UKERC
UK Energy Research Centre



Public Attitudes to Nuclear Power and Climate Change in Britain Two Years after the Fukushima Accident

Synthesis Report

Public Attitudes to Nuclear Power and Climate Change in Britain Two Years after the Fukushima Accident

Synthesis Report

Wouter Poortinga
Nick Pidgeon
Stuart Capstick
Midori Aoyagi

January 2014

This report should be cited as: Poortinga, W., Pidgeon, N.F., Capstick, S. and Aoyagi, M. (2014) Public Attitudes to Nuclear Power and Climate Change in Britain Two Years after the Fukushima Accident - Synthesis Report (UKERC: London).

REF UKERC/RR/ES/2014/001

About UKERC

The UK Energy Research Centre carries out world-class research into sustainable energy systems.

It is the hub of UK energy research and the gateway between the UK and international energy research communities. Its interdisciplinary, whole-systems research informs UK policy development and research strategy.

- UKERC's Meeting Place, based in Oxford, serves the whole of the UK research community and its popular events, designed to tackle interdisciplinary topics and facilitate knowledge exchange and collaboration, are regularly oversubscribed – www.ukerc.ac.uk/support/TheMeetingPlace
- The National Energy Research Network provides regular updates on news, jobs, events, opportunities and developments across the energy field in the form of a popular weekly newsletter – www.ukerc.ac.uk/support/NERN
- UKERC's Research Atlas is the definitive information resource for current and past UK energy research and development activity. The online database also has information on energy-related research capabilities in the UK and a series of energy roadmaps showing research problems to be overcome before new technologies can be commercially viable – http://ukerc.rl.ac.uk
- UKERC is also the research delivery partner in the Technology Strategy Board's Knowledge Transfer Network (KTN) for Energy Generation and Supply, with responsibility for analysis of future and emerging opportunities. The KTN aims to accelerate the innovation of technology across the energy generation and supply landscape
- All UKERC's publications and articles can be accessed via our online Publications Catalogue, which you can link to from our home page – www.ukerc.ac.uk

Contents

Acknowledgements

This research was supported by the UK Energy Research Centre (UKERC) under the Natural Environment Research Council award NE/G007748/1 (GrantNE/I006753/1). This research was initiated as part of the FY2012 Japan Society for the Promotion of Science (JSPS) Invitation Fellowship for Research in Japan (S-12008).

We would like to thank Ipsos MORI, Edward Langley in particular, for organising the data collection. We also would like to thank the respondents for providing their views. Additional support for the earlier surveys was received from the Economic and Social Research Council (RES-062-23-1134; RES-152-25-1011) and the Leverhulme Trust (F/00 407/AG). We further thank the British Science Association (BSA) for repeating some of the items in 2011. For the Japanese part of the project, we thank the Environment Research and Technology Development Fund, the Ministry of the Environment Japan (1 ZE-1202). Also, Dr Michio Umino, Professor Emeritus at Tohoku University, Dr Yoko Niiyama, Professor at Kyoto University, and Dr Takehiko Murayama, Professor at Tokyo Institute for Technology for their valuable comments.

Executive Summary

This report describes the findings of a nationally representative British survey (n=961) conducted in March 2013. The main aim of the survey was to assess British attitudes to nuclear power and climate change two years after the Fukushima accident. The results are compared to a number of British surveys that were conducted at different stages before and after the Fukushima accident (2005, 2010, 2011, and 2012). This provides an overview of how public attitudes to nuclear and climate change have developed over the past decade and in particular after the Fukushima accident. In the longer term the data will be used for more detailed cross-national comparisons with Japan.

Attitudes to Different Forms of Electricity Generation

In line with previous research, the current survey found that renewable options are perceived far more favourably than nuclear power and fossil fuel based forms of electricity production. However, as compared to the previous studies, there was a marked drop in popularity of renewables, in particular of wind and solar power. The decline in favourability of renewable sources is accompanied by a rebound in support for fossil fuels after a short-lived drop in popularity in 2012, while nuclear power remains one of the least favoured energy sources.

Attitudes to Nuclear Power

Generic Unconditional Attitudes to Nuclear Power

The study found that public attitudes towards nuclear power in Britain have not followed a trajectory that could have been expected after a major nuclear accident. Attitudes to and trust in the regulation of nuclear power have been surprisingly resilient. While nuclear power remained among the least favoured forms of electricity production, public opposition to and concern about nuclear power have dropped substantially after the Fukushima accident. This means that broadly similar proportions of people now support or oppose the use of nuclear power in Britain.

The drop in opposition, concern and perceived risks of nuclear power is accompanied by increasing numbers of respondents opting to not express an opinion on these key tracker questions, suggesting that groups traditionally opposed to nuclear power have become more ambivalent about nuclear power. However, overall, substantial levels of concern remain over the storage of radioactive waste, nuclear accidents, and the targeting of nuclear facilities by terrorists.

Conditional Attitudes to Nuclear Power

In line with previous research, the current study found that more people are willing to express support for nuclear power where it is stipulated that its use will help tackle climate change and improve energy security. That said, the proportion of people who express support for the use of nuclear power conditional upon it helping to

address climate change has declined somewhat over recent years, especially in the years after the Fukushima accident.

However, this may be associated as much with an increase in climate scepticism as with changing attitudes to nuclear power (see below). Whilst a majority of the British public remain of the view that renewable energy is a better way of tackling climate change than nuclear power, there has been a relative shift in favour of nuclear power in recent years.

Public Perceptions of Climate Change

The present study found the proportion of people doubting the reality of climate change has risen to one of the highest levels obtained since 2005. Whilst doubts about the basic reality of climate change have increased in the past three years, the present study nevertheless finds that the level of acceptance of an anthropogenic component to climate change has remained stable over the same period. Likewise, the extent to which people view the seriousness of climate change to be exaggerated has remained largely unchanged since 2010, as has perceived personal responsibility to act upon climate change.

It would seem that changes in patterns of belief about climate change have not been uniform. These patterns warrant further attention in future research, not least because of the demonstrated importance of climate change perceptions for attitudes towards low-carbon electricity production.

Introduction

1

Background

Climate change presents a formidable challenge for governments worldwide. Profound reductions in carbon emissions are needed in both the medium and long term to lessen the chances of dangerous climate impacts. The Copenhagen Accord contained a commitment by Japan to reduce its emissions by a quarter by 2020 and by the United Kingdom as an EU member by between 20-30 per cent over the same time period. Both Japan and the UK have announced long-term emissions reduction of 80 per cent by 2050. Fundamental changes will be needed in the ways energy is produced to achieve large and sustained cuts of this kind. This is unlikely to succeed without the support of the general public.

Nuclear power has in recent years been advanced as a means of enabling both low-carbon electricity generation and energy security (Brook, 2012; Sailor *et al.*, 2000; Pacala and Socolow, 2004; Teräväinen *et al.*, 2011; Valentine and Sovacool, 2010). Previous studies have suggested that this reframing of nuclear power has been endorsed to some extent by members of the public – although such support appears to be contingent upon the portrayal of the particular purpose to which nuclear power is put.

Truelove and Greenberg (2013) have argued that the perception of climate change as a significant risk tends to make people more open to the idea of new nuclear facilities. Likewise, whereas only around a third of people unconditionally favour nuclear power in the UK, a small majority are favourable where it is stipulated that its use will help tackle climate change, and a similar proportion are favourable where nuclear power is presented as a means of improving energy security (Corner *et al.*, 2011). Such contingent support has been argued to reflect what has been termed 'reluctant acceptance' (Bickerstaff *et al.*, 2008; Pidgeon *et al.*, 2008) although these latter authors cautioned that such support could change dramatically were any major nuclear accident to occur in any part of the world.

Within this changed context it is important to study public opinion about climate change and different energy technologies and systems, as they are critical to achieving environmental sustainability targets and energy security policies (Spence *et al.*, 2010).

Case studies from around the world have shown that community opposition can lead to delays or even cancellation of the deployment and siting of energy technologies, while mitigating climate change through energy demand reduction requires serious commitment from the general public to change their own behaviour (Pidgeon *et al.*, 2008).

Both Britain and Japan were considering an ambitious expansion of nuclear power as part of their strategies to reduce carbon emissions and to deliver a reliable and secure supply of electricity (Cyranoski, 2010). The UK currently has 16 operating reactors, generating around 18 per cent of its electricity (Department of Energy and Climate Change, 2012), of which all but one will retire within the next ten years (World Nuclear Association, 2013). After opening the way for new nuclear power stations in the 2006 Energy Review (DTI, 2006) and 2008 White Paper on Nuclear Power (BERR, 2008), the UK Government announced in October 2013 a deal to build the first of a planned new generation of nuclear power plants in the UK (BBC, 2013).

Nuclear power has for a long time been a national strategic priority in Japan and was one of the main pillars of Japan's policy to achieve future carbon-emission reductions. The 2010 Strategic Energy Plan committed to radical reductions in greenhouse gas (GHG) emissions through investments in renewable energy, the promotion of energy conservation, and an ambitious expansion of Japan's nuclear energy generating capacity from 26 per cent in 2010 to nearly 50 per cent in 2030. The latter would be achieved by the construction of at least 14 new reactors (METI, 2010; Hayashi and Hughes, 2013a). However, the accident at the Fukushima Daiichi nuclear power plant that followed the devastating Great East Japan earthquake and tsunami on 11 March 2011 has thrown nuclear power as a publicly acceptable energy technology into doubt (Cyranoski, 2012).

One consequence of the accident in Japan has been a greater impetus to move away from nuclear generation and towards increasing use of renewable energy (Vivoda, 2012; Hayashi and Hughes, 2013a). The Fukushima Daiichi accident has also had policy implications further afield (Hayashi and Hughes, 2013b); although policy responses have varied widely across Europe (Wittneben, 2012).

The authors of this report have been involved in a number of nationally representative surveys that have been conducted in Britain and Japan at different stages before and after the Fukushima accident (e.g., Poortinga *et al.*, 2006; Spence *et al.*, 2010; Aoyagi *et al.*, 2011; Demski *et al.*, 2013). The datasets include the "Public Risk Perceptions, Climate Change and Reframing of UK Energy" and "Public Perceptions of Climate Change and Energy Choices in Britain" surveys that were conducted in Britain in 2005 and 2010 respectively (Poortinga *et al.*, 2006; Spence *et al.*, 2010), as well as a nationwide Japanese survey that was conducted in 2007 (see Aoyagi, 2013a). These pre-Fukushima datasets formed a useful baseline to which Post-Fukushima data could be compared.

A number of items were repeated in a study commissioned by the British Science Foundation (BSA) as part of the 2011 British Science Festival as well as in a Japanese survey on "Public understanding of risk-risk trade-offs between climate change and energy options" that was conducted in July 2011 (Aoyagi *et al.*, 2011).

Analyses of the datasets suggest that British attitudes towards nuclear power have hardly changed in the wake of the Fukushima accident. In contrast, the Japanese public appear to have completely lost trust in the safety and regulation of nuclear power. While trust in the regulation of nuclear power was already low in Japan before the accident, it collapsed to extremely low levels subsequently - with less than one out of ten expressing any level of trust in the management of nuclear power (Poortinga *et al.*, 2013). The low levels of support and trust prior to the accident have most likely been caused by a series of nuclear incidents and accidents throughout the 1990's and 2000s. There are indications that trust in risk regulation has held up relatively well in Britain (Poortinga *et al.*, 2013).

Aim of the Research

The work by Poortinga and colleagues (2013) has shown that British and Japanese publics have responded very differently to the Fukushima accident. However, the surveys included in the analyses were not specifically designed to examine the impacts of the Fukushima accident and therefore contained only a limited number of items that could be used for cross-national comparisons.

This report describes the main findings of the British survey conducted in March 2013. The survey builds upon the previous work conducted by the authors of the report to assess British attitudes to nuclear power and climate change two years after the Fukushima accident. The results are compared to previous British surveys where possible (i.e. Poortinga *et al.*, 2006; Spence *et al.*, 2010; Demski *et al.*, 2013). This provides an overview of how public attitudes to nuclear power and climate change have developed over the past decade and in particular after the Fukushima accident. Technical details of the previous British surveys are provided in Box A.

The British survey was coordinated with a similar survey in Japan that was conducted in February 2013 (Aoyagi, 2013a; 2013b). In the longer term, the British data will be used for more detailed cross-national comparisons with Japan.

Box A: Previous British Surveys

GB2005: The first British survey was conducted between 1 October and 6 November 2005. A national representative quota sample of 1,491 people aged 15 years and older were interviewed face-to-face in their own homes by the market and opinion research company MORI (see Poortinga *et al.*, 2006 for more details).

GB2010: The second British survey was conducted between 6 January and 26 March, 2010. A nationally representative quota sample of the British population aged 15 years and older (i.e. England, Scotland and Wales; n=1,822) were interviewed face-to-face in their own homes by trained Ipsos MORI interviewers (see Spence et al., 2010 for more details).

GB2011: The third British survey was conducted between 26 August 2011 and 29 August 2011. Populus Ltd interviewed a random sample of 2,050 adults online and subsequently weighted the sample to make it representative of the British adult population. The data were collected for the 2011 British Science Festival organised by the British Science Association (BSA).

GB2012: The fourth British Survey was conducted as part of a UKERC-funded study on public attitudes to whole energy system transformations. Data for this online quantitative survey (n=2,441) were collected by Ipsos MORI between 2 and 12 August 2012 (Demski *et al.*, 2013).

The Survey

2

Procedure and Respondents

A nationally representative sample of British people (England, Scotland, Wales) was interviewed face-to-face in their own homes using Computer Assisted Personal Interviews (CAPI) methodology (n=961).

The 38 questions of the survey were added to Ipsos MORI's face-to-face omnibus that was conducted between 8 and 26 March 2013. The face-to-face omnibus provides a nationally and regionally representative sample of adults aged 15 years and over.

A controlled dual-stage sampling strategy was used. A total of 170-180 sampling units are randomly selected with probability of selection proportional to their size. The primary sampling units are stratified according to field region to ensure a good geographical spread. The sampling units consist of two adjacent output areas (OAs), made up of about 125 addresses each. Quotas are set for gender, age, working status and tenure within each sampling unit to control for the likelihood of respondents being at home.

Fieldwork is conducted during weekends as well as weekdays to meet the set quotas on working status. The final sample is weighted to ensure it reflects the national demographic profile (see Table 1). In this sample weighting is applied to correct for the oversampling of low-income owner occupiers.

The Questionnaire

The 38-item questionnaire consisted of three main sections, covering public attitudes towards climate change, nuclear power, and other forms of electricity generation (see Appendix).

Table 1. Characteristics of the weighted survey sample (n=961)

Characteristic		%	Characteristic		%
Gender	Male	49	Social Grade[1]	AB	26
	Female	51		C1	28
				C2	22
Age	15-24	16		DE	24
	25-34	16			
	35-44	17	Region	North East	5
	45-54	17		North West	10
	55-64	14		Yorkshire and Humberside	9
	65+	20		West Midlands	9
				East Midlands	8
Employment Status	Emplyed full time	38		East Anglia	4
	Employed part time	11		South West	9
	Self employed	5		South East	19
	Unemployed - looking for job	6		Greater London	13
	Not in paid work	10		Wales	5
	Retired	23		Scotland	9
	In full time education	7			

Note: The percentages in the table may not always add up to 100 per cent due to rounding.

[1] The social grades presented here reflect the social class definitions as used by the Institute of Practitioners in Advertising based on the occupation of the chief income earner. This classification is standard on all surveys carried out by Ipsos MORI. The classification is as follows: A: Higher managerial, administrative or professional (Upper Middle Class); B: Intermediate managerial, administrative or professional (Middle Class); C1: Supervisor or clerical and junior managerial, administrative or professional (Lower Middle Class); C2: Skilled manual workers (Skilled Working Class); D: Semi and unskilled manual workers (Working Class); and E: State pensioners etcetera, with no other earnings (those at the lowest levels of subsistence).

First, respondents were asked to give their overall opinions or impressions of different forms of electricity generation (see e.g. Poortinga *et al.*, 2006).

Second, respondents were asked in detail about their attitudes to nuclear power. This second section covered generic 'unconditional' attitudes to nuclear power (e.g. general support, concern, perceived risks and benefits) as well as 'conditional' attitudes to nuclear power in the context of climate change and energy security (see Corner *et al.*, 2011).

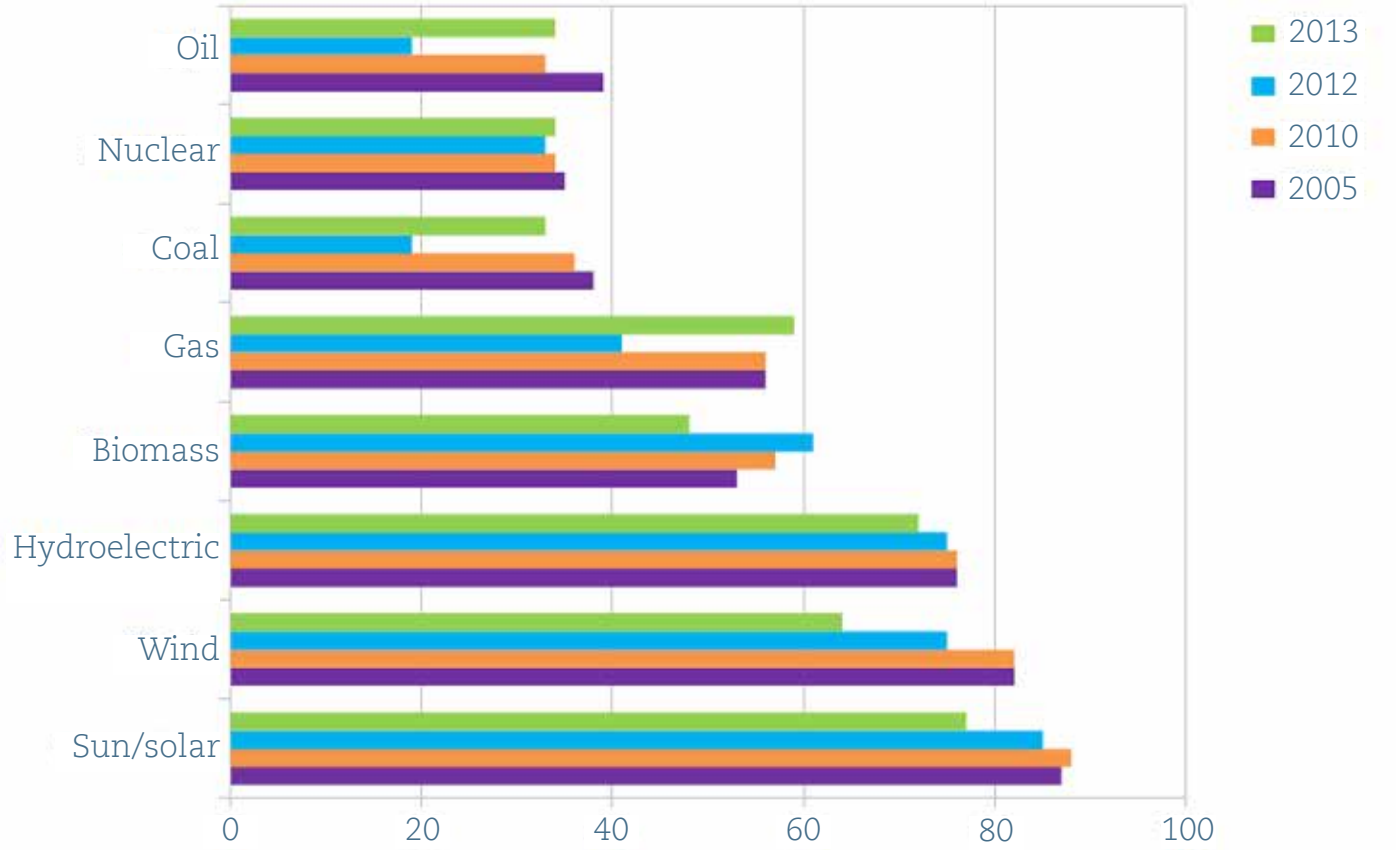
Other related issues included the perceived safety of nuclear power, trust in risk regulation, and views on the future of nuclear power in Britain. This second section further included a new battery of questions examining the perceived risks of nuclear power in more detail.

The third section of the questionnaire covered attitudes, beliefs and concern about climate change. Questions were designed to assess levels of trend, attribution, and impact scepticism (see Rahmstorf, 2004; Poortinga *et al.*, 2011). The items were selected to provide a comprehensive overview of how the general public perceives the reality, causes and impacts of climate change.

Results

3

Figure 1. Percentage of respondents having mainly or very favourable opinions or impressions of different energy sources for producing electricity



Across the options for fossil fuel based electricity generation, natural gas was the most favoured (59 per cent mainly or very favourable). Across all forms of electricity generation, nuclear (34 per cent), coal (33 per cent) and oil (34 per cent) were the least favoured.

Figure 1 shows that, while renewables remained the most favoured form of electricity production, support for them has dropped substantially over the years. Favourability ratings of wind power in particular have shown a sharp decline, from 82 per cent in 2005 to 64 per cent in 2013. Favourability ratings of solar power have dropped from 87 per cent in 2005 to 77 per cent in 2013. Gas is the only form of electricity production that is now perceived more favourably (59 per cent) than in 2005 (56 per cent).

Attitudes to Nuclear Power

Generic Unconditional Attitudes to Nuclear Power

The survey included a range of items to assess how the general public thinks about nuclear power. About the same number of people generally supported (32 per cent) or opposed (29 per cent) nuclear power in 2013, where no additional context was given for the rationale for its use. Overall support for nuclear power has increased by six percentage points since 2005, while opposition has decreased by eight percentage points since 2005 (see Table 2).

The number of people reporting being ambivalent about nuclear power (i.e. being unsure whether to express support or opposition) dropped from 32 per cent in 2005 to 27 per cent in 2013. However, the number of respondents choosing the 'other', 'none of these' and 'don't know' options increased substantially from 1 per cent to 9 per cent over the same period.

In line with these findings, Figure 2 shows that concern about nuclear power decreased between 2005 and 2013. The proportion of people reporting being fairly or very concerned dropped from 58 per cent in 2005 and 54 per cent in 2010 to 47 per cent in 2011 and 2013. The proportion of respondents being 'not very' or 'not at all' concerned about nuclear power remained fairly stable over the same time period (38 per cent in 2005, 43 per cent in 2010, 45 per cent in 2011, and 43 per cent in 2013). The proportion reporting that they do not know or

Table 2. Overall support and opposition to nuclear power (in %)		
	2005	2013
Overall, I support nuclear power	26	32
Overall, I oppose nuclear power	37	29
I am not sure whether I support or oppose nuclear power	32	27
I don't care what happens with nuclear power	3	3
Other/None of these/Don't know	1	9

Note: The percentages in the table may not always add up to 100 per cent due to rounding.

have no opinion as to whether they are concerned about nuclear power increased from 3 per cent in 2005 to 10 per cent in 2013.

As well as these data pointing to increased acceptability of nuclear power over the 2005-2013 period, the proportion of those perceiving there to be risks to Britain from nuclear power dropped from 73 per cent in 2005 to 61 per cent in 2010 and further to 55 per cent in 2013. The perceived benefits of nuclear power remained relatively stable over the same period (49 per cent in 2005, 60 per cent in 2010, and 58 per cent in 2013; see Appendix Q7).

The proportion of respondents who agree that the risks of nuclear power either slightly or far outweigh the benefits has likewise fallen (from 41 per cent in 2005 to 29 per cent in 2013). The proportion of people who agree that the benefits of nuclear power slightly or far outweigh the risk of nuclear power increased slightly (32 per cent in 2005, 38 per cent in 2010 and 37 per cent in 2013), whilst the proportion being of the opinion that the risks and benefits of nuclear power are about the same remained stable (20 per cent in 2005 and 2013).

Figure 2. Concern about nuclear power (in %)

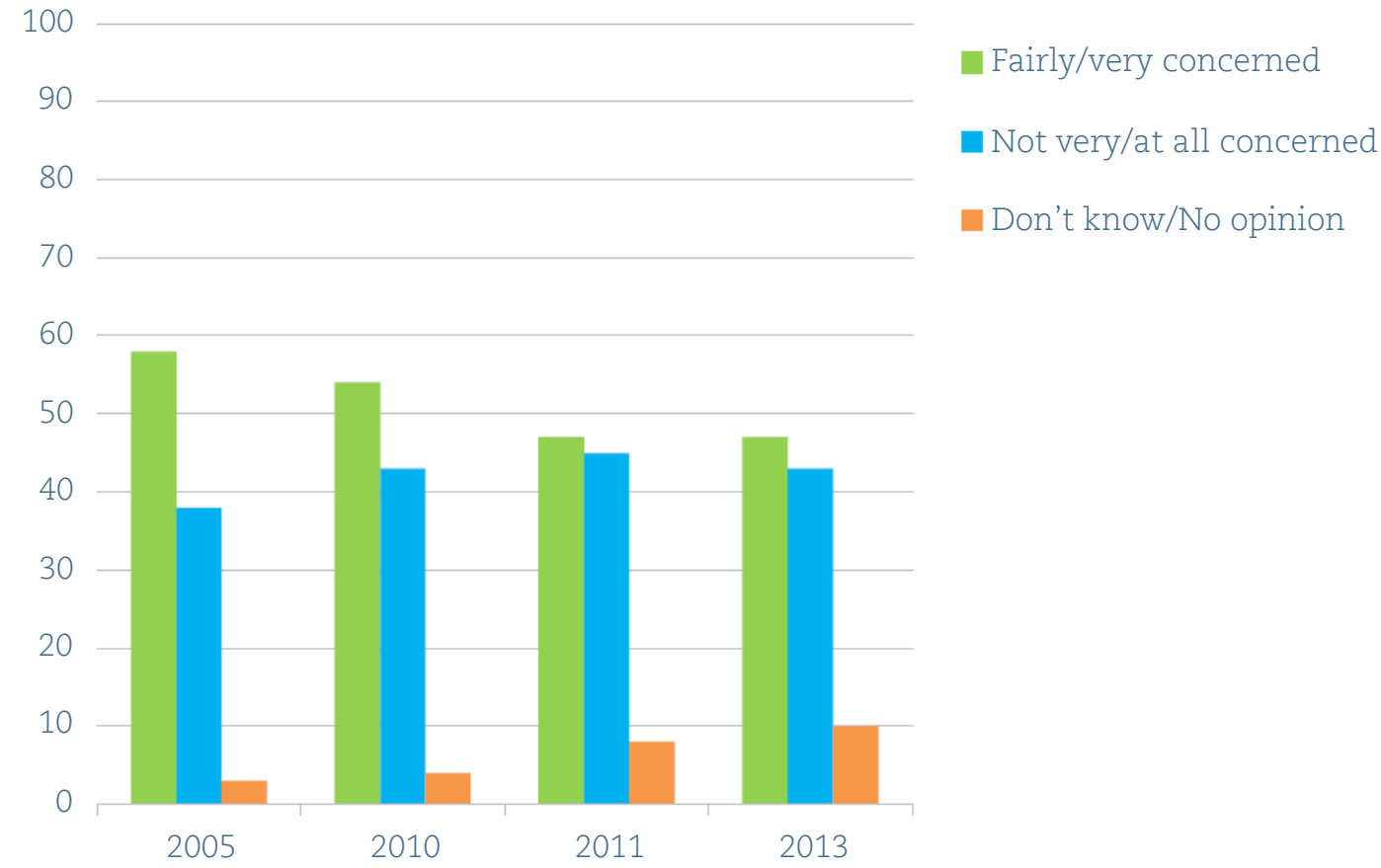
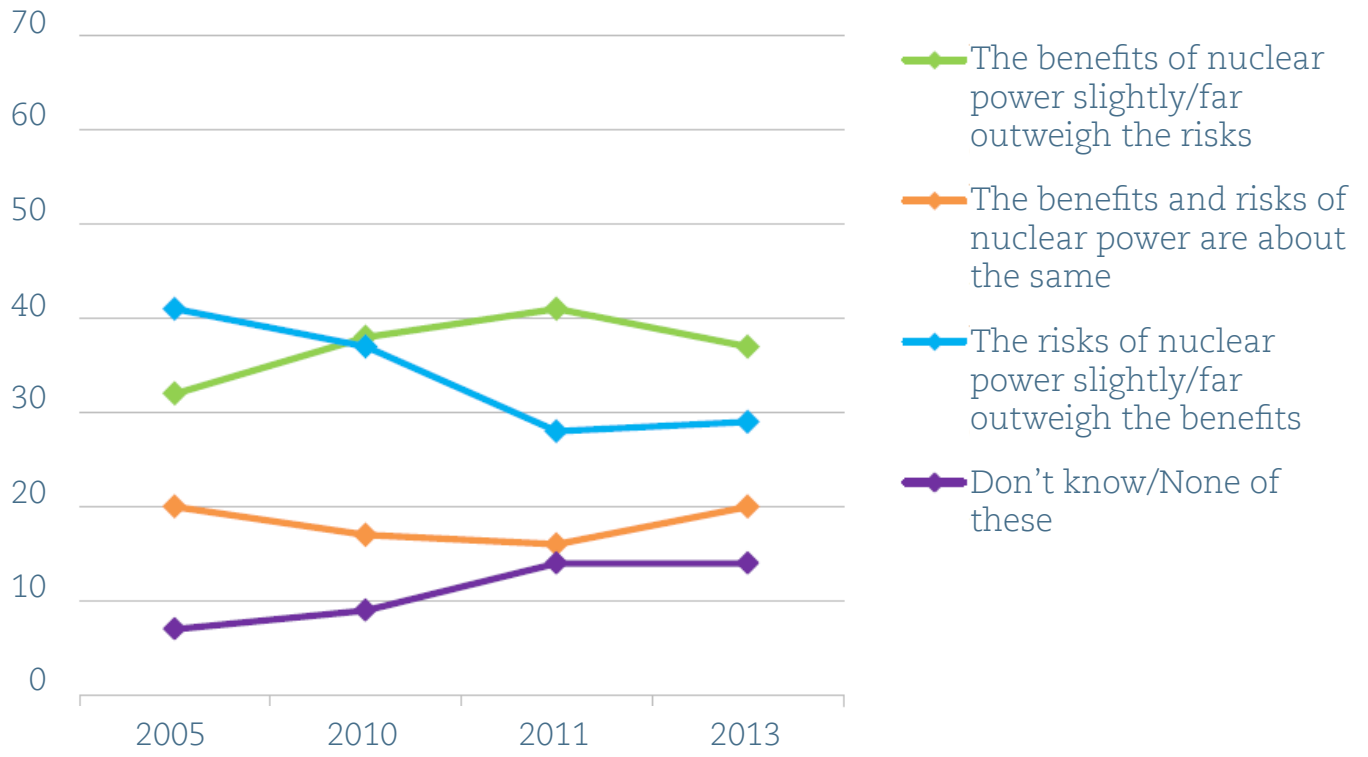


Figure 3. Perceived risks and benefits of nuclear power (in %)



However, those choosing the 'don't know' or 'none of these' options have increased by seven percentage points since 2005 (Figure 3). It is notable that in 2005 a greater proportion of people were of the view that the risks of nuclear power outweighed its benefits rather than the other way round. This situation was effectively reversed by 2013.

Regarding the future of nuclear power in Britain, Table 3 shows that public views were evenly balanced. While 15 per cent maintained that the number of nuclear power stations should be increased, 13 per cent were of the opinion that all existing nuclear power stations should be shut down immediately. Thirty per cent of the sample were of the opinion that "We should continue using the existing nuclear power stations and replace them with new ones when they reach the end of their life"; whereas 27 per cent agreed that "We should continue using the existing nuclear power stations but not replace them with new ones when they reach the end of their life".

The aggregate proportion wanting to phase out nuclear power (immediately or gradually) decreased from 50 per cent in 2005 to 40 per cent in 2013. The aggregate proportion wanting to replace nuclear (at current levels or with expansion) however changed little since 2005 (43 per cent in 2005 and 44 per cent in 2013).

The proportion of the sample choosing the 'don't know' or 'none of these' options increased by nine percentage points in the same period, perhaps indicating greater uncertainty or ambivalence around this issue among the public.

A new survey item included in the 2013 study suggests that there is overall more support for the building of new nuclear power stations than there is opposition. Forty-two (42 per cent) percent of respondents tended to support or strongly support the building of new nuclear power stations in Britain to replace those being phased out over the next few years, while 32 per cent tended to oppose or strongly opposed this. Ten percent (10 per cent) did not know or had no opinion as to whether they supported or opposed the building of new nuclear power stations in Britain (see Appendix Q3).

The perceived safety of nuclear power has remained fairly stable over the years. A similar proportion in 2013 (55 per cent) as in 2005 (53 per cent) agreed that they would be prepared to support new power stations being built on the condition that these were safer. The proportion of the population that thinks we should stop using nuclear power stations because we do not know how to store radioactive waste safely dropped slightly from 44 per cent in 2005 to 39 per cent in 2013 (see Appendix Q7).

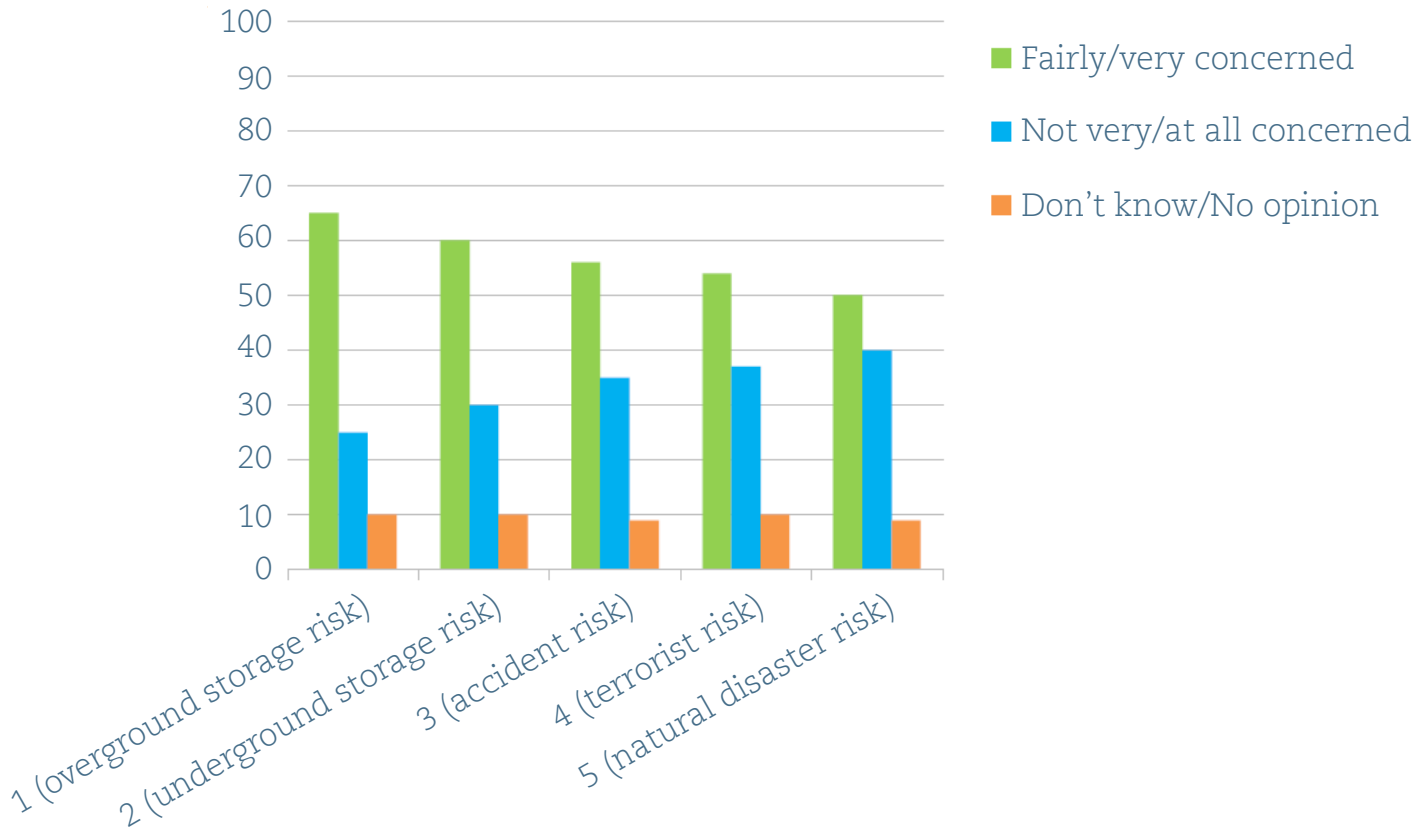
Table 3. Views on the future of nuclear power in Britain (in %)					
	2005	2010	2011	2012	2013
We should increase the number of nuclear power stations	9	17	23	21	15
We should continue using the existing nuclear power stations and replace them with new ones when they reach the end of their life	34	29	31	26	30
We should continue using the existing nuclear power stations but not replace them with new ones when they reach the end of their life	34	33	21	32	27
We should shut down all existing nuclear power stations now and not replace them with new ones	15	13	11	9	13
Don't know/none of these	7	7	15	12	16

Note: The percentages in the table may not always add up to 100 per cent due to rounding. The aggregate figure quoted in the text for those wanting to replace nuclear power is derived from non-rounded data.

Levels of trust in the regulation of nuclear power has remained relatively stable over the past eight years. Confidence that the British Government adequately regulates nuclear power dropped back to 33 per cent in 2013, after an increase from 33 per cent in 2005 to 39 per cent in 2010. Similarly, agreement that current rules and regulations are sufficient to control nuclear remained at comparable levels between 2005 (32 per cent) and 2013 (34 per cent; see Appendix Q7).

The 2013 survey included a new battery of questions that was designed to examine the perceived risks of nuclear power in more detail.

Figure 4. Concern about risks associated with nuclear power (in %)[2]



[2] (1) The risks associated with the storage of nuclear waste overground at a nuclear power station; (2) The risks associated with the storage of nuclear waste at an underground storage site; (3) The risks of an accident at a nuclear power station; (4) The risks of terrorists targeting a nuclear installation in Britain; (5) The risks of a natural disaster triggering a nuclear accident.

Figure 4 shows that the British public is the most concerned about the risks associated with overground (65 per cent) and underground (60 per cent) storage of nuclear waste; this is followed by concerns about the risks of an accident at a nuclear power station (56 per cent) and the risks of terrorists targeting a nuclear installation in Britain (54 per cent); the lowest level of concern was found for the risks of a natural disaster triggering a nuclear accident (50 per cent). About 10 per cent of the sample had no opinion or did not know whether they were concerned or not about the risks associated with nuclear power.

Conditional Attitudes to Nuclear Power

This study suggests that around half of the British population is willing to accept the building of new nuclear power stations if it would help to tackle climate change (47 per cent) or if it would help to improve energy security (52 per cent). The proportions who reported being unwilling to accept these two conditional uses of nuclear power were 24 per cent and 22 per cent respectively. Figure 5 shows that support for nuclear power as a solution to climate change is somewhat lower in 2012 (47 per cent) and 2013 (47 per cent) than in 2005 (54 per cent), 2010 (56 per cent) and 2011 (54 per cent). The proportion of the sample that are not willing to accept the building of new nuclear power stations to help tackle climate change has remained relatively stable over the years. The proportion of the sample choosing the 'don't know' or 'none of these' options has increased by six percentage points since 2005.

Support for nuclear power as a way to increase energy security decreased slightly from 56 per cent in 2010 and 61 per cent in 2011 to 52 per cent in 2013 (see Figure 6). The proportion of the sample that is not willing to accept the building of new nuclear power stations to help improve energy security also dropped slightly from 27 per cent in 2010 to 20 per cent in 2011 and 22 per cent in 2013. The proportion choosing the 'don't know' or 'none of these' options increased from 2 per cent in 2010 to 9 per cent in 2013.

Agreement with the statement "we shouldn't think of nuclear power as a solution for climate change before exploring all other energy options" decreased over the years from 74 per cent in 2005 to 70 per cent in 2010, and 53 per cent in 2013. Similarly, agreement that promoting renewable energy sources is a better way of tackling climate change than nuclear power was lower in 2012 and 2013 (61 per cent) than in 2005 and 2010 (78 per cent and 71 per cent respectively). Agreement that

Figure 5. Willingness to accept the building of new nuclear power stations if it would help to tackle climate change (in %)

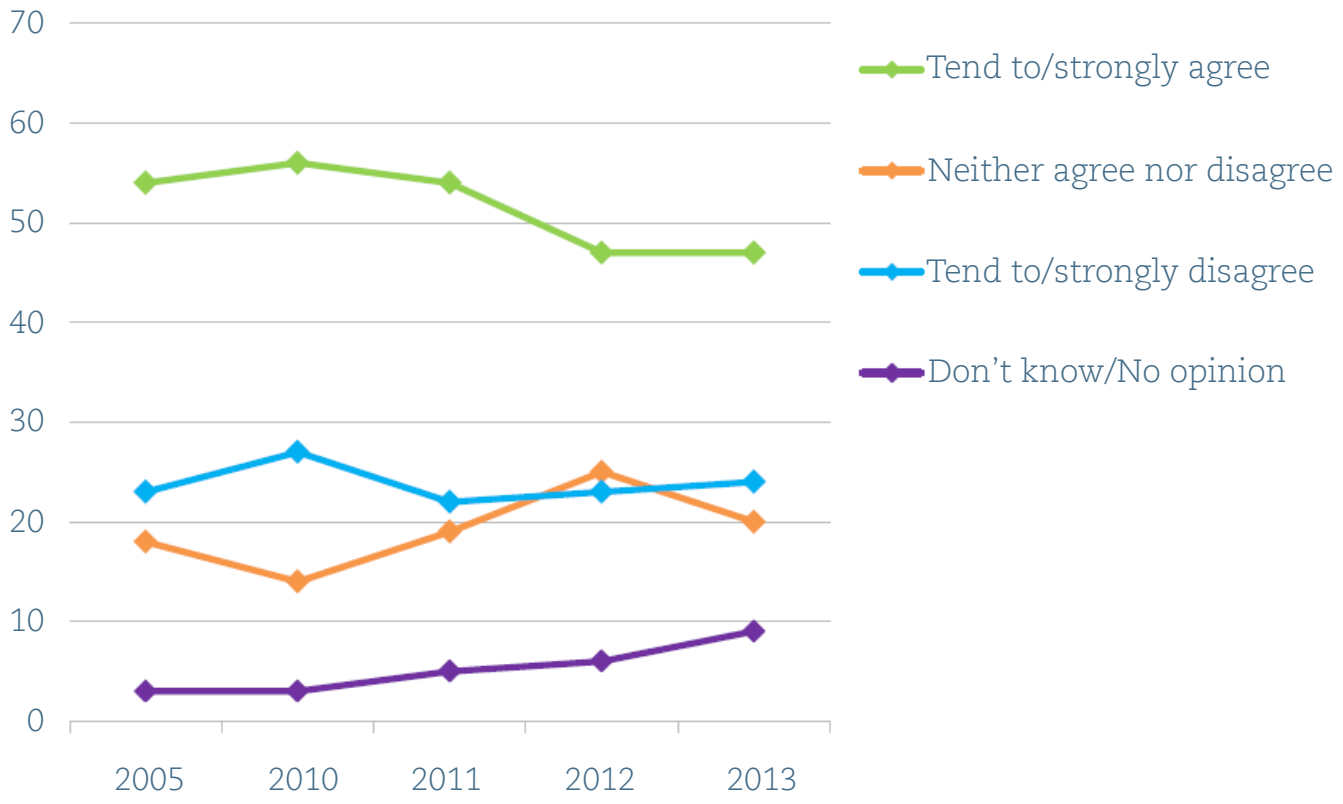
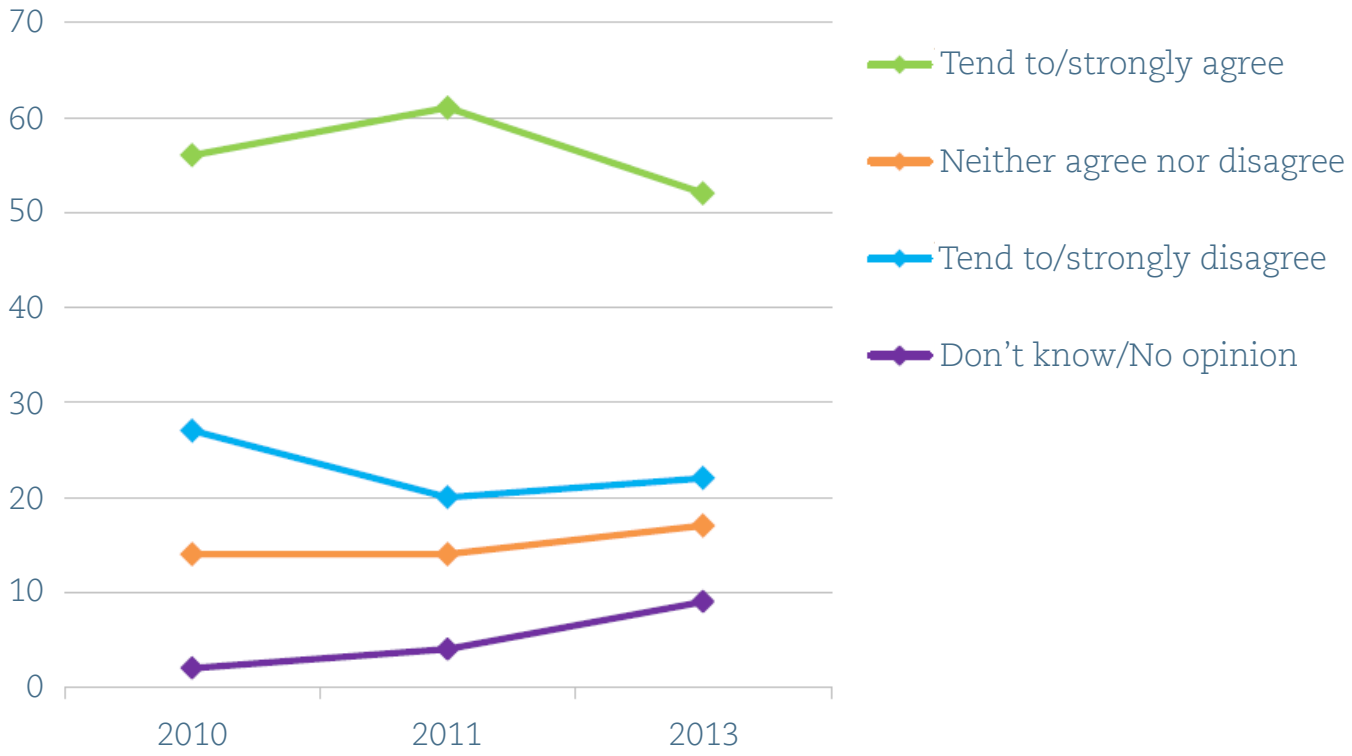


Figure 6. Willingness to accept the building of new nuclear power stations if it would help to improve energy security (in %)



reducing energy use through lifestyle changes and energy efficiency is a better way of tackling climate change than nuclear power decreased from 76 per cent in 2005 to 63 per cent in 2013 (see Appendix Q7).

Demski et al. (2013) have separately shown that the perceived need for nuclear power has remained relatively stable over the years. That is, agreement with the statement "We need nuclear power because renewable energy sources alone are not able to meet our electricity needs" increased slightly from 48 per cent in 2005 to 55 per cent in 2010 and 54 per cent in 2012. Agreement with the statement "Britain needs a mix of energy sources to ensure a reliable supply of electricity, including nuclear power and renewable energy sources" increased from 63 per cent in 2005 to 74 per cent in 2010, but then dropped back to 66 per cent in 2012 (see Appendix Q7).

Public Perceptions of Climate Change

This section of the study builds on research exploring public attitudes, beliefs and concerns about climate change conducted by Poortinga *et al.* (2006), Spence *et al.* (2010) and Demski *et al.* (2013). Where possible results are contrasted with the findings of these previous surveys. The survey contained a number of key indicators to assess levels of trend, attribution and impact scepticism (see Rahmstorf, 2004; Poortinga *et al.*, 2011).

Table 4 suggests that the downward trend in public belief in the reality of climate change is continuing. Although a clear majority (72 per cent) still think that the world's climate is changing, this has to be compared to 91 per cent in 2005 and 78 per cent in 2010. Trend scepticism has increased from 4 per cent in 2005 to 15 per cent in 2010 and 19 per cent in 2013. The proportion of the sample reporting that they do not know whether or not the world's climate is changing was higher in 2012 and 2013 (11 per cent and 9 per cent respectively) than in 2005 and 2010 (5 per cent and 6 per cent respectively).

Table 4. As far as you know, do you personally think that the world's climate is changing? (in %)

	2005	2010	2012	2013
Yes	91	78	79	72
No	4	15	11	19
Don't know	5	6	11	9

Note: The percentages in the table may not always add up to 100% due to rounding.

Table 5. Thinking about the causes of climate change, which, if any, of the following best described your opinion? (in %)			
	2010	2012	2013
Climate change is entirely caused by natural processes	6	4	5
Climate change is mainly caused by natural processes	12	12	12
Climate change is partly caused by natural processes and partly caused by human activity	47	48	46
Climate change is mainly caused by human activity	24	28	22
Climate change is entirely caused by human activity	7	4	6
I think there is no such thing as climate change	2	2	2
Don't know/No opnion	3	2	7

Note: The percentages in the table may not always add up to 100% due to rounding.

Table 5 shows that the perceived causes of climate change have hardly changed since 2010. Just as in 2010 (47 per cent) and 2012 (48 per cent), most people commonly consider that climate change is caused by a combination of human activity and natural processes (46 per cent).

A similar proportion in 2010 (31 per cent), 2012 (32 per cent) and 2013 (28 per cent) thought that climate change is mainly or entirely caused by human activity, and a similar proportion in 2010 (18 per cent), 2012 (16 per cent) and 2013 (17 per cent) thought that climate change is mainly or entirely caused by natural processes. The proportion choosing the 'don't know' and 'no opinion' options increased from 3 per cent in 2010 to 7 per cent in 2013.

Table 6 shows that the British public's views on the seriousness of climate change have remained relatively stable over the 2010 to 2013 period, although overall levels of impact scepticism have decreased. Agreement with the statement "The seriousness of climate change is exaggerated" decreased from 40 per cent in 2010 to 30 per cent in 2012 and 34 per cent in 2013. Disagreement with the statement moved from 42 per cent in 2010 to 47 per cent in 2012, and back to 41 per cent in 2013. The proportion choosing the 'don't know' and 'no opinion' options increased from 3 per cent in 2010 to 7 per cent in 2013.

Figure 7 shows that concern about climate change decreased from 71 per cent in 2010 and 74 per cent in 2012 to 60 per cent in 2013. The proportion of the sample indicating that they are not very or at all concerned about climate change increased from 27 per cent in 2010 and 25 per cent in 2012 to 35 per cent in 2013. The perceived impacts of climate change were comparable in 2010 and 2013.

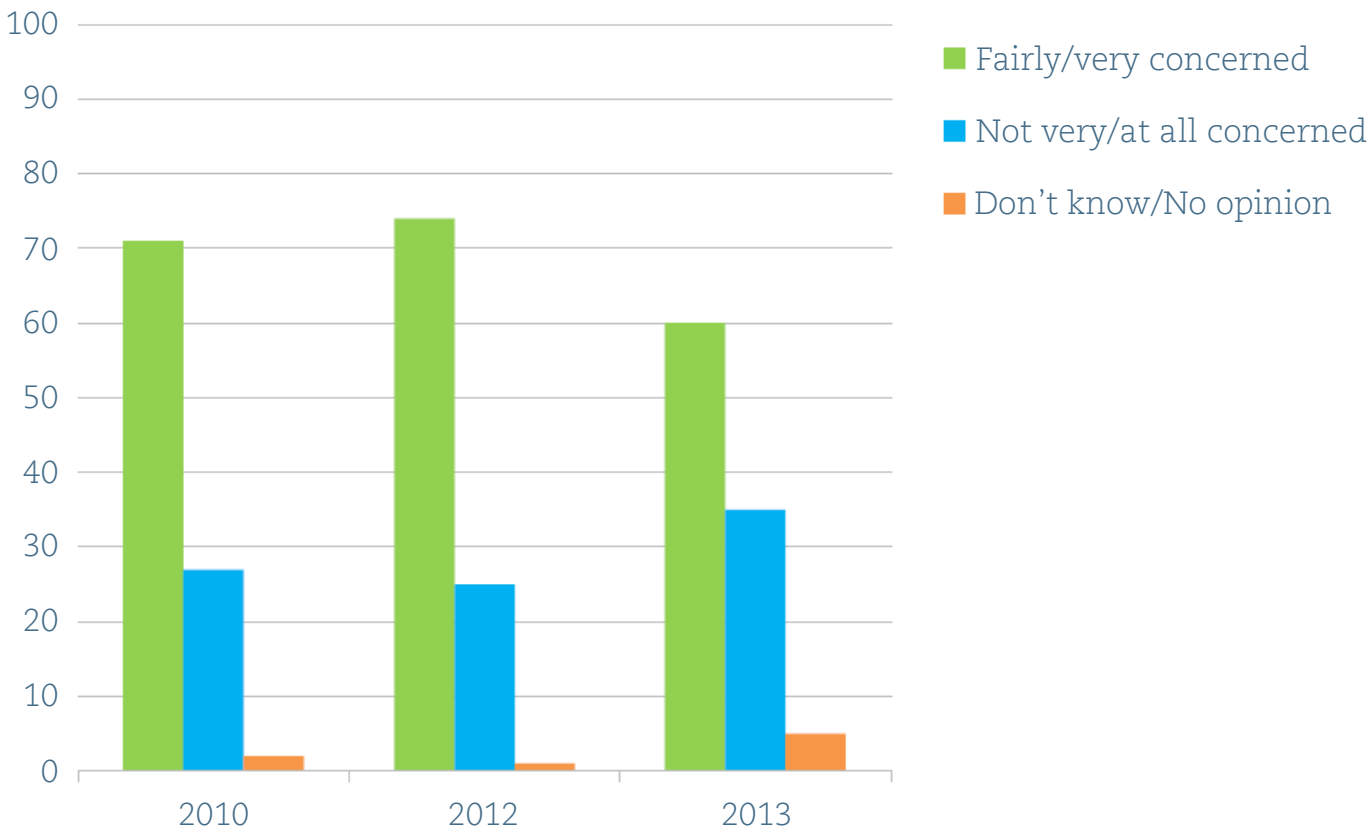
Fewer people agreed with the statement "My local area is likely to be affected by climate change" in 2013 (47 per cent) than in 2010 (53 per cent). At the same time, a slightly smaller proportion disagreed with the statement (24 per cent in 2013 versus 27 per cent in 2010). More people neither agreed nor disagreed (21 per cent in 2013 versus 16 per cent in 2010) or chose the 'don't know' and 'no opinion' options (8 per cent in 2013 versus 4 per cent in 2010; see Appendix Q12).

A similar pattern was found for the statement "Climate change is likely to have a big impact on people like me". Slightly smaller proportions agreed (43 per cent) and disagreed (28 per cent) with this statement in 2013 as compared to 2010 (45 per cent and 32 per cent respectively). More people neither agreed nor disagreed with the statement (23 per cent) or chose the 'don't know' and 'no opinion' options (7 per cent) in 2013 than in 2010 (20 per cent and 4 per cent respectively; see Appendix Q12).

Table 6. Agreement that the seriousness of climate change is exaggerated (in %)			
	2010	2012	2013
Strongly agree	12	9	10
Tend to agree	28	21	24
Neither agree nor disagree	15	21	18
Tend to disagree	28	28	27
Strongly disagree	14	18	14
Don't know/No opinion	3	2	7

Note: The percentages in the table may not always add up to 100% due to rounding.

Figure 7. Concern about climate change (in %)



Perceived personal responsibility to do something about climate change remained stable between 2010 and 2013. Similar proportions of the sample agreed with the statement "It is my responsibility to do something about climate change" in 2013 (67 per cent) and in 2010 (71 per cent). Only 12 per cent disagreed with the statement in 2013 (15 per cent in 2010). The proportion of the sample that neither agreed nor disagreed with the statement (16 per cent in 2013 versus 14 per cent in 2010) or chose the 'don't know' and 'no opinion' options (5 per cent in 2013 versus 1 per cent in 2010) increased slightly (see Appendix Q12).

A substantial proportion of the sample (68 per cent) agreed that extreme weather events have become more frequent in Britain in the past ten years. Only 13 per cent disagreed with the statement, or did not know or had no opinion (6 per cent). Of the people who agreed that extreme weather events have become more frequent in Britain in the past year, 74 per cent attributed this increased frequency to climate change (see Appendix Q13).

Main Findings and Conclusions

4

This report describes the findings of a nationally representative British survey (n=961) conducted in March 2013. The main aim of the survey was to assess British attitudes to nuclear power and climate change two years after the Fukushima accident. The results are compared to a number of previous British surveys that were conducted at various stages before and after the Fukushima accident (2005, 2010, 2011, and 2012). This provides an overview of how public attitudes to nuclear power and climate change have developed over the past decade and in particular after the Fukushima accident. In the longer term the data will be used for more detailed cross-national comparisons with Japan.

The study found that public attitudes towards nuclear power in Britain have not followed a trajectory that could have been expected after a major nuclear accident. In the context of high levels of 'reluctant acceptance' of nuclear power as a climate mitigation strategy, Pidgeon et al. (2008) argued that this could alter dramatically were there to be any major nuclear accident in any part of the world. It would appear that this has not materialised, at least from the perspective of the British public. We find instead that there have been no marked changes in public concerns about nuclear power and its perceived risks since 2011. If there has been any 'Fukushima effect' in Britain, it is likely to have been short-lived (cf. Knight, 2012). The relative durability in attitudes follows an increase in the level of general support for nuclear power since 2005, meaning that in 2013 broadly similar proportions of people now support and oppose its use.

Although the lack of change in public attitudes may seem counter-intuitive, it is to some extent reminiscent of the attitudinal impacts of the Chernobyl accident. According to De Boer and Catsburg (1988), increases in opposition that were observed immediately after the accident returned to pre-Chernobyl levels within a year. However, the claim that nuclear accidents only impact on public attitudes in the short term is challenged by long-running time series. Rosa and Dunlap (1994) found that the initial upturn in support after the Three Mile Island accident was followed by a steady growth in opposition over a prolonged period of time; while Renn (1990) reported enduring attitudinal changes as a result of the Chernobyl accident, in spite of a modest recovery of public support in the year following the accident.

Nevertheless, there is strong evidence that people engage in sophisticated strategies to deal with new information that challenges existing beliefs (Abelson, 1959). One of these strategies is to 'differentiate' between circumstances to justify continued support. For example, Eiser and colleagues (1989) found that supporters of nuclear technology were more likely to see the Chernobyl accident as an isolated event that was caused by specific conditions, while opponents were more likely to see nuclear power as inherently unsafe. From this perspective, it may not be surprising that that a nuclear accident on the other side of the world that was arguably triggered by a tsunami has produced so little attitudinal change in Britain. It can easily be argued that the circumstances under which the Fukushima accident took place are unlikely to happen in the UK.

The absence of a falling away in acceptance of nuclear power in Britain appears to be in contrast to that experienced in other parts of the world (Kim *et al.*, 2013). Perhaps not surprisingly, Japan experienced a collapse in public acceptance and trust in the safety and regulation of nuclear power following the Fukushima accident (Aoyagi, 2011; Aoyagi, 2013; Kim *et al.*, 2013; Poortinga *et al.*, 2013) together with a parallel shift in policy away from its use (Cyranoski, 2012). In Germany, too, events lead directly to an increase in already high levels of public opposition to nuclear power (BBC, 2011a; Srinivasan and Gopi Rethinaraj, 2013) and to the German government's decision to completely phase out nuclear generation of electricity over a ten-year period (Butler *et al.*, 2011).

Similarly, the Swiss government decided to close down all existing nuclear power plants at the end of their operational life, amid growing opposition shortly after the Fukushima accident (BBC, 2011b Foratom, 2012; Siegrist and Visschers, 2013; World Nuclear Association, 2013b).

Protests against nuclear power in Berlin, Germany, May 2011. Credit: Julia Reschke/ Shutterstock

However, while in some cases Fukushima stalled or curtailed plans for new nuclear programmes, the majority of nations with an existing reliance on nuclear power continued their commitment to the long-term use of nuclear power (Schneider & Froggatt, 2013). Other European countries that will continue their reliance upon nuclear power (e.g. Sweden, France) only saw relatively moderate changes in public attitudes to nuclear power after the Fukushima accident (Holmberg 2013; IRSN, 2013).

The differences in public and policy responses across Europe may in part be connected to the intensity of reporting of the Fukushima accident (Wittneben, 2012) and also to historical differences in the cultural acceptability of nuclear power (Wiliarty, 2013). Butler *et al.* (2011) argue that the events at Fukushima tended to be portrayed in the UK as part of 'learning from experience' whereby new nuclear power development has been seen as compatible with ongoing improvement of safety measures and procedures. The Fukushima accident has therefore in some ways acted as an impetus for current policy trends in the UK in favour of nuclear generation, rather than as an impediment. In contrast, the German and Swiss media portrayed the Fukushima accident as an exemplar of the dangers of nuclear power (Kepplinger and Lemke 2012).

Notwithstanding these cross-national differences, the present study found that there are still substantial levels of public concern in Britain around the use of nuclear power. In particular, survey respondents expressed concern about the risks of storage of radioactive waste, the risks of an accident, and the targeting of nuclear facilities by terrorists. That the present study finds that, across different risks, the level of concern is lowest overall with respect to that of a natural disaster, indeed suggests that 'differentiation' (cf. Abelson 1959) can partly explain the relative resilience of British attitudes to nuclear power following the Fukushima accident.

Regarding the future of nuclear power, the present study found that public opinion in Britain is currently evenly balanced. As many people are of the view that the number of nuclear power stations should be increased as are of the view that all should be shut down, with the majority of people holding views somewhere in between – i.e. that existing nuclear capacity be utilised but then shut down or replaced thereafter.

Where the building of new nuclear power stations is presented as conditional upon it helping to address climate change or to bolster energy security, a larger proportion of people are willing to see this happen than under a generic unconditional framing as described above. This finding is in line with other literature which has suggested that some people may be more supportive of nuclear power where this is construed as a means of addressing climate change and/or energy security (Corner et al., 2011; Truelove and Greenberg, 2013). That said, the proportion of people who express conditional support for nuclear power has declined somewhat over recent years, in particular in the years after the Fukushima accident. However, this may be associated as much with an increase in climate scepticism as with changing attitudes to nuclear power, as we discuss further below.

Whilst in 2013 a higher proportion of people remain of the view that renewable energy is a better way of tackling climate change than nuclear power (by a ratio of around 4:1), there has been a substantial shift over recent years in favour of nuclear power (in 2005 the ratio was around 10:1 in favour of renewable energy). Likewise, there has been a shift in the relative preference for lifestyle change and energy efficiency towards nuclear power since 2005, although the former are still favoured overall. The diminishing view that renewable energy is a better way of tackling climate change than nuclear power most likely reflects the weakening popularity of renewable energy rather than an increased popularity of nuclear power. This is evidenced by a marked drop in people having favourable views of wind and solar power. The slow decline in favourability of renewable sources appears to be accompanied by a rebound in support for fossil fuels after a drop in popularity in 2012. More detailed research is needed to examine what is behind the changing perceptions of the different forms of electricity production.

The present study found that just under three-quarters of the British public accept that the world's climate is changing. Nevertheless, the proportion of people doubting the reality of climate change has risen to one of the highest levels obtained since 2005. Similarly, overall levels of concern have dropped away compared to previous years, although a majority of people still express some concern about climate change. The reasons for the observed increase in 'trend scepticism' and decrease in concern are probably multiple: studies have suggested that sustained public doubts about climate change may be related to such factors as the global economic downturn (Scruggs and Benegal, 2012), the continued influence of sceptic voices in the media (Brulle et al., 2012), increasing 'climate fatigue' (Nordhaus and Shellenberger,

2009), and more general fluctuations in public attention towards climate change (Ratter *et al.*, 2012).

Whilst doubts about the reality of climate change have increased in the past three years, the present study nevertheless finds that the level of acceptance of an anthropogenic component to climate change has remained stable over the same period. Likewise, the extent to which people view the seriousness of climate change to be exaggerated has remained largely unchanged since 2010, as has perceived personal responsibility to act on climate change. It would seem that changes in patterns of belief about climate change have therefore not been uniform. These patterns warrant further attention in future research, not least because of the demonstrated importance of climate change perceptions for attitudes towards low-carbon electricity production.

A striking finding of the study is the increasing numbers of respondents choosing the 'don't know', 'no opinion' or 'none of these' options. In particular after the Fukushima accident more people have opted to express no opinion on some of the key tracker questions. While this could be attributed to the specific methodologies used in the post-Fukushima surveys (which were either conducted online or as part of an Omnibus), it may also reflect greater attitudinal ambivalence regarding nuclear power and climate change. Overall it appears that the increases in 'don't know'/'no opinion'/'none of these' responses are accompanied by fewer negative responses, suggesting that groups traditionally opposed to nuclear power have wavered or become ambivalent about its use after the Fukushima accident. With regard to climate change, the increasing no-opinion responses could be symptomatic of the mixed messages provided by the media (Brulle *et al.*, 2012) or reflect increasing disengagement from the climate debate altogether (e.g., O'Neill and Nicholson-Cole, 2009).

Conclusions

This study found that attitudes to nuclear power have been surprisingly resilient in the wake of the Fukushima accident. Public opinion in Britain currently appears evenly balanced, with as many opposing as supporting nuclear power. Despite the apparent durability of attitudes, substantial levels of concern remain over the risks associated with nuclear power, most notably about the overground and underground storage of nuclear waste and an accident at a nuclear power station.

The overall drop in support for nuclear power as a way of addressing climate change and energy security issues may be as much due to an increase in climate scepticism as to changing attitudes to nuclear power. While renewables remained the most favoured form of electricity production, support for them has dropped steadily over the years. This is also reflected in a relative drop in support for renewables as a better way of tackling climate change than nuclear power. The study further found a continuing upward trend in doubt regarding the reality of climate change, even if the level of acceptance of an anthropogenic component and the seriousness of the impacts of climate change has remained largely unchanged.

The results of this study raise a number of questions that could provide a basis for further research. Most notably, it is surprising that the worst nuclear accident in decades has had such limited impact on British attitudes. More detailed research is needed to understand the social and psychological processes that contributed to the diverging public and policy responses across Europe and the rest of the world. There are indications that the intensity and content of public debates as well as historical differences in the cultural acceptability of nuclear power form part of the explanation. Furthermore, while levels of support for nuclear power remained largely unchanged, opposition dropped alongside an increase in ambivalent responses. This suggests that groups traditionally opposed to nuclear power appear to have become split after the Fukushima accident.

Finally, surprising changes were observed regarding the favourability of different forms of electricity production. While renewables remain the most favoured form of electricity production, they have become less popular over the years. It is important to keep tracking views on different systems of energy production in combination with more in-depth qualitative approaches to examine what is behind these changes. As noted by Demski and colleagues (2013), preferences and choices regarding energy systems and transitions are unlikely to exist in isolation. It is possible that the results reflect changes in the way the public thinks climate change should be tackled, considering the diminishing view that renewable energy is a better way of tackling climate change than nuclear power; although it needs to be seen if this is part of a long-term trend or a short-term fluctuation.

References

5

Abelson, R. P. (1959). Modes of Resolution of Belief Dilemmas. Journal of Conflict Resolution, 3, 343–52.

Aoyagi, M. (2013a). Public attitudes to nuclear power an climate change in Japan. Topline findings of surveys conducted in 2007, 2011 and 2013. Tsukuba, Japan: National Institute for Environmental Studies (NIES).

Aoyagi, M. (2013b). Public opinion survey on lifestyle report. Tsukuba, Japan: National Institute for Environmental Studies (NIES).

Aoyagi, M., Tasaki, T., Yoshida, A., and Kanamori, Y. (2011). Public understanding of risk-risk trade-offs among climate change and energy options: Tsukuba, Japan: Research Group of Sustainable Consumption and Lifestyles, National Institute for Environmental Studies.

BBC (2011a). Opposition to Nuclear Energy Grows: Global Poll. Available from: http://www.globescan.com/images/images/pressreleases/bbc2011_nuclear_energy/bbc2011_energy.pdf (accessed 17 October 2013).

BBC (2011b). Swiss to phase out nuclear power. Available from: http://www.bbc.co.uk/news/world-europe-13549985 (accessed 17 October 2013).

BBC (2013). UK nuclear power plant gets go-ahead. Available from: http://www.bbc.co.uk/news/business-24604218 (accessed 21 October 2013).

BERR (2008). Meeting the Energy Challenge: A White Paper on Nuclear Power London: Department for Business, Enterprise and Regulatory Reform.

Butler, C., Parkhill, K., and Pidgeon, N.F. (2011). Nuclear Power After Japan: The Social Dimension. Environment: Science and Policy for Sustainable Development, 53, 3-14.

Bickerstaff, K., Lorenzoni, I. Poortinga, W., Pidgeon, N.F., and Simmons, P. (2008). Reframing the nuclear debate in the UK: radioactive waste and climate change mitigation. Public Understanding of Science, 17, 145-169.

Bird, D.K., Haynes, K., Van den Honert, R., McAneney, J., & Poortinga, W. (2013). Nuclear power in Australia: A comparative analysis of public opinion regarding climate change and the Fukushima disaster. Energy Policy, available online 3 October 2013, http://dx.doi.org/10.1016/j.enpol.2013.09.047.

Brook, B. W. (2012). Could nuclear fission energy, etc., solve the greenhouse problem? The affirmative case. Energy Policy, 42, 4-8.

Brulle, R. J., Carmichael, J., Jenkins, C. (2012). Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the U.S., 2002–2010. Climatic Change, 114, 169-188.

Corner, A., Spence, A., Venables, D., Poortinga, W., and Pidgeon, N. (2011). Nuclear power, climate change and energy security: Exploring British public attitudes. Energy Policy, 39, 4823-4832.

Cyranoski, D. (2010). Japan plans nuclear power expansion. Nature, 464, 661-661.

Cyranoski, D. (2012). Japan considers nuclear-free future. Nature, 486, 15-15.

De Boer, C., & Catsburg, I. (1988). The impact of nuclear accidents on attitudes toward nuclear energy. Public Opinion Quarterly, 52, 254-261.

Demski, C., Spence, A. and Pidgeon, N. (2013). Transforming the UK Energy System: Public Values, Attitudes and Acceptability — Summary Findings of a Survey Conducted in August 2012. May2013. London: UK Energy Research Centre.

Department of Energy and Climate Change (2012). UK energy in brief 2012. London: Office of National Statistics.

DTI (2006). The Energy Challenge: Energy Review Report 2006. London: Department of Trade and Industry.

Eiser, J. R., Spears, R., & Webley, P. (1989). Nuclear attitudes before and after Chernobyl: Change and judgement. Journal of Applied Social Psychology, 19, 689–700.

Hayashi, M., and Hughes, L. (2013a). The policy responses to the Fukushima nuclear accident and their effect on Japanese energy security. Energy Policy, 59, 86-101.

Hayashi, M., and Hughes, L. (2013b). The Fukushima nuclear accident and its effect on global energy security. Energy Policy, 59, 102-111.

Holmberg, S., (2012). Fukushimaeffekten. In: L. Weibull, H. Oskarsson, A. Bergström, (Eds.). I framtidens skugga. SOM-report.2011:54. Göteborg: SOM-institutet, pp. 263–274.

IRSN (2013). Plus de 30 ans d'opinion des Français sur les risques nucléaires Édition spéciale du Baromètre IRSN 2012. Paris: Institut de radioprotection et de sûreté nucléaire.

Kepplinger, H.M., & Lemke, R. (2012). Die Reaktorkatastrophe bei Fukushima in Presse und Fernsehen in Deutschland, Schweiz, Frankreich und England. Presentation at the Jahrestagung 2012 der Strahlenschutzkommission, 15 March 2012. Available at: http://www.kepplinger.de/files/Kepplinge&Lemke%282012%29_Fukushima_in_Presse_und_Fernsehen.pdf (accessed: 17 October 2013).

Kim, Y., K., M., & K, W. (2013). Effect of the Fukushima nuclear disaster on glabal public acceptance of nuclear energy. Energy Policy, 61, 822-828.

Knight, R. (2012). Nuclear energy update poll. London: Ipsos-MORI.

METI(2010). Establishment of the strategic energy plan of Japan. Ministry of Economy, Trade and Industry Tokyo: Government of Japan. Available at: http://www.meti.go.jp/english/press/data/20100618_08.html (accessed: 17 October 2013)

Nordhaus, T., and Shellenberger, M. (2009). Apocalypse fatigue: Losing the public on climate change. Yale Environment, 360, 16.

O'Neill, S., Nicholson-Cole, S. (2009). 'Fear won't do it': promoting positive engagement with climate change through visual and iconic representations. Science Communication, 30, 355–379.

Pacala, S., and Socolow, R. (2004). Stabilization wedges: solving the climate problem for the next 50 years with current technologies. Science, 305(5686), 968-972.

Pidgeon, N.F., Lorenzoni, I., and Poortinga, W. (2008). Climate change or nuclear power – no thanks! A quantitative study of public perceptions and risk framing in Britain. Global Environmental Change, 18, 69-85.

Poortinga, W., Aoyagi, M., and Pidgeon, N.F. (2013). Public perceptions of climate change and energy futures before and after the Fukushima accident: A comparison between Britain and Japan. Energy Policy, accepted for publication (http://dx.doi.org/10.1016/j.enpol.2013.08.015).

Poortinga W., Pidgeon, N.F. and Lorenzoni, I. (2006). Public Perceptions of Nuclear Power, Climate Change and Energy Options in Britain: Summary Findings of a Survey Conducted during October and November 2005. Technical Report (Understanding Risk Working Paper 06-02). Norwich: Centre for Environmental Risk.

Poortinga, W., Spence, A., Whitmarsh, L., Capstick, S., Pidgeon, N.F. (2011). Uncertain climate: an investigation of public scepticism about anthropogenic climate change. Global Environmental Change 21(3), 1015-1024.

Rahmstorf, S (2004). The Climate Sceptics. Potsdam: Potsdam Institute for Climate Impact Research.

Ratter, B., Philipp, K., von Storch, H. (2012). Between hype and decline: recent trends in public perception of climate change. Environmental Science and Policy, 18, 3-8.

Renn, O. (1990). Public responses to the Chernobyl accident. Journal of Environmental Psychology, 10, 151–167.

Rosa, E. A., & Dunlap, R. E. (1994). The Polls-Poll Trends: Nuclear Energy: Three Decades of Public Opinion. Public Opinion Quarterly, 58, 295-325.

Sailor, W. C., Bodansky, D., Braun, C., Fetter, S., and van der Zwaan, B. (2000). A nuclear solution to climate change?. Science, 288(5469), 1177-1178.

Scruggs, L., Benegal, S. (2012). Declining public concern about climate change: Can we blame the great recession? Global Environmental Change, 22(2), 505-515.

Siegrist, M., & Visschers, V. H. M. (2013). Acceptance of nuclear power: The Fukushima effect. Energy Policy, 59, 112-119.

Spence, A., Venables, D., Pidgeon, N., Poortinga, W. and Demski, C. (2010). Public Perceptions of Climate Change and Energy Futures in Britain: Summary Findings of a Survey Conducted in January-March 2010. Technical Report (Understanding Risk Working Paper 10-01). Cardiff: School of Psychology.

Srinivasan, T.N., and Gopi Rethinaraj, T.S. (2013). Fukushima and thereafter: Reassessment of risks of nuclear power. Energy Policy, 52, 726-736.

Teräväinen, T., Lehtonen, M., and Martiskainen, M. (2011). Climate change, energy security, and risk—debating nuclear new build in Finland, France and the UK. Energy Policy, 39(6), 3434-3442.

Truelove, H.B., and Greenberg, M. (2013). Who has become more open to nuclear power because of climate change? Climatic Change, 116(2), 389-409.

Valentine, S. V., and Sovacool, B. K. (2010). The socio-political economy of nuclear power development in Japan and South Korea. Energy Policy, 38(12), 7971-7979.

Vivoda, V. (2012). Japan's Energy Security Predicament post-Fukushima'. Energy Policy, 46, 135-43.

Wiliarty, S.E. (2013). Nuclear Power in Germany and France. Polity, 45(2), 281-296.

Wittneben, B.B.F. (2012). The impact of the Fukushima nuclear accident on European energy policy. Environmental Science and Policy, 15, 1-3.

World Nuclear Association (2013a). Nuclear Power in the United Kingdom. Available from: http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/United-Kingdom (accessed 4 October 2013).

World Nuclear Association (2013b). Nuclear Power in Switzerland. Available from: (accessed 17 October 2013).

Appendix: Questionnaire Items

Attitudes to Different Forms of Electricity Generation

Q1. How favourable or unfavourable are your overall opinions or impressions of the following energy sources for producing electricity currently? Just read out the number that applies.

		(1)	(2)	(3)	(4)	(5)	NHOI	NO/DK
Biomass	2013	16	32	25	8	4	8	8
	2012	22	40	25	5	2	6	-
	2010	24	34	19	9	5	7	3
	2005	18	36	17	6	2	10	9
Coal	2013	5	28	27	22	12	*	6
	2012	3	16	35	32	14	*	-
	2010	9	27	19	30	13	*	2
	2005	7	31	24	25	8	*	3
Gas	2013	10	49	22	11	4	*	4
	2012	7	33	35	19	4	*	-
	2010	14	42	20	18	4	*	2
	2005	10	45	21	14	4	*	3
Hydroelectric power	2013	34	38	15	3	1	3	7
	2012	39	36	18	2	1	4	-
	2010	39	37	13	3	1	5	3
	2005	36	40	11	2	1	3	7
Nuclear power	2013	10	24	23	16	19	1	8
	2012	11	23	27	21	18	*	-
	2010	10	24	20	21	20	1	3
	2005	9	27	22	20	17	1	6
Oil	2013	6	28	26	22	11	1	7
	2012	3	16	38	31	12	*	-
	2010	5	27	26	28	10	1	2
	2005	6	33	22	25	8	*	4
Sun/Solar power	2013	36	40	13	3	2	1	5
	2012	51	34	11	3	1	*	-
	2010	56	32	6	3	1	*	1
	2005	55	32	6	2	1	*	2
Wind power	2013	26	38	15	7	7	*	6
	2012	38	37	13	7	5	*	-
	2010	49	33	9	5	3	1	1
	2005	50	31	8	5	2	*	2

Note: (1) Very favourable, (2) Mainly favourable, (3) Neither favourable nor unfavourable, (4) Mainly unfavourable, (5) Very unfavourable, NHOI= Never heard of it, NO=No opinion, DK=Don't know; * denotes a value of less than 1% but greater than zero; The percentages in the table may not always add up to 100% due to missing values and rounding.

Attitudes to Nuclear Power

Q2. Which, if any, of the following statements most closely describes your own opinion about nuclear power in Britain today?

	2005	2010	2011	2012	2013
We should increase the number of power stations	9	17	23	21	15
We should continue using the existing NP stations and replace them with new ones when they reach the end of their life	34	29	31	26	30
We should continue using the existing NP stations but not replace them with new ones when they reach the end of their life	34	33	21	32	27
We should shut down all existing NP stations now and not replace them with new ones	15	13	11	9	13
Don't know/none of these	7	7	15	12	16

Note: The percentages in the table may not always add up to 100% due to missing values and rounding.

Q3. To what extent do you support or oppose the building of new nuclear power stations in Britain to replace those being phased out over the next few years? This would ensure that the previous proportion of nuclear energy is retained (18%).

	2013
Strongly support	16
Tend to support	26
Neither support nor oppose	16
Tend to oppose	18
Strongly oppose	15
Don't know/No opinion	10

Note: The percentages in the table may not always add up to 100% due to missing values and rounding.

Q4. Which, if any, of the following statements most closely describes your own opinion about nuclear power in Britain today? Just read out the number that applies.

	2005	2013
Strongly support	26	32
Tend to support	37	29
Neither support nor oppose	32	27
Tend to oppose	3	3
Strongly oppose	*	4
Don't know/No opinion	1	5

Note: The percentages in the table may not always add up to 100% due to missing values and rounding; * denotes a value of less than 1% but greater than zero.

Q5. How concerned, if at all, are you about nuclear power?

	2005	2010	2011	2013
Very concerned	28	16	12	13
Fairly concerned	31	38	35	34
Not very concerned	27	30	34	31
Not at all concerned	11	12	11	12
No opinion/Don't know	3	4	8	10

Note: The percentages in the table may not always add up to 100% due to missing values and rounding.

Q6. From what you know or have heard about using nuclear power for generating electricity in Britain, on balance, which of these statements, if any, most closely reflects your own opinion?

	2005	2010	2011	2013
The benefits of nuclear power far outweigh the risks	13	16	20	18
The benefits of nuclear power slightly outweigh the risks	19	22	21	19
The benefits and risks of nuclear power are about the same	20	17	16	20
The risks of nuclear power slightly outweigh the benefits	16	19	12	16
The risks of nuclear power far outweigh the benefits	25	17	16	13
None of these	1	1	2	4
Don't know	6	7	12	10

Note: The percentages in the table may not always add up to 100% due to missing values and rounding.

Q7. To what extent do you agree or disagree about the following statements on nuclear power?

	SA	TA	NN	TD	SD	NO/DK
Conditional Support						
I am willing to accept the building of new nuclear power stations if it would help to tackle climate change						
2013	15	32	20	14	10	9
2012	12	34	25	15	8	6
2011	15	39	19	11	11	5
2010	17	39	14	16	11	3
2005	11	43	18	15	8	3
I am willing to accept the building of new nuclear power stations if it would help to improve energy security (i.e. a reliable supply of affordable energy)						
2013	20	32	17	13	9	9
2012	-	-	-	-	-	-
2011	22	39	14	10	10	4
2010	20	36	14	16	11	2
2005	-	-	-	-	-	-
We shouldn't think of nuclear power as a solution for climate change before exploring all other energy options						
2013	25	28	20	13	5	8
2012	-	-	-	-	-	-
2011	-	-	-	-	-	-
2010	30	39	12	11	4	3
2005	29	45	10	7	3	3
Promoting renewable energy sources, such as solar and wind power, is a better way of tackling climate change than nuclear power						
2013	31	31	17	11	3	8
2012	29	31	20	11	4	5
2011	-	-	-	-	-	-
2010	37	33	14	9	4	2
2005	40	38	10	6	2	2
Reducing energy use through lifestyle changes and energy efficiency is a better way of tackling climate change than nuclear power						
2013	28	35	18	10	2	8
2012	-	-	-	-	-	-
2011	-	-	-	-	-	-
2010	-	-	-	-	-	-
2005	31	44	13	6	2	2

Note: the scale included the response options of SA=strongly agree, TA=tend to agree, (3) NN=neither agree nor disagree, TD=tend to disagree, SD strongly disagree; NO=No Opinion; DK= Don't Know; * denotes a value of less than 1% but greater than zero; The percentages in the table may not always add up to 100% due to missing values and rounding.

Q7. To what extent do you agree or disagree about the following statements on nuclear power? (Cont'd).

	SA	TA	NN	TD	SD	NO/DK
Safety of Nuclear Power						
If we had safer nuclear power stations, I'd be prepared to support new ones being built						
2013	24	31	17	12	8	8
2012	-	-	-	-	-	-
2011	-	-	-	-	-	-
2010	-	-	-	-	-	-
2005	15	38	19	15	8	3
We should stop using nuclear power stations because we do not know how to store radioactive waste safely						
2013	17	22	21	21	10	10
2012	-	-	-	-	-	-
2011	-	-	-	-	-	-
2010	-	-	-	-	-	-
2005	19	25	23	21	8	3
Perceived Risks and Benefits						
There are risk in Britain from nuclear power						
2013	14	40	18	14	4	9
2012	-	-	-	-	-	-
2011	-	-	-	-	-	-
2010	17	44	16	15	3	5
2005	24	48	14	8	1	3
There are benefits to people in Britain from nuclear power						
2013	16	41	17	10	6	10
2012						
2011						
2010	16	44	16	12	6	6
2005	9	40	25	12	7	6
Need for Nuclear Power						
We need nuclear power because renewable energy sources alone are not able to meet our electricity needs						
2013	-	-	-	-	-	-
2012	17	36	22	10	5	9
2011	-	-	-	-	-	-
2010	17	38	18	16	7	5
2005	10	38	22	17	6	5

Note: the scale included the response options of SA=strongly agree, TA=tend to agree, (3) NN=neither agree nor disagree, TD=tend to disagree, SD strongly disagree; NO=No Opinion; DK= Don't Know; * denotes a value of less than 1% but greater than zero; The percentages in the table may not always add up to 100% due to missing values and rounding.

Q7. To what extent do you agree or disagree about the following statements on nuclear power? (Cont'd).

	SA	TA	NN	TD	SD	NO/DK
Perceived Risks and Benefits						
Britain needs a mix of energy sources to ensure a reliable supply of electricity, including nuclear power and renewable energy sources						
2013	-	-	-	-	-	-
2012	24	42	18	8	4	5
2011	-	-	-	-	-	-
2010	28	45	11	9	4	2
2005	17	46	17	11	3	3
Trust						
I feel confident that the British Government adequately regulates nuclear power						
2013	8	25	25	19	11	13
2012	-	-	-	-	-	-
2011	-	-	-	-	-	-
2010	7	33	22	20	12	8
2005	4	28	26	23	10	8
I feel that current rules and regulations are sufficient to control nuclear power						
2013	8	26	26	15	9	16
2012	-	-	-	-	-	-
2011	-	-	-	-	-	-
2010	-	-	-	-	-	-
2005	4	28	30	18	7	12

Note: the scale included the response options of SA=strongly agree, TA=tend to agree, (3) NN=neither agree nor disagree, TD=tend to disagree, SD strongly disagree; NO=No Opinion; DK= Don't Know; * denotes a value of less than 1% but greater than zero; The percentages in the table may not always add up to 100% due to missing values and rounding.

Q8. Thinking about the risks of nuclear power IN THIS COUNTRY. How concerned, if at all, are you about…

	(1)	(2)	(3)	(4)	NO/DK
The risks of an accident at a nuclear power station	21	34	29	6	9
The risks associated with the storage of nuclear waste at an underground storage site	24	36	24	6	10
The risk associated with the storage of nuclear waste overground at a nuclear power station	29	35	19	6	10
The risks of a natural disaster triggering a nuclear accident	21	29	28	12	9
The risks of terrorists targeting a nuclear installation in Britain	24	30	28	8	10

Note: (1) Very concerned; (2) Fairly concerned; (3) Not very concerned; (4) Not at all concerned; NO=No Opinion; DK= Don't Know; The percentages in the table may not always add up to 100% due to missing values and rounding.

Public Perceptions of Climate Change

Q9. As far as you know, do you personally think that the world's climate is changing or not?

	2005	2010	2012	2013
Yes	91	78	79	72
No	4	15	11	19
Don't know	5	6	11	9

Note: The percentages in the table may not always add up to 100% due to missing values and rounding.

Q10. How concerned, if at all, are you about climate change, sometimes referred to as 'global warming'?

	2010	2012	2013
Very concerned	28	24	21
Fairly concerned	43	50	39
Not very concerned	19	20	27
Not at all connected	8	6	7
Don't know/No opinion	2	1	5

Note: The percentages in the table may not always add up to 100% due to missing values and rounding.

Q11. Thinking about the causes of climate change, which, if any, of the following best describes your opinion?

	2010	2012	2013
Climate change is entirely caused by natural processes	6	4	5
Climate change is mainly caused by natural processes	12	12	12
Climate change is partly caused by natural processes and partly caused by human activity	47	48	46
Climate change is mainly caused by human activity	24	28	22
Climate change is entirely caused by human activity	7	4	6
I think there is no such thing as climate change	2	2	2
Don't know/No opinion	3	2	7

Note: The percentages in the table may not always add up to 100% due to missing values and rounding.

Q12. To what extent do you agree or disagree that with the following statements about climate change?

	SA	TA	NN	TD	SD	NO/DK
The seriousness of climate change is exaggerated						
2013	10	24	18	27	14	7
2012	9	21	21	28	18	2
2010	12	28	15	28	14	3
My local area is likely to be affected by climate change						
2013	10	24	18	27	14	7
2012	9	21	21	28	18	2
2010	12	28	15	28	14	3
Climate change is likely to have a big impact on people like me						
2013	10	33	23	20	8	7
2012	-	-	-	-	-	-
2010	11	34	20	25	8	3
It is my responsibility to help do something about climate change						
2013	22	46	16	8	4	5
2012	-	-	-	-	-	-
2010	20	50	14	9	5	1
Extreme weather events have become more frequent in Britain in the past ten years						
2013	26	42	14	10	3	6
2012	-	-	-	-	-	-
2010	-	-	-	-	-	-

Note: the scale included the response options of SA=strongly agree, TA=tend to agree, (3) NN=neither agree nor disagree, TD=tend to disagree, SD strongly disagree, NO=No Opinion, DK= Don't Know; The percentages in the table may not always add up to 100% due to missing values and rounding.

Q13. To what extent do you agree or disagree that with the following statements about extreme weather events such as flooding, heat waves and drought?

SA	TA	NN	TD	SD	NO/DK
Extreme weather events have become more frequent in Britain in the past ten years					
26	42	14	10	3	6
This increased frequency is due to climate change [ALL WHO AGREE TO Q13_1; n=627]					
23	51	15	5	2	4

Note: the scale included the response options of SA=strongly agree, TA=tend to agree, (3) NN=neither agree nor disagree, TD=tend to disagree, SD strongly disagree, NO=No Opinion, DK= Don't Know; The percentages in the table may not always add up to 100% due to missing values and rounding.

UKERC

UK Energy Research Centre

58 Prince's Gate
Exhibition Road
London SW7 2PG
tel: +44 (0)20 7594 1573
email: ukercpressoffice@ukerc.ac.uk

www.ukerc.ac.uk

The Meeting Place - hosting events for the whole of the UK energy research community - www.ukerc.ac.uk/aupport/TheMeetingPlace

National Energy Research Network - a weekly newsletter containing news, jobs, event, opportunities and developments across the energy field - www.ukerc.ac.uk/support/NERN

Research Atlas - the definitive information resource for current and past UK energy research and development activity - http://ukerc.rl.ac.uk

UKERC Publications Catalogue - all UKERC publications and articles available online, via www.ukerc.ac.uk

Follow us on Twitter @UKERCHQ