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Evaluation of barriers to national CO₂ geological storage assessments

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Abstract

A survey to evaluate the main perceived barriers to national CO₂ storage assessments was carried out in 2015, targeting countries where some Carbon dioxide Capture and Storage (CCS) activity was known or where CCS could potentially be implemented in the future. All the questionnaire respondents indicated that some level of national assessment had been achieved. In most cases, these assessments had been sufficient to allow policy makers to make informed decisions about priorities for follow-up actions. Where national storage assessments had been carried out, the major barriers had been mainly overcome through strong political and regulatory support for CCS and policies enabling access to relevant data.

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1. Introduction

Decision-makers need to understand their national carbon dioxide (CO₂) storage resource, to assess the potential contribution that deployment of CO₂ Capture and Storage (CCS) could make to national targets for emissions reduction. The first step in assessing national CO₂ storage potential is commonly the preparation of a country-level inventory of potential storage options and large sources of CO₂ emissions.

A study to support the work of the Carbon Sequestration Leadership Forum (CSLF) was undertaken to evaluate perceived barriers to undertaking high-level geological CO₂ storage assessments and to identify how these barriers had been overcome. The purpose of the exercise was to draw out common themes across a number of countries including recommendations on how barriers to national CO₂ storage assessments could be overcome based on the survey results.

The report providing detail of the survey results and analyses will be made available through the British Geological Survey website [1].

2. Survey method and organisations contacted

An online survey was prepared with 23 questions, aiming to elucidate the achieved level and future aspirations for a national storage assessment, perceived major barriers to carrying out national assessments, how these barriers had been overcome, and the storage assessment methodologies used.

Key stakeholders representing more than 15 countries where some CCS activity was known or where CCS could potentially be implemented in the future were invited to complete the questionnaire. Representatives of government departments and other expert authorities who were expected to have a good overview of CCS or CO₂ storage opportunities at a national level and representatives of international funding bodies with an interest in CCS were contacted.

Individual personal emails were sent by BGS staff to international contacts in May and September 2015 asking them to participate in the online survey. Further contacts were followed up by repeat emails and interviews held in person or by telephone from April to November 2015. Additional and follow-up interviews were conducted with a number of national experts to gather more detailed responses and broader evidence.

3. Survey response

The questionnaire received 29 responses from 15 countries. The countries represented were; Australia, Brazil, Canada, China, France, Germany, Japan, Netherlands, Norway, Spain, South Africa, South Korea, Thailand, UK and USA. A respondent who did not leave contact details provided information for China and Indonesia (Fig. 1). It should be noted that whilst we have sought to obtain a range of responses, these results may not fully represent these countries' positions. Our conclusions and recommendations should not be taken to refer to the specific actions or programmes of individual countries.

Responses to the questionnaire were received from representatives of government directorates, national geological surveys, international funding organisations, membership associations, hydrocarbon companies, research organisations and universities. The largest group of respondents were from geological surveys (37%).

Assessments of national storage potential were generally carried out by national bodies; if national geological surveys, government bodies, national research centres/institutes and nationalised hydrocarbon companies are considered together, 70% of the national storage assessments were undertaken by this group.

The majority of respondents had a senior/principal scientist role, the second dominant group were project or programme directors of a branch or programme relating to geo-resources. Over half of the respondents have experience in undertaking storage capacity assessments or developing methodologies. Others have experience in financing, providing advice and coordinating storage assessments.

Follow-up interviews with selected questionnaire respondents were conducted to obtain supplemental information, including Spain, USA, South Africa, China, Japan and South Korea. In addition, representatives from international funding bodies who had not been invited to complete a questionnaire were interviewed to discuss China, Indonesia, the Philippines and Africa, where it was deemed a more general framework for discussion would be more appropriate.

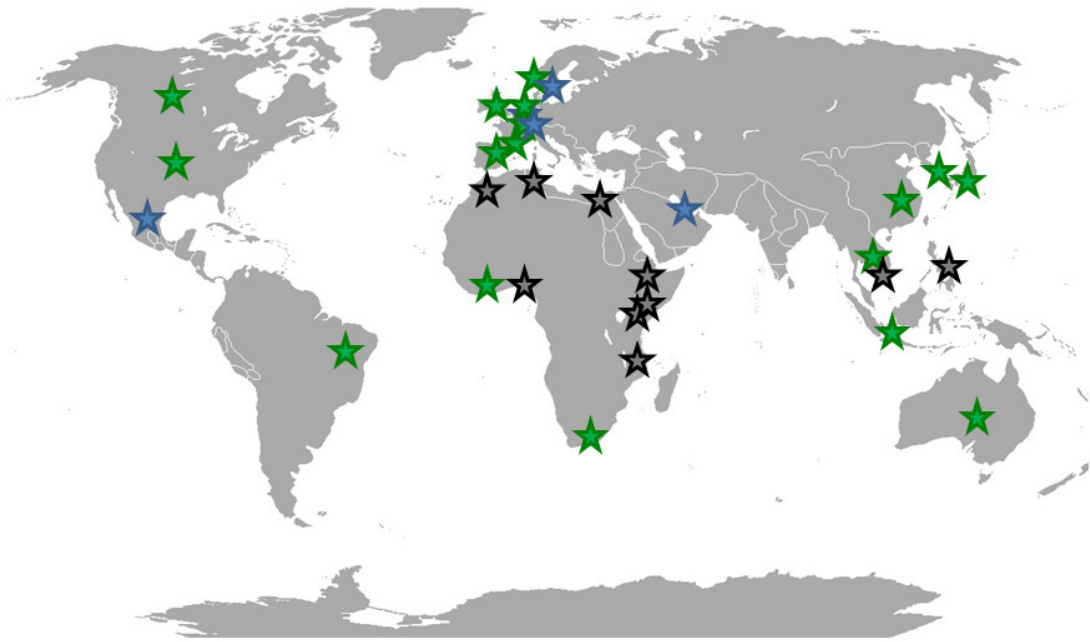


Fig. 1. Countries surveyed by the questionnaire and follow-up/additional interviews. Key: Countries represented by respondents (green); countries for whom reported information was used by BGS reviewers but with no direct respondent (grey); countries contacted with no response received (blue).

3.1. Level of storage assessment desired and achieved

For the purpose of this study, the level of storage assessment achieved was defined using the widely recognised CSLF methodology of ‘theoretical’, ‘effective’, ‘practical’ and ‘matched’ capacity [2].

All of the 15 countries, that responded to the questionnaire had completed national CSLF-methodology ‘theoretical’ storage capacity assessments. The picture was less uniform in terms of onshore and offshore assessments, most countries reported that offshore storage had been assessed at a national level, but three countries reported that offshore storage had not been investigated, even though offshore territory was present. Seven of the 15 countries reported that the national assessment had been carried out at sedimentary basin level, indicating that the assessment had moved past the initial theoretical stages and promising areas for storage had been highlighted and evaluated.

In terms of timescale, questionnaire respondents reported that national assessments to the level of ‘effective’ capacity were achieved within two years in a few countries but more typically took five to ten years to complete. Extending these assessments to ‘practical’ capacities and some site-specific ‘matched’ capacity estimates was reported to typically take at least five years.

Countries that had most rapidly achieved a national ‘effective’ potential storage capacity assessment were those where the work was undertaken by national or regional geological surveys with access to available data of sufficient quality. In two countries where ‘effective’ capacity assessments were achieved within two years, the governments also set up and provided strong funding support to a national body responsible for driving CCS forward.

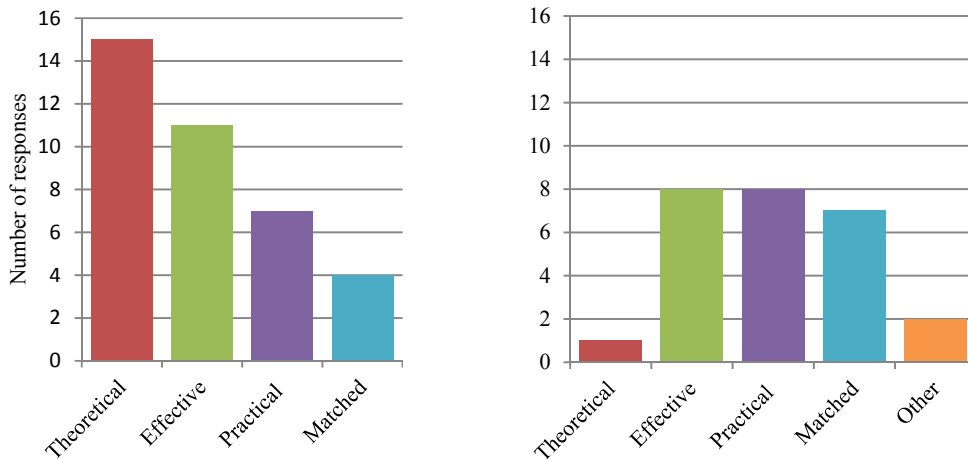


Fig. 2. Questionnaire responses, comparing achieved (left) and desired (right) level of national storage assessment.

Overall, the questionnaire responses indicated that as a minimum, respondents wanted to see an ‘effective’ national storage assessment (Fig. 2). The majority of respondents indicated they wanted to see a more advanced level of storage assessment, either at a national level or focused in the most promising areas. Two comments suggested that instead of additional storage assessments, examples of full storage projects to gain practical experience were needed as these would have a greater positive effect on accelerating deployment of CCS. Comments from one of the interviews indicated that, in some countries where CCS assessments had not yet been carried out, energy efficiency and low-carbon renewable energy sources, rather than CCS were being targeted to keep their national emissions low. However, the possibility of CCS was not excluded where CCS could be relevant in the future to (emerging) fossil fuel industries or high purity industrial CO₂ sources.

Representatives from four countries reported assessments in which storage capacities were ‘matched’ to potential emissions sources and the authors are aware of an additional three countries included in the survey where detailed studies have been carried out for potential full-chain CCS projects.

3.2. Findings on perceived barriers for national storage assessments

All of the countries who participated in the questionnaire have undertaken some level of storage assessment, therefore the answers to this question refer to the barriers encountered whilst planning or conducting those storage assessments. Some of the countries discussed during interviews had not yet completed national CO₂ storage assessments.

The questionnaire offered 11 possible major barriers to national CO₂ storage assessments and included a ‘free text’ field to allow respondents to include any other barriers. The most frequently reported barriers to progressing national assessments of CO₂ storage capacity were: data availability, either due to sparsity, absence, or data that is available but inaccessible; data quality, often due to the age of the available data; lack of industrial support for CCS; differing methodologies for storage assessment; absence of political and regulatory support for CCS¹. Other commonly perceived barriers included lack of funding for to undertake assessments, insufficient regulatory or public support, no identified agency responsible for storage assessments and conflicts of interest. No respondent indicated

¹ Please note that some respondents used the comments field to report barriers but the authors felt that the reported barriers could be included in the existing categories so the results in Fig. 3 include these reclassified responses.

that ‘lack of storage options’ was an issue. Around 17% of questionnaire respondents indicated there were no barriers to high-level national storage assessments (Fig. 3).

Data availability was reported as the most significant barrier with 41% respondents reporting this as an issue, which is compounded with data quality being a problem (reported by 34% of the respondents). National inventories of subsurface data for storage assessment are available for 76% of the countries who responded to the questionnaire. However, these data were available under different conditions and over different timescales. Data access appeared to be strongly dependent on working relationships between institutes within each country. Data required to carry detailed site-specific studies was notably more difficult to obtain. More modern and commercially sensitive data was much more difficult (and sometimes impossible) to access. Discussions suggested that data access might become easier if the profile of low-carbon technologies, including CCS, was increased so that it was clearer to data holders that requests for data were related to greenhouse gas emissions mitigation and not competition for energy resources.

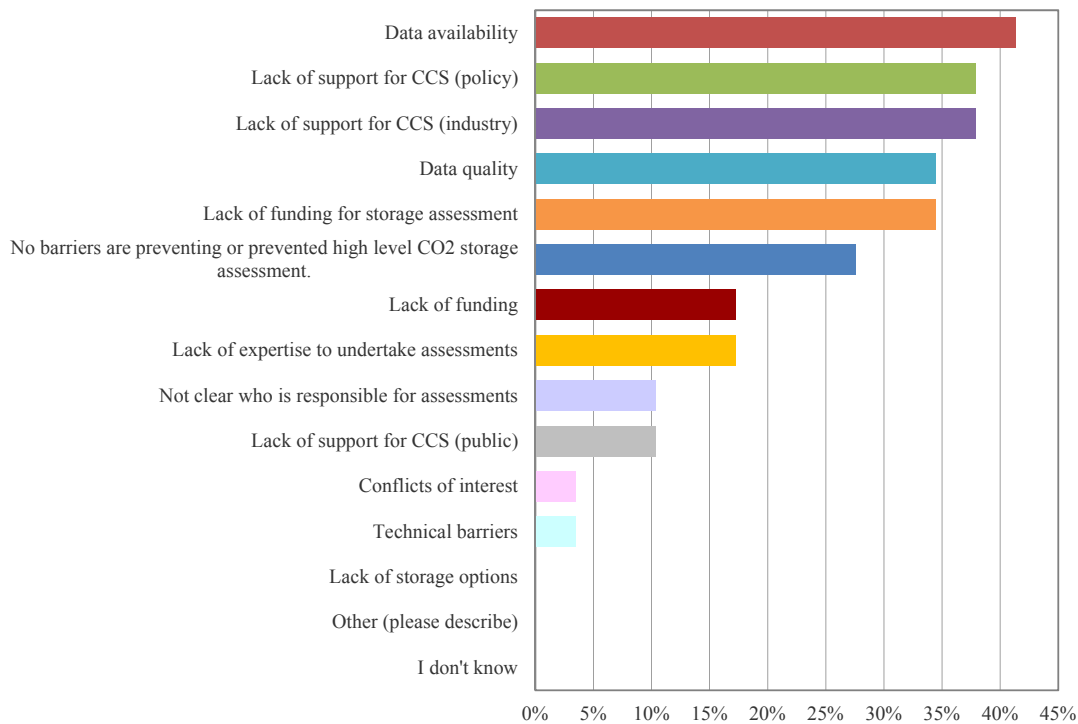


Fig. 3. Main perceived barriers when planning or conducting storage assessments from questionnaire responses

Lack of support for CCS from a policy or regulatory point of view was also raised by several organisations, along with lack of industry buy-in to CCS. National storage assessments were usually undertaken with support from the national government: without state support, it appears to be very unlikely that a national storage assessment would be prepared. During discussions, respondents from some developing countries highlighted other potential barriers that reduced political support for CCS, e.g. the need to prioritise development of essential national infrastructure or the intention to avoid CO₂ emissions through implementation of other low-carbon technologies instead of becoming dependent on fossil fuels. Lack of or low current levels of emissions per capita or low legacy emissions reasons were also quoted as a reason for lack of interest in CCS in some developing countries. Lack of industrial support for CCS was raised as an issue by several respondents; the main reported reason for lack of support for CCS amongst

industrial sectors was the increased cost of producing commodities (power, cement, steel, etc.).

Funding for national assessments could usually be identified, but funding for more detailed assessments was an issue according to respondents. National assessments in developed countries always involved some public or national funding for the very early stages of national assessment. National assessments in European countries were also heavily reliant on research funding. In developing economies international funding plays an important role in early national assessments for CO₂ storage.

The availability of expertise required to carry out assessments of CO₂ storage capacity to a 'practical' level was generally available in all countries reviewed, though some respondents did note that if CCS rapidly accelerated towards deployment then the availability of expertise could potentially become an issue. In some countries where political support for CCS had waned, respondents observed that experts in CO₂ storage had already moved into other fields. In countries where CCS assessments had not yet been carried out, specialists with relevant geological expertise were working in other areas and so some adaptation would be needed.

4. Recommendations to overcome barriers to national storage assessments

A number of commonalities were identified that had enabled assessments of national storage potential. These included regulatory and political support, presence of a national body to manage and coordinate access to relevant data and existence of an organisation with access to national datasets with a clear mandate to undertake such an assessment. Further recommendations based on the questionnaire results and interviews are given below.

4.1. Data access and quality assessment

Data access needs to be facilitated at national level; national storage assessments were achieved more quickly and a more mature level of assessment was achieved where a public organisation existed with a clear mandate from their national government to manage the assessment and particularly to coordinate access to, and collation of, relevant data. Enabling data access at national level is of wider benefit as sharing of geological and geophysical data is relevant to a large number of applications (e.g. hydrogeological surveying, nuclear waste disposal).

Results from state-funded assessments should be made publicly available (while of course respecting primary data confidentiality, if required) which will accelerate storage assessments through knowledge sharing.

Raw data should be made available in tabulated format, e.g. depth, porosity, formation thickness, net sandstone to gross thickness, areal coverage, volume of hydrocarbons removed, formation compartmentalisation, pressure and temperature values. This will enable researchers to apply a preferred methodology, allow comparison between different storage sites and permit quality control. Quality assessment and control of data at the time of collection in repositories is essential to ensure that any issues are resolved (e.g. to ensure that all metadata are present and that any uncertainties in the data are explicit). It was apparent that a good understanding of the uncertainties and constraints in the underlying data remains critical throughout all stages of assessment.

A clear and comprehensive description of the capacity assessment methodology used is also essential, so that the limitations of the different approaches are understood, as there is currently no agreed/standard methodology.

Simple volumetric estimates are a strong first stage in a national storage assessment. These can be performed using existing data and give decision makers an early indication of the role CCS could play in reducing national CO₂ emissions. Fluid flow simulations providing dynamic capacity estimates (including the impact of site-specific dynamic factors) are needed to fully understand the potential CO₂ storage capacity following on from national storage assessments. Depending on the existing level of data available for capacity assessment, new data will almost certainly be required to meet this increased level of understanding.

4.2. State and policy support, long-term vision for reducing greenhouse gas emissions

Where assessments of national storage capacity had been carried out, all respondents reported that public (government) funding, or international funding had been required for at least early stage national storage assessments so it seems that this support is essential in initiating national CO₂ storage assessments. More advanced storage assessments (e.g. site specific evaluations) were usually supported by a mix of public and private funding.

Where national CO₂ storage potential exists, policy support should ensure that there is a long-term vision for reducing greenhouse gas emissions which may include deployment of CCS. This will help to create an enabling environment in which industrial support for CCS may develop, by reducing uncertainty in the future political and regulatory support for CCS. Countries with more advanced storage assessments also often benefitted from the presence of CCS ‘champions’ who increased awareness of CCS and promoted it as a greenhouse gas mitigation technology.

The great value of knowledge sharing between forerunner and follower countries was also evident, as this had enabled national storage assessments in countries where CCS expertise is not yet available. Developing countries, particularly where oil and gas resource development is absent or still maturing, are likely to experience greater difficulty sourcing the expertise needed to perform CO₂ storage assessments. Generally, there was an interest in international collaboration and knowledge sharing so overcoming limited or reduced national expertise in CO₂ storage seems feasible.

5. Conclusions

The greatest barriers to storage assessments identified in this study are sparsity or absence of data, lack of access to existing data, and the quality of available data. Lack of funding and insufficient policy support were also amongst the barriers highlighted by the respondents. Despite identified issues, all countries, from which responses to the questionnaire were received, have undertaken some form of national assessments of their storage potential.

A number of commonalities were identified that had enabled assessments of national storage potential. These included: clear national emission reduction strategies, which may include CCS; policy support with public (government) funding, or international funding, for at least early stage national storage assessments; public organisation(s) with a clear mandate from their national government to manage the assessment and particularly to coordinate access to and collation of the relevant data.

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