

# **COOLTRANS (Dense Phase Carbon Dioxide (CO<sub>2</sub>) Pipeline Transportation)**

## **Public Perceptions of Risk**

### **Executive Summary**

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## **Executive Summary**

This report presents results from a study into the public perceptions of the risks of CO<sub>2</sub> transportation by pipeline. It has been produced as part of COOLTRANS (Dense Phase Carbon Dioxide (CO<sub>2</sub>) Pipeline Transportation), 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 transportation of dense phase anthropogenic CO<sub>2</sub> as part of Carbon Capture and Storage (CCS) schemes. This Executive Summary reviews the wider conclusions from Work Package 5.2, undertaken by the team at the University of Manchester.

National Grid is proposing a CO<sub>2</sub> transportation pipeline to transport CO<sub>2</sub> 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 project supports this process by providing an independent, academic assessment of the information about CO<sub>2</sub> transportation in pipelines that is useful to lay publics, their 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, Visschers et al. 2011)).

The aim of this executive summary is to provide an overview of Work Package 5.2 and to summarise its key findings. Following a brief description of the approach adopted in the two work packages (WP 5.2.1 and WP 5.2.2) respectively and an overview of existing relevant literature, the results are presented from the work package as a whole.

### ***Workpackage 5.2***

The aim of this work package was to assess the social impacts arising from, and public perceptions of, transportation of CO<sub>2</sub> in pipelines. While there is a growing body of research on the public perceptions of CCS in general, there is very little understanding specifically relating to CO<sub>2</sub> transportation in pipelines and yet the public response to this stage in the CCS chain could have a significant impact. There are many 1000s of miles of pipeline which transport many different types of fluid long distances across the UK and in many cases the public are unaware of local pipelines, what they transport and where they are located. In the case of a CO<sub>2</sub> pipeline, public attitudes to the pipeline will be influenced not only by any risks or impact associated with the pipeline itself, but also

by a host of other factors such as a lack of familiarity with the technology, belief in climate change or opposition to fossil fuel developments. This work package was arranged into two sub-work packages; the first reviews experience from existing and planned pipeline developments and the second assesses the public perceptions of CO<sub>2</sub> transportation in pipelines along the proposed pipeline route.

### **WP 5.2.1 Social impacts of CO<sub>2</sub> pipelines**

This work package explored the social impacts of the installation of previous pipeline (and one CCS demonstration) projects in order to guide the framing of the focus groups conducted in WP5.2.2. Five case study examples were presented, with a summary of each development and a description of the nature of associated controversy, concluding with a description of particular themes that emerge across the associated protests. The case studies looked at four pipeline developments and one full chain CCS demonstration project (Weyburn-Midale in the US, Milford Haven in South Wales, Corrib gas project in the Republic of Ireland, Barendrecht in the Netherlands, Keystone XL pipeline in N. America); one of the case studies (Weyburn-Midale) related to a CO<sub>2</sub> pipeline. Each case study from this small sample encountered significant challenges from parties either opposing the project in the planning and consenting phase, or in the case of the Weyburn-Midale pipeline during operation. These case studies were selected in order to focus specifically on controversies related to pipelines or CCS, to help us to better understand how individuals and groups accommodate and respond to the prospect of this type of infrastructure development.

### **WP 5.2.2 Public perceptions of CO<sub>2</sub> transport in pipelines**

This work package aims to support National Grid's consultation process by providing an independent, academic assessment of the information surrounding CO<sub>2</sub> transportation in pipelines that could be useful to lay publics. 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 with CO<sub>2</sub> transportation in pipelines and potential public responses to the risks, the factors influencing the public perceptions and the potential social impacts of transportation in CO<sub>2</sub> pipelines.

Participants were guided 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 discussions and related activities.

## ***Background***

There are many studies that have explored public perceptions and acceptance of CCS as a technology (see (Whitmarsh, Upham et al. 2011) for a review) and some that have looked at public understanding of CO<sub>2</sub> as part of an assessment of opinions on CCS in general (Wallquist, Visschers et al. 2009; de Best-Waldhober, Paukovic et al. 2011; de Best-Waldhober, Brunsting et al. 2012; Itaoka, Saito et al. 2012). For example, Itaoka et al. (2012) found a correlation between misperceptions of CO<sub>2</sub> and misperceptions of CCS, highlighting the importance of providing information about CO<sub>2</sub> 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<sub>2</sub> transportation by pipeline. One study has explored the relationship between the understanding of CO<sub>2</sub> and acceptance of CCS in three countries but not specifically how it relates to CO<sub>2</sub> transportation by pipeline (Itaoka, Saito et al. 2012) and found low levels of understanding and familiarity with the physical and chemical properties of CO<sub>2</sub> or its uses in everyday applications / products. Another study, conducted in Switzerland, found that interview respondents related atmospheric release of CO<sub>2</sub> (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, Visschers et al. 2009), similar associations were expressed in the former study in which CO<sub>2</sub> was associated with “soot” or “air pollution” (Itaoka et al. 2012).

A large scale survey into perceptions of CCS in the Netherlands (de Best-Waldhober, Paukovic et al. 2011; de Best-Waldhober, Brunsting et al. 2012) found a proportion of respondents unsure over whether CO<sub>2</sub> was a cause of cancer, 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<sub>2</sub> and those with a positive view of CCS (ibid). Whereas a survey can be useful in providing 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 way in which lay people engage with a subject and how opinions might evolve.

## ***Public opposition in pipeline developments***

Public opposition appears to have been a feature of a number of large pipeline projects, both during the routeing and consent processes and, in the case of the Weyburn pipeline, during pipeline operation. Each controversy is unique – while much can be learned from individual cases, the evolution and scale of a controversy may not be predictable, since it is dependent on contingencies and individuals. Certain themes and patterns can be identified as local communities respond to proposed developments in their environs. Based on case studies of four previous pipeline developments and one CCS project, which met with controversy, the report of WP5.2.1 (Gough, Thom and Mander, 2012) identified a number of themes common across the controversies, namely history and local context; physical risks, the role of scientific arguments, trust and justice. Of these, three themes (history and local context, physical risks and trust) were echoed in the discussions within the focus groups.

### **History and local context**

The importance of understanding the local context of a development has been described previously (see for example, (Bradbury, Ray et al. 2009; Hammond and Shackley 2010; Ashworth, Bradbury et al. 2011). Key to the primary stages for developing a public engagement strategy is to understand the local area and to assess the impact the project will have on local residents (Kuijper 2010). Familiarity with large infrastructure projects can have positive or negative impacts on the way in which a new project is perceived locally. On the one hand, familiarity with industrial or energy infrastructure may result in a local community perceiving a plant to be a ‘good neighbour’ and increase understanding and acceptance of the level of risks associated with the facility. Conversely, and this was the case in the Barendrecht CCS project, local people may suffer from ‘development fatigue’ (Hammond and Shackley 2010) and feel that they bear more than their fair share of the burden of industrial development. This latter reaction was evident amongst participants attending the focus groups, where some felt that a new power station, and associated CO<sub>2</sub> pipeline added to existing concentrations of electricity generating capacity in the area (power stations and wind turbines).

Understanding local context is also important to ensure that developers consider issues that matter to local people and the potential impact of the development upon them. Thus the focus groups highlighted the issue of limited employment opportunities locally and within the wider region, hence the need to employ local or regional contractors, or where possible to source materials from within the region. The disruption to local traffic, in an area where many of the roads are small and therefore often prone to congestion, was a concern in both focus groups. From an environmental

perspective, the East Yorkshire coast is subject to coastal erosion, thus participants were highly sensitive to any potential impact on the coastal infrastructure upon the existing erosion problem. This was contextualised by the importance of tourism to the local economy, particularly at the coast.

## **Physical risk**

In many cases, a protest may begin small and local, supported by specific and 'local' arguments relating to physical risks or impacts; these may often be the primary concern, other research suggests that risk issues that cause the greatest concern are those that directly affect personal security, financial security, health and well being both during and after the development (Ashworth 2009). Focus group participants expressed concerns over the safety of the pipeline, and the potential impacts on people and the wider environment in the case of a leak, or accident involving the pipeline. Whilst initially unfamiliar with CO<sub>2</sub> and its properties at the start of the focus group, participants learned enough over the course of the day, and understood enough about the potential risks, to recognise the severity of the large-scale leak and the need for emergency planning to reduce the risks.

## **Trust**

Genuine early engagement that is responsive and reflexive is a pivotal part of the process in establishing trust around a proposed development. A mutual trust requires that citizens have faith in the developers and authorities to act honestly and transparently and that their own opinions and concerns will be respected and taken seriously (Terwel, Harinck et al. 2011). The developers involved in each of the case studies were all keen to stress the safety of each of the pipelines, but this did not allay the fears of local residents. Similarly, as highlighted by focus group participants, the proposed CO<sub>2</sub> pipeline, will be the first in the UK, and will pass through areas of higher population density, transporting CO<sub>2</sub> at higher pressures than the existing Weyburn pipeline. Thus, trust in those developing and planning the pipeline is a key element if local people are to accept a new and potentially hazardous infrastructure facility, of which there are no other examples to demonstrate safe operation. The 'first of a kind' nature of the pipeline was frequently brought up during discussions.

Issues of trust, and the need for transparency, are also important when participants discussed the motivations of those involved in CCS and the CO<sub>2</sub> pipeline. Thus, our groups mirror the findings of (Terwel and Daamen 2012) who found that citizens are more likely to accept environmental NGOs (Non Governmental Organisations) who are motivated by local interests, than industrial partners who were perceived to be motivated by profits.

## ***Key concerns: Transport of CO<sub>2</sub> by pipeline***

The main concerns around pipelines focused on five areas: safe operation of the pipeline; the risks to people, livestock and vegetation arising from the leakage of CO<sub>2</sub> from the pipeline; the innovative and 'first of its kind' nature of the pipeline and, as a consequence, the lack of operating dense phase CO<sub>2</sub> pipelines which can demonstrate the technology; impacts on coastal erosion at the landfall site; and the potential disruption to local communities during construction. Of these five areas, the safe operation of the proposed pipeline prompted the most discussion, notably around the following issues:

- After the pipeline has been installed there was concern that it will be either forgotten or that measures/regulation to prevent third party damage will be ignored;
- Speed, accuracy and responsibility associated with leak detection;
- Procedures to repair and maintain the pipeline;
- Potential for the pipeline to become a terrorist target.

The presentation about pipelines outlined a number of measures and systems that are used by pipeline operators to ensure the safe operation of their pipelines. Thus, participant concerns over pipeline maintenance were allayed by information about the electrical testing of cathodic pipeline protection systems and the use of pipeline pigs to assess potential corrosion. In a similar vein it was understood that a pipeline leak could be detected quickly, if the pressure in the pipeline dropped or the CO<sub>2</sub> flow reduced, and that block valves would be closed off to prevent the loss of all the CO<sub>2</sub> in the pipeline. Surprise was expressed, however, that valves in a natural gas pipeline were 16km apart, which struck participants as being a long distance apart. Participants also wished for local evacuation plans to be developed in consultation with local people and clear instructions on what to do if there was a pipeline leak.

At the start of the pipeline presentation, a map of major UK pipelines was shown to highlight that their use is common place. Thus, whilst there are no CO<sub>2</sub> pipelines currently operating in the UK, participants were reassured by the safety record of National Grid and other pipeline operators, as well as being surprised at the size and capacity of the UK pipeline network. No-one attending the group, facilitators included, knew prior to the presentation that pipeline markers were used to mark the route of pipelines, and some participants realised that they already lived close to marked pipelines which they were previously unaware of. Trust in National Grid and others organisations involved in the project emerged, once again highlighted as a crucial aspect of securing support for the project.

By the end of discussions, the major area of concern for the safe operation of the pipeline, focused on third party interference, either because regulations covering excavation work, or planning new development, were ignored, or because of the perceived risk of the pipeline being a terrorist target.

### ***Minimising risk of public opposition***

While there are no rules that can *guarantee* a development proceeds without protest (the opportunity for opposition and debate is an essential part of the democratic process, provides learning opportunities and ultimately a check on inappropriate developments), a healthy and well run engagement process can help to avoid unnecessary hostility and deliver a more positive outcome for all parties. Participants expressed a high degree of scepticism surrounding the key drivers of a company planning a CO<sub>2</sub> pipeline, suggesting that an honest and clear approach to communicating the motivations of such a project are crucial. Other factors relate to how the developers and (other proponents of the technology) are perceived; trust in the processes through which sites are selected, and operations and maintenance are regulated; views on the nature and implications of perceived risks associated with the development; the distribution of benefits (the balance between economic, social or environmental benefits to the developer, the local community and beyond); acceptance of the broader context (for example, the deployment of CCS as a climate change mitigation option) for the development; access to different sources and forms of information and communications materials.

If opposition does emerge however, it is important to understand why people are protesting and who is protesting. Initial concerns from participants about the potential for explosion were allayed by appropriate information and experts answering questions about pipeline safety and properties of CO<sub>2</sub>. Allowing local voices to be heard at the beginning of the process could be critical in preventing larger scale protests; as campaigns grow and external parties (i.e. those not living in the local area) become involved, often driving a campaign and using the project to fight a bigger cause. As protest escalates (both in content, form and protagonists) the terms of the protest are amplified and charges become grander. When this happens, dialogue becomes a much more complex and intractable process, positions become entrenched and a long term legacy of hostility is more likely to be established. Trust within the local community that the developer will minimise risk during the route selection and subsequent construction, operation and maintenance of the pipeline was seen as key during focus group discussions.



## ***Presentation of technical information***

The focus group sessions included presentation of explanations of the physical and chemical properties of CO<sub>2</sub>, about CCS technologies and about pipeline engineering and risk assessment. The lay participants were comfortable engaging with these topics and responded positively to the opportunity to do so, despite an initial lack of confidence in discussing such unfamiliar topics prior to the presentations. In particular, the use of visual / practical explanations of CO<sub>2</sub> properties were seen as being useful aids to understanding, especially when they could be related to familiar products and materials. Despite an initial unfamiliarity with the subject matter, the presentations enabled participants to comprehend some of consequences of transporting CO<sub>2</sub> (such as the pipeline design and routing) and of potential exposure to CO<sub>2</sub> (for example, that it is an asphyxiant) and to conceptualise different types of risk associated with pipelines.

## ***Communication and consultation processes for a proposed CO<sub>2</sub> pipeline***

This report does not attempt to set guidelines for the communication of risk, CCS or CO<sub>2</sub> transport - there already exists a body of literature that addresses these issues (for example (WRI 2008; Ashworth 2009; Hammond and Shackley 2010) and National Grid has a well-established and comprehensive engagement programme already in place. However, a good communication and consultation process does not guarantee success of a project, certain steps can be taken to mitigate against the risk of projects failing because of a poorly planned or implemented communication process. Certain themes that have emerged during this research and are echoed in the wider literature on communication and engagement strategies:

- The importance of understanding and adapting to the local community context and the diversity of interests and cultural values within it (Ashworth 2009, Ashworth, Bradbury et al. 2011, WRI 2008);
- Trust in the sources and providers of information, in the organisations involved and in the regulatory processes governing the development is critical;
- The positive impact of involving a variety of stakeholders (professional and lay) throughout the project in such a way that they feel empowered to have a voice in the process (WRI 2008; Ashworth 2009; Ashworth, Bradbury et al. 2011);

- An open and transparent communication and engagement process, as well as explaining the details of what the project entails, should present information explaining the reason for the development, the choice of location, the associated risks and benefits (the what, why, where, and how of the project) (Hammond and Shackley,2010);
- Communication materials should include information about the physical and chemical properties of CO<sub>2</sub>;
- Information and communication processes should be tailored to meet the needs of different stakeholders or individuals and may include informal communications networks (Ashworth 2009; Itaoka, Saito et al. 2012);
- Involvement of different trusted organisations (such as NGOs), for example in the development of communication materials or at other points in the process can deliver benefits in terms of both widening the discussion and presenting a broader support base for the development.

## ***Conclusion***

This document has summarised the combined results of case study and focus group analyses to explore the potential public response to the transportation of CO<sub>2</sub> by pipeline. These have delivered valuable results in terms of improving our understanding of how members of the local public understand and relate to the transportation of CO<sub>2</sub> in pipelines and their potential concerns relating to the prospect of such a pipeline development in their neighbourhood. While this approach provides insights into the nature of the potential response, establishing the extent to which the views of participants are representative of the wider local population would require further research, employing different research methods (such as a survey) in order to access a larger sample.

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