Faculty of Science & Technology

Knowledge and support for wind and solar renewable technologies in Bournemouth, Dorset

A dissertation submitted as part of the requirement for the BSc (Hons) Applied Geography

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Abstract

In the face of global warming, the UK aims to tackle greenhouse gas emissions by reducing CO_2 from the energy sector. Renewable energy projects such as wind and solar farms are, in theory, more favourable for the environment than fossil fuel based sources of energy. They are often supported in abstract by the general public, however, specific local projects face opposition during the planning process which can sometimes halt projects altogether. This paper assesses whether levels of knowledge of the general public plays a role in their attitudes towards renewable energy projects. The knowledge and attitudes towards offshore and onshore wind, as well as solar PV energy sources, were investigated through a postal and online questionnaire. The key finding of this paper is that individuals with a higher level of knowledge are more likely to support renewable energy. Other findings were; the main methods of communication to the public about renewables are television, the internet and newspapers. The level of knowledge did not vary by age, gender, level of education or household income. Respondents were more accepting rather than supporting towards the development of renewable energy in Dorset. The leading concerns towards renewable energy development in Dorset are the impacts upon aesthetics, particularly near the area of Outstanding Natural Beauty and the Jurassic Coastline. This paper recommends that more research is needed into understanding the specific type of knowledge the general public needs to further accept as well as support more projects in the future.

Key words: **Renewable Energy, Bournemouth, Knowledge, Support**

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1. Introduction

1.1 Abbreviations and definitions

BIS	Department for Business, Innovation and Skills (UK Government)
CC	Climate Change
CO_2	Carbon Dioxide
DECC	Department for Energy and Climate Change (UK Government)
EIA	Environmental Impact Assessment
IPCC	International Panel on Climate Change
LCOE	Levelised Cost of Energy
LCA	Life Cycle Analysis
NIMBY	Theory - Not In My Back Yard
RSPB	The Royal Society for the Protection of Birds
UK	United Kingdom
Carbon Dioxide	"A naturally occurring gas, also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the earth's radiative balance" (IPCC 2001).
Climate Change	"Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcing's, or to persistent anthropogenic changes in the composition of the atmosphere or in land use" (IPCC 2001).
Kyoto Protocol	An international convention for countries to commit to reducing six greenhouse gas emissions between 2008 and 2012 but an average of 5.2%, since revised by the Doha amendment until 2020 (Almer and Winkler 2017).
Renewable energy	"Any form of energy from solar, geophysical or biological sources that is replenished by natural processes at a rate that equals or exceeds its rate of use. Unlike fossil fuels, most forms of RE produce little or no CO2 emissions" (Moomaw et al. 2011 , pg. 164).
Sustainable development	"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987).

1.2 Introduction

This study explores the relationship between knowledge of renewable energy and perceptions of these technologies in the coastal town of Bournemouth, UK. Figure I shows a location map of the coastal town situated in East Dorset. The next section will provide a background to the issues surrounding public perception, followed by the aims, objectives, and research questions.

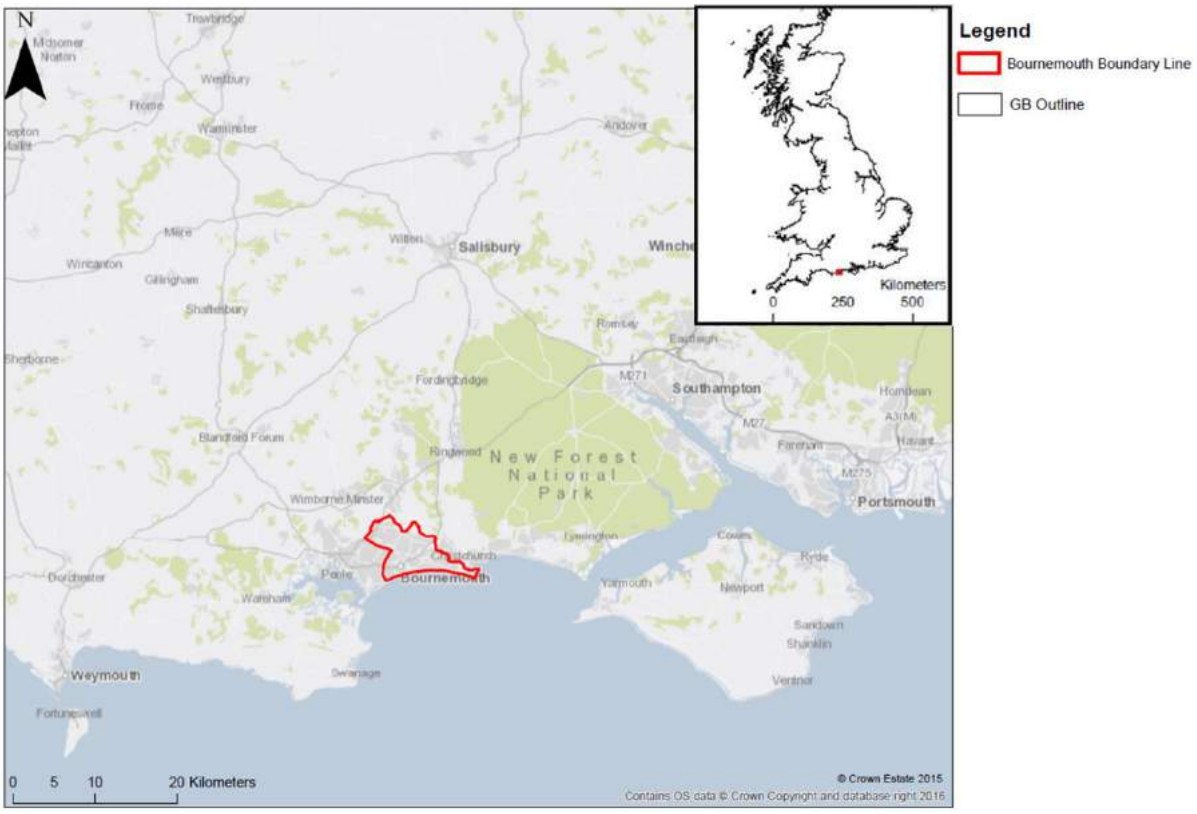


Figure I: Location map of the Bournemouth study area (Own creation).

1.3 Background to the issue

In broad terms, it is well documented in literature and in the media that we are approaching a worldwide climate crisis (IPCC 2014). The need to innovate solutions is more urgent than ever (Devine-Wright 2007). CO_2 is a contributing factor to the greenhouse effect, through which thermal heat is trapped by the atmosphere and consequently warms the earth (Newton and Cantarello 2014).

Anthropogenic climate change refers to the release of greenhouse gases emitted by human activity and this is causing warming over and above natural cycles. The effects on climate cycles and regionalisation of differing implications and associated costs is unknown and hotly debated, due to finer details of complex climate dynamics not being fully understood yet (Oreskes 2004). It is of scientific consensus that climate change is happening (Oreskes 2004), however there is still a considerable about of public doubt that climate change is being caused by anthropogenic means (Anderegg et al. 2010).

A minority of climate change sceptic researchers, who do not believe in the anthropogenic influences on the climate, receive media attention and influence the debate in the public debate when it comes to impacts and policy making (Anderegg et al. 2010). The topic of climate change has been highly politicized. Perspectives on climate varies between political groups (McCright and Dunlap 2011) and between countries.

The UK signed up to international treaties such as the Kyoto Protocol (UNFCCC 1998), which sets out goals for reducing greenhouse gases under the basis of two assumptions; that global warming exists and that anthropogenic CO_2 is the

cause. To combat this, changes in energy production including low carbon technologies are being rolled out including; solar, biomass, wind (on and offshore), tidal and wave power among others. For carbon management and renewable technologies to form an active part of a transition to a less fossil-fuel dependent economy, the public must be on board. This is not only due to the fact that public are end consumers who will be paying for the technology through taxes and energy bills, but that it will have to be built usually in proximity to people, as Carbon management is just one element of a larger picture in developing a sustainable strategy for the UK. Addressing climate change is part of sustainable development and developing a 'green economy' (Newton and Cantarello 2014). Low carbon technologies have a complex network of economic, environmental, technical and socio-political factors involved shown in Figure II.

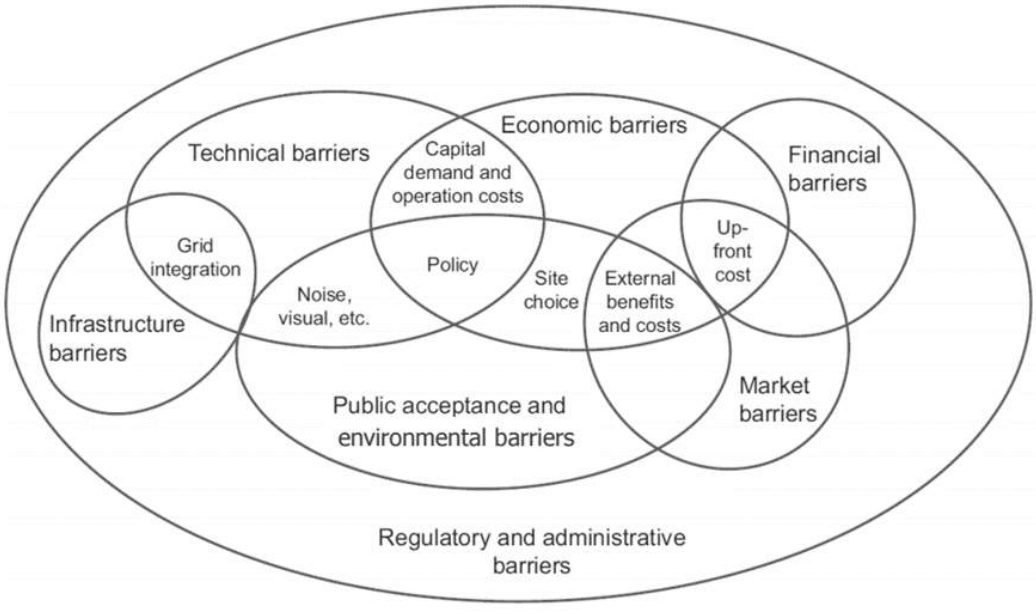


Figure II: Barriers to renewable energy development and their linkages (Müller et al. 2011)

Government and public support is essential to transition from a carbon-dependent energy mix, to a sustainable energy mix for the future. Germany is an example of a government and economy backing renewables. RE currently supplies 25% of the country's electricity needs and is investing $EUR 1.5 billion a year in energy research, with Schiermeier (2013) estimating a 'middle of the road' scenario of renewables will provide 85% of electricity by 2050. Research funding includes development into battery storage development and electricity grid improvements to be able to include remote wind turbines and small scale solar PV (Schiermeier 2013). There are incentives to the general public too, such as being able to sell energy from their own solar panels to the grid at fixed price that is higher than the open market. This illustrates the coupling of supporting the technology economically, whilst having incentives for the general public to increase participation and awareness. As well as combatting climate change, the wider benefits of renewable energy can help a countries become energy secure, reduce negative environmental impacts and also improve social and economic prosperity (Moomaw et al. 2011)

Public perception is just one aspect of the barriers to renewable energy development shown in Figure II and this thesis will investigate knowledge, opposition, perceptions and barriers to the development in terms of the general public.

1.4 Aims, objectives and research questions

This thesis investigates whether levels of knowledge about renewable energy is linked to perception of renewables in Bournemouth, Dorset

1.4.1 Aim

To investigate the issues relating to public perceptions around the commercial scale development of renewable energy in Dorset by exploring links between knowledge levels and perceptions of renewable energy on a local level.

1.4.2 Objectives

1. To review the existing literature surrounding public perception of renewable energy
2. To research the main methods of communication to the public about renewable energy
3. To investigate what levels of knowledge currently exist in Bournemouth about renewable energy
4. To investigate and compare levels of knowledge to public perceptions of renewable energy in Bournemouth
5. To find out what the main concerns are for the commercial scale development of RE in Bournemouth

1.4.3 Research questions

1. What are the top three methods of communication about renewable energies to the public?

2. Does level of knowledge about wind and solar vary by age, gender, income or education?

3. Is there a statistical link between level of knowledge about RE and level of support for wind and solar?

4. Are there similar levels for ‘acceptance’ and ‘support’ for wind and solar?

5. What are the main concerns about the commercial scale production of renewable energy?

These research questions aim to assess the knowledge levels about renewables in Bournemouth, where that knowledge came from, compare different demographic factors and eventually contribute to the main aim of finding out why there are such big issues at the planning stage due to public perceptions and objections.

The outcome will aim to be of use to Dorset County Council or other local authorities aiming to promote a less-carbon based energy system and help more renewable projects be accepted. This hopes to benefit the local economy, residents and business. This thesis hopes to contribute insight into whether increasing public knowledge should be a focus, or whether knowledge is independent of support.

2. Literature review

A vast array of literature has tried to explain the ‘gap’ between high support in opinion polls for wind energy and resistance at the development stage (Devine-Wright 2005; Ek 2005; Toke 2005; Wolsink 2006; Devine-Wright 2007; Ellis et al. 2007; Aitken 2010) This literature review aims to consider both solar and wind energy, although previous literature on public acceptance is much more established for the latter. Many of the issues stemming from this research includes the public consultation side of planning applications. This literature review is comprised of six main themes; public engagement with science and RE, common issues regarding renewables, terminology for public acceptance, case studies on public knowledge and perception, sociodemographic factors, and finally a focus on the Bournemouth strategy for RE.

2.1 Public engagement with science and renewable energy

To understand how public perception varies when science and technology engage the public, it is important to understand how they are initially engaged and the reliability of these sources. A study by Ipsos Mori and the Department for Business, Innovation & Skills (BIS) titles Public Attitudes to Science, intending to find out what the public really think about science (Castell et al. 2014). Some of the overall themes from the study show the public think scientists, the government and regulators should engage more with the public and three in ten would like to have more of a say on scientific issues, although not all would like to be personally involved (Castell et al. 2014). Agreeing with the previous survey in 2011, the study concludes that people do not think the government do enough to consult the public on science. However, it is

acknowledged although that this may be linked to cynicism about public consultation events (Castell et al. 2014).

In the report, the data supporting Figure III, also highlights differences in knowledge transfer to those with higher educational attainment and gender. For example, women are more likely than men to hear about science from colleagues, family and friends (14% vs 9%), and men are more likely to get their information from online newspapers (18% vs 13%). In terms of education, those with higher social grades/education get their information from newspapers and scientific journals than their counterparts, who get most of their knowledge from television (Castell et al. 2014).

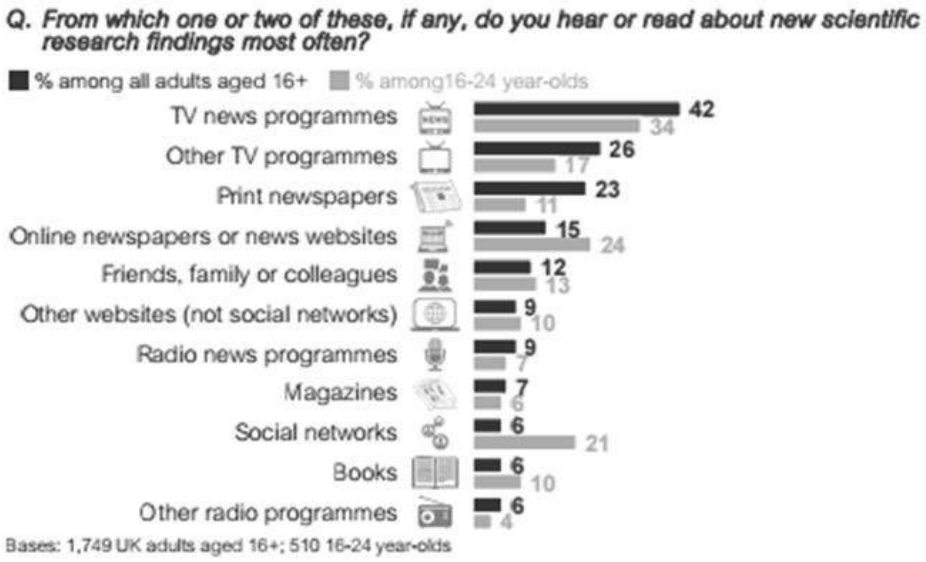


Figure III: Survey results for where people hear about new scientific research (Castell et al. 2014).

Devine-Wright (2007) summarises research for studies of public awareness and understanding. Findings showed that in rural areas, local newspapers are an important source of information (Devine-Wright 2007). In general terms,

however, TV is the main source of information about renewable energy, as well as direct experience of a project (Devine-Wright 2007). Furthermore, knowledge is higher in those people who live in close proximity to a project; although this will not be directly tested in this thesis as it is only being run in one area (Bournemouth). Funded by the Economic and Social Research Council, Devine-Wright is not researching within the vested interest of a company or renewable development, which is likely to provide an unbiased opinion. Finally, Devine-Wright (2007) sums up that there is high awareness for the 'iconic' renewables (i.e. wind and solar), but less so for those of biomass and carbon capture. This means that awareness may affect knowledge levels about the renewables, so biomass for instance should not be tested in the same research with solar and wind, unless comparing them.

When investigating public perception, it covers a wide range of subject areas and variables. Devine-Wright (2007) for example, suggests public acceptance and opposition can fit into three categories; personal, contextual and psychological. A study investigating perceived barriers to public consultation in science asked what the main barriers are the public being more involved in scientific decision making (BIS 2008). The highest scoring answer was public lack of understanding in science (28%), followed by lack of interest in science (12%), the public not having time (7%) and government policies make it difficult (7%). Six percent thought that the main barrier is scientific technical jargon and language, as well as lack of awareness in scientists of public understanding (BIS 2008).

A common theme in barriers in public involvement is understanding of the science, including technical terms and ability of the scientific community to understand the public. Clearly, the missing link is knowledge and this is what public consultation should aim to bridge. Taking scientific findings and knowledge, and translating them in an understandable way, is essential for public knowledge to increase for renewable energy.

Why is public knowledge and perception about climate mitigation strategies and renewable energies important? (de Coninck and Puig 2015) acknowledges that there is a lack of recognition of the role that users and household consumers play in the energy market. Although their study is investigating developing countries, it recognises the gap that research does not generally mention the role of the user and the increasing potential of community guidance could help develop further innovation and development.

In a positive light, public acceptance of projects can influence design, communication to citizens and implementation of the projects. Ultimately, being able to understand factors surrounding the opposition means more of the technology can be deployed (Hall et al. 2013). When investigating public perception, some studies use questionnaires to see a statistical link with knowledge levels, and some use more qualitative open ended interview techniques to get a bigger range of responses (Hall et al. 2013).

2.2 Common standpoints for rejection of renewable projects (and the NIMBY concept)

Large-scale deployment of RE technologies face opposition at the development stage and public support is a significant barrier (Cherry et al. 2014). There are three main themes that regularly become points of contention that public understanding and knowledge play a role, including economic, environmental and personal concerns. These are important to review in order to understand the wider context of public opposition that can be any of the following factors or a combination of more than one.

2.2.1 Economic

Economic arguments are regularly cited as issues for the development of RE (Toke 2005; Ellis et al. 2007; Zoellner et al. 2008; Salvatore 2013; Cherry et al. 2014). Zoellner et al. (2008) shows that one of the strongest predictors for public acceptance is positive cost benefit analysis made by the individual questioned. The issue with making such direct conclusions is complexity of the topic but also the applicability of this to other areas such as Bournemouth. Opinion surveys in polls similar to this show that they are location and culturally context specific, in this case study to Germany. Furthermore, self-reporting is problematic due to differing baselines and knowledge between people, but this method is regularly utilised in renewable opinion polls. A UK study found a similar outcome, that local perceptions of the economic impacts was crucial in determining the outcomes of local planning authority decisions (Toke 2005).

Zoellner et al (2008) refers to an individual's perspective on cost but it is much more complex including subsidies, initial investment costs, and the overall levelised cost of energy (LCOE) which includes maintenance and decommission costs (Salvatore 2013). Subsidies can distort the costs of existing conventional sources of coal and gas for example and maintain a cheaper price than RE, or be used to subsidise RE development to help it grow and reach 'socket-parity' pricing. Basic cost projections do not always incorporate when unexpected things go wrong such as pollution costs, fuel spills, accidents, health costs, and the overarching long term costs of climate change (Moomaw et al. 2011). These costs are usually attributed to conventional sources of energy. However for RE, there is the issue of the intermittency of power sources (MacKay 2008). This can be combatted by a diverse mix of renewables, or be potentially reliant on other countries for renewable energy, but this deals with only intermittency issues and does not deal with public opposition (MacKay 2008). The subject of implementing low carbon strategies and associated infrastructure is a focus worldwide. Public, and at the smaller scales, local opposition can slow down, or sometimes even halt project development (Batel et al. 2013).

Local acceptance is key, as the general public are the funding source through tax if government owned, and are entitled to pose opposition to projects even if they are commercially owned. The public must be consulted as part of the process, where economic arguments are usually used in conjunction with other objection to refuse projects and knowledge about the economic impacts influences decision making.

2.2.2 Environmental

Environmental concerns come from a wide range of disciplines, but are not always unanimous. For instance, some studies claim that wind turbine contribute to significant collisions of birds and bats (Kunz et al. 2007; Saidur et al. 2011; Wang and Wang 2015). Negative perception of wind energy is increasingly evident, this may prevent the installation of the wind energy in some countries (Saidur et al. 2011) and studies do acknowledge that appropriate siting of projects with migration patterns in mind can reduce mortality. On the other hand, organisations such as RSPB are 'pro-wind', due to the fact that climate change poses the "single greatest long term threat to birds and other wildlife" (RSPB 2017) subject to the wind farms having suitable environmental assessments. This illustrates the larger complex discussion of reducing CO_2 emissions and the threat of climate change. Their support has been further demonstrated by erecting a wind turbine at their headquarters in Bedfordshire, with new pioneer bat mitigation methods (RegenSW 2016). This is just one example of differences between studies and geographical context.

These issues should be addressed by a detailed EIA (environmental impact assessment) to mitigate the impacts of proposed new projects at the planning and design stages, which can form part of an overarching life cycle analysis of the project LCA (Newton and Cantarello 2014). However, one criticism of EIA's is that recommendations are not necessarily implemented in practice throught planning conditions, one study showing as much as 50% of the time (Tinker et al. 2005).

Climate change technologies form part of a long-term strategy with unknown costs and consequences and is therefore open to interpretation and distortion to vested interests. This multi-disciplinary subject is vast and when investigating public perception there are many different disciplines can be approached from. Environmental concerns are not the focus of this study, but a background on studies and perceptions is needed to provide context. In short, with all the mitigation and adaptation strategies in place to help a project be least environmentally damaging which can also match up economically, that provide a solution to climate change, why are the public still greatly opposed to the development of RE?

2.2.3 Personal - perceived justice and trust

Rogers et al. (2008) has researched the possibility for more local engagement in Cumbria in the UK. Rogers et al. (2008) reasons that the most common reasons for rejection of RE projects are scales of development that are not appropriate for the proposed area, inadequate communication to the local community and high ratio of costs to benefits to the local community. Research suggests further opportunity for communication and consultation would be welcomed by locals and are more likely to be accepted than company own top down control of development (Zoellner et al. 2008). Toke (2005) also believes that also in the UK perceived justice and trust by the local community plays a key role, suggesting that there is a high correlation between planning success and the opinions of the local officers, councils and organisations. This research states that the most important influence is the attitude of the people in the immediate area surrounding the project proposal area, suggesting that local

politics and people play a large role in the success or demise of RE projects. A way to get local people on board with a project could positively influence communities but also help get more planning applications through successfully.

2.2.4 NIMBY's

Literature on public rejection of renewable developments regularly includes the subject of "NIMBY" - Not In My Back Yard. The concept of "NIMBYism" is a broad-brush term to describe those who are generally in favour of renewable energy, which is, until it is in their local area – 'back yard', or are directly affected by it. There is controversy over the term, Devine-Wright (2011) damming it a pejorative label used to undermine opponents viewpoints.

Opinion polls regularly have shown continued support for renewable energy (McGowan and Sauter 2006) with the most recent study by the Department for Energy and Climate Change in 2016. This survey, the seventeenth wave of the opinion tracker, showed 81% of people supporting renewable energy, and only 4% opposed, only 2% of which were strongly opposed (DECC 2016). However, in practice real projects face difficulty at the public consultation stage and are sometimes even abandoned completely (Toke 2005).

Devine-Wright (2009) points out the NIMBY concept assumes a direct correlation between proximity to a project and level of opposition, but Devine-Wright (2009) argues that it is a much more complex psychological process associated with place change. van der Horst (2007) from the university of Birmingham has reviewed and concludes that a) proximity does have an influence on public perception but this varies on the spatial context, and b) the

influence of the term ‘NIMBY’ can actually negatively affect the truthfulness of interviewees for fear of being branded with the term .

Finally, the NIMBY concept is also used as a derogatory term that groups people, who have little knowledge about renewables, and the avenue of research should be to dispel myths; when conversely people in opposition are often highly informed (Devine-Wright 2009). By assessing knowledge levels, this report aims to see if this is the case on a regional basis in Dorset, and whether views also vary with demographics.

Public engagement and the sharing of knowledge from both the development agency and the local residents, public engagement can provide to opportunity to identify any concerns or issues (Wolsink 2006) in the areas addressed above and accommodate them early on in the process.

2.3 Ambiguous terminology for ‘public acceptance’?

Extensive research has developed to understand why there is such opposition to the development of renewables also termed as ‘public acceptance’, or being ‘pro-renewable’. However, the terms used are themselves a sliding scale and ambiguous (Batel et al. 2013). Batel et al. (2013) argues that the use of the term ‘acceptance’ should be further discussed. Although this study is concerned with overhead power lines and not directly renewable projects, it highlights the effects of wording when dealing with public opinions. There are also differences in general attitude, local attitude, acceptance, and support (Devine-Wright 2007; Aitken 2010; Batel et al. 2013). Batel et al. (2013) critiques people may accept the infrastructure associated, but not necessarily actively support it, and this is

distinctly different shown in Figure IV. For instance, Regen South West (2004) only uses ‘support’. Wording has a critical influence (Aitken 2010), and every study has inherent biases ranging from who conducted the survey, style of questioning, intent and purpose of the survey and how knowledgeable the people being surveyed are (McGowan and Sauter 2006; Aitken 2010).

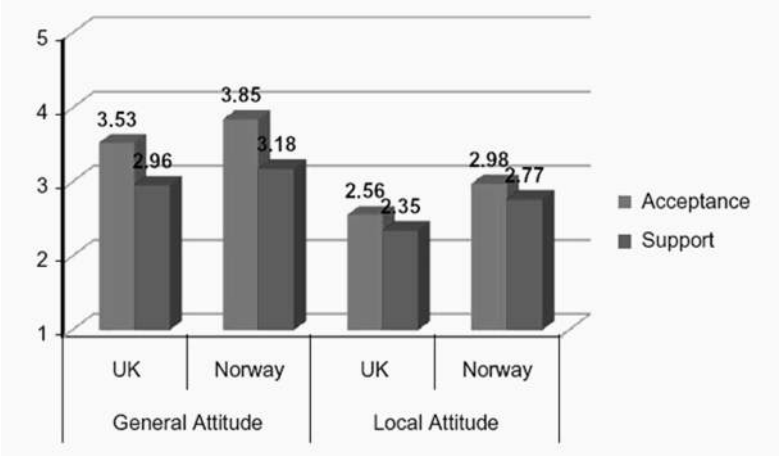


Figure IV: (Batel et al. 2013) showing differences in acceptance and support for infrastructure associated with technologies, in this case overhead powerlines in Norway and the UK. Answer 1 is not accepting/supporting and 5 as very accepting/supporting.

2.4 Links between knowledge levels and public acceptance of renewable energy

Previous studies of public acceptance have been driven by assumed deficits in public knowledge and consequently understanding (Devine-Wright 2007). Some studies show individuals are more accepting or positive about renewable technologies with awareness but other hand studies have found levels of support are independent of high or low levels of awareness (Devine-Wright 2007). For wind energy, Ellis et al. (2007) found no relationship between knowledge and acceptance.

Opinion of renewable energy is rarely black and white, either on the side of purely supporting or against the development. A more accurate depiction is

described by Wolsink (2007) in a review of the current literature of a ‘U-shaped’ opinion. Public acceptance can range from very positive to negative, and vary over time. In the case of wind power in Europe, it is a continuum from positive in general about wind power, to more negative when a specific project is proposed to positive gain after construction (Wolsink 2007) although this is a broad generalisation and needs to be investigated at the local level in Bournemouth.

2.5 Socio-demographic factors

When studying social acceptance of renewable energies, many different factors are investigated. Some examples are; socio-economic background, age, income, political stance, behavioural psychology and place attachment (Hall et al. 2013). Perceived trust or justice in systems can also play a role but is much harder to assess (Huijts et al. 2012). It can even be down to the personal reputation of the company (Hall et al. 2013).

Support for renewables as discussed previously is high in general (DECC 2016). Devine-Wright (2007) summarises that factors for public perception studies can be limited to three levels;

- Personal (age, gender, class, income)
- Social-psychological (knowledge and direct experience, environmental and political beliefs, place attachment)
- Contextual (technology type and scale, institutional structure and spatial context)

Delving into psychological, institutional e.g. trust, beliefs is outside the scope of this paper, and is highly variable in how it is tested. This paper aims to tease out

only awareness and understanding against support for renewables, acknowledges it is not in isolation without other factors. Social class is difficult to categorise on a household level, so income is used as a better indicator and has produced differences in previous studies, e.g. the £30,000 limit, whereby Devine-Wright (2007) reports that individuals earning over this bracket are more likely to support renewables. This is slightly higher for the DECC (2016) study that found self-reported support for renewable energy particularly high in people earning over £35,000 (91%). This report aims only to investigate commercial scale technologies so as not to have variability among scale of projects (contextual).

2.5.1 Age

Age is regularly referred to by papers on public perceptions of renewable energy, whether this is to do with awareness, knowledge, and/or level of support. Devine-Wright (2007) shows higher awareness and likeliness to be opposed to RE in older age groups and similarly, Ek (2005) finds less support with increasing age. McGowan and Sauter (2006) found age to be in some cases contradictory, particularly in older age groups. A study showed the oldest age group (65+) to be the least aware of renewable energies alongside the youngest (16-24) (DTI 2003). In contrast, closer to Dorset studies in Devon concluded the oldest age group (60+) to be the most informed (McGowan and Sauter 2006). Interestingly, Jaber et al. (2017) found, although conducting the study in Jordan, age was the least significant factor in knowledge of renewable energy compared with other factors including differing universities, university departments, and gender.

2.5.2 Gender

Gender studies sometimes show contradictory results depending upon how it is questioned. Differences are found when asking about RE in general, or a specific type of technology (Devine-Wright 2007).

Kollmuss and Agyeman (2002) compared environmental knowledge in terms of how it impacts pro-environmental behaviours, in this case knowledge feeding into environmental attitudes and values. The study found both gender and years of education to be of significance in knowledge and attitudes. Women were found to have less environmental knowledge than men, but had more concern around depleting the environment, also believing less in technological solutions to the problem, but were more willing to change their behaviours (Kollmuss and Agyeman 2002).

Findings show support is higher in women for general renewable energy development compared to men (90% vs 66%) (Devine-Wright 2007). However, national surveys have identified higher levels of awareness of renewables amongst men (85% vs. 67%) (Devine-Wright 2007). Furthermore, the same report summarises women to support wind farms less than men.

2.5.3 Economic prosperity and income

It is indicated that individuals earning more than £30,000 and of ‘AB’ social class are more supportive of renewable energy, and more specifically towards wind energy (Devine-Wright 2007), which is in direct contrast to findings of Ek (2005) which found higher income translated to less support.

2.5.4 Level of education

Kollmuss and Agyeman (2002) also found the longer time spent in education meant more knowledge around environmental issues, although more education did not necessarily translate to more pro-environmental behaviours. Furthermore Castell et al. (2014) previously highlighting the differences surrounding where people get their information from in depending on educational attainment.

It is important to be aware of these demographic influences, not only to acknowledge the sampling set diversity, but also to be aware of the effects these may have on levels of knowledge and support for renewables shown in Table I.

Personal Factors	**Psychological Factors**	**Contextual Factors**
Age (DTI 2003; RegenSW 2004; Devine-Wright 2007; Batel et al. 2013)	Degree of awareness/understanding (Kollmuss and Agyeman 2002; Devine-Wright 2007)	Technological: scale and type (micro – building, meso – community, macro – power station) (Devine-Wright 2007)
Gender (RegenSW 2004; Devine-Wright 2007; Batel et al. 2013; DECC 2016) KOLLMUSS	Political beliefs (Devine-Wright 2007)	Ownership structures (Devine-Wright 2007)
Social class (Devine-Wright 2007; Batel et al. 2013; DECC 2016)	Environmental beliefs and concern (Kollmuss and Agyeman 2002; Devine-Wright 2007)	Distribution of benefits and use of participatory public engagement (Devine-Wright 2007)
Income (RegenSW 2004; Ek 2005; DECC 2016)	Place attachment (Devine-Wright 2007)	Spatial: regional and local context, proximity (Devine-Wright 2007; Batel et al. 2013)
Education (Kollmuss and Agyeman 2002; Castell et al. 2014)	Perceived fairness and levels of trust (Devine-Wright 2007)	

Table I: A summary of socio-economic factors affecting studies of renewable energies (Own creation).

2.6 Dorset focus: Solar PV, onshore wind and offshore wind

To focus in on Bournemouth's public perception of renewable energy, it is important to include the context of renewables at present in the area. At present, the latest summary statistics for renewable installations in Dorset was by Regen South West (2016) in Figure V.

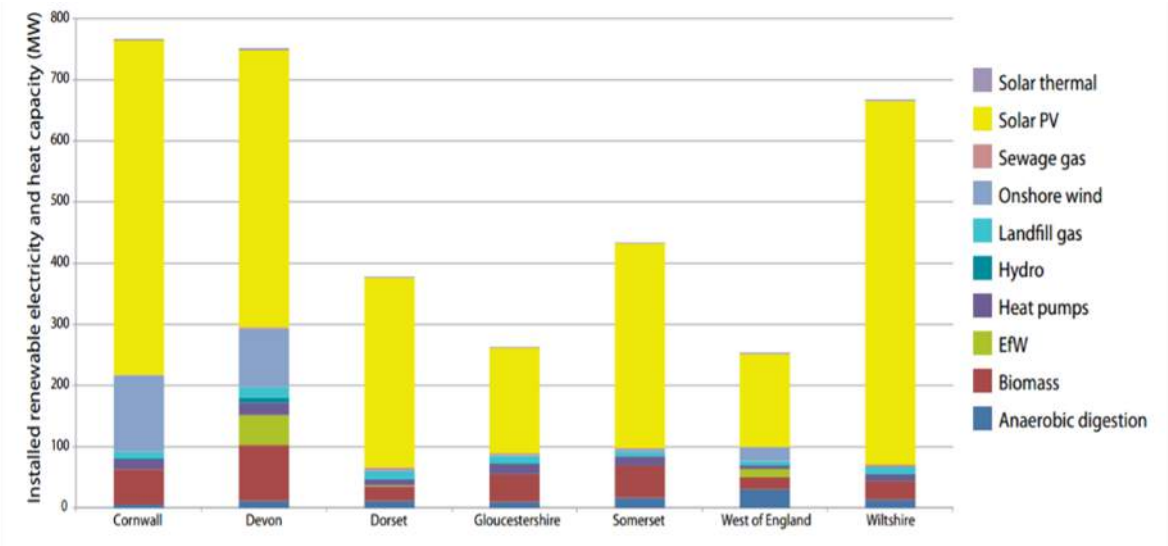


Figure V: Geographical spread of renewable energy capacity in the South West, showing differences between onshore wind deployed in Dorset and neighbouring Devon (RegenSW 2016).

For onshore wind power, opposition to planning applications has meant installed capacity is much less than the rest of the South West (BournemouthCouncil 2013). The strategy proposed to 2020 is actually thought to be a fraction of the potential due to public opposition; opinion surveys finding 26% 'strongly opposed to onshore wind' and 55% 'supporting or strongly supporting' (BournemouthCouncil 2013).

There is high awareness about wind and solar, and lower public understanding for other low carbon sources such as biomass, biogas and carbon capture

(Devine-Wright 2007) so this study will only test wind and solar together to minimise variance in knowledge around technologies when grouping them together. According to a scenario study by Regen South West (2016), solar PV and wind top capacities in the future scenarios for Dorset, although also highly ranked biomass is not included because of the difference in awareness.

As previously stated, regionalism and the local community are important when investigating the resistance to large scale projects. In Dorset, commercial solar and wind are the highest generators of electricity, and the most iconic. Studies usually consider these two renewables in isolation, this thesis questions both together to whether the public are in general opposition to renewable energy and scope the reasons behind this.

Dorset has had a troubled past with planning applications on renewable projects. ‘Navitus bay’ was a highly contentious offshore wind farm off of the Dorset coastline and had massive public rejection, which caused a polarisation of opinions, and ended in complete rejection of the proposal upon grounds of visual impact. A report on Navitus bay found that the best method for engagement among stakeholders (coastal residents, businesses, divers and environmentalists) would be an open online forum and reactions were more likely to be positive if financial compensation was involved. However, it is not uniformly the case, and mariners (commercial and recreational) rejected the projects the most, regardless of incentive (William 2015).

The aims of this study hope to address the reasons why this is the case, and whether education, and raising knowledge levels around renewables would help the public endorse a positive opinion of these projects. Conversely, if there is no

link between knowledge and perception, what are the main concerns that can be addressed to create a harmonious renewable development programme like case studies seen already in Europe?

4. Methodology

4.1 Overview

To investigate knowledge, the method follows a questionnaire style survey approach, released in Bournemouth both online and by post. A combination of qualitative and quantitative questions were analysed to statistically test in SPSS, but also to gain a more in depth insight into the issues surrounding the commercial development of RE.

4.2 Literature search methods

Journal articles were used from dates 2007- present. In select cases, a few journal papers were used from before (UNFCCC 1998; Tinker et al. 2005) where these were used to illustrate a set purpose or legislation. It was acknowledged that the opinions represented here will be dated compared to the present. Literature searches were conducted using 3 primary sources; Google scholar, Scopus and Bournemouth University library search. Furthermore, Bournemouth university library hard copies of books were used.

Key words used in the initial search were; “public perception”, “public attitudes”, “public opinion”, and refined by search terms “renewables”, “renewable energy”. The initial search for literature was conducted on Google scholar, searching “Public perception renewable energy”. There were 17,900 total returns and 20

were selected and 10 directly cited in this report. From these papers, a large web of literature was identified through in text citations and summaries of other research.

Paper selection was based upon the source of the information and the date, to maintain relevance constantly changing environment of public perception. Journal articles were preferential, supported by books to gain an introduction to the topic, and only online sources were used when directly sourcing information such as datasets or statistics, for example current statistics for Dorset, which could not be found in peer-reviewed articles. Studies in the UK were favoured, but some European case studies were included and only worldwide papers were cited where the material is relevant but it is acknowledged opinions may not directly reflect those in the UK.

4.3 Approach to the project

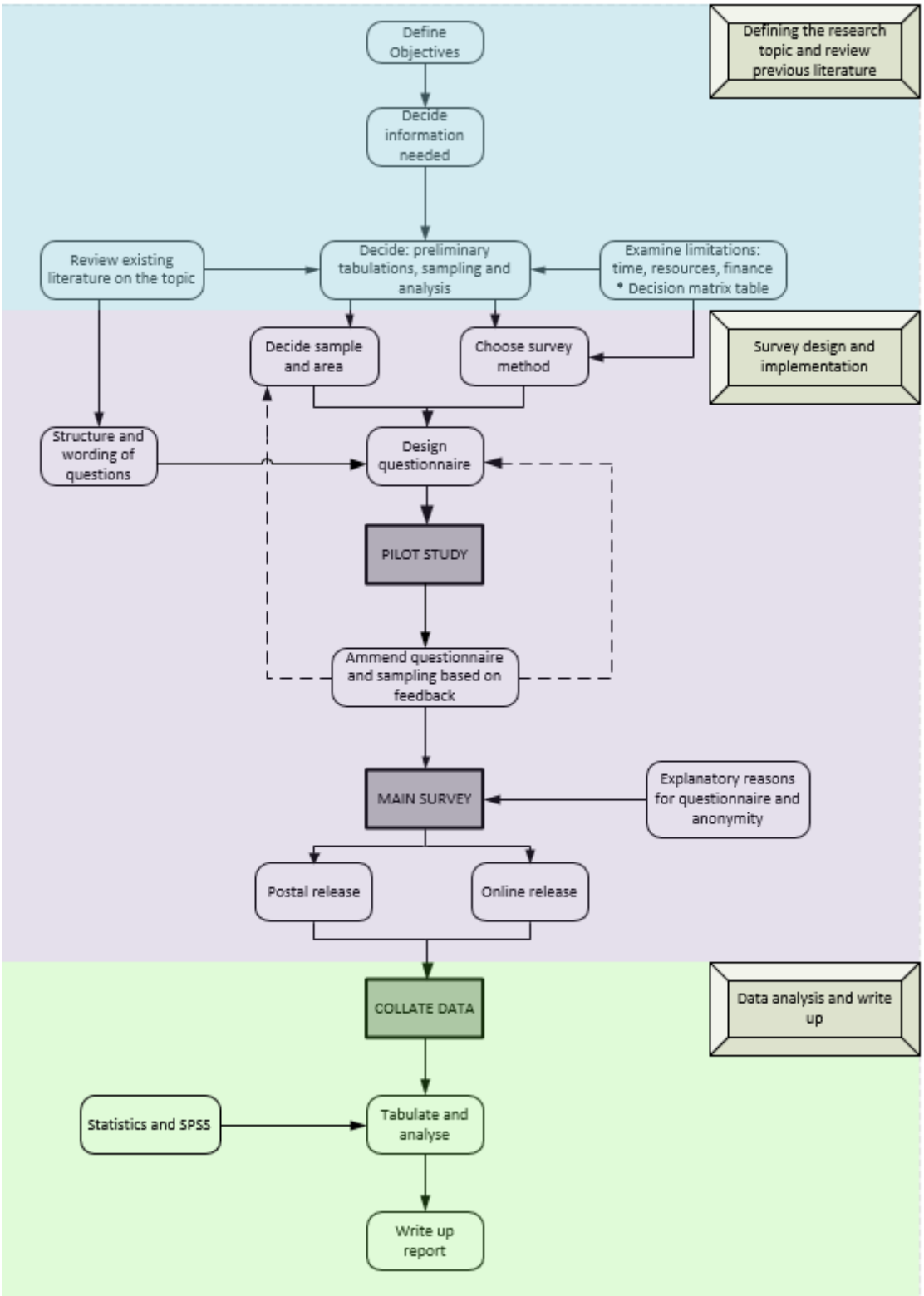


Figure VI: Flow chart of the research design through stages 1-3: defining the research, survey design and implementation, data analysis and write up (Own creation, adapted from (Robinson 1998) (Gillham 2008)).

4.4 Methods of data collection

4.4.1 Ethical Considerations

Ethical considerations were assessed using Bournemouth University's ethical checklist form. The project was deemed not to be on sensitive or confidential subjects. However, it was acknowledged that when questioning personal information, such as age, gender, and income, these used only tick-box style questions (Robinson 1998) and a statement of confidentiality and anonymity.

4.4.2 Development of data collection method

Formal questionnaire surveys are one of the most common ways in which geographers obtain information (Robinson 1998). They vary greatly in style of questions and can combine both open and closed, qualitative and quantitative question styles (Robinson 1998; Gillham 2008). Questionnaires are a rapid, inexpensive way of assessing a populations characteristics of beliefs (Robinson 1998), in this case opinion about renewable energies. In line with the aims of this project, the main purpose of the survey was to collect data from the general public on their perceptions of commercially sized solar and wind technologies. Table II summarises the decision-making process that ended in a questionnaire style survey that was released both by hand-delivered post and online. The rationale to combine both of these methods is to capture the views of both young and old audiences by post and online. The research followed a plan outlined in Figure VI that was focussed around the survey style data collection summaries as most appropriate in Table II below.

Survey type	Timescale/length		Costs incurred		Expected response and data quality		Advantages		Limitations		Total (30)
Questionnaire Postal Hand delivery and collection	Long return time by post without guaranteed response, delivery/collection guarantees timescale. Short completion 5-30 mins (Dixon and Leach 1978)	1 5	Postage costs (Dixon and Leach 1978). Expensive (1st class 64p, 2nd class 55p) and printing cost. No postage costs when delivered by bicycle only paper and printing costs (Dixon and Leach 1978)	1 5	Postal response rate 56% (Ek 2005), but very variable in different studies, by one researcher 300-500 contactable (Dixon and Leach 1978). Data is quantifiable (Dixon and Leach 1978)	2 4	Household owners expected to be majority of respondents, Respondents fill out when it suits them, analysis of closed questions is straightforward, respondent anonymity, no interviewer bias, standardisation of questions (Gillham 2008)	4 4	Only older viewpoints, and literate individuals who can be addressed by name or household. Open ended questions only in small numbers (Dixon and Leach 1978). Data issues (completeness and accuracy), misunderstandings cannot be corrected, question wording has a large effect, respondent literacy (Gillham 2008)	3 3	11 **21**
Face to face questionnaire	Time consuming to collect and transcribe but questionnaire can be short or vary in length	3	Only printing of questionnaires (9p per questionnaire) and travel costs	5	Guaranteed response at time of survey if accept to take part, qualitative data obtained.	3	Instant responses, can gauge the feeling/personal responses of interviewees, can use visual aids or show cards for explanation of issues (Holbrook et al. 2003), trust and rapport formed during interview (Holbrook et al. 2003), social interaction cues such as body language can add information (Opdenakker 2006)	3	Depends on time/place for balanced demographics Intrusive, people may not have time, interviewer bias.	2	16
Online surveys	Quick to collect and quick response times (van Selm and Jankowski 2006; Wright 2005)	5	Inexpensive compared to other survey methods (van Selm and Jankowski 2006; Wright 2005), generally free for online services but pricing packages can vary on how many responses are required (Opdenakker 2006; Wright 2005)	5	High response rate and can be disseminated to a wide audience easily and quickly. Quantitative and qualitative. However, only number of responses is known, not response rate (van Selm and Jankowski 2006; Wright 2005)	5	Can control non-responses by forcing choice before continuing, absence of interviewer bias (van Selm and Jankowski 2006), efficiency of data collection and collation (van Selm and Jankowski 2006), convenience for respondents (van Selm and Jankowski 2006) anonymity can increase openness of opinion and higher response rate in young people (van Selm and Jankowski 2006)	4	Difficult to control area of respondents so large geographic reach may loose where respondents are coming from (van Selm and Jankowski 2006) potential for multiple responses from one person unless collecting a unique code e.g. email but limits anonymity (Wright 2005) systematic self-selection bias i.e. already interested in the subject more likely to participate (Wright 2005)	2	**21**
Telephone interviews	Quick turnaround time (Holbrook et al. 2003) once dialling list is identified	2	Low costs (Holbrook et al. 2003) only minimal phone call costs (depending on number of respondents)	3	If organised, 100% of attempted calls, but will be to a smaller range of people targeted Qualitative, potential call blocking from unknown numbers (Holbrook et al. 2003), wide geographical access and, anonymity (Opdenakker 2006).	3	Can get responses that are more in depth and personal opinion, phone interviews can be a very effective and economical way of collecting quantitative data, if the individuals in the sampling frame can all equally be accessed via a telephone and if the questionnaire is fairly short, cannot assess social cues such as body language (Opdenakker 2006) when cost is restrictive (Opdenakker 2006)	4	Some may not have landline (Holbrook et al. 2003). Intrusive at home, can work for focus interviews i.e. with companies, selection of respondents introduces bias and focus only on one person's viewpoint when general public views are the aim, studies have shown lower education level, fewer older people in respondents over the phone than face to face (Holbrook et al. 2003)	2	14
Structured / unstructured interview	Long to organise, transcribing time can be long especially with complex questions to code. Timescale sample size dependent (Dixon and Leach 1978)	2	Interviewers and travel costs, stationary, recording devices (Dixon and Leach 1978) Interview and travel costs, stationary, recording devices (Dixon and Leach 1978)	1	Not a high response rate but detailed qualitative or exploratory data. 30-50 contactable by one researcher (Dixon and Leach 1978)	3	Can get a variety of response and get in-depth exploration of issues and ideas. Appropriate for when the subject matter is very sensitive, but not personal. Subjectivity and emotional responses can be explored and suitable for complex opinions (Clifford and Valentine 2010).	4	Only get the viewpoints of a few, select people when required is the broader tests of the general public's knowledge. Long transcription times and complex analysis hinder how many can be undertaken (Opdenakker 2006), not suitable for large sample surveys (Robinson 1998)	2	12
Focus groups	Long time to organise, transcription is particularly complex with large numbers of people in the recording (Clifford and Valentine 2010).	2	Organising, reimbursing respondents travel or providing incentives is expensive and interview material costs.	1	Not a high response rate but detailed qualitative or exploratory data. Cultural context is important to consider (Clifford and Valentine 2010).	3	Can get a variety of response and get in-depth exploration of issues and ideas. Subjectivity and emotional responses can be explored (Clifford and Valentine 2010).	4	Only get the viewpoints of a few, select people when it is the broader tests of the general public's knowledge that is required., long transcription times (Opdenakker 2006)	2	12

Table II: Decision matrix for sampling strategy, illustrating that to get the general public's knowledge and perception on renewable energy – a questionnaire style survey (postal and online) to target both older and younger age groups is the approach selected (Own creation) (Dixon and Leach 1978; Holbrook et al. 2003; Ek 2005; Wright 2005; Opdenakker 2006; van Selm and Jankowski 2006; Gillham 2008; Clifford and Valentine 2010)

4.4.3 Pilot study and development of the questionnaire

Questionnaire development was initiated after the literature review. The research questions were refined into quantifiable and qualitative questions to in turn answer the broader aim and research questions (Gillham 2008). It was distributed with a sampling strategy that aimed to be both a comparative and representative sample (Gillham 2008) of the larger population of Bournemouth.

Question		Style and aim of the question, data type	Applied literature
Do you live in the Bournemouth area? (Within the black line) ***[Online only]***		Closed question	Local and spatial context is important (Devine-Wright 2007; Batel et al. 2013)
Have any of the following have contributed to your knowledge of renewable energy?		Multiple choice closed question	(Castell et al. 2014)
Which of the following are renewable energy sources?		Test of basic level knowledge, closed, quantitative Multiple choice closed question	Knowledge levels (Kollmuss and Agyeman 2002; Devine-Wright 2007; Castell et al. 2014)
Which of the following apply to renewable energy?			
Where can wind and solar renewable energy be generated?			
Which renewable energy does the word "photo voltaic" relate to?		Test of higher level knowledge / technical terms Multiple choice closed question	Knowledge levels (Kollmuss and Agyeman 2002; Devine-Wright 2007; Castell et al. 2014)
Which country leads Europe in installed WIND energy (end of 2016)*			
What does "MW" mean in terms of renewable energy generation?			
Please rate your own knowledge about renewable energy		To compare to scoring system, couldn't be used alone as it is very subjective	Self-reported
To what extent do you agree with the following statements?	*"I accept the development of renewable energy in the UK"*	To test differences between acceptance/support as well as local/national support differences (testing NIMBY hypothesis) LIKERT style closed questions	Acceptance and support (Batel et al. 2013) and LIKERT to describe an attitude continuum (Robinson 1998)
	"I support the development of renewable energy in the UK"		
	"I accept the development of renewable energy in Dorset"		
	"I support the development of renewable energy in Dorset"		
Which technology do you prefer? (All commercial scale/size)		Qualitative, to understand whether technology preferences play a role	Technology scale and type influences perceptions (Devine-Wright 2007)
Why do you prefer this technology?			
What are your main concerns (if any) about the commercial scale development of wind and solar in Dorset, or have any other comments?		Are any of these related to understanding or knowledge that could be improved?	(Rogers et al. 2008; Devine-Wright 2011)
What is your age?		Obtain quantitative demographics	(Ek 2005; McGowan and Sauter 2006; Jaber et al. 2017)
What is your gender?		Obtain quantitative demographics	(Devine-Wright 2007)
What is your level of formal education?		Obtain quantitative demographics	(Kollmuss and Agyeman 2002)
What is your yearly household income?		Obtain quantitative demographics	(Ek 2005; Devine-Wright 2007)

Table III: Questions in the survey, aims, applications and supporting literature (Own creation).

A mixture of open and closed questions were used. Robinson (1998) describes the advantages of using both open and closed questions, or preferably a combination of both depending on the type of information required. Advantages to closed questions include; avoiding uncertainty of how to record longer

answers, pre-coding ensures data fits the code needed, and a large number of respondents can be transcribed easily (Robinson 1998). For opinion questions a LIKERT scale was used to refer to an attitude continuum (Robinson 2008). A seven-fold scale was chosen because the target audience are assumed to be less specialist (Sapsford and Jupp 2006), which gives more detail than the five point scale with a wider range of opinion. If the aimed respondents were highly educated and knowledgeable about renewable energy, a 10 point scale would have been more appropriate (Sapsford and Jupp 2006) however the study did not draw assumptions of specialist level knowledge in the general public.

The pilot study was undertaken in the BH9 postcode region. 20 questionnaires were handed out with a 20% response rate. The results indicated that the knowledge questions were of an appropriate level to be answered by the general public as most questions were answered correctly, and a low response indicated issues with the survey.

One question “what directly does the word photovoltaic mean” was altered because it was misleading. The direct definition answer was “light electricity” but is also related to “solar energy” regularly so was ambiguous. This question was consequently changed to “which renewable energy does the word photovoltaic relate to” with solar being the correct answer. Furthermore, the questionnaire layout was deemed to be intimidating and too crowded, so the layout was adapted to an online survey style tick box method with an extension from 2 pages to 3.

Some questions began with harder concepts that people with very basic renewable knowledge may find intimidating such as “geothermal” being the first

multiple choice answer. This was changed to “coal” as the first answer as this would be more familiar with respondents. One respondent found the demographic information to be intrusive and not relevant, so in the improved study, a statement of anonymity and explaining why the questions were asked, to maintain a representative sample, was included.

It was acknowledged that in the final questionnaire that it should be self-explanatory and contain no ambiguities (Robinson 1998). Secondly, it should be aware of the factors affecting respondents decision making and answers such as the demographics (Robinson 1998), in this case age, education, and income and gender, however not including those suggested by Robinson (1998) such as family background and type of employment. The pilot study helped refine the questionnaire to have simple language, contain understandable concepts and require a manageable workload for the respondent (Robinson 1998).

A postal pilot study of 20 people with a 20% response rate was to test whether respondents understood questions by asking them to assess the difficulty (Robinson 1998) and also by judging the answers. The pilot was used to refine which is essential any successful implementation of this survey method (Robinson 1998) but the responses were not used in the final analysis. Demographic questions were altered to make it clearer they are anonymous and why they are asked. Some questions were intimidating, such as “which are renewable technologies” – geothermal was listed first and not a familiar resource so was replaced by coal. The general layout and design was altered to be more user friendly and final versions are found in Appendix II.

4.4.4 Postal survey sampling methods

In the postal survey, to maximise representation of all demographic factors identified as influencing opinion in the literature review (Age, Gender, Income, Education) the Index of Multiple Deprivation was utilised (DCLG 2015). The rationale behind this was to spatially locate areas where there are differences in these affecting factors that were identified in the literature review.

The index of multiple deprivation divides the area of investigation into Lower Super Output Areas (LSOAs) which are small parcels of areas within counties or smaller areas, like Bournemouth (ONSGeography 2011). The index identified areas of high and low deprivation separately such as income and education shown in Figure VII and VIII. However, the reason multiple deprivation was used is to see a full picture of all the factors combined in Figure IX. This allowed stratification of sampling by different index scores 1-5 indicated in Figure IX. This enabled a balanced sample of all the demographic factors, with area 1 most deprived to area 5 least deprived. A limitation of this technique is it does not incorporate gender, as it is up to the respondents within a household who fills out the questionnaire.

The sampling process followed Shaw and Wheeler (1994). Initially, the whole population was defined, then the sample frame was defined, sampling unit (post code), sample size and then specify sampling plan and method to collect.

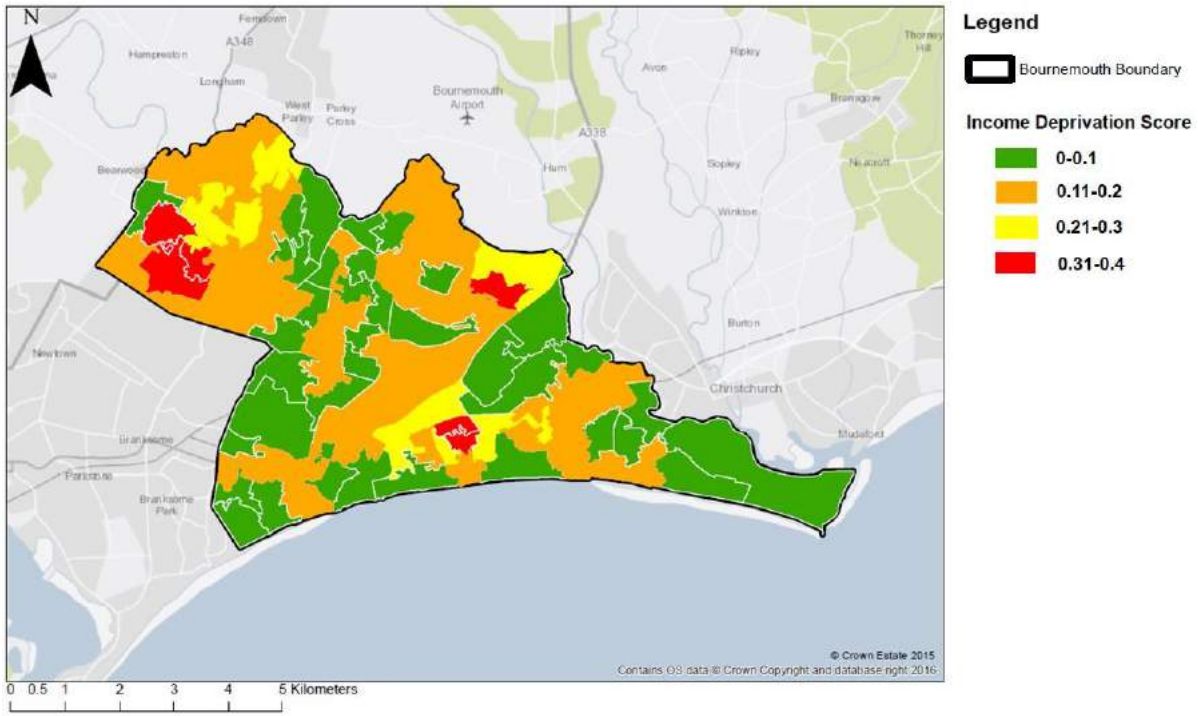


Figure VII: Income deprivation score for Bournemouth, one factor in multiple index of deprivation (Own creation)

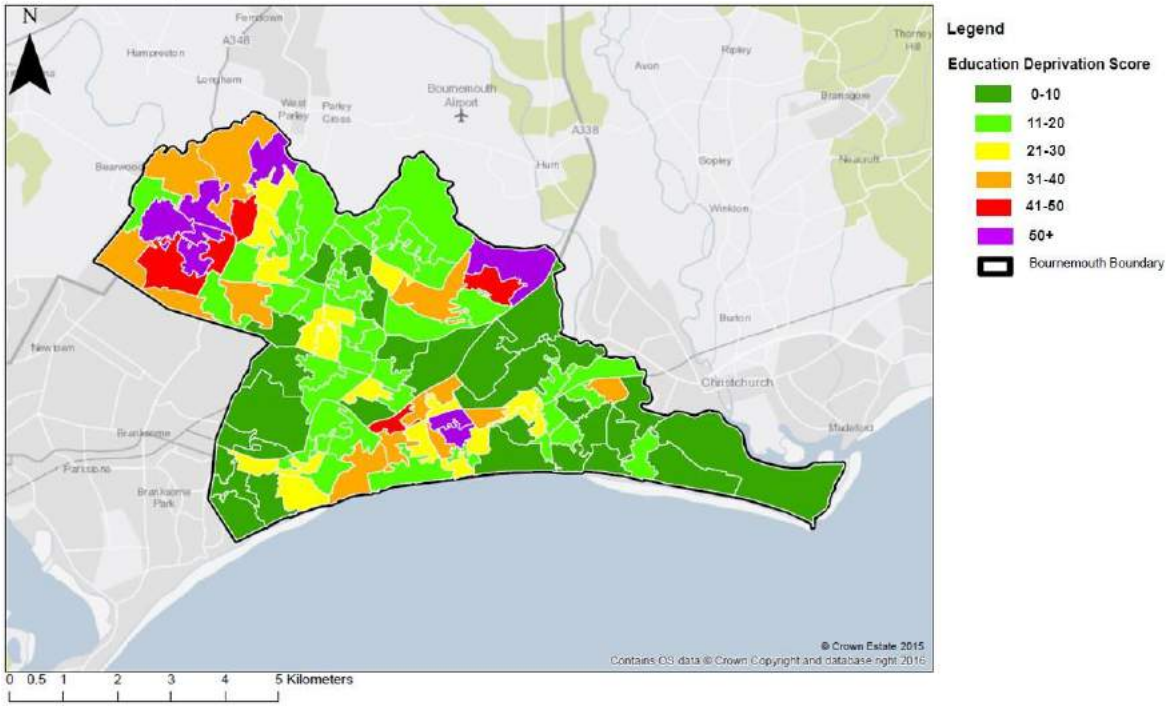


Figure VIII: Education deprivation score for Bournemouth, one factor in the multiple index of deprivation (Own creation).

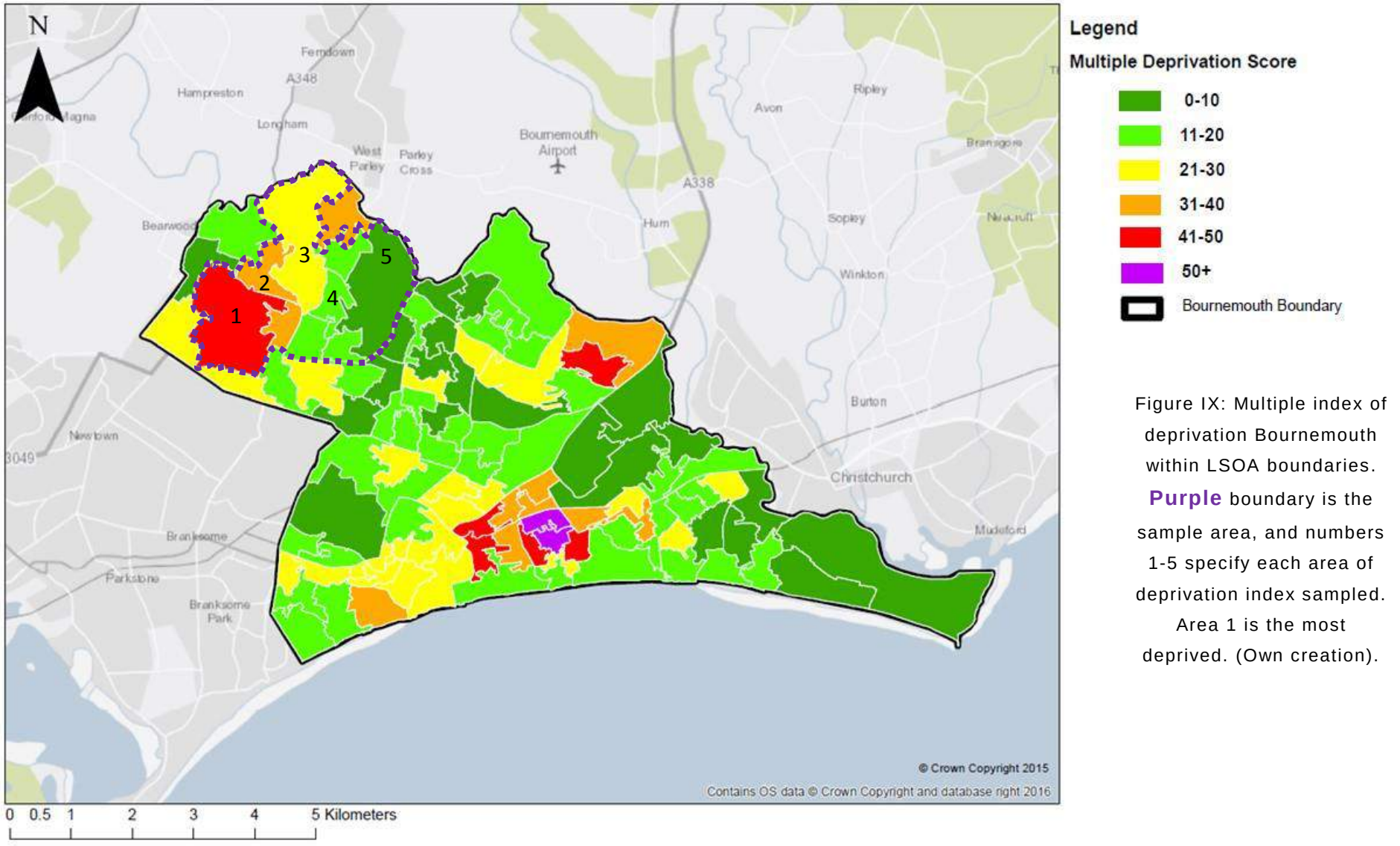


Figure IX: Multiple index of deprivation Bournemouth within LSOA boundaries. **Purple** boundary is the sample area, and numbers 1-5 specify each area of deprivation index sampled. Area 1 is the most deprived. (Own creation).

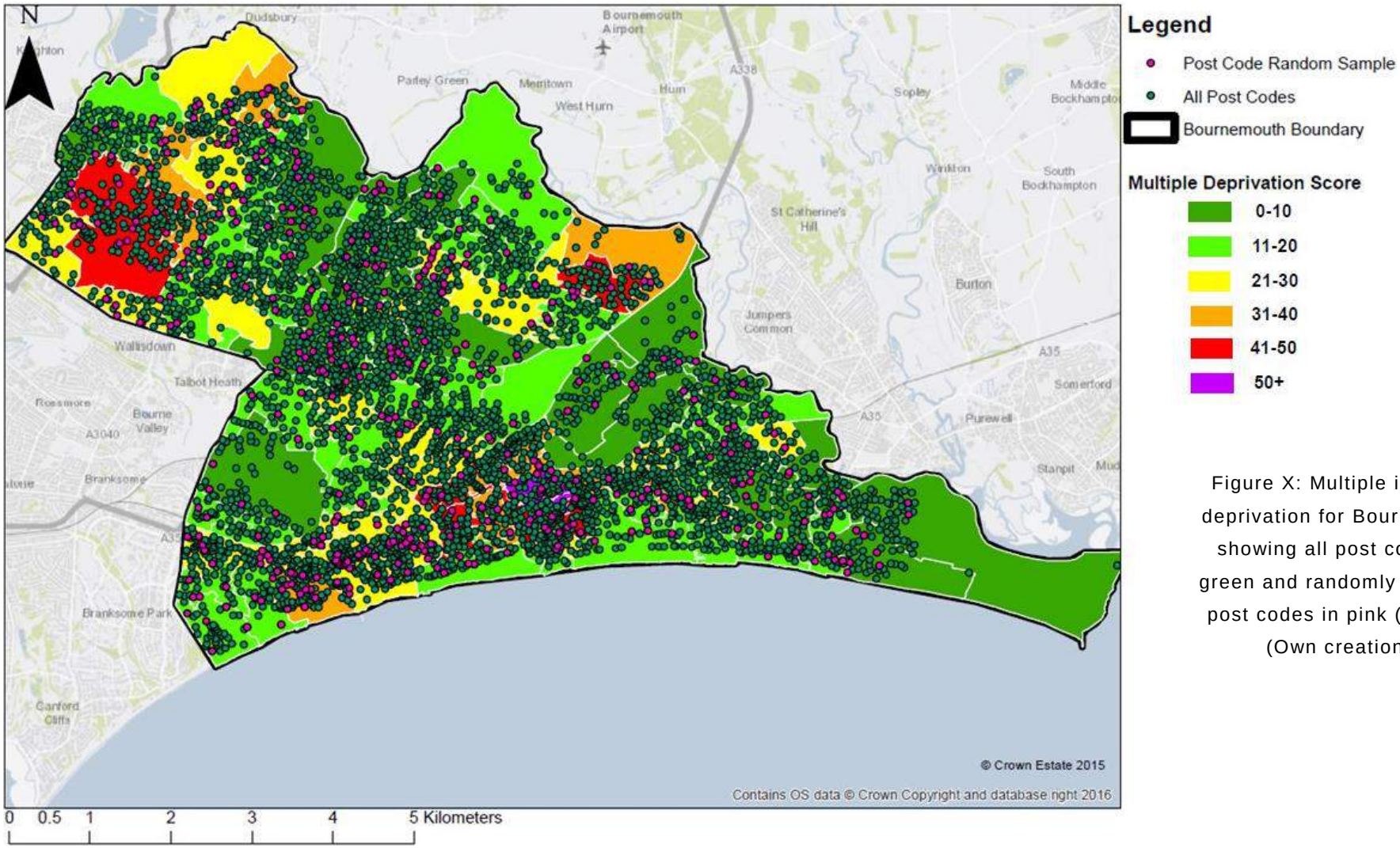


Figure X: Multiple index of deprivation for Bournemouth showing all post codes in green and randomly sampled post codes in pink (1 in 10) (Own creation).

Data sets used for GIS analysis are summarised in Table IV below.

Dataset Name	Source/Reference	Licence
Post code data	(OrdnanceSurvey 2017)	C*ontains OS data © Crown copyright and database right (2017)*
Bournemouth boundary data	(OrdnanceSurvey 2016)	C*ontains OS data © Crown copyright and database right (2017)*
Index of Multiple Deprivation (2015)	(DCLG 2015)	Contains public sector information licensed under the Open Government Licence v3.0.
Lower Super Output Area boundaries (LSOAs)	(ONSGeography 2011)	Contains National Statistics data © Crown copyright and database right [2016]
OS raster colour map 1:25,000	(EdinaDigimap 2017)	© Crown copyright and database rights 2017. Ordnance Survey (Digimap Licence)

Table IV: Summary of data sources for postal method in Figures VII-X (Own creation).

All of the datasets and boundaries were searched online for the bespoke needs of the sampling strategy.

The postal sampling strategy was stratified random, which means any individual in the population is likely to be included by random, and also the population divided into subsets with representation from each category (Robinson 1998; Gillham 2008). Stratifying the population is particularly important if there is identifiable natural strata in the sample such as socio-economics of age; in this case by age, gender, income and education (Robinson 1998). It assumes that these stratified populations are internally similar and every member must only fit into one category (Robinson 1998) and in this case Figure IX by intervals of score on the index.

The final sample was stratified by the multiple index of deprivation (DCLG 2015) and randomised by post code. All of the postcodes in the Bournemouth

boundary were identified in Figure X (OrdnanceSurvey 2016, 2017), and then using the “Sample Design Tool” in ArcMap software 1 in 10 random points were selected for points to sample in (Buja 2016). The area indicated by the purple boundary in Figure IX were the LSOAs sampled because there was every multiple index score adjacent to each other close enough to post by foot, post codes were identified in the attribute table in ArcMap. 150 questionnaires in total were delivered and hand-collected, 30 in each area of deprivation marked 1-5 on Figure IX between the 2nd and 7th of February 2017.

4.4.5 Online sampling methods

To complement the postal survey, the same questionnaire was released online to reach a younger audience. The benefits of this method are summarised in Table II. The problem with this data collection method is limited ability to control the sample strategy in terms of age, gender, income and education, however the influences of this are summarised in the results section and the benefits that on a social media platform a younger audience can be reached to complement the postal survey.

The online questionnaire was released on 5th April 2017 for two weeks on social media (Facebook) to reach out to a younger audience or those more inclined to respond online. Table V summarises the places it was released after a search was conducted to find community pages and pages about Bournemouth. Political stance was not included as a factor for this questionnaire so was not a restrictive factor when selecting where to release the questionnaire.

Arts University Bournemouth	Bournemouth Community Centres
Bournemouth University	**BH Green group**
Bournemouth labour, **Bournemouth green party**	Bournemouth voice
Kinson community centre	Bournemouth, Dorset and Poole Activities Coordinators Forum
Bournemouth voice	Skills & Learning Bournemouth, Dorset & Poole: People & Community

Table V: Groups on social media where the questionnaire was released highlighted in **bold** are political groups which could potentially be biased in terms of opinion of renewable energy but due to the limited number of places found for it to be released they were included to maximise response rates and political stance was not investigated (Own creation).

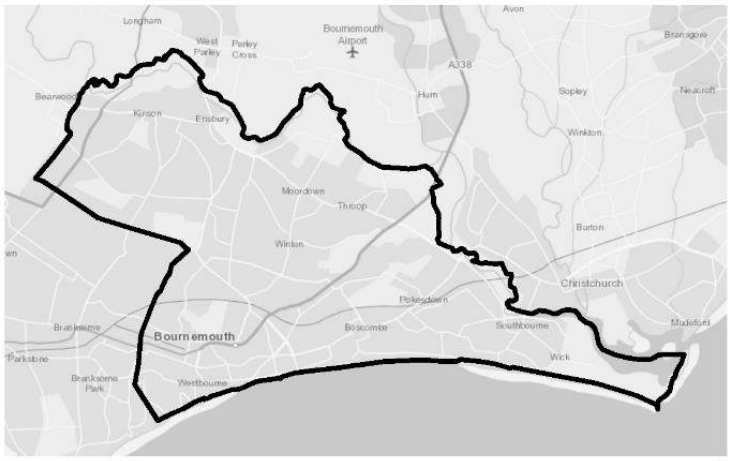
In support of the Bournemouth offshore wind farm	Bournemouth & Poole events
Bournemouth, Dorset	Branksome Dene Community *(outside survey area)*
Bournemouth Echo	**Conservative, UKIP, Liberal Democrats** *(could not post on the page)*

Table VI: Groups on social media that were either deemed heavily biased in terms of renewable energy opinion, general pages that may not necessarily target residents, or pages that were not able to be posted on by the public.

In **bold** are the political groups that were not omitted due to political stance, but because the pages did not allow public postings for the survey on the page.

The format of the surveys were the same layout as the postal which was printed from the online version and condensed to 3 pages. There was only one difference between the surveys, which was an additional question to make sure the respondent lived in the Bournemouth boundary area, to compensate for less control over the survey area when disseminated online in Figure XI.

Do you live in the Bournemouth area? (Within the black line)



- Yes
- No
- Not sure

Figure XI: Additional question for online sampling to make sure that sampling area strategy is maintained.

4.5 Sampling issues and limitations of the data collection methods

The first consideration for the questionnaire is to be careful that it was written by a researcher with a special interest in the topic (Robinson 1998), which could overcomplicate the questionnaire for respondents that would make it too demanding, which was much more likely to be the case than it being oversimplified (Robinson 1998). However, once the survey is sent out, there is limited room for interviewer bias as they are not present, such as that in an interview style approach (Robinson 1998). During the online release of the survey, some of the respondents could have had a bias towards renewable energy, such as the “BH Green Group” or the Green political party.

Limitations of the method are summed up in the decision matrix in Table II. To address issues of the ages of respondents, the combination of both online and

postal methods were used. To complement the restrictive scope of closed questions, open questions were also include to allow further issues surrounding concerns about renewable energy (Robinson 1998). However, these do not allow the complex in depth discussions that interviews could.

4.6 Methods of data analysis

The methods of analysis follow the structure of the research questions outlined in section 1.4.3.

4.6.1 Top three methods of communication about RE

The data obtained from question one is a quantitative multiple-choice style. The answers were totalled per category and age group and summarised.

4.6.2 Level of knowledge by age, gender, income and education

To analyse knowledge split into categories, box plots were displayed to visually see differences in spread of data and variances in means. Standard deviation is quoted, which is the square root of variance measuring the average deviation of the points about the mean (Robinson 1998). Furthermore, ANOVA analysis was used with a 95% confidence level. This was used for age, income and education because there are more than two samples to assess whether there is a significant difference between groups (Robinson 1998). If significant differences are found between groups, then post-analysis tests would be used to decide which groups these are (Robinson 1998). For gender, an independent T-test was used because there were only two categories.

4.6.2 Link between knowledge and level of support

The two sets of data collected here were score out of 21 for knowledge, and a LIKERT score for support in Dorset. The total knowledge score was in two sections. In the first section there were 3 questions, each with six answers to choose from and three are correct. Each correct tick was a point, as well as correctly left alone questions. The second section was 3 questions, each out of four with only one correct answer. Correctly answered questions scored a point, with a total of 3.

Spearman's rank was used to test the relationship, which tests a sample that is representative of the larger population (Robinson 1998). Spearman's rank was used because support is ordinal data (score 1-7), and knowledge is continuous (score out of 21) (Robinson 1998). The correlation coefficient represents a measure of the differences in ranking of the two variables (Robinson 1998). Significance was used at least at the 95% confidence level, which means there is only 5% chance the relationship observed occurred by chance, to accept or reject the null hypothesis. 'N' was reported for all statistics, which is the number of observations (Robinson 1998).

4.6.3 Comparisons between acceptance and support

Paired t-tests were used to compare both acceptance and support in Dorset and the UK. Four tests were run to compare all combinations; support in differing areas, acceptance in different areas, and acceptance and support within both areas.

4.6.4 Main concerns about the commercial development of renewable energy

These questions in the survey obtained open ended qualitative responses. For analysis they were treated like other qualitative data like semi-structured interviews. Essentially, the responses were coded to identify main themes in the data, and one response can have more than one code or theme (Robinson 1998). Each theme is then summarised and presented, including direct quotes and summaries as to how many people saw this as an issue. This allows insight into personal views and development on the questions that multiple choice quantitative questions do not. Visual graphs were included to group the quotes and views into factors to allow easy interpretation of main themes. The reasons behind using this qualitative method is to understand whether any concerns about the commercial development is to do with public knowledge around the subject.

6. Data results and analysis

The results are presented summarising all responses, followed by sections detailing results to answer each of the research questions. One significant point to note is that the pilot study responses were not used in the final analysis, or any spoiled questionnaires. These included three online because they were outside the survey area, shown in in Figure XI, and one by post because the respondent did not feel they were capable of answering any questions.

5.1 Summary statistics

In total there were 78 responses to the questionnaire. 48 were by post between the 2nd and 7th of March 2017 and the remaining 30 were online questionnaires collected between 5th and 19th April. Below is a summary of the demographics of the respondents, split by postal and online.

Gender	*Postal (percentage / number of total 48)*	*Online (percentage / number of total 30)*	*Total (percentage / number of total 78)*
Male	48% / 23	33% / 10	42% / 33
Female	43% / 21	66% / 20	52% / 41
Prefer not to say	8% / 4	0% / 0	5% / 4

Table VII: Summary of gender statistics for online and postal responses, and totals for each (Own creation).

Age	*Postal (percentage / number of total 48)*	*Online (percentage / number of total 30)*	*Total (percentage / number of total 78)*
16-24	2% / 1	**80% / 24**	**32% / 25**
25-34	2% / 1	**10% / 3**	5% / 4
35-44	8% / 4	0% / 0	5% / 4
45-54	21% / 10	3% / 1	14% / 11
55-64	**23% / 11**	3% / 1	15% / 12
65+	**31% / 15**	3% / 1	**20% / 16**
Prefer not to say	13% / 6	0% / 0	7% / 6

Table VIII: Summary of age statistics for questionnaire survey, highlighted in **bold** are top two response categories for both postal, online and the total.

Level of education	*Postal (percentage / number of total 48)*	*Online (percentage / number of total 30)*	*Total (percentage / number of total 78)*
GCSE / O-level	**29% / 14**	3% / 1	19% / 15
A – level / Apprenticeship	**29% / 14**	**13% / 4**	**23% / 18**
Degree	17% / 8	**77% / 23**	**39% / 31**
Postgraduate	6% / 3	7% / 2	6% / 5
Prefer not to say	19% / 9	0% / 0	11% / 9

Table IX: Summary of education statistics for questionnaire survey, highlighted in red are the top two response categories for postal, online and the total (Own creation).

N.B: where more than one education category was ticked, highest attainment was used.

Household income	*Postal (percentage / number of total 48)*	*Online (percentage / number of total 30)*	*Total (percentage / number of total 78)*
0-14K	2% / 1	**43% / 13**	**17% / 14**
15-24K	4% / 2	**20% / 6**	10% / 8
25-34K	**17% / 8**	7% / 2	12% / 10
35-44K	0% / 0	10% / 3	3% / 3
45K+	4% / 2	13% / 4	7% / 6
Prefer not to say	**73% / 35**	7% / 2	**47% / 37**

Table X: Summary of household income statistics for questionnaire survey, highlighted in **bold** are the top two response categories for postal, online and the total.

In the postal survey, response rates within the zones of multiple index of deprivation areas varied shown in Table XI according the zones in Figure IX. For online questionnaires, it can only be ascertained that they were from the Bournemouth area.

Zone	*Number of responses*	*Percentage response*
1 – most deprived	4	13.3%
2	5	16.6%
3	12	40%
4	10	33.3%
5 – least deprived	17	56.6%

Table XI: Number of responses and response rates by area of deprivation index 1-5.

5.2 Top three methods of communication about RE

TV is the number one source of information about renewable energy used by 52 people, followed by the internet used by 46 people and then newspapers with 35 answers which are summarised in Table XII.

	Newspaper	*Radio*	*Internet*	*Social Media*	*TV*	*Friends & Family*	*School or taught education*	*Local renewable project*	*Maga zine*	*Environ mental group*
16-24	6	2	**18**	**15**	14	10	**17**	7	2	0
25-34	**2**	1	**3**	**3**	1	**2**	1	0	0	0
35-44	1	0	**3**	1	**4**	1	**2**	0	0	0
45-54	**6**	5	**8**	4	**8**	3	3	3	1	1
55-64	**5**	**6**	4	1	**8**	1	1	0	1	0
65+	**10**	**7**	**7**	1	**13**	5	0	2	3	1
Prefer not to say	**5**	2	**3**	0	**4**	0	0	0	1	0
Total using method	**35**	23	**46**	25	**52**	22	24	12	7	2

Table XII: Summary statistics for Q1, which sources of information are different age groups using to inform them on renewable energy. Highlighted in **bold** are the top three methods of communication for each age group.

5.3 Level of knowledge by age, gender, income and education

Knowledge questions were generally well answered shown in Figures XII and XIII below. Most respondents scored 13-18 points in the first section, and were much more evenly spread in scores on the technical questions.

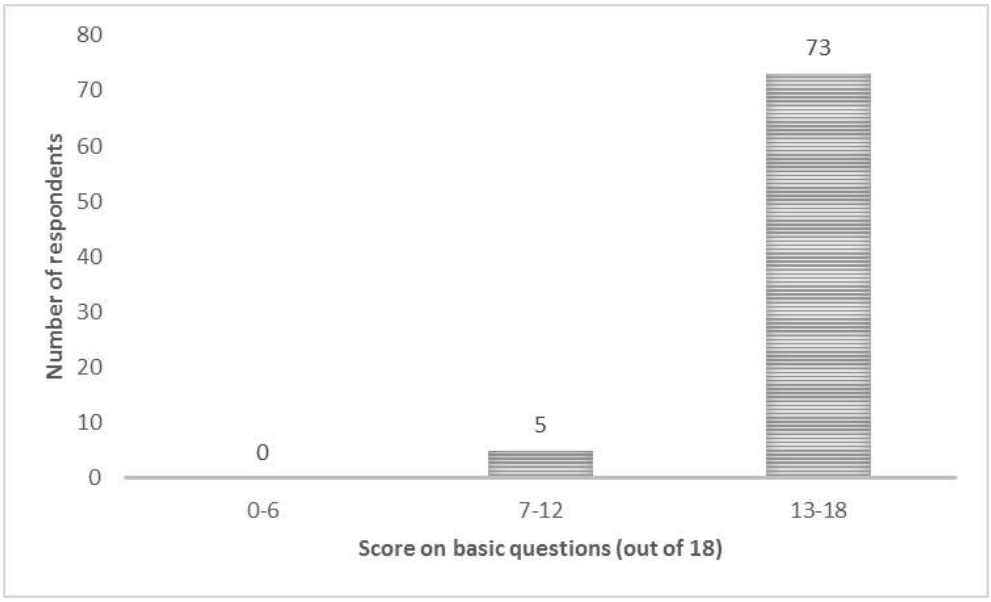


Figure XII: Total scores achieved by all respondents in the three basic level questions with a maximum score of 18.

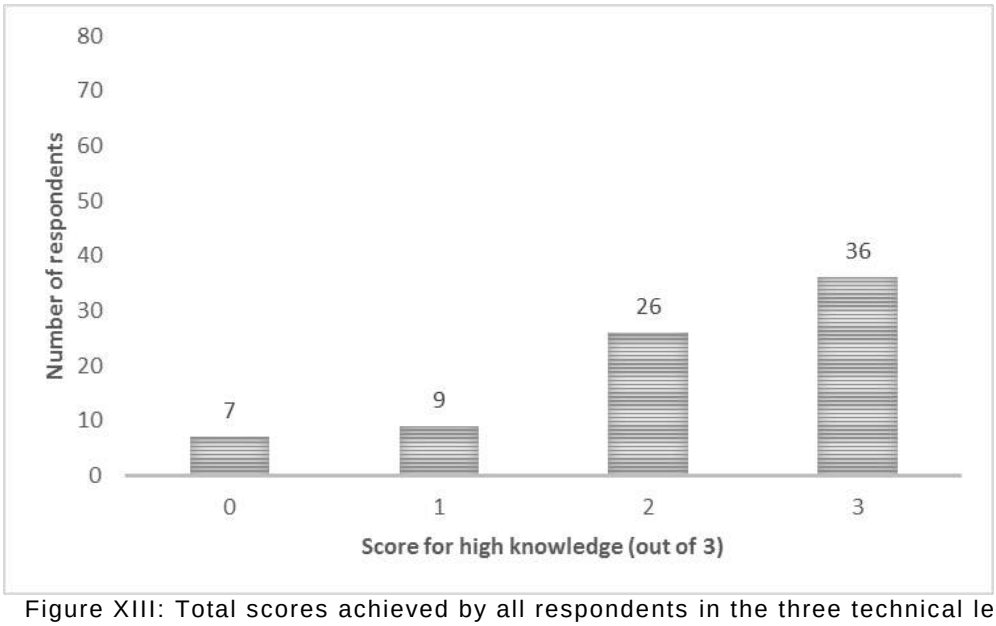


Figure XIII: Total scores achieved by all respondents in the three technical level questions with a maximum score of three.

5.3.1 Age

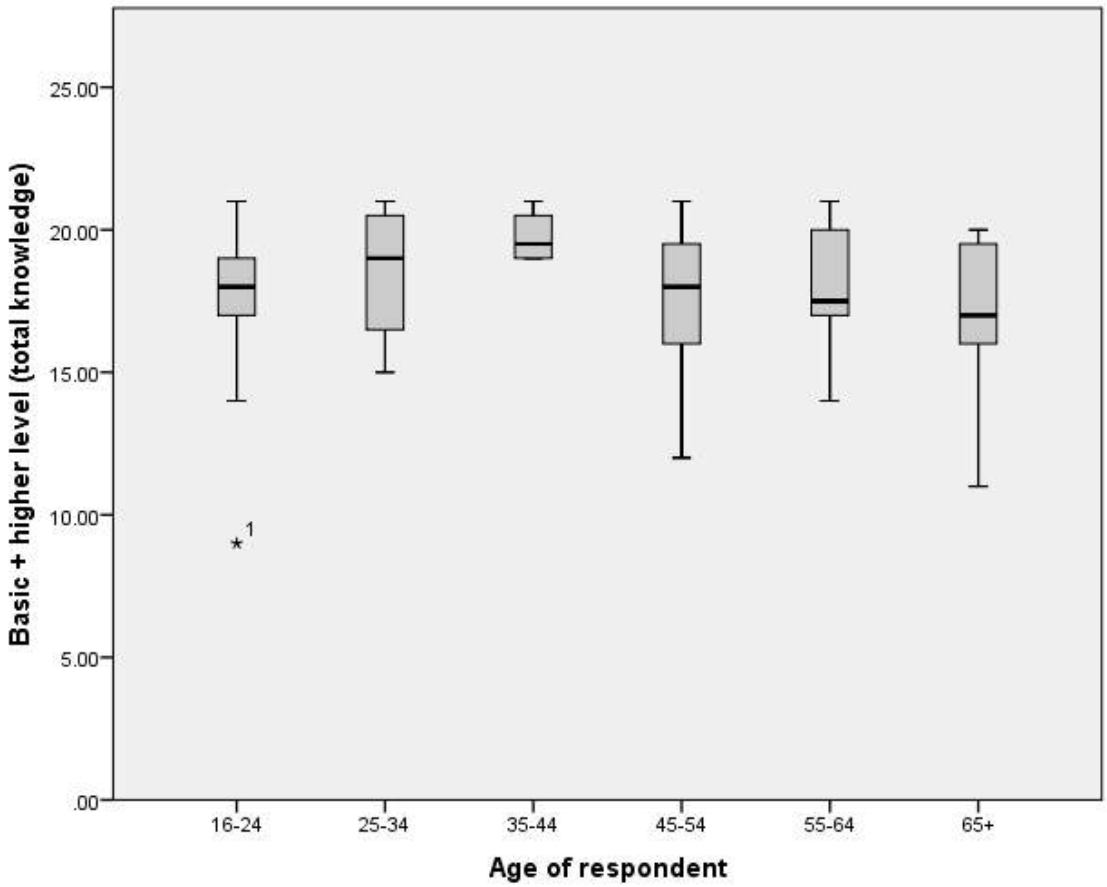


Figure XIV: Box plot of knowledge levels split by age category.

The null hypothesis was “There is no significant difference in knowledge levels between the different age groups”. ANOVA analysis showed there was no significant difference between level of knowledge and age at the 95% confidence level (df = 10, p = 0.392, n= 72), and therefore accepts the null hypothesis.

5.3.2 Gender

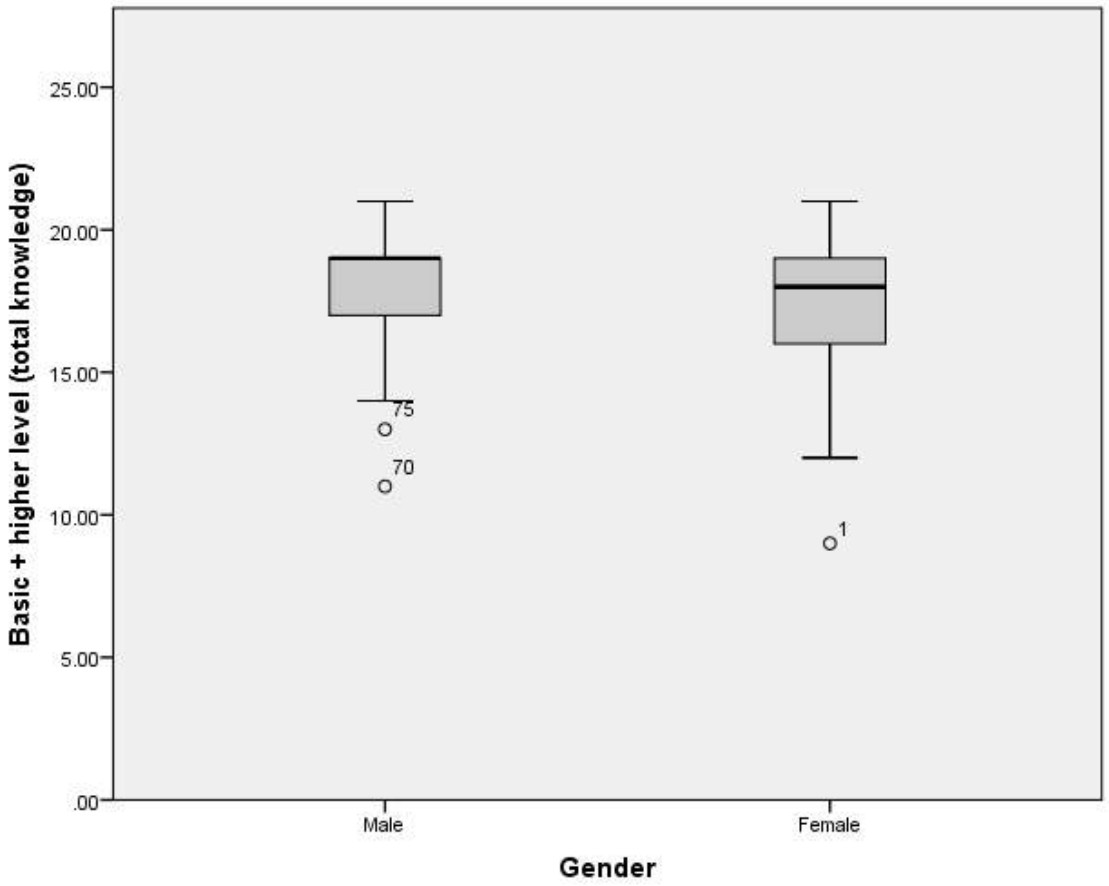


Figure XV: SPSS output box plot of knowledge levels split by gender.

The null hypothesis was “There is no significant difference in knowledge levels between genders”. The independent T-test showed there was no significant difference between level of knowledge and genders at the 95% confidence level (df = 72, p = 0.354, n= 74), and therefore accepts the null hypothesis.

5.3.3 Household income

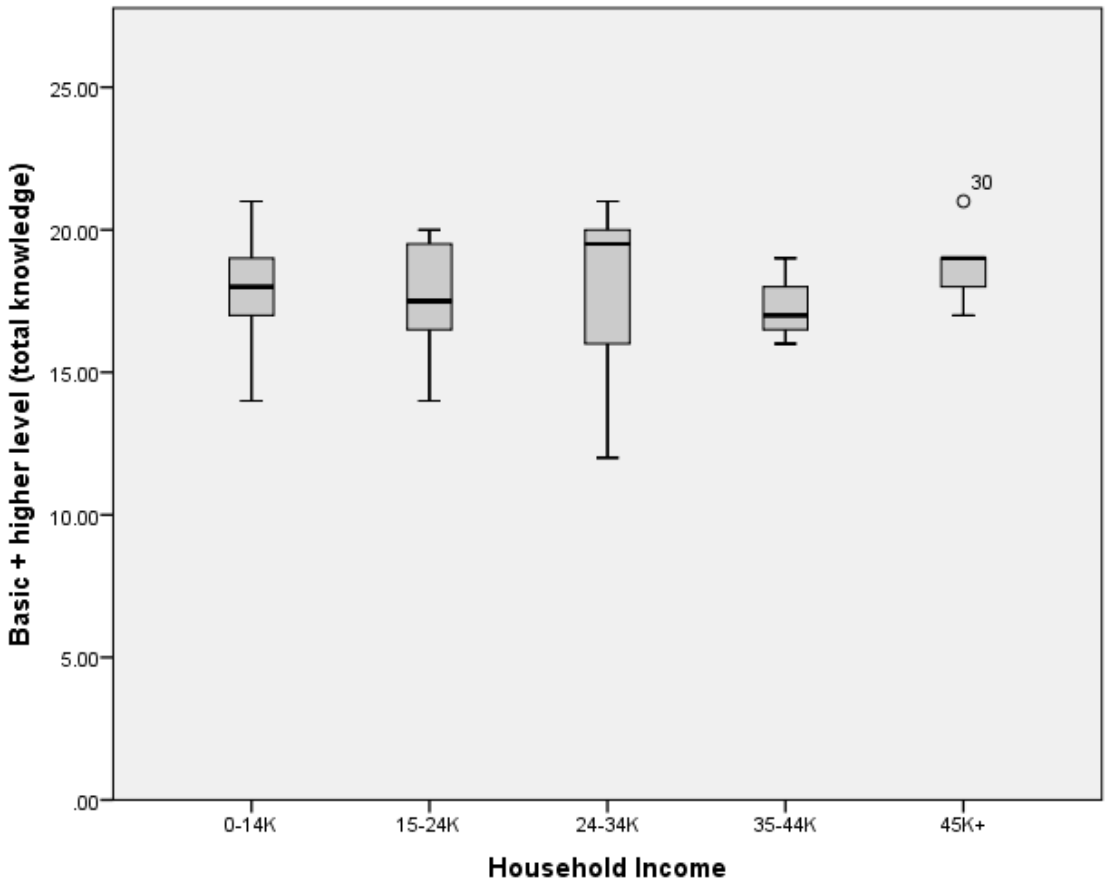


Figure XVI: Box plot of knowledge levels split by level of household income.

The null hypothesis was “There is no significant difference in knowledge levels between the different levels of household income”. ANOVA analysis showed there was no significant difference between level of knowledge and income at the 95% confidence level (df = 8, p = 0.920, n= 41), and therefore accepts the null hypothesis.

5.3.4 Level of education

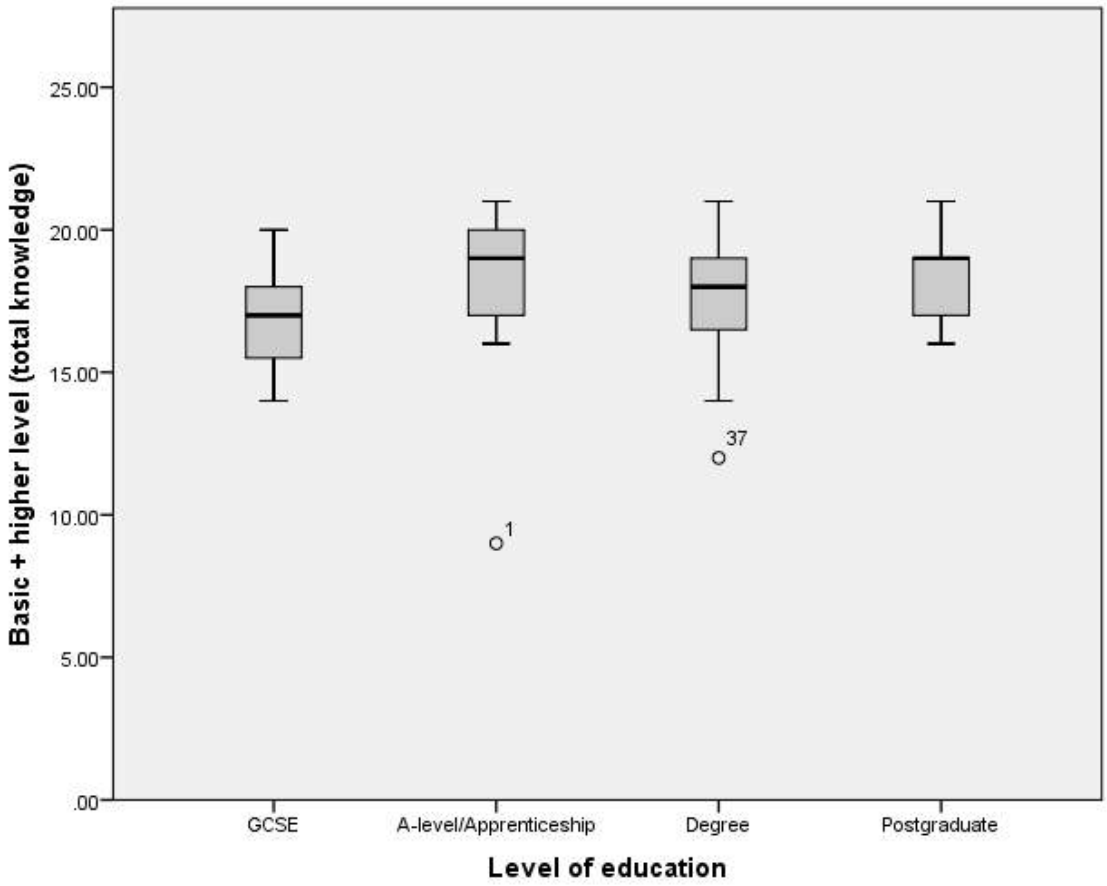


Figure XVII: Box plot of knowledge levels split by level of education.

The null hypothesis was “There is no significant difference in knowledge levels between the different levels of education”. ANOVA analysis showed there was no significant difference between level of knowledge and education at the 95% confidence level (df = 9, p = 0.452, n= 69), and therefore accepts the null hypothesis.

5.4 Link between knowledge and level of support

The null hypothesis is; “There is no significant correlation between level of knowledge and level of support for renewable energy in Dorset”. There was a weak significant positive relationship between level of knowledge of renewable energy and level of support for projects in Dorset (Spearman’s Rank Correlation coefficient 0.403, $p < 0.001$, $n = 78$), with 1 as support and 7 as not support. The result is significant at the 95% confidence level, as the p value is less than the significance threshold of 0.05.

5.5 Comparisons between acceptance and support

The null hypotheses are “there is no significant difference between the mean values for [acceptance/support] in [Dorset/the UK]. The lowest mean was for acceptance in the UK (mean = 2.00, n = 78) with a score of 1 meaning strongly agree, and highest for support Dorset (mean = 2.19, n = 78).

Analysis with paired sample t-tests showed that the only significant combination was between acceptance and support within Dorset ($p = 0.006$, $df = 77$, $n = 78$), whereby it is below the threshold of 0.05 so the test rejects the null hypothesis that “there is no significant difference between the mean values for acceptance and support in Dorset”.

The other non-significant tests included; acceptance for the UK and acceptance for Dorset ($p = 0.748$, $df = 77$, $n = 78$), support for the UK and support for Dorset ($p = 0.689$, $df = 77$, $n = 78$), and acceptance for the UK and support for Dorset ($p = 0.13$, $df = 77$, $n = 78$).

5.6 Preference and main concerns about the commercial development of renewable energy

In short, the most preferred technology is solar with 49 votes, followed by offshore wind with 43 and onshore wind with 26 votes. 5 people preferred none, or other technologies that were not suggested. There are more votes than the total number of respondents (78) because some people chose more than one technology.

The most prevalent themes for preference of technology are visual impact, technological benefits and constraints, and space required. Nine respondents spoke about the impacts on the visual environment in both positive and negative perspectives, some examples are; “wouldn’t ruin the visual aesthetics of the country”…”[solar] is less likely to be considered damaging to the natural beauty”…”[wind] is miles out to sea so it’s not unsightly” and “offshore wind so we don’t have to look at turbines”. Technological benefits are referred to five times, such as “We need options that don’t run out” and “Less noise pollution”, and concerns are referred to three times such as; “UK wind is strongest offshore”… “Not reliant on sunshine (in a grey UK!)”. All of the preference reasons are grouped and summarised in Figure XVIII.

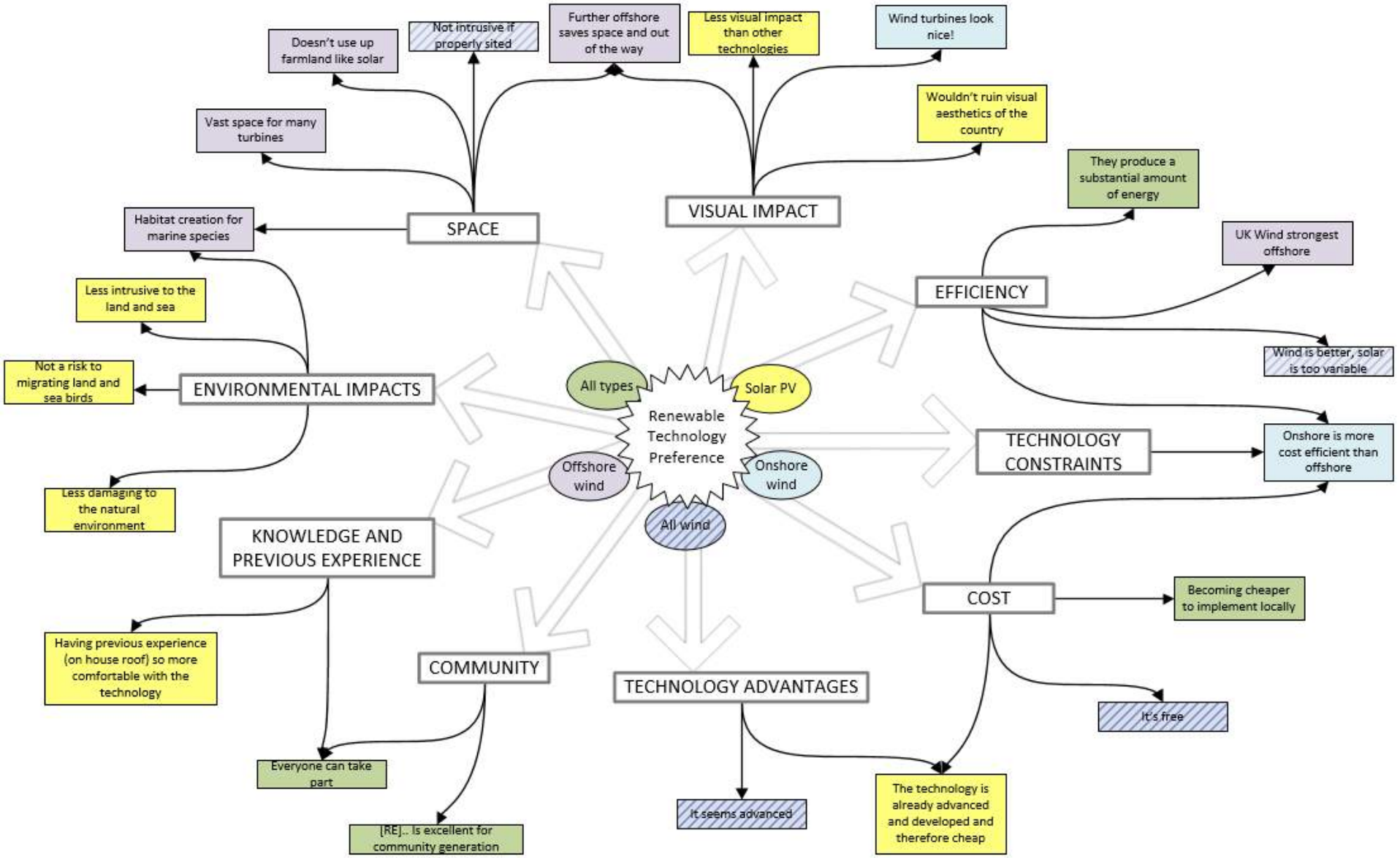


Figure XVIII: Qualitative visual on reasons why the public prefer some technologies to others – a representation of main themes and comments (Own creation).

The top two main concerns, both mentioned 10 times are visual impact, and more specifically negative effects on Area of Outstanding Natural Beauty (AONB) and the Jurassic coast. Difference in opinion is clear here - positive comments for general visual impacts include; “I actually think wind turbines can be a very interesting visual feature and shouldn't be stifled by people, particularly offshore”, “It should never have been blocked due to 'the view'”. Negative comments in direct contrast such as; “Wind farms are unsightly especially offshore”, and “Changes to the natural beauty of its surroundings”.

Comments more focussed around AONB and the Jurassic coast include; “I think wind farms are necessary, despite people's concerns of them affecting the Jurassic Coast view”, and “had Navitus Bay gone ahead, Dorset would be in a much more secure position than it is since fracking has been approved, which poses a threat even to Dorset's own UNESCO World Heritage site at Lulworth Cove”. Negative comments about placing in a sensitive area include; “A large part of the Dorset economy is based on tourism due to Dorset's natural coastline which is a part of UNESCO world heritage, wind could put off tourists”, “My opinion on how supportive I am would depend on the project and the suitability of the area (e.g. not in AONB)”. Comments such as these include a wide range of issues, from perceived effects on the local economy, personal preference, and a wider appreciation of the alternatives such as a fossil fuel based economy or fracking.

To a lesser extent, three ‘C’s’ are regular concerns; cost, community, and careful planning all mentioned 6 or 7 times. The nature of concerns raised together mean that these are not problems in isolation but are complex issues.

Comments include; “Rise in council tax”, “Companies will take the profits, we will still have to pay”, “that money made by companies building it will not get seen by our community“, “That the benefits will be passed on to the general public”, “Furthermore the coastline is busy with shipping which could be affected”, “Loss of farmland for agriculture and livestock”, and finally “That they won’t be placed in appropriate locations”.

Also mentioned 7 times is the technological constraints of wind and solar sources of energy. For instance; “That they are future proofed so that they don’t become obsolete when technology advances”, “I don't believe it can supply the whole country's needs”, “Do they reduce wind speed by absorbing energy?”

Spoken about the least, two to four times but still important, are environmental concerns, issues with complicated planning processes, and efficiency of technologies. Explanation of main concerns revealed the following; “Energy efficiency”, “solar not efficient yet”, “There will not be enough getting through planning to be able to power the UK”, “We are far behind some more civilised European nations”, “Consequence on wildlife etc.”, “I'm unaware of any adverse effects of wind turbines on ecosystems, but this should be considered when building things in the ocean”. These concerns are summarised in Figure XVIV.

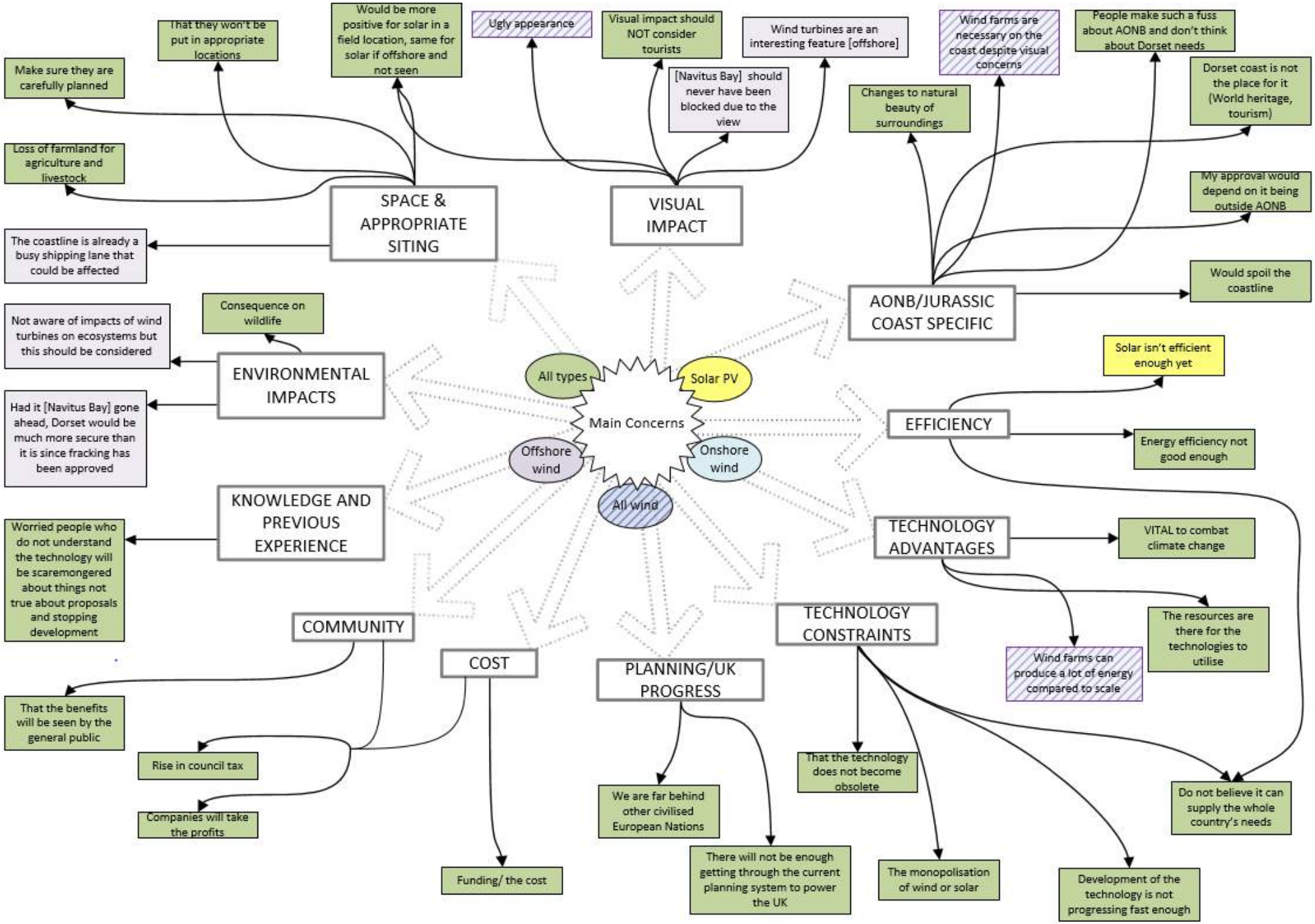


Figure XVIV: Qualitative visual on main concerns about the commercial development of renewable energy – a representation of main themes and comments (Own creation).

5.7 Summary of results

In summary, the demographics of respondents varied between postal and online survey methods as expected from the literature review. By post, the most common respondents were the oldest age groups (55-64, 65+), and online the youngest (16-24, 25-34). The gender split was more even by post, with postal 48% male to 43% female, and online 33% male to 66% female. Most respondents were had an educational level of A-level/apprenticeship or degree. Household income was poorly answered, with 47% choosing not to disclose this information.

There is a significant trend between level of knowledge and support for renewable energy in Dorset. There is no significant correlations between age, gender, income and education with the levels of knowledge. There is a significant difference between only acceptance and support in Dorset. No other combinations of acceptance and support in Dorset and the UK were significant. Main concerns about the commercial development of renewable energy were spread across a variety of issues concerning social, political, technical, economic and environmental issues. The next chapter will discuss these results.

6. Discussion

6.1 An overview of biases

Table XIII discusses three biases; nonresponse, self-selection and response bias. The significance of where each bias will have the most influence on the results and how the method aimed to mitigate this. Further suggestions are included later alongside the discussion of each result.

Bias	What it is and influences	Significance for results
Nonresponse	Nonresponse is the lack of data from people who do not respond to the survey and are whose data is not included in the results. This can impact if the people who do not response are different in opinion or behaviour of the majority sampled, and in turn conclusions and generalisations about the population from the sample incorrectly (Mangione 1995).	All results. Underrepresentation in some age categories, main concerns, knowledge and self-reported level of support.
Self-selection	It is whereby the characteristics of the respondents are biased through their own selection to participate in the survey (Whitehead 1991). For example, in this survey, they may be more likely to initially click on the link to the survey if they are interested in it. An example is the two respondents who mentioned in Q1 that they belonged to an environmental campaign group. Although by post it distributed without this influence, those choosing not to reply may be more interested in the survey.	All results, particularly for the online responses. Those who respond to the survey are more likely to be interested in it or feel it is relevant to them (Mangione 1995).
Response (social desirability)	Only applicable to self – reporting, this bias is whereby people answer in a way that makes them over exaggerate good traits and under exaggerate bad ones (Nederhof 1985; Furnham 1986). For instance, if the respondent believes it is seen as admirable to be pro-renewable and combat climate change, they may respond more positively and underplay their underlying concerns when reporting their acceptance or support for these technologies.	It is most prevalent in structured interviews or surveys, and is only applicable to self – reporting in this case acceptance and support questions.

Table XIII: Potential sources of bias in this study (Own creation).

6.2 Main methods of communication about RE to the public

When trying to educate the public and raise levels of knowledge about renewable energies, it is vital that appropriate and effective channels of communication are used to reach the desired target audiences (Simanauskaite 2013). The overall results highlight the most popular methods are television, the internet, and newspapers, for all age groups. However, for the youngest age group (16-24 years), the order was different from the overall most used methods of communicating information, with taught education, the internet and social media respectively. This may indicate a generational shift to more online sources, such as, social media, or that this appeals to a younger audience.

TV as the number one source for information about RE agrees with research by Castell et al. (2014), which found TV to be the most popular source of information on science. Furthermore, it is consistent with research by Devine-Wright (2007) with TV is the main source of information about renewable energy. The second most popular source of information on RE was the internet. Newspapers and social media in this study are separate answers, so in this the internet includes source items, such as, non-news sources like websites, or online versions of newspapers. Finally, newspapers were the third most popular source of information in this study. This agrees with Castell et al. (2014), who found newspapers (in print form) the third most popular source of information. It would be interesting with further research to see the effects of how specific renewable projects are portrayed in each medium.

Results showed social media with 25 votes, school or taught education with 24 and friends and family with 22 showing these are also important channels of

information. This is in line with findings by Castell et al. (2014), for social media to be a prominent source of information for 16 to 24 year olds.

It is an important point to consider the reliability of the information gained from these sources. Social media can be used in both a positive way, to be a platform to share information and increase knowledge and awareness, or alternatively to share discontent with renewable projects such as the "Bournemouth against wind farms" Facebook page identified in the methodology. Friends and family as a source of information on RE may be effective as knowledge creation is known to be a social process (Simanauskaite 2013) and this is reflected by the friends and family category, however similarly to social media, it is open to distortion of personal opinion. School education a useful channel for communication of information because it will be presented in a factual environment with less politicisation and it is promising to see this is prevalent among the youngest age group. Only twelve people indicated that they used engaging with local renewable projects. This could be due to limited amounts of renewable projects that the public can visit, or hear about, in Dorset due to lack of existing deployment.

6.3 What levels of knowledge currently exist in Bournemouth?

To investigate the influences associated with knowledge levels, it is first important to establish a baseline knowledge level (Simanauskaite 2013). The results show a high level of basic renewable knowledge for all respondents, defined by respondents being able to identify which are renewable resources, state where wind and solar renewable energy can be generated, and recognise the benefits of RE.

Higher-level technical knowledge had much more variability in knowledge scores. Technical knowledge is assessed by the ability to know the terms ‘photovoltaic’ and ‘megawatt’ and to be up to date with current renewable affairs, such as Germany being a leader in wind energy. The report by Castell et al. (2014) found similar results and that technical language and jargon should be minimised when dealing with the general public.

Knowledge did not vary significantly by age, gender, income or education. These results show that knowledge is not, in this sample, affected by demographic factors in the same way literature has found opinion of renewables to be affected (Devine-Wright 2007). With a larger sample size, and a more even representation of demographics this could have been more significant.

Gender proportions were relatively even with slightly more female responses with 41 compared to 33 male responses, not including the four people wishing not to disclose their gender. Underrepresented age groups are the middle categories between the age of 35 and 54. This was due to a large number of responses for young age groups online and a high number of responses in older age groups by post. 37 people chose not to disclose income level. Therefore, with less data it is less likely to find a statistical difference reference. In consequence, the fact that this result was not statistically significant should be treated with caution and improved by improving the response rate. Household income is regularly an issue when eliciting demographic information (Groves et al. 2002). Although this study followed advice by keeping questions ‘closed’ and ‘multiple choice’ the question response rate was low (Groves et al. 2002; Gillham 2008).

To address the underrepresentation of these demographic groups, the survey could be redesigned to be more balanced and proportional. Online responses were limited to people who have Facebook, introducing a self-selection bias. The methodology limited any biased nature of the Facebook groups that were used, but in future a study should look to use more online platforms or email out surveys. Additionally a follow up of respondents should investigate if the sample represented by these online respondents are different from the wider sample population (Whitehead 1991). The advantages of this include the ability to control who responds and also people are more targeted in terms of demographic representation. Another example of how to do this is through opt in survey screening (Evans and Mathur 2005), to be more selective about respondents.

Nonresponse bias is present in both online and postal surveys, however the main difference is online there is no record of how many people were reached and did not participate. The number of responses would be improved if a follow up survey was conducted by post, and online this could be achieved by using email addresses to link to the survey and send reminders (Groves et al. 2002).

By post, balancing the demographic variables could be achieved by combining the index of deprivations demographic data, such as census survey data to target representative proportional numbers. Alternatively, with a larger sample the method could assign quotas to numbers of responses proportional to each age group of Bournemouth (Groves et al. 2002). For example if the 20% of the population is aged 65+ then the number of responses in this category for 1000 responses would be capped at 200.

One further suggestions to address the issues with people not disclosing their demographics is to better bridging the gap in trust without the researcher present (Groves et al. 2002). This could be applied by including sponsorship of a legitimate agent, in this case Bournemouth University logo (Mangione 1995; Groves et al. 2002), and making the confidentiality statement more prominent. Make clear how they were selected and why – so they feel it is relevant to them (Mangione 1995).

Educational responses only asked level of education, and may have been affected by the subject of specialism. For example, someone who has taken up further education in an arts subject may not be more likely to know more about renewable energy, whereas someone studying a Science Major may. Furthermore, the influences of non-response bias cannot be measured in this study (Groves et al. 2002) as they are not returned and included in the analysis so people who are less educated may not understand the survey, be intimidated by it or not see the value in the research so not respond (Mangione 1995).

Jaber et al (2017), although undertaking research in Jordan, found significant differences in knowledge about energy sources between different academic departments in universities. Education may be more complex than just level of education, and people are also able to take an interest in RE outside of the scope of formal education, through main sources of information discussed in the previous section.

Some questions seemed to repeatedly be answered incorrectly by otherwise well-scoring respondents. One knowledge question “Where can renewable energy be generated” with three correct answers, “In the North of the UK”, “In

the South of the UK", and "Anywhere in the world". Although the question specified to tick all correct answers lots of respondents only chose the final answer. This may be due to wording issues, as technically anywhere in the world includes anywhere in the UK, but all three needed to be ticked to score full marks. The questionnaire could be redesigned to better assess what knowledge is associated with opinion. For example basic knowledge about the concepts of RE does not accurately assess they know the complex issues surrounding it. To better score it, it is recommended for future research to separate categories for knowledge, for example, the environment, the social, the economic, from general knowledge and see where the differences lie to get a better representation of knowledge.

6.4 Comparison of knowledge and perceptions of RE

The research questions addressed two aspects; links between knowledge and level of support and the differences between 'acceptance' and support. In terms of results, knowledge and support showed a weak positive correlation, so that people who had a higher level of knowledge were more likely to support RE. For the second, results showed a significant difference between acceptance and support within Dorset, with those more likely to accept than support renewable energy in Dorset.

When delivering the questionnaires, it was noted that in all of the sites 1-5, there were houses sampled that has solar panels on the roofs of houses, most often in the high index areas (least deprived). This may have an influence on previous experience with the technology and understand the process more, even if not on a commercial scale with solar. It is noted that solar is the most popular technology, so this could be due to the familiarity with the process.

Figure XX: Solar panels sited in Zone 5 – least deprived (top left) Zone 3, (top right), Zone 2 (bottom right) and Zone 1 – most deprived (bottom left) (Personal collection 2017).

6.4.1 Knowledge vs. support

The results show a positive correlation between knowledge and support showing if the public are more knowledgeable they are more likely to support RE. This could indicate that an increase in knowledge could increase support for renewables. It cannot be implied that there is a direct link, and further improvements to the survey could include opinions before and after initiatives like educational programmes about renewables to test for a difference.

One limitation of this data is support for RE is in self-reporting aspect. Devine-Wright (2007) found support independent of levels of awareness although the basis for these findings are also self-reported. There is potential for response bias, in this case there may be a tendency for respondents towards a socially desirable answer such as being pro-renewable as tackling climate change is seen as something society should aim to do. To further challenge and understand the influences of this bias additional analysis to see if those people who responded to support renewables behaved in similar ways, such as during public consultation when a local project is proposed.

6.4.2 Acceptance vs. support

To investigate the influences of a NIMBY attitude, acceptance and support was asked for both Dorset and the UK. Results showed a significant difference between acceptance and support within Dorset, with those more likely to accept than support renewable energy in Dorset. These opinions however, are only relevant for this target population as spatial context is important (Devine-Wright 2007). This does not support the NIMBY theory and agrees with Devine-Wright (2007) that there is no differences between UK in general and Dorset. It also

agrees with Batel et al. (2013) to some extent that yes, there is a difference between acceptance and support. However, this self-reported measure does not indicate the reasons why there is a difference and the nature of the questions is again susceptible to response bias. A future recommendation would be to find a way of quantifying support without directly questioning their opinion, similar to how knowledge has been tested in this study.

6.5 Main concerns for the development of RE in Bournemouth

Main concerns based on knowledge are; knowledge and previous experience; environmental impacts; cost; technology efficiency and advantages. Technology is linked to knowledge, but renewable project developers would not promote a project that was not economically, or technically feasible, so in terms of the public this knowledge should be communicated first. When communicating renewable energy knowledge in general, the methods of communication of TV, the internet and local newspapers should be used to advertise it.

Concerns about space, appropriate siting, visual impacts, AONB and Jurassic coast specific concerns and, UK progress are not directly linked to needing an increase in public knowledge that are more complex issues outside the scope of this study. Results from the qualitative data on main concerns showed community as an important factor. This sense of community can be used to develop a sound knowledge base and wider community development, for instance providing renewable energy jobs.

6.6 Further limitations and recommendations

One limitation of the study is lack of funding available to undertake it. This affected the study particularly in the sampling strategy, which, in light of this limitation opted for a delivery and collection style postal survey justified by the decision matrix. This meant that although the sampling strategy aimed in every way to balance demographic factors in the methodology, the sample area was spatially small. This does not mean the opinions and views reflected by the residents of Bournemouth are not valid, but a small sample size might have influence on the significance of some of the results. Therefore, a first recommendation for further research is to investigate the issues surrounding public perception on a larger scale in Dorset, to not only be able to compare spatially different factors involved and potentially identify different areas of knowledge levels, but also to gain a larger, more representative sample. Funding would have particularly helped with postage and printing costs, which could have reached out to many more households.

Another limitation is the timescale for the project. This paper aimed to benchmark a level of knowledge for the residents of Bournemouth, but it is vital to know how knowledge levels and opinions develop and change over time. For instance, the methods of communication about renewable energy may change or develop more effectively over time, led by the general public demanding more information on developments or companies wanting to engage more to be more successfully when developing projects. By analysing the changes temporally in knowledge, future studies can delve deeper into the complex nature of knowledge sharing and development of opinions.

7. Conclusions

Public opposition has been challenging in the past to deploy commercial scale renewable projects. This study provides a snapshot into knowledge, support and concerns around renewable energy in Bournemouth. There are a few main conclusions that can be drawn from this study. The first is that there is a good level of general and basic renewable knowledge amongst those people surveyed. As shown by the main concerns of residents, this knowledge supports a wide range of concerns by residents. However, technical knowledge is more limited amongst the general public. To tackle concerns about environmental degradation or siting of projects, communication is key. This means using the mediums for engaging that are effective.

Most of the public in Bournemouth use television, the internet and newspapers to inform them about renewable energy. This should be acknowledged by anyone wishing to disseminate information to residents about any future proposals or projects as they are the most used channels for information.

In terms of the linkages between knowledge and support, it is concluded here that there is a link between the two, and those who have a higher level of general renewable knowledge are more likely to be supportive of RE. Within Dorset, people are more likely to accept than support renewables, but the overall opinion finds residents in favour of further development of renewable energy in the area.

7.1 Further research

Two suggestions for further research are suggested in light of this study. Firstly, this paper is only snapshot in time. With more time and resources, opinion and knowledge levels should be tracked as they evolve and develop over time in the Bournemouth area. Also, further investigation into what specific aspects of knowledge have an effect on support over time would provide further insight.

Secondly, a study over a larger geographical area could build up a picture of not only the residents of Bournemouth but a wider context. This is because development of renewable energy needs a coordinated effort of councils to work together to use their resources. Communicating information and successes about renewable energy should form part of the development strategy.

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Appendices

Appendix I – Evaluative Supplement

More than anything, this study has been a learning experience on how to be strategic in my approach to a large project. At first the topic and supporting literature seemed to be vast and cover a wide range of topics, which was initially overwhelming. I defined the scope of the study by considering which topic I found to be of interest to me but also where there was a lack of definitive research. I restricted myself to focussing on knowledge, by concentrating my research on my five research objectives. By choosing a topic that required engagement with the public I learnt how to better communicate my thoughts and express my ideas. Most of all, I learnt that being concise and clear is of upmost importance when communicating to the public, but also in my own academic work.

I feel like my independent research project suited me and my course of study in Applied Geography well. I have integrated skills such as GIS mapping and SPSS to produce a quantitative detailed approach to the topic. During my final year I balanced modules such as globalisation and sustainable development alongside being a research assistant for engaging staff in pro-environmental behaviours. It was at times stressful to try and maintain focus on coursework, research and exams as well as my own project but I ultimately found myself able to put all of my expertise to produce my most in-depth piece of work to date.

I found my biggest challenge to be getting words down into writing early on. I felt the need to know exactly what I wanted to say with extensive research behind me before trying to put anything down on paper, which meant that I felt pressure to produce a good draft once I did begin. I found it extremely useful to have the support of my dissertation supervisor and also friends and family who enabled me to discuss my ideas with them. Ideas that I had in my head were always translated into my writing better when I could explain them to someone else.

This study has contributed to the field of study by investigating how knowledge plays a role in the public's perception of renewable energy. I feel the method was a strength by using the multiple index of deprivation to stratify the population. This is because demographics are regularly cited in the literature as something to be considerate of, and this approach meant that these variables were controlled. A recommendation for further research would be to use this new approach to do a study of a much wider geographical area such as the whole of the UK to see what variance there is within a larger population.

A limitation of the study was the timescale. It would have been preferable to have time to follow up the postal responses with reminders and try to limit the number of non-responses, and consequent bias. Similarly, the online questionnaire could have been left open for a longer time – but due to the need to start writing up the results this time was limited. One disappointment was that out of a number of research questions, only two results were significant in the SPSS tests. However, this did mean that my discussion was only more rigorous because it made me consider in more depth the reasons behind why this might

be, and which areas could be improved next time, such as the wording of questions.

In summary, the main thing I have taken away from this project is how to think about scientific research in terms of the real world. This research contributes by providing a quantified level of what pre-existing knowledge there is in Bournemouth and how to better engage people with regards to renewable energy.

Appendix II – Questionnaire layout: pilot study and final

Public Perception of Renewable Energy in Dorset

Dear/Sir Madam, I am a student at Bournemouth University conducting a survey for my final project to understand public perceptions and knowledge about renewable energy in Bournemouth and Poole. I value your opinion and would be grateful if you could fill out all of the questions asked, but you may leave any questions you are not comfortable with. **Please answer all questions only according to commercial sized wind turbines (on/off shore) and solar energy farms.** Please place a X in the boxes that apply to you. This information will remain strictly anonymous, if you have any questions or comments, or wish to withdraw your comments please email i7670413@bournemouth.ac.uk.
Thank you in advance for your time, Clare Scarborough.

I have delivered this survey in an envelope and I would be most grateful if you could fill it out and leave it outside your front door/doorstep before 10am on MONDAY for collection.

Have any of the following informed your knowledge of renewable energy (if any): *(Please mark all that apply)*	Newspaper	Radio (and podcasts)	Internet	Social Media	TV	Friends & Family
	School or taught education	Local renewable energy project	Magazine	Other (please specify)		

Which of the following are renewable energy sources? *(Please tick all that apply)*	Geothermal	Coal	Solar	Natural Gas	Petroleum	Wind
Which of the following apply to renewable energy? *(Please tick all that apply)*	Reduces carbon dioxide emissions	Technology is still yet to be developed	Reduces air pollution	Is NOT suitable for the UK climate	Will make energy prices more vulnerable to unexpected spikes	Potentially unlimited energy supply
Where can wind and solar renewable energy be generated? *(Please tick ALL that apply)*	In the north of the UK	In the south of the UK	Solar energy only in very sunny countries	Wind energy in only very windy countries	Anywhere in the world (with differing efficiencies)	THINK OF A FALSE ONE

In terms of solar power, the word photovoltaic directly means: (Tick only CORRECT answer)	Sun-powered	Light-electricity	Light cells	Solar energy		
Which nation leads the world in installed wind energy capacity (*end of 2016)? (Tick only CORRECT answer)	Germany	China	UK	USA		
What does "MW" mean in terms of renewable energy generation? (Tick only CORRECT answer)	Mega Watt	Medium Wind	Medium Watt	Micro Watt		

Please rate *your own* knowledge about renewable energy *(please tick ONE that applies best)*	Very Good 1	2	3	Neither - 4	5	6	Very Poor 7

(Please tick which box you agree with most)	Strongly agree 1	2	3	Neither 4	5	6	Strongly disagree 7

"I accept the development of renewable energy in the UK"							
"I am support the development of renewable energy in the UK"							
"I accept the development of renewable energy in Dorset"							
"I am support the development of renewable energy in Dorset							

Which technology do you prefer?	Onshore Wind	Offshore Wind	Solar	None
Why do you prefer this technology?	ANSWER HERE			
What are your <u>main concerns</u> (if any) about the commercial scale development of renewable energies [wind/solar] in Dorset Or have any other comments?				
ANSWER HERE (Economic/Environmental/Social/Trust/Anything Else)				

(Please tick one)	Male	Female	Other	Prefer not to say	
What is your gender?					
	GCSE / O-Level	A Level / Apprenticeship	Degree	Postgraduate	Prefer not to say
What is your level of formal education?					
	£0-10K	£11-25K	£26-50K	£50K+	Prefer not to say
What is your yearly household income?					

Thank you for taking the time to fill out this survey: Please don't forget to leave it outside your front door on XXXXXX, Clare Scarborough.

Public Perception of Renewable Energy in Dorset

Dear Sir/Madam, I am a student at Bournemouth University conducting a survey for my final year project to understand opinions and levels of knowledge about renewable energy in Bournemouth and Poole. I value your opinion and would be grateful if you could fill out all of the questions asked, but you may leave any question if you are not comfortable. If more than one person wishes to fill out the survey, please complete in a different coloured pen.

Please answer the opinion questions only on commercially sized wind and solar energy farms.

Your answers will remain strictly anonymous, if you have any questions or comments or wish to withdraw your comments please email i7670413@bournemouth.ac.uk.

Thank you in advance for your time, Clare Scarborough.

I have delivered this survey in an envelope and I would be most grateful if you could fill it out and leave it outside your front door before 9am on TUESDAY for collection.

---

1. **Have any of the following informed your knowledge of renewable energy?** *
   Tick all that apply.

- ☐ Newspaper
- ☐ Radio (and podcasts)
- ☐ Internet
- ☐ Social Media
- ☐ TV
- ☐ Friends & Family
- ☐ School or taught education
- ☐ Local renewable energy project
- ☐ Magazine
- ☐ Other: _____

2. **Which of the following are renewable energy sources?** *
   Tick all that apply.

- ☐ Coal
- ☐ Solar
- ☐ Geothermal
- ☐ Natural Gas
- ☐ Petroleum
- ☐ Wind

3. **Which of the following apply to renewable energy?** *
   Tick all that apply.

- ☐ Reduces carbon dioxide emissions
- ☐ Technology is still yet to be developed
- ☐ Reduces air pollution
- ☐ Is NOT suitable for the UK climate
- ☐ Will make energy prices more vulnerable to unexpected spikes
- ☐ Potentially unlimited energy supply

4. **Where can wind and solar renewable energy be generated?** *
   Tick all that apply.

- ☐ In the North of the UK
- ☐ In the South of the UK
- ☐ Solar energy ONLY in very sunny countries
- ☐ Wind energy ONLY in very windy countries
- ☐ Anywhere in the world (with differing efficiency)
- ☐ Only in countries with a good electricity grid

5. **Which renewable energy does the word "photo voltaic" relate to?** *
Mark only one oval.

- ◯ Wind
- ◯ Wave
- ◯ Solar
- ◯ Tidal

6. **Which country leads Europe in installed WIND energy (end of 2016^)** *
Mark only one oval.

- ◯ Germany
- ◯ UK
- ◯ Turkey
- ◯ Poland

7. **What does "MW" mean in terms of renewable energy generation?**
Mark only one oval.

- ◯ Mega watt
- ◯ Medium watt
- ◯ Medium wind
- ◯ Micro wind

8. **Please rate your own knowledge about renewable energy** *
Mark only one oval.

	1	2	3	4	5	6	7	
Very Good	◯	◯	◯	◯	◯	◯	◯	Very Poor

To what extent do you agree with the following statements?
(All commercial size/scale WIND and SOLAR)

9. **"I accept the development of renewable energy in the UK"** *

	1	2	3	4	5	6	7	
Strongly agree	◯	◯	◯	◯	◯	◯	◯	Strongly disagree

10. **"I support the development of renewable energy in the UK"** *

	1	2	3	4	5	6	7	
Strongly agree	◯	◯	◯	◯	◯	◯	◯	Strongly disagree

11. **"I accept the development of renewable energy in Dorset"** *

	1	2	3	4	5	6	7	
Strongly agree	◯	◯	◯	◯	◯	◯	◯	Strongly disagree

12. **"I support the development of renewable energy in Dorset"** *

	1	2	3	4	5	6	7	
Strongly agree	◯	◯	◯	◯	◯	◯	◯	Strongly disagree

13. **Which technology do you prefer? (All commercial scale/size)** *

Tick all that apply.

- [ ] Offshore Wind
- [ ] Onshore Wind
- [ ] Solar
- [ ] None of the above

14. **Why do you prefer this technology?**

15. **What are your main concerns (if any) about the commercial scale development of wind and solar in Dorset, or have any other comments?** *

The following information is only to make sure the questionnaire is representative, and all of the data is anonymous. Feel free to answer "prefer not to say" if you are not comfortable with a question.

What is your age? *

Mark only one oval.

- ◯ 16-24
- ◯ 25-34
- ◯ 35-44
- ◯ 45-54
- ◯ 55-64
- ◯ 65+
- ◯ Prefer not to say

What is your gender? *

Mark only one oval.

- ◯ Male
- ◯ Female
- ◯ Prefer not to say

What is your level of formal education?

Mark only one oval.

- ◯ GCSE/O-level
- ◯ A level/Apprenticeship
- ◯ Degree
- ◯ Postgraduate
- ◯ Prefer not to say

What is your yearly household income?

Mark only one oval.

- ◯ £0-14K
- ◯ £15-24K
- ◯ £25-34K
- ◯ £35-44K+
- ◯ 45K+
- ◯ Prefer not to say

Thank you for taking the time to complete this survey. Please don't forget to leave it outside your front door before 9am on TUESDAY.

Appendix III – Mid review comments form

Independent Research Project Interim Interview: Agreed Comments Form

Student Name: Clare Scarborough	Programme: Applied Geography
Date: 17/11/2016	IRP Title: Is there a relationship between public knowledge of renewables, other socioeconomic factors and their attitudes to renewable energies.
Supervisor Name: Pippa Hillingham	

Clare has redesigned her project and now has a sensible plan for data collection. She has also done a good deal of reading and has a structure for her literature review. The next step is to design her questionnaire and refine her sampling strategy which should be completed by next month to stay on track.

Two copies of this form are needed – student to retain one copy the other is to be handed in to the student admin office C114.

Student Signature:	Supervisor Signature:

Appendix IV – SPSS Outputs

Paired sample t-test SPSS output for acceptance and support

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Acceptance for the UK	2.0000	78	1.34840	.15268
	Support for the UK	2.1538	78	1.49525	.16930
Pair 2	Acceptance for Dorset	2.0256	78	1.43223	.16217
	Support for Dorset	2.1923	78	1.52943	.17317

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Acceptance for the UK	2.0000	78	1.34840	.15268
	Acceptance for Dorset	2.0256	78	1.43223	.16217
Pair 2	Support for the UK	2.1538	78	1.49525	.16930
	Support for Dorset	2.1923	78	1.52943	.17317

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Acceptance for the UK & Support for the UK	78	.934	.000
Pair 2	Acceptance for Dorset & Support for Dorset	78	.940	.000

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Acceptance for the UK & Acceptance for Dorset	78	.874	.000
Pair 2	Support for the UK & Support for Dorset	78	.844	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Acceptance for the UK - Support for the UK	-.15385	.53639	.06073	-.27478	-.03291	-2.533	77	.013
Pair 2	Acceptance for Dorset - Support for Dorset	-.16667	.52016	.05890	-.28394	-.04939	-2.830	77	.006

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Acceptance for the UK - Acceptance for Dorset	-.02564	.70203	.07949	-.18392	.13264	-.323	77	.748
Pair 2	Support for the UK - Support for Dorset	-.03846	.84427	.09559	-.22881	.15189	-.402	77	.689

Spearman's Rank: knowledge and support

Correlations

			Basic + higher level (total knowledge)	Support for Dorset
Spearman's rho	Total Knowledge Score	Correlation Coefficient	1.000	-.403**
		Sig. (2-tailed)	.	.000
		N	78	78
	Support for Dorset	Correlation Coefficient	-.403**	1.000
		Sig. (2-tailed)	.000	.
		N	78	78

Knowledge: Age, Income, Gender, Education

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age of respondent	72	1.00	6.00	3.4028	2.03947
Total Knowledge Score	78	9.00	21.00	17.6154	2.49795
Valid N (listwise)	72				

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	44.398	10	4.440	1.079	.392
Within Groups	250.921	61	4.113		
Total	295.319	71			

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Total Knowledge Score	78	9.00	21.00	17.6154	2.49795
Household Income	41	1.00	5.00	2.4878	1.41637
Valid N (listwise)	41				

Household Income

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.077	8	.885	.387	.920
Within Groups	73.167	32	2.286		
Total	80.244	40			

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Total Knowledge Score	78	9.00	21.00	17.6154	2.49795
Level of education	69	1.00	4.00	2.3768	.90913
Valid N (listwise)	69				

Level of education

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.424	9	.825	.998	.452
Within Groups	48.779	59	.827		
Total	56.203	68			

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Gender	74	1.00	2.00	1.5541	.50046
Total Knowledge Score	78	9.00	21.00	17.6154	2.49795
Valid N (listwise)	74				

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Total Knowledge Score	Equal variances assumed	.588	.446	.933	72	.354	.54915	.58831	-.62363	1.72193
	Equal variances not assumed			.947	71.416	.347	.54915	.58005	-.60732	1.70562

Appendix V – Questionnaire wording and timescale of the project

The wording accompanying the online questionnaire to ensure people knew the purpose and their anonymity.

> "Hi, I am a student at Bournemouth University conducting a survey for my final year project to understand opinions and levels of knowledge about renewable energy in Bournemouth. Please only complete this survey if you live in Bournemouth.
>
> I value your opinion and would be grateful if you could fill out my online survey, please only complete this survey if you live in Bournemouth.
>
> Your answers will remain strictly anonymous, if you have any questions or comments or wish to withdraw your comments please email i7670413@bournemouth.ac.uk. You are welcome to leave any questions you are not comfortable with.
>
> Thank you for your time, Clare."

Timescale for the project

Gantt chart for project planning, planning and development tasks for the Gantt chart were based upon Figure VI, whereby the thesis flows through the three stages to reach the deadline in time (Own creation).