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## **Exploring public perceptions of energy security risks in the UK**

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### **1 INTRODUCTION**

#### *1.1 BACKGROUND*

Notions of 'energy security', although continuously renegotiated and defined, have arguable always been present in debates around energy policy in the UK and many other countries around the world (World Economic Forum, 2006). Although the specific energy security aspects and policies differ across countries, many of the same principles apply (e.g. ensuring uninterrupted energy access; Winzer, 2011). More recently notions of 'energy security' (ES) have become increasingly important within UK energy policy debates, driving proposals for major energy system change, alongside climate change (CC) and affordability (DECC, 2009).

Energy security is a complex, multi-faceted concept with numerous definitions (Chester, 2010). Despite its importance, little attention has been paid to how the public thinks and feels about this aspect of sustainability and energy policy. Interest in public perceptions of ES is however increasing internationally, particularly because of their role in understanding public engagement with (low-carbon) energy generating technologies, as well as behaviours around demand reduction and management (Knox-Hayes et al., 2013; Sovacool et al., 2012; Hobman et al., 2013; Poortinga et al., 2012).

We explore what ES means to the general public, and provide a way of measuring ES concerns quantitatively using data from two surveys. We also engage critically with conceptual discussions around public perception of ES to provide further theoretical elaboration of the topic. To begin, we will briefly discuss the

conceptualisation of ES, which provides the context for the examination of public perceptions.

### 1.2 *CONCEPTUALISING 'ENERGY SECURITY'*

As Chester (2010) notes, while the term 'energy security' is used widely in a variety of sectors (government, industry, academia), there has been little discussion of the notions which underpin its meaning. As a result, ES is often discussed in various terms including references to causes for concern (threats to continuous supply, e.g. failing infrastructure, depletion of resources), consequences of these risks (price spikes, petrol shortages) and ways of enhancing energy independence (reducing demand, alternative resources). Nonetheless, Winzer (2011) notes that all of these conceptualisations encapsulate a basic idea of avoiding sudden changes in the availability of energy relative to demand, and refer to an 'idealised' resilient system with low risks of interruptions to energy supply.

Chester (2010) has further elaborated on the polysemic nature of the ES concept, where 'energy security' may be delineated through multiple dimensions (e.g. temporal, geographical) taking on different specificities in different contexts. Although ES can be narrowly discussed in terms of market-centric definitions and 'measured' with quantitative indicators, there are also broader definitions which include qualitative aspects that go beyond the basic (un)availability of energy supply, such as affordability and sustainability (IEA, 2012a).

In UK energy policy, ES is often described in terms of the risks it poses to the country, where "concerns over energy security are caused by either physical supply disruptions or spikes in energy prices" (POST, 2012 p1). Concerns about those aspects of ES are heightened in the UK for a number of reasons:

First, the UK faces the nearing closure of many aging power stations and hence concerns are raised over possible electricity shortages if timely investment into new generation and transmission infrastructures is not found. For example, around a fifth of UK electricity capacity available in 2011 will close by the end of the decade, while peak demand is projected to grow by around 7GW (DECC, 2012b).

Second, dependency on fossil fuels and energy imports has increasingly been a concern because the demand for fossil fuels will rise globally, even though resources are becoming scarcer and are located in fewer parts of the world (DECC, 2012a). UK import dependency has steadily risen in the last decade and is expected to continue to increase (DECC, 2012a). It is argued that this high import dependency leads to greater exposure to global energy price fluctuations. In addition, many of the remaining fossil fuel reserves in 2020 and beyond will be located in politically unstable parts of the world which leads to worries about market manipulations and

increased vulnerabilities through longer supply chains. Although, at the moment, the UK receives most of its imported gas through Norway and the Netherlands, and is therefore less exposed to possible supply disruptions in Eastern Europe, this risk will increase over time (DTI, 2007). Similarly, it is highly uncertain whether domestic production of unconventional gas will deliver a degree of energy independence in the future (IEA, 2012b).

Third, large investment in domestic, diverse and low-carbon sources is seen as necessary to achieve CC targets and simultaneously reduce dependence on foreign energy imports. It has been estimated that if 15% of the UK's electricity comes from renewable sources in 2020, this could lead to a 20-30% decrease in gas imports (DECC, 2009). However, the likely diversification of supply sources and increased use of wind energy lead to concerns about producing reliable supply. As an example, the UK electricity sector currently enjoys reliability close to excellent with "the average consumer in the UK spending less than an hour and a half without power a year" (DECC, 2009, p72). It is therefore desirable to maintain this stable balance between demand and supply as the system undergoes major transformation<sup>1</sup>.

Finally, conceptualisations of ES differ depending on the perspective taken, ranging from the international through to regional, national, and local, and also differ across stakeholders such as industry, communities and individuals (Chester, 2010). From the perspective of the individual, it could be argued that diminished 'energy security' is primarily experienced through fuel shortages or power cuts, as well as through the price of energy, i.e. energy bills (Burgess & Nye, 2008). In addition, it has been suggested that most people think about 'energy' in terms of the services it provides, for example heating and feeling comfortable in our homes (e.g. Sovacool, 2011). Traditionally these perspectives have been underrepresented in energy policy, where energy is typically conceptualised as a strategic resource or commodity (Stern & Aronson, 1984). Nonetheless the above mentioned ES risks, although quite abstract in nature, all have potentially significant impacts on both the price and availability of energy as experienced by the individual.

ES issues are therefore becoming ever more important in the UK and internationally, with various occurrences highlighting different aspects of ES. The "Arabian Spring" has highlighted the issue of Western (especially European) dependence on this part of the world for much of its oil, while the Fukushima Daiichi nuclear emergency in Japan has refocused attention on the viability of the so-called 'nuclear renaissance' (Hindmarsh, 2013). In the UK the energy regulator Ofgem has reported an increased likelihood of power shortages by 2015, highlighting ES risks other than price spikes for the first time in such a public manner (BBC News, October 2012). These events make different aspects of energy

salient for periods at a time, which may or may not have lasting effects on people's views. It therefore also becomes of importance to develop methodologies to understand public perspectives on ES, and to effectively incorporate these into decision-making in energy policy.

### 1.3 PUBLIC PERCEPTION OF ENERGY SECURITY

Public perceptions of ES have not been studied extensively, especially when compared with other issues affecting energy policy, such as attitudes to CC or specific supply technologies (e.g. Devine-Wright, 2011; Pidgeon, 2012). A large part of existing research comes from opinion polls (mostly commissioned by interest groups). These polls have typically asked a multitude of questions quite unsystematically, and public views on ES are generally inferred from a wide variety of questions on energy policies, without further discussion in terms of their meaning (e.g. Eurobarometer, 2006; IpsosMori, 2010).

Previous research has found that importance of energy issues is low when respondents are asked to choose between different social issues. In 2006, energy related issues were seen to be of secondary importance compared to concerns over unemployment, crime, the economy, and environmental protection in many European countries (Eurobarometer, 2006). In a UK poll, price and affordability was rated more important than environmental considerations in relation to gas and electricity (IpsosMori, 2010), and in a similar poll, respondents prioritised clean air and affordability before reliability and energy independence (Bisconti Research, 2007). However in a more recent poll (Populus, 2011), respondents were asked to rank three key energy policy goals. Although cost was still ranked highest by most people, this was followed by "enough energy to keep the lights on" before environmental concerns. Findings from these types of questions are difficult to compare, however, and can vary substantially due to subtle aspects of question framing and hence the implicit trade-offs respondents are asked to make (Oppenheim, 1992).

One aspect of ES that has been focused on quite extensively is that of dependence on fossil fuels and foreign supplies of energy. For example, 61% are extremely or very concerned over the UK's dependence on energy produced in other countries (Ipsos Public Affairs, 2010). A slightly different question shows that 74% are concerned that Britain might run out of gas in the next 10-15 years (IpsosMori, 2010). Hence concern for dependence on fossil fuels seems relatively high among members of the UK public.

A more subtle picture emerges when respondents are asked about the *likelihood* of potential consequences (e.g. Eurobarometer, 2006). These questions are interesting

because they ask about risks more closely related to our personal use of energy. The 2006 Eurobarometer found that a large majority in the UK (86%) thinks it is very, or somewhat, likely that energy prices would be multiplied by two or more times in the next three years; a lower percentage (62%) believe it likely that there will be significant disruptions in gas supply, although only 16% think this *very* likely.

Reiner (2006) reported a high degree of support for government subsidies of renewable energy technologies, but also significant support for attaining 'energy independence'. International public opinion is in line with this UK research, where concern about ES as a 'foreign policy' issue was found to be high in countries across the world, with a significant degree of support for measures such as energy conservation and investment in renewables to tackle ES (World Council on Foreign Relations, 2009).

Finally, some recent research has begun to examine how ES beliefs influence and determine other beliefs around energy policy, for example linking beliefs about ES to the acceptability of nuclear power (Corner et al., 2011; Jones et al., 2012), renewable energy (Lockwood, 2011) and energy-saving measures (Poortinga et al., 2012). However the specific impacts of ES concerns are likely to be dependent on the context in which ES is framed and how public views are subsequently elicited.

#### 1.4 AIMS OF THIS PAPER AND CONCEPTUAL INFLUENCES

The current research begins to systematically explore UK public views on ES in more detail. We present an attempt to quantitatively measure ES concerns in two surveys using a multi-item scale covering different aspects of ES. We sought to measure ES concerns to explore public perceptions in more detail than previous polls; to explore patterns of views; to ascertain whether some aspects or framings of ES attract more concern than others; and to analyse ES concerns in relation to other beliefs around energy and sustainability by presenting a comparison to CC concern.

Public risk perceptions around ES are likely to be less developed than for example CC perceptions, partly because of its complex nature and partly because its lower profile (e.g. in the media, Happer et al., 2012). To aid interpretation of the findings we therefore take direction from theory around preference construction (Slovic, 1995; Lichtenstein & Slovic, 2006). Behavioural decision research has demonstrated the strong influence of context on measures of preferences and values. It is recognised that, especially under conditions of unfamiliarity, the range and order of items being evaluated, the method of elicitation, and many other contextual factors can affect responses.

We therefore assume that people do not have well-defined preferences in advance and instead will draw on a combination of information presented at the task, as well as information readily available to them (e.g. recent experiences, cultural and

social understandings about the world) to construct a response (Payne et al., 1992). Although this means that responses are somewhat contingent on the context, expressed preferences also reveal something about immediate reactions, and the deeper values that inform that response.

The notion that responses are not fully-formed but rather “constructed” is particularly important to consider in survey research, and interpreting any particular survey finding therefore has to involve a degree of caution (e.g. Lichtenstein & Slovic, 2006; Pidgeon et al., 2012). Accordingly, we complement the use of surveys with findings from more qualitative data, which further contextualises public risk perceptions around ES.

As a result, this article presents an initial exploration of public perceptions in the UK context, and although this represents only one set of issues at a particular point in time, it provides a useful platform for highlighting emerging issues and lines of inquiry. It is also a useful starting point for continuing to investigate how public perceptions may shift over time as both the UK and international context changes.

## **2 PUBLIC VIEWS ON ENERGY SECURITY – FINDINGS FROM TWO SOCIAL SURVEYS**

### **2.1 METHODS**

We present findings from two separate surveys conducted in 2010; both surveys took between 15-30 minutes to complete and focused on beliefs around renewable energy, CC and ES. Here we present the findings from a 10-item ES scale used in both surveys.

#### **2.1.1 Measures**

The previous sections have outlined the complex polysemic nature of ES (Chester, 2010), which may make it difficult to operationalise in quantitative social surveys to capture public views. Due to the exploratory nature of this research we sought to include a range of different ES aspects. Ten items were subsequently constructed following analysis of the existing literature and pilot surveys to test different question formats (Demski, 2011). They represent five broad aspects of ES, i.e., the reliability of the energy system to have sufficient reserves to meet demand, the affordability of energy (i.e. preventing price increases/fluctuations), dependency on energy imports, the vulnerability to interruptions of the energy supply system (e.g. through terrorist attacks etc.), and an (over) dependency on fossil fuels. These items range from more immediate concerns such as price increases to more abstract causes for concern (e.g. perceived vulnerability to running out of fossil fuels) to reflect the diverse nature of ES issues in the UK context. Item presentation was randomised in the online survey. Respondents were asked to indicate their level of concern for each item on a 4-point concern scale (not at all concerned, not very concerned, fairly concerned, very concerned) as well as a 'don't know' response<sup>2</sup>.

In both surveys CC concern was measured using the question: "How concerned are you, if at all, about climate change?" Respondents were asked to indicate their concern on the same 4-point scale as for the ES items to make comparison between the two measures possible. The Cardiff survey also included a direct trade-off question asking respondents to indicate preference for ES and CC as energy policy goals. A 5-point bipolar response scale was used, where the mid-point indicates equal importance of both ES and CC, and the end-points indicating preference for ES or CC as the only important or more important issue (Appendix B). This item was developed to assess the relative importance of the two issues.

#### **2.1.2 Procedure - The Cardiff survey**

A total of 1,963 questionnaires were delivered during May and June 2010 in five Cardiff areas<sup>3</sup>. The five sampling areas were chosen using approximate social grade<sup>4</sup>



as measured in the 2001 UK census to achieve a sample with a diverse socio-economic background. The chosen areas also represent slight oversampling of lower social-economic status areas because it was expected that these would show lower response rates (Dillman, 2007). A postal procedure was used where questionnaires were dropped through the letterbox and either collected or mailed back. The procedure for data collection consisted of three major phases (pre-notification, distribution, reminder) and follows that recommended by Dillman (2007) to maximise response rates. All materials are available on request (also see Demski, 2011).

Overall, 26.5% of people returned their questionnaires resulting in 520 usable responses. This response rate compares with other similar unsolicited UK postal surveys (Whitmarsh, 2011). It was evident that respondents in areas with higher socio-economic status were more likely to return the questionnaire, in turn resulting in a somewhat more highly educated sample than found in the national population, particularly with regards to postgraduate-level education. Younger people between the ages 16 and 34 were also under sampled (see Appendix A).

### *2.1.3 Procedure - The online survey*

In order to test the measures on a more diverse sample, a second survey was carried out later in the year (November 2010). Although the specific focus was on attitudes to wind energy it still included questions on CC and ES. This also allows analysis of the ES items in a more representative sample. This survey was distributed to a UK online panel of respondents by the recruitment company Maximiles, which provides its members with rewards in exchange for redeemable loyalty points. The company have a monitored panel of 950,000 UK opt-in members representative of the UK population.

Online software was used to construct and host the questionnaire (Qualtrics Labs, 2010). Age and gender quotas based on the 2001 census (UK population) were used for sampling to ensure a balanced sample. The survey was distributed to all regions in the UK, and to potential respondents with diverse educational backgrounds.

Overall, 510 completes were recorded when the quotas had been filled. Eleven participants were deleted for quality purposes (survey response time below 3:30 minutes or no response variability on all questions) leaving 499 usable responses. Response rates were not recorded and are considered non-indicative when using online quota-sampling because non-response cannot be easily defined.

Demographic information was consulted instead (Dillman, 2007). The sample is broadly representative of the UK population in terms of age and gender, although the level of education was somewhat higher than the national average; especially in terms of degree-level education (see Appendix A). The sample was weighted to the

known UK population on the basis of age, gender, education and working status (using aggregated weights based on 2001 census data and mid-year population estimates; ONS, 2007); however descriptive statistics were not found to be significantly different between weighted and unweighted samples (generally responses different by no more than 1%). As such, unweighted statistics are reported.

## 2.2 RESULTS

### 2.2.1 Concerns about different aspects of energy security

Examining the individual items across the two surveys, differences emerge but the pattern of responses is very similar (Table 1, Figure 1). At first, it looks as if respondents in the Cardiff survey were more concerned than the online survey. For example 83% of respondents in the online survey were very or fairly concerned about dependence on other countries, compared to 88% in the Cardiff survey ( $z = 2.27, p < 0.05$ ). However, upon closer analysis, the mean concern for each item is very similar across both surveys (Table 1) with the main difference the number of people who chose the “don’t know” (*DK*) option. In the online sample, between 2-5% more respondents indicated not knowing as compared to the Cardiff survey. These differences might have occurred due to methodological differences in the surveys, particularly because completing questionnaires online can increase DK responses (Heerwegh & Loosveldt, 2008). Similarly, people with higher educational attainment (overrepresented in the Cardiff survey) are less likely to indicate ‘don’t know’ than respondents with lower levels of formal education (Dillman, 2007).

DK responses are highest for the item on *terrorist attacks* (9%) and *another country cutting off the UK’s energy supply* (9%). The fact that a relatively high percentage of respondents opted for the DK response indicates that perhaps people find it difficult to judge these types of risks and are reluctant to provide answers.

**Table 1**

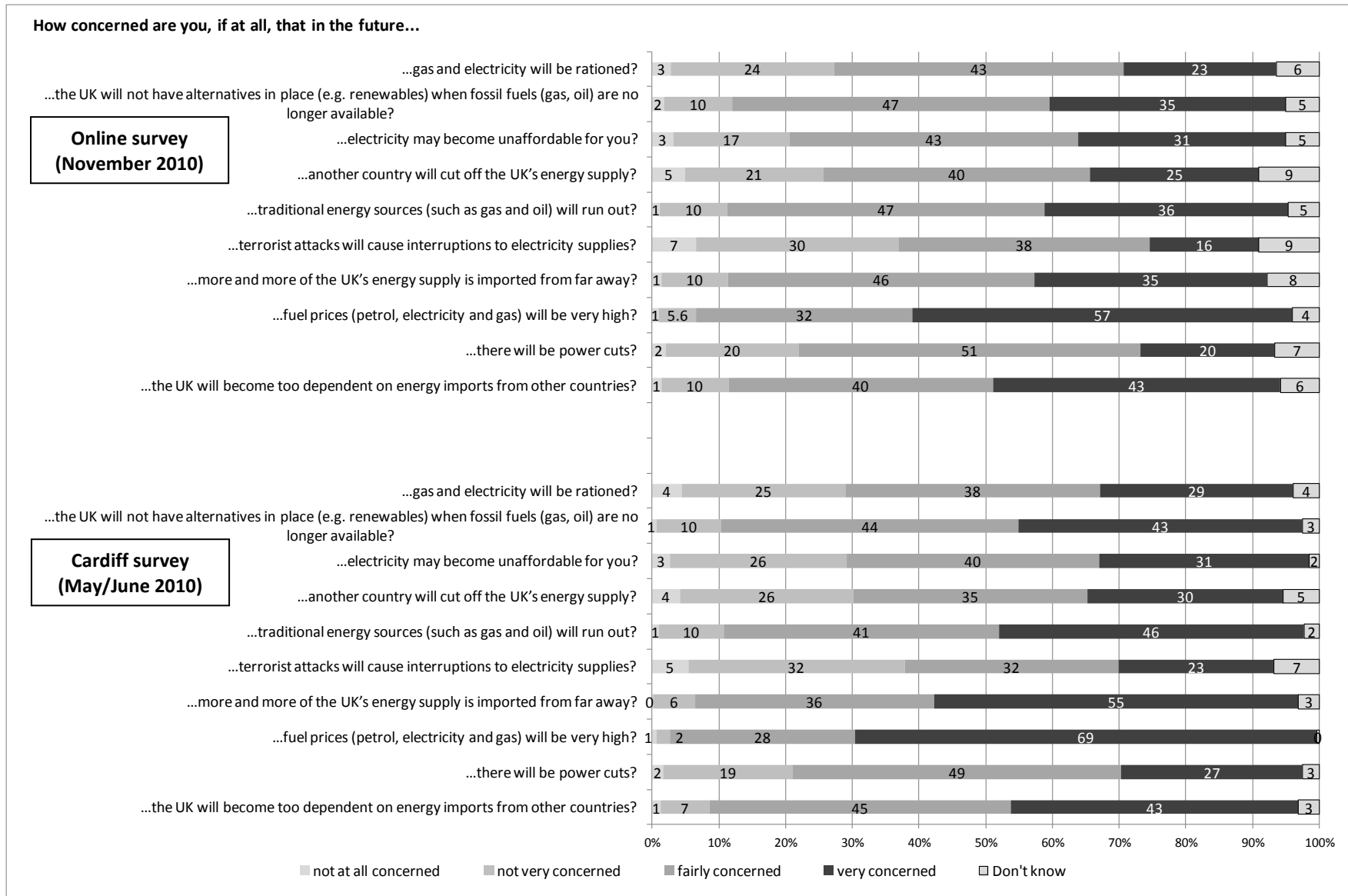
Mean concern (and standard deviations, SD) for the individual energy security items in the Cardiff (May/June 2010) and online surveys (November 2010).

<b>How concerned are you, if at all, that in the future...</b>	<b>Mean (SD) Cardiff survey</b>	<b>Mean (SD) Online survey</b>
...the UK will become too dependent on energy imports from other countries?	<b>3.34</b> (.68)	<b>3.32</b> (.72)
...more and more of the UK's energy supply is imported from far away?	<b>3.50</b> (.62)	<b>3.24</b> (.70)
...fuel prices (petrol, electricity and gas) will be very high?	<b>3.66</b> (.55)	<b>3.51</b> (.66)
...electricity may become unaffordable for you?	<b>3.00</b> (.84)	<b>3.08</b> (.80)
...traditional energy sources (such as gas and oil) will run out?	<b>3.35</b> (.70)	<b>3.25</b> (.69)
...the UK will not have alternatives in place (e.g. renewables) when fossil fuels (gas, oil) are no longer available?	<b>3.33</b> (.68)	<b>3.23</b> (.71)
...terrorist attacks will cause interruptions to electricity supplies?	<b>2.79</b> (.89)	<b>2.70</b> (.85)
...another country will cut off the UK's energy supply?	<b>2.95</b> (.87)	<b>2.94</b> (.85)
...there will be power cuts?	<b>3.04</b> (.74)	<b>2.96</b> (.72)
...gas and electricity will be rationed?	<b>2.95</b> (.86)	<b>2.92</b> (.79)

The pattern of concern is very similar across both surveys despite differences in the demographic profile of the samples. Respondents were most concerned about *fuel prices being high* and least concerned about *terrorist attacks on energy infrastructure*. The highest concerns in both cases also included items relating to importing fuel from far away and being dependent on other countries, as well as

risks of running out of traditional energy sources. Similarly, risks associated with another country cutting off supply, or rationing energy, were relatively lower in concern. These findings are also closely in line with a similar scale<sup>5</sup> used in a fully nationally-representative survey in 2010 (Spence et al., 2010b).

Subtle differences between items emerge when examining responses more closely. For example in the online survey, a large majority (57%) was very concerned over fuel prices being high and that the UK will become too dependent on energy imports (43%) whereas a much smaller percentage was very concerned over power cuts (20%), terrorist attacks (16%) and the possibility of rationing of electricity (23%). This suggests that these latter types of events are perhaps less expected, or attract more uncertainty and less urgency compared to others. This might be because they are less abstract in nature (e.g. compared to national dependence on imports) and in some cases ask respondents to consider concrete events (e.g. power cuts). The high concern over energy prices is perhaps unsurprising and aligns with sharply growing energy expenditure by UK households in the last decade (DECC, 2013).



**Fig. 1.** Concern for each of the 10 energy security items in the Cardiff and online surveys (percentage of respondents).

### 2.2.2 Concerns about Energy Security and Climate Change

Concern for the ten ES items was averaged for each respondent; both surveys showed fairly high concern overall (mean = 3.19 and 3.12)<sup>6</sup>. Prior to this, the ES scales were found to be reliable in both surveys; Cronbach’s  $\alpha$  = 0.87 (Cardiff survey) and 0.90 (online survey).

We now compare results of the ES scale to concerns over CC to provide further insights into public perspectives around ES risks. This comparison is also appropriate because both are important framings of energy policy, often being evoked to provide support for various decisions about supply and demand side changes to the energy system. Although in theory CC targets and ES goals have been converging in UK energy policy, conflicts could occur where one is given priority over the other (UKERC, 2009).

In both surveys the ES and CC questions were counterbalanced to check for any possible order effects. In fact, the order of questions did not affect the level of CC concern expressed in either survey (Cardiff survey  $F(1,518)=0.555$ , n.s.; Online survey  $F(1,493)=0.007$ , n.s.), but it did affect the level of ES concern (Table 2). Concern for ES issues was higher when respondents first answered the ES section compared to those that completed the CC section first. This effect was found in both the Cardiff survey ( $F(1,505)=14.718$ ,  $p<0.001$ ) and the online survey ( $F(1,459)=5.749$ ,  $p<0.05$ ).

**Table 2**

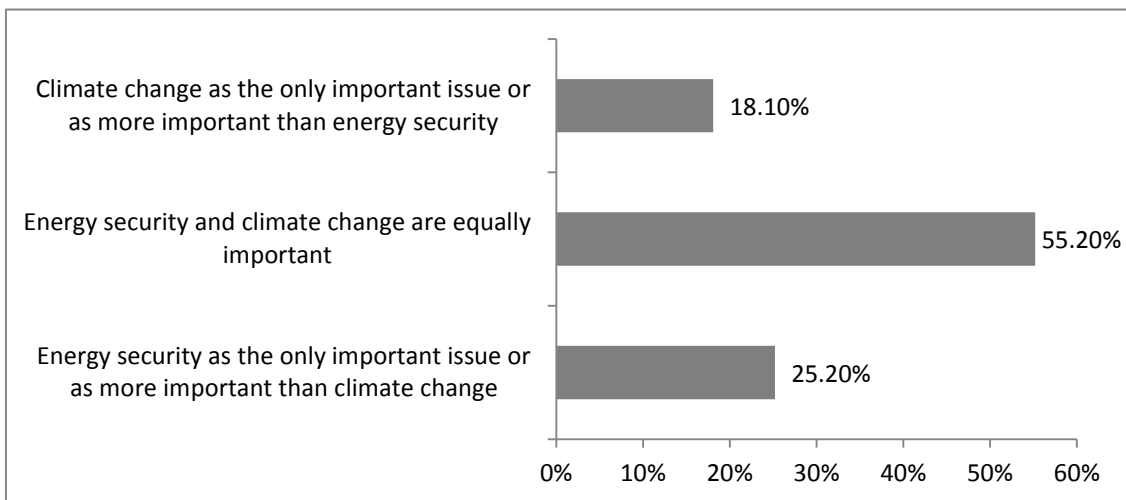
Means (and standard deviations) for energy security and climate change concern as a function of which section was completed first in the Cardiff and online surveys.

		Section completed first	
		Energy security	Climate change
Cardiff survey	Energy security concern	<b>3.28</b> (0.48)	<b>3.11</b> (0.51)
	Climate change concern	3.06 (0.76)	3.01 (0.79)
Online survey	Energy security concern	<b>3.17</b> (0.51)	<b>3.05</b> (0.55)
	Climate change concern	2.72 (0.78)	2.73 (0.80)

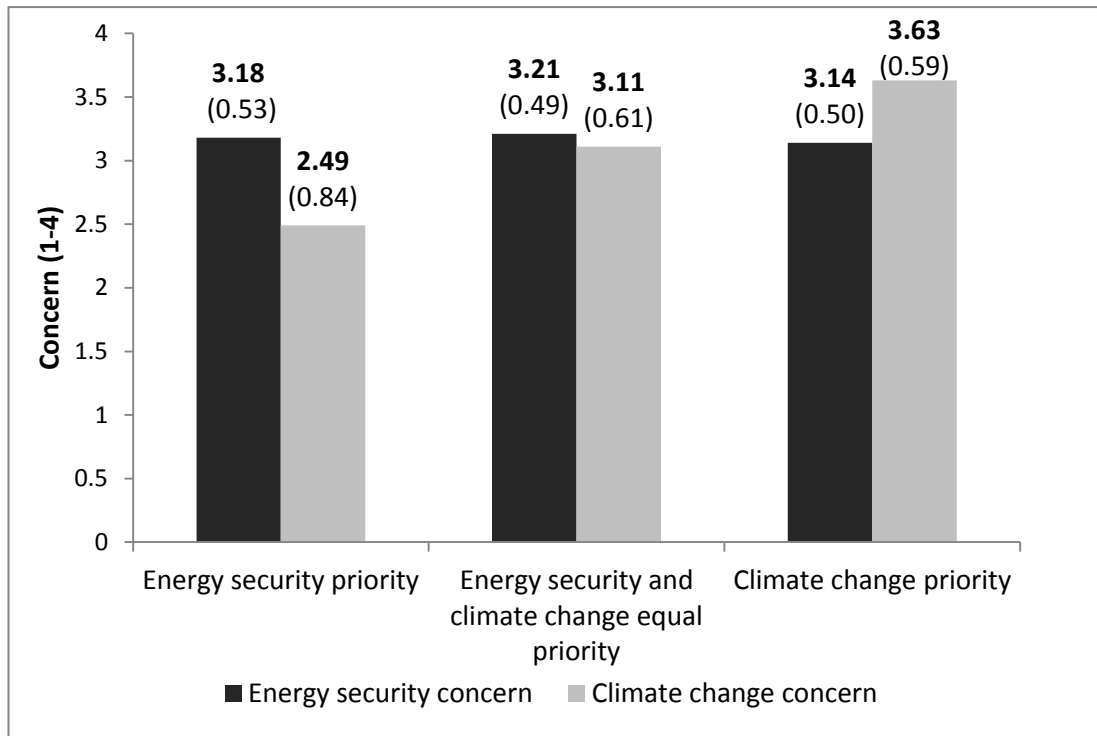
It may be the case that the way people in the UK feel about CC is much more stable, and having indicated (quite substantial) concern for CC, this may then dampen (in comparison) the concern for other issues, i.e. ES, a much less known and discussed issue. Hence when first expressing concern for CC, this may then act as a direct contrast or anchor for subsequent responses. This represents a very subtle framing effect that must be kept in mind when conducting surveys of this

kind where multiple issues are asked about. Undeniable, however, is the fact that ES concern is still very high in both groups.

Exploring these relationships further, the Cardiff survey included a question in which respondents were asked to indicate which energy policy goal they found more important when directly compared (Figure 2). Unsurprisingly, the most frequent response was that both ES and CC are equally important when considering Britain's energy future (55.2%). However, further analysis reveals that more respondents were leaning towards ES (25.2%) than CC (18.1%), confirmed by a one sample t-test, ( $t(516) = -3.340, p = 0.001; M = 2.88, SD = .757$ ). Of course this means that overall a large majority find both goals equally important. However, upon analysing differences between these three preference groups, only CC concern seems to distinguish between the groups, not ES concern (Figure 3). In fact, ES concern was equally high for all three groups ( $F(2,501) = 0.645, n.s.$ ), whereas CC concern was significantly different for all three ( $F(2,514) = 83.129, p < 0.001$ ), being the highest in the CC preference group and the lowest in the ES preference group.



**Fig. 2.** Results (percentage of respondents) of the climate change vs. energy security trade-off question in the Cardiff survey.



**Fig. 3.** Mean energy security and climate change concern as a function of prioritising energy security or climate change goals (standard deviations indicated in brackets).

Together these findings suggest key differences between CC and ES concerns among the general UK public. Whereas CC concern seems more stable, ES concern seems more susceptible to framing effects. Previous research has found that CC concern is linked to environmental values and more fundamental ideologies (Spence et al., 2010a; Pidgeon, 2012). In contrast, the findings here suggest that ES concern may be more of a constructed, less solid belief, dependent on the context and only an emerging concern among the general public. Yet Figure 3 also suggests that ES does not vary much within the sample, always relatively high, whereas CC concern shows higher variability, a finding that is in line with increased attention being paid to ‘sceptical’ CC beliefs (Poortinga et al., 2011). Nonetheless the ES scale itself was reliable and successful in showing that ES issues are something that the public is concerned about when explicitly confronted with these issues; with consistent findings across both surveys.



### **3 UNFAMILIARITY AND UNCERTAINTY WITHIN ENERGY SECURITY CONCERNS**

Having shown that the general public expressed relatively high concern over ES issues we now offer some further context in which these results should be interpreted. We will use findings from interviews with members of the public conducted prior to the survey research<sup>7</sup> to supplement this discussion (see Demski, 2011).

#### **3.1. METHODS**

The interviews (N=20), which contained a range of ages, genders and occupational background, were conducted separately to the surveys, although they were connected by being part of a wider project with similar aims (to explore public perception of renewable energy and other energy supply technologies). As such, the interviews did not focus solely on ES but on perceptions of energy sources and futures. Although a section at the end of the interview was earmarked for discussion of ES, this turned out to be challenging because the term itself was unknown to interviewees. We therefore present a thematic analysis of discussions of aspects of ES that were expressed spontaneously throughout the interview. This analysis was deemed exploratory and allowed us to better understand how, and if, people understood ES in relation to energy supply and futures (Demski, 2011).

#### **3.2 FINDINGS**

The most important finding is that the term “energy security” was unfamiliar to our participants, which has been replicated in other studies (Happer et al., 2012; Parkhill et al., 2013). Participants did not use the term, or variations of it, to refer to identified concerns such as running out of oil. If asked, many stated that they had never heard of it:

Interviewer: “...have you heard of the term energy security before?”

Participant: “Energy security? No I don’t think so...”

Interviewer: “What do you think it might mean?”

Participant: “I have no idea...energy security...” (Male, age 30)

Although there may be little awareness of the term itself, this did not mean people had no understanding of some of the underlying issues. Indeed, some aspects of ES were quite firmly embedded in discussions around, and even definitions of, various energy sources. Virtually all interviewees discussed the future of UK energy (supply) in terms of fossil fuels running out: this was seen as certain and inevitable and therefore renewable forms of energy supply were seen as vital in the long-term:

“There’s limited time until fossil fuels run out. So we need, in Britain, to increase our renewable energy sources, so that we can survive in the future.” (Female, age 26)

“So within our lifetimes it might not actually be possible to extract anymore of these resources. So clearly it is absolutely imperative that we develop sustainable, renewable sources of energy” (Female, age 67)

This discourse, or some form of this, was the basic rationale underlying all discussions around the future supply of energy and shows an interpretation of ES aspects in relation to energy supply. However there were differences and more uncertainty in terms of the urgency to act which are important qualifiers with regards to “concern” over these issues. For example, one participant thought (in relation to fossil fuels running out that) “he’d be long dead before that happens” (Male, age 46) whereas the second quote above displays a lot more urgency with respect to fossil fuels needing replacement.

Examining the spontaneous discussion of ES issues, most of the discourse focused around “dependence” and future supply. Dependence was discussed in terms of UK vulnerability due to dependence on fossil fuels and dependence on other countries/imports. Spontaneous discussion of these aspects was quite prominent and was accompanied by substantial concern, which is in line with the findings from the surveys where highest concern was expressed for these aspects relative to others.

Other aspects of ES were less often discussed in terms of threats to future supply. For example, the reliability of wind and solar energy was discussed when these supply sources were considered, but that did not prevent them from being proposed as solutions to other ES concerns such as reducing dependence, ensuring future supply and diversifying our energy. The conception of domestic, diverse, endless and clean energy was more powerful than any notions around (un)reliability. It is perhaps unsurprising that when ES is framed in this way, this provides a strong positive framing for the development of renewable sources as found in some recent research (Lockwood, 2011).

It is also interesting to note that these risks (e.g. of dependence) were mostly discussed in the abstract, rather than how they might concretely manifest themselves, or affect the UK specifically or one personally. The perceived international and abstract nature of these risks may also remove the individual from the more personal implications of ES, and hence suggests a psychological distancing effect similar to that found for CC beliefs (Spence et al., 2012). This is in line with the quantitative findings from the surveys, where more abstract ES issues like dependence on imports received higher concern than more concrete events such as terrorist attacks or ‘consequences’ of risks such as rationing of energy.

As mentioned previously, the main way people might feel the effects of energy insecurity is through energy bills, fuel shortages and blackouts which disrupt the services provided by energy. In particular, high energy costs (e.g. because of our dependence on fossil fuels) were discussed frequently. This is not surprising considering that this is the primary manner in which many people currently interact with energy, in addition to price increases frequently making the headlines in the UK (BBC News, December 2012). In addition, both surveys found high levels of concern over energy prices. On the other hand, the risks of fuel shortages and power cuts were acknowledged in the interviews at times but, unlike prices, not necessarily seen as inevitable, particularly disruptions of any significance (e.g. a power cut lasting longer than a few minutes). However the consequences of a national blackout were at times acknowledged and evoked experiences from previous fuel shortages, such as “queues at petrol stations, 30 or 40 cars”.

## 4 DISCUSSION

In summary, the findings presented in this paper suggest that ES risks are of concern to the UK public, but with attitudes being potentially more unstable when compared to those of CC. The interviews in turn suggest that the term “energy security” is unfamiliar to people. Notions around ES may be loosely based on dependence and external threats to supply, aspects of ES that received the highest concern in both surveys, and that arose spontaneously in the interviews.

Previously we introduced the idea of preference construction as a way of thinking about the current status of ES attitudes, in part, due to the unfamiliarity and low salience of ES issues, and in part, due to its complex nature (Chester, 2011). Both of these characteristics make it more likely that people do not have stable or fully-formed views about ES. Instead people may arrive at a response by drawing on a range of their existing beliefs and values, their instant affective reactions, and inferred context (Lichtenstein & Slovic, 2006). In this regard examining public perceptions of ES has similarities with the examination of public perceptions of emerging technologies or other complex social issues – e.g. nanotechnologies (e.g. Pidgeon et al., 2011). Indeed, several findings point to the notion that ES is quite intangible in nature, and public representations and understandings have yet to be fully established. There were generally high DK responses in the surveys indicating that some members of the public may have found it difficult to make a judgement. Similarly, concern over ES was subject to a framing effect, where the level of expressed ES concern varied depending on whether it was preceded by a question on CC concern or not. In addition, the interview findings suggest that there was a considerable amount of uncertainty among members of the public, for example when considering personal implications of ES risks.

Although preference construction theory would suggest variability in people’s responses, there are aspects of the results that point to more stable characteristics of public perceptions. First, we generally observed consistently high concern across all ES items in both surveys. Second, more abstract notions around dependence on other countries and running out of fossil fuels generally received higher concern than more concrete events like blackouts or terrorist attacks on infrastructure.

Although we did not examine *why* people displayed high concern for ES issues, the nature of the findings led us to think through other factors, primarily drawn from risk perception literature that might be relevant in understanding public responses. We envisage this following discussion to provide a basis for future examinations of public views on ES and related beliefs.

On one hand, the findings that concern for ES issues was consistently and generally high among members of the UK public invites questions as to what underlies this

concern. On the other hand, the relatively high number of DK responses in the survey and the unfamiliarity expressed in the interviews also raise questions for further research. One line of inquiry that might shed further light on both of these findings is to consider risk perceptions in relation to the probability or likelihood of something occurring versus the severity of consequences. Indeed, previous research suggests that people often base a large part of their evaluations of a risk on the latter (severity of consequences) more than the former (probability; e.g. Breakwell, 2007; Parkhill et al., 2013). As such, the high concern for ES issues found in the surveys may be linked to perceptions of threat to something that is particularly essential in our society. For example, if there were to be problems leading to significant supply disruptions, the consequences for the nation and individuals could be quite severe, e.g. petrol shortages might mean you are unable to get to work, or supermarkets run low on food supplies etc. The role of affect and emotions associated with the perceived consequences of various ES risks would be an important further examination (Slovic et al., 2004).

In addition, ES risks are qualitatively high on characteristics which have been shown to increase public risk perceptions, for example risks are perceived to be higher (and more unacceptable) if they are imposed on us, if they are relatively uncontrollable (e.g. dependence on imports, lack of alternatives), and if they have the potential for catastrophic outcomes (e.g. prolonged electricity shortage leading to societal breakdown; Fischhoff et al., 1978; Slovic, 2000). Examining these specific risk perceptions would provide a more in-depth understanding of why publics express relatively high concern for ES risks.

In contrast, uncertainty in the interviews and high DK responses, especially for more concrete items like terrorist attacks compared to more abstract notions around scarcity of fossil fuels, might be related to judgements about likelihood rather than severity. Although we did not ask people for their judgements about 'likelihood', it might be understandable why people find it difficult to judge these risks and their probability of occurrence considering the complex nature of the energy system and its many national and international dimensions. Judging probabilities of specific ES risks is difficult and problematic, especially in an energy system that has suffered little disruption in recent years. A lack of experiences may mean that disruptions in energy service are not readily available in memory to draw upon (Tversky & Kahneman, 1973). This discussion however must be supplemented by the acknowledgement that even experts find it notoriously difficult to assess and agree on the degree of the various risks to the system (Chester, 2010). It is also possible that uncertainty may manifest specifically in judgements about personal consequences of ES risks, for example judgements as to whether conflicts in another country will have direct impacts on the supply at home, e.g. through price spikes or actual disruptions.

As mentioned previously, the current study finds a difference between public perceptions of more abstract or national risks compared to perceptions of more concrete or personal risks. Here we find a tendency that the latter receive perhaps slightly less concern compared to the former (with the exception of energy prices). However the current research does not fully pull these two apart; further work closely looking at personal, more concrete notions of ES risks would be particularly useful, including an examination of how perceptions differ across individuals with, for example, different socio-demographic backgrounds (Sovacool et al., 2012).

One type of personal risk associated with ES that was included in the surveys involved energy affordability; here we find that people are highly concerned about being able to afford energy in the future. Emerging research around public perception of energy costs also shows that these are further bound up with other beliefs around fairness, equity and responsibility, and in that regard might represent one way in which public and 'official' notions of ES diverge (Parkhill et al., 2013). The nature of public perceptions of energy costs and their implications are starting to be explored (Butler et al., 2013), but represent a key area for further research.

Similarly, understanding in more detail how ES risks are perceived by the public might also be informed by further inquiry into what energy means to people in their everyday lives and associated beliefs around dependence and control. As such, events that threaten the continuity of energy services, even if hypothetical, may temporarily make the taken for granted 'visible' (e.g. Hargreaves et al., 2010). If this is coupled with a sense of high dependence on energy and a lack of control (e.g. 'there are no alternatives to driving my car'), this may result in high risk perceptions. This line of thought has been suggested when investigating the view that energy is seen as a social good (Stern & Aronson, 1984), evoking imported questions about who is seen to be responsible for ensuring a continuous access to energy services (Parkhill et al., 2013). For example, do publics ascribe responsibility to government and industry actors or is there a sense of personal responsibility, and in what areas of ES? Do publics see a role for personal action in maintaining ES? The answers to these questions will also have important implications for risk communication and public engagement around ES. For example, if we find that high concern is coupled with little perceived personal responsibility and a perceived lack of control, risk communication strategies could focus on linking national and personal aspects of ES risks, and engaging people with how they personally can contribute to their own ES (e.g. by reducing their overall energy use). In addition, reassurances by government may be useful in areas where publics have little control, for example, communication about emergency procedures for more national-level concerns.

In conclusion, the results of this study suggest that ES is perhaps only an emerging concept within public discourse. Although concern over ES issues is likely to remain high, specific perceptions are also likely to vary and emerge as the ES landscape shifts and changes. Domestic and international developments will impact upon these perceptions at any given point in time; examples might include the increasing rhetoric around shale gas and its role in energy dependence and pricing both in the UK and elsewhere. It is thus important to both track the emergence and development of public ES risk perceptions and discourses, and to explore what drives these risk perceptions in more detail.

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<sup>1</sup> Although this is a particular focus on the electricity sector, transport and heating are also vulnerable because they are almost entirely dependent on gas and oil in the UK currently.

<sup>2</sup> The pilot surveys prior to this stage indicated that respondents were reluctant to answer 'likelihood' questions in questionnaires (e.g. "How likely do you think it is that the UK will have frequent power cuts in 10 years?") hence a concern scale was used instead.

<sup>3</sup> The first survey was carried out in Cardiff in part because of limited resources. Nonetheless choosing a UK capital city allowed access to a diverse sample in terms of socio-economic background.

<sup>4</sup> Social grade is a variable computed based on the occupation of the Main Earner (which is the previous occupation for those retired or unemployed and current occupation for others). The Main Earner occupation variable is populated according to ISCO (International Standard Classification of Occupations, available at <<http://www.ilo.org/public/english/bureau/stat/isco/>>).

<sup>5</sup> The national survey conducted in 2010 (reported in Spence et al., 2010b) used similar items to measure public perceptions of ES. Both sets of items were created from the same piloting (Demski, 2011). In the case of the 2010 survey, only 6 items were used and these were embedded in a survey examining public perceptions of climate change and nuclear power.

<sup>6</sup> Instead of listwise deleting all respondents with a DK response in any of the ten items, we adopted a procedure whereby we calculated mean ES concern for all respondents who had 3 or less DK responses to retain numbers and allow inclusion of their views.

In the online survey, 15% of respondents had 3 or less DK responses. These were more likely to be women. 6% of the sample had more than 3 DK responses, but these did not belong to any particular demographic group.

In the Cardiff survey, 11% of respondents had 3 or less DK responses. These were more likely to be aged over 65. Only 2% of the sample had more than 3 DK responses.

The mean concern in both surveys did not differ depending on whether all DK responses were excluded or the '3 or less' rule was used. For the Cardiff survey,  $t(955) = 0.125$ ,  $p = 0.901$  where  $M = 3.19$ ,  $SD = .50$  if DK responses are included and  $M = 3.19$ ,  $SD = 0.51$  if they are listwise deleted. For the online survey,  $t(853) = -0.137$ ,  $p = 0.853$  where  $M = 3.12$ ,  $SD = 0.53$  if DK responses are included and  $M = 3.12$ ,  $SD = 0.55$  if they are listwise deleted.

<sup>7</sup> Twenty semi-structured interviews were conducted in May-August 2009 with diverse members of the public in Cardiff, recruited from the *Community Panel* of the Cardiff University Psychology department. This panel is maintained by the department by advertising for paid or voluntary participation in psychology studies. A diverse range of participants were contacted on the basis of age, gender, education and occupation. On average, the sample is well educated (over half say they have a postgraduate degree) with the youngest interviewee being 21 and the oldest being 67 years old. 12 women and 8 men were interviewed. The interviews lasted between 30 and 60 minutes. See Demski (2011) for full methodological details.

**Appendix A. Sample characteristics of the Cardiff and online surveys in comparison to national data (based on 2001 UK census data and 2007 mid-year population estimates; ONS, 2007<sup>a</sup>).**

	Cardiff survey (N= 520)	Online survey (N= 499)	UK National
<b>Gender</b>			
Male	49%	48%	48%
Female	49%	52%	52%
Declined	2%	-	
<b>Age</b>			
16-24	2%	(18-) 12%	(15-17) 3 (18-24) 12%
25-34	11%	16%	14%
35-44	21%	19%	18%
45-54	22%	17%	17%
55-64	23%	16%	14%
65-74	12%	12%	13%
75-84	6%	7%	9%
85+	1%		
Declined	2%	-	-
<b>Level of education</b>			
No formal qualifications	14%	13%	18%
GCSE/O-level	15%	18%	19%
Vocational/NVQ	11%	7%	11%
A-Level /Higher/BTEC	9%	20%	18%
Degree or equivalent	19%	31%	19%
Postgraduate	28%	5%	6%
Other	2%	2%	8%
Still studying	Below 1%	4%	Below 1%
Declined	3%	Below 1%	-
<b>Working status</b>			
Working (full-time)	45%	40%	36%
Working (part-time)	12%	12%	13%
Unemployed – seeking work	2%	4%	
Unemployed-not seeking work	1%	2%	8%
Retired	27%	24%	27%
Looking after house/children	5%	7%	7%
Disabled	2%	5%	3%
Student	2%	5%	7%
Other	1%	1%	Below 1%
Declined	2%	Below 1%	-

<sup>a</sup> ONS, 2007. Office for National Statistics. Mid-year population estimates. Available from <http://www.ons.gov.uk/ons/publications/all-releases.html?definition=tcm%3A77-22371>

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**Appendix B. Full text of the energy security vs. climate change trade-off question in the Cardiff survey.**

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When considering what energy technologies Britain should use in the future, which of these two issues do you think is more important?

**Energy security** – making sure the UK has a continuous, secure and affordable supply of energy

**Climate change** – reducing the use of carbon emitting energy sources like fossil fuels (coal, oil, gas)

	Both – but <b>energy security</b>		Both – but <b>climate</b>	
<b>Energy security</b> as the only important issue	is more important than climate change	Both are equally important	change is more important than energy security	<b>Climate change</b> is the only important issue
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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