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BEYOND RISKS AND BENEFITS – WHAT DETERMINES PUBLIC OPINION TOWARDS NUCLEAR AND WIND POWER IN THE UK?

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Abstract

This paper assesses predictors of public support for nuclear and wind power in the UK. In particular, the paper tests whether there is a common set of determinants, or whether predictors of opinion differ. Additionally, information sources, proxied by newspaper readership, and trust in information sources are included as independent variables to test whether they assist in explaining support. Part I of this paper reviews conventional determinants of public opinion towards energy sources and develops the conceptual framework used for the analysis. For the analysis an attitudinal survey (n=1915) was designed and distributed with YouGov in May 2013. Using the results of this survey, Part II of the paper finds that there is no common set of determinants for support of nuclear and wind power. It furthermore establishes that newspaper readership is not a significant predictor of opinion, while trust in information sources is, however only in support for wind power. A recommendation for future tailored communication of energy policies in the UK is provided.

Acknowledgement

I would like to thank my supervisor Dr. David Howarth for his confidence and trust in my abilities as well as Dr. Andreas Kontoleon for his advice on statistical matters. Moreover my gratitude goes to Dr. Joel Rogers from YouGov for helping me to design the survey and collecting the data.

Contents

1. Introduction

The aim of this study is to investigate what determines public opinion towards energy sources in the UK and, in particular, what determines support for wind and nuclear power.[1] Like other governments, the British Government has reassessed energy policies in consideration of current and anticipated problems of 'fossil fuel price volatility, climate change and ensuring security of energy supply' (OECD, 2010, p. 3). Additionally, it has committed, with the Climate Change Act (2008), to reduce its carbon dioxide emissions by 80% by 2050 (based on 1990 levels) (Great Britain, *Climate Change Act* 2008). In order to direct the UK on a low-carbon trajectory, chief scientific advisor at the Department of Energy and Climate Change (DECC), David MacKay, projects a four-fold increase in nuclear power and a 12 to 20-fold increase in wind power to supply the UK industry with energy in 2050. However, nuclear power is contentious with the public (OECD, 2010; Portinga, Pidgeon and Lorenzioni, 2006). On the other hand, wind power is accepted by the British public, but it remains a controversial topic which even divides opinions of environmentalists (Warren et al., 2011). It is a common assumption that 'attitudes and behaviours need to be modified to secure a sustainable energy future' (Owens and Dirfilli, 2008, p. 4412). For this reason, and due to its significance in shaping energy policies (OECD, 2010), public opinion i.e. 'the expressed attitudes and views of ordinary people on issues of public concern' (Brooker and Shaefer, 2006, p. 5, cited after Petrova, 2010, p. 28) is chosen as the unit of analysis in this study. To answer the stated aim, the following objectives have been defined:

1) To examine what predicts support with regard to nuclear and wind power

2) To understand public opinion towards nuclear and wind power in the UK

3) To appraise whether predictors of support differ for nuclear and wind power in the UK.

In the UK, research on public opinion towards different energy sources mainly centres around its direction and intensity and focuses less on actual predictors of support (DECC, 2012b; Ipsos MORI, 2012; OECD, 2010; Portinga, Pidgeon and Lorenzioni, 2006; Curry et al., 2005). Outside the UK, determinants of support such as risk perceptions, political beliefs and values have received more attention (see for example Petrova, 2010; Greenberg, 2009; Ansolabehere, 2007). In the US, Whitfield et al. (2009) showed that

[1] Throughout this dissertation the terms wind power and wind farms are used interchangeably.

traditional values have a significant explanatory power, with individuals who hold traditional values being more supportive of nuclear power compared to individuals with altruistic values. Additionally, Petrova (2010) exemplified that knowledge about the technology increases support. Among critics of nuclear power, wind power is often presented as the most favourable alternative in the UK (House of Commons Energy and Climate Change Committee, 2013). Yet with the current energy strategy of the UK, there is no decision between either nuclear or wind power as both are part of the British energy strategy (DECC, 2012a). Conceptualizing what drives public opinion on these issues 'will help policy makers to [better] interact with their publics to [ensure] an informed debate on energy matters' (OECD, 2010, p. 9) and shape policy accordingly.

This study complements the existing literature by combining and adapting the frameworks used by Devine-Wright (2007), Petrova (2010) and Whitfield et al. (2009) to predict support towards energy sources as well as including information source and trust in information sources as independent variables, which have thus far received only scant attention in this regard. Furthermore, it is assessed whether the same variables help to explain support for two different energy sources, namely nuclear and wind power. An attitudinal survey (n=1915) was designed and distributed with the help of YouGov in May 2013 in order to understand public opinion on nuclear and wind power as well as factors which influence this opinion. YouGov is an online polling company based in the UK which uses Internet polling and provides a monetary incentive for participants (YouGov, 2013). By providing this dataset, this study allows for the analysis of socio-economic data, familiarity with science and technology, knowledge about energy generation, distribution and use, party membership, information sources and trust in information sources to understand attitudes towards nuclear and wind power.

The paper finds that age, gender, membership in the Conservative party, knowledge on electricity generation, delivery and usage and having studied science to A-levels significantly increase support for nuclear power. Neither information source, nor trust in information sources is significant in the nuclear model. However, trust in information sources is a significant determinant for support for wind farms along with being a member of the Labour party. Ceteris paribus, trusting the BBC on energy relevant information increases support by about 15%, while trusting the EU on information about energy issues increases support by about 19%. The main limitations of these results are a lack of other determinants identified by the literature, such as environmental values, due to limited survey space as well as a missing control for the perception of risks and

benefits. The variable for perception of risks and benefits is a perfect predictor of favourability and had to be dropped from the regressions to obtain clear results.

The paper is organised as follows. Chapter 2 reviews attitude theory as well as conventional determinants of public opinion towards energy sources and develops the conceptual framework for the analysis. Chapter 3 analyses public opinion towards nuclear and wind power in the UK. Chapter 4 demonstrates empirically and discusses which variables predict favourability for nuclear power and which variables predict favourability for wind farms. Chapter 5 concludes the paper by illustrating how significant predictors can be used for future tailored communication of energy policies in the UK.

2. Literature Review

2.1 Overview

This section provides an introduction into attitude theory as well as an overview of conventional determinants of public opinion on energy sources. This is followed by the development of a conceptual framework which is used during the analysis. As the unit of analysis is public opinion, it needs to be noted that the *public* in this study comprises citizens and electricity consumers, but not other stakeholders such as energy companies or lobby groups. Nevertheless, the public is conceived to be heterogeneous with varying 'interests, experiences, beliefs and values' (Whitmarsh et al., 2011, p. 22).

2.2. Attitude Theory

Attitude theory is an established field in social psychology. An early definition of attitudes comes from Allport, who in 1935 defined an attitude as:

> 'a mental and neural state of readiness, organized through experience, exerting a directive and dynamic influence upon the individual's response to all objects and situations with which it is interrelated'. (p. 810)

Today, attitudes are defined as 'hypothetical constructs that refer to an individual's evaluation of something' (Whitmarsh et al., 2011, p. 3). The hypothetical construct stems from the fact that attitudes are general preferences and only become opinions when they are vocalized (Brooker and Shaefer, 2006). Expanding Allport's definition (1935), it is now understood that attitudes encompass three general domains: '*knowledge*, relating to the intellect and cognition, *affect*, relating to emotions and feeling and *behavioural* intentions' (Brooker and Shaefer, 2006, p. 6). Attitudes are furthermore known to be 'dynamic, influenced by a range of factors, often ambivalent or uncertain, and frequently not predictive of behaviour' (Whitmarsh et al., 2011, p. 26). Attitudes differ according to whether they result from direct experience with a particular object, which commonly leads to the formation of strong and coherent attitudes, or whether they are mediated, resulting in weaker and less coherent attitudes (Fazio et al., 1981). Besides strength (strong or weak) and direction (positive or negative) of attitudes, equivocation about an attitudinal object can occur (Whitmarsh et al., 2011, p. 26). A variety of determinants such as 'certainty, ambivalence, confidence, involvement, importance, emotional intensity and underlying values' can influence the strength of attitudes (ibid). The measurement of attitudes can therefore either be in the form of direct elicitation, where participants state

their support or opposition toward an attitudinal object via a questionnaire for example, or can be inferred from different reactions to the attitudinal object (Bech-Larsen and Nielsen, 1999).

2.3 Conventional Determinants of Public Opinion towards Energy Sources

The following section discusses determinants of public opinion which have been used in studies of favourability towards energy sources. These are later combined into a conceptual framework.

i. Demographics and Socio-Economic Factors

Devine-Wright (2007) conceptualizes support for energy sources under three factors: 'personal', 'psychological' and 'contextual' (pp. 5-7). Personal factors include age, gender, class and income. He identifies a difference in opposition by older respondents between national and regional surveys. At a regional level, elderly people tend to be more opposed to renewable energies compared to younger people (Somerset County Council, 2004; MORI Social Research Institute for Regen SW, 2003) while at a national level opposition is generally lower. Favourability towards nuclear power is also correlated with age, with older people being more supportive than younger ones (OECD, 2010; Populus, 2005).

An analysis of gender and support towards different energy sources has led to mixed results. In general, women are less favourable towards wind farms than men (MORI SW Studies, 2004; 2003), but are overall more favourable towards renewable energy development than men (Devine-Wright, 2007). A similar picture is drawn for support of nuclear power, where men express higher favourability than women (OECD, 2010).

A positive correlation exists between social class, income and levels of support for nuclear and renewable energy (Devine-Wright, 2007). Additionally, research by MORI (2004) suggests that individuals of the AB social class who earn more than £30,000 per year are generally more favourable towards renewable energy and specifically wind energy as well as more supportive of nuclear power compared with individuals of the class DE.[2] Pampel (2011) and Greenberg (2009) find a significant relationship between income and support for nuclear power. Yet Whitfield et al. (2009) do not find any variation of attitudes towards nuclear power among 'gender, age, education, [or] income' in the US (p. 425).

[2] 'Individuals in high or intermediate managing positions' belong to social grade AB while 'semi and unskilled workers as well as state pensioners' belong to social grade DE (Ipsos MORI, 2009, p. 3).

ii. Risk Perception and Benefits of Energy Technologies

Various studies have examined the perception of risk by the public towards nuclear power. Researchers in the US (Greenberg, 2009; Whitfield et al., 2009) in particular have studied determinants of risk sensitivity. Whitfield et al. (2009) find that attitudes toward nuclear power are influenced by risk perception and that risk perceptions as well as attitudes are furthermore determined by 'values, beliefs and trust in the institutions that influence nuclear policy' (p. 425). Finucane and Holup (2006) have similar findings and conclude that risk perception is a distinct type of attitude, which possesses the same general attitude domains (knowledge, affect and behaviour). A major concern for the public regarding nuclear energy is safety. Associated risks with nuclear power are thereby mainly connected to 'collective problems' (de Groot and Steg, 2010, p. 1365). Consequently, a common belief is that an increase in the number of nuclear power stations heightens the risk of 'nuclear accidents, waste management problems, or environmental pollution' (ibid). Yet, there are also benefits associated with it such as supplying low-cost energy and climate change mitigation (Portinga, Pidgeon and Lorenzioni, 2006). The perception of risks associated with nuclear power can be overcome by increasing trust in organisations dealing with nuclear safety, which Whitfield et al. (2009) describe as the 'most consistent finding in the risk literature' (p. 428). Risks with regard to wind power mainly relate to intermittence in energy supply, but also health risks associated with the sound of the turbines as well as ecological effects such as the killing of birds (Bassi, Bowen and Fankhauser, 2012).

iii. Political Beliefs and Values

Stern et al. (1999) use the universal human value framework (Schwartz, 1994) to develop a model of environmental decision making, which includes human values as well as variables for social context. The argumentation behind this model is that people place decisions about risk perceptions within a larger framework comprising general beliefs and values. Adapting this framework and using structural equation models on US nationally representative survey data, Whitfield et al. (2009) find significant explanatory power in values and beliefs as an influence on support for nuclear power. Accordingly, individuals holding traditional values ('assigning importance to family, patriotism and stability', p. 427) support nuclear energy, while individuals with altruistic values (being concerned 'with the welfare of other humans and other species', ibid) oppose it. Political beliefs, as one expression of general values, are generally correlated with support of

various low carbon technologies. Empirical findings, such as those by Populus (2005), show that supporters of the Conservative party (compared to supporters of the Liberal Democrats and Labour) are more likely to support nuclear power while they are also more likely to reject renewable energy developments. Whitfield et al. (2009) however find that political orientation in the US does not have any influence on attitudes towards nuclear power.

iv. Energy Knowledge and Familiarity with Science and Technology

Petrova (2010) studies determinants of public opinion towards wave energy development in Oregon, using multiple regression analysis on survey data (n=1200). She finds statistically significant results for 'familiarity with the technology' (p. 14). In addition, support for renewable energy projects increases not only due to a certain level of familiarity with the project development, but also due to an understanding of the technology itself combined with general knowledge of energy issues (ibid). Furthermore, people who are very familiar with energy issues, especially people who are 'energy experts', are generally supportive of nuclear power (US Congress, Office of Technology Assessment, 1984, pp. 217-218.). This finding is also supported by Pampel (2011) who uses multilevel models for countries of the EU to study determinants of support for nuclear energy. He finds that familiarity with the technology is a significant predictor for support of nuclear energy. However, for a slight increase in knowledge, results for predicting support are mixed, supporting a 'selective perception' hypothesis that people who are strongly favouring something, select information according to whatever supports their beliefs (US Congress, Office of Technology Assessment, 1984, p.216). Sjoberg (2004) acknowledges 'the often observed gap between experts and the public when it comes to socially and economically important hazards, such as those associated with nuclear technology' (p. 51). Yet Devine-Wright (2007) argues the opposite, stating that:

> 'although studies of public acceptance have been driven by assumed negative implications of deficits in public understanding, there is limited evidence that more informed individuals are more accepting of low carbon technologies'. (p. 6)

Nevertheless, there is a difference between more informed individuals and individuals with a background affiliated with science and technology. The DTI, Scottish Executive et al. study (2003) as well as the MORI Social Research Institute for Regen SW (2004) found a significant relation between scientific knowledge and acceptance of low carbon energy sources, while the London Renewables study (2003) did not find more knowledgeable

individuals to be more supportive of low carbon energy. These mixed findings might also result from different proxies which were used for measuring 'knowledge'. To measure familiarity, commonly two different approaches, an objective and a subjective one are used. The objective approach thereby asks questions based on specific aspects of a certain issue, while the subjective measure asks for a self-assessment by each individual (Delli Carpini and Keeter, 1996). Hence, combining the two of them facilitates a better understanding of the determinants for favourability.

2.4 Information Sources, Trust in Information Sources and Public Opinion

To understand public opinion towards energy sources, it is necessary to take into consideration the sources from which the public obtains information. Commonly, there are two ways in which the media can control public opinion; firstly, by selecting information which is reported and secondly, by emphasising certain viewpoints and 'framing' them (Horning, 1993; Ryan, 1991). The literature in the US shows a strong and positive relationship between 'policy-relevant knowledge' of the environment and frequent reading of newspapers (Steger et al., 1988, p. 760; Jamieson, 2000; Pierce et al., 1992). Additionally, a study by Braunholtz (2003) demonstrates the importance of local newspapers for public opinion on renewable energies, especially wind farms in rural areas of the UK. Even though watching television is the 'most common source of environmental information gathering' (Petrova, 2010, p. 125; Devine-Wright, 2007), research shows a questionable credibility and reliability of its information provision (Steel, 1997; Pierce et al., 1992; Steger et al. 1988). Looking at the relationship between environmental knowledge and the use of TV in the US, Pierce et al. (1992) and Steger et al. (1988) show a negative relationship, while Jamieson (2000) has found no relationship between these factors. Whitfield et al. (2009) even attribute the *come-back* of nuclear power in the US to the media. They identify the following factors as responsible for the come-back: firstly, presenting the public as supportive towards nuclear power in the media, secondly, increased media coverage in the *New York Times*, *The Economist* and science magazines, and thirdly, influential scholars and government officials openly discussing and supporting an increase in nuclear power. However, information sources are not only important for nuclear power, but also for renewables. Wind power and nuclear power have both been framed as climate change mitigation technologies by the media and support groups (Corner et al., 2011; Lovell, Bulkeley and Owens, 2009; Bickerstaff et al., 2008). Nevertheless, both face environmental criticism, such as nuclear waste and

pollution as well as destroying landscapes and killing birds (Bassi, Bowen and Fankhauser, 2012; de Groot and Steg, 2010).

Besides the selection of information sources, trust in them also plays a role. Leiserowitz et al. (2009) study, with the help of nationally representative surveys, the impact of Climategate – 'the unauthorized release of emails between climate scientists in England and the US' (p. 1). They find a decrease in trust in information from scientists after Climategate, and a significant effect on public opinion in the US towards global warming. This leads to the hypothesis that besides information sources, trust in them is also important for predicting public opinion towards energy sources.

2.5 Conceptual Framework

Figure 1 is a summary of the discussed predictors of support and presents the conceptual framework which is used during the empirical analysis. The 'personal factors' (Devine-Wright, 2007, p. 6) which are substantial for supporting energy sources are age, gender, income, political party membership as well as place of residence. Furthermore, '[socio-]psychological factors' (ibid) which play an important role in predicting support are, among others, the perception of risks and benefits (Whitfield et al., 2009), knowledge about energy issues and familiarity with science and technology. Information sources and trust in information sources are additionally proposed as significant predictors of public support for nuclear and wind power. The categories (personal factors and socio-psychological factors) individually influence support, however also the interaction between variables of these categories might influence support. Accordingly, being male and being very knowledgeable about energy issues might result in strong support for nuclear power. This is accounted for by the arrows. Additionally, in theory, individual variables representing socio-psychological factors, such as being very knowledgeable about energy issues might be influenced by a certain level of familiarity with science and technology and the choice of information sources, which is indicated by the lines from one box to another.

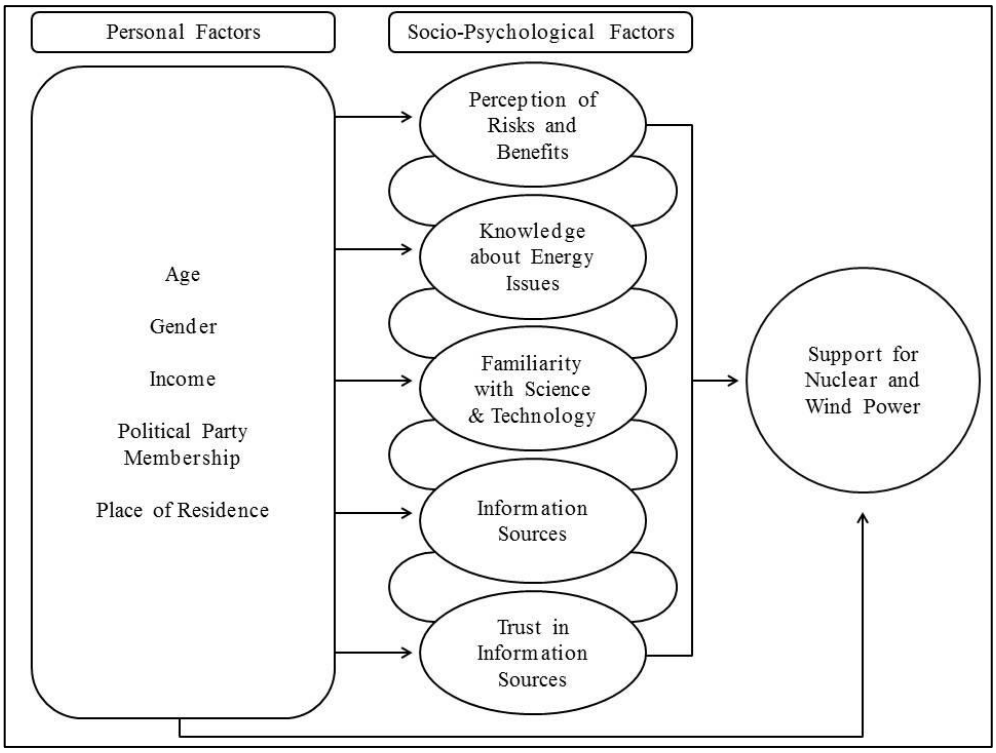

Figure 1: Conceptual Framework

(adopted from Petrova, 2010, p. 38)

3. Nuclear Power, Wind Power and Public Opinion in the UK

Nuclear power accounts for 20% of the UK's total electricity generation (World Nuclear Association, April 2013). In 1956, nuclear power assumed a role in the energy market, when the world's first commercial nuclear power station, Calder Hall, was opened in Cumbria, UK (Bolton, 2013). Currently, 16 reactors are operating in the UK, out of which 15 will be retired over the next 10 years (World Nuclear Association, April 2013). Making use of the low carbon potential of nuclear power stations, the government anticipates '16 GWe of new nuclear capacity on line by 2030' (ibid). Since as early as 1956, nuclear power has been consistently debated within and outside the UK. In the early 1970s, Britons started vocalizing their concerns in the anti-nuclear movement and during the 1970s and 80s, they primarily protested against the risks and reliability of the technology (Chafer, 2007). Nevertheless, it is fair to say that the anti-nuclear movement in the 1980s was more connected to nuclear weapons than nuclear power due to various contemporary socio-political reasons (ibid). However, the consequence was a reduction in investment for nuclear power and a decrease on its reliance over consequent decades. In recent years, especially because of the nuclear accident in Fukushima in 2011, opposition against nuclear power was on the rise again, with various demonstrations held against nuclear waste and the construction of new nuclear power plants (Stopnuclearpower UK, 2013). Regardless, the Government has put an emphasis on the communication of climate change benefits of nuclear power, which has led to a 'reluctant acceptance' of nuclear power by British citizens (Pidegeon, Lorenzio and Poortinga 2008, p. 8). Pidgeon, Lorenzio and Poortinga (2008) study how support of nuclear power changes when it is presented as a climate change mitigation technology by using a split sample technique with national surveys of ($1400 \leq n \geq 1900$). Their findings show an increase in support of nuclear power when its climate change benefits are communicated. Additionally, Bickerstaff et al. (2008) study the reframing of nuclear power using a mixed-methods approach, presenting nuclear power in the context of energy security and sustainability. They find an inner re-negotiation process taking place, weighing risk and benefits about nuclear power differently in the presented context, with the outcome of increased support for nuclear power. The process of re-negotiation, particularly re-evaluation of the issue is described by Bickerstaff et al. (2008) as 'reluctant acceptance' (p. 12).

The UK has a cumulative installed wind energy capacity (both onshore and offshore combined) of 8.4 GW which is equivalent to 8% of the total EU capacity, with a total number of 3,867 onshore wind turbines in operation (Renewable UK, 2013). With

this, the UK is falling behind its onshore wind power capacity trajectory by approximately 470 MW which is equivalent to 2% (European Wind Energy Association, 2013). Despite the fact that the UK has the 'best wind resources in Europe', its deployment of wind energy is smaller than in other European countries with less wind (Sustainable Development Commission, 2005, p. 13). The first wind turbine which could be connected to the grid was built in 1951. It however took twenty more years before wind energy was considered as a commercial generator of electricity and it was only in 1991 that the first commercial wind farm Delabole in Cornwell, UK started operating with 10 turbines. The reasons for building this wind farm lie in the local opposition to a proposed nuclear power plant (Delabole, 2013). On a national scale, views towards wind power are highly favourable, while opposition remains harsh at a local level (Jones and Eiser, 2010). This divide is not only true for wind energy, but also for nuclear energy. The view with which respondents answer questions in a poll changes from a national level, where issues are perceived to be country-related, taking into consideration energy security and problems of climate change, to a local level where issues are contextualized with home and hence residence and personal impacts of the energy technology (Pidgeon, Lorenzioni and Poortinga, 2008). Nevertheless, especially high levels of support for wind farms, also at local levels, can be found in Scotland (Scottish Renewables, 2013). In addition to local opposition against wind farm developments, which is often resultant of poorly undertaken public consultation processes and a limited perception of fairness of residents (Jones and Eiser, 2010), national opposition also is increasing. A major concern, along with the destruction of the landscapes, is the unreliable electricity supply (Bassi, Bowen and Fankhauser, 2012). However, there exists not only opposition from the public, but also opposition within the ranks of Members of Parliament, which was voiced in a letter, signed by 106 MPs in the beginning of 2012 to the Prime Minister, asking to cut down on subsidies for wind farm development (letter published in *The Telegraph*, 05th February 2012).

Figures 2 and 3 depict public opinion towards nuclear power and wind farms in the UK over the years from 2007 to 2013.[3] Based on these graphs, favourability towards nuclear power has increased from 38% (2007) to 45% in 2013 and was only intermitted by a decrease in support in 2011, which can be attributed to the nuclear accident at

[3] Data for the years from 2007-2012 was used from the time-series research by YouGov for EDF. The same question was asked in the survey for this study; hence data was also available for the year 2013.

Fukushima in March 2011. Favourability towards wind farms however depicts the opposite trend where support for wind farms continuously decreased from 76% (2007) to 57% in 2013. This can mainly be attributed to the reasons outlined above, however it might also be that wind technology is still perceived "as controversial per se" (Khan, 2003, p. 567), which could have led to ever-decreasing levels of favourability. Furthermore, it can be noted that opposition to nuclear power is much higher than opposition against wind farms. Reasons for this might lie in the associated risk with nuclear power accidents and nuclear waste, which can have a detrimental impact on the whole population, while wind farms only have a direct impact on the surrounding communities.

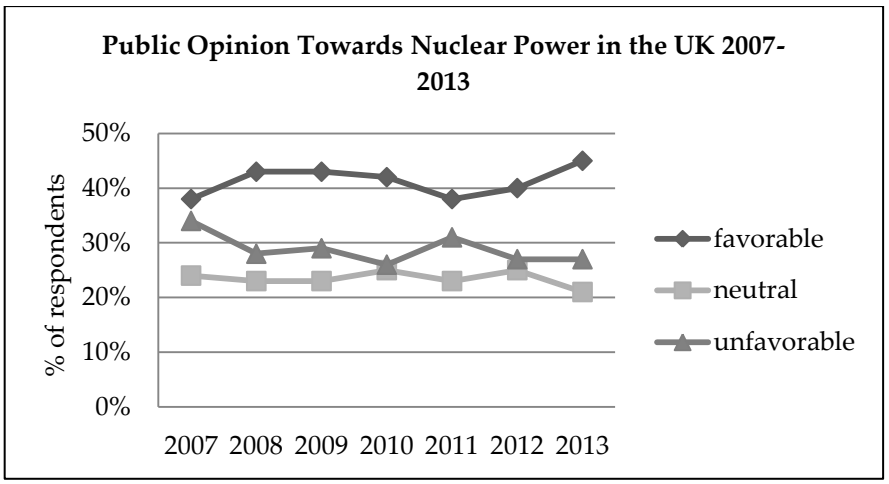

Figure 2: Public Opinion towards Nuclear Power in the UK 2007-2013

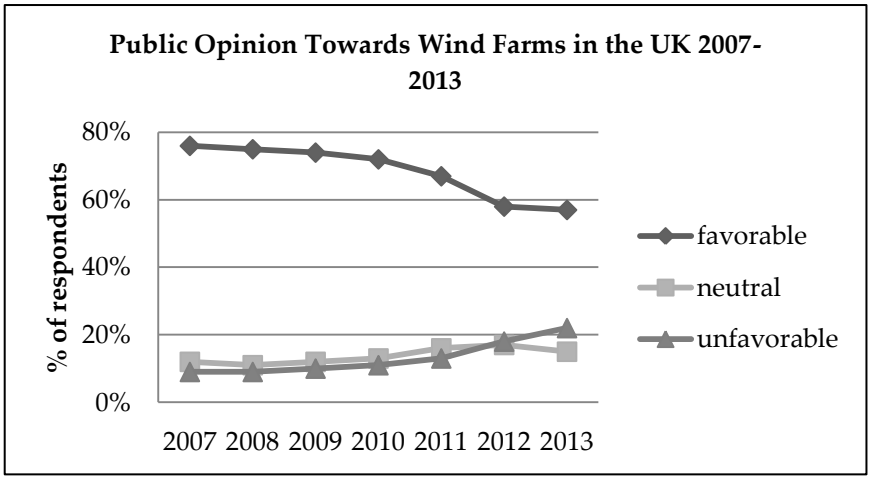

Figure 3: Public Opinion towards Wind 'Farms' in the UK 2007-2013

4. Empirical Analysis

4.1 Objectives

This section tests whether there is a common set of determinants of favourability towards nuclear and wind power in the UK, or whether predictors of opinion differ. Taking into account variables which have been identified by the literature review, this study furthermore adds the variables information source, which is proxied by newspaper readership, as well as trust in these and other information sources. It is proposed that favourability towards nuclear and wind power may be affected by newspaper readership and trust in information sources. For the analysis, an attitudinal survey (n=1915) was designed and distributed with the help of YouGov.

4.2 Survey Description

i. Design

A total number of eight questions were asked, accounting for the fact that the data collection was done pro-bono and survey space was limited. Survey questions were continuously refined and tested by YouGov beforehand to avoid bias regarding answer choices in the questionnaire and to ensure clarity of the questions. The survey is introduced by a general question on the overall knowledge of the participant on energy production, delivery and use of different energy sources. This is followed by a question on the participant's favourability towards sources for electricity generation. Even though this study focuses solely on the favourability towards nuclear and wind power, favourability towards coal as well as gas-fired power stations was asked, to give people a more realistic picture of the current electricity sources contributing to the UK energy supply. This also ensured less biased results. Moreover, the question was phrased in the same way as it has been done annually since 2007 by YouGov for a study commissioned by EDF, the EDF Tracker, to see whether favourability towards nuclear and wind power has been changing over the last years and to put the survey answers into a better context. Afterwards, questions on advantages and disadvantages associated with nuclear and wind powers, as well as familiarity with science and technology were raised. The final question asked people about their trust in information sources for energy related issues. All questions had different answer categories and allowed for a 'don't know/none of these' answer. Additionally, socio-economic data of participants such as age, gender,

party membership, last vote, newspaper readership, social grade and region were made available by YouGov, covering personal factors in this study's conceptual framework.

ii. Data Collection

An attitudinal survey was selected as a data collection tool to undertake analyses with statistical significance and less bias, facilitating a good understanding of attitudes of British individuals from different regions and different social classes. The survey was sent out on the 28th of May and the nationally representative data was available on the 30th of May (2013). The data collection was done according to an 'active sampling' procedure, where only people who are approached and invited by YouGov to participate can fill out the survey (YouGov, 2013). In total, YouGov has a panel size of over 360,000 British adults from which it draws respondents over a variety of socio-economic environments, gender and age categories as well as different newspaper readership to answer the survey (ibid). A username and password are needed to complete the survey, which can only be filled out once. Participation in the survey is facilitated via an email invitation including a link to the survey, which is hosted on the YouGov website. Upon completion of the survey, a monetary reward is obtained by the participant, which affirms a representative sample and avoids a majority of answers which are politically motivated (ibid).

4.3 Sample Statistics

In total, 1915 respondents answered the survey. Sample statistics adequately represent the British population as the following discussion shows.

i. Socio-Economic Characteristics

The youngest respondent was 18 and the oldest respondent was 84 years old. A preliminary analysis of age categories revealed that they were mostly equally represented; only the age category 74+ was underrepresented. This is due to the fact that the survey was administered online and e-literacy and internet access in the UK significantly decreases after the age of 64 (Selwyn et al., 2003). Gender was evenly split among respondents, with 48.6% being male and 51.4% being female. Social grade was also more or less evenly split, with 28% of respondents being assigned to AB ('high or intermediate managing positions'), 29% assigned to C1 ('supervisory, clerical and junior management positions'), while 21% respectively 22% were assigned to C2 ('skilled manual workers')

respectively DE ('semi and unskilled workers as well as state pensioners') (Ipsos MORI, 2009, p. 3).

ii. Party Membership and Regional Characteristics

Party membership varied among respondents with 32.5% being a member of the Labour party, 28.5% were Conservatives, and 12% Liberal Democrats, while 20.2% are not members of any political party. The remaining 3% were members of other parties or did not know (3.8%) respectively (Figure 4). Additionally, respondents indicated the region in which they live with 'London' (12.8%), 'Rest of South' (32.5%), 'Midlands/Wales' (21.4%), 'North' (24.6%) and 'Scotland' (8.7%) respectively.

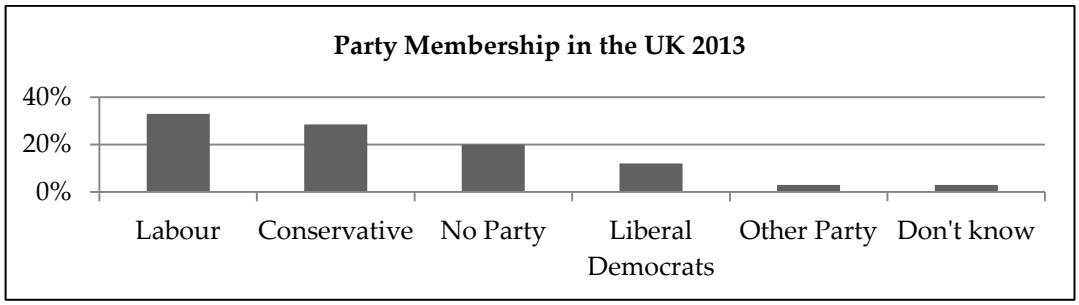

Figure 4: Party Membership in the UK 2013

iii. Knowledge about Energy Production, Delivery and Use of different Energy Sources

To better understand the subjective component of familiarity with science and technology, especially with regard to energy issues, the variable knowledge is a subjective rating by respondents based on their own appraisal how knowledgeable they are with regard to energy generation, delivery and use on a scale from 'very knowledgeable' (1) to 'not knowledgeable at all' (4). The majority of respondents felt either 'fairly knowledgeable' (42.3%) or 'not very knowledgeable' (35.7%). Only 6.1% perceived themselves as 'very knowledgeable', and 10.3% as 'not knowledgeable at all'.

iv. Attitudes towards Nuclear and Wind Power

Respondents were asked to rank their favourability for coal-fired power stations, gas-fired power stations, nuclear power stations and wind 'farms' on a scale from 'very favourable' (1) to 'very unfavourable' (5) for the following question:

> How favourable or unfavourable are your overall opinions or impressions of the following energy sources for producing electricity currently?

> Coal-fired power stations, gas-fired power stations, nuclear power stations and wind 'farms'.

The following Figure 5 shows survey responses for nuclear and wind.

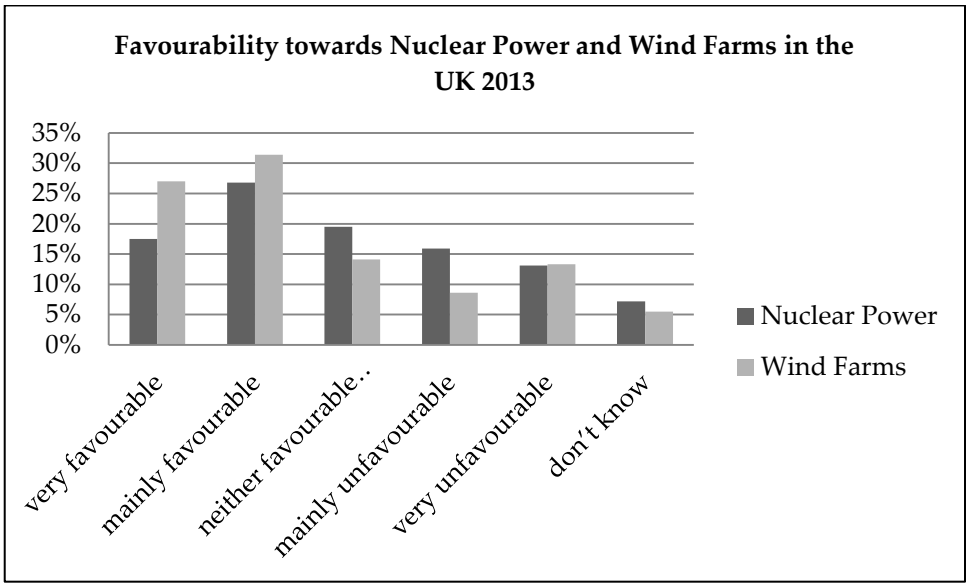

Figure 5: Favourability towards Nuclear Power and Wind Farms in the UK 2013

This distribution shows a higher favourability towards wind power, as it was predicted in the literature review as well as a higher frequency of people opposing nuclear power. For both forms of electricity generation, respondents feel that benefits greatly outweigh the risks with nuclear power (26.9%) and wind (35.3%).

Additionally, respondents were asked the following question:

> All methods of electricity generation have some sort of advantage or disadvantage. Which, if any of the following, do you associate with wind power (nuclear power)?
>
> (Please select all that apply) air pollution, environmental damage, hazardous waste, dangerous to human health, inefficient, affordable prices, clean, good for the economy, reliable, safe, low carbon, don't know/none of these.

When asking about specific advantages and disadvantages associated with both electricity generation technologies, it is interesting to note that answers about the low carbon potential of both technologies were divided for wind power (51.4% (advantage):48.6% (disadvantage)) and rejected for nuclear power (69.2%(disadvantage)), leading to the assumption that respondents did not understand what low carbon means as both, nuclear and wind power, are low carbon technologies. The biggest concern with regard to wind power was that prices were not affordable (89%), the technology is not reliable (86.9%)

and that it is not good for the British economy (72.3%). For nuclear power, the biggest risk is a safety concern (87.3%). Moreover, nuclear power is also perceived as not being good for the British economy (78%), not having affordable prices (78.2%) and neither being clean (74.8%) nor reliable (70.6%). Hazardous waste was only a concern for 68%, while answers for nuclear power having a dangerous impact on health were divided (41.8% (yes):58.2% (no)).

v. Familiarity with Science and Technology

Different questions were asked to proxy familiarity with science and technology. Some of them identify a professional familiarity, such as 'being an engineer' (5.8%), 'being a scientist' (3.6%), 'have worked as an engineer or scientist' (6.7%), 'being a science teacher' (3.7%), 'working with scientists and engineers' (8.7%), and 'being a member of a science organisation in the last 5 years' (3.7%). Others targeted academic familiarity such as 'having a science or engineering degree' (9.3%), 'having studied science to a degree level' (10.1%) and 'currently or previously had a subscription to a science magazine' (6.2%) as well as 'bought a science magazine in the past year' (8.6%). Further questions addressed basic familiarity such as 'having studied science to A-levels' (18.2%), 'having studied science to GCSE/O level' (49.5%), and 'looked up scientific information on the internet' (29.8%).[4]

vi. Newspaper Readership

Newspaper readership is very diverse among respondents as YouGov draws respondents from different newspapers, to ensure a balanced sample. Respondents of this survey indicated their readership of the following newspapers: *The Express* (1.7%), *The Daily Mail/The Scottish Daily Mail* (14.5%), *The Mirror/Daily Record* (10%), *The Daily Star/The Daily Star of Scotland* (2.3%), *The Sun* (21.1%), *The Daily Telegraph* (4.1%), *The Financial Times* (0.3%), *The Guardian* (3.3%), *The Independent* (1.1%), *The Times* (5.1%), *The Scotsman* (0.4%), *The Herald* (0.5%), *The Western Mail* (0.1%), other local daily morning newspaper (4.1%) and other newspaper (6.3%).

[4] Besides the 'don't know/none of these' answer category, the category 'I have never met a scientist/engineer' (7.5%) was included by YouGov, which is not reported here because it was excluded from the analyses as it does not proxy familiarity with science and technology, but the opposite.

vii. Trust in Information Sources about Energy related Issues

Respondents had to indicate their trust in information sources on a scale from 1 to 7, with 'totally' (7) and 'not at all' (1). Answers are presented in Table 1. In detail, they were asked:

> To what extent do you trust information about energy related issues from each of the following sources?
>
> Scientists, the BBC, journalist on 'upmarket' newspapers (e.g. Times, Telegraph, Guardian), journalists on 'mid-market' newspapers (e.g. Mail, Express), journalists on red-top tabloid newspapers (e.g. Sun, Mirror), the European Union, regional/local government, environmental protection organisations, national government, political parties and electricity, gas and other energy companies.

Table 1: Median Values of Trust in Information Sources about Energy related Issues

Information Source	**Trust (median, out 7 ('totally') and 1 ('not at all')**
Scientists	6
BBC	5
Journalists of Broadsheet newspapers	4
Environmental Protection Agencies	4
National Government	4
Regional/local Government	4
Environmental Protection Agencies	4
European Union	4
Journalists on Mid-market newspapers	3
Energy Companies	3
Political Parties	3
Journalists of Tabloid newspapers	2

4.3 Empirical Strategy

This section describes the empirical methods and results of the analysis of factors that may predict favourability towards nuclear and wind power. It is proposed that the factors knowledge, familiarity with science and technology, newspaper readership and trust in information sources may predict favourability towards both energy sources. The hypothesis is tested through a series of ordinal probit regressions which were run in Stata12, and will be discussed in this section.

i. Data Construction for Modelling

Each of the two dependent variables *NUC* (favourability towards nuclear power) and *WIND* (favourability towards wind farms) were grouped together on a scale from 1 to 3, with favourable (1), neutral (2) and unfavourable (3). As the dependent variables are ordinal, but the metric used for coding is not meaningful as such, ordered probit regressions were used (Jackmann, 2000).

The key predictor variables of favourability are constructed as binary variables. In order to make the analysis more transparent, categorical variables addressing familiarity with science and technology are grouped together. After testing for Cronbach's alpha two categories were created in which answers provided an internally consistent scale: *professional familiarity* (Cronbach's α: 0.715) including scientists, engineers, science teachers, working with scientists or engineers, retired scientists and engineers as well as members of professional science organisations and *academic familiarity* (Cronbach's α: 0.763). *Academic familiarity* includes a science/engineering degree, studying science to a degree level and a current or previous subscription to a science magazine. Additionally, newspapers were logically grouped together into three different categories labelled *Broadsheet*[5], *Midmarket*[6], *Tabloid*[7] and *OtherNews*. Having no readership was also taken into account during the analysis. The variable *knowledge* takes the value 1 for both categories, 'very knowledge' and 'fairly knowledgeable', and 0 for 'not very knowledgeable' as well as 'not knowledgeable at all'. Responses are almost equally distributed with this grouping (48.4% (knowledgeable):46% (not knowledgeable)). There is no underlying metric for the trust scale. After computing the average (3.81) of the medians of trust in different information sources, 4 was chosen as a cut-off point so that the variable *Trust* for each different category takes the value 1, for the range of values from 7 to 4 and 0 for the rest. Individuals who answered with 'don't know' were omitted from the analysis. Risks and benefits for nuclear and wind power were grouped together into 'Risks outweigh Benefits' (*NUCRisks, WINDRisks*), 'Risks equal Benefits' (*NUCEqual, WINDEqual*) and 'Benefits outweigh Risks' (*NUCBenefits, WINDBenefits*).

Along with these key variables, several control variables were included in the analyses that have been relevant in past studies. These are the binary variables *gender*, party

[5] Including: The Financial Time, The Guardian, The Independent, The Times, The Daily Telegraph, The Scotsmen and The Herald

[6] Including: The Express and The Daily Mail

[7] Including: The Mirror, The Daily Star, The Sun, The Western Mail and the category 'other local daily'

memberhsip (*Labour, LibDem, Conservative* and *NoParty*), regions as well as social grades and the continuous variable *age* (Petrova, 2010; Whitfield et al., 2009 and Devine-Wright, 2007).[8] The following Table 2 presents all variables used during the regression, their sample characteristics as well as corresponding research hypotheses.[9]

[8] Given the sample distribution, *age* was also included as *age*^2.

[9] After testing for significance and not obtaining significant results, the following variables were omitted from the analysis and are therefore not reported in Table 2 'have ever bought a science magazine' and 'looked up scientific information on the internet'.

Table 2: Variable Description and Research Hypotheses

Variable Name (Group)	**Variable Description**	**Research Hypothesis**
NUC	Favourability towards nuclear power (1=favourable, 2=neutral, 3=unfavourable)	Dependent variable
WIND	Favourability towards wind farms (1=favourable, 2=neutral, 3=unfavourable)	Dependent variable
Age (Age^2)	Mean: 47,86 Min: 18 Max: 84	Positively correlated with NUC Not correlated with WIND
Gender	(1=female, 0=male)	Negatively correlated with NUC Positively correlated with WIND
Social Grade (proxy for income)	Grade_ab, Grade_c1, Grade_c2, Grade_de	Grade_ab positively correlated with NUC and WIND
Region	London, Midlands/Wales, North, South, Scotland	Scotland positively correlated with WIND
Party Membership	Conservative, Labour, LibDem, OtherParty, NoParty	Conservative positively correlated with NUC Labour positively correlated with WIND
Knowledge	Subjective estimation of knowledge about electricity generation, delivery and use	Positively correlated with NUC and WIND
Professional Familiarity	Scientist, Engineer (both also retired) Working with Scientists and Engineer, Science teacher, Member of Science Organisation	Positively correlated with NUC and WIND
Academic Familiarity	Science/Engineering degree, studied science to degree level, subscription to science magazine	Positively correlated with NUC and WIND
Scialevels	Having studied science to A-levels	Positively correlated with NUC and WIND
Scigcse	Having studied science to GCSE level	Positively correlated with NUC and WIND
Newspaper Readership	Broadsheet, Midmarket, Tabloid, OtherNews, NoReader	Positively correlated with NUC and WIND
Trust in Information Sources	Scientist, BBC, Broadsheet, Midmarket, Tabloid, BBC, Env. Protection Agencies, Governmental institutions, EU, Energy companies, Political parties	Positively correlated with NUC and WIND (except: energy companies, tabloid and political parties)
Risks and Benefits	NUCBenefits/WINDBenefits (benefits outweigh risks); NUCEqual/WINDEqual (benefits equal risks)	NUCBenefits/WINDBenefits positively correlated with NUC and WIND

4.3.1 Regression Model – Nuclear Power

The sample is adjusted for heteroscedasticity and a weighting factor (provided by YouGov) is applied to draw nationally representative conclusions. Model diagnostics indicate no concern regarding multicollinearity (average variance inflation factor (VIF): 7.06) (Kutner, Nachtsheim and Neter, 2004).[10] After omitting individuals who answered the favourability question with 'don't know', 1777 observations remained for the dependent variable.

i. Baseline Regression

In regression (1) (Appendix), which includes all variables identified from the literature review as well as all control variables discussed before, *gender* and *knowledge* are significant on the 1% level, while *age2*, *conservative,* and *scialevel* are significant on the 5% level. Additionally, *Scotland* and *South* are significant on a 10% level. Neither social grade, nor any variable linked to familiarity with science and technology is significant. The variable for the risks and benefits perception, stating that respondents perceive risks to outweigh benefits or risks to equal benefits had to be dropped after the first regression as it completely determined favourability, leading to errors in the estimation of coefficients for other variables in the regression. However, acknowledging the low pseudo R-squared value (9.97%) of this model, the favourability predictions can only be taken as rough assumptions of the real predictions and should be regarded with caution.[11]

ii. Augmentation with Newspaper Readership and Trust in Information Sources

To test the hypothesis that the inclusion of information and trust in information sources increases the amount of variation explained by the basic favourability model, I augment the first model with newspaper readership and trust in various information sources, among them the newspaper readership categories. After the inclusion, pseudo R-squared increases to 11.2%, supporting the hypothesis (regression 2 Appendix). As expected, *age2, gender* and *knowledge* are significant on a 1% level. *Gender* and *knowledge* do not change over more than one standard error, while *age2* changes slightly above one standard error. The variable for party membership in the Conservative party and *scialevel*, which means having studied science until A-levels, remain significant on a 5% level and do neither change their coefficient in sign or magnitude over more than one standard error. With

[10] Kuter, Nachtsheim and Neter (2004) propose a VIF of 10 as an indication for high multicollinearity. Even after using interaction terms, the mean VIF is 8.04.
[11] Note: McFadden's pseudo R-squared.

regard to information sources and trust in information only the category *broadsheet* and trust in the national government are significant on a 10% level, respectively 5% level.

iii. Accounting for Interaction Effects

Devine-Wright (2007) and Petrova (2010) suggest that some variation might be explained due to interaction effects, mainly concerning age and gender. When controlling for interaction terms with *age2* and *gender, age2, gender, conservative, knowledge,* and *scialevel* remain significant like in the previous regressions. Additionally, *agelabour, genderlabour* and *gendernoparty* become significant on a 10% level, suggesting that even though party membership in the Labour or no party in itself is not a predictor of favourability, there is some further explanatory power in party membership. Furthermore, *genderknowledge* becomes significant suggesting that males who perceive themselves to be knowledgeable of energy issues are more supportive. Also, *agemidmarket, agenoreader* and *agetrusteu* are significant on a 10% level, proposing some explanatory power of newspaper readership and trust in information sources in predicting support for nuclear power.[12]

iv. Marginal Effects

After augmenting the baseline model and controlling for interaction effects, regression 3 (Appendix) incorporates all variables which remained significant in all regressions. As the probit coefficients are not directly useful for interpretation (Jackmann, 2000), marginal effects are computed. These assist in interpreting probabilities to predict support of nuclear power and are presented in Table 3.

Table 3: Marginal Effects of Significant Predictors for Support of Nuclear Power

	dy/dx	**Delta-method Std. Error**	**z**	**P>|z|**	**[95%**	**Conf. Intervall]**
Age2	.000059	9.62e-06	6.14	0.000	.0000402	.0000779
Gender	-.2102679	.0290346	-7.24	0.000	-.2671747	-.1533611
Conservative	.1716791	.0305983	5.61	0.000	.1117076	.2316506
Agenoreader	-.0000289	9.35e-0.6	-3.09	0.002	-.0000472	-.0000105
Knowledge	.109724	.031076	3.53	0.000	.0488162	.1706317
Scialevel	.1013476	.360977	2.81	0.005	.0305974	.1720978

Surprisingly, neither professional familiarity nor academic familiarity was significant. This indicates a deviation from the literature (Petrova, 2010) and shows that

[12] Regression results available upon request.

the hypothesis that individuals who are more familiar with science and technology are more likely to support nuclear power was not supported. Only *scialevel* is a significant predictor (p-value: 0.005). Having studied science to A-levels therefore increases the probability of supporting nuclear power by 10.13%. Even though a higher education in science or engineering, or being concerned with science and technology issues at work is not a significant predictor of support for nuclear power, the variable *knowledge* is. Knowledge remains significant during all regressions and does not change over more than one standard error of its original value. The coefficient for knowledge is positive, suggesting that individuals who perceive themselves to be very or fairly knowledgeable are more supportive of nuclear power, compared with people who perceive themselves to be not knowledgeable. A change from not being knowledgeable to being knowledgeable, keeping all other variables constant, increases support for nuclear power by 10.97%. Possible reasons for this might be that people who rate themselves as more knowledgeable have a greater interest in energy issues per se, hence they are more aware about advantages and disadvantages of various energy issues and collect more information, resulting in a positive voicing of support. In contrast, individuals who have a lesser interest in energy issues might voice their support more moderately. However, if knowledge is linked to a greater collection of information on energy issues, this might be done in a very subjective way, so that individuals look for information supporting their already existing assumptions. To understand whether knowledge is connected to the information source, interaction variables between the different newspaper categories and knowledge were created and included in the regression. However, none of them was significant rejecting the hypothesis that the newspapers collected by the survey and perceived knowledge on energy issues jointly predict support for nuclear power.

Another variable which remains significant throughout all regressions and does not change over more than one standard error is *gender*. The coefficient of gender is negative, the variable being coded as 1=female and 0=male suggests that females are less likely to support nuclear power, as it was predicted by the literature review (Greenberg, 2009). Ceteris paribus, being female decreases the probability of supporting nuclear power by 21.02% compared to being male. As it could not be controlled for the risks and benefits perception, a possible hypothesis for explanation could lie in the perceived risks associated with nuclear power, as Croson and Gneezy (2009) suggest that women are more risk averse than men.

With regard to political beliefs, the variable *conservative*, indicating membership in the Conservative party is significant (p-value: 0.000). Britons are 17.17% more likely to support nuclear power as a Conservative, compared to non-Conservatives. This is consistent with the literature (Devine-Wright, 2007; Populus, 2005). Nevertheless, reversed causality could be a possible explanation for this, which means that individuals could be a member of the Conservative party because they support nuclear power (Conservatives UK, 2013a).

Ceteris paribus, *age2* has an overall positive effect on favourability towards nuclear power (p-value: 0.000); however the change of being one year older, is very small, which suggests that there is clearly no negative relationship between age and support for nuclear power. This is consistent with the literature review (OECD, 2010). Additionally, a preliminary analysis of the correlation between age and support for nuclear power revealed an increasing trend in support for nuclear, with least support from individuals who were in their teens during the nuclear accident in Tschernobyl (1986).

Social grade, as a proxy for income was not a significant predictor at all. This is a deviation from the literature, which suggests that income and support for nuclear power are correlated (Pampel, 2011; Greenberg, 2009). Consequently, social grade might be a wrong proxy for income in this study and should for future research be replaced with different income categories.

For newspaper readership in itself, only *agenoreader* remained significant (p-value: 0.002). Yet the marginal effect is really small, suggesting that even though age has an overall positive effect on being favourable towards nuclear power, this effect is smaller for Britons who do not read any newspapers. With regard to trust in information sources, no variable of this group is significant; rejecting the hypothesis that trust in information sources is a predictor of support for nuclear power.

iv. Robustness Test

To ensure that the models are not vulnerable to changes in assumptions, a robustness test addressing the issue of omitted variables bias is conducted.[13] For this purpose, variables from the sample which might be correlated with the variables *age2*, *gender*, *conservative, agenoreader, knowledge* and *scialevel* were added respectively dropped. Among these are several variables that proxy familiarity with science and technology as well as all

[13] Regression results available upon request.

newspaper categories, the different political parties and various interaction terms. All variables remain significant in the above-described robustness tests and the coefficients neither change in sign nor over more than one standard error in magnitude. Yet *age2* changes slightly above one standard error in magnitude. Nevertheless, as the number of variables was limited through the survey, omitted variable bias cannot completely be excluded.

4.3.2 Regression Model – Wind Farms

The wind regression follows the same procedures as outlined for the nuclear regression. After omitting 'don't know' answers of the favourability towards wind farms, 1810 observations remain for the dependent variable.

i. Baseline regression

Regression 4 (Appendix) again includes all variables identified by the literature review. As expected the variable *gender* is significant on a 1% level. Additionally, the variables *labour* and *lidbem* are significant on a 5% level, while *age* is significant on a 10% level. All other variables are not significant, indicating that neither knowledge about energy issues nor a familiarity with science and technology is a predictor of support for wind farms, which contradicts the literature review (Petrova, 2010; Devine-Wright, 2007). This suggests that wrong proxies might have been used for familiarity with science and technology; hence either more specific questions addressing familiarity with wind power should have been raised, or familiarity does not influence support for wind farms. Again, pseudo R-squared is very low (7.6%), indicating that these predictions should only be considered with care.

ii. Augmentation with Information Sources and Trust in Information Sources

To test whether information sources and trust in information sources also help to explain variation in the basic favourability model, I include all newspaper categories and variables for trust in different information sources in the regression (5) (Appendix). After inclusion, pseudo R-squared increases to 13.32%, suggesting a better explanation of variability. *Age* does not remain significant as expected from the literature (Devine-Wright, 2007). *Gender* is now only significant on a 5%, while *labour* and *libdem* are significant on a 10% level. Additionally, *midmarket* and *broadsheet* are significant on a 1% level while *tabloid* is on a 5% level, suggesting some explanatory power of information

source in prediction support for wind energy. Furthermore, *trustbbc* and *trusteu* are significant on a 1% level as well as *trustbroadsheet* on a 5% level respectively. These results propose some support of trust in information sources in predicting favourability towards wind farms.

iii. Accounting for Interaction Effects

To ensure comparability of the results with the nuclear model, interaction terms were created for variables with *age2* and *gender*. *Gender* does not remain significant; however interaction terms with gender become significant, suggesting that its significance might be captured within one of these terms. *Labour* and *Genderlabour, trustscientist, gendertrustcompanies, agetrustnatgov* are significant on a 10% level, while *trsutbbc* and *trusteu agetrustscientist agetrustparty, gendertrustparty* and *gendertrustnatgov* are significant on a 5% level. Additionally, *trustnatgov* is significant on a 1% level.[14] As mainly variables related to trust in information sources are significant, the hypothesis that trust in information sources is positively correlated with support for wind farms is supported.

iv. Marginal Effects

After augmenting the baseline model and controlling for interaction effects, regression 6 (Appendix) incorporates all variables which remained significant in all regressions. These are presented in the following Table 4.

Table 4: Marginal Effects of Significant Predictors for Support of Wind Farms

	dy/dx	**Delta-method Std. Error**	**z**	**P>|z|**	**[95%**	**Conf. Intervall]**
Labour	.2787465	.0684226	4.07	0.000	.1446408	.4128523
Genderlabour	-.1064637	.0560617	-1.90	0.058	-.2163425	.0034151
Trustbbc	.1526927	.0517915	2.95	0.003	.0511832	.2542022
Trusteu	.188188	.0667924	2.82	0.005	.0572772	.3190988

As predicted by the literature review (Devine-Wright, 2007; Populus, 2005), *labour* (p-value: 0.000) has a significant effect on the favourability towards wind power and only changes slightly above one standard error over its original value. The sign of the coefficient is positive, suggesting that Britons who are members of the Labour party are 27.87% more likely to support wind farms than Britons who are not Labour. Nevertheless,

[14] Regression results available upon request.

as is already the case with nuclear power, there might be reversed causality with regard to party membership as the Labour party is more supportive of renewables in general than for example the Conservative party (Labour UK, 2013). However, for females which are Labour members, the probability of being favourable is only 17.23%, suggesting that males of the Labour party are more favourable towards wind farms, which is in line with the current literature (Ipsos MORI, 2003).

Surprisingly, neither region nor social grade play a role in predicting support for wind farms, which is a deviation from the current literature (Devine-Wright, 2007). A possible explanation might lie in the national focus of the survey. Perhaps a regional survey targeting Scotland would reveal a different picture. Newspaper readership does not play any significant role in predicting favourability towards wind farms, which rejects the hypothesis. However, trust in information sources plays a role. Two trust variables remain significant throughout all regressions. These are *trustbbc* (p-value: 0.003) and *trusteu* (p-value: 0.005), partially supporting the hypothesis that trust in information sources assists in predicting support for energy sources, at least for wind power. Ceteris paribus, trust in the BBC with regard to their information on energy issues increases support for wind farms by 15.27%. Moreover, trust in the European Union about information on energy issues, increases support by 18.82% respectively. This is surprising as trust in information by the European Union is not ranked very high (median of four out of seven), compared with other information sources such as scientists and the BBC. Moreover, trust in the EU itself has been decreasing due to the economic recession (Standard Eurobarometer, 2012).

v. *Robustness Check*

In line with the nuclear model, omitted variable bias was also addressed for the wind model to ensure that predictions are not influenced by a change in assumptions.[15] Various survey variables, especially related to trust in information sources and their interaction effects were added and dropped during regressions. Yet the above presented variables remain significant and only change slightly above one standard error over the original value. However, as the number of variables was limited through the survey, omitted variable bias can also not be completely excluded for the wind model.

[15] Regression results available upon request.

4.4 Limitations

The main limitations of the analysis of predictors for supporting nuclear power and wind farms lie in the lack of data for other predictors such as environmental values as well as general values and beliefs. Furthermore, it could not be controlled for a perception of risks and benefits, which however is suggested as a significant predictor by Whitfield et al. (2009). Additionally, reversed causality might exist for party membership. Individuals might be likely to choose a party based on its support for nuclear power or renewables. To account for this, an instrumental regression is proposed for future studies, which can show the direction of causality (Greene, 2008). Moreover, as the variables for familiarity with science and technology neither accurately predict support for nuclear power, nor support for wind power, other proxies such as visits to power plants or wind farms, or working on nuclear/renewable issues might enhance prediction (Devine-Wright, 2007). In addition, explanation about information source might be lost with the grouping of newspapers into Broadsheet, Middle market and Tabloid. However, some newspapers had a very small readership (<5%) such as *The Independent*, *The Daily Star*, *The Scotsmen* and others, which supported the grouping of newspapers. Moreover, surveys have limitations in themselves mainly regarding biases. A very common form of bias is social desirability. It acknowledges the fact that individuals tend to 'present themselves in the most favourable manner relative to prevailing social norms' (King and Bruner 2000, p. 80) which might threaten internal validity of results.

5. Recommendations and Concluding Remarks

In the UK, the direction and intensity of public opinion on the favourability towards different energy sources has been well studied. However, studies have focused less on actual predictors of support. This paper thus tests several variables such as socio-economic data, party membership, knowledge about energy generation, distribution and supply as well as familiarity with science and technology, which have been identified by the literature review, mainly from studies carried out in the US (Petrova 2010; Whitfield et al., 2009; Ansolabehere, 2007) in predicting support for both, nuclear and wind power. Additionally, this paper tests the hypothesis that information sources and trust in information sources predict support for energy sources, which so far has only received limited attention.

The regression results establish that there is no common set of determinants predicting favourability towards nuclear and wind power. Current support for nuclear power is high with 45% and has been increasing over the last seven years. Additionally, opposition to nuclear power has been decreasing over the same time period. Contrary, support for wind farms has been decreasing from 76% in 2007 to only 57% in 2013. Simultaneously, opposition has been rising. Given the plans by the current British Government to increase the number of onshore wind farms and to comply with the Carbon Budgets outlined in the Climate Change Act (Great Britain, *Climate Change Act* 2008) there is a need to foster and raise support for wind power among the British. This study finds, as expected, that being a member of the Labour party increases support for wind farms by about 28% compared with non-members of the Labour party. Furthermore, it supports the hypothesis that trust in information sources predicts support. Especially information communicated by the BBC in particular, as well as information on energy issues by the European Union enhances support for wind farms. These are important findings when considering the communication of energy policies and plans. Ceteris paribus, trusting the BBC on information about energy issues enhances favourability towards wind farms by about 15%. The BBC is already a widely used medium for information collection in the UK and this study showed that it is a trusted medium (median of five out of seven). In total, 67% of respondents trust the BBC with regard to information on energy issues and only scientists are more trusted on these matters than the BBC. Nevertheless, communication strategies of energy policies to foster support could still be improved, perhaps through a series of podcasts on wind farms and the importance of wind energy to direct the UK on a low carbon trajectory. This however has to be undertaken in a

'transparent' manner by the BBC to ensure support from the Conservatives (Conservatives UK, 2013b). Additionally, the survey revealed that the term *low carbon* is not properly understood by respondents as it was rejected as an advantage for nuclear power and only accepted as an advantage by half of the respondents for wind farms. Therefore it is recommended to put a greater emphasis on communicating the meaning and possibilities of low-carbon technologies to the British public, which might enhance support for both energy sources even further. Furthermore, trust in energy relevant information from the EU increases support for wind power by 19%. Consequently, it is important to aim at more trust in the EU to enhance support for wind power. In the survey, 837 out of 1915 respondents indicated that they trust the EU with regard to information on energy issues. Nevertheless, given the recent economic crisis, increasing trust seems to be a difficult task as trust in the EU itself has been decreasing (Standard Eurobarometer, 2012). It should be tested in future studies whether the streamlining of communicating national energy policies by the national government and the BBC along with statements by the EU would increase support for wind farms.

The analysis suggests that being knowledgeable about energy issues and having studied science to A-levels increases support for nuclear power. In order to increase support for nuclear power, schools should place a greater emphasis on the science curriculum, possibly also including the study of energy sources as well as the basics of electricity production by nuclear power plants and by wind farms. Additionally, energy production, delivery and use should be discussed as it was shown that being knowledgeable with regard to these issues, increases support of nuclear power by 11% compared to not being knowledgeable. As no particular information source specifically predicted support, nor was trust in information sources important, this could be done through different media. Furthermore, results confirm that women are less likely to support nuclear power compared to men. However, it can only be speculated about the direct reasons, such as a possibly stronger risk aversion than men (Croson and Gneezy, 2009).

Given the apparent importance of trust in information sources to predict support for wind farms, future research should further investigate the relationship between information sources, trust in them and support for wind farms, not only taking into consideration newspaper readership, but also TV and radio. Furthermore, studies on knowledge about energy issues and their relationship with information sources should be conducted to better understand from where the British public obtains information on energy issues and what a perceived threshold for 'knowledgeable' is. This will assist in a clearer formation

of objectives improving knowledge on energy issues of the public along with a targeted, successful communication of energy policies, shifting the UK on a low carbon trajectory, not only from a technological side, but with great support from the public.

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7. Appendix

Regression Results

	(1) nuc	(2) nuc	(3) nuc	(4) wind	(5) wind	(6) wind[16]
age	0.0148			0.0276*	0.0238	0.0194
	(0.0147)			(0.0164)	(0.0177)	(0.0181)
Age2	-0.000305**	-0.000154***	-0.000167***	-0.0000422	-0.0000630	0.000318
	(0.000152)	(0.0000318)	(0.0000280)	(0.000164)	(0.000177)	(0.000211)
gender	0.604***	0.613***	0.594***	-0.279***	-0.256**	-0.280
	(0.0868)	(0.0938)	(0.0858)	(0.0881)	(0.101)	(0.225)
grade_ab	-0.0140	-0.0752		-0.0524	0.0570	
	(0.134)	(0.138)		(0.131)	(0.140)	
grade_c1	0.177	0.0867		-0.128	-0.0384	
	(0.134)	(0.135)		(0.131)	(0.136)	
grade_de	0.217	0.0485		-0.00127	0.00415	
	(0.148)	(0.156)		(0.143)	(0.158)	
london	0.0110	-0.0521		0.248	0.196	0.194
	(0.128)	(0.137)		(0.154)	(0.170)	(0.138)
scotland	0.259*	0.310*		0.0460	0.175	
	(0.154)	(0.169)		(0.176)	(0.193)	
south	-0.192*	-0.241**		-0.00870	-0.00154	
	(0.111)	(0.120)		(0.119)	(0.126)	
north	-0.123	-0.144		0.0713	0.0535	0.101
	(0.121)	(0.126)		(0.130)	(0.136)	(0.104)
labour	0.0137	0.0310		-0.462**	-0.419*	-0.949***
	(0.208)	(0.210)		(0.204)	(0.224)	(0.238)
libdem	0.0217	0.0124		-0.597**	-0.487*	-0.352
	(0.237)	(0.241)		(0.250)	(0.264)	(0.322)
conservati	-0.519**	-0.429**	-0.543***	0.0613	-0.0670	
ve	(0.210)	(0.212)	(0.0900)	(0.205)	(0.223)	
noparty	0.0233	0.00470		-0.154	-0.210	-0.308*
	(0.217)	(0.220)		(0.213)	(0.229)	(0.178)
knowledg	-0.293***	-0.295***	-0.325***	0.0374	0.00488	0.151
e	(0.0919)	(0.0969)	(0.0881)	(0.0917)	(0.102)	(0.148)
prof.fam	-0.103	-0.0700		-0.0161	0.0603	
	(0.109)	(0.116)		(0.108)	(0.114)	
academicf	0.0269	0.0207		0.139	0.171	-0.302
am	(0.127)	(0.136)		(0.139)	(0.132)	(0.244)
scialevel	-0.234**	-0.249**	-0.254**	-0.119	-0.172	-0.141
	(0.116)	(0.126)	(0.107)	(0.125)	(0.132)	(0.122)
scigcse	-0.0313	-0.0948		-0.0606	-0.00812	
	(0.0859)	(0.0899)		(0.0882)	(0.0971)	
midmark		-0.0854			0.644***	0.617***
et		(0.148)			(0.150)	(0.157)
tabloid		-0.0839			0.379**	0.540***
		(0.153)			(0.159)	(0.191)

[16] Note: The variables *midmarket*, *tabloid, broadsheet, noreader, trustscientis and trustbroadsheet* are reported as significant in the column, however they became non-significant during the robustness test and are therefore not included in the discussion of the analysis. Additionally, some interaction variables such as *Agetrustscientist*, *Gendertrustcompanies*, *Agetrustparty*, *Gendertrustparty*, *Agetrutnatgov* and *Gendertrustnatgov* are significant, yet after computing the correct marginal effects for interaction terms in non-linear models as outlined in Ai and Norton (2003), they became non-significant and are hence not reported in the discussion of the analysis.

	(1) nuc	(2) nuc	(3) nuc	(4) wind	(5) wind	(6) wind
broadshee		-0.271*			0.439***	0.420**
t		(0.154)			(0.161)	(0.168)
noreader		0.0383			0.0613	0.422*
		(0.130)			(0.139)	(0.226)
t[17].scientis		0.140			-0.103	1.091***
t		(0.174)			(0.188)	(0.415)
t.bbc		0.0352			-0.599***	-0.520***
		(0.124)			(0.141)	(0.178)
t.broadsh		-0.102			0.314**	0.327**
eet		(0.119)			(0.132)	(0.130)
t.midmar		-0.174			-0.0470	-0.148
ket		(0.112)			(0.132)	(0.150)
t.tabloids		-0.0335			0.128	0.325
		(0.133)			(0.139)	(0.229)
trusteu		0.124			-0.327***	-0.640***
		(0.123)			(0.123)	(0.227)
t.reglocal		0.124			-0.0367	
gov		(0.127)			(0.131)	
t.compani		-0.0761			0.0234	0.492*
es		(0.104)			(0.117)	(0.262)
t.party		-0.0287			0.0287	0.401
		(0.117)			(0.127)	(0.262)
t.natgov		-0.259**			-0.204	-0.987***
		(0.111)			(0.130)	(0.254)
Agenorea			0.0000852***			
der			(0.0000261)			
Aget.scie						-0.000372***
ntist						(0.000123)
Gendert.c						-0.612***
ompanies						(0.231)
Aget.part						-0.000275***
y						(0.0000838)
Gendert.p						0.681***
arty						(0.235)
Aget.natg						0.000213**
ov						(0.0000848)
Gendert.n						0.766***
atgov						(0.236)
N	1686	1514	1686	1715	1534	1534
adj. R^2	0.0997	0.1120	0.1029	0.0796	0.1332	0.1794

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[17] Note: t.=trust