UK Public Perceptions of Shale Gas, Carbon Capture & Storage and Other Energy Sources & Technologies: Summary Findings of a Deliberative Interview Study and Experimental Survey

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1 Background

Energy and environmental targets imply significant change to UK energy systems. Ensuring sustainable, secure, affordable energy supply has major ramifications for the public, who will be asked to accept new energy infrastructure and technologies, and to change patterns of demand. Understanding public attitudes to these changes, and the ways in which energy and technologies are themselves understood and used, is vital (Whitmarsh et al., 2011a). Social acceptability can also represent a major potential barrier to developments of new energy sources and technologies, as indicated by protests and moratoria in respect of Carbon Capture and Storage (CCS) in several countries (Van Noorden, 2010). Similar novel technologies (e.g., underground coal gasification, shale gas fracking) have also received negative media coverage and been the subject of public protests in the UK and elsewhere (e.g., Harvey, 2012). It is therefore critical to understand public attitudes and the bases of concern about CCS and similar energy technologies, and where possible feed this understanding and engagement in at an early stage in decision-making (before attitudes become polarised and decision-makers distrusted; NETL, 2009; Rogers-Hayden & Pidgeon, 2007).

Studies of public attitudes to energy sources and technologies consistently show the public favours renewable sources (e.g., solar, wind) over fossil fuel or other sources (see Whitmarsh et al., 2011a for a review; DECC, 2014); and are ambivalent about CCS, nuclear, biofuels, electrification and demand management (Parkhill et al., 2013). Public values underlying engagement with energy system change include efficiency, nature protection, safety, reliability, affordability, freedom, fairness, and quality of life (Parkhill et al., 2013). Consistent with this, most feel fossil fuels are polluting, outdated and finite; for example, 79% of the UK public agrees 'the UK should reduce its use of fossil fuels' (Parkhill et al., 2013).

Comparatively little work has explored perceptions of unconventional fossil fuels, but many of the public's concerns about conventionals appear to apply here. Attitudes to shale gas, specifically, show considerable ambivalence – as of June 2014, of the 74% of the British public who have heard of it, half neither oppose nor support it, with support and opposition each accounting for around one-quarter (DECC, 2014). Concerns about shale gas relate primarily to water contamination (with associations with earthquakes now in decline), while many also believe it represents a 'cheap' energy source (O'Hara et al., 2014). Women, older people, those with left-of-centre political views, and newspaper readers appear to be particularly concerned about the technology (O'Hara et al., 2014; Boudet et al., 2014).

In contrast to the relatively high levels of awareness of shale gas (due to recent media coverage; e.g., Jaspal & Nehrich, 2013), there is low public awareness about CCS (Curry et al., 2005; De Best-Waldhober et al., 2009). Views about the technology – based on little information – appear mixed, with support at around 30% (and 50% unsure; Reiner et al., 2006). Concerns include the long-term viability ('temporizing') of CCS, its safety (e.g., risk of CO_2 leaks, explosion), association with coal mining, cost, and the ability of institutions to

regulate/monitor storage sites (Palmgren, 2004; De Best-Waldhober et al., 2009), similar concerns having been raised in relation to underground coal gasification (Shackley et al., 2004). However, people are positive about CCS' impacts for GHG reduction. It is also clear that support for CCS is contingent on CCS being just one part of a wider strategy for achieving significant cuts in CO_2 emissions; CCS may be an acceptable 'bridging policy' while other renewable sources of energy or energy efficiency are being developed (Shackley & Gough, 2005; Gough et al., 2002). Importantly, the way in which information is framed and questions posed influences public views on CCS (van Knippenberg & Daamen, 1996). For example, when asked about technologies to address the electricity shortfall, there appear to be somewhat higher levels of support for CCS; however, in addressing climate change, the public clearly prefer renewables over CCS (Reiner et al., 2006). Understanding of CCS appears to relate to broader issues of institutional trust, local experience, perceived costs and benefits, and so on, as well as whether (and how) alternatives are presented (e.g., Einsiedel et al., 2013). This project thus explores CCS and shale gas proposals in the context of alternatives and broader energy system change.

Audience characteristics also influence perceptions of energy technologies, such as CCS. For the general public, factors such as values, beliefs, trust, and education are likely to predict CCS support; while for proposed/actual communities affected, familiarity with the industry, operator trust, place identity, perceived costs and benefits are likely to be more important (Desbarats et al., 2010). Furthermore, since CCS is an unfamiliar technology for the public, prior beliefs and experiences will shape how the technology (and associated risks and benefits) are conceptualised. In order to make sense of novel, technical information, individuals draw on familiar concepts and experiences (Whitmarsh et al., 2011b). This process of sense-making in relation to a novel, complex and technical issue is explored in this project, using CCS and shale gas as case studies.

2 Aims & Research Questions

This project aimed to explore how CCS, shale gas and other energy sources/technologies are understood by non-expert publics and identify factors that determine public understanding and acceptability of CCS and shale gas proposals. The following questions guided the research:

1. How does the public conceptualise CCS, shale gas and other energy sources/technologies, and how does this conceptualisation vary by factors such as location, knowledge, experience, trust, and values?
2. How are the risks and benefits of CCS, shale gas and other energy sources/technologies perceived by different sections of the public?
3. How do different messages or types of information about these technologies/sources shape beliefs and acceptability; and does this vary according to the audience's prior attitudes or values?

3 Methods

Research question 1 focuses on understanding and conceptual models held by different publics, while question 2 addresses more affective and evaluative assessments. Both can be assessed through qualitative and/or quantitative descriptive and correlational methods (e.g., interviews, surveys); although a necessary precursor is information provision, since very few people have heard of CCS. Consequently, the study requires a partly deliberative design – i.e., providing participants with information before eliciting informed opinions (as well as exploring naïve understandings pre-information). Question 3 requires an experimental design to test the impact of different forms of message.

Study 1. Deliberative interviews

Following five pilot interviews, a total of 30 interviews were conducted between November 2013 and April 2014. Participants were recruited via Cardiff School of Psychology's community participant panel from South Wales, mostly in the area between the Vale of Glamorgan and Newport.

Two types of area were targeted for recruitment: one with a history of energy and mining industry (e.g., Merthyr Tydfil) and the other with little/no industrial experience and recent reactions against shale gas or methane coal-bed extraction (e.g., Vale of Glamorgan). In practice, it was difficult to recruit equal numbers living in industrial and non-industrial areas, both because industry was mostly located away from residential zones, and, whilst efforts were made to locate potential participants by location, there were very few panel members living in such locations, with the exception of small areas of Cardiff and Newport and a few small villages in the Vale of Glamorgan. Consequently, of the 30 participants, 9 (30%) responded that they lived near to industry, whilst the remaining 21 (70%) did not.

Participants tended to be older people, which was unremarkable given that we conducted interviews on weekdays during the day (16-24=10%, 25-44=10%, 45-64=40%, 65+=40%). There was a slightly higher proportion of females to males (female=56.7%). A fifth of the sample were members of an environmental organisation. With reference to political views, almost a third of the sample voted Labour, followed by just over a quarter who supported Conservatives (Labour=30%, Lib Dem=10%, Conservative=26.7%, Plaid=3.3%, Green=3.3%, other=6.7%, did not vote=6.7%, prefer not to say=13.3%). Over two-thirds had lived at their current address for more than ten years (<1 year=10%, 1-3 years=3.3%, 4-9 years=16.7%, 10+years=70%). Most had not worked for an energy company (currently working=6.7%, had worked in past=6.7%, not worked=86.7%).

The interviews included several exercises designed to explore conceptual understandings, associations and risk perceptions:

- *Questionnaire*: First, participants completed a short survey eliciting familiarity with nine exemplar energy technologies/sources (Bioenergy, Solar, Offshore wind, Nuclear, CCS, UCG, Shale gas, Coal, and Natural gas), as well as demographic and residential details.
- *Naïve attitudes*: Next, participants were asked several open-ended questions about where they live and place identity/attachment, and about their existing understanding and attitudes towards the various energy sources/technologies listed in the survey.
- *Card sort:* Information sheets were then provided to participants (see Box 1), outlining the nine energy technologies/sources (see above) and associated risks and benefits; these were developed from published literature and in consultation with earth science colleagues. Participants were asked to sort the cards according to 'what they feel they have in common with each other' in order to establish conceptual associations between sources/technologies. Participants were asked for the rationale for their groupings.
- *Informed attitudes:* Participants were then asked about how they felt about each of the technologies and the associated risks and benefits, whether they felt each should be supported and why, and whether they would be happy to live near it.
- *Colour coding:* Drawing on work indicating colour-meaning associations, participants were asked which colour (from a sheet provided) they would assign to each technology and why.

- *Risk sort:* Participants were then provided with a set of cards on which the risks identified in the information sheets were individually printed, and asked to rank the cards according to perceived severity of the risks.
- *Mapping:* Finally, participants were shown a map of their region (South Wales and North Somerset) and asked to locate, using stickers, where they thought each technology should be situated[1].

Interviews were analysed thematically using a hierarchical procedure (Miles & Huberman, 1984), while the card sort and risk ranking were analysed using statistical software.

Box 1. Information sheet provided to interviewees (shale gas example)

Shale gas

Shale gas is a natural gas that forms within a particular type of rock, formed from clay and other minerals. This rock is known as 'shale'. To extract gas from the shale, a process called 'hydraulic fracturing' is used (known more commonly as 'fracking'). Water, sand and chemicals are injected at high pressure into the shale, cracking it open and allowing the gas to escape. The water is then allowed to flow back to the surface where it is collected and treated or reused. The gas can then be collected and burnt in a power plant to generate electricity. When finished, the sand that has been injected fills and stabilises the cracks in the rock. Shale gas could increase global gas reserves by over 40%. Natural gas already accounts for 21% of the world's electricity.

Benefits

- Hydraulic fracturing enables engineers to **reach underground gas deposits** that may be too deep or difficult to get using conventional methods. Using this process might **generate substantial quantities of gas globally** and contribute to **energy self-sufficiency**.
- As natural gas **burns more cleanly** (releasing less CO_2 and other pollutants) than other fossil fuels, it is considered a viable alternative to coal and oil in **reducing climate change**.

Risks

- **Waste water** used to fracture the rock underground needs to be safely extracted and disposed of because it contains chemical additives and other residues that could **pollute local water sources**.
- **Air quality** near the extraction point may be affected by the release of gases into the atmosphere. The gas extraction process can also be **very noisy**.
- Hydraulic fracturing of shale rock to extract gas may cause minor **earth tremors and land subsidence**.

Study 2. Online experimental survey

Following the interviews, an online survey was conducted during August 2014 (N=1,457) to investigate the representativeness of the findings from the interview stage and further examine factors predicting acceptability. Participants were drawn from an online market/social research panel (ResearchNow). A breakdown of the sample is as follows:

- *Location:* We sampled three regions: one where shale gas fracking has already commenced (Lancashire, focussed on Weeton, Elswick, Roseacre Wood, Preston New Road, Westby, Banks; 32%); one with potential for (but so far no exploitation of) shale gas fracking (South Wales, focussed on Pontrhydyfen, Cwmafan and Llandow; 34%); and one where shale gas is not available (Mid/North Wales, including neighbouring English towns; 34%).

[1] We selected this area in order to confine participant mapping decisions to a relatively manageable area with which they were (hopefully) fairly familiar. Using a larger scale map was avoided as it may have made it easy for participants to site all technologies far away from their locations in places that they were unfamiliar with. We also decided against using hypothetical maps because this would have removed a degree of realism from their decisions. A number of participants struggled with this task, and many objected to siting specific technologies anywhere on the map, effectively registering protest responses. The interviewer allowed participants to place stickers outside the map. This suggests participants were significantly engaged by the exercise and did not site technologies in a superficial way. Also note that, to some degree, participants had different ideas about the type of technology they were being asked to locate, as evidenced in the interviews, when the interviewer was asked for clarity on the 'technology' they were being asked to locate (e.g. was it a coal mine or coal-fired power station, nuclear reactor or nuclear waste 'dump'?).

- *Age*: Ages ranged from 16 to 75 or over (55-64, 27.7%; 65-74, 20.0%; 35-44, 13.8%; 25-34, 11.9%; 16-24, 4.3%; 75 or over, 3.0%).
- *Qualifications*: Participants ranged from having no formal qualifications to having a postgraduate degree. The highest percentage of participants had an undergraduate degree (22.9%) and/or GCSE/O-Level (21.8%). (A-Level/Higher/BTEC, 19.5%; Vocational/NVQ, 17.7%; Postgraduate degree, 12.3%; No formal qualifications, 6.0%).
- *Science-related qualifications*: For 44.6% of participants, GCSE/O-Level was their highest level of qualification in a science-related subject. 23.2% had no formal qualifications, 13% had an A-Level/Higher/BTEC, 9.7% Undergraduate level, 5.2% Vocational, and 4.1% Postgraduate.
- *Political party*: The highest percentage of participants supported Labour (28.2%), followed by conservative (22.0%); 15.3% were undecided and 11.8% voted UKIP. (5.9% would not vote, 5.0% Other, 5.0% BNP, 4.7% Lib Dem, 4.1% Welsh National Party/Plaid Cymru, 3.5% Green party and 3.2% preferred not to say). The lowest percentages were for SNP (1.0%) and Democratic party (1.0%).
- *Years living in area*: The majority of participants (70.2%) had lived at their current address for more than 10 years. (4-6 years, 10%; 7-10 years, 9.3%; 1-3 years, 7.7%; less than 1 year, 2.8%).
- *Rurality*: 34.4% Rural, 25.7% Urban, 9.9% Sub-urban.
- *Energy industry*: 94.4% had never worked in the energy industry, 3.6% had in the past and only 1.9% did currently.

The questionnaire was administered using Qualtrics online survey software. Following an initial set of questions on demographics, location, place identity, environmental identity and values, and climate change attitudes, initial (naïve) understandings and attitudes about energy technologies/sources were elicited. Questions were drawn from existing, published scales where possible.

After this, information was provided about shale gas fracking, in order to establish how information provision might influence attitudes. Importantly, we varied the information that was provided, such that there were four experimental conditions. Specifically, we provided two texts focussed on economic benefits and two on environmental benefits. For each kind of benefit, the information was either framed in loss or gain terms, following predictions from Prospect Theory (Kahneman & Tversky, 1979), namely that individuals tend to avoid losses more than seek equivalent gains. The information gave a short description of shale gas fracking followed by an environmental/economic and loss/gain benefit framing:

- *Economic – gain*: “One of the main benefits is that fracking could generate substantial quantities of gas in the UK, contributing to energy self-sufficiency. This means that widespread extraction of shale gas across the UK could reduce household energy bills.”
- *Economic – loss*: “One of the main benefits is that fracking could generate substantial quantities of gas in the UK, contributing to energy self-sufficiency. This means that, without widespread extraction of shale gas across the UK, households could face higher household energy bills.”
- *Environmental – gain*: “One of the main benefits is that, as natural gas burns more cleanly (releasing less CO2 and other pollutants) than other fossil fuels, it is considered a viable alternative to coal and oil. This means that widespread extraction of shale gas across the UK could help reduce climate change.”

- *Environmental – loss*: "One of the main benefits is that, as natural gas burns more cleanly (releasing less CO2 and other pollutants) than other fossil fuels, it is considered a viable alternative to coal and oil. This means that, without widespread extraction of shale gas across the UK, we could see increased climate change."

The full texts are shown in the appended questionnaire.

Finally, attitudes to shale gas fracking were again elicited in order to examine any impact of the information provided.

4 Results

Study 1: Deliberative interviews (n=30)

Questionnaire

Looking at Table 1 below, questionnaire data show that across all technologies, few participants claimed to know 'a lot' about any of them, though knowledge was skewed towards traditional technologies (the best known technology was coal with 23% of participants claiming to know 'a lot'). Nobody at all claimed to know 'a lot' about UCG and only 3.3% knew 'a lot' about CCS.

The majority of participants claimed to know 'a little' about most of the technologies, particularly traditional fossil fuel based technologies such as natural gas (86.7%), coal (70%), as well as nuclear power (83.3%). With reference to renewables, nearly all subjects knew 'a little' about offshore wind power (83.3%) and solar power (90%).

UCG and CCS appear to be the most poorly understood technologies based on participant self-judgements. Whilst most of the other technologies appear to be understood by the minority (to a limited degree), a significant proportion of participants reported that they knew 'nothing' about UCG (33%) and CCS (23%).

Table 1. Self-reported judgements about knowledge of energy technologies

	Natural gas	Coal	Shale gas	UCG	CCS	Nuclear	Offshore wind	Solar	Bio-energy
A lot	10%	23.3%	6.7%	0%	3.3%	10%	6.7%	3.3%	10%
A little	86.7%	70%	73.3%	20%	46.7%	83.3%	83.3%	90%	40%
Only the name	3.3%	6.7%	16.7%	46.7%	26.7%	6.7%	6.7%	6.7%	46.7%
Nothing	0%	0%	3.3%	33..3%	23.3%	0%	3.3%	0%	3.3%

Place identity

Participants from industrial and non-industrial areas commonly felt a sense of attachment to where they lived, which was unconnected to the length of time they had lived in that location and where they were born. For example, a number of participants had been born outside Wales but felt a sense of affinity with their communities. Important features of place tended to be both recognisable landmarks and less recognised, more mundane places that were nonetheless intimately connected with participants' day-to-day lives. The countryside and coast were often mentioned as being special places for rural residents, whilst urban dwellers emphasised the importance of access to shops, services, cultural landmarks, and entertainment venues. The landscape was a common marker of place identity, particularly outside of towns. Family and social/community connections were also important markers of place. For a few participants living around Sully and East Aberthaw, industry was an important part of the character of place. For those in other areas, traces of industry were still visible in the landscape (e.g. in Cardiff and Newport docks), even though the locality was no longer industrial in character. Some were reluctant to describe their area as 'industrial', as this appeared to be interpreted as a pejorative term.

Naïve attitudes

As noted above, knowledge about energy technologies was generally quite low, although there was considerable variation between participants. Of the less well-known technologies, shale gas was typically known through media coverage leading to perceptions of fracking as a controversial, and sometimes unwanted, technology. A number of participants also drew attention to plans to test drill for shale gas in the Vale of Glamorgan. Those who had heard of CCS were divided into those who knew more about the technology and saw it as environmentally beneficial, whilst those who had not heard of it sometimes felt a little negative about it, because of its associations with carbon technology. Few participants knew anything about underground coal gasification. There was some negativity expressed towards underground coal gasification, which typically sounded negative to participants.

Generally, traditional carbon based technologies (e.g. coal and gas) were perceived with some ambivalence. On the one hand, these technologies were polluting and finite, on the other hand, acknowledging that they were abundant and relatively cheap. Some participants (typically older) saw such technologies as a means of achieving energy security. Perhaps unsurprisingly, since the sample was drawn from South Wales, coal was associated by some with the heritage and culture of the area.

Renewable technologies were typically perceived as positive technologies, though there was some criticism of renewables as expensive and ineffective, whilst solar panel *fields* in the countryside and offshore wind turbines were sometimes seen as aesthetically damaging. However, others saw them as much more positive, adding interest and even beauty to the landscape, whilst symbolising pollution-free energy.

When asked which technologies government should support, participants were divided between those who favoured renewables and thought that a range of renewables could meet our energy needs if given sufficient investment, and those who thought that renewables alone could not deliver the energy that was required. For the latter, nuclear energy was sometimes viewed as the transition technology that could bridge carbon and renewables. A number of participants questioned why hydro-energy was not featured in the list of technologies, particularly with the richness of water courses and coastline in Wales, which could deliver a significant proportion of Wales' energy needs.

Information cards

The feedback on the energy cards was generally very positive amongst those with a very general level of knowledge about energy technologies. However, a few participants raised important points that had been missed. The information cards rarely changed participants' perceptions about the technologies in any significant way, with the important exception of the less well-known technologies such as underground coal gasification and bioenergy.

Energy card sort

Table 2 gives a graphical indication of the strength of relationships between pairs of technologies based upon paired frequencies expressed as a percentage: the deeper the colour, the stronger the relationship between that pair of technologies. The final column (green) represents the percentage of time that each technology was not grouped with any other technologies.

Results indicate that the most frequently paired technologies were (a) coal-gas and (b) wind-solar, which accord with rationales of 'fossil-fuel' and 'renewable' technologies, respectively. These pairings were followed by the common pairings of shale-UCG, gas-shale, gas-UCG, coal-UCG, and coal-shale. Such pairings suggest that links between unconventional fossil fuels are recognised; as are links between unconventional and

conventional fossil fuels. CCS tended to be paired more often with UCG and bioenergy, whilst nuclear energy was most commonly paired with the low-carbon renewables.

The final column indicates that whilst most of the technologies were always grouped with others, nuclear and CCS were commonly set apart on their own (43.3% and 40% of the time, respectively). Therefore, whilst commonalities were found for the others, nuclear and CCS were frequently perceived as having little in common with the other technologies.

Table 2. Strength of card sort pairings between the energy technologies

Bioenergy	13.30%	20%	10%	13.30%	23.30%	3.30%	33.30%	36.70%	-	23.30%
Solar	3.30%	0%	6.70%	6.70%	3.30%	36.70%	86.70%	-	36.70%	0%
Offshore wind	3.30%	3.30%	6.70%	10%	3.30%	26.70%	-	86.70%	33.30%	0%
Nuclear	10%	10%	20%	10%	10%	-	26.70%	36.70%	3.30%	43.30%
CCS	10%	13.30%	16.70%	26.70%	-	10%	3.30%	3.30%	23.30%	40.00%
UCG	53.30%	53.30%	63.30%	-	26.70%	10%	10%	6.70%	13.30%	0%
Shale gas	56.70%	46.70%	-	16.70%	16.70%	20%	6.70%	6.70%	10%	0%
Coal	83.30%	-	46.70%	13.30%	13.30%	10%	3.30%	0%	20%	0%
Natural gas	-	83.30%	56.70%	10%	10%	10%	3.30%	3.30%	13.30%	0%
	Natural gas	**Coal**	**Shale gas**	**UCG**	**CCS**	**Nuclear**	**Offshore wind**	**Solar**	**Bio-energy**	**Grouped alone**

Mapping exercise

The mean distance between participant location (expressed as nearest town) and siting location across all nine technologies ranged between 14.041km (solar) to 37.9484km (nuclear); see Table 3. Whilst it cannot be assumed that mean distances reflect positive and negative evaluations of the technologies, the results do appear to parallel participants' perceptions (more positive about solar energy and less positive about nuclear energy). There appears to be a slight pattern in mean distances, whereby the more renewable technologies tend to be sited on average more closely to participant locations than fossil fuel technologies. The anomaly in the above table is shale gas, which accounts for the third lowest mean distance. Given the current controversy over fracking, one might expect shale gas to be distanced further than other technologies. One explanation for this may be due to participants' knowledge of areas mooted for exploratory shale gas exploration (e.g. near to Llandow in the Vale of Glamorgan) and the fact that several participants lived in the Vale, which may have influenced distances between location and the technology.

In order to take protest responses into account (where participants expressed that they were unhappy putting a technology anywhere on the map and so put a sticker off-map), mean distances were recalculated, assigning each protest-response a nominal distance of 200km as an arbitrary standard (based upon a subjective judgement reflecting mean distances from other technologies that were all less than 100km). Note that assigning an arbitrary distance may conceal actual differences between technologies, had participants, for example, had the opportunity to position a given technology on a larger map. In addition, some participants stated that certain technologies should not go anywhere. Therefore, assigning them a distance may not represent participant perceptions. From Table 3 below, as expected, mean distances for almost all the technologies (with the exception of bioenergy which drew no protest responses) increased due to the extra distance conferred by protest responses in the revised calculations, this time ranging between 20.239km (for solar) and 97.367 (for nuclear).

Table 3. Mean distance between participant residence & technology sites with/out protest responses

Mean Distance (w/o protest responses)		Mean Distance (with protest responses)	
Technology	*Km*	*Technology*	*Km*
Solar	14.041	Solar	20.239
Bioenergy	24,7261	Bioenergy	24.7261
Shale gas	27.3291	Coal	39.667
CCS	28.2058	Offshore wind	43.374
Coal	28.2154	UCG	51.09
Natural gas	31.7488	Natural gas	54.1823
Offshore wind	32.187	CCS	57.041
UCG	34.553	Shale gas	67.619
Nuclear	37.9484	Nuclear	97.367

Risk card sort

Table 4 displays participant rankings of risk ordered by mean rank, where a numerically low mean indicates high severity, and a numerically high mean indicates low severity. Across the whole sample, direct human health-related risks were ranked on average as the most severe, particularly those related to nuclear technology. This appears to reflect the widespread and prolonged nature of these risks. Meanwhile, non-health-related risks, such as financial costs and loss of local businesses, were ranked on average as the least severe. Note that respondents may have conflated risk in the sense of probability and risk in the sense of hazard or severity of impact.

Table 4. Mean ranking of technology-related risks from risk card sorting exercise

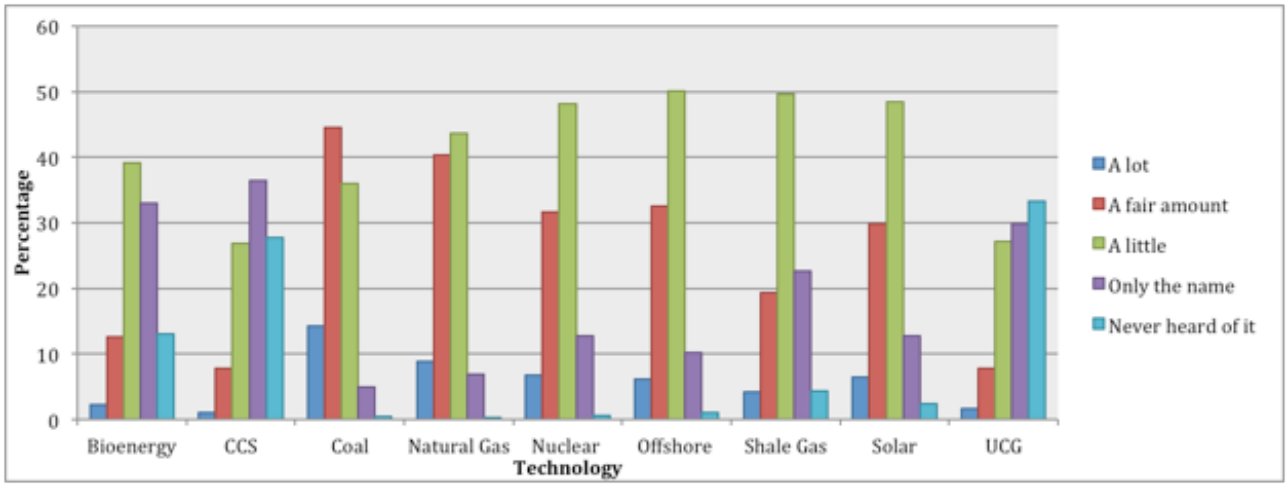
Mean rank	Risk	Mean rank value	Modal rank	Highest rank	Lowest rank
1 (most severe)	Radiation leak	4.23	1	1	14
2	Radioactive waste	5.93	3	1	17
3	Explosion of flammable gas	6.51	1	1	18
4	Pollution of water sources	6.79	6	1	16
5	Hazardous conditions for workers	7.43	1	1	17
6	Airborne pollution	7.9	5	1	19
7	Hazardous solid waste	8.0	4	3	17
8	Slow to shut down	9.0	3	2	19
9	CO2 escapes into atmosphere	9.2	11	1	19
10	Depletion of natural resources	9.6	2	1	18
11	Loss of species	11.10	9	3	18
12	Food shortages	11.55	15	2	19
13	Minor earthquake	11.86	14	1	19
14	High noise levels	12.06	14	1	19
15	CO2 leaks near people's homes	12.13	18	3	19
16	High financial costs	12.26	17	2	19
17	Loss of local businesses	13.0	10	1	19
18	Variable energy generation	13.7	19	1	19
19 (least severe)	Disruption to landscape	13.27	19	1	19

Study 2. Online experimental survey (N=1,457)

Knowledge about energy technologies/sources

Consistent with the interview findings, the majority of survey participants claimed to know 'a little' about most of the technologies and few claimed to know 'a lot' (Figure 1). Participants were most familiar with coal, followed by natural gas, nuclear, wind and solar. Participants were least familiar with CCS and UCG, both scoring highly for 'never heard of it'. Of these two, UCG was the most unfamiliar.

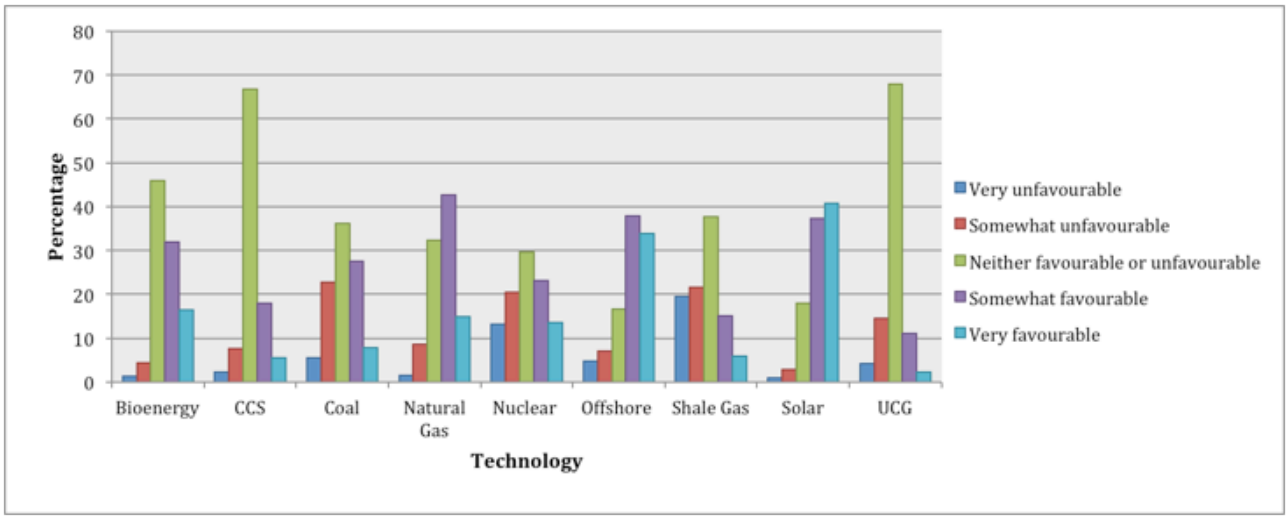
Figure 1: Knowledge of energy sources/technologies



Favourability of energy sources/technologies

Turning from knowledge to attitudes, participants rated solar energy as most favourable (40.8% considered it 'very favourable') followed by offshore wind (33.9% 'very favourable'; Figure 2). Other technologies were rated considerably lower than these. UCG and CCS were consistently rated as 'neither favourable nor unfavourable', a likely reflection of the lack of knowledge about them (see above). Shale gas was rated the most unfavourable (19.5% considering it 'very unfavourable') of the technologies, followed by nuclear (13.2% 'very unfavourable'). However, more participants (37.7%) rated shale as 'neither favourable nor unfavourable' than any other option, with ambivalence also high for bioenergy and nuclear.

Figure 2: Favourability towards energy sources/technologies



Consistent with the overall favourability ratings, when asked to allocate a national energy 'budget' for the different energy sources/technologies, the highest percentage of the UK budget was allocated to offshore wind and solar (Figure 3). However, personal favourability and preferences for national budget are not entirely consistent. Along with natural gas, nuclear was also rated fairly high – perhaps reflecting a 'reluctant acceptance' that this technology is necessary despite its risks. UCG and CCS were allocated the least, perhaps more reflecting lower knowledge about these technologies than dislike of them.

When asked to rate the risks and benefits of shale gas, almost a quarter of participants (24.8%) answered 'don't know' to this question. However, more seem to feel the risks outweigh the benefits, than vice versa (see Figure 4).

Figure 3: UK budget assigned to energy sources/technologies

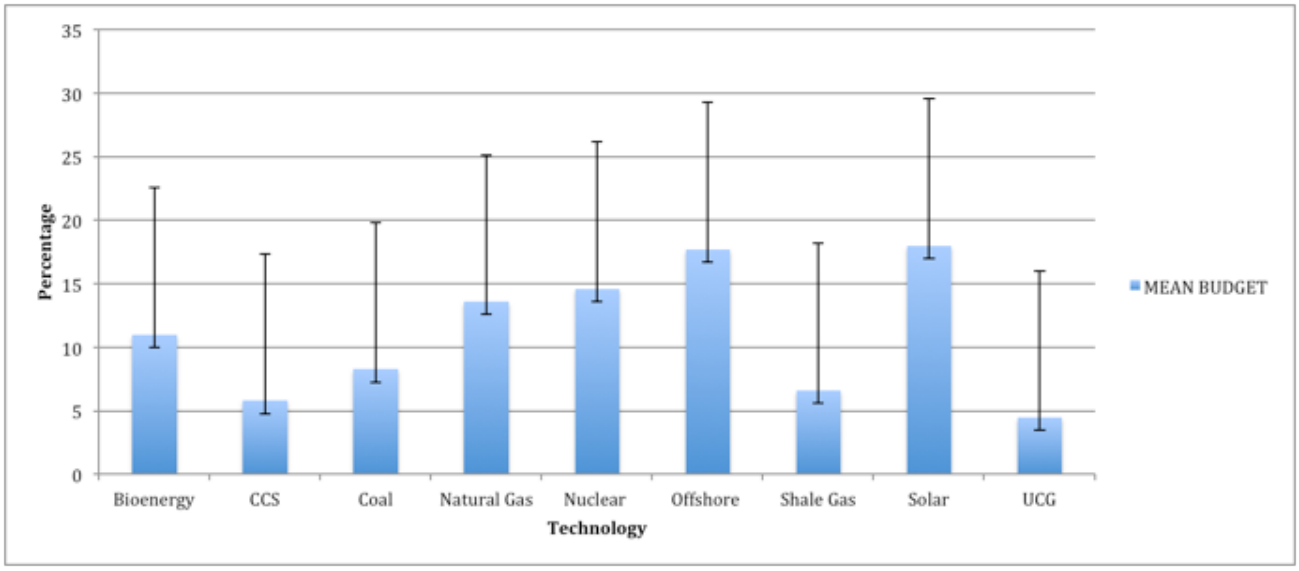
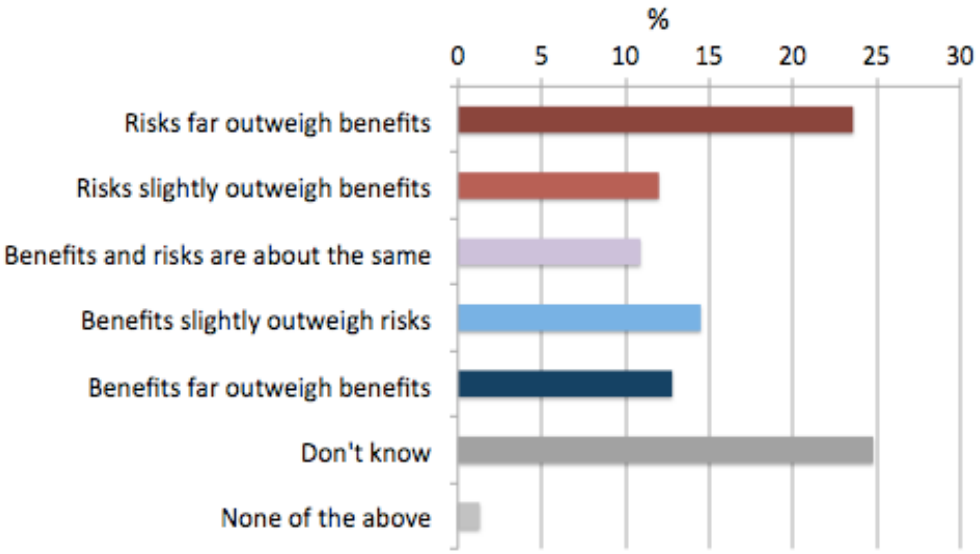


Figure 4: Perceptions of risks versus benefits of shale gas fracking



Responses to the attitude statements on shale gas similarly show considerable ambivalence (Table 5). The largest proportions were 'Neither Agree nor Disagree' for every item (for most items, this accounted for more than 40% of participants). The most strongly disagreed with statement was 'I feel confident that the British Government will adequately regulate shale gas'. The most strongly agreed with statement was 'I am concerned about the risks of water contamination from shale gas fracking'.

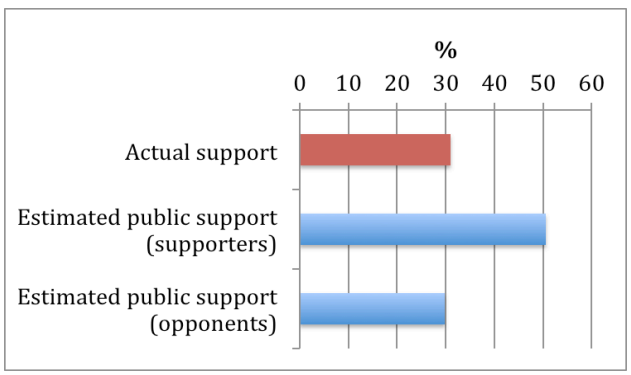
When asked whether they felt shale gas would make a difference to their lives in the next 20 years, almost half of participants indicated they were unsure. The remaining responses were fairly evenly distributed across making their lives better, no difference and worse. Similarly, when asked whether widespread shale gas extraction should be allowed in the UK, the highest proportion (40%) of participants indicated they did not know; while 31% responded in the affirmative (Figure 5).

Table 5: Attitudes to shale gas fracking

	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree	*Mean*	*SD*
I am concerned about the risks of water contamination from shale gas fracking	19.4	31.4	36	9.6	3.6	*3.53*	*1.02*
Producing energy from shale gas will reduce reliance on foreign energy sources	13.5	33.4	42.4	7.3	3.4	*3.46*	*0.93*
If politicians think shale gas fracking is a possibility, it will make them less likely to pursue other policies to tackle climate change	13.1	31.7	45.1	8.4	1.7	*3.46*	*0.89*
I am concerned about the risks of earthquakes from shale gas fracking	13.2	27.2	38.7	14.9	5.9	*3.27*	*1.06*
Producing energy from shale gas will ensure a reliable source of energy for the UK in the future	9	23.8	47.8	12.3	7	*3.16*	*0.99*
Shale gas is a cheap energy source	5.7	20.3	53.4	14.1	6.5	*3.05*	*0.91*
When people find out about shale gas fracking, it will reduce their motivation to make changes in their own behaviour to tackle climate change	5.1	16.7	58.2	15.7	4.3	*3.03*	*0.84*
Producing energy from shale gas will reduce the UK's greenhouse gas emissions	2.7	15	57.9	16.5	8	*2.88*	*0.85*
Producing energy from shale gas will reduce energy bills	4.3	16.6	48.9	18.7	11.4	*2.84*	*0.98*
Shale gas is a clean energy	3.1	14.8	54.2	18	10	*2.83*	*0.91*
I feel that current rules and regulations are sufficient to control any risks from shale gas fracking	3.7	16.2	42.5	21.5	16.1	*2.7*	*1.04*
I feel confident that the British Government will adequately regulate shale gas fracking	4.6	18.1	35.4	22.8	19.1	*2.66*	*1.11*
Knowing shale gas fracking is a possibility makes me feel less inclined to make changes in my own behaviour to tackle climate change	2.3	5.4	46.4	29.6	16.3	*2.48*	*0.91*

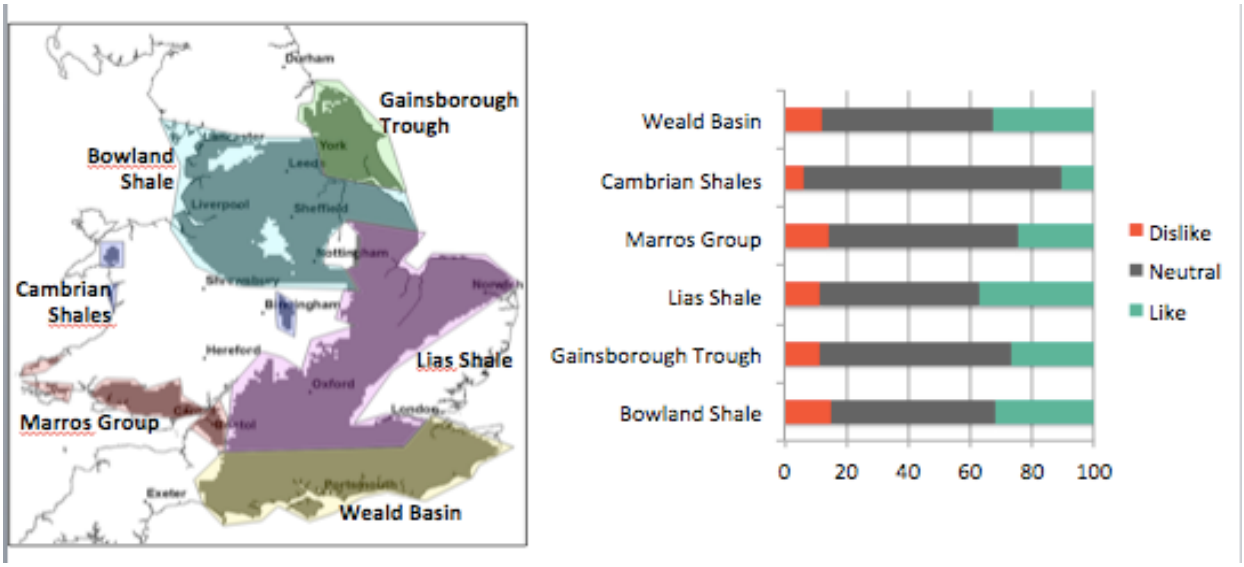
In respect of perceived public support for shale gas (Figure 5), the most frequently occurring percentage that participants selected was 30% (7.7% of all participants selected this amount). However, responses were varied, ranging from 0% to 100%. The mean estimate was 37.4% - which compares with 31.1% of the sample who *actually* agree that shale gas extraction should be allowed in the UK (i.e., the public's estimates of public opinion are reasonably accurate). However, consistent with the false consensus effect (Leviston et al., 2013), desegregating by opinion, we see that those who say it should be allowed estimate 50.6% of the public agree; while those who don't think it should be allowed only estimate 29.8% of the public agree. This difference is significant ($t(844)=-15.5$, $p<.001$).

Figure 5: Support (and perceived support) for widespread extraction of shale gas across UK



For the mapping exercise, respondents were asked to indicate whether they thought shale gas should be extracted ('like') or not ('dislike') in the UK regions where deposits have been identified. As shown in Figure 6, the majority of participants were neutral for each region, while the smallest percentages selected 'dislike' for every area. However, almost half of participants (42.8%) selected 'I do not think shale gas fracking should occur anywhere'.

Figure 6: Preferred locations for shale gas extraction



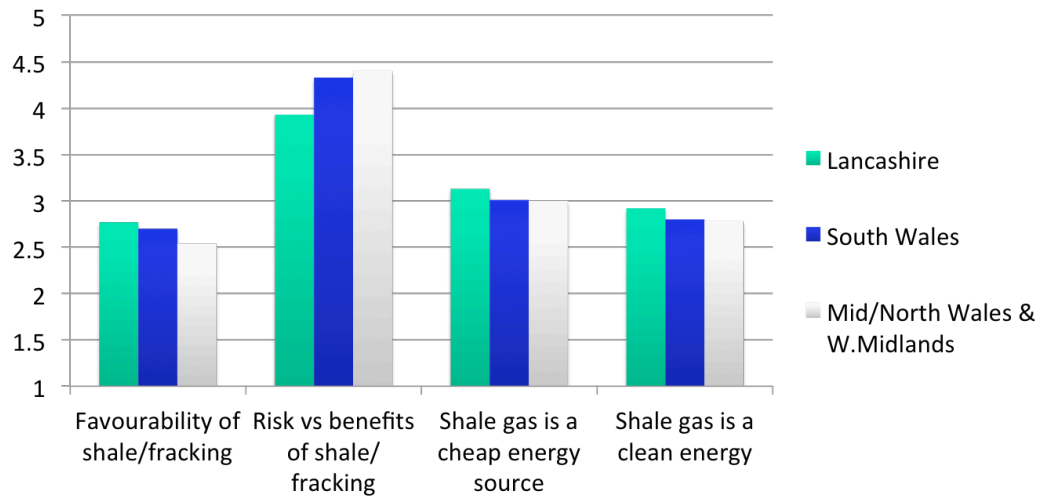
Location analysis

Analysis next explored whether shale attitudes varied according to where survey respondents lived (Figure 7). Using Analysis of Variance (ANOVA), we examined differences in attitudes between the three regions described earlier (i.e., Lancashire, South Wales and Mid/North Wales & Midlands). Shale favourability showed a significant relationship with location $F(2, 1434) = 4.952$, $p = .007$. Participants from Lancashire (i.e., an area where fracking has been ongoing for some years) rated shale gas as a more favourable energy source ($M = 2.77$, $SD = 1.14$) than those from Mid/North Wales & Midlands ($M = 2.54$, $SD = 1.12$) where fracking is not possible, a statistically significant mean difference of, $M = .223$, 95% CI [0.05, 0.40], $p = .007$.

There was also a marginally significant relationship between viewing shale as a 'cheap' energy source and respondents' location: Welch's $F(2, 941.563) = 2.602$, $p = .075$. Participants Lancashire rated shale gas as a cheaper energy source ($M = 3.13$, $SD = .988$) than those from Mid/North Wales & Midlands ($M = 3.00$, $SD = .853$), a marginally statistically significant mean difference of, $M = 0.127$, 95% CI [-0.01, 0.27], $p = .085$). Similarly, there was a significant relationship between seeing shale as clean and respondents' location $F(2, 1422) = 3.528$, $p = .030$. Participants from Lancashire rated shale gas as a cheaper energy source ($M = 2.92$, $SD = .931$) than those from Mid/North Wales & Midlands ($M = 2.78$, $SD = .852$), a statistically significant mean difference of, $M = .145$, 95% CI [0.00, 0.29], $p = .042$.

Consistent with the more favourable attitudes amongst those in Lancashire, we also found a significant relationship between location and shale risk perceptions $F(2, 1422) = 7.076$, $p = .001$. Participants from Mid/North Wales & Midlands rated shale gas as more risky ($M = 4.40$, $SD = 2.03$), than those from Lancashire ($M = 3.93$, $SD = 2.06$) a statistically significant mean difference of, $M = .467$, 95% CI [0.15, 0.79], $p = .002$. Participants from South Wales rated shale gas as more risky ($M = 4.33$, $SD = 2.12$), than those from Lancashire ($M = 3.93$, $SD = 2.06$) a statistically significant mean difference of, $M = .406$, 95% CI [0.08, 0.73], $p = .008$.

Figure 7. Perceptions of shale gas across different locations



Demographic, value, and knowledge analysis

While we found location correlated with shale attitudes, other factors (e.g., sector of employment) may be driving these effects. Consequently, we ran regression analyses of the dependent variables to examine the relative influence of location and other factors, such as demographics, values, and knowledge. As shown in Table 6, men, those with higher science education, Conservative voters, urban residents, those more attached to place, those with lower environmental identity and those with higher climate scepticism scores are more favourable towards shale gas – both pre and post information. Political affiliation, followed by climate change attitudes, are the strongest predictors. However, location is no longer a significant predictor, suggesting the effects described above are associated with other factors.

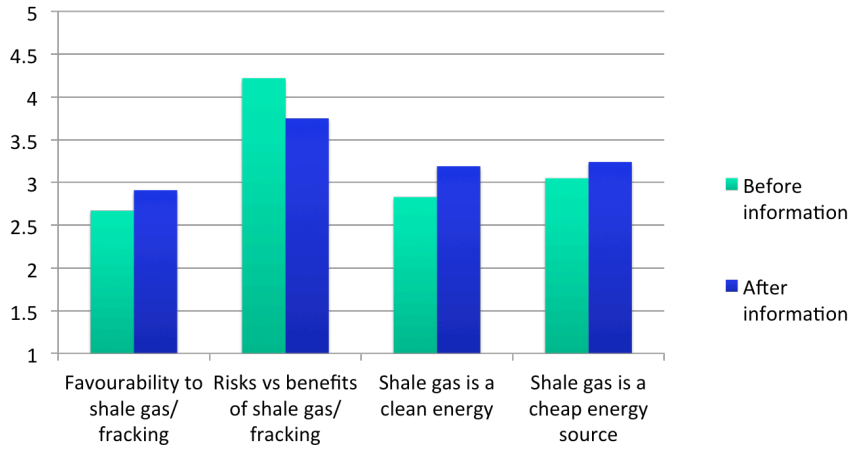
Table 6. Regression analysis of favourability towards shale gas (post information)

	B	Std. Error	Beta	t	Sig.
(Constant)	.406	1.164		.349	.727
Gender	**.215**	**.067**	**.088**	**3.188**	**.001**
Age	-.040	.024	-.050	-1.712	.087
Education	-.044	.025	-.054	-1.721	.085
Science education	**.084**	**.027**	**.097**	**3.087**	**.002**
Politics_conservative	**2.318**	**1.117**	**.793**	**2.075**	**.038**
Politics_labour	1.719	1.117	.648	1.539	.124
Politics_libdem	1.929	1.124	.340	1.716	.086
Politics_green	1.089	1.127	.164	.966	.334
Politics_UKIP	1.965	1.119	.521	1.756	.079
Politics_plaidcymru	1.755	1.124	.290	1.561	.119
Politics_undecided	1.784	1.118	.534	1.595	.111
Politics_wouldnotvote	1.617	1.124	.315	1.438	.151
Politics_other	1.933	1.125	.325	1.718	.086
Location_NEngland	.006	.079	.002	.073	.942
Location_SWales	.020	.077	.008	.257	.797
Length of residence in area	.004	.029	.003	.123	.902
Rurality	**-.090**	**.042**	**-.058**	**-2.156**	**.031**
Employed in energy industry	.169	.099	.044	1.703	.089
Place attachment	**.137**	**.052**	**.075**	**2.628**	**.009**
Environmental identity	**-.114**	**.039**	**-.090**	**-2.912**	**.004**
Climate scepticism	**.252**	**.040**	**.187**	**6.276**	**.000**
Knowledge of shale gas	-.034	.039	-.024	-.856	.392
Experimental condition	-.024	.027	-.023	-.890	.374

Experimental analysis

We next examined the impact of different forms of information provision on shale attitudes. We included environmental identity as an additional independent variable, as we expected based on previous work (e.g., Corner et al., 2012) that people who considered themselves to be 'green' may perceive the information differently to those who do not.

Figure 8. Impact of information on shale gas perceptions



As shown in Figure 8, favourability towards shale gas changed after information provision $F(1, 1414 = 129.675, p < .001$, partial $\eta^2 = .084$. Participants rated shale gas as more favourable post information (M = 2.91, SD = 1.20) compared to pre information (M = 2.67, SD = 1.13). There were no significant differences between conditions $F(3, 1414) = .619$, $p = .603$, nor differences by environmental identity $F(1, 1414) = 1.988$, $p = .114$.

There was also a significant impact of information provision on perceptions of shale gas as a 'cheap energy source', $F(1, 1405) = 84.872$, $p < .001$, partial $\eta^2 = .058$. Participants rated shale gas as a cheaper energy source post manipulation (M = 3.24, SD = 1.02) than pre manipulation (M = 3.05, SD = 0.91). This did not vary between conditions $F(3, 1399) = 1.216$, $p = .302$, and there was no significant influence of environmental identity, $F(1, 1399) = 1.342$, $p = .247$.

Similarly, **t**here was a statistically significant impact of information provision on seeing shale as a 'clean energy source' $F(1, 1394) = 300.014$, $p < .001$, partial $\eta^2 = .177$. Participants rated shale gas as a cleaner energy source post manipulation (M = 3.19, SD = 1.03) than pre manipulation (M = 2.83, SD = .917). This *did* vary by condition $F(3, 1394) = 22.987$, $p < .001$, partial $\eta^2 = .047$. Post hoc with Bonferroni correction revealed that there was a significant difference between the 'Economic – gain' and 'Environmental – gain' conditions. Participants in the Environmental – gain condition rated shale gas as a cleaner energy source (M = 3.12, SD = .047) than those in the Economic – gain condition (M = 2.91, SD = .047), a statistically significant mean difference of, M = 0.20, 95% CI [0.20, 0.37], p = .18. There was also a significant main effect of environmental identity, $F(1, 1394) = 5.245$, $p = .022$, partial $\eta^2 = .004$. Participants with low environmental identity rated shale gas as a cleaner energy source than those with high environmental identity both pre (Low, M = 2.96, SD = .812; High, M= 2.70, SD = .976) and post manipulation (Low, M = 3.28, SD = .915; M = 3.09, SD = 1.13).

In respect of risk perceptions, there was a statistically significant influence of information $F(1, 1410) = 113.587$, $p < .001$, partial $\eta^2 = .075$. Participants rated shale gas as less risky/more beneficial post manipulation (M = 3.75, SD = 1.98) compared to pre manipulation (M = 4.22, SD = 2.08). There were no significant differences between conditions $F(3, 1410) = 1.282$, $p = .279$ nor differences by environmental identity $F(1, 1410) = .003$, $p = .958$.

5 Summary

Interviews (N=30) and an online survey (N=1,457) with members of the UK public were conducted between November 2013 and August 2014 to explore attitudes to shale gas fracking and CCS in the context of other energy sources/technologies.

In terms of interview results, our findings are consistent with previous research (e.g., Whitmarsh et al., 2011a) that shows the public are more positive about renewable energy sources than other sources or technologies. Conceptually, renewables (particularly solar and offshore wind) are grouped together; while fossils (and to some extent unconventionals) are seen as a separate group. Participants found CCS and nuclear hardest to group with other technologies/sources. Consistent with their attitudes, interviewees would prefer to live closest to solar and furthest from nuclear installations. When presented with a list of possible risks, interviewees ranked direct human health-related risks on average as the most severe, particularly those related to nuclear technology; while non-health-related risks, such as financial costs and loss of local businesses, were ranked least severe.

The survey showed relatively low levels of knowledge about energy technologies. Participants were most familiar with coal, natural gas and nuclear; and least familiar with CCS and UCG. Again, renewables were seen favourably: solar and offshore were rated as most favourable, while other technologies were rated considerably lower. UCG and CCS were most commonly rated as 'neither' favourable or unfavourable, a possible reflection of the lack of knowledge about them. Shale gas was the most unfavourable of the technologies, followed by nuclear.

Attitudes to shale gas show considerable ambivalence, as also indicated by previous work (O'Hara et al., 2014; DECC, 2014). One-quarter of participants answered 'don't know' about the risks versus benefits of shale gas fracking. However, one-quarter also indicated that the risks far outweigh the benefits, double the proportion who said the benefits far outweigh the risks. In respect of most attitude statements, a large proportion selected 'neither agree nor disagree', highlighting considerable public uncertainty about shale. However, many express doubts about the government's ability to adequately regulate shale gas, and there is concern about the risks of water contamination from fracking (cf. O'Hara et al., 2014). Almost half of participants were not sure whether shale gas would make a difference to their lives in the next 20 years; and 40% did not know if widespread shale gas extraction should be allowed in the UK. Participants have few preferences on where shale gas extraction should occur, many stating that it should not occur anywhere.

Comparison of survey responses by location showed those living in a region where shale gas extraction is already underway (Lancashire) are significantly more positive than those living in regions where shale gas fracking is not possible. However, these location differences disappear where controlling for demographic and value factors. Rather, political affiliation and attitudes to climate change, as well as gender, rurality, place identity and environmental identity, appear to be more important predictors of shale gas attitudes (cf. O'Hara et al., 2014).

When provided with information about shale gas, participants became more positive – in most cases this was irrespective of whether environmental or economic benefits were highlighted.

Further analyses will include additional qualitative analysis (e.g., rationale for card sorts) and mediation analyses to explore relationships between location, demographics, values, attitudes, knowledge, and risk perceptions.

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Appendix. Survey questionnaire

I live in...
- ... South Wales (1)
- ... Mid Wales (2)
- ... North Wales (3)
- ...Northern England (4)
- ...Other (5)

Please indicate your gender:
- Female (1)
- Male (2)

Please indicate the age bracket you are in:
- 16-24 (1)
- 25-34 (2)
- 35-44 (3)
- 45-54 (4)
- 55-64 (5)
- 65-74 (6)
- 75 or over (7)

What is your highest qualification?
- No formal qualifications (1)
- GCSE / O-Level (2)
- A-Level / Higher / BTEC (3)
- Vocational / NVQ (4)
- Undergraduate degree (5)
- Postgraduate degree (6)

What is your highest qualification in a science-related subject?
- No formal qualifications (1)
- GCSE / O-Level (2)
- A-Level / Higher / BTEC (3)
- Vocational / NVQ (4)
- Undergraduate degree (5)
- Postgraduate degree (6)

Which political party are you most likely to support?
- Conservative (1)
- Labour (2)
- Liberal Democrats (Lib Dems) (3)
- Green Party (4)
- UK Independence Party (UKIP) (5)
- British National Party (BNP) (6)
- Scottish National Party (SNP) (7)
- Welsh Nationalist Party / Plaid Cymru (8)
- Democratic Party (9)
- Other (10)
- Undecided (11)
- Would not vote (12)
- Prefer not to say (13)

What is the first part of your postcode (e.g., BS1):

How many years have you been living in this area?

- Less than 1 year (1)
- 1 - 3 years (2)
- 4 - 6 years (3)
- 7 - 10 years (4)
- More than 10 years (5)

Which of the following best describes the area in which you live?

- Urban (1)
- Sub-urban (2)
- Rural (3)

Do you work, or have you ever worked, in the energy industry (i.e., companies involved in producing or selling gas, oil, coal, solar, etc.)?

- Yes, currently (2)
- Yes, in the past (1)
- No (0)

Please indicate to what extent you agree or disagree with the following statements:

	Strongly agree 5 (5)	4 (4)	3 (3)	2 (2)	Strongly disagree 1 (1)
I feel like I belong to the community where I live					
I can influence decisions that affect the area where I live					
The place where I live is very special to me					
Other places in the world are just as important to me as the area where I live					
I am very attached to the natural environment in my area					
I would feel less attached to my area if the native plants and animals that live here disappeared					
If I need advice about something I could go to someone in my neighbourhood					
I believe my neighbours would help in an emergency					
I regularly stop and talk with people in my neighbourhood					
Given the opportunity, I would like to move out of this neighbourhood					
I rarely have a neighbour over to my house to visit					
People in my local community pull together to improve the area					
I think of myself as someone who is concerned about the environment					
I would be embarrassed to be seen as having an environmentally-friendly lifestyle					
Being environmentally-friendly is an important part of who I am					

Using the scale below, please rate your feelings regarding environmental protection versus economic growth, choosing options closer to the statement you most agree with:

Avoiding harm to the environment should be given priority 1 (1)	2 (2)	3 (3)	4 (4)	Economic growth should be given priority 5 (5)

Now please indicate how much you agree or disagree with the following statements about climate change:

	Strongly agree 5 (5)	4 (4)	3 (3)	2 (2)	Strongly disagree 1 (1)
Climate change is too complex and uncertain for scientists to make useful forecasts					
Claims that human activities are changing the climate are exaggerated					
The media is often too alarmist about issues like climate change					
I do not believe climate change is a real problem					
Floods and heat-waves are not increasing, there is just more reporting of it in the media these days					
Climate change is just a natural fluctuation in Earth's temperatures					
There is too much conflicting evidence about climate change to know whether it is actually happening					
It is too early to say whether climate change is really a problem					
Too much fuss is made about climate change					
The evidence for climate change is unreliable					
Many leading experts still question if human activity is contributing to climate change					
I am uncertain about whether climate change is really happening					
There is solid evidence that the Earth is warming because of human activities					
I am convinced that climate change is really happening					

How much would you say you know about each of the following energy sources and technologies?

	A lot (5)	A fair amount (4)	A little (3)	Nothing - have only heard the name (2)	Nothing - have never heard of it (1)
Gas (also known as 'natural gas')					
Coal					
Shale gas or 'fracking'					
Underground coal gasification					
Carbon capture and storage					
Nuclear power					
Offshore wind power					
Solar photovoltaic / solar energy					
Bioenergy					

Now please group together the energy options according to categories that you think make sense – in other words, making groups according to what, in your view, they have in common. To do this, just click on an energy option on the left and drag it into a group on the right. There's no right or wrong answer - we're just interested in how you see these energy sources. You can make as many or as few groups as you like (up to a maximum of 6). If there are technologies/sources you haven't heard of, just leave them and don't try and place them in a group.

Gas (also known as 'natural gas')
Coal
Shale gas or 'fracking'
Underground coal gasification
Carbon capture and storage
Nuclear power
Offshore wind power
Solar photovoltaic / solar energy
Bioenergy

How favourable or unfavourable are your overall opinions or impressions of the following energy options currently?

	Very favourable5 (5)	Somewhat favourable 4 (4)	Neither favourable nor unfavourable 3 (3)	Somewhat unfavourable2 (2)	Very unfavourable1 (1)
Gas (also known as 'natural gas')					
Coal					
Shale gas or 'fracking'					
Underground coal gasification					
Carbon capture and storage					
Nuclear power					
Offshore wind power					
Solar photovoltaic / solar power					
Bioenergy					

What proportion of the UK's budget for energy do you think should be invested in supporting each of the following? Click and drag each pointer. The total should add up to 100%.

_____ Gas (also known as 'natural gas')
_____ Coal
_____ Shale gas or 'fracking'
_____ Underground coal gasification
_____ Carbon capture and storage
_____ Nuclear power
_____ Offshore wind power
_____ Solar photovoltaic / solar
_____ Bioenergy

From what you know or have heard about using shale gas fracking in Britain, on balance, which of these statements most closely reflects your own opinion?

- The benefits of shale gas fracking far outweigh the risks (1)
- The benefits of shale gas fracking slightly outweigh the risks (2)
- The benefits and risks of shale gas fracking are about the same (3)
- The risks of shale gas fracking slightly outweigh the benefits (4)
- The risks of shale gas fracking far outweigh the benefits (5)
- None of these (6)
- Don't know (7)

To what extent do you agree or disagree with each of the following statements?

	Strongly agree5 (5)	Agree4 (4)	Neither agree nor disagree 3 (3)	Disagree 2 (2)	Strongly Disagree1 (1)
I am concerned about the risks of earthquakes from shale gas fracking					
I am concerned about the risks of water contamination from shale gas fracking					
Shale gas is a clean energy					
Producing energy from shale gas will reduce the UK's greenhouse gas emissions					
Shale gas is a cheap energy source					
Producing energy from shale gas will reduce energy bills					
Producing energy from shale gas will reduce reliance on foreign energy sources					
Producing energy from shale gas will ensure a reliable source of energy for the UK in the future					
Knowing shale gas fracking is a possibility makes me feel less inclined to make changes in my own behaviour to tackle climate change					
When people find out about shale gas fracking, it will reduce their motivation to make changes in their own behaviour to tackle climate change					
If politicians think shale gas fracking is a possibility, it will make them less likely to pursue other policies to tackle climate change					
I feel that current rules and regulations are sufficient to control any risks from shale gas fracking					
I feel confident that the British Government will adequately regulate shale gas fracking					
I feel conflicted about shale gas					
I am undecided about shale gas					
I have mixed feelings about shale gas					

Do you think that in the next 20 years, shale gas fracking will...

- ... improve our lives (1)
- ... make our lives worse (-1)
- ... make no difference either way (0)
- Not sure (9)

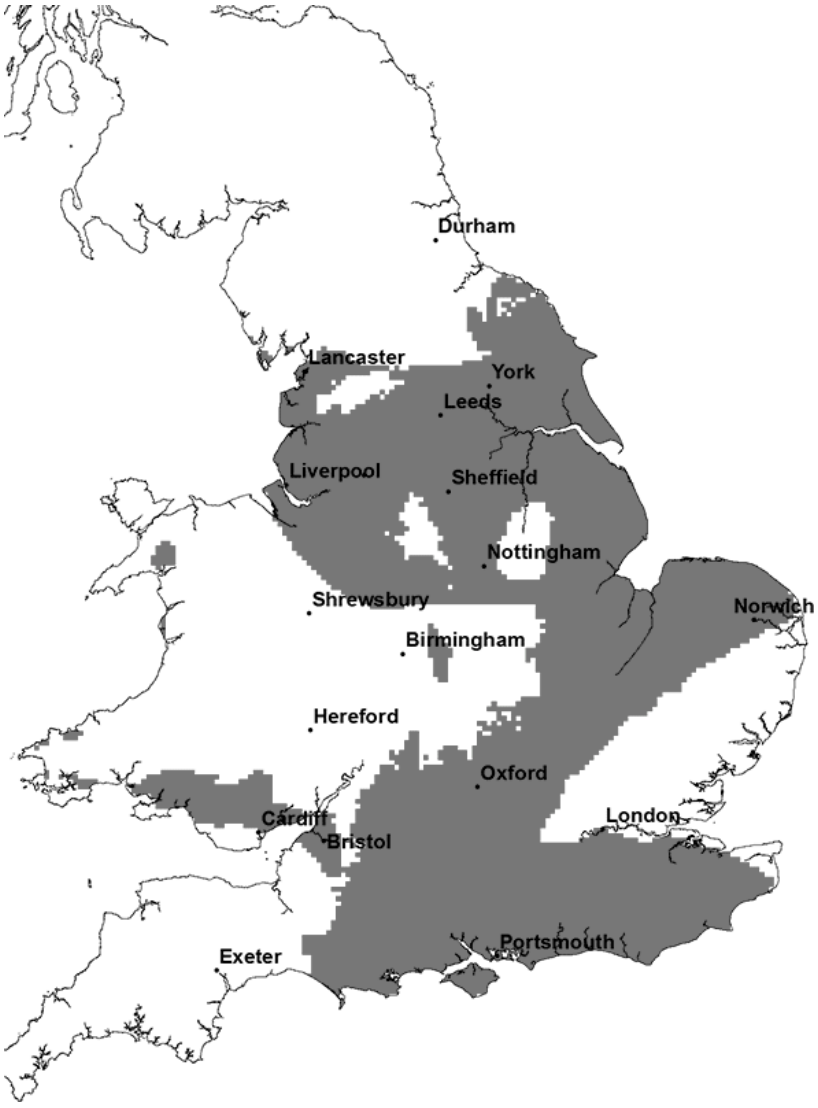
Should shale gas extraction be allowed in the UK?

- Yes (1)
- No (0)
- Don't know (9)

What percentage of the UK public do you think would agree that shale gas extraction should be allowed in the UK?
_____ UK public

The map below indicates (in grey) where potentially prospective shale gas is located. Please indicate where you think shale gas fracking should take place by clicking on a region once for places you think it should occur, or twice for places that you think it should not occur. If you wish to change an answer, please continue to click on a region until you reach the desired response. (If you do not think fracking should occur anywhere, please select this option below the map instead).

	Dislike (1)	Neutral (2)	Like (3)
Marros Group			
Weald Basin			
Gainsborough Trough			
Bowland Shale			
Upper cambrian shales			
Lias Shale			



- I do not think shale gas fracking should occur anywhere (1)

If you selected this box, please indicate why you feel this here:

On the next screen, you will see some information about shale gas fracking. Please read the information carefully as you will be asked some questions about it afterwards:

C1 The UK government has announced that it wants to see the widespread extraction of shale gas across the UK. Shale gas is a natural gas that forms within a particular type of rock, formed from clay and other minerals. This rock is known as 'shale'. To extract gas from the shale, a process called 'hydraulic fracturing' is used (known more commonly as 'fracking'). Water, sand and chemicals are injected at high pressure into the shale, cracking it open and allowing the gas to escape. The water is then allowed to flow back to the surface where it is collected and treated or reused. The gas can then be collected and burnt in a power plant to generate electricity. When finished, the sand that has been injected fills and stabilises the cracks in the rock. Shale gas could increase global gas reserves by over 40%. There are both benefits and drawbacks associated with shale gas fracking. One of the main benefits is that fracking could generate substantial quantities of gas in the UK, contributing to energy self-sufficiency. This means that widespread extraction of shale gas across the UK could reduce household energy bills.

C2 The UK government has announced that it wants to see the widespread extraction of shale gas across the UK. Shale gas is a natural gas that forms within a particular type of rock, formed from clay and other minerals. This rock is known as 'shale'. To extract gas from the shale, a process called 'hydraulic fracturing' is used (known more commonly as 'fracking'). Water, sand and chemicals are injected at high pressure into the shale, cracking it open and allowing the gas to escape. The water is then allowed to flow back to the surface where it is collected and treated or reused. The gas can then be collected and used to heat homes, power industry and generate electricity. When finished, the sand that has been injected fills and stabilises the cracks in the rock. Shale gas could increase global gas reserves by over 40%. There are both benefits and drawbacks associated with shale gas fracking. One of the main benefits is that, as natural gas burns more cleanly (releasing less CO2 and other pollutants) than other fossil fuels, it is considered a viable alternative to coal and oil. This means that widespread extraction of shale gas across the UK could help reduce climate change.

C3 The UK government has announced that it wants to see the widespread extraction of shale gas across the UK. Shale gas is a natural gas that forms within a particular type of rock, formed from clay and other minerals. This rock is known as 'shale'. To extract gas from the shale, a process called 'hydraulic fracturing' is used (known more commonly as 'fracking'). Water, sand and chemicals are injected at high pressure into the shale, cracking it open and allowing the gas to escape. The water is then allowed to flow back to the surface where it is collected and treated or reused. The gas can then be collected and used to heat homes, power industry and generate electricity. When finished, the sand that has been injected fills and stabilises the cracks in the rock. Shale gas could increase global gas reserves by over 40%. There are both benefits and drawbacks associated with shale gas fracking. One of the main benefits is that fracking could generate substantial quantities of gas in the UK, contributing to energy self-sufficiency. This means that, without widespread extraction of shale gas across the UK, households could face higher household energy bills.

C4 The UK government has announced that it wants to see the widespread extraction of shale gas across the UK. Shale gas is a natural gas that forms within a particular type of rock, formed from clay and other minerals. This rock is known as 'shale'. To extract gas from the shale, a process called 'hydraulic fracturing' is used (known more commonly as 'fracking'). Water, sand and chemicals are injected at high pressure into the shale, cracking it open and allowing the gas to escape. The water is then allowed to flow back to the surface where it is collected and treated or reused. The gas can then be collected and used to heat homes, power industry and generate electricity. When finished, the sand that has been injected fills and stabilises the cracks in the rock. Shale gas could increase global gas reserves by over 40%. There are both benefits and drawbacks associated with shale gas fracking. One of the main benefits is that, as natural gas burns more cleanly (releasing less CO2 and other pollutants) than other fossil fuels, it is considered a viable alternative to coal and oil. This means that, without widespread extraction of shale gas across the UK, we could see increased climate change.

What thoughts came to mind when you were reading the text?

Which of the following was mentioned in the information you read?

- Widespread extraction of shale gas could increase climate change (1)
- Widespread extraction of shale gas could increase energy bills (2)
- Widespread extraction of shale gas could reduce climate change (3)
- Widespread extraction of shale gas could reduce energy bills (4)

How favourable or unfavourable are your overall opinions or impressions of shale gas 'fracking' currently?

- Very favourable5 (5)
- Somewhat favourable4 (4)
- Neither favourable or unfavourable3 (3)
- Somewhat unfavourable2 (2)
- Very unfavourable1 (1)

From what you know or have heard about using shale gas fracking in Britain, on balance, which of these statements most closely reflects your own opinion?

- The benefits of shale gas fracking far outweigh the risks (1)
- The benefits of shale gas fracking slightly outweigh the risks (2)
- The benefits and risks of shale gas fracking are about the same (3)
- The risks of shale gas fracking slightly outweigh the benefits (4)
- The risks of shale gas fracking far outweigh the benefits (5)
- None of these (6)
- Don't know (7)

To what extent do you agree or disagree with each of the following statements?

	Strongly agree5 (5)	Agree4 (4)	Neither agree nor disagree3 (3)	Disagree 2 (2)	Strongly Disagree1 (1)
Shale gas is a clean energy					
Shale gas is a cheap energy source					
I feel conflicted about shale gas					
I am undecided about shale gas					
I have mixed feelings about shale gas					