be found in Table 19.

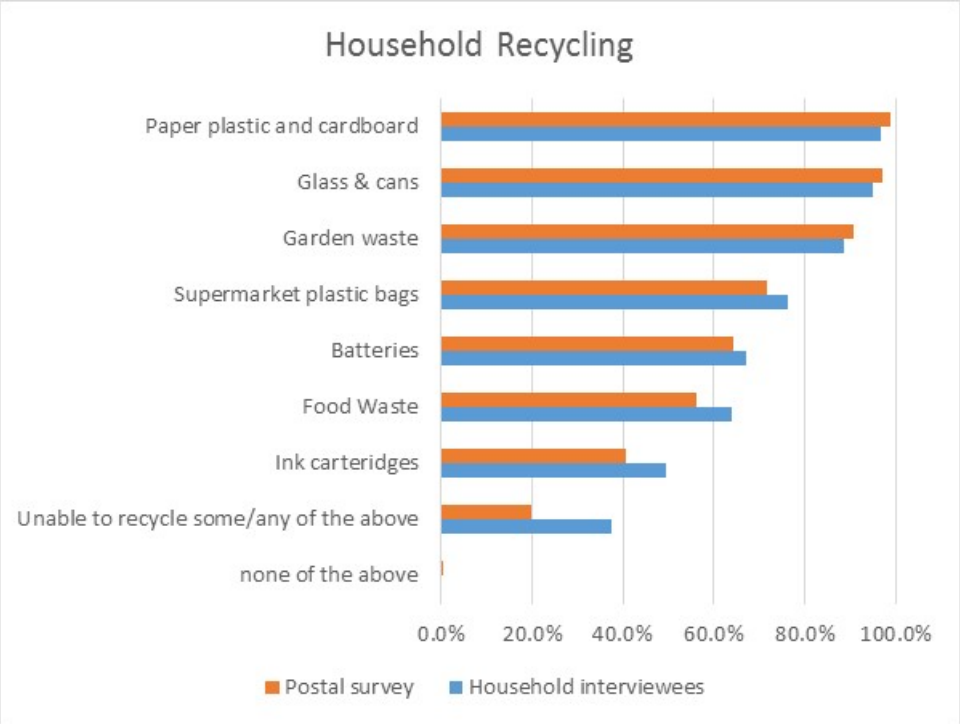
Table 19: Recycling of household waste by survey responses

Which of the following do you regularly recycle?	Lincs	DHP	ER	Average across the three sites
Food Waste	47.7%	82.9%	35.1%	56.1%
Paper plastic and cardboard	98.7%	98.0%	100.0%	98.8%
Glass & cans	98.7%	97.6%	94.2%	97.2%
Garden waste	89.0%	95.1%	88.5%	90.9%
Batteries	61.3%	69.5%	62.8%	64.4%
Ink cartridges	44.2%	43.1%	31.9%	40.7%
Supermarket plastic bags	70.3%	73.2%	72.8%	71.9%
Recycle in none of the categories	not available	0.4%	0.0%	0.2%
Unable to recycle some/any of the categories	not available	14.6%	26.7%	19.9%

As Table 19 shows, there was little difference between the three case study areas in terms of recycling habits. The exception being in DHP around food waste. The DHP local Council operates a kerbside food waste collection and this was reflected in the significantly higher proportion of DHP respondents reporting that they recycled their food waste. There was also a significant proportion of survey respondents in the other two case study areas reporting recycling food waste which is linked to the proportion stating they actively composted food waste alongside garden green waste.

Figure 13 compares household recycling habits of the full cohort of survey responses with the sub-group of household interviewees. Whilst the two groups exhibit broadly similar recycling patterns, interviewees were slightly more likely to recycle supermarket plastic bags, batteries, food waste and ink cartridges and slightly less likely to recycle the other waste items. However, with the exception of the 'unable to recycle some / any of the above, the difference is not statistically significant.

Figure 13: Comparing household recycling habits of interviewees with survey respondents



A number of Lincs respondents in the postal survey commented on why they did not, or were unable to, recycle certain categories of waste which led to specific questions on this topic being included in the subsequent DHP and ER surveys. Overall 19.9% of the survey respondents provided a justification. The most common response was that no recycling facilities were available or its location was unknown. Additionally, several replied that the household did not have a printer or "did not waste food". There was a significant increase in the proportion of interviewees that commented on elements that could not be recycled compared to survey respondents as a whole.

It could be argued that this, coupled with other features such as a greater use of the internet by the interviewees, demonstrates that a more independent learning style may exist amongst the interview sub-group. It could also be inferred that they had a different outlook on sustainability than the survey respondents as a whole and that combined these factors led to them volunteering to be interviewed. Further, the data might suggest that practical involvement (however mundane) in the recycling process where individuals take responsibility for their recycling, at least some of the waste they generate, is more motivational and rewarding than having renewable energy systems or projects foisted onto a community.

c) Fuel poverty

The study found a high level of energy literacy amongst interviewees regarding both awareness and an understanding of the general concept of fuel poverty. The vast majority of interviewees (93%) had heard the term fuel poverty and were able to articulate, at least in principle, what it meant. However, relatively

few (just 11%) knew the full official definition. Used by policymakers since 2001[14], it states that a household is fuel poor if it needs to spend more than 10% of its income on fuel to maintain a satisfactory heating regime, which is usually 21 degrees for the main living area, and 18 degrees for other occupied rooms. Whilst none of those interviewed initially identified themselves as being in fuel poverty, on reflection and clarification of the 10% of income definition, several concluded that they must 'officially' be living in a fuel poor household.

Despite a widespread awareness of fuel poverty amongst the interviewees and latest official figures showing some 2.28 million, (DECC, 2014: 5)[15], (or 10.4% of) households in England alone, and some 20.7% of all households across the three study areas, deemed to be fuel poor, very few interviewees (9%) stated they actually knew anyone in that position. However, many interviewees felt they probably did know people who were fuel poor but were not admitting to it. One interviewee commented '*it kind of gets hidden away'* (ER). Another interviewee who regularly helps with the local food bank in Lincs said he had not heard of anyone asking for help with fuel. However, by the time interviews were conducted in DHP and ER a small number of interviewees did mention they had heard of people visiting food banks asking for food that did not need to be cooked, surmising that this was an indication that fuel poverty was a real issue for some.

Interviewees speculated as to why people might be unwilling to admit to being in fuel poverty. It was felt that the elderly, in particularly, may be too proud to ask for help or that there is a perceived social stigma attached to fuel poverty.

Commonly, those most perceived to be affected were the elderly followed by people on low income, those claiming benefits and young families. Several interviewees mentioned the sick or long-term ill and some believed it to be a growing problem amongst middle-class families.

Several interviewees from across all three case studies talked about the social justice aspect of affording household fuel bills. They pointed out that the poorest, those in rented accommodation and/or on benefits, do not have access to the best energy tariffs through direct debit payment methods. Instead they are forced to pay a higher price for their energy and obliged to pay up-front using coin meters. They do not have the luxury in the winter of putting on the heating now and paying later.

Some interviewees felt that landlords should take more responsibility for making their properties energy efficient for their tenants; something the government is now encouraging[16]. However, at the same time, some interviewees felt there were a number of measures people could take to prevent fuel poverty and that affording heating was sometimes a matter of personal priorities or a life-style choice. Several interviewees commented that young people are wasteful with energy; especially when they do not have to pay the bill. Comments were also made that some people would rather spend their money in the pub, on alcohol, buying cigarettes, a large flat-screen TV or on subscription TV packages. Whilst a number of interviewees felt the cost of household energy could be shared more equitably, one even suggesting that it should be supplemented by the rich, no one felt that it should be free to anyone group of people in society.

[14] DETR, (2001) UK Fuel Poverty Strategy, *2001*. London: DETR.
[15] DECC (2014) Annual Fuel Poverty Statistics Report, Crown Copyright, London https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/319280/Fuel_Poverty_Report_Final.pdf
[16] https://www.gov.uk/getting-a-green-deal-information-for-householders-and-landlords

Interestingly, the latest government fuel poverty annual statistics report (DECC, 2014), whilst mentioning key contributing factors to household poverty as being household characteristics, composition, tenure and residents employment status, there is no mention of rurality. However, it does state those living in the East Midlands are the second most likely to be living in fuel poor homes, which provides validity for RHEES, as a project, choosing the East Midlands as its English rural case study region.

d) A new definition for fuel poverty

In July 2013, just prior to carrying out this research, the government published a new definition of fuel poverty[17]. Based on a Low Income High Costs (LIHC) framework, the new definition no longer works on a percentage of income but states that a household is fuel poor when "their income is below the poverty line (taking into account energy costs); and their energy costs are higher than is typical for their household type," (DECC, 2014; 11). The new definition also uses a 'fuel poverty gap' which is "...the difference between a household's modelled bill and what their bill would need to be for them to no longer be fuel poor" (DECC, 2014; 11). None of the interviewees, in any of the case study areas, were aware of the new definition. Almost everyone found it difficult to understand, complicated and unhelpful calling it '*vague'*, '*unclear'*, '*meaningless'*, '*rubbish'*, *shocking'*, '*gobbledegook'* '*a politicians definition'*, and '*typical government spiel'*. Therefore, there was a very low level of energy literacy, both in terms of awareness and understanding, amongst the interviewees of the new fuel poverty definition.

Using this new definition the government fuel poverty report (August 2013)[18] at the time of the interviews estimated that the number of households suffering from fuel poverty had decreased by 80,000 households (comparing figures from 2010 with 2011). The majority of our interviewees were surprised by this fall, particularly in light of the rising costs of household fuel. Some interviewees felt that the new definition had been used to '*manipulate'* or '*massage'* the figures favourably downwards; there was some scepticism amongst interviewees as to why the definition had been changed.

e) Fuel versus food debate

Two-thirds of interviewees (66%) had heard of the term 'fuel versus food' mostly in relation to the so called 'eat or heat' debt but also concerning the growing of crops for fuel.

To 'eat or heat' came to public attention in October 2013 when, in reaction to the proposed increases in household fuel prices by the Big six, (discussed earlier in Section C1d) Sir John Major warned that some families would be facing the choice of either eating or heating in the coming winter, especially if it turned out to be a harsh winter[19]. The lowest awareness of this debate occurred in Lincs with just 43% of interviewees aware of the issues. However, in DHP and ER awareness was much greater (both at 78%). Whilst a few interviewees felt it to be predominantly media hype and scaremongering others perceived it to be: '*fundamentally wrong'* (DHP) especially when considering Britain is one of the richest countries in the

[17] DECC (2013) Fuel poverty: a framework for future action, The Stationary Office, London https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/211180/FuelPovFramework.pdf).

[18] DECC, (August 2013) Fuel poverty report – updated, August 2013, Crown Copyright, London, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/226985/fuel_poverty_report_2013.pdf

[19] http://www.dailymail.co.uk/news/article-2471752/John-Major-Osborne-impose-emergency-tax-energy-firms-help-people-stay-warm-winter.html / http://www.bbc.co.uk/news/uk-politics-24621391

world; that people '*shouldn't have to make such decisions*' in today's Britain; and it is '*not a debate we should be having in a civilised society*' (Lincs). Other concerns mentioned around this issue included the selling of food in smaller packs by the supermarkets to make it more affordable, to reduce waste and the need to educate young people to cook since home cooked food is cheaper (and healthier) than pre-packed or takeaways.

The practice of growing bio-fuels instead of food crops on agricultural land is another aspect to this debate. It is one which has been in the public domain for some time. There was less awareness and understanding of the food versus fuel debate (44% of all interviews) in terms of bio-fuels than for the 'eat or heat' debate; probably due to the amount of recent media attention the latter had received around the time of the interviews. Many were strongly against this practice believing it takes too much land that is needed for food; *'it's not right when people are going hungry*' (DHP). It was also seen as '*ludicrously expensive'*, not a good use of resources with one interviewee feeling it to be '*…a rather silly way of generating fuel*' (ER). Others felt it to be away forward if it was economically viable, especially for the farmer and if it did not damage the environment. Some interviewees were '*morally conflicted'* finding this a difficult issue to grapple with.

Overall, the energy literacy awareness and knowledge and understanding in relation to the fuel versus food debates, particularly around using land for growing bio-fuels, could be described as high, particularly in Britain's biggest food producing county: Lincolnshire. However, it was considerably lower than for fuel poverty.

f) Energy Security

Energy security, relating to where we get our energy supplies from and how reliable our supply is, was a term that just over half of all interviewees (55%) had come across. Therefore, overall energy literacy awareness levels here can be classified as moderate; lower than for fuel poverty and eat or heat debates but higher than for the bio-fuels debate. However, there was a marked difference between the three case study areas. Around two-thirds of interviewees in the two English case study areas were aware of energy security as a term whilst for ER, in Scotland, it was much lower with less than one-third of interviewees being aware of energy security. We can only surmise why this might be. It could possibly be attributed to the fact that Scotland has its own natural energy supplies in terms of North Sea gas and oil reserves (some of which were close to the area of the case study The 500 council house estate at ER1 was built in the early 1970s for the workers constructing the Invergordon aluminium smelter and the infrastructure and rigs for the Fortes North Sea oil field, therefore energy in that region of the UK might be seen as more secure and reliable and less of an issue.

Once energy security was explained the majority of interviewees (56%), who expressed an opinion (for many said they did not know enough about it to comment), felt it was issue. One interviewee commented, *'it worries me a lot. We are rather dependent upon unsettled parts of the world for our oil, gas and coal.*' (ER). Interviewees main concern centred on the potential for energy supplies to be disrupted or cut off altogether. Linked to this was the issue of UK storage capacity and not being in control of our energy prices. One interviewee commented, '*I don't think we have energy sovereignty'* (Lincs).

Interviewees (especially those in DHP) were most concerned about our energy supplies coming from Russia with many stating that they did not trust the Russian President; '*yes, it's an issue, especially with 'old Putin'. All the power is with the gas suppliers'* (DHP). Several interviewees pointed out that this situation of energy

dependency is not new, giving the example that the UK has long since relied on oil from the Middle East, which has always been a volatile region. One interviewee cited the Suez Crisis back in the mid-1950s. One interviewee summed up the sentiments of many on this issue stating:

> *Our gas comes from the EU or Russia. When people do things that Putin doesn't like, he's already threatening to switch off the gas. I think he's a scary man. We get a lot of gas from the Middle East with Syria and Iraq. Governments of all colours go on their knees to the Saudi Arabians just because they have oil. We should be much more concerned about energy security.* (DHP).

Interviewees suggested that the situation might be more secure if the UK produced more of its own energy, preferably close to its site of consumption.

A small number, (9%) of interviewees *did not* feel energy security was an issue. The main reasons for this included the perception that the UK will always have coal to fall back on and that whilst companies may be in a different country (for example Russia) they are commercial enterprises and, as such, rely on customers for their revenue. Therefore stopping supplies would serve only to damage their profits.

Many observed that, as a country, we have increasingly moved away from our own energy sources, such as Coal and North Sea oil, towards a growing dependence upon energy imported and produced by others. Interviewees felt that this should be a key driver towards the development of renewable, local energy production and self-sufficiency.

g) Fracking

Whilst not a renewable energy but rather a potential new source of energy, interviewees were asked what they thought about, and knew about the process of, fracking. All but five (5%) interviewees had heard of Fracking; mostly because of extensive and continuing media coverage. However, few knew very much, if anything, about the process. Therefore, in relation to fracking, energy literacy awareness could be described as very high but their knowledge and understand as very low.

Nearly one-third (32%) of interviewees declined to comment on whether or not fracking was a good idea as they did not feel well enough informed of the debates surrounding fracking to form a valid opinion. Of those who did comment (47%) nearly two-thirds (63%) felt it was something that should be pursued albeit with a number of caveats attached before they would be completely comfortable with the process going ahead. Positive comments for fracking included: '*We have got to swallow it and hope they just make a tiny dent in the landscape*' (DHP); '*it's the next answer*' (ER); '*it fills a gap'* (Lincs); and '*it will have to come. If we want everything then we have to do it'* (Lincs). Several interviewees viewed it as a short-term solution but nevertheless one that would be worth investigating and '*an important bridge'* whilst alternative energy sources were explored and developed. On balance those in favour felt it was a source of energy worth pursuing, as long as it was done safely and with consideration to the environment.

Those against fracking raised many concerns (as did some of those in favour), predominantly about its environmental impact and that it is largely untested in the UK. Interviewees felt the case for fracking still needed to be proven with one interviewee commenting '*it's a bit of an unknown'* (DHP), another seeing it as '*a get out of jail free card'* (DHP). It was seen as potentially dangerous, for example it might pollute the water table or result in earthquakes, and that it could be costly. One interviewee called it '*scrapping the barrel'* (DHP). Interviewees were also concerned about local impact and even those in favour admitted they

might not be so keen if fracking was proposed locally: '*if they came to the bottom of my garden I might change my mind'* (DHP). NiMBYism (not in my back yard) was highly prominent in discussions around fracking. Some interviewees did not trust the companies' motives for being involved and did not believe it would necessarily lead to cheaper household fuel. Others felt fracking would allow the focus to remain on consumption levels rather than addressing the issue of reducing energy use.

Fracking was a contentious area for interviewees which at times evoked strong views. There appeared to be a lot of miss-information and sensationalism around the issue particularly from media sources and politicians, leaving most interviewees feeling it was all '*a bit confusing'* (DHP) and many stating that they did not know who or what to trust on the issue.

4) Moving forward: attitudes towards, and engagement with, local rural hybrid energy enterprise systems (RHEES)

Having established interviewees energy usage and attitudes, awareness, knowledge and understanding levels of the key energy debates, this section explores their views on how Britain's future energy needs might best be met; particularly in light of claims that fossil fuels are a limited and diminishing resource and the place, if any, of community energy within a future energy strategy. The section begins by examining the survey data relating to green technologies before exploring the issues in more detail drawing specifically on the interview data.

a) Survey respondents knowledge and experience of 'green' technologies

Survey respondents were asked to state which 'green' technologies they were aware of, which they currently owned and which they were likely to consider purchasing or engaging with in the future. The results are presented in Figure 14.

Figure 14: 'Green' technology awareness and ownership aspirations of survey respondents

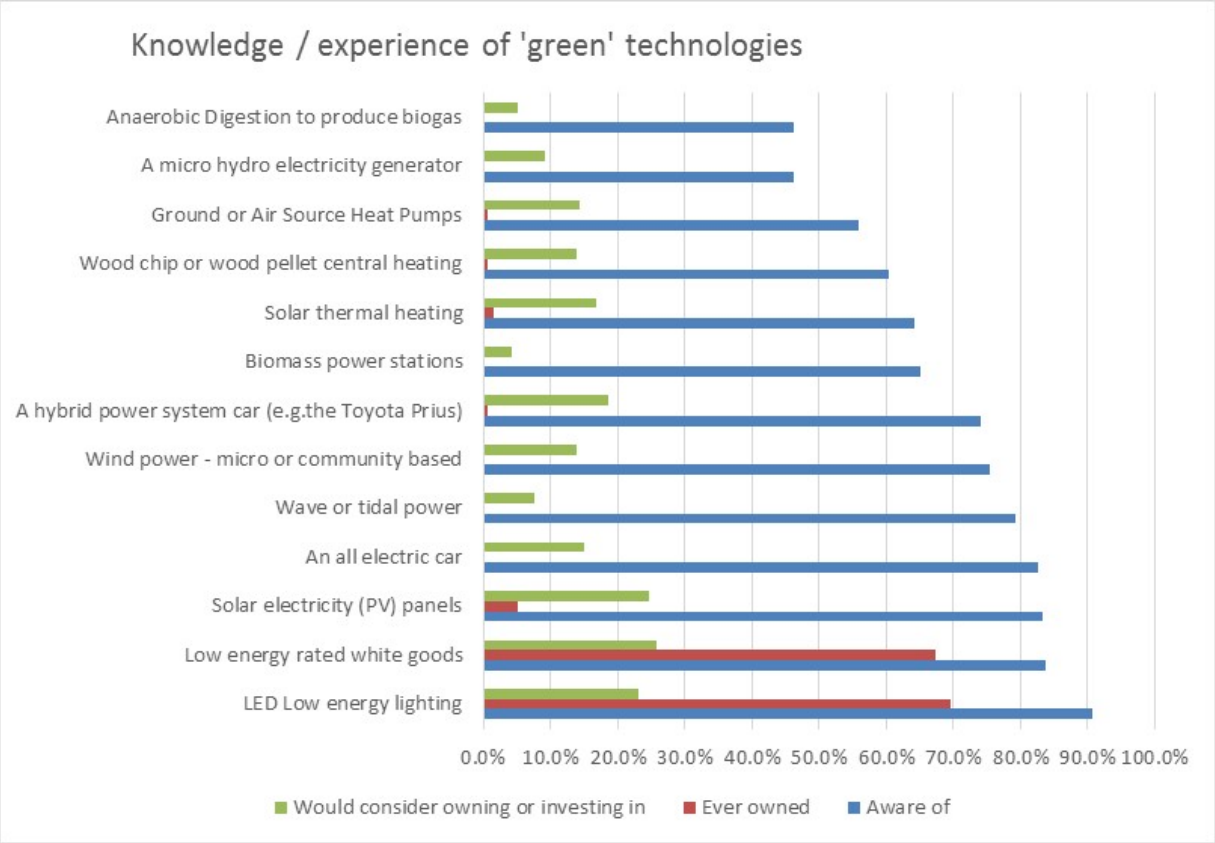
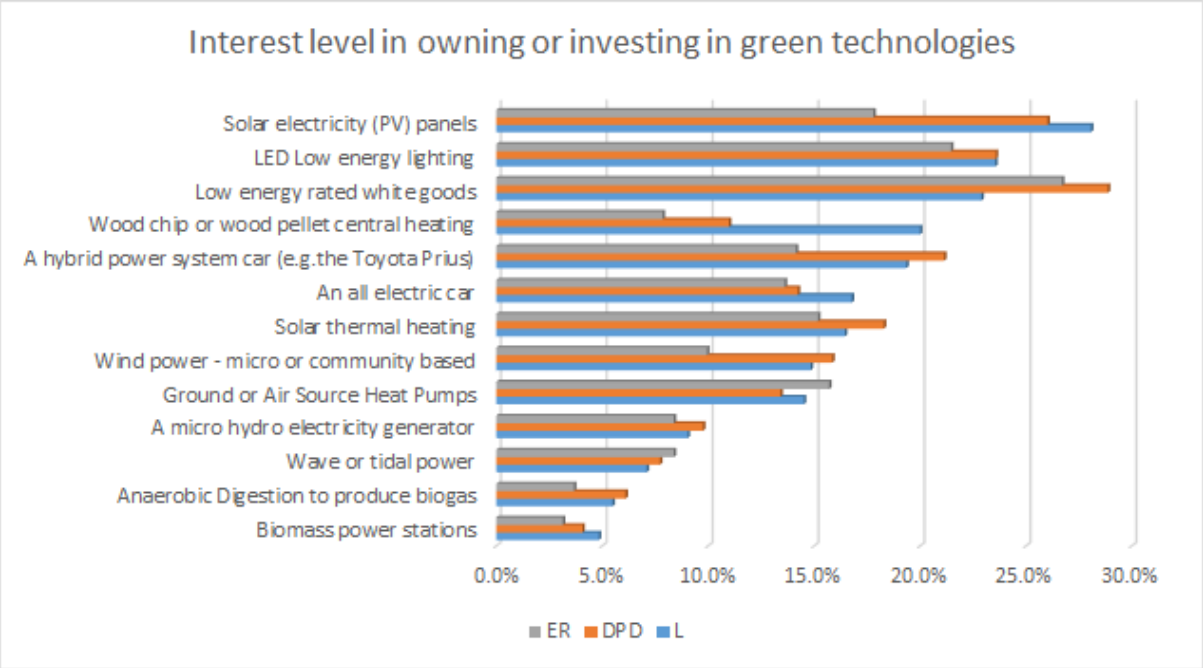


Figure 14 shows a clear graduation from awareness at a high level for domestic scale 'green' technologies such as LED Lighting and low energy rated white goods and a similar trend for well publicised technologies such as Solar PV and electric/hybrid vehicles that contrasts with AD which had the lowest, or near lowest scores, in all three questions.

Looking across the three case study sites (Figure 15) the data revealed that ER survey respondents had a much lower interest in installing wood chip or wood pellet central heating systems compared to the other two areas. This could possibly be linked to housing type and the background of the majority of the survey respondents. Many of the homes in ER visited for interviews would not have been able to accommodate any form of wood burning stove. There was also the issue of the large-scale translocation of an urban population from Glasgow into the area in the late 20th Century to support the oil boom. Therefore, it is plausible that these incomers would have been less likely to have an interest in the rural idyll of wood burners.

Figure 15: Survey respondents interest levels in owning or investing in green technologies



b) Fossil fuels and other energy sources

Not everyone interviewed was convinced that our coal reserves (seen by many as the primary fossil fuel) are in immediate danger of running out, nor that it cannot be extracted cleanly or economically. Several believed there to be 80-100 years of coal left to be mined. Some 18% of interviewees talked about the countries coal reserves and that, as long as the CO_2 could be safely extracted to produce clean coal, it might become economically viable to start mining again.

However, the majority of interviewees would like to see other sources of energy being developed such as tidal, wave, hydro, wind, solar, heat pumps and even nuclear. Many questioned why there is not more investment into developing tidal or wave power, given that the UK is an island and it was therefore seen as a constant and reliable source of energy; unlike wind or solar power, both of which were seen as problematic. One interviewee echoed the views of many when he commented, *'it seems barmy that we don't use tidal more'*, (Lincs).

Views on wind power were divided; interviewees were generally either strongly for or against. Some found wind farms and wind turbines ugly and noisy whilst others saw them as graceful and quiet. Those against felt they were still too expensive and unreliable and many did not understand the rationale behind subsidises, especially when no energy is being produced. According to a recent report published by the European Wind Energy Association (EWEA) wind is in fact the cheapest source of renewable energy once environmental and health facts are taken into consideration[20]. However, off-shore wind farms were seen as more acceptable. Issues over decommissioning were also raised.

[20] Wind power is cheapest energy, EU analysis , Monday 13 October 2014
http://www.theguardian.com/environment/2014/oct/13/wind-power-is-cheapest-energy-unpublished-eu-analysis-finds

Interestingly, at the time of the interviews, there were no wind farms or turbines of any sort in the DHP district. Conversely, they were not only prevalent in the Scottish ER case study area (probably a reflection of the Scottish governments' policy to generate 100% of its electricity from renewable sources by 2020[21]) but one of the two settlements used for the research had a local wind cooperative with others planned. Many of the locals interviewed had considered buying into the cooperative. The ER2 Wind Cooperative was funded by open subscription to investment that was made to the local community. All 179 investors have voting rights and in addition the cooperative has pledged to contribute annually to a local fund to support projects brought forward by local residents. The project has benefitted from the supportive governmental framework in Scotland and an appropriate skills mix and local profile amongst the board members.

Views on the wind turbines in ER were split, some commenting along the lines of this interviewee who stated '*Scotland is blighted by them'* (ER) whilst others felt '*they are not as unsightly as people make them out to be'* (ER). Wind drew the largest number of comments (31) from survey respondents than any other renewable energy technology. The overwhelming majority of comments were negative, with just one respondent pro-wind. The majority of comments came from ER, followed by Lincs with just a few from DHP – reflecting the prevalence of wind in each area. Survey respondents identified the same issues as interviewees namely; cost, efficiency, noise and appearance. The following survey comments are representative of those received on this issue: '*Wind farms are a waste of tax payers money'* (Lincs); '*Wind power is ineffective and no figures produced to show effectiveness and no 'cash' benefits seen to population*' (Lincs); and *'[I'm] strongly opposed to wind farms which industrialise Scottish rural landscapes'(ER).*

This quote sums up the view of many:

> *My wife and I abhor the proliferation of wind turbine farms. They are primarily inefficient and scar the landscape, short life span and will leave a residual blot on the landscape once they are de-commissioned, particularly when developers will no doubt run out of money! (as with the case of disused quarries and borrow pits). Furthermore they are a danger to wildlife e.g. eagles & bats.* (Lincs survey respondent)

Solar energy was viewed more favourably; but mentioned by fewer interviewees or survey respondents. Many were still not convinced of its effectiveness. The main issue here was aesthetics; how PVs looked on the roof. To resolve this issue several suggested PV should be placed in fields rather than on roofs.

c) Anaerobic Digestive Systems

The majority of interviewees (63%) had not previously come across the term Anaerobic Digestion (AD). However, over a third of all interviewees (37%) and nearly half of all survey respondents (46.2%) were aware of AD. The majority of interviewees that were aware of AD (86% or 32% of all interviewees) were able to articulate the concept or principles of AD, usually by relating it to composting or farming. Those interviewed in DHP had the highest level of understanding (52%), whilst those in ER the lowest (22%). However, only two interviewees knew it had the potential to be employed to generate community energy and was fully versed with the technology. Therefore, interviewees exhibited a moderate level of energy

[21] http://www.snp.org/sites/default/files/news/file/energy_priorities.pdf

literacy in relation to general AD awareness and understanding but a very low levels of energy literacy in relation to its community possibilities. Several stated that their information on AD had come predominantly from the media; most notably by listening to the Archers or watching Country File. After clarification and explanation of the AD concept, perceived issues with community AD included: start-up costs; ensuring sufficient, quality feedstock; finding a community space and a neutral site for the digester; reliability of the energy produced; and the age of the community. A particular concern here was whether or not an older rural community would be physically able to operate a digester.

Awareness of *bio-fuels* to generate energy was somewhat higher than it was for AD with 44% of all interviewees having heard the term and just over one-third (36%) having a good grasp of the technology. However, there was wide variance between the three case study sites with greatest awareness in ER (70%), least awareness in DHP (30%) and a moderate awareness in Lincs (40%). Energy literacy awareness and understanding of biomass could therefore be described, overall, as moderate.

Interviewees felt there were a number of issues with biofuel production, some of which were practical, others a matter of ethics or morals. The latter often mirrored concerns raised during the 'food versus food' debate pertaining to the growing of biofuels (Section 2c). Other concerns included: the bi-products and its effect on carbon emissions, specifically fumes and smoke; supply of combustible materials, i.e. the ability to grow wood fast enough to keep pace with demand and replace forests or the shipping in of wood from other countries such as Canada; the cost; the mess and being too old to operate and maintain such a plant. Interviewees in ER were most concerned about the use of forests to supply biomass units; perhaps not surprising given that wood is one of the regions natural resources. One interviewee in favour of bio-mass commented *'if you can make it work quick enough and balance energy with agricultural use of land then great'* (DHP). AD systems and bio-fuels are discussed in more detail in Section D of this report.

Although not a RE, nuclear power was raised by many interviewees as a potential future solution to the impending energy crisis. Nuclear power was also a contentious issue and one on which people admitted to be changing their minds. Many interviewees were no longer as set against nuclear as they had been in the past. Some were even willing that society should pursue it as a viable alternative to meeting future needs. Several cited the example of France and China in taking nuclear fuel forwards.

However, many talked about the energy situation and the need to cut carbon emissions as being a global rather than a local issue and one for which everyone needs to take some responsibility. China and India were often quoted as significantly adding to the problem in terms of increasing both their consumption levels and industrial pollution outputs.

Some pointed out that there should be less focus on producing energy and more effort made to reduce energy consumption by changing our modern lifestyles as the only way to resolve the impending energy crisis.

Overall, many, both interviewees and survey respondents, felt that, with the demise of fossil fuels, new sources of energy should be developed. However, with the exception of nuclear power, there was concern that, at present, none of the renewable alternatives are capable of meeting *all* our future energy needs on their own. Therefore, many interviewees recognised the need to develop a mixed, or hybrid, system of renewable energy generation.

d) Hybrid Energy Systems

Whilst many interviewees (42%) had some understanding and knowledge of, or could make an educated guess what, the *concept* of a hybrid energy system might entail (a mix of conventional and renewable energy sources to meet energy need), just 5% of interviewees had specifically come across the term in the context of a domestic setting. Hybridity was most commonly known to interviewees in relation to cars (20%). Therefore, it could be said that energy literacy awareness levels were moderate concerning the term 'hybrid', low in relation to cars and very low for household systems. For all three areas of hybridity understanding was very low.

In the majority of cases it was necessary to explain hybrid energy systems to the interviewee using a series of diagrams and examples (appendix C). However, interviewees soon grasped the basic concept and once explained nearly half of all interviewees (48%) felt such domestic systems would be a good idea and could help to meet future energy needs in society. It would appear that the terminology was the issue rather than the principle. The most reluctant were the very elderly who found it both a difficult concept to grasp and felt it was too late for them. Other issues raised included the cost of such systems and the need to develop better ways of storing the energy produced until such time as it is needed. Producing energy close to where it will be consumed was also considered important. However, some felt it would be better to design houses that are more energy efficient from the outset with one interviewee seeing renewables as more of a '*sticking plaster*' than a long-term solution.

e) *Attitudes towards individual and community hybrid energy systems*

One of the keys to implementing hybrid energy systems in the future may be the ability and willingness of individuals and communities to generate, or participate in the generation of, their own energy; moving from passive energy users to active energy producers. Interviewees were therefore asked if they had ever considered producing their own energy – either individually or with their neighbours – which technology they would be most likely to consider and the associated challenges and perceived benefits.

In principle interviewees were in favour of generating local renewable energy using hybrid systems, either individually or in conjunction with others. Over one-third (39%) stated they would consider generating their own energy with interviewees in DHP being most receptive to the idea (DHP 56%, Lincs 34% and ER 30%). Indeed, at the time of the study, 18% of interviewees were already producing some of their own household energy. In effect they already had a working hybrid energy system in place. Wood burners were the most popular (14%) choice followed by PV (11%); except in Lincs where just one interviewee had installed PV. Other possibilities included installing: a mini windmill; air source heat pumps; a generator; a mini incinerator; a Poly Tunnel; an anaerobic digestive system; and a biomass boiler. One couple had considered buying a plot of land and building a fully functioning eco house.

Overall, slightly more interviewees said they would consider participating in community energy generation (55%) than in individual energy production. In contrast to individual energy production, interviewees in DHP were least likely to be in favour of the community option (DHP 41%, Lincs 60% and ER 61%). However, there were very few examples of community-based energy initiatives operating in the immediate vicinity of the case study areas, and none which fitted with the governments' criteria as set out in its Community

Energy Strategy (CES)[22], (DECC, 2014). The strategy, which aims to encourage greater community engagement with, and take up of, renewables, uses the term 'community energy':

> …to mean community projects or initiatives focused on the four strands of reducing energy use, managing energy better, generating energy or purchasing energy. This include[s] communities of place and communities of interest. These projects or initiatives shared an emphasis on community ownership, leadership or control where the community benefits…. [With] the sharing of benefits and a focus on social outcomes, rather than only financial benefit for shareholders [particularly important] (DECC, 2014: 20).

The majority of projects proposed, or operating in or near the case study areas, focused more on shareholders than community benefits and several interviewees had considered the idea of investing some of their pension into renewable energy shares. There were initiatives that could loosely be defined as 'community projects' in Lincs, one in DHP and several – all relating to wind – in ER. The first example in Lincs was a group buying oil scheme operating in L3 as discussed in 1a above. The second, related to PV installed on the roof of a row of local authority retirement bungalows in the village; none of which were occupied by any of our interviewees. According to our interviewees living in L3 the latter had benefited the residents by providing them with some free electricity on a daily basis. In addition, several Lincs interviewees were aware of an energy cooperative in a nearby market town where residents each had a share in the local wind farm[23]. The DHP example was an 'Archimedes screw' installed in a neighbouring village on the local stream, and reportedly run by a small local cooperative. In ER there was a wind cooperative into which everyone in the local area had been invited to buy shares[24]. However, benefits were not directly to the community but to the shareholders. Several of the interviewees had considered the option but decided not to pursue it on this occasion. There were also reports of other cooperatives being proposed by local farmers and businessmen.

f) Potential benefits and challenges of individual and community energy production

The potential for cheap(er) energy costs was viewed as one of the main benefit of engaging with individual or community energy initiatives. Reducing carbon miles by producing energy near to its site of consumption was another. Some felt it could serve to *'bring people together'*. Several were keen that profits were ploughed back into the community; a key defining feature of community energy projects according to the governments CES. However, many felt that in practice individual and community generated energy was fraught with more challenges than benefits.

Barriers to individual production included: the initial cost versus benefits, especially when considering PV; storing energy in populated areas; the practicalities of operating systems; the interviewees' age, a consideration for both pay-back time and the ability to physically engage with such initiatives; living in a rented property; longevity of residence and the look and sound of renewables.

[22] DECC (2014) Community Energy Strategy: Full Report, Crown Copyright, London

[23] Market Deeping where Energy4All established one the first community investment opportunities resulting in two wind turbines being owned by households located with a 20 mile radius of the wind farm.

[24] http://dingwallwind.org.uk/

Whilst some of the individual challenges were also applicable to community initiatives (namely economic viability and energy storage) interviewees raised a number of other concerns which can be grouped into three main areas, community buy-in, project management and operational logistics.

Getting *community buy-in* to any proposed initiative was considered by interviewees to be a major stumbling block. Some noted the lack of community spirit in the area; others felt it would be difficult to get a consensus with one interviewee pointing out that everyone would have their own agendas. Then there was the issue of people either not wishing to take part or moving in and out of the area and how these factors would be managed.

Project *management* was another potential stumbling block. Interviewees asked who would be best placed to take on this role, with some suggesting the local or Parish Council could spearhead such community initiatives.

Overall, just 12% of interviewees knew of any renewable energy activists operating locally. The highest awareness occurred in ER where 35% of interviewees had either heard of the local wind farm cooperate or were aware of the local Transition Town Network that had, until recently, been very active in one of the two case study settlements (ER1). Transition Town Networks are groups of like-minded local individuals that come together under the Transition Town organisation umbrella[25]. Their key aim is to facilitate the transition of local economies from being highly dependent on fossil fuels to ones that have a lower fossil fuel dependency. They were originally established in response to climate change. Each Network is run independently and its activity are specifically tailored to the local context. In the past the once active Network in ER had advised local households (particularly those living in social housing on a very deprived estate) on energy efficiency; worked in partnership with other local Transition Networks on transport initiatives, ran information days and installed a ground source heating pump in the local community centre where they were based. Unfortunately, at the time of the study its numbers were somewhat depleted, its funding diminished and it was no longer active. Whilst very low (4 / 9%), awareness of local activists was second highest in Lincs which also had an active local Transition Town Network in the largest of the three case study settlements (L3). Such groups might be in a position to help drive forward future renewable energy community project but only if they have access to relevant funding streams and support mechanisms. There were no reports from interviewees in DHP of any community activists operating locally and neither could the research team find any such evidence.

The practicalities or *logistics* of operating community energy projects were seen as further barriers to success. This covered everything from the logistics of getting the energy from its place of production into local properties – private homes, business and even public buildings such as schools – to the collection and transportation of the raw materials. One interviewee cited an area near to the village of L3 which comprised of just a handful of houses, as a good example of where a community energy initiative might be successful because many of the logistic issues such as collecting the raw material and transporting the energy could potentially be easily overcome. However, several highlighted the fact that producing local renewable energy would be labour-intensive. Some interviewees were concerned about the effect of such initiatives, particularly wind farms and PV, on house prices.

[25] Link to the Transition Town Network main web page http://www.transitionnetwork.org/

g) Suggested ways forward

Interviewees came up with a number of suggestions to help address some of the barriers mentioned above.

- Many felt society needs to change its habit so that we can collectively reduce our consumption rates. Installing SMART meters that show exactly how much household energy is consumed were felt by some to be a good idea.

- More investment into renewables as a matter of urgency. Interviewees were particularly keen for wave and off-shore wind to be explored and development.

- More and better insulation for current housing stock.

- Some suggested that the solution lies in the European or even global arena believing this is not a problem we can resolve alone but everyone's responsibility.

- Joined-up policy making and thinking not only between different government departments but also government and industry. An example here would be a greater willingness of mortgage lenders to grant mortgages to non-conventional houses or for planning applications on such homes to be accepted.

- One interviewee suggested an Energy Tsar to promote renewable energy understanding and benefits.

- More reliable and trustworthy information on new renewable technologies including their potential, their positives and their drawbacks.

- Whilst interviewees recognised that it was not practical or cost effect to convert many existing properties, many suggested that all new builds should be legally obliged to incorporate some form of renewable hybrid energy system, for example, PV, into their designs. One interviewee commenting, *'better we get the house design to need less energy in the first place*' (DHP). One suggestion was that architects, developers and builders could be given a particular date from which to start the process; something which is now in place.

- One interviewee suggested that local rural communities could be nodes of a bigger network or that local authorities could take initiatives forward, at least in the early stages of project development.

- Finally, there was a feeling amongst many interviewees that we should learn both from the mistakes of the past and the successes of other countries, particularly Scandinavia for insulation and the Netherlands, Denmark and Germany for renewable energy initiatives. The former two are encouraging individual wind turbines and the latter supporters of solar energy.

In general, the majority of interviewees were aware of, and concerned about, how we, both as a nation and global citizens, will meet our future energy needs. Most, regardless of age, were concerned for the environment and were actively taking measures to reduce their energy usage where possible. There was a feeling that it should be a shared responsibility and that '*everyone should make an effort*'. But to do this it was recognised that there would need to be a change in public attitudes and potentially a change in

people's lifestyles. However, some interviewees felt that for many people this would only occur at the point the lights go out; when they get '*a reality check*' (L2).

There was also concern that renewable energy technology was not being incorporated into the designs of current new builds, not just new homes but all builds including businesses and public building. Interviewees were keen to know when this would happen. They also pointed out if energy efficient homes are to be built then mortgage lenders would need to be more open to approving mortgages on non-traditional builds than they are at present.

Using waste products to produce energy and reduce landfill was seen as a positive and using waste to produce energy seemed to be preferable to using agricultural land to grow bio-fuels. Not everyone was against wind farms per se and they appeared to be a more popular choice than PV. Interviewees were keen that other forms of energy, such as tidal and heat pumps were also invested in. There was some agreement that the way forward would be to use several different energy sources, both conventional (i.e. nuclear) and renewable (such as wind or solar); to have a hybrid system for all.

It is clear from both the interviews and the open survey responses that people want and need more and better quality, reliable information on the current energy situation and on the availability and development of renewable alternatives to be able to make informed energy choices.

Section D: Anaerobic Digestion scoping study

Introduction

During our investigations into RHEES in rural communities it became increasingly clear that community AD plants were, at that time, largely absent from the UK (community) renewable energy landscape. WP1 (looking at Resource and Demand Mapping) and WP3 (concerned with Business Enterprise Models) came to similar conclusions through their respective investigations. Whilst WP2 found that some householders were aware of the principle of AD technology, none of our interviewees had experience of living with AD in their particular community. We therefore decided to investigate the current AD and Biomass situation more closely to ascertain if this was in fact the case. To do this we looked at current UK government policy on AD and community energy; we scoped the general AD field; talked to several AD experts and organisations working in the area and identified two community AD case studies; one rural in the late stages of planning and one urban, which was newly operational. The latter case study was carried out in collaboration with WP3 who initially identified the project as of interest from a business enterprise model perspective. Information collected through interviews with stakeholders such as Community Energy Scotland during our main research study were also drawn on as further evidence of the UK AD situation. In addition, the biomass situation, which is slightly more active in the community context than AD, was considered.

Scoping the policy and technology situation

The process of AD is a tried and tested form of generating renewable energy. Small, community plants and individual sized units have been working well in many countries for some time, particularly in countries with favourable climatic conditions, such as India and China (Wellinger, 2005)[26]. One of the earliest recorded examples of an industrial scale AD plant (1859) was also in India whilst the earliest UK example was a sewage treatment plant in Exeter that supplied gas to fuel the cities street lighting (Monnet, 2003)[27]. The system was installed in 1895 partly as a way of reducing the odour from the gas. Today, such RE technology is frequently used in the poorer more rural remote areas of developing economies where communities are not connected to the national grid. Their main purpose in such situations is to provide clean fuel to households for cooking. In India such systems have been widely and successfully used for over 30 years (Raha et al., 2014[28]). Indeed, there have been various government initiatives aimed at encouraging and subsidising their operation. Although this has not been without its difficulties, issues have largely been around administrative processes, training and maintenance of the AD units, rather than the technology itself.

AD is also present, and growing fast, in developed economies such as Australia, America and Europe. It is most extensive in Germany who are generally considered to be leading the way in this area of renewable energy generation. According to the Centre for Climate and Energy Solutions, in 2010 there were some 6,800 AD plants operating in Germany, 551 in Austria (the European country with the second largest number of AD plants) but just 84 in the UK. Over the past four years there has been a rapid rise in the

[26] Wellinger, A. (2005). Anaerobic Digestion - An Overview - Biogas Production and Utilisation. International Energy Agency Bioenergy Task 37 Aadorf, Switzerland, Nova Energie GmbH.

[27] Monnet, F. (2003) An introduction to anaerobic digestion of organic wastes, Remade Scotland, http://www.biogasmax.co.uk/media/introanaerobicdigestion__073323000_1011_24042007.pdf

[28] Raha, D., Mahanta, P. and Clarke, M. L. (2014) The implementation of decentralised biogas plants in Assam, NE India: The impact and effectiveness of the National Biogas and Manure Management Programme, Energy Policy.

number of AD plants across Europe and the figure for Germany currently stands at 9,945[29]. However, the current rate of expansion in Germany is slowing as government support mechanisms are modified. This is likely to cause a significant domestic slowdown and potentially impact on some UK AD projects if their German technology suppliers cease trading. In light of this, Germany is currently increasing its efforts to export its AD technologies globally. In the UK however recent support mechanisms for electricity, heat and 'Gas to Grid' have been driving a rapid expansion. As at 31st December 2014 the Waste Resources Action Programmes (WRAP) database listed 147 operational AD sites (excluding those in the water based industry) in the UK[30]. Of these the majority (40%) are classified as being on-farm sites, followed by commercial (35%) and industrial (17%) sites. The remaining plants are either demonstration sites or part of an integrated waste system management. However, the 2014 Autumn Financial Statement has indicated a change in the status of AD investment packages, specifically the removal of the Enterprise Investment Scheme (EIS). The scheme has been providing support for small and medium enterprises (SMEs) which dominate the on-farm smaller scale AD projects. This combined with ongoing degression of the payment rates within government output subsidies (Renewable Heat Incentive (RHI) and Feed in Tariffs (FIT)) is likely to cause a noticeable slowing of new projects coming forward.

At the time of writing (early 2015), AD in the UK context was probably the least popular and most underutilised of all the renewable energy options. However, each month more AD plants were coming online. In January 2015 the Biogas website[31] showed a total of 313 AD plants operating in the UK. Of these, 146 were directly related to the water industry and used in the treatment of sewage sludge providing an energy contribution to the overall operation of the water treatment works. The remaining 167 were spread across the country and classified under one of three categories; agricultural (80), industrial (27) and community (60). In this context agricultural digesters are defined as those exclusively using slurries, manures, crops or crop residues produced on-farm. Industrial digesters are AD plants used to treat on-site waste, such as brewery effluent or food processing residues. Community digesters are AD plants predominantly using food waste, collected from multiple sources, for example, according to the Biogas website, one plant in Scotland uses segregated kerbside and commercial food waste, liquid slurries, fish waste, and three different types of animal by-products.

According to information on the Biogas website, the 60 community AD plants range in size from a capacity of 8kwe (Southampton University demonstration unit) to 6,000 kWh (Biffa, Cannock) with an input capacity of 183 tonnes per annum and 120,000 tonnes per annum respectfully. Our investigations showed that the majority of the UK community ADs are sited on farms, outside, rather than in, villages or market towns. They do not come cheap with capital expenditures commonly in seven figures for plants with energy outputs above 250kW.

Defining 'community AD'

The term 'community' is highly contested, the debate long-running and definitions numerous; at least 94 (Neal and Walters, 2008)[32]. Neither is defining 'community' in relation to RE straightforward since it is

[29] IEA Bioenergy Task 37 report, January 2014 http://www.iea-biogas.net/files/daten-redaktion/download/publications/country-reports/november2013/Countryreport2013.pdf

[30] http://www.wrap.org.uk/content/operational-ad-sites

[31] http://www.biogas-info.co.uk/ad-map.html

[32] Neal, S. and Walters, S. (2008) Rural Be/longing and Rural Social Organizations: Conviviality and Community-Making in the English Countryside, Sociology, Vol. 42 (2) pp.279-297

widely used by the sector, government departments and others, often without any clear explanation as to what it means or who it includes or excludes (See Walker and Devine-Wright 2008[33] for a fuller discussion). Whilst the Biogas website uses the term 'community' as one of its three AD categories, there are several other definitions of 'community' in play in terms of energy production more broadly and AD specifically. The research undertaken by WP2, and that of WP1 and WP3, have all found that many renewable energy projects are labelled as being 'community' in nature when in fact there is little, if any evidence, they have a community aspect. Walker (2008)[34] also concluded that, of the 500 projects he identified as being either completed or ongoing in 2004 with the word 'community' in their title or rationale, just a small number involved community ownership[35]. Hence, it is important to explore definitions of 'community' energy before going further.

The definition of 'community' (as well as industrial and agricultural) AD employed by Biogas above focuses solely on the type and source of feedstock used in a digester. It does not consider other aspects of 'community', from a sociological or even a social geography perspective, such as location or the type of individuals that make up a community; i.e. whether or not they are communities of *locality* or communities of *interest* (Walker 2008). Walker and Devine-Wright (2008: 498) developed these concepts further identifying two main dimensions of 'community' in terms of RE. The first is a *process* dimension and relates to '…who a project is developed and run *by*, who is involved and has influence'. The second, is an *outcome* dimension, relating to who the project is *for,* (see WP3s report for a fuller discussion on these concepts).

Other definitions may be more comprehensive and broader, but also more complex. For example, the Governments CES, (DECC 2014: 20), does not have one succinct definition of what energy communities should be but suggests, in their call for evidence, that community projects or initiatives should be focused on at least one of the following four strands: reducing energy use; managing energy better; generating energy; or purchasing energy. It also included communities of *place* as well as communities of *interest*. Further, projects should ideally have 'an emphasis on community ownership, leadership or control where the community benefits'. The CES call for evidence found that, not only did the majority of respondents to their call for evidence broadly agreed with this definition but that '…the sharing of benefits and a focus on social outcomes, rather than only financial benefits for shareholders', along with shared ownership were important to many.

Ownership, in this context, can take several different forms, such as formal co-operatives, social enterprises, community charities, development trusts and community interest companies (CiC), as well as projects without such formal structures. Our work (and that of WP3) has found that the majority of projects labelled 'community' RE are either social enterprises or CiCs.

Community Energy Scotland[36] have also had a long-standing debate over defining 'community', finding it easier to define 'community' in the rural Highlands and Islands where it is geographically more obvious where one community starts and another ends and where communities generally identifies their own

[33] Walker, G. & Devine-Wright, P. (2008) Community renewable energy: What should it mean? Energy Policy, (36) pp. 497-500

[34] Walker, G. (2008) What are the barriers and incentives for community-owned means of energy production and use?, Energy Policy, (36) pp. 4401-4405

[35] Walker (2008) noted that no precise figures were available.

[36] Community Energy Scotland website: http://www.communityenergyscotland.org.uk/what-we-do.asp

boundaries, often in conjunction with their locality. Therefore, they could be described as both communities of locality and communities of interest.

A new type of community of interest may be emerging where the production of renewable energy is seen as desirable because it also benefits a broader sustainability agenda. For example, the UK-wide Biomass to Bioenergy[37] project led by DECC and DEFRA. Here nature reserves are cooperating with the bioenergy sector to develop and market fuel from the biomass produced as a result of the management of nature reserves. The marketing will be, in part, driven by the proposition to the communities that are associated with the reserves (for example the five million RSPB membership) that using this fuel will benefit biodiversity within the sites that they feel ownership of through their existing membership or their community of interest.

To achieve this sort of strategic buy-in requires considerable work on the development of the proposal; something that is generally absent in many of the AD development processes this project was able to examine.

Our proposed definition

We suggest there are three key features to be considered when defining a renewable energy project or initiative – for example an AD or Biomass plant – as being 'community' in nature; locality, ownership and outcome benefits. The location of the project should be predefined and inclusive of households, business and public buildings. Ownership may be joint or otherwise, but should involve at least some members from the predefined locality. Finally, all those within the defined community should have the opportunity to benefit from project outputs, either directly or indirectly. For example, biogas from a digester may be used to heat a public building or the resulting digestate could potentially be used as fertiliser on public gardens or individual allotments. However, it is *not* necessary for the renewable energy to be produced at the locality; plants may be sited a short distance away, for example on farms. We would argue that the more of these three features a project exhibits, the greater its connection to the community. Whilst it may not be necessary for projects to have all three features to be considered a 'community' renewable energy project; we would suggest that they should exhibit, to some degree, at least two of the three features.

Whilst potential projects are frequently described as being 'community' in nature many offer little or no evidence that this is in fact the case. They do not set out in any concrete or clear way what they anticipate the direct community benefits will be or how the community might be involved, beyond initial consultation with local residents of the proposed AD plant. We also found (as did WPs 1 and 3) that most projects labelled as community AD are in fact, based, not within the community but outside. However, the site is usually on farm a short distance from populated areas; which is in keeping with the data presented earlier in this section. Potential reasons for this are discussed in the next section.

Local United, an organisation that supports community activists to set up social enterprises to address the challenges of peak oil and climate change, published a report (no date) on AD and energy farms which specifically considered how to develop a community-led agricultural AD. The publication has a section entitled 'Why should communities look at AD?' The section suggests there are a number of community benefits to AD. It is relatively profitable compared to other renewable energies such as wind. It takes less

[37] https://decc.blog.gov.uk/2014/05/16/wetland-biomass-to-bioenergy-enters-its-final-phase/

time to get projects up and running. AD projects generate large amounts of local employment both at the construction and operational stages, estimating a 1000kW AD plant will create up to seven jobs and sustain approximately 19 directly. Finally, AD has the potential to produce heat as well as electricity and thereby impact on a communities carbon emission levels. However, it does not mention shared ownership or community buy-in. It appears to be a model where the AD plant will be done '*unto'* the community in close proximity to the farm rather than one where the AD plant is established *with* the community.

We suggest that often the term 'community' is used as a way of attracting funding, to appeal to planners or to tap into community funding streams, rather than to describe projects that directly involve and benefit the community.

What we found on the ground

Whilst the CES (2014) call for evidence found over 5,000 active community energy groups operating in the UK there is very little reference to AD plants at this level. Indeed, in the entire 108 page document AD is mentioned just twice in one paragraph (page 70, para. 240) where the strategy talks about on-farm AD units in relation to the community.

The lack of AD at community level was confirmed during interviews and literature searches. According to Community Energy Scotland there are no community level AD plants, operating or proposed, in Scotland. Nor did we find any evidence of community AD in Northern Ireland. However, in July 2014 funding was awarded (by the Green Investment Bank and the Foresight Group) to support the development of two on-farm AD plants in Northern Ireland. Similarly, no community AD was found in Wales. The first AD plant in Wales of any size went live in April 2014[38]. However, one Welsh village, Llangattock[39] does have plans to establish a community scale AD facility in the near future. The village aims to be carbon neutral by 2015 and was crowned the greenest village in Wales in 2009 and won the British Gas Green Streets award for the UK in 2011[40] and with it £100,000 to spend on local environmental projects of their choice. It has already led a number of RE and energy saving initiatives in homes and community buildings, including installing photovoltaic (PV) and radiator panels at the local school and an air source heat pump in the village hall. The fact that this village, which is highly dedicated to carbon reduction and to using renewable energy, is only just beginning to contemplate an AD plant illustrates the current difficulties facing community AD as a viable and attractive alternative community energy option.

The situation in England is slightly more active, however finding a fully operational community AD plant, rural or otherwise, still proved challenging. In total four rural community AD projects came to our attention in England; one of which was also used as a case study by WP3. However, there were reports of several other proposals, such as the one in Silloth, Cumbria supported by CoRE[41]; all of which were in the early conception or planning stages.

[38] http://www.businessgreen.com/bg/news/2339850/wales-cuts-ribbon-on-first-food-waste-anaerobic-digestion-plant.
[39] Llangattock village website http://www.llangattockgreenvalleys.org/about-lgv/
[40] PAVO funding news, (5th July 2011) Llangattock wins British Green Streets Title, http://pavofundingnews.blogspot.co.uk/2011/07/llangattock-wins-british-green-streets.html
[41] Community Renewable Energy http://groups.energyshare.com/community-renewable-energy/

In addition, through the Community Composting Network(CCN)[42] we found reference to a proposed micro-AD plant in 2011, (note: the project is not badged as 'community AD' but micro-AD), funded through the Big Lottery Food Fund and supported by WRAP and the REalliance partnership. There are two documents[43] publically available on the CCN website relating to the project. The first is a review of small scale, community biogas in the industrialized world, by Gell (no date)[44], which points out that such systems are uncommon in developed economies because '…it is considered uneconomical for energy or fertilizer production, and the landfill and sewage infrastructure and associated regulations…', (abstract - pg1). Despite this, the steering group were encouraged by the successes of millions of small-scale AD in less developed economies to explore its viability here in the UK. The second document, produced by LeAF (the Lettinga Associates Foundation in the Netherlands) (Schuman, E, 2010)[45], details the outcome of the projects second phase; predominantly the conceptual design of the proposed micro AD plant. However, whilst the LeAF report and project website both suggest there would be a third phase, constructing and testing the proposed micro-AD unit, it would appear that the project has not reached this stage as no further information or reports are publically available.

The four rural English AD projects that did come to our attention were all at various stages of development, but none were operational at the time of the study. One had been operational when visited by WP3 some months earlier but had subsequently ceased production. Three of the projects were based in Cumbria and one in Leicestershire. All four were joint ventures with at least one local business. This partnership was reflected in the community projects organisational structures and ownership status. Therefore, the three projects in Cumbria had been set up as social enterprises of one type or another and the one in Leicestershire as a CiC. At least one of the proposed AD plants was located in a deprived rural area. Three were benefiting from WRAP funding; however, funding AD was often reported to be complex with community organisations frequently using a number of different funders, often for different stages of the project.

Although all four AD proposals were described as 'community' projects, there were no plans to site any of the plants within a residential community. Rather they are all to be located on nearby farms or rural businesses. In the case of the proposed AD plant in Leicestershire they were hoping to site it at a local joinery business that already runs a biomass plant but is interested in using new technologies to generate energy. Siting the AD plant in the village was not felt to be feasible as there was no suitable piece of (neutral) land available on which to place it. Even if available, buying land in the village would render the project unaffordable. Other issues would be gaining planning permission to operate an AD plant and getting connected to the main grid. By finding a site outside of the village and working with a local business all the above issues were resolved. Similar issues had arisen in Cumbria leading to proposals to site AD plants on farms where there was space, expertise, a ready supply of feedstock, a willingness of the farmer to participate in the initiative and ultimately a use for the resulting digestate in terms of either free fertiliser or a product that will be sold to generate a small amount of income.

[42] http://www.communitycompost.org/index.php/about-us

[43] Note, both reports are written by Dutch authors seemingly under the guidance of LeAF, (http://www.leaf-wageningen.nl/en/leaf/About-LeAF.htm) which is a sub-department of the Environmental Technology of Wageningen UR, in the Netherlands.

[44] Gell, K., (n.d.) Review of Small Scale, Community Biogas in the Industrialized World

[45] Schuman, E. (2010) Development of decentralised anaerobic digestion systems for application in the UK: Phase 2, Lettinga Associates Foundation

It is proposed that the three Cumbrian plants will run on dung or wet mix and the Leicestershire plant on a mix of supermarket waste and farm manure. In addition, around ten percent of the feed will be supplied from a local abattoir. Cumbria was viewed by those we interviewed as a highly desirable county in which to site AD plants due to its large dairy herds which have the potential to supply a consistent feedstock for AD plants. None of the three plants will use household food waste. Those connected to the projects felt using food waste was not a viable option. They saw it as fraught with numerous difficulties both legal and logistically. Legally in terms of the complex rules around the disposal of household food waste. Logistically there were concerns around collection: reliability, volume, ensuring the mix was correct and cost.

A rural AD case study

The Leicestershire AD CiC is a not for profit organisation running local energy projects that benefit the community. It is run by a small group of six individuals living in the village that believe in the decentralising of power generation and in producing their own energy. Through their professional lives together the group have the necessary skills, knowledge and experience needed to push forward such an ambitious community energy agenda. Two of the most active members believe that if they are asking others to engage in local energy generation through their work then they should lead by example. They have implemented a number of energy saving initiatives in the community including issuing energy efficiency meters to households and acquiring funding to install PV panels on three village community buildings. The PV panels were subsequently gifted to the organisations so they can benefit directly and indefinitely from the energy generated. The proposal for the AD plant had completed the scoping, community consultation and viability stages. A suitable AD plant and local site outside the village had also been identified. At the time of the research they were awaiting confirmation of the site before moving to the next stage of development.

In terms of wider community engagement, local residents had been consulted on a range of energy projects, including the proposed AD plant. Resident consultations were said to be common place in the village for all sorts of issues and one of the challenges identified by the project leader was keeping people engaged due to the numerous other consultations. The core group also place a monthly article in the Parish magazine detailing their progress and regularly attend Parish Council meetings. They plan to hold a public consultation when the project moves to the next stage. In general the feedback from the community was reported to be positive with most supporting the idea. One of its attractions is that it will provide a sustainable funding stream for the community.

However, some concerns had been raised by residents, including the potential smell from an AD plant and an increase in heavy lorry traffic through the village. Such concerns are common. An article in the South Wales Evening Post (February 2013)[46] highlights these as the two main objections by one Town Council on behalf of its residents to a proposed AD plant site 2kms outside of the village of Gwyneth. They also raised concerns that bacteria could be blown into the village from the proposed hillside location.

Whilst AD plants are struggling to come into operation in a community setting, biomass is proving to be more popular, especially in Scotland and elsewhere following the introduction of the RHI. According to their website Community Energy Scotland have, to date, assisted with some 16 community biomass projects.

[46] South Wales Evening Post (February 21st 2013) Health fears over anaerobic digestion plant at Maesgwyn site in Glynneath, http://www.southwales-eveningpost.co.uk/Health-fears-anaerobic-digestion-plant-Maesgwyn/story-18208269-detail/story.html

More recently the introduction of the Rural Community Energy Fund[47] in England has stimulated additional interest in biomass as a community renewable energy resource. There are currently 38 communities carrying out feasibility studies into a range of biomass energy projects. Their models include Trusts, CiC's and other existing community structures. Biomass is under consideration in many of the studies and may either be used to heat existing community facilities, new buildings or groups of dwellings. There is already, however, an emerging conclusion that the cost of refitting may inhibit some aspirations especially involving rural district heating projects.

Nevertheless, the biomass industry is responding to these opportunities by offering Energy Supply Agreements through ESCo (Energy Supply Company) arrangements whereby they own and service the capital equipment, supplying the fuel in a just in time relationship and harvest the RHI payments whilst the client benefits from fuel that is cheaper per kWh than oil, bulk propane gas or electricity (but not grid supplied natural gas).

An urban AD case study: the Calthorpe project

One AD project that was operational at the time of the research and could, under the proposed definition outlined above, be described as 'community' in nature was found not in a rural context but very much in an urban setting. Located a short walk from Kings Cross Station in the Borough of Camden, the Calthorpe project[48] has been operating for the past 30 years. It began as a food growing project based in the local community. Local residents can rent a raised bed on which to grow flowers and vegetables. Over the years it has developed and evolved and now offers a range of activities for children and adults from all sectors of the community including, horticultural training for adults and those with learning difficulties, volunteering opportunities, daily early years drop in sessions, sports development and a recreational area for use by the surrounding community. They also grow a small amount of salad crops which are occasionally sold to nearby cafes and restaurants. The project site is flanked by terraced Georgian houses (and converted flats) on one side (Figure 16). Across the road is a Further Education College and numerous businesses are situated nearby. It sits in the heart of a community and works with those in the community, including local schools and businesses.

[47] http://www.wrap.org.uk/content/rural-community-energy-fund
[48] http://www.calthorpeproject.org.uk/

Figure 16: Georgian houses overlooking the Calthorpe project

The project is one of WP3's social enterprise case studies and full details of the project and their AD system can be found in their report. However, it is worth stating here, if only briefly, some of its key features in order that the reader of this report understands the nature of the AD unit in question. Unlike many of the AD projects or proposals mentioned above, the Calthorpe AD plant is situated on-site. The 1 cubic meter custom built, low cost, low technology – no moving parts - AD plant was located in an old greenhouse (Figure 17).

Figure 17: Calthorpe AD unit situated in the old green house

It was designed and modified to suit the projects particular requirements. The AD plant looked similar to a large wooden packing case. It loaded the feedstock, a mix of food and greenhouse waste, from the top (Figure 18).

Figure 18: Calthorpe AD unit – top loader

The project manager estimated it took approximately two to three hours twice a week to run and that the AD plant needed to be fed 'a few' caddies (small bins in which appropriate food waste is placed ready for the digester) three times a week to keep it running. This was not considered to be a particularly onerous

task, nor a time consuming one. However, whilst some of the feedstock came from their own kitchen and garden waste, it also involved the collection of food waste from local businesses.

When ready, the liquid digestate produced by the AD plant will be extracted via a pipe attached to the top loader feeder point and the digestate drained into a large plastic container. At the time of the case study visit the AD plant had been in operation for a few months and was almost ready for the first batch of digestate to be extracted (note in India the digesate is ready after about 10 days). The resulting digestate will be used by community members on their raised beds and to boost their greenhouse salad crops.

The plant had a fully computerised monitoring system attached that relayed data to Leeds University, who were tracking its performance. It had four, 250w PV panels on the roof of the greenhouse, powered by four batteries, to help heat the unit for maximum digestate and gas yield. The gas produced will, in due course, be used to heat the adjacent volunteer space and to boil a kettle. They also have plans to build a new greenhouse and pipe the gas, via Polly Tunnels, to the new structure to increase yield and extend their salad growing season. The resulting produce will then be sold to local restaurants and cafes, on what they hope will be a more regularly basis. This will provide a small but steady and welcome income stream for the project that they do not currently have.

WP2 was interested in the project from a community engagement perspective, particularly given its close proximity to local residents and businesses. Although not legally obliged to do so (since it was a change in building use rather than a new structure), the project leafleted local residents (some of whom lived less than ten feet away from the boundary of the premises) and businesses to inform them of their intentions to install a small AD plant. They had just two enquiries about the proposal, both from residents already involved with the project. One was described as a regular visitor to the project. The other, a retired lady who rents a raised bed and has been a long-standing supporter of the project since it began. The first resident phoned for more information. The second resident enquired, when she next visited the project to tend her beds, if there would be an issue with odour. Both residents were satisfied that the AD plant would not be problematic.

The second resident (who was interviewed by a member of the research team) felt the AD plant was a 'splendid' idea seeing it as a great way to recycle waste. She had not come across this renewable technology previously. Despite living in close proximity to the AD plant, and being able to see it from her back window, she had no concerns about its operation. When asked how she felt about it now that it was up and running, she commented, '*it's absolutely fine'*, '*it's right outside my bedroom window. It just sits there'*. She felt the plant would offer '*huge'* benefits to the community, the project and to herself when fully operational commenting, '*it will be fantastic for composting veg and hopefully put paid to all the slugs and snails that we get*.'

As well as residents, local businesses were also engaging with the projects AD plant, mainly by providing the food waste with which to feed the digester. Food waste was collected, or sometimes brought into the project, from two or three local food businesses, one of which was a community café located in the nearby church. The café has a long-standing relationship with the project. Staff from the project frequent the café and the café, which aims to use organic and locally sources produce where possible, has, in the past, brought salad and vegetables from the projects garden. From the AD planning stages the café manager and the Calthorpe project manager discussed the possibility of the café regularly supplying food waste. The café was keen to be involved for a number of reasons. From an ideological perspective the café manager liked what the project was trying to do. It also fitted with their sustainability ethos and their desire not to '*leave*

too bad a footprint on this planet'. In practical terms supplying food waste to the project (some five caddies a week) had significantly reduced the amount of daily waste the cafe sends to landfill. Other benefits were reported to be the '*feel good*' factor of not sending the waste to landfill and potentially a more regular supply of produce available for the café to buy that is locally and organically grown.

However, the food waste arrangement between the café and the project was not without its difficulties, something that was acknowledged by both parties. The project collects the caddies twice a week free of charge. It was agreed that this would be for an initial trial period of three months. Unfortunately, due to funding issues, the project was considering charging their food waste suppliers for the collection service. The café manager, which has his own funding constraints, not least his commitment to not only buying organic produce but to paying all staff the London Minimum Wage, were not in a position to pay such a fee. Further, the café does not receive any reduction to their Borough waste collection bill despite having less waste collected. A potential solution was being considered in the form of payment in kind. The café manager was willing to feed the food waste collector when collecting the caddies and the project would have free access to meeting rooms at the church. This is an innovative proposal which, if workable, has the potential to benefit both parties.

The project manager hoped that the AD plant would benefit the project and the local community in a number of different ways over and above the boosting of the salad crops. Community composting was the most obvious potential benefit. They hope to waste less and save money. They also saw it as a vehicle they could use to educate the local community about renewable energy issues and gain a greater understanding of AD processes. They planned to compile a training manual and offer the community training courses on running AD units. They were looking to incorporate such working into their wider education programmes and to encourage other organisations to consider similar approaches to renewable energy generation. Already a local housing association they work with were considering the possibilities of installing an AD plant that would benefit their tenants.

AD summary comments

At the time of this research there were very few fully operational community AD units in the UK, rural or otherwise.

It is crucial to consider the wider, national context in which community AD plants are employed. The evidence shows, not least by their popularity and prevalence, that they work most effectively under the following conditions. First, in countries that have a consistently warm climate i.e. parts of India and China. Secondly, where there is a need within the (rural) community to generate clean, reliable energy locally; i.e. they are not connected to the national grid system or the national grid is unreliable or costly for poor rural communities. Third, and finally, there needs to be a guaranteed local feedstock supply, i.e. a village, community or individual household must own (or have access to) a certain number of livestock (usually cattle), or other waste product, to produce sufficient levels of waste to feed the digester. The above three factors go some way to explain why AD is less popular and more problematic in the UK.

The performance level and reliability of AD, in general, have been examined by the Green Investment Bank. In a recent report on the performance of AD plants in the UK[49] they noted that outputs from UK plants were variable and driven by technical performance, operator skills and quantities and consistency of

[49] http://www.greeninvestmentbank.com/media/5188/ad-market-report-june-2013.pdf

feedstock supply. The report also noted that the best AD units were performing at around 80% capacity compared to an industry average of 50% signalling that when conditions are right AD has the potential to work well, and possibly exceed expectation.

There appears to be a number of issues around AD at this time which still need to be resolved before it can be considered a viable community renewable energy in the UK context. One of the key difficulties, as discussed above, is defining AD projects as being 'community' in nature. Greater clarity and some common agreement is needed than currently exists. Other issues include, scale, and the fact that they are expensive and time consuming to set-up at a community level. The evidence thus far indicates that it is a rather lengthy process and one that is not guaranteed to be successful.

One of the key issues is community acceptance of renewable energy and specifically AD. According to Wustenhagen, et al., (2007)[50] there are three dimensions to the social acceptance of renewable energy innovations; the socio-political, the market and community acceptance. The latter largely revolves around NIMBYism, and stems from the fact that the visual impact of new energy technologies, particularly in the case of wind but increasingly for AD, is greater than for established forms of energy generation. This attitude was clearly visible in our wider study amongst some of the interviewees and survey respondents. Wustenhagen, et al., give the example of coal mines that were below ground and mostly invisible to the end user whereas wind turbines are highly visible to all. Visual impact was cited as the main objection to one AD plant proposal in Lincolnshire recently[51]. Another factor is their size, being smaller in nature, RE innovations require more sites and therefore more siting decisions to be made (Wustenhagen, et al., 2007:2684).

Overall, it would seem that other renewable energy technologies, such wind and solar, are viewed as cleaner and more attractive to communities as a whole and the individuals within. More research needs to be undertaken to establish why this might be the case.

Whilst not all residents or communities are anti-AD, with some believing AD can be beneficial, at this time it is difficult to articulate precisely what the nature of these benefits might be. This is largely due to the fact that very few community AD plants were actually operational at the time of the study. Benefits are talked about as something for the future. Even the Calthorpe project, which was up and running, had not progressed far enough for any benefits to be realised.

There are currently a number of possible AD types that could become relevant to communities seeking to develop their own localised biogas production enterprises. The examples below are all either UK-based designs or have very strong UK footprints. They are based around shipping container sized units with energy outputs of around 20 to 45kW depending on the feedstock employed. They are:

- bioQUBE: http://www.quberenewables.co.uk/bioqube_what.html
- Muck Buster: http://seabenergy.com/products/anaerobic-digesters/
- Clearfleu: http://www.clearfleau.com/page/small-scale-anaerobic-digestion

[50] Wustenhagen, R., Wolsnik, M., Burer, M. (2007) Social Acceptance of Renewable Energy Innovation: An introduction to the concept, Energy Policy, 35 (5) pp.2683-2691

[51] Lincolnshire Echo, 5th November 2014 http://www.lincolnshireecho.co.uk/Residents-fury-Sleaford-anaerobic-power-plant/story-24104714-detail/story.html

- Archemax (thermophyllic system:) http://www.ngbiogas.com/ngb-launches-archemaxits-ground-breaking-high-throughput-anaerobic-digester/

The greatest issue with these four AD units for communities may be their capital costs. Innovative finance models may need to be established to make them viable for, and attractive to, communities. Another, wider issue is developing an effective community engagement model. One suggestion is to adapt the self-delivery of domestic food wastes using the caddy boxes already employed by several local authorities (i.e. DHP) to a semi-automatic weighing system so that the individual supplier can be rewarded for their contribution to the feedstock stream when the biogas outputs are sold.

A further challenge with community projects is to develop a proposition as described above which is in line with the moral compass of 'western' consumerism and concern for the environment and wellbeing of others at a local level or beyond. The concept of Fair Trade products is an example of a success in changing behaviour in some parts of the consumer population. More recently there has been an international outcry over the damage being done to pollinators and public opinion has been widely mobilised. The UK Government has responded with the launch of a National Pollinator Strategy for bees and other pollinators in England[52]. This includes modification of land management practices to improve local biodiversity that will generate new sources of potential feedstock for biomass burners and small scale anaerobic digesters. The back story behind the generation of bio-energy from this material may well work as the concept of Fair Trade has done for a segment of the food sector.

It is the conclusion of this AD case study research that, at the time of the study, it was too early to assess ADs full potential, viability or benefits, at a community level. Currently there is very little to investigate. We would suggest that another piece of research is commissioned to track community AD development, challenges and benefits over the next five years.

[52] Defra (2014) https://www.gov.uk/government/publications/national-pollinator-strategy-for-bees-and-other-pollinators-in-england

Section E: Key findings and recommendations

This research has a number of key findings.

Key findings

- *There is a disjuncture between an individuals' awareness and knowledge, and understanding.* This study found a marked difference between individuals' awareness of renewable technologies and current debates surrounding related issues and their actual understanding of how such technologies operate, their benefits and their possible challenges.
- *There is a need for better and more trustworthy information.* If government is to engage the general public in future renewable energy initiatives there needs to be better, more accessible and trustworthy information on what is available, what is expected and how the public can contribute. The current debate on fracking is a case in point. Many of those we interviewed felt they were not in a position to decide if fracking was a positive or negative way forward largely because they felt they did not have enough reliable information about the process and its potential environmental consequences.
- *'Communities' is a contentious and undefined term.* It is clear from this study that the term 'community' renewable energy means different things to different people. It would therefore be beneficial to either have one workable definition that all adhere to or to take into consideration, and acknowledge the various definitions when discussing what is and what is not a community renewable energy technology or initiative. A simple understandable definition which could be used to trigger local debate would be most helpful.
- *Community hybrid energy systems, at least in principle, do appeal to householders.* This study found the concept of generating energy using community hybrid systems was attractive to many householders with over half of interviewees stating they would be interested in participating in such initiatives. However, the majority had concerns as to how it would work in practice and that it would rely on someone, ideally from the local community, to take it forward.
- *Fuel poverty.* The data suggests there is a social stigma attached to being in fuel poverty, especially for the elderly. Yet, despite all three of our areas having a higher than average percentage of households in fuel poverty and many of our interviewees being 'fuel poor' according to the established government definition employed since 2001, few felt that the term applied to them or their community. No one really understood the new definition of fuel poverty[53] (see report section 3d) and few found it understandable or helpful.
- *Energy efficient home improvements.* Householders in our study were keen to ensure their homes were as energy efficient as possible. Those most pro-active in this area were home owners. Those in rented accommodation relied on their landlords to install the majority of energy efficient improvements. This was most likely to occur with social rather than private landlords. Those in older properties also found it difficult and expensive to make their home more energy efficient. However, the main driver for making such improvements was financial, particularly in terms of potential savings on household energy bills, rather than environmental.

[53]DECC, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/211180/FuelPovFramework.pdf

- *Government energy saving initiatives* – Few were aware of government energy saving initiatives. Those that were found the eligibility criteria difficult and complex to understand.
- *Many interviewees were pro-development of alternative energy sources.* Whilst not everyone was convinced that fossil fuels are unviable or that they are diminishing at a rate that means we should no longer be extracting them for use, many interviewees were pro-development of new energy technologies. There was a lot of support for hydro and tidal energy. There appears to be a shift in opinion regarding the acceptability of nuclear power as a way forward.
- *It is too early in the development and use of community AD* to make a full and proper assessment of whether or not it has the potential to be a viable renewable energy at community level. However, there does appear to be some evidence to suggest that AD per se could potentially play a part in a future hybrid energy system. Further, this study suggests community AD units are most likely to be sited on-farms rather than within communities.
- *There was an openness to alternative styles of energy efficient homes.* Interviews, regardless of age, were generally interested in new ways of constructing and designing homes that reduced carbon emissions. However, many pointed out the numerous perceived difficulties attached to such concepts including, gaining planning permission, getting a mortgage on non-traditional properties and being too old or not well enough to meet the demands of some new housing designs.

This research also found a willingness amongst householders from a cross-section of rural society, especially older residents, to participate in all stages of our study. There was a genuine interest in the subject and a concern for how we, as a country, will meet our future energy needs in an increasingly technologically dependant society that relies on reliable, affordable energy sources. Several participants were interested in our findings and in receiving a summary of the research report. Many interviewees reminded us about the difficulties of, and opportunities for, hybrid energy solutions in contemporary rural Britain.

In sum, this study found that what is required is more reliable and trustworthy information flowing from all professional sectors to the general public, improved user-friendly community energy technology solutions and a greater level of support for those wishing to engage in the rural hybrid energy praxis; including financial. The rise in popularity of photovoltaics on roof tops (which according to the DECC at the end of March 2014 numbered 530,970 domestic installations alone with a generating capacity of nearly 2,000,000 Kws per week) shows that the public can be proactive. However, one of the main stumbling blocks is finances and long pay-back time. Even though photovolitcs have significantly reduced in price over the past five years (Brazilian et al., (2013[54]) estimate a price reduction of over 60% since 2008) they are still an expensive undertaking. Householders are unlikely to invest in AD or other renewable energy technologies unless they a) have the financial resources, b) are living in a settled home for the foreseeable future and c) believe they will live long enough for their investment to pay them back. Indeed, there is a danger that instead of addressing energy and fuel poverty, renewable energy initiatives as they currently stand could

[54]Brazilian, M., Onyeji, I., Liebreich, M., MacGill, I., Chase, J., Shah, J., Gielen, D., Arent, D., Landfear, D. and Zhengrong, S. (2013) *Re-considering the Economics of Photovoltaic Power,* Renewable Energy (53), http://az2112.com/assets/energy-bnef_re_considering_the_economics_of_photovoltaic_power_a_co_authored_white.pdf

widen the fuel poverty gap; in rural or urban areas. Our research found that those most likely to engage were home owners, educated and from professional backgrounds. In other words the median income group. They were also more likely to be over the age of 45; a time when they have a greater level of disposable income or savings. In addition, historically low bank interest rates have encouraged small scale investors to look at other investment opportunities; including renewable energy technologies. Those in rented accommodation (private or social housing), on low incomes and in less secure employment are the least likely to be in a position to engage with, and benefit from, RHEES type innovations and initiatives.

We would suggest that at this time there is little evidence of 'active community participation' in the renewable energy agenda. This could be because individuals within communities – be they householders, commercial businesses, public services or third sector organisations – do not yet see the need to be actively engaged in such initiatives. In addition, where there is an awareness and understanding of the issues facing society by some individuals in terms of the need to reduce carbon emissions there are few mechanisms to help them do so. In fact, the complexity of government initiatives, coupled with a lack of coherent information or consistent messaging from all quarters (i.e. central and local government, scientists – they do not all agree that climate change is happening and that humans can take action to at least slow its effects - and the RE sector) on the consequences of taking no action, we would suggest, not only hinders public engagement with the AD and broader RE agenda but actively discourages it. It may be that until the lights go out, or the cost of energy is too great for households to bare, many in society will not see the need to take these matters seriously by which time it may be far more difficult to affect a change.

Recommendations:

To policy / government

- Establish a simple understandable definition of 'community renewable energy' to stimulate debate both locally and regionally.

- Lead future public campaigns to raise awareness of the need to reduce carbon emissions and the possibilities of using RE, highlighting the potential consequences of inaction for society.

- Government should monitor the impact of renewable energy on rural communities especially in terms of:
    - Economic activity, i.e. increased employment opportunities and improved facilities
    - Age profiling – does it help reduce the exodus of the young?
    - Opportunities to participate in initiatives or set up community projects
    - Wider community benefits
    - Promote the improvement of energy literacy levels – possibly including a set of energy literacy questions into the 10 year census (or local surveys) and feeding the results into the energy literacy Matrix

- That Government considers giving discounts on RE household new builds.

To Educators - all stages

- Trial the energy literacy matrix shown earlier in this report.

- Be willing to engage in the renewable energy and climate change debates in both formal and non-formal contexts.
- Establish a community education programme to raise awareness and address RE initiatives, including AD issues. This will also help develop a more sustainable energy sector.

To the renewable energy sector

- Engage with the general public, especially householders, to a greater extent in a contextually appropriate format. Providing greater levels of support, particularly in terms of offering expertise and sharing knowledge and information, for communities that would like to take renewable energy technologies forward.

To other stakeholders, namely commercial organisations, developers, landlords and financial services

We recommend the following:

- That mortgage lenders broaden their offers and/or soften eligibility criteria to include properties that have an element of alternative energy systems or design. That they are open to new forms of housing structures and types.
- That all new builds carefully consider renewable energy options as a matter of course, and where possible, future proof developments. For example the installation of PV panels which also requires consideration at planning stages as to the direction roofs face to maximise solar energy potential or the installation of ground source heart pumps during the building phase.
- That landlords take a greater share of responsibility in terms of ensuring the homes they rent are as energy efficient as possible. To do this they need to be aware of government incentives and schemes that will help them implement, and more importantly afford, energy efficiency measures.

Appendices:

Appendix A

Public opinion survey on environmental and renewable hybrid energy issues in Lincolnshire

Environmental issues such as climate change, renewable energy and fuel poverty are often in the news and Bishop Grosseteste University, Lincoln is coordinating a household survey across the East Midlands to try to assess public engagement with, and knowledge/experience of, these issues. Partners in the research include the universities of Birmingham, Leicester, Loughborough, Manchester Metropolitan and Nottingham.

If you would like any further information about the project please contact Professor Chris Atkin at chris.atkin@bishopg.ac.uk or by telephone on 01522 527 347. This survey should take about 10-15 minutes to complete and we are most grateful for your support.

Information provided by you will be confidential under the terms of the Data Protection Act and will be seen by the research team **only** at Bishop Grosseteste University. Data used in the survey report will be presented in aggregated form and no individuals will be identified.

Please only fill in **one** survey per household. You must be over 18 years of age to participate. When you have filled in the survey, please return it to us using the pre-paid envelope **by Tuesday 12th November 2013. All fully completed surveys will be entered into a prize draw.**

About your home

Q1 Is your household in:

An owner occupied property ..... ☐
A tenanted property of a private landlord ..... ☐
A tenanted property of a housing association ..... ☐
A tenanted property of the local authority ..... ☐

Q2 Is your home a:

Semi-detached house ..... ☐
Detached house ..... ☐
Terraced house ..... ☐
Flat ..... ☐
Semi-detached bungalow ..... ☐
Detached bungalow ..... ☐
Mobile home ..... ☐
Other - please state _____

Q3 How old is your house?

10 years or less ..... ☐
11 - 25 years old ..... ☐
26 - 75 years old ..... ☐
76+ years old ..... ☐
Don't know ..... ☐

Q4 Does your house have any of the following? (Please tick all that apply)

	Yes	*No*	*Would like to have it installed*
Cavity wall insulation	☐	☐	☐
Additional draft proofing to windows and doors	☐	☐	☐
External wall insulation (if a solid walled house)	☐	☐	☐
Fully insulated loft	☐	☐	☐
Double glazing	☐	☐	☐

Q5 Which, if any, of the following fuels provides the main or secondary source of heating in your home? (Please tick all that apply)

	Main	*Secondary*
Natural Gas	☐	☐
LPG or bottled gas	☐	☐
Oil	☐	☐
Coal	☐	☐
Logs	☐	☐
Wood chips/pellets	☐	☐
Electricity	☐	☐

Q6 Which, if any, of the following fuels, is used for heating water or for cooking? (Please tick all that apply)

	Water heating	*Cooking*
Natural Gas	☐	☐
LPG or Bottled Gas	☐	☐
Oil	☐	☐
Coal	☐	☐
Logs	☐	☐
Wood chips/pellets	☐	☐
Electricity	☐	☐

Q7 Which, if any, of the following renewable energy technologies do you use to supply some of your energy needs?(Please tick all that apply)

Solar panels (Photovoltaic) for generating electricity ..... ☐
Solar thermal panels for heating water ..... ☐
Wind turbine ..... ☐
Wood chip/pellet fuelled boiler ..... ☐
Micro Combined Heat and Power gas burner ..... ☐
Air Source Heat Pump ..... ☐
Ground Source Heat Pump ..... ☐
Hydro electricity ..... ☐
None of the above ..... ☐

Your relation to, and role within, your community

Q8 How long have you lived at your current address?

0 - 5 years ..... ☐
6- 10 years ..... ☐
11 - 25 years ..... ☐
25+ years ..... ☐

Q9 Does your household have family links in the local area?

Yes ..... ☐
No ..... ☐

Q10 Does any member of your household operate a business in the area (within 10 miles)? If No skip to Q13

Yes ..... ☐
No ..... ☐

Q11 If Yes does the business operate from your home?

Yes ..... ☐
No ..... ☐

Q12 Which of the following sector labels best describes the business?

Manufacturing a product ☐
Transportation of people and/or goods ☐
Office based service supplier ☐
Leisure and tourism, including catering & hospitality ☐
Other – please specify

Transport

Q13 How often do members of your household use public transport?

All the time ..... ☐
Weekly ..... ☐
Monthly ..... ☐
Occasionally ..... ☐

Q14 Which mode of transport is usually used by household members to make the following journeys? Please tick all that apply)

	Car	*Train*	*Bus*	*Taxi*	*motor bike*	*Bicycle*	*Walk*	*Fly*
Travel to work	☐	☐	☐	☐	☐	☐	☐	☐

Travel to school	☐	☐	☐	☐	☐	☐	☐	☐
Food shopping	☐	☐	☐	☐	☐	☐	☐	☐
Other shopping	☐	☐	☐	☐	☐	☐	☐	☐
Socialising	☐	☐	☐	☐	☐	☐	☐	☐
Holidays	☐	☐	☐	☐	☐	☐	☐	☐
Access health services	☐	☐	☐	☐	☐	☐	☐	☐

Knowledge of and attitude to environmental issues

Q15 Which of the following does your household regularly recycle? (Please tick all that apply)

Food waste ..... ☐
Paper, plastic & cardboard ..... ☐
Glass & cans ..... ☐
Garden waste ..... ☐
Batteries ..... ☐
Ink cartridges ..... ☐
Supermarket plastic bags ..... ☐

Q16 Does your household compost food and/or garden waste?

Yes ..... ☐
No ..... ☐

Q17 Is your household part of a group buying scheme for heating fuel?

Yes ..... ☐
No ..... ☐

Q18 Where do you get most of your information from about renewable energy issues? (Please tick all that apply)

Newspapers ..... ☐
Radio ..... ☐
TV ..... ☐
Internet ..... ☐
Friends & family ..... ☐
Local Government ..... ☐
National Government ..... ☐
Environmental interest/lobby group ..... ☐
Other - please specify _____

Q19 **We would like to understand a little about your opinions and beliefs concerning climate change. Please read the following statements and tick accordingly.**

	Strongly agree	*Agree*	*Disagree*	*Strongly Disagree*
Human activities have little impact on climate change	☐	☐	☐	☐
Climate change is part of nature's natural cycles	☐	☐	☐	☐
Climate change does not affect me adversely	☐	☐	☐	☐
I do not need to do anything about climate change	☐	☐	☐	☐
Climate change will affect future generations more than mine	☐	☐	☐	☐
I am aware of what causes climate change	☐	☐	☐	☐
Britain is increasingly experiencing change to its weather patterns due to climate change	☐	☐	☐	☐
I have experienced an extreme weather event that I think might be linked to climate change	☐	☐	☐	☐
People should be encouraged to modify their lifestyles to minimise their influence on climate change	☐	☐	☐	☐
The cost of fossil fuel is going to continue to rise	☐	☐	☐	☐
Burning fossil fuels is a major factor driving climate change	☐	☐	☐	☐
Fuel poverty is an issue for me or someone that I know	☐	☐	☐	☐
Renewable energy projects and other green technology could create new jobs in my locality	☐	☐	☐	☐

Q20 Please could you tell us a little more about your knowledge or experience of any of the following '*green*' energy technologies? (Please tick all that apply in <u>each</u> of the three columns below)

	Which of the following are you <u>aware</u> of?	*Which of the following have you <u>ever</u> owned?*	*Which would you <u>consider</u> owning or investing in?*
Low energy white goods with an energy rating label.	☐	☐	☐
LED Low energy lighting	☐	☐	☐
Ground Source or Air Source Heat Pump	☐	☐	☐
Wood chip or wood pellet central heating	☐	☐	☐
Solar electricity (PV) panels	☐	☐	☐
Solar Thermal heating	☐	☐	☐
Wind power - micro or community based	☐	☐	☐
A micro hydro electricity generator	☐	☐	☐
A hybrid power system car (e.g. the Toyota Prius)	☐	☐	☐
An all-electric car	☐	☐	☐
Wave or tidal power	☐	☐	☐
Biomass power stations	☐	☐	☐
Anaerobic Digestion to produce biogas	☐	☐	☐

Q21 Which of the following Government initiatives are you aware of? (Please tick all that apply)

Feed in Tariffs ..... ☐

Renewable Heat Incentive ..... ☐

The Green Deal and the Energy Company Obligation (ECO) ..... ☐

The Renewable Heat Premium ..... ☐

Energy switching schemes ..... ☐

The Government Cash Back Scheme ..... ☐

None of the above ..... ☐

<u>Personal profile</u>

Q22 Are you

Male ..... ☐

Female ..... ☐

Q23 Age

18-24 ..... ☐

25-40 ..... ☐

41-55 ..... ☐

56-65 ..... ☐

66+ ..... ☐

Q24 Marital Status

Married ..... ☐

Civil Partnership ..... ☐

Divorced ..... ☐

Single ..... ☐

Widowed ..... ☐

Q25 How many people live in your household?

	1	*2*	*3*	*4*	*5*	*6*	*7+*
Adults	☐	☐	☐	☐	☐	☐	☐
Children 5 - 18	☐	☐	☐	☐	☐	☐	☐
Children under 5	☐	☐	☐	☐	☐	☐	☐

Q26 Employment status (Please tick as appropriate)

Self employed ..... ☐

Full time working ..... ☐

Part time working ..... ☐

Further or higher education full time student ..... ☐

Seeking work ..... ☐

Not seeking work ..... ☐

Retired ..... ☐

Q27 Nationality

Q28 Is there anything you would like to add about renewable energy not covered elsewhere in this survey? We would also appreciate any feedback on the survey itself; particularly any areas you found challenging.

Stage two of the project - interviews

Q29 Would you be willing to be interviewed by a member of the research team to explore further some of the issues raised in the survey?

Yes ..... ☐

No ..... ☐

If yes please supply the details requested in Q31 - Q33.

Q30 Contact details: 1. Name

_____
_____
_____
_____

Q31 Contact details: 2. Landline and/ or Mobile Phone number and/or email address

_____
_____
_____
_____
_____
_____

Q32 Alternatively please supply a postal address

_____
_____
_____
_____
_____
_____
_____
_____
_____

Thank you for taking the time to complete and return this survey. Remember, in November, all completed and returned surveys will be entered into a prize draw for an eco - radio to be drawn on Friday 6th December at 12.00.

Appendix B

Semi-structured face to face interview and focus group schedules

- First explain who we are what we are doing and thank people for agreeing to be interviewed (***hand interviewees an information sheet to read and keep***).
- Interviews will take **45 minutes** and no more than 1 hour
- Ensure ***confidentiality*** and ***anonymity***. Emphasise that we operate under strict ethical guidelines set out by the University, the sector (i.e. BERA – British Education Research Association) and the UK Research Councils.
- **Ask interviewees to sign the consent form before starting the interview.**
- Ask permission to **record** the interview. If they do not wish to be recorded take only hand written notes.

Section A - Current household energy needs and priorities

1) **Roughly how much does your household currently spend on energy use? (Prompt***: actual cost / % of income 2012*)

2) **Does this include running a vehicle? (Explore:** *how many / how often it's used / type etc / if they have ever run a car / if they did why they don't now)*

3) **Has your energy use gone or up down in recent years and why? (Prompt:** *age / more time at home / cost too expensive / energy efficient measures put in place / include using vehicle***)**

4) **What are your energy priorities? (Prompt:** *heating the house / water / cooking / electrical appliances / transport i.e. running a car or other vehicle***)**

5) **How do you feel about the current cost of energy?**

6) **What are the challenges of, and compromises you make, to meet your current household energy needs?**

7) **Have you made any energy efficiency improvements to your home in the last 2 years?**

    a. **If yes, which ones?** *(i.e. Cavity Wall insulation / Draft proofing / external wall insulation / double glazing / radiator thermostats)*

b. **If no, why not? (Prompt:** *rented property / cost / time / lack of information as to possibilities -list of current schemes especially for pensioners)*

Show interviewee pictures of 4 different energy efficient homes

8) Would you consider any of these energy efficient measures and why?

9) Which, if any, features of an energy efficient lifestyle do you feel are impractical and why?

10) Would you live in a house like this?

Section B - Understanding and knowledge of wider energy debates (energy literacy)

1) **What do you understand the term 'Fuel Poverty' to mean?**

(Definition - '...a household is said to be fuel poor if it needs to spend more than 10% of its income on fuel to maintain a satisfactory heating regime (usually 21 degrees for the main living area, and 18 degrees for other occupied rooms).[55]' – https://www.gov.uk/government/collections/fuel-poverty-statistics. This means approximately 2.39 Million households in England were in fuel poverty in 2011 = 11% of the population down 80,000 from 2010. The average gap has risen by £24 to £438.)

2) **Is fuel poverty an issue for your household or anyone you know in the local community? Or do you see it becoming an issue for your household in the near future and why?**

3) **Government figures show the number of households in fuel poverty went down in 2011 from 2010 by 80,000 households, what do you think about this statement?**

4) **Do you consider energy supply to households an essential service? Why? Which is the most important? (Prompt:** *opinion of Cartels and so called 'big 6' energy suppliers / gas, electric / water*)

5) **What is your view on the 'fuel versus food' so called 'eat or heat' debate?**

6) **There is a lot of talk about energy security, have you heard of this and do you think it is an issue?**

[55] There is a new government definition (August 2013) based on Low Income High Costs (LIHC) framework that doesn't give percentages of income: "they have required fuel costs that are above average (the national median level) were they to spend that amount they would be left with a residual income below the official poverty line." https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/211180/FuelPovFramework.pdf

7) **Fossil fuels are claimed to be a limited and diminishing resource, what do you think could/should be done to secure future energy needs? (<u>Prompt</u>:** *find alternative energy sources / charge more / have more control on supply / regulation of use / use energy more efficiently / community initiatives)*

8) **Have you heard of fracking? Do you think it's a good idea, why or why not?**

<u>Section C – Meeting future energy needs: opportunities for engagement with, and openness to, local/community hybrid renewable energy initiatives</u>

1) **Have you taken up any government energy incentives or schemes either as an individual household or as part of the local community? (Explore:** *if they are aware of any schemes*)

   a. **If <u>yes</u> which ones? How successful were they and why?**

   b. **If <u>no</u> would you consider being involved in the future and why? (***Pros and cons***)**

2) **Have you ever thought of producing energy yourself, with your neighbours or local community? (Explore:** *why or why not, pros and cons / barriers and enablers / investment opportunities e.g. the 'Good Energy' investment bonds - offering to buy into their renewable energy programmes - income of 7.5% over 4yrs then sell them)*

3) **Do you think that community based energy projects are a good way of responding to the current energy situation and why?** *(e.g. a) clubbing together to erect a PV panels on group houses i.e. tower blocks in London / b) joint shared ownership in a wind farm* – in Market Deeping Lincs)

4) **Is there a champion or activist's group in the local community that could take such a project forward? (***If <u>yes</u> then explore which and what the interviewee knows about it)*

5) **Have you heard of <u>community anaerobic digestive systems</u> or of using <u>bio-sources</u> for fuel? (***<u>AD</u> uses food and garden waste / horse manure. Can purchase kits for around £120k. <u>Bio-sources</u> uses wood chips / palettes / logs, anything that's combustible***)**

6) **Have you heard of Hybrid energy systems before? If yes can they explain what it is?**

   ("Hybrid Renewable Energy Systems (HRES) are made up of **one renewable and one conventional** energy source or more than one renewable with or without conventional energy sources, that works in standalone or grid connected mode. The important feature of HRES is to combine **two** or **more renewable** power generation technologies to make best use of their operating characteristics and to obtain efficiencies higher than that could be obtained from a single power source."[56] (p2927))

[56] Reference: Hybrid renewable energy systems for power generation in stand-alone applications: A review Prabodh Bajpai, Vaishalee Dash

7) **Introduce the concept of Rural Hybrid Energy Enterprise Systems – define briefly and simply, explain using the laminated diagrams prompts and ask the interviewees opinions:**

   a. **Are they a good idea or not?**

   b. **Are they viable alternatives why and why not?**

   c. **Would they consider installing / being part of one and why?**

Finally, would you like to keep in touch with the project or be part of any on-going community developmental hybrid system as part of the project?

Thank you for your time
Don't forget to leave the information sheet and bring back the consent form.

Focus group schedule - 1 hour maximum

Topics to be covered

Section A - Current household energy needs and priorities

1) **How do they feel about the current cost of energy? (Explore**: how much they spend on energy**)**

2) **Has their household energy use gone or up down in recent years and why? (Explore:** *age / more time at home / cost too expensive / energy efficient measures put in place / include using vehicle / do they prioritise energy use*)**

3) **What, if any, energy efficiency improvements have they made to their homes in the last 2 years and why or why not?**
   - Have they taken advantage of any government energy efficiency initiatives or schemes?
   - Which ones, why or why not?

4) **Show the pictures of energy efficient homes, Explore:**
   - Would they consider any of the energy efficient measures and why?
   - Which, if any, features of an energy efficient lifestyle do they feel are impractical and why?
   - Would they live in any of these houses, if not why not?

Section B - Understanding and knowledge of wider energy debates

1. **Do they consider energy supply to households an essential service? (**Explore**,** Why? Which is the most important?, their *opinion of 'big 6'*)

2. **Fuel poverty debt explore:**
   - what they understand it means
   - if they are experiencing it or know anyone who is
   - if they have heard of the new government definition and if they understand it (Read / hand out definition)

3. **Eat or heat debate, explore:**
   - What they think of it
   - what, if anything, should be done about it

4. **Explore their understanding of energy security**

5. **Raise the concept of fracking and allegedly diminishing fossil fuels:**

<u>Section C – Meeting future energy needs:</u>

1. **Has anyone ever thought of producing energy themselves, with their neighbours or the local community?**

   Explore:

   - *why or why not, pros and cons / barriers and enablers*
   - *possible investment opportunities*
   - *if they think it would be a good idea and why?*
   - *if they know of any local activists or groups that working in this area?*

2. **Have they ever heard of <u>community anaerobic digestive systems</u> or of using <u>bio-sources</u> for fuel?**

3. **Have they heard of Hybrid energy systems?**

   Explore:

   - if they think they are a good idea to meeting future energy needs
   - Would they consider installing one or part of one, and why?

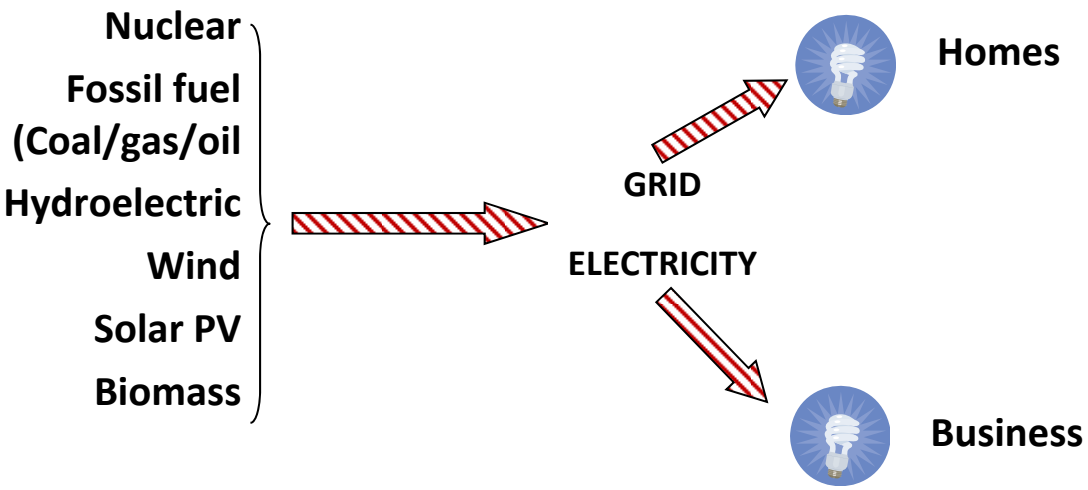
<u>Finally (if time allows):</u>

Finish by asking each participant to write on a post-it note **one** thing they have **learnt** from the discussion that they didn't know before and **one** thing (i.e. a behaviour or energy efficient home improvement) they may consider **changing**, in the near future.

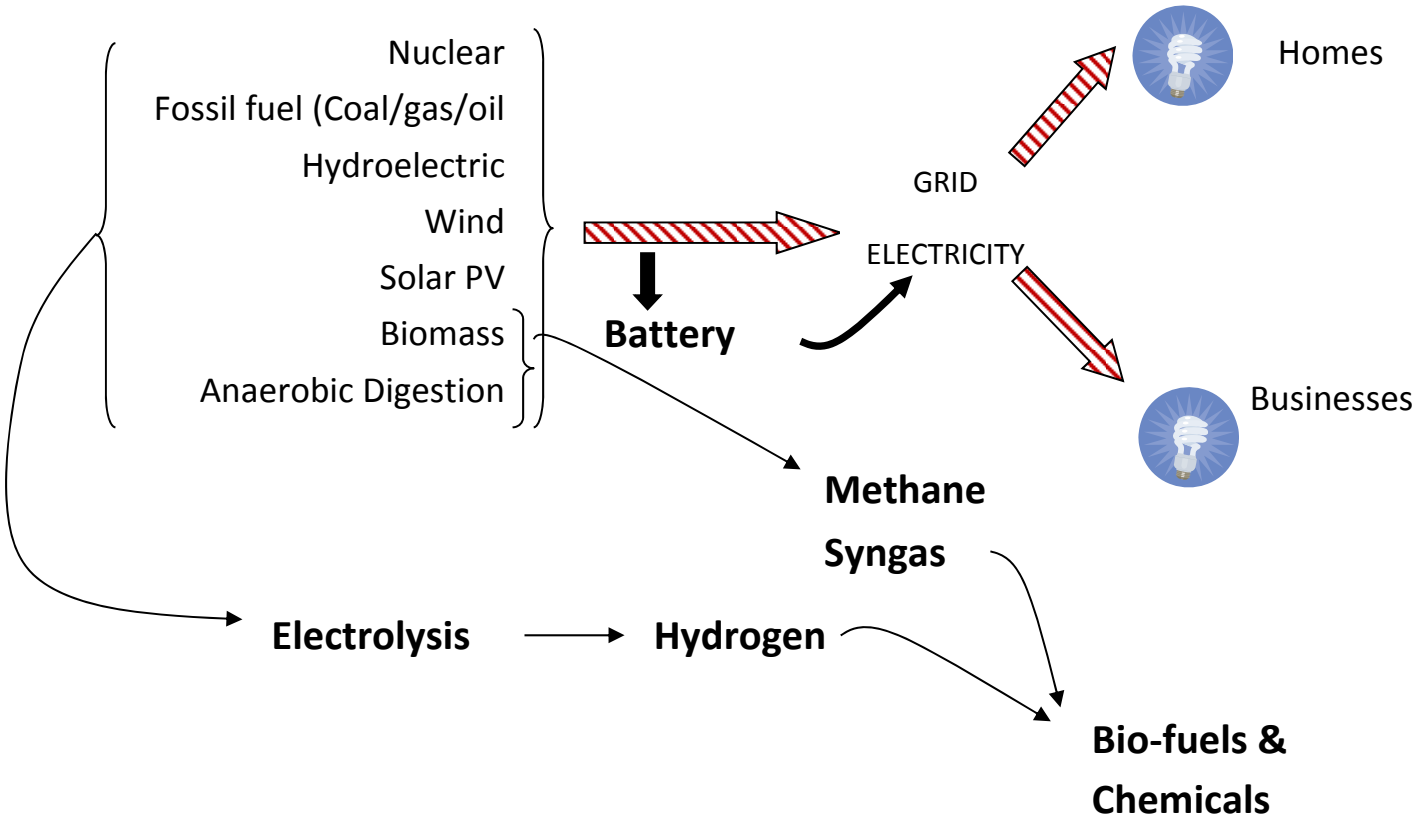
Appendix C

What do we mean by a hybrid energy system?

Traditional – several types of generator producing one energy output type

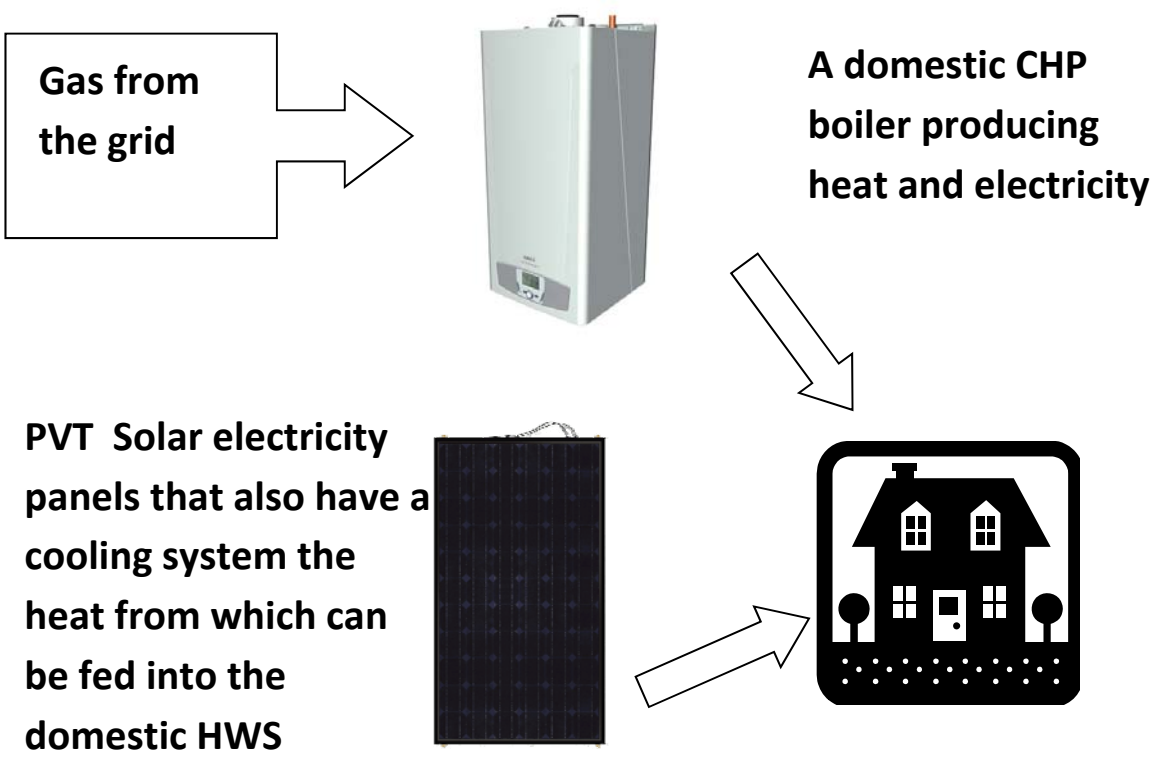


Advanced– several types of generator producing more than one energy output type



What do we mean by a hybrid energy system?

A domestic scale hybrid energy system



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