Marine Policy 45 (2014) 9–15

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

# Perceptions of sub-seabed carbon dioxide storage in Scotland and implications for policy: A qualitative study

Leslie Mabon [a,*], Simon Shackley [b], Nathan Bower-Bir [b]

[a] School of GeoSciences, University of Edinburgh, Grant Institute, King's Buildings, Edinburgh EH9 3JW, United Kingdom
[b] School of GeoSciences, University of Edinburgh, Drummond Library, High School Yards, Edinburgh EH8 9XP, United Kingdom

ARTICLE INFO

*Article history:*
Received 27 August 2013
Received in revised form
14 November 2013
Accepted 17 November 2013
Available online 6 December 2013

*Keywords:*
Carbon dioxide capture and storage (CCS)
Climate change social dimensions
Low-carbon energy
Marine governance
Public perception

ABSTRACT

The geological storage of carbon dioxide ($CO_2$) offers notable potential, as part of larger carbon dioxide capture and storage (CCS) processes, to be a significant climate change mitigation technology. This paper challenges the argument often put forward that, due to the greater distances from centres of population, it will be 'easier' to garner public and stakeholder support for offshore $CO_2$ storage than onshore. Based on the results of research interviews carried out with stakeholders and informed publics in Scotland, challenges for public and stakeholder acceptance of sub-seabed $CO_2$ storage that may require further policy attention are identified. Whilst existing policy for sub-seabed $CO_2$ storage is cognisant of the need for societal engagement, it may be the case that these regulations may need further reinforcement to ensure future developments are able to address social acceptability issues as fully as possible. The value of taking into account social as well as physical characteristics at the site selection phase, the need for mechanisms to take seriously stakeholder conceptions of uncertainty, and the importance of extending social engagement beyond risk communication are discussed.



## 1. Introduction

Geological storage of carbon dioxide ($CO_2$) is considered to offer significant potential in the attempt to mitigate anthropogenic climate change. As the final stage of the larger process of carbon dioxide capture and storage (CCS), $CO_2$ storage entails injecting $CO_2$ emitted from fossil-fuel burning power stations and factories into underground geological structures. This means the 'captured' $CO_2$ does not go into the atmosphere, thereby reducing the increase in atmospheric $CO_2$ and slowing down the rate of climate change.

Several early attempts to use onshore geological structures for $CO_2$ storage in Europe have met public consensus difficulties. This has led to suggestions among some developers and policy makers that offshore storage in sub-seabed geological structures may be 'easier' from the point of view of garnering public acceptance, a blog post by a contributor to a major CCS website noting that "(s)eagulls tend to be rather silent about underground storage" [1]. However, this paper argues it should not be assumed this will always be the case, and that existing provisions for societal engagement in offshore $CO_2$ storage legislation may need to be refined as large-scale projects near fruition. Interviews with stakeholders and publics in Scotland, United Kingdom (UK), suggest that although there is at present no clear opposition to plans for sub-seabed $CO_2$ storage, potential for contestation to emerge certainly exists if future projects are not governed carefully. It is thus crucial that policy-making for sub-seabed $CO_2$ storage does not become complacent, and allows for flexibility in responding to public and stakeholder concerns at as early a stage as possible.

## 2. Context

CCS is a process for trapping $CO_2$ emissions produced by fossil fuel-burning power stations and industrial sources, transporting this $CO_2$ by ship or pipeline, and injecting it into underground geological structures. The justification for doing this given by proponents of CCS is that anthropogenic $CO_2$ is the main cause of climate change, which poses potentially serious threats to humans, wildlife and ecosystems worldwide. CCS is at the pilot and early demonstration stage, and according to its supporters has significant potential for global deployment as a climate change mitigation technology [2]. Recent years have also seen increased interest in the use of $CO_2$ captured via CCS for enhanced oil recovery (EOR), whereby $CO_2$ is pumped into oil fields to increase the amount of oil returned [3].

The geological structures into which $CO_2$ can be injected can be either onshore or offshore. Recent attempts to deploy CCS onshore in Europe have faced public consensus difficulties, most notably at

* Corresponding author. Tel.: +44 131 650 7339.
*E-mail address:* leslie.mabon@ed.ac.uk (L. Mabon).

0308-597X/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.marpol.2013.11.011

Barendrecht in the Netherlands where public opposition to plans to store $CO_2$ in a depleted gas field under the town contributed to the outright cancellation of the project, and to the Dutch government placing a moratorium on onshore storage [3]. Public opposition also contributed to the cancellation of the Beeskow–Oderbruch project in Germany [4] and was an issue at the early stages of the otherwise successful Lacq project in France [5]. In each of these cases, storage was land-based.

Partly due to these consensus difficulties and also due to geological suitability, European countries are increasingly looking to sub-seabed sites for $CO_2$ storage [6,7]. The regulatory and policy landscape for sub-seabed $CO_2$ storage has evolved notably since 2007 – starting with the 2007 amendments to the 1992 OSPAR Convention (Convention for the Protection of the Marine Environment of the North-East Atlantic), enabling the sub-seabed storage of $CO_2$ in the North Atlantic area for the first time [8]. This is supported by the OSPAR Guidelines for Risk Assessment and Management of Storage of $CO_2$ Streams in Geological Formations [9], which provide detailed environmental impact and risk assessment procedures to be undertaken by parties pursuing $CO_2$ storage projects. A 2009 amendment to the London Protocol (Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter) [10] will when ratified [3] enable "the export of carbon dioxide streams for the purpose of sequestration in transboundary sub-seabed geological formations" [11] following on from a 2007 amendment that provided the basis for regulating $CO_2$ storage in sub-seabed formations [12]. Directive 2009/31/EC of the European Union (EU) [13] introduced a variety of amendments to EU law in relation to the geological storage of $CO_2$, relevant to both on- and offshore storage.

Stakeholder engagement is given some attention in these documents, the OSPAR Guidelines [9] stating that "(s)takeholder involvement is not defined as a separate element in the framework, but it is included as a part of risk management and risk characterisation. Stakeholder involvement is an important feature of these processes, as to ensure completeness of the assessment. The objective is to promote a high level of public acceptance" (p. 8). Directive 2009/31/EC also mandates the need to make environmental information pertaining to $CO_2$ storage sites publicly available, and acknowledges the role of good reporting practices in increasing public confidence in CCS. The guidelines to the amendment to the London Protocol [14] likewise recommend the provision of opportunities for public review and participation in the storage permitting process.

In short, recent developments in regulation of sub-seabed $CO_2$ storage are cognisant of the importance of public and stakeholder engagement in facilitating the deployment of $CO_2$ storage. It is, however, somewhat concerning that CCS developers have in general shown comparatively little concern about potential public perception issues arising from sub-seabed $CO_2$ storage. Some documents explicitly note that offshore storage reduces the likelihood of social opposition to projects, Prangnell [15] reporting the management of the ROAD CCS demonstration project in the Netherlands believe the lack of opposition to their project is "due in large part […] to the project's offshore storage option" (p. 12).

Offshore $CO_2$ storage may well reduce the potential for *some* of the public perception issues that have been seen with onshore storage (such as concerns over access to land, adverse effects on property pricing, and risks to human health). Nonetheless, there is ample evidence from energy research to demonstrate offshore developments are not immune to social acceptance issues. Greenpeace's opposition to Shell's plans to sink the decommissioned Brent Spar oil platform into the North Sea in the mid-1990s [16] remains the classic example of how societal opposition can develop in response to something happening hundreds of miles from any populated area. Haggett [17] and Devine-Wright [18] use the case of offshore wind in England and Wales to argue that public perception issues can arise with barely-visible offshore energy developments just as much as with onshore developments. The well-documented opposition of American developer Donald Trump to plans for an offshore wind farm in north-east Scotland [19], and the polarisation in public opinion that his stance evoked, further illustrates how offshore energy issues continue to remain very much in the public consciousness in Scotland. In CCS, Kamishiro and Sato [20] found opinions among the Japanese public towards a fictitious marine $CO_2$ storage project varied depending on trust in the execution body, risk perception and personal ethics – wider contexts that do not necessarily correspond to land–sea boundaries. The spatial distance between sites of population and sub-seabed $CO_2$ storage locations should thus not be taken to mean there is no potential for opposition from land-based publics and stakeholders.

## 3. Methods

The data used in this paper comes from a larger comparative study on public perceptions of $CO_2$ storage in the UK and Italy [21]. This comparative study is itself part of the European Union Framework Package 7-funded ECO2 project [22], which explores effects of sub-seabed $CO_2$ storage on marine ecosystems. Within the UK section of the study, it was decided to devote particular attention to Scotland due to the higher likelihood of storage taking place in the region.[1] In addition, an experimental release of $CO_2$ into Ardmucknish Bay on the west coast of Scotland as part of the QICS project (quantifying and monitoring potential ecosystem impacts of geological carbon storage) [23] gave a valuable opportunity to study public perceptions of an actual $CO_2$ storage-related event as opposed to discussing an abstract concept.

Twenty-three in-depth interviews were carried out for the Scottish section of the study. The target sample was informed publics and stakeholders who had some knowledge of CCS through a peripheral interest, such as conservation organisations and local councillors – people on the boundary between what Shackley et al. [24] describe as tier 3 (lay public) and tier 2 (those with a more general role in energy policy and climate change). As the aim of the study was to understand in-depth how perceptions of $CO_2$ storage are formed and expressed, publics or stakeholders with no awareness were excluded from the sample on the grounds that (a) they would have very little to talk about, and (b) in situations where awareness is low, it has been shown that people's opinions are 'unstable' and subject to frequent change [25].

In light of low public awareness of CCS in the UK [26], recruitment was carried out in three areas where CCS-related activity meant the likelihood of public and stakeholder awareness of the concept was increased. The first of these areas was the north-east of Scotland, where discussions over the Peterhead CCS project are ongoing and there is a long history of oil and gas extraction. The second was Argyll on the west coast, where the experimental $CO_2$ release described above was carried out. The third was the urbanised 'Central Belt' stretching from Edinburgh to Glasgow, where the majority of research facilities, government offices and non-governmental organisation (NGO) headquarters are located. Recruitment was carried out through a combination of personal contacts, snowball sampling, and contacting stakeholders who had responded to previous Scottish Government consultations on climate change matters. With the aim of the study being to understand how people came to know about CCS and how they formed their opinion, and with public awareness of the

[1] When the research project was being developed, potential CCS projects at Longannet and Peterhead were both hoping to store $CO_2$ under the North Sea. Longannet has subsequently been cancelled, however at the time of writing Peterhead remains under consideration for the UK government's investment competition.