COOLTRANS (Dense Phase Carbon Dioxide Pipeline Transportation)

WP5.2.2: Public perceptions of CO_2 transport in pipelines

Interim Project Report

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1 Introduction

COOLTRANS (Dense Phase Carbon Dioxide (CO_2) Pipeline Transportation) is a large consortium project funded by National Grid. The overall aim of the COOLTRANS programme is to carry out research to inform the design and safe operation of pipelines for the transport of dense phase anthropogenic CO_2 as part of Carbon Capture and Storage (CCS) schemes. This report presents the results of Work Package 5.2.2, the overall purpose of which is to understand the public perceptions of CO_2 and its transportation by pipeline and follows on from the first Interim Report (September 2011) which assessed the societal impacts associated with Case Studies of previous pipeline developments. The work presented in two Interim reports is brought together in an Executive Summary which presents the wider conclusions from work package 5.2 as a whole (public perception of risk).

National Grid is proposing a CO_2 transportation pipeline to transport CO_2 from two CCS schemes in Yorkshire and Humber (the White Rose CCS project and the Don Valley Power Project). The proposed route corridor has been selected following an informal consultation process and technical (National Grid 2012) and environmental assessments (National Grid 2013). Further statutory consultations will be conducted under the Planning Act (2008). Work Package (WP) 5.2 of the COOLTRANS research programme supports this process by providing an independent, academic assessment of the type of information about CO_2 transportation in pipelines that is useful to lay publics, their key concerns and existing knowledge and gaps in understanding, in order that the nature and content of communications material can be tailored to a lay audience's needs (see for example, Wallquist et al. 2011). WP 5.2.2 conducted focus groups at two locations along the proposed Yorkshire and Humber pipeline route with the aim of exploring specific concerns to CO_2 transportation in pipelines and potential public responses to the risks.

This report describes the process and results of the two focus groups held; the research has been designed to explore the understanding and perceptions of residents along a proposed CO_2 pipeline route and the factors influencing the public response to potential social impacts of transporting CO_2 pipelines. Specifically the groups considered:

- What do people know and understand about CO_2 and its properties;
- What issues around the transportation of CO_2 cause concern and how might those concerns be allayed.

The report begins with a brief overview of previous recent relevant research, followed by a description of the Focus Group Methodology as it was implemented in the present study; Section 2

of this report presents the results from the Focus Group discussions in detail and are summarised in Section 3. A short discussion places these results in the context of other related research results from the wider literature. More general conclusions, which combine the results from this Work Package (WP 5.2.1) with those from Work Package 5.2.1 (Social impacts of the installation of pipeline networks) are presented in a separate Executive Summary.

1.1 Previous research

There are many studies that have explored public perceptions and the acceptance of CCS as a technology (see Whitmarsh et al. 2011 for a review) and some that have looked at public understanding of CO_2 as part of an assessment of opinions on CCS in general (Wallquist et al. 2009; de Best-Waldhober et al. 2011; de Best-Waldhober et al. 2012; Itaoka et al. 2012). For example, Itaoka (2012) found a correlation between misperceptions of CO_2 and misperceptions of CCS, highlighting the importance of providing information about CO_2 as part of all CCS communications, not just with respect to pipelines.

However, there is very little research which specifically explores the public response to CO_2 transportation by pipeline. A study into public acceptance of the different components of the CCS chain in Switzerland found that the prospect of a CO_2 pipeline in the respondents' locality held a greater influence on acceptability than storage or plant type but that CO_2 pipelines were viewed less negatively than natural gas pipelines (Walquist et al. 2012). These findings contrast with those of other studies which have found that CO_2 storage is the element of the CCS chain that typically causes greatest concern to lay publics (Brunsting et al. 2011; Hammond and Shackley 2010; Mander et al. 2010; Upham and Roberts 2011).

One study has explored the relationship between understanding of CO_2 and acceptance of CCS but not specifically how it relates to CO_2 transport by pipeline (Itaoka et al. 2012). Exploring public perceptions of CO_2 in Japan, Australia and the Netherlands using a combination of qualitative and quantitative research methods, Itaoka et al. (2012) found low levels of understanding and familiarity with the physical and chemical properties of CCS or its uses in everyday applications / products. Another study, conducted in Switzerland, found that interview respondents related atmospheric release of CO_2 (whether from a power station or from part of the CCS process) to a reduction in the local air quality – comparing it to "exhaust gases" (Wallquist et al. 2009), similar associations were expressed in the former study in which CO_2 was associated with "soot" or "air pollution" (Itaoka et al. 2012).

A large scale survey into perceptions of CCS in the Netherlands of ca. 400 individuals (de Best-Waldhober et al. 2011; de Best-Waldhober et al. 2012) asked respondents to indicate the extent to which they agreed with statements describing various properties and sources of CO_2 and how confident they were in their response, alongside other questions about different aspects of CCS (none pertaining specifically to the transportation stage of the process). Over a third of respondents were unsure over whether CO_2 was a cause of cancer (20% thought that it did), was harmful if it came into contact with the skin, or whether it made the earth's climate habitable. A positive correlation was found between respondents with a good understanding of CO_2 and those with a positive view of CCS. Only 7% of respondents were "very convinced" that anthropogenic CO_2 is a cause of climate change. Presenting respondents with a list of issues to evaluate is a very good way of assessing levels of initial understanding – respondents are engaged in a process of running through a longer list of questions and are anonymous in their response. So, while a focus group is a much better way to explore the *processes* of understanding and the *nature* of responses to information, it is sometimes harder to identify detailed misperceptions such as these – participants are often reluctant to expose a lack of knowledge or understanding about a topic. So whereas a survey can provide a snapshot of the instantaneous opinions of a large number of people on a range of topics, the focus group approach supports a better understanding of the of the way in which lay people engage with a subject and how opinions might evolve in the process.

1.2 The Focus Group method

A focus group is a process through which a group of people are asked in an interactive and deliberative setting about their attitudes towards a particular topic (Morgan 1993) and has been successfully applied within other studies on public understanding of CCS (Shackley et al. 2005; Bradbury et al. 2009; Oltra et al. 2010; Upham and Roberts 2011). Although surveys are also a popular methodology in CCS studies, and are useful for establishing the baseline level of awareness of CCS (Palmgren et al. 2004; Reiner et al. 2006; Tokushige et al. 2007), their use in understanding wider opinions about CCS, given very low levels of existing knowledge of CCS technology, has been challenged (Malone et al. 2010;de Best-Waldhober et al. 2009). To overcome this issue, a focus group approach was adopted where a mix of presentations, activities and facilitated discussions enabled participants to learn about an unfamiliar technology. This allowed a more in-depth exploration of attitudes, opinions and concerns around the relatively unfamiliar topic of CO_2 pipelines, in order to gain a unique insight into public understanding (Morgan 1993; Therwell 1999; Krueger and Casey 2000). A key disadvantage of this approach is, however, that only small samples of respondents can be accessed, with implications for any claims of representativeness of the wider population. While measures are taken (see below) to avoid recruitment bias as far as possible,

conclusions from focus group studies are more useful for understanding *how* and *why* the lay public might respond to and form opinions about a particular project or technology than for *predicting* the response of the wider population. Their aim is to gain a greater insight into the level of existing knowledge and the types of issue that inspire concern or reassurance amongst people typical of the local community. Note also that the reach of a focus group extends beyond the immediate participants to the group to the network of family, friends and acquaintances of the participants as they talk about the content of the groups (Roberts and Mander 2012).

1.2.1 Focus group recruitment

Participants were recruited from selected areas around the preferred route corridor of the proposed Yorkshire and Humber CCS pipeline. Evidence suggests that the most successful groups comprise of between 6 and 8 people giving enough variety of personalities to initiate group discussion (Krueger and Casey 2000). 10 participants were invited to each of the focus groups which is normal practice in this type of methodology in anticipation of participants who fail to attend on the day (Gibbs 1997; Stewart et al. 2007). In total, 19 participants attended the two full day focus groups held, which took place in Barmston and Holme-on-Spalding-Moor on the 13th and 14th October 2012 respectively. A demographic profile of participants and the averages of the local area can be seen in Table 1 and Table 2.

Participants were recruited as a purposive sample and as such, are not necessarily representative of the whole population; they are selected to serve a very specific purpose, i.e. their proximity to the proposed pipeline (Carson et al. 2001). Potential participants were approached through a mailshot (see Appendix 1) to households in selected areas (n=1000) and asked to contact the research team at the University of Manchester if they were interested and to receive further information. The mailshot detailed the time and date of the focus group and stated that participants would be discussing an issue of national and local significance but did not reveal that the topic was related to energy, CCS or pipelines. This was done in order to recruit a wide cross section of people and to avoid both deterring those who may be intimidated by a topic such as pipelines and CO_2 and attracting individuals with a particular or specific prior interest in the discussion topic.

A screening questionnaire was conducted with potential participants to deliver a spread in age, gender and level of education attained, and included a specific inclusion and exclusion criteria (see Appendix 2). Inclusion criteria we included to ensure that participants lived close to the pipeline route and were aged 18 or over. Exclusion criteria included employees of National Grid or any

pipeline related companies. A reward of £75 was paid to each participant at the end of the focus group session. The recruitment process, all supporting documentation and the subsequent focus group implementation and analysis were approved by the University of Manchester Research Ethics Committee prior to conducting this research.

Table 1: Demographic Profile of Focus Group Participants

	Area: West Wolds and Coast (**Barmston**)	Area: Howdenshire (**Holme on Spalding Moor**)
Population	14,735	14,219
Gender breakdown (Population)	Male 49.3% Female 50.89%	Male 50.3% Female 49.7%
Ethnicity	White British 98.6% White Irish 0.3% Other 1.1%	White British 98.7% White Irish 0.2% Other 1.1%
Working Status	Full time 34.2% Retired 17.1% Self Employed 14.9% Part time 12.7% Look after house/family 6% Student 5.1% Unemployed 3% Economically inactive 2%	Full time 39% Retired 16.1% Part time 13.8% Self Employed 10.7% Look after house/family 6.4% Student 5.5% Unemployed 2.7% Economically inactive 1.9%

Table 2: Demographic Information - Average of Local Area

	Barmston	**Holme-on-spalding Moor**
Gender	5 x Male 4 x Female	5 x Male 5 x Female
Age	1 x 45-54 yr 1 x 55-59 yr 2 x 60-64 yr 4 x 65-74 yr 1 x 75+ yr	1 x 15-24 yr 1 x 25-34 yr 3 x 35-44 yr 1 x 45-54 yr 1 x 60-64 yr 2 x 65-74 yr 1 x 75 + yr
Ethnicity	8 x White British 1 x White Irish	10 x White British
Working Status	2 x Full time 6 x Retired 1 x Unable to work	2 x Full time 2 x Part time 1 x Unemployed 4 x Retired 1 x Takes care of house/children
Education	2 x GCSE 2 x A-Level 1 x Bachelor's degree 1 x Masters 1 x Vocational 2 x Other	3 x GCSE 2 x A-Level 4 x Bachelor's degree 1 x Other

1.2.2 The focus group process

Groups were held on a Saturday and Sunday, respectively, in October 2012 and ran from 10am until 4pm. The day was structured around four topics: carbon dioxide, CCS, CO_2 pipelines and qualitative risk assessment. A topic guide was planned in advance outlining key areas of discussion which were tailored to address specific research questions. The 6 hours timing for the session, allowed for in-depth discussion of all areas covered within the topic guide. Facilitation was shared between two members of the research team, each taking the same sessions on each day to ensure consistency between the groups. Participants were directed through four main topics during the 6 hour session - carbon dioxide, CCS, pipelines and risk assessment. Each session included a presentation by an expert and in-depth facilitated group discussion; the CCS and pipeline sessions also included additional interactive activities. Prior[1] to the focus group, participants were provided with an information sheet (see Appendix 3), describing the research and were asked to sign a consent form (see Appendix 4) as required by the University of Manchester Ethics Committee. Each of the participants also filled in two short questionnaires (see Appendix 5 and Appendix 6); these were used to identify participants' knowledge and trust levels around a number of areas before and after the groups had taken place.

The focus groups opened with the facilitator giving participants a quick introduction which covered: why the groups were taking place, the consent procedure, the funders of the project, how the results of the focus groups would be used and a short explanation of what would be happening during the groups. They were also encouraged, both during the introductions and throughout the sessions, to ask any questions of clarification. Each group started with an ice-breaker exercise in which participants, facilitators and the expert presenters were asked in pairs to discuss the positive and negatives of living in their local area, before reporting back to the group as a whole. This was a successful exercise, enabling everyone involved in the groups to get to know each other and participants to feel more relaxed while providing contextual information about how the participants viewed the surrounding area.

Session 1: Carbon Dioxide

The first session topic was carbon dioxide. This began with a facilitated discussion aimed at gauging the base level of understanding among participants and was followed by a presentation delivered by an experienced science communicator external to the project team. The presentation was

[1] At least 24 hours before the start of the group.

interactive and included a number of demonstration activities to support the understanding of CO_2 and its properties and was followed by a facilitated discussion. Demonstrations included:

- CO_2 as a natural component of air (using a conker to illustrate how a plant uses CO_2 from the air to grow);
- What is CO_2? (using molecular models);
- The properties of CO_2 (using a fish tank and dry ice to demonstrate that CO_2 is denser than air);
- Everyday uses for CO_2 (examples of different types of food);
- CO_2 production from burning fossil fuels (demonstrated with a candle in a confined space);
- The greenhouse effect (comparative heating of bottles filled with oxygen and CO_2);
- Ocean acidification (using red cabbage as natural litmus to indicate change in pH as CO_2 is added to water).

Session 2: Carbon dioxide capture and storage

The second session provided an overview of CCS, to provide the context for the development of the pipeline, and began with a brief discussion to identify participants existing level of knowledge and awareness of the technology. A power point presentation given by a member of the project team from Tyndall Manchester included:

- The UK generating mix and energy demand;
- Link with fossil fuels and climate change impacts;
- Climate change policy and 2050 targets;
- Description of CCS technologies;
- Current CCS demonstration projects.

Following the presentation, participants discussed what they considered to be the pros and cons of CCS in groups of 2 or 3 before a wider facilitated discussion with the whole group.

Sessions 3 and 4: Pipelines and qualitative risk assessment

The afternoon sessions focused solely on pipelines and included presentations on CO_2 pipelines and the quantitative risk assessment process, delivered by an experienced pipeline engineer involved in the broader COOLTRANS project. Each presentation was followed by an opportunity to ask questions

and a facilitated discussion to explore participants' reactions to the presentation topics. The CO_2 pipeline presentation covered:

- Substances transported by pipeline;
- Pipeline materials;
- Pipeline dimensions;
- Operating pressures;
- Safety measures;
- Pipeline routes.

The second presentation covered risk issues, including a description of risk and how safe levels of risks are defined and a description of how pipeline routeing decisions are made. Between the first and second presentations, participants were asked to undertake an activity to identify their main concerns relating to the prospect of a CO_2 pipeline located close to their neighbourhood, working with a map of the proposed pipeline route. They were invited to express their initial reactions and identify what they consider to be the most important issues in promoting acceptance of the pipeline development. This exercise was carried out in unfacilitated groups of two or three before reporting back to the rest of the group. The group as a whole then discussed these concerns and issues in more detail during facilitated discussion.

2 Results

In this section we firstly report the results of the pre-group questionnaire before the responses of the lay participants to the focus group sessions described above. In accordance with the project aims the focus here is on how participants relate to CO_2 and its potential transportation by pipeline in their local area. Results are presented as a description of the key issues covered in discussions, supported by direct quotations where these are considered to support the responses described. All quotations have been anonymised to obscure the identity of the speaker while allowing the reader to distinguish between speakers. Although a session was included on CCS, in order to contextualise the discussions, public opinion has been widely studied and reported elsewhere (including by the authors of the present report) and is not addressed in any detail here.

The aim was to conduct both focus groups with a range of ages, however participants eligible for the group in Barmston were all over the age of 45. The second group which took place in Holme-on-

Spalding Moor had a greater range of ages taking part. The group in Holme-on-Spalding Moor (located further inland and hence closer to the power station site) were more cynical about what was discussed during the groups, whereas the group in Barmston, were more positive about the technology in general. During the ice-breaker session, the group in Barmston reported positives of living in the local area as its location close to the sea, its peacefulness and good amenities whereas the Holme-on-Spalding Moor group focused on the scenery, the safety of the area and also the local amenities. Participants also discussed the negatives of living in their area, the group in Barmston focused on the deteriorating town centre with many shops closing down whereas in Holme-on-Spalding Moor group had more concerns about traffic.

2.1 Pre-group questionnaire

Participants were asked to fill in a questionnaire before the focus group took place (see Appendix 6), this was done to identify their opinions on a variety of different topics before they were given any further information by experts.

Participants were asked a number of different questions surrounding the topic of climate change. Deforestation, loss of the ozone layer, air pollution and burning fossil fuels were all considered by participants to be the main causes of global climate change. Almost 60% of participants felt that the risks of climate change outweighed the benefits and the remaining felt the benefits and risks were about the same (26%) or didn't know (10%).

Participants were given the following a brief description of CCS before being asked to select from four options to describe their opinion of CCS:

> *"The Government is currently looking at capturing Carbon Dioxide (the main greenhouse gas attributed to causing climate change) produced by Power Stations and other heavy industries and storing it in underground storage sites below the seabed. The process is called Carbon Capture and Storage"*

42% of participants indicated that they didn't know enough about CCS to have an opinion, while 21% agreed with the statement that it was a great idea, 15% thought that it could work in the short term and 10% selected the statement that it was not a good idea. When asked about the costs and who should be responsible for paying for this technology, 42% thought that it should be a combined effort between the energy companies, the Government and consumers. Participants however

thought that the monitoring should be down to the company who placed the CO_2 underground (42%) or by an independent organisation (42%).

Prior to any knowledge about the pipeline being provided to participants, participants were asked of their initial reaction to a CO_2 pipeline routed through East Yorkshire. Over half (52%) stated that it would not worry them, with 42% of participants indicating it would worry them a little. Participants were asked to what extent they trusted a number of different stakeholders, including National Grid: 42% of participants trusted National Grid, with 21% feeling distrust towards them, and the remainder neutral. The full results from the questionnaires can be found in Appendix 7.

2.2 Carbon dioxide

This section details discussions which took place during this first session of the focus group. Group participants were not comfortable discussing the properties of CO_2 prior to the presentation, which successfully engaged the groups in the discussion topics that it introduced.

2.2.1 Initial understanding

Participants appeared to be unconfident in discussing an unfamiliar subject such as CO_2[2]. Prior to any presentations or demonstrations, although participants demonstrated some awareness of CO_2 they were not familiar with its sources or properties:

> *I think general perception is not – it isn't understood for I would say the majority of people. We don't understand it at all, well, I certainly didn't properly. You know bits about it but not enough clearly.*
> Female (F1) Barmston

> *Isn't it said to be the major cause of global warming?*
> Male (M3) Barmston

> *Does it have a smell?*
> Female (F1) Holme-on-Spalding Moor

[2] The term "carbon dioxide" was used throughout the sessions however, for the sake of brevity we refer to it as "CO_2" in this document.

Participants were initially asked for words or phrases they associated with the CO_2, the language surrounding this question was deliberately kept very open to avoid leading participants in answering in a particular way. Answers were grouped in the analysis stages into positive and negative associations (see Table 3). While participants were reasonably clear that CO_2 played a role in natural plant processes, and about some of the anthropogenic aspects of CO_2, some participants expressed confusion between CO_2 and carbon monoxide, associating CO_2 with carbon monoxide poisoning. However no-one from either group, considered CO_2 to be explosive or flammable.

Table 3: Participant associations with CO_2 (Groups Combined)

Positive associations	Negative associations
trees	poisonous
plants	faulty heaters
photosynthesis	global warming
natural	electricity generation
	pollution
	industrial
	invisible

To further unpack the understanding of participants the facilitator asked how they would describe CO_2 to someone who knew nothing about it; descriptions varied but the narrative focused on the actual gas rather than any of the associations they had previously described (see Table 3) and tended to include the words invisible, colourless and odourless.

While the majority of participants had a basic understanding of CO_2 prior to the presentation, during initial discussions there were certain areas of confusion which focused primarily on the mix up between carbon monoxide and carbon dioxide - a misconception which was corrected by other members of the group. Carbon monoxide was also brought up in the Holme-on-Spalding Moor group, in relation to industrial towers but again the participant was corrected by another member of the group:

But it can be an invisible killer.
Male (M4), Barmston

Faulty heaters and flues.
Female (F2), Barmston

Does carbon monoxide come out of the chimneys?
Female (F2), Holme-on-Spalding Moor

2.2.2 Natural or manmade

In addition to discussing their general associations with CO_2, participants were also prompted to discuss whether they considered CO_2 to be a natural or manmade product. Participants recognised that CO_2 is both naturally occurring and a product of industrial activity and this led to some confusion about where to place it:

It's got to be natural if we breathe it out.
Female (F1), Holme-on-Spalding Moor

What we breathe out is natural and then we produce it when we burn fossil fuels, so you could class that as being manmade.

Male (M4), Barmston

It pollutes the environment and things like that, which is really bad view or whatever. If you live in a city, then you have bad problems. But then it can't be so bad because plants use it and things like that.

Female (F4), Holme-on-Spalding Moor

2.2.3 Terminology

Throughout the sessions the term "carbon dioxide" was used in preference to "CO_2", however, the relative implications of the different terminology, and which term participants were more comfortable using, were also explored prior to the expert presentation to the group. The two groups differed in their responses. The majority of the female respondents in Barmston preferred the chemical formula (CO_2) to "carbon dioxide". A small number of participants said that carbon dioxide sounded dangerous, and it was suggested that this was due to its similarity to the term "carbon monoxide". The remaining participants in Barmston and the majority of participants in Holme-on-Spalding Moor were equally comfortable with either term. "Carbon dioxide" was considered by participants to be a familiar term, known to the majority of people; despite this, in some cases the use of chemical formula "CO_2" was considered to sound more technical:

I think carbon dioxide perhaps sounds a bit more menacing because you associate it with carbon monoxide.

Female (F2), Barmston

I think of the whole – I think, you know, well, CO_2, carbon dioxide, it's all the same thing to me, I don't differentiate.

Male (M1), Barmston

2.2.4 Responses to CO_2 demonstrations

A presentation entitled "An Introduction to carbon dioxide" was delivered by an expert in science communication from the chemistry department at the University of Hull. The presentation involved a series of different experiments and demonstrations. On the whole, participants enjoyed the visual and interactive nature of the CO_2 demonstration, reporting that they found it to be engaging and a useful way to communicate an unfamiliar topic such as CO_2 to a lay audience. There were over 9 different demonstrations during this presentation, each of which elicited different responses from the participants. The most popular demonstrations, and the reaction of participants to the demonstration, are outlined in Table 4.

Table 4: Preferred demonstrations during expert presentation

Demonstration	Reason for demonstration	Overall Participant reaction
Discussion of plant CO_2 uptake using a conker.	To show that CO_2 is a natural component of air and a tree is largely made from carbon which has been extracted from the CO_2 in air.	B: Positive HSM: Negative
Red cabbage in water, adding dry ice.	To demonstrate the impact of CO_2 on ocean acidification.	B: Positive HSM: Positive
Carbon dioxide in food – it has an 'E' number, popping candy, yeast, bicarbonate of soda.	To show the everyday uses of CO_2.	B: Positive HSM: Positive
Make up of carbon dioxide molecules using kits to build a model.	To illustrate that carbon dioxide is made from 2 oxygen and 1 carbon atom. Explained difference between CO_2 and CO.	B: Positive HSM: Negative

The first demonstration in this session used a conker as a prop, to explain how a plant converts atmospheric carbon into plant material, as part of the natural carbon cycle, as it grows into a tree. Opinion among the groups was split over this demonstration. The Barmston group responded most positively, describing the presentation as delivering a simple manageable message which put the 'whole picture' of CO_2 into perspective - something they had not considered previously. The Holme-on-Spalding Moor group, however, considered that the demonstration was quite confusing and did not give a clear message. The Holme-on-Spalding Moor group also struggled with the molecular models - several participants found these to be particularly confusing and complicated. Those

participants who had not studied science since school found the technical explanations of the demonstrations harder to connect with and did not consider them to be a successful method to communicate to a lay audience:

> *Because we haven't been to school for years, a bit of it went over my head, even though I knew basically what he was getting at.*
>
> Female (F1), Holme-on-Spalding Moor

Both groups responded favourably to the experiment to demonstrate that CO_2 is denser than air; a fish tank was filled up with CO_2 (using dry ice), soap bubbles blown into the CO_2 are then seen to bounce along the top. This was found to be both visually engaging and a useful way to portray the density of CO_2:

> *[Bubbles] bouncing off the container of CO_2, very visually you can see that it was solid.*
>
> Female (F2), Barmston

The "cabbage pH" demonstration consisted of a simple experiment designed to support the explanation of the process of ocean acidification as an impact of increased atmospheric CO_2 concentration. CO_2 was added (as dry ice) to a tank of water containing chopped red cabbage, as the acidity of the water increases (and its pH falls), the change in pH is indicated by a change in colour of the water. Both groups considered it to be a great way to visualise ocean acidification, particularly since the demonstration used some everyday items that they could use themselves to demonstrate to others what they had learnt at the focus groups (the experiment could be repeated at home using vinegar and baking soda to make the CO_2). The demonstration was considered to deliver a clearly understandable message that could be widely and easily understood.

The presentation consisted of 9 demonstrations in total, all delivering key messages about CO_2 using different methods. Participants expressed enthusiasm for this approach and found the style of engagement to be useful and informative given their limited understanding of the topic beforehand:

> *Yeah, for me it just reinforced it all. So, more knowledgeable and therefore that knowledge can be used to make a [difference].*
>
> Male (M1), Holme-on-Spalding Moor

> *I think the two - they were such basic components, just carbon and oxygen, and yet it's a massive spectrum of where it is and what it is. And I just - it didn't register at all to start with, I just thought carbon dioxide, it's a negative gas, we breathe it out, it's waste, and it isn't, there's more to it than that.*

Male (M1), Barmston

The majority of participants expressed more positive opinions about CO_2 following the presentation, which was considered to have helped inform a better understanding of the compound. The presentation was also seen as being useful in helping to clarify unfamiliar concepts:

> *It seems more manageable, with it being heavier than air, it seems that you would be able to direct it more easily and therefore it's safer.*
>
> Female (F1), Barmston

> *I think the difference between the monoxide and the dioxide that I wasn't too sure about but now I know there's not enough air in there becomes monoxide. I understand that a little bit more.*
>
> Male (M4), Barmston

> *It's a fairly non hazardous commodity anyway, carbon dioxide, it's not like it's oil.*
>
> Male (M3) Barmston

While the majority of participants were positive about the informative role of the presentation, a small number of participants remained hesitant in their opinions, preferring experts to make a more explicit judgement about CO_2:

> *I think his presentation was good and it was eye catching, the colours and the ice and everything, but it didn't, to me, really let me know if it is good or bad. It still doesn't prove to me, what he was saying; is it a good thing or is it a bad thing?*
>
> Female (F1) Holme-on-Spalding Moor

Lack of knowledge in CO_2 was not universal, there were a number of participants who were already reasonably confident in their knowledge of CO_2 as a result of their previous job roles (e.g. as a nurse, gardener and potter) and did not change their opinion as a result of the presentation:

> *To be honest, my opinion about it hasn't changed. It's there. Like you said, it's always going to be there, whether we like it or not. It's just a natural thing which is always going to be there. So, no, it hasn't really changed.*
>
> Male (M4) Holme-on-Spalding Moor

The CO_2 presentation confronted participants with a large amount of information in a short space of time. Here we summarise the key messages participants reportedly took from the presentation and why these were considered to be important to them. Participants were surprised about the presence of CO_2 in so many everyday things, particularly as they are now more aware of its impact on climate change:

It seems to be part of everything I think, doesn't it?
Male (M1), Barmston

Obviously, I mean it has always been there in the atmosphere. It's sort of one of life's facts, I suppose. But I suppose the fact that we, as people, contribute to that, whether inadvertently or not.
Female (F4), Holme-on-Spalding Moor

The impact of CO_2 on ocean acidification was also identified as a new concern for participants following the presentation as something they had not previously heard of in relation to CO_2 emissions. Although this was raised as an important factor for participants in both groups, this was particularly the case in the Barmston group, situated on the Holderness coast overlooking the North Sea. Participants were more concerned about the impact of CO_2 after the presentation and discussed possible solutions to the growing problem:

*Theoretically you can solve the problem by just planting millions and millions of trees***.**
Male (M3), Barmston

Instead of cutting them all down.
Male (M1), Barmston

2.3 Carbon Capture and Storage

The CCS session followed on from the CO_2 discussions, detailed below are the results.

2.3.1 Participant understanding of CCS

Prior to the expert presentation on CCS, participants were asked to engage in a short discussion to uncover their initial understanding around CCS. Across the two focus groups (19 participants), only 3 male participants in the Barmston group were familiar with the term, for the remaining participants, the focus group was the first time they had ever been introduced to it. For the three participants

who had come across CCS before, their source was information they had read in the local free press about the pipeline project. Despite reading the article, their knowledge was however limited with only one participant recalling enough of the article to attempt an interpretation of CCS:

> *They're talking of storing it and piping it from miles and miles away into West Riding in huge pipelines underground to some offshore caverns as I understood it.*
>
> Male (M2), Barmston

2.3.2 Initial reaction to CCS

For the majority of participants, the focus group was the first time they had ever heard about CCS and as such, discussions prior to the expert presentation were somewhat limited. Given this lack of knowledge, the presentation provided participants with an initial overview of an unknown topic, intended to inform subsequent discussion in an biased manner. In the session post-presentation, participants were asked for their initial reaction to CCS and what they felt were the main positives and negatives of the CCS process were. Participants, particularly in Barmston were more open to the technology, reporting that if it had to be introduced to their local area and if CCS was going to be part of the future of Britain then they should not stand in the way:

> *It needs to be somewhere, doesn't it, so why not here?*
>
> Male (M1), Barmston

> *I think you can't do the NIMBY bit to be perfectly honest, it's got to be somewhere and eventually they'll be everywhere.*
>
> Female (F1), Barmston

Participants discussed the impact a CCS project would have on them and questioned whether it would have a direct bearing on their lives. Many suggested that the benefits of such a technology would have little benefit to them their lifetime, however they had the responsibility to go ahead with such a technology to ensure that future generations were looked after:

> *But we're all responsible, aren't we, you know, we should all take our slice.*
>
> Male (M4), Barmston

> *Well, the fact that it's not going to affect us, particularly, but I've got grandkids. What's going to happen to them in fifty years' time? They're going to have the brunt of what we're creating. If this was to go forward, then it's probably going to make a big difference to their lives.*

Male (M3), Holme-on-Spalding

Others were less concerned about CCS, considering it to have little impact on them and hence not provoking strong opinions. Other members of the group felt that participants should care more given the impact it may have on others around them:

> *But I just think directly, on a personal – I mean it might in terms of financial or even when you drive through the countryside you might see it, but it's not going to really directly affect you emotionally or physically.*
> Female (F4), Holme-on-Spalding Moor

> *But is that fair to think it won't affect me, therefore it's not a problem?*
> Female (F3), Holme on Spalding Moor

After the CO_2 session, many participants in the CCS session found it to be a positive step forward that something was being done to reduce the amount of CO_2. Participants were reportedly more informed and had an increased awareness of the problems associated with CO_2 and as such felt that CCS could be useful tool to try and reduce a growing problem:

> *I just think the CO_2 is better down where it can be monitored and not floating around.*
> Male (M1), Barmston

> *They're actually actively doing something. Whether it works or not, but they're trying.*
> Female (F1)*, Holme-on-Spalding Moor*

> *Of course, and if you put it off another ten years, or another twenty years or – you're never going to get a situation where everybody is happy with it, but we are fire fighting and so we need to do something.*
> Female (F2), Barmston

Participants in both groups displayed a sense of pride in their local area, alongside their anxiety over the increasing lack of jobs in the area (expressed in the icebreaker session). Although a primary concern about a CCS project was the potential cost, they could see the benefits of a new development in providing a boost for the local economy. Groups were of the opinion that local companies should be involved, particularly during the construction stages:

Well, it's going to cost a lot to do it, to create it and to build it, but then it's relating to the job bit. So it's going to cost a lot, but it's going to create employment.

Female (F3) Holme-on-Spalding Moor

Another issue participants raised in relation to the introduction of CCS to the local area was the lack of "tried and tested" projects in the UK they could look to for reassurance. However, while they were initially concerned about the lack of CCS projects in the UK (participants were told about successful CCS projects elsewhere), participants considered that, if the project was to go ahead, Yorkshire would be used as a positive example for others:

But also, we've got to look at this from a global perspective as well rather than just Yorkshire. And so another positive element is that Yorkshire can be used as an example of how the world should go because it can only be of any use if the whole world does it rather than just a small region of the UK.

Male (M1), Barmston

There was not universal approval among the groups for CCS, for a number of participants felt that CCS was just masking a problem (coal power stations) that they had been told for years that was damaging to the environment. They felt that more drastic changes had to be made to move away from environmentally damaging processes:

Yeah, because I think you said it was a coal-fired power station and we thought the plan was to try and move away coal-fired stuff. So why are we building more?

Male (M4), Holme-on-Spalding Moor

2.3.3 Storage

In line with our research aims, discussion focused primarily on CO_2 pipelines; however, participants in both groups shifted discussion towards the storage of CO_2, suggesting that out of the different stages of the CCS cycle storage was a significant area of concern with many unknowns:

The world can only store so much and then what?

Male (M1), Barmston

Yeah, I don't think there can possibly have been enough, no disrespect to you, research into it to see what could happen.

Female (F2), Barmston

Do they know what timescale have we got, how long can we go on storing the CO_2, what capacity we have to store it once we've outgrown the storage, then what do we do?

Male (M4), Barmston

Although acknowledging the computer modelling currently used to predict the fate of stored CO_2 over long time periods, participants considered that this was insufficient to provide reassurance for such a new technology. They were concerned that, without adequate empirical data on which to base modelled predictions, there could be little confidence in the accuracy of such predictions. Although participants understood some of the concepts around storing CO_2 and the benefits of doing so, (as explained in the morning CCS presentations), they questioned how 'environmentally friendly' storing CO_2 was. A number of participants queried how 'natural' it was to put such a substance, into the ground and feared there may be consequences of doing so:

Because it's not storing, it's dumping?

Male (M3), Barmston

In an unprompted discussion, participants in the Holme-on-Spalding Moor group also made a connection with the process of fracking for Oil Shale production and queried whether CO_2 storage could cause earthquakes. Prior to the focus groups, the majority of participants had never heard of CCS and those that had, had very limited knowledge. In the context of limited prior knowledge of CCS, despite a detailed presentation, certain concerns resulted from misapprehensions about aspects of the storage process:

So if it's heavier than air then and we pipe it all in huge pipelines to huge caverns underground, will it not slowly over the years percolate downwards?

Male (M2), Barmston

All these storage places, I mean, the different countries now you're talking about all have different climates and, you know, Dakota is I know very dry, Norway is very cold, Canada very cold. Compared to where you're going to store it in Britain, is that likely to affect the storage at all?

Female (F4), Holme-on-Spadling Moor

2.3.4 Other uses of CO_2

For the majority of participants, storing CO_2 underground was a new concept to them. A number of participants questioned whether the CO_2 could be put to better use and questioned whether in the future, with more research, it might be something we discover to be more useful to us that we think:

> *I think is it – it's a shame really I suppose in years to come I don't know, but the way that we're developing, that we can't find a use for this rather than just storing it.*
>
> Male (M4), Barmston

> *Can it be recovered? Can we get it back again if we need to?*
>
> Male (M3), Barmston

> *Yeah, I don't have any objection to it in principle, I think there are better ways we could look to the future, but if it has to happen...*
>
> Female (F2), Holme-on-Spalding Moor

2.3.5 Comparison with other technologies

Participants discussed the use of CCS as a climate change mitigation measure. Although somewhat accepting of the technology if the pipeline project was to go ahead, both groups discussed whether the UK would be better suited to concentrating on other (renewable) methods of energy generation:

> *I think – I don't know if we put as much research in, I mean, we're an island, we're surrounded by water, the tide goes in and out what, every three hours, are we putting enough research into capturing the power of the water?*
>
> Male (M4), Barmston

> *What about solar energy? There's always going to be the sun. Perhaps I'm naive, but if everything is warming up, then surely the sun will be more – surely we could utilize more energy more efficiently. That's why everyone's getting solar panels on their houses.*
>
> Female (F4), Holme-on-Spalding Moor

2.4 Transportation of CO_2 by pipeline

The afternoon session of the focus groups focused exclusively on pipelines. Prior to the pipeline presentation, participants considered themselves relatively uninformed. The presentation was seen by participants as providing clear and transparent information, leaving them more comfortable

about the pipelines and the risks they bring. Participants were encouraged that so many factors were considered by the companies involved, which gave them confidence in the overall process:

> *That the powers, underground, and how they plan and think of exactly where to put it, and also that they put everything back, you know, the scenery. It's disrupted for a bit, yes, when the work's happening but then when they've finished it's back and it was lovely seeing that picture, it's all put back and as you say, you wouldn't know unless you know…it's less concerning that they do actually plan right down to where it's not going through a wood, it's not going through this.*
>
> Female (F1), Barmston

> *It seems the utmost care is taken with routing.*
>
> Male (M2), Holme-on-Spalding Moor

Following the expert presentation, participants were asked to discuss which elements of the presentation reassured them, what concerns they held about CO_2 transportation by pipeline and what would allay those concerns. The greatest concerns, in terms of frequency and length of discussions, related to: disruption, safety and trust in the companies involved. More general concerns around the storage side of CCS were also raised, responses to this topic are described in the following section (in section 2.3.3) in which we present some of the less specific issues that emerged during the group discussions. Participant concerns will now be discussed in more detail below.

2.4.1 Safety

The broader issue of safety was manifested in different contexts during the discussions. Participants in Barmston introduced the issue of safety early to the discussion as one of their key concerns. Because both CCS and CO_2 pipelines were seen as a new technology to the UK, and one which participants were unfamiliar with prior to the focus groups, participants voiced concerns over whether safety could be guaranteed – in relation to both long- and short-term health and safety implications. Participants' main concerns related to the consequences of a pipeline leak:

> *We haven't really heard if there was a big escape from the pipeline, what would happen?*
>
> Male (M4), Barmston

Given the low level of awareness of the properties of CO_2 and its behaviour within a pipeline at the start of the process, the discussions reveal that, as a result of the presentation and subsequent discussions, participants achieved a certain level of understanding of the most extreme consequence of a leak:

Well, it would kill whatever was in that area.
Female (F1), Barmston

If it was concentrated enough and didn't disperse quickly, yeah.
Female (F2), Barmston

Participants were concerned about the local safety aspects of leaking pipes, the speed and accuracy with which leaks can be detected and what steps are taken to both prevent leaks from happening and put right if a pipeline does indeed leak. They were also concerned about the environmental impact of a pipeline leak, for example on plants, wildlife and farm animals, on a local scale:

If it escapes by a field full of cattle, is it going to kill that cattle?
Male (M3), Barmston

The pressure at which the pipeline will operate also raised safety concerns for participants who were confused about the possibility of a change in pressure of the pipeline and the consequences of this occurring. Given the risk of asphyxiation in the event of a leak, participants discussed whether there would be an "evacuation plan" for local residents if something was to go wrong:

Because it's heavier than – it's more dense, if it were to explode here under this room, it would just sort of be here and we'd be asphyxiated.
Male (M2) Holme-on-Spalding Moor

The fact that the pipeline in question would be the first of its kind in the UK, with no other 'tried and tested' CO_2 pipeline within the UK was a concern for participants. They questioned the reasons behind transporting CO_2 by pipeline and the CCS process in general. Evidence of other successful projects was discussed by participants as an important factor in accepting this relatively new technology if the area was to be the first in the UK to have such a development. They were concerned that there could be problems in the future if the pipeline was to go ahead:

I don't know because I'm not a scientist, but there's always in the future lots of things [that] come back to bite us.

Female (F2), Holme-on- Spalding Moor

Rather than just letting us be a guinea pig.
Female (F4) Holme-on-Spalding Moor

Relating to the novelty of the process, participants were also concerned about who would have control of the pipeline and its operation, there was a need for reassurance that if something went wrong there would be known steps in place to control the damage done and in particular that the flow of CO_2 could be halted in the event of an incident. The threat of terrorism was discussed during the Barmston group, with a small number of participants suggesting that the CO_2 pipeline could become a potential target. During the group process, participants decided that they had been given enough information to allay concerns about an explosion, but that the pipeline may nevertheless be vulnerable to terrorism, on the grounds that this understanding might not extend sufficiently widely to avoid it remaining a potential target. However participants discussed this amongst themselves and came to the conclusion the damage would be minimal compared to other potential targets that terrorists may pursue:

> *Regarding the terrorists, gas pipe, yeah, but not a CO_2 pipe. I can't see what they've got to gain.*
>
> Male (M4), Barmston

The possibility of human error and the potential impacts of such errors on the pipeline, led participants to consider what could happen if, for example, a farmer accidentally damaged the pipeline with a piece of machinery, what regulations would be in place to reduce the likelihood of this happening and how could compliance with regulations be ensured:

How many ruthless builders are out there and will ignore it?
Female (F3), Barmston

2.4.2 Disruption

Disruption was a concern for participants in both groups, although more so for those in Barmston. Key concerns were related to the disruption that the initial pipeline construction may bring and in particular, the short term disruption that might directly impact them and their families. The local area is characterised by small roads connecting each of the towns and villages and traffic was

identified as an issue of concern from the start of the Holme-on-Spalding Moor group. Any disruption caused by construction of a pipeline was seen as potentially exacerbating this already growing problem:

Especially in little villages – heavy trucks and stuff like that, you know. With tiny B roads.
Female (F2), Barmston

Participants were concerned about the length of time construction would take and impacts of the construction process. Expressing a need for realistic estimates of how long it would last, so they could plan accordingly and for the disruption to be kept to a minimum. Concerns related to pipeline construction from some members of the Barmston group also extended to the wider environmental impacts of a pipeline, notably the impact a pipeline may have on the local wildlife, local historical sites and rural landscape, counteracted by other members of the group that were more confident that things would be restored after construction had taken place:

But it will have an impact on wildlife when you're doing it.
Male (M4), Barmston

When you're doing it, but that's short.
Male (M1), Barmston

Participants in this group, located close to the East coast, which has suffered significant problems from coastal erosion in recent years, were already concerned about the environment in their local area and considered the construction of the pipeline and related processes might exacerbate this deterioration of the coastline:

This coastline is eroding badly. So if they're pumping it out into the sea at a certain distance...
Male (M4) Barmston

It could impact on that erosion
Female (F2) Barmston

With a sense of pride in their local area, participants were also very aware of the potential impact of pipeline construction on local businesses, especially near Barmston where the tourist trade is critical to the local economy. The scenery and landscape were seen as a major attraction to visitors to the East Riding of Yorkshire; with falling tourist rates already a concern, anything that may discourage visitors was seen as damaging for the area.

Typically, concern about any disruptive effects of the pipeline related to the short term issues. Only one participant suggested that there might be longer term implications:

Just it goes straight through my little village. I think we'll be selling the house.
Female (F3) Barmston

2.4.3 Trust

The issue of trust recurred through both groups, in particular revealing scepticism towards the companies involved in the pipeline project; this combines with a fear of the unknown to prompt questions about the consultation itself:

> *Just the fact that there seems to be some glaringly obvious catches that none of us are not quite aware of because we're not quite knowledgeable. I mean the fact alone that you're running a focus group about it, I mean, why?*
>
> Female (F4), Holme-on-Spalding Moor

There was a concern among participants over who would be running the pipelines – from construction to the long term storage plans. Participants in both groups discussed the motivation behind the project and in particular, National Grids involvement. They queried whether National Grid was a private or public sector organisation and what sort of relationship they had with external regulators. They recognised National Grid as a supplier of electricity and gas and so queried this as something separate to that. Participants discussed the motivations behind building the pipeline and the primary reasons for companies to become involved. They considered that although CCS and the CO_2 pipeline were being portrayed as something positive which could be used to reduce the impact of CO_2, it was inevitable that the company' main motivation would be potential profit from the project. Transparency was important:

Most people will only tell you what they want you to know anyway.
Male (M4), Barmston

> *I have a concern that things that are shareholder owned like this, all they're worried about is the money to give the shareholders.*
>
> Female (F1), Holme-on-Spalding Moor

It's true, are they actually bothered about improving the environment?
Female (F5), Holme-on-Spalding Moor

They discussed who would have overall control over the companies involved and whether they would be Government or shareholder driven. They were keen to understand who was in control of the project during each of the different stages of the CCS process and the type of safety regulations they would have to adhere to:

> *Just the cynic in me, you know, we presently have an issue with all the water pipes, the fact that water's not been – our pipes haven't been maintained that well and that a lot of money has now been put into that and water rates have gone up and everything else, and suddenly they're having to repair them. So it's, you know, what guarantee, because we don't really have a guarantee, that things will be properly maintained?*
>
> Female (F4), Holme-on-Spalding Moor

> *I think in a perfect world all of this would be getting done just to save the planet or whatever, but at the end of the day you don't get many businesses whose purpose in life is to save the planet*
>
> Female (F5), Holme-on-Spalding Moor

2.4.4 Other

Revisiting the issue of trust, participants discussed the companies who were responsible for the storage site and, given the long time periods involved, questioned who would take responsibility for the site and its content in the long term. With their sense of attachment to the local area, participants also expressed a need for a more thorough explanation of benefits of CCS. With an existing concentration of both large fossil fuel power stations and wind farms across the region, there was concern that this could be "another thing" that residents had to tolerate with no apparent direct benefit to them:

> *I think there's definitely a feeling from people in this area that we, in East Yorkshire, are being dumped on a bit.*
>
> Female (F1), Holme on Spalding Moor

> *That's why everyone's like, "Why are all the power stations in Yorkshire? Are you trying to poison everyone?*
>
> Female (F4), Holme on Spalding Moor

> *I wonder why they have specifically targeted the east coast, is it because the land is flat?*
>
> Female (F3), Barmston

I can just imagine that when this is going up, if it does, you can just see the headlines in the local newspapers saying, "What's this in our back garden?" People get upset about roadworks and a power station is a different kettle of fish.

Female (F4), Holme on Spalding Moor

2.5 Post- Group questionnaire

Participants were asked to fill in a further questionnaire after the focus group had taken place to identify any change in opinions (see Appendix 6).

Reactions to CCS improved as a result of the discussions: 47% of participants now agreed with the statement that it was a great idea (compared to 21% prior to group discussions beforehand). Opinions on who should be responsible for monitoring stored CO_2 and how much more a month they would be willing to pay for such a technology remained unchanged, with the maximum acceptable increase in electricity bills of £2 per month (31% of participants), however the same percentage of participants were unwilling to pay anything additional. Despite having more information, reaction to the idea of a pipeline in East Yorkshire remained unchanged with over half (52%) stated that it would not worry them, with 42% of participants suggesting it would worry them a little. Opinions on National Grid did not change after the focus group. Further results can be seen in Appendix 7.

3 Summary

The section below summarises participants' responses during the focus group discussions with respect to the key themes; CO_2, CCS and pipelines. Participants' main areas of concern within each of the themes are identified as well as which aspects of the expert presentations they found reassuring.

3.1 About CO_2

- Participants are familiar with CO_2 but not with details of its sources or properties;
- CO_2 / carbon dioxide: the terminology is not critical, although "carbon dioxide" is more likely to be confused with carbon monoxide;

- CO_2 is viewed as both a natural and man-made compound and this ambiguity can lead to some confusion;
- Participants responded positively to being presented with information about the properties of CO_2 and were reassured: that it is denser than air (seen as making it more "manageable"); by how CO_2 is formed through the combustion process and the conditions that produce carbon monoxide (CO), which could not occur in a power station;
- The potential for utilisation of CO_2 was raised as an alternative to CCS and also in relation to whether stored CO_2 could later be recovered and used.

3.2 About CCS

- There was very limited awareness of CCS - only one participant could describe what CCS was;
- Following the presentation participants were broadly positive:
    - CCS is seen as actively "doing something" about the problem of climate change
    - A sense of pride that Yorkshire could be seen as a leader (although concerns were also expressed that the area supports an excessively high concentration of energy infrastructure suggest that this could be finely balanced)
    - Identifying benefits in terms in terms of local jobs
    - Local impacts would not be significant
- Although none of the participants were opposed to CCS (or the proposed pipeline) in principle, negative aspects of CCS were also raised:
    - That CCS perpetuates the use of coal fired power stations
    - That eventually storage sites will be filled and at that point we will need alternative power generation options
    - The investment in CCS would be better directed to a longer term solution and questioned whether the UK should be concentrating on renewable energy instead (tidal, wind, solar all mentioned)
- The main concern expressed around impacts of CCS related to storage:
    - Seen as "dumping" rather than storing
    - Lack of confidence in modelling of the fate of stored CO_2
    - The implications of interfering with nature, including the potential for inducing earthquakes (making the link to recent incidents related to fracking)

3.3 About pipelines

- Trust in the companies responsible for the pipeline is crucial and operates at different levels:
    - Participants expressed scepticism surrounding the motivations of private companies that claim environmental benefit as a driver for a particular project or development. It was understood that private companies need to operate profitably; however, it was seen as important that the relative benefits of a project are perceived to be distributed fairly between the developer and the local community
    - Once a decision to build the pipeline has been taken, the local community must trust that the developer will minimise risks during the selection of the route and subsequent construction, operation and maintenance of the pipeline
- Participants were reassured by information on the wide variety of issues considered in the development of a pipeline;
- Initial concerns about the potential for explosion were allayed by provision of information about the pipeline safety and the properties of CO_2.

Main concerns around pipelines:

- That the installed pipeline will be either forgotten or that measures/regulation to prevent third party damage will be ignored;
- Consequences of a pipeline leak on health and safety and impacts on vegetation and livestock;
- Speed and accuracy of leak detection;
- Procedures to repair and maintain the pipeline;
- First of its kind in UK;
- Potential for the pipeline to become a terrorist target;
- Short term disruption during construction (landscape, wildlife, cultural sites, tourism);
- Impacts on coastal erosion at the landfall site.

4 Discussion

This report has presented results from two focus groups in which members of the lay public were guided through detailed discussions relating to CO_2 and its transport by pipeline. Other research has shown how CO_2 is perceived as a substance is a key factor governing how people view CCS technology overall (Itaoka et al. 2009). When considering potential responses to a CO_2 pipeline, the existing associations, understandings and perceptions of what is being transported are likely to play

a large part. The research presented here complements findings from previous studies suggesting that there is a reasonable level of general knowledge about CO_2 among the lay public but a poor understanding of its more specific properties (see Itaoka et al. 2012).

While the participants to the groups were not initially familiar with the properties of CO_2, an explanation of its basic physical properties supported participants' understanding of some of the consequences of transporting CO_2 (such as the pipeline design and routeing) and of potential exposure to CO_2 (for example that it is not toxic but is an asphyxiant). This level of understanding was evidenced in discussions relating to the relative implications of transporting different substances, revealing an ability to use this new understanding to conceptualise different types of risk. For example, participants appreciated that, unlike natural gas, CO_2 is not explosive but that its high density results in a very different dispersion pattern to that of natural gas.

Although the reaction of participants to the issue of the wider use of CCS as a climate change mitigation option was not a central aim of this study, it is likely to be a major factor in the response to the proposed pipeline development (as arguably the most high profile and visible aspect of a CCS project). The potential public response to CCS technologies has been extensively studied previously with findings consistent with those described in this report (see for example, Shackley et al. 2005; Ashworth et al. 2010; Fleishman et al. 2010; Oltra et al. 2010; Upham and Roberts 2011 and Whitmarsh, et al. 2011). Participants have very little prior knowledge of CCS - few have even heard of the technology – making it difficult to predict how the debate will evolve as it enters the mainstream. However, on provision of introductory information about CCS, initial responses do not reflect an intuitive opposition to the technology. Renewable energy supply options are typically preferred and acceptance of CCS may be conditional on it being introduced as part of a portfolio of measures and not as a substitute for renewable alternatives. As described in the introduction to this report, previous studies suggest that CO_2 storage is the step in the CCS chain that causes greatest concern to lay respondents and this was again reflected in the discussions during the present groups.

Participants voiced a high degree of scepticism and questioned the motivations behind the pipeline construction. While trust in organisations involved in any development is a critical component of its public acceptability (Midden and Huijts 2009; Terwel et al. 2009; Terwel et al. 2011), people are not naïve and understand that companies need to make profit – and may question claims that companies are investing in something for purely environmental protection reasons. Previous research suggests that arguments presented by organisations need to be congruent with the type of organisation - a more positive response to statements by private companies is generated when the

economic case is presented alongside the environmental case than when the environmental case alone is presented (Terwel et al. 2011). Once a decision to build the pipeline has been taken, the local community must also trust that the developer will take every step to minimise risks during the route selection and subsequent construction, operation and maintenance of the pipeline. The role of trust in public acceptability extends beyond trust in organisations and their representatives, to the trust in the adequacy of scientific research prior to introducing a new technology, and in the regulatory and public protection processes in place - that they are both adequate and enforceable.

From a technical perspective, risk is the product of the likelihood and severity of an adverse event occurring. When deciding on a pipeline route, and appropriate design measures to reduce any associated risks, a quantitative risk assessment (QRA) is performed to calculate the individual and societal risks arising from the pipeline. The QRA process was presented to participants during the focus groups and a map of the proposed route corridor was used as a means of prompting discussions focusing on the risks that participants associated with the proposed CO_2 pipeline. Lay perceptions of risk, however, go beyond the immediate physical risks (prioritised in the QRA) and included the local, direct and tangible as well as the wider and more abstract. Thus, impacts that participants associated with a proposed CO_2 pipeline through Yorkshire and Humberside were expressed in terms of the safety aspects but also the physical disruption and impact on the landscape and a sense of bearing the burden of energy supply infrastructure in the region (where there is a concentration of both fossil fuel power stations and large scale wind farms). Studies into public acceptance of new technologies have found that public acceptance is, in part, influenced by how perceptions of associated risks are balanced against perceived benefits (Frewer et al. 1998). Financial risk, in terms of large investments made against a technology that, ultimately, was not seen as a not a long term solution were balanced against the benefits of job creation in the area. Participants understood the wider benefits to climate change mitigation, the potential benefits to the local economy and the kudos of pioneering a new technology. Participants were able to rationalise the need to balance risks and benefits across different scales.

The notion that opposition to a new development or technology is simply a result of a lack of knowledge and understanding about the development on the part of lay communities (often referred to as an “information deficit”) has been widely contested in the social science literature (see for example Irwin and Wynne 1996). Research into previous controversies has identified a wide range of factors that can contribute to a community opposing a technology (see for example Devine-Wright 2005; Bradbury et al. 2009; Scannell and Gifford 2011 and Roberts et al. 2013). While a lack of information rarely tells the full story, it does not mean that communities don’t need access to

clear, transparent and balanced information in order to form an opinion. Participants of our groups responded positively to being given detailed information explaining the motivations and processes behind the proposed pipeline development and having the opportunity to ask questions. However, while there is some experience of so-called large group processes that suggests that a level of engagement equivalent to the focus group process may be possible on a larger scale (Ashworth et al. 2009; Howell et al. 2012), a variety of engagement and information approaches is likely to be needed. The challenge of recruiting a sufficient number of participants, both to the focus groups and the wider consultation process indicates a tension between a claimed desire for information and uptake of the information when it is provided. Different types and levels of engagement will be suitable for different individuals, information materials need to be tailored to different audiences and opportunities to engage provided in a variety of ways.

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Appendix 1 - Mailshot

Invitation to attend a Focus Group

Dear Local resident,

You are being invited to take part in research conducted by the University of Manchester to understand public perceptions of an issue with both local and national relevance. I am looking to recruit **fluent English** speakers from your local area to take part in a one-off focus group, during which you will be discussing a number of topics in an informal group setting.

The focus group will take place in a local venue on Saturday the **13th of October 2012**, starting at 10am and finishing at 4pm. Both lunch and refreshments are provided and as a thank you for taking part you will receive **£75 in cash** for completing the full day (6 hour) focus group.

If you are interested in taking part or require any further information, please contact the researcher Laura Thom on 0161 275 4330 or via email Lauralouise.Thom@manchester.ac.uk to book your place.

I look forward to hearing from you

Laura

Appendix 2 - Screening Questionnaire

1. Name :
2. Age: 18-24 [ ] 25 – 33 [ ] 34 – 42 [ ] 43 – 51 [ ] 52 – 60 [ ] over 60 [ ]
3. Contact telephone number:
4. Address and postcode:
5. Are you available on the:

13th October (Barmston)		14th October (Holme)	

6. Have you taken part in any other research or focus groups in the past 6 months?

No		Yes Specify	

7. Are you or any of your close family employees of companies or organisations working in areas related to climate change research, pipeline development, carbon capture and storage or for national grid?

No		Yes Specify	

8. If selected to take part are you willing to commit to the 6 hours focus group (food and drink will be provided)?

No		Yes	

Appendix 3 - Information Sheet

Participant Information Sheet

Public perceptions of CO_2 transport in pipelines – a focus group study as part of the Dense Phase *CO_2* Pipeline Transportation (COOLTRANS) consortium project.

Dear Sir/Madam,

You are being invited to take part in research conducted by the University of Manchester to understand public perceptions of CO_2 transport in pipelines. The reason you have been contacted is that you live close to a proposed pipeline route. Before you decide whether or not you would like to take part in this research, it is important for you to understand why the research is being done and what it will involve. The following information sheet will give you a brief overview of the project funded by National Grid Plc, please take time to read the following information carefully and discuss it with others if you wish. If you have any further questions please do not hesitate to get in touch with the research team (contact details below).

What is the purpose of the study?

The purpose of this study is to explore public perceptions of CO_2 transport in pipelines.

Where is this research taking place?

This research will take place in a location close to the proposed pipeline, detailed instructions on how to get there will be sent to you if you decide to take part.

Who is being asked to participate?

Participants who live in a location close to a proposed pipeline route.

What would I be asked to do if I took part?

If you decided to take part the researcher, Laura Thom, would arrange for you to attend a focus group with approximately 9 other people. The focus group would last 6 hours during which time you would be asked to discuss your opinions on issues relating to CO_2 pipelines.

You will not need to have any prior knowledge of the discussion topic in order to participate. The discussions will be audio recorded.

Do I have to take part?

It is up to you whether or not you take part. If you do decide to take part you will be asked to sign a consent form. If you do decide to take part, you are still free to withdraw at anytime without giving a reason.

Will my taking part be kept confidential?

Yes it will. The focus groups are being carried out in accordance with the Data Protection Act 1998 and have been approved by the University of Manchester's committee on the ethics of research on human beings. The focus groups will be recorded, transcribed and analysed for key themes. The transcriptions will be kept anonymous, your name will not be attached to any records the researcher keeps or reports that are written. Electronic copies of the research will be kept on encrypted computers and hardcopies will be kept in locked cabinets.

How will this benefit me?

Other than the opportunity to engage in a stimulating and informative debate and have your opinions heard, you will receive a financial incentive on completion of the focus group of £75 for 6 hours focus group discussion.

Where can I find more information if I need it?

If you require any more information or would like to take part, please contact:

Dr Laura Thom
Tyndall Centre, Room H1, Pariser Building, University of Manchester, M13 9PL
Tel: 0161 275 4330
E-mail: Lauralouise.Thom@manchester.ac.uk

This Project has been approved by:
University of Manchester Committee of the Ethics of Research on Human Beings

Appendix 4 - Consent Form

Consent form

Title of project: Public perceptions of CO_2 transport in pipelines – a focus group study as part of the Dense Phase *CO2* Pipeline Transportation (**COOLTRANS)** consortium project.

Please initial the box to confirm

1. I confirm that I have read and understood the information sheet dated 7th June 2012 (version 2) for the above study and have had the opportunity to ask any questions and have had these answered satisfactorily.	
2. I understand that this research is voluntary and I am free to withdraw at anytime, without giving reason.	
3. I understand that any information that I give will be used anonymously.	
4. I understand this focus group is being audio recorded for use by the researcher.	
5. I agree to take part in this study.	

Name of Participant Signature Date

Name of Researcher Signature Date

Appendix 5 – Pre Group Questionnaire

Focus Group questionnaire

Thank you for taking part in the focus group. Please complete this questionnaire before the group starts. If you require any assistance in answering these questions, please don't hesitate to ask one of the facilitators.

1. Name _____

2. Gender (please select one answer)

	Please tick
Male	
Female	

3. Age (please select one answer)

	Please tick
15-24	
25-34	
35-44	
45-54	
55-59	
60-64	
65-74	
75+	

4. Ethnicity: (please select one answer)

WHITE		**ASIAN OR ASIAN BRITISH**	
British		Indian	
Irish		Pakistani	
Any other white background		Bangladeshi	
MIXED		Any other Asian background	
White and Black Caribbean		**BLACK OR BLACK BRITISH**	
White and Black African		Caribbean	
White and Asian		African	
Any other mixed background		Any other black background	
Chinese		**Other** (please state)	

5. Working Status (please select one answer)

	Please Tick		
Working - Full time (30+ hrs)		Not working - Looking after house/children	
Working -Part-time (9-29 hrs)		Not working - Invalid/disabled	
Not working - Unemployed		Student	
Not working - Retired		Other	

6. Highest educational or professional qualification you have obtained. (Please tick all relevant boxes)

	Please Tick		Please tick
GCSE/O-level/CSE		Other	
Vocational (=NVQ1+2)		No formal qualifications	
A level or equivalent		Still studying	
Bachelor Degree or equivalent (=NVQ4)		Don't know	
Masters/PhD or equivalent			

7. How much do you trust the following? (Please answer all questions)

	Strongly Trust	Trust	Neutral	Distrust	Strongly Distrust	Don't know	Not applicable
The Internet	1	2	3	4	5	6	7
Television news	1	2	3	4	5	6	7
Radio	1	2	3	4	5	6	7
Newspapers and Magazines	1	2	3	4	5	6	7
Environmental organisations (e.g. friends of the earth, Greenpeace)	1	2	3	4	5	6	7
Books	1	2	3	4	5	6	7
Academic articles	1	2	3	4	5	6	7
Family and friends	1	2	3	4	5	6	7
Local Government	1	2	3	4	5	6	7
National Government	1	2	3	4	5	6	7
Doctors	1	2	3	4	5	6	7
Scientists	1	2	3	4	5	6	7
National Grid	1	2	3	4	5	6	7
2CO	1	2	3	4	5	6	7
Teachers	1	2	3	4	5	6	7
Your MP	1	2	3	4	5	6	7
University Researchers/ Academics	1	2	3	4	5	6	7
Wind farm company (e.g. infinis)	1	2	3	4	5	6	7
Health and Safety Executive (HSE)	1	2	3	4	5	6	7
Local campaign groups	1	2	3	4	5	6	7
Yorkshire Forward	1	2	3	4	5	6	7

8. How concerned, if at all, are you about each of the following issues? (Please answer all questions)

	Very Concerned	Fairly Concerned	Not very concerned	Not concerned at all	No Opinion
Acid rain	1	2	3	4	5
Air pollution	1	2	3	4	5
Climate change, sometimes referred to as global warming	1	2	3	4	5
Damage to the ozone layer	1	2	3	4	5
Deforestation/Destruction of tropical forests	1	2	3	4	5
Genetically modified food	1	2	3	4	5
Sea level rise	1	2	3	4	5
Lack of access to parks/green spaces	1	2	3	4	5
The state of the economy	1	2	3	4	5
Extinction of species (plants and animals)	1	2	3	4	5
New development in the countryside	1	2	3	4	5
Nuclear power	1	2	3	4	5
Pesticides, fertilisers and chemical sprays	1	2	3	4	5
Pollution of rivers, lakes and seas	1	2	3	4	5
Radioactive waste	1	2	3	4	5
Using up energy resources that are not replaceable, such as oil and coal	1	2	3	4	5

9. What, if anything, do you think is causing the world's climate to change? (Please select all relevant answers)

	Please Tick		Please Tick
Air pollution		Natural causes	
Burning fossil fuels/such as coal and oil		Nuclear power	
Burning trees/Forest fires		Oceans/Oceanic circulation	
Carbon dioxide		Solar radiation/The sun	
Cars/Planes/Transport		Volcanoes/Volcanic activity	
Deforestation/Logging/clearing of rainforests		Other	
Industry/Factories/Emissions from factories		None of these	
Loss of ozone layer			

10. From what you know or have heard about climate change, on balance, which of these statements, if any, most closely reflects your own opinion? (Please Select one answer)

	Please Tick
The benefits of climate change outweigh the risks	
The benefits and risks of climate change are about the same	
The risks of climate change outweigh the benefits	
None of these	
Don't know	

11. Which, if any, of the following statements most closely describes your own opinion about taking action against climate change? (Please select one answer)

	Please Tick
Every possible action should be taken against climate change	

Some action should be taken against climate change	
No action should be taken against climate change	
Don't know	

12. From what you know or have heard, what would you say are the most important for deciding which methods of electricity production should be used in Britain in the future? (Please select up to 3 answers)

	Please Tick
Cost	
Effects on the landscape	
Efficiency of production	
Helping to prevent climate change	
Impacts on communities living nearby	
Impacts on human health	
Impacts on the economy	
Impacts on the environment	
Impacts on the jobs market	
Independence from other countries' fuels	
Level of pollution	
Reliability of electricity supplies	
Vulnerability of terrorist attack	
Safety	
None of these	
Don't know	

13. How strongly do you support the use of the following forms of energy? (Please answer all questions)

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
Wind	1	2	3	4	5
Carbon Capture and Storage (CCS)	1	2	3	4	5
Nuclear	1	2	3	4	5
Hydro-electric	1	2	3	4	5
Coal	1	2	3	4	5
Natural Gas	1	2	3	4	5
Geothermal (hot rocks)	1	2	3	4	5
Solar	1	2	3	4	5
Biofuels	1	2	3	4	5
Oil	1	2	3	4	5
Wave/tidal	1	2	3	4	5

14. Do you think generating electricity from coal? (Please select all relevant answers)

	Please Tick
…causes air pollution	
…causes climate change	
…creates dangerous waste	
…is a hazard to human health	
…is cheap	
…is clean	
…is good for communities living nearby	
…is good for the economy	
…is inefficient	

…is reliable	
…is safe	
…spoils the landscape	
Other (Please state)	

15. The Government is currently looking at capturing Carbon Dioxide (the main greenhouse gas attributed to causing climate change) produced by Power Stations and other heavy industries and storing it in underground storage sites below the seabed. The process is called Carbon Capture and Storage. What is your initial reaction to this idea? (Please select one answer)

	Please Tick
It sounds like a great idea	
I don't think it is a good idea	
It could work in the short term until we can fully develop renewable energy technology	
I don't know enough about it to have an opinion	

16. If the Government approved Carbon Dioxide Storage, who should pay for it? (Please select one answer)

	Please Tick
The energy companies	
Government (The tax payer)	
Consumers (added to electricity bills)	
The cost should be shared amongst the above	
I don't know	

17. If Carbon dioxide were to be stored underground it would require long term monitoring. Who do you think should be responsible for monitoring stored Carbon Dioxide? (Please select one answer)

	Please Tick
The Government	
The company placing the Carbon Dioxide underground	
An independent organisation	
I don't know	

18. Would you be prepared to pay more for electricity to support a carbon storage scheme? (Please select one answer)

	Please Tick
Yes - up to £2 per month	
Yes - up to £5 per month	
Yes – up to £10per month	
Yes - more than £10 per month	
No	
I don't know enough about it to have an opinion	

19. What would be your initial reaction to a CO_2 pipeline routed through East Yorkshire?

	Please Tick
It would not worry me	
It would worry me a little	
I would be very concerned	
I don't know enough to have an opinion	
Other (please comment)	

Thank you for taking the time to fill out this questionnaire.

Appendix 6 – Post Group Questionnaire

Final Focus Group questionnaire

Thank you for taking part in the focus group. If you require any assistance in answering these questions, please don't hesitate to ask one of the facilitators.

Name _____

1. How much do you trust the following? (Please answer all questions)

	Strongly Trust	Trust	Neutral	Distrust	Strongly Distrust	Don't know	Not applicable
The Internet	1	2	3	4	5	6	7
Television news	1	2	3	4	5	6	7
Radio	1	2	3	4	5	6	7
Newspapers and Magazines	1	2	3	4	5	6	7
Environmental organisations (e.g. friends of the earth, Greenpeace)	1	2	3	4	5	6	7
Books	1	2	3	4	5	6	7
Academic articles	1	2	3	4	5	6	7
Family and friends	1	2	3	4	5	6	7
Local Government	1	2	3	4	5	6	7
National Government	1	2	3	4	5	6	7
Doctors	1	2	3	4	5	6	7
Scientists	1	2	3	4	5	6	7
National Grid	1	2	3	4	5	6	7
2CO	1	2	3	4	5	6	7
Teachers	1	2	3	4	5	6	7
Your MP	1	2	3	4	5	6	7

Manchester University	1	2	3	4	5	6	7
Wind farm company (e.g. infinis)	1	2	3	4	5	6	7
Health and Safety Executive (HSE)	1	2	3	4	5	6	7
Local campaign groups	1	2	3	4	5	6	7
Yorkshire Forward	1	2	3	4	5	6	7

2. What is your reaction to Carbon capture and Storage? (Please select one answer)

	Please Tick
It sounds like a great idea	
I don't think it is a good idea	
It could work in the short term until we can fully develop renewable energy technology	
I don't know enough about it to have an opinion	

3. Who do you think should be responsible for monitoring stored Carbon Dioxide? (Please select one answer)

	Please Tick
The Government	
The company placing the Carbon Dioxide underground	
An independent organisation	
Other (Please state)	
I don't know	

4. Would you be prepared to pay more for electricity to support a carbon storage scheme? (Please select one answer)

	Please Tick
Yes - up to £2 per month	
Yes - up to £5 per month	
Yes – up to £10per month	
Yes - more than £10 per month	
No	
I don't know enough about it to have an opinion	

5. What would be your initial reaction to a CO_2 pipeline routed through East Yorkshire?

	Please Tick
It would not worry me	
It would worry me a little	
I would be very concerned	
I don't know enough to have an opinion	
Other (please comment)	

6. How strongly do you support the use of the following as part of the UK energy system? (Please answer all questions)

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
Wind	1	2	3	4	5
Carbon Capture and Storage (CCS)	1	2	3	4	5
Nuclear	1	2	3	4	5
Hydro-electric	1	2	3	4	5

Coal	1	2	3	4	5
Natural Gas	1	2	3	4	5
Geothermal (hot rocks)	1	2	3	4	5
Solar	1	2	3	4	5
Biofuels	1	2	3	4	5
Oil	1	2	3	4	5
Wave/tidal	1	2	3	4	5

7. We hope you have enjoyed the focus group today, what have found most interesting/useful in each of the sessions:

Carbon Dioxide	
Carbon Capture and Storage	
Pipelines and AGIs	
Qualitative Risk Assessment	

8. We really appreciate your attendance at today's focus group and would welcome any feedback (positive or negative) on the sessions or information provided during the sessions:

Thank you for taking the time to fill out this questionnaire.

Appendix 7 – Questionnaire Results

	How strongly do you support the use of the following as part of the UK energy system?									
	Strongly Agree		Agree		Disagree		Strongly Disagree		Don't Know	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Wind	37%	31%	37%	31%	5%	16%	10%	5%	5%	10%
Carbon Capture and Storage (CCS)	10%	16%	5%	74%	10%	0%	0%	0%	68%	10%
Nuclear	5%	5%	42%	63%	16%	26%	26%	5%	5%	0%
Hydro-electric	37%	16%	37%	84%	0%	0%	5%	0%	16%	0%
Coal	5%	5%	42%	37%	21%	47%	21%	0%	5%	10%
Natural Gas	10%	5%	53%	68%	10%	26%	10%	0%	10%	0%
Geothermal (hot rocks)	16%	16%	37%	58%	0%	10%	0%	0%	42%	16%
Solar	58%	5%	31%	63%	0%	10%	0%	0%	5%	0%
Biofuels	10%	0%	53%	68%	16%	21%	0%	5%	16%	5%
Oil	0%	5%	26%	47%	31%	31%	10%	5%	26%	10%
Wave/tidal	31%	47%	47%	42%	5%	5%	0%	0%	10%	5%

	How much do you trust the following?											
	Strongly trust		Trust		Neutral		Distrust		Strongly Distrust		Don't Know	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
The Internet	5%	5%	37%	37%	42%	42%	0%	0%	5%	5%	10%	10%
Television news	0%	0%	47%	47%	37%	37%	16%	16%	0%	0%	0%	0%
Radio	0%	0%	58%	58%	31%	31%	5%	5%	0%	0%	5%	5%
Newspapers and Magazines	0%	0%	16%	16%	42%	42%	42%	42%	0%	0%	0%	0%
Environmental organisations (e.g. friends of the earth, Greenpeace)	0%	0%	63%	63%	21%	21%	16%	16%	0%	0%	0%	0%
Books	16%	16%	58%	58%	21%	21%	5%	5%	0%	0%	0%	0%
Academic articles	21%	21%	58%	58%	16%	16%	0%	5%	0%	0%	5%	0%
Family and friends	26%	26%	47%	47%	26%	26%	0%	0%	0%	0%	0%	0%
Local Government	16%	0%	42%	16%	42%	42%	0%	42%	0%	0%	0%	0%
National Government	5%	5%	10%	10%	31%	31%	42%	42%	10%	10%	0%	0%
Doctors	31%	31%	47%	47%	21%	21%	0%	0%	0%	0%	0%	0%

	Strongly trust		Trust		Neutral		Distrust		Strongly Distrust		Don't Know	
Scientists	21%	21%	53%	53%	26%	26%	0%	0%	0%	0%	0%	0%
National Grid	5%	5%	42%	42%	31%	31%	21%	21%	0%	0%	0%	0%
2CO	0%	0%	26%	26%	31%	31%	5%	5%	0%	0%	0%	0%
Teachers	10%	10%	42%	42%	31%	31%	10%	10%	0%	0%	5%	5%
Your MP	10%	10%	5%	5%	47%	47%	37%	37%	0%	0%	0%	0%
Manchester University	5%	5%	74%	74%	16%	16%	5%	5%	0%	0%	0%	0%
Wind farm company (e.g. infinis)	10%	10%	21%	21%	37%	37%	21%	21%	5%	5%	5%	5%
Health and Safety Executive (HSE)	0%	0%	53%	53%	37%	37%	10%	10%	0%	0%	0%	0%
Local campaign groups	0%	0%	31%	31%	63%	63%	0%	0%	0%	0%	5%	5%
Yorkshire Forward	5%	5%	31%	31%	31%	31%	10%	10%	16%	16%	0%	0%