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POLICY GROUP
TECHNICAL GROUP

Technical and Societal Issues for Co-Management of Land Use in Developing Storage Sites for Carbon Capture and Storage

Note by the Secretariat

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Background

At the Joint Business Meeting of the Carbon Sequestration Leadership Forum (CSLF) Policy and Technical Group in Paris, France on the 28 March 2007, a proposal was put forward for a Joint Policy Group-Technical Group Task Force on Societal Issues. The proposed Task Force was characterized as examining the technical and societal issues for co-management of land use in development of storage sites. After discussion, consensus was reached for Australia to prepare a paper on this topic in consultation with any other CSLF task force that would be interested in this issue. The purpose of this paper is to support any discussion on whether a CSLF task force should be established to consider these and any additional related issues in further detail.

Action Requested

The Policy Group and Technical Group are requested to review and consider the paper by Australia on "Technical and Societal Issues for Co-Management of Land Use in Developing Storage Sites for Carbon Capture and Storage" and to consider if a new task force should be established.

Conclusions

The Policy and Technical Groups are invited to note in the Minutes of this meeting that:

"The Policy and Technical Groups, in their Joint Meeting, reviewed and considered the paper by Australia and considered the formation of a new task force."

TECHNICAL AND SOCIETAL ISSUES FOR CO-MANAGEMENT OF LAND USE IN DEVELOPING STORAGE SITES FOR CARBON CAPTURE AND STORAGE

AN AUSTRALIAN EXPERIENCE

March 2008

Australian Government

Department of Resources, Energy and Tourism

Australian Government

Geoscience Australia

Preface

At the Joint Business Meeting of the Carbon Sequestration Leadership Forum (CSLF) Policy and Technical Group in Paris, France on the 28 March 2007, a proposal was put forward for a Joint Policy Group-Technical Group Task Force on Societal Issues. The proposed Task Force was characterised as examining the technical and societal issues for co-management of land use in development of storage sites. After discussion, consensus was reached for Australia to prepare a paper on this topic in consultation with any other Task Force that is interested in this issue.

This paper was written from an Australian perspective and briefly examines the legal, technical and societal issues for co-management of land use in developing storage sites for CCS in Australia. It is not intended to be comprehensive but outlays the common issues with the aim to assist discussions on whether a Task Force should be established under the Carbon Sequestration Leadership Forum to consider these and additional related issues in further detail.

This paper was developed by Jeannette Marshall, Peta Ashworth, Clement Yoong and John Bradshaw. Comments and suggestions should be directed to the authors at peta.ashworth@csiro.au, clement.yoong@ret.gov.au, john.bradshaw@ga.gov.au

Introduction

Carbon dioxide capture and geological storage (CCS) has been identified by the Australian Government as one of several medium term options to meet the objectives of sustainable energy use, lowering greenhouse gas emissions and utilising Australia's competitive advantage in low cost and abundant fossil fuels (coal and gas). The timely uptake of CCS is seen as a key priority that will allow Australia to continue to reap the benefits of its rich endowment of fossil fuels while reducing its emissions of greenhouse gases. A number of issues relating to public acceptance, resource use and access to land will, however, need to be addressed in approving CCS projects. This paper also refers to a proposed framework which has been extensively developed but remains subject to Government endorsement.

Development of Legislation and Regulatory Framework

A key step in the deployment of CCS technologies is the development of a management framework that establishes an environment where CCS can compete equally with other greenhouse abatement technologies and provides the community and investors with the certainty and assurances required to enable the development of new projects. In November 2005, Australian Commonwealth and State Ministers endorsed a set of *Regulatory Guiding Principles for Carbon Dioxide Capture and Storage* (the *Regulatory Guiding Principles*)[1]. This step was required to provide a basis for a nationally consistent framework for CCS which would enhance community acceptance of CCS. The *Regulatory Guiding Principles* covered six key areas

- assessment and approvals processes
- access and property rights
- transportation
- monitoring and verification
- liability and post-closure responsibilities
- financial aspects.

The Australian Government (Commonwealth) is currently considering the development of a Bill to amend the Commonwealth *Offshore Petroleum Act 2006* (OPA) to provide a legal and regulatory framework for CCS in geological structures beneath the seabed in waters under the control of the Australian Government. The Bill being currently drafted has been developed consistently with the *Regulatory Guiding Principles*. The OPA was identified as the most appropriate vehicle for implementation of a CCS access regime because:

- the petroleum and CCS industries will apply similar technology relating to access to the sub-surface pore space where interests will often overlap
- there is a need to reflect co-existence and determinable rights between the petroleum and CCS industries
- the structure of the OPA has provided a successful mechanism for regulating the petroleum industry since 1967.

The proposed amendments to the OPA will assist the development of complementary legislation to regulate onshore CCS activities in Australia's States.

[1] Ministerial Council on Mineral and Petroleum Resources, 2005. *Carbon Dioxide Capture and Geological Storage, Australian Regulatory Guiding Principles,* Canberra.

Access and Property Rights

Given the costs and long period of operation of CCS projects, proponents will require clearly defined access and property rights before being willing to invest in new projects. Relevant matters include ownership of the CCS stream, and access to sites and infrastructure. The Australian Government has recognised that rights will need to be based on established arrangements and accommodate the likely evolution of multi-user CCS infrastructure and facilities.

Ownership of the CCS stream at each stage of a project needs to be established in legislation and be transferable, with the rights and responsibilities associated with ownership clearly defined and predictable, taking into consideration the long term risks and management issues.

Timely access to sites for exploration, storage and infrastructure purposes is vital to the development of new projects and operators will require a high degree of certainty that they will be granted access to a selected site before committing to a project. In Australia, sites may be subject to a range of different tenures including freehold land, unallocated Crown land[2], Crown land which has been dedicated for a specific purpose, and offshore regions under State or Australian Government (Commonwealth) jurisdiction. Differing legal rights and restrictions apply to these different types of tenure and competing/existing uses for these tenures need to be taken into account.

Australia has many reserves and protected areas managed by the Commonwealth and/or States that are subject to controls to protect the environment and/or heritage values. Sites may also be subject to different forms of Indigenous title including native title, which may give procedural rights to Indigenous holders and claimants, and the inalienable freehold conferred by the *Aboriginal Land Rights (Northern Territory) Act 1976* which generally requires Indigenous consent to developments on Aboriginal land. While the issues raised by Indigenous landholders in relation to CCS are likely to be similar to those for mining operations, it will be essential to ensure that Indigenous landholders have access to information about CCS in a form that they can understand to enable them to consider the potential risks and impacts of CCS developments on their land.

CCS projects may be subject to transboundary issues particularly where pipelines cross State borders or where the injected CCS stream may migrate across jurisdiction boundaries (such as between Commonwealth and State waters). The development of a nationally consistent regulatory framework for CCS would reduce the burden for companies operating projects subject to these issues.

CCS projects may have impacts on a range of different activities and there is a need to provide approvals processes that are transparent and equitable and which take account of the interests of stakeholders including preserving the rights of existing titleholders where appropriate. The *Regulatory Guiding Principles* recognise that governments need to consider land use planning issues that may arise as a result of the grant of CCS injection licences, including potential future land use decisions. The approval of CCS storage activities may also have more direct impacts on existing or future mining and petroleum operations where

[2] Crown land is a general term for all lands owned by and controlled by government. In effect, Crown land is land that is not privately owned and has remained in public ownership.

proponents may be competing for access to the same or adjoining geological strata. Pipeline corridors could also affect a broad range of landholders.

The needs of different stakeholders is a particular issue for the Australian Government in relation to offshore petroleum activities where petroleum accumulations and geological storage sites are likely to be located close to one another, or occupy the same footprint at the surface, and the pre-existing rights of petroleum title holders need to be protected. The policy imperative is to minimise sovereign risk to existing title-holders' investment in Australia's offshore resources. The regulator would, in approving the CCS activity, need to be satisfied that there would be no significant adverse impact on petroleum operations or that relevant concerns were addressed in a joint agreement between the CCS proponent and petroleum operator. (The development of joint agreements could also assist other operational arrangements such as access to infrastructure and the sharing of data and other information.)

For future titles (granted following the introduction of the CCS regime), it will be possible to accommodate both petroleum and CCS activities. This could be achieved by enabling the regulator to issue directions and decide between the different activities where they cannot coexist, on the basis of a public interest test.

Given that CCS titles are likely to need to be relatively large, arrangements for relinquishment will need to avoid the possibility of companies warehousing large areas for extended periods of time. Warehousing of CCS acreage is an issue not only for other CCS projects but for proponents seeking to develop mining and petroleum projects in an area.

It is likely that companies' proposed work programs will be used to assess bids for access to exploration acreage. To ensure this process is fair, the assessment process will need to consider the impact on proposed work programs of the outcomes of any previous exploration undertaken by the applicant(s) in the relevant area, such as exploration carried out under a previous petroleum exploration licence.

Governments have recognised the need for arrangements that accommodate the likely evolution of multi-user CCS infrastructure and facilities. Part IIIA of the Australian *Trade Practices Act 1974* establishes legal rights for third parties to share the use of infrastructure services on reasonable terms and conditions. CCS pipelines and injection facilities may be susceptible to applications for third party access rights and regulatory processes and need to take account of the possibilities and benefits of multi-user access. While shared access to pipelines is feasible where there is more than one storage reservoir or where a single company is responsible for injection and management of a reservoir, the provision of shared access to storage sites (where more than one company injects into a particular lease area or reservoir) is likely to be more problematic due to liability issues and difficulties in managing the cumulative impacts of more than one site user and the impacts on other site users. These regulatory constraints may, in practice, preclude joint access to storage reservoirs.

Implications of the Properties of Carbon Dioxide (CO_2) on Geological Storage

There are some fundamental aspects in which the way legislation and regulation associated with geological storage of CO_2 will need to differ from arrangements applying to petroleum and mining activities. Of principal importance to regulators is realisation that injection and storage of CO_2 results in a substance being resident in the geological subsurface may exhibit a transitory behaviour over time. CO_2 is buoyant in the geological subsurface compared to

most other subsurface fluids (less dense than water), and can and will migrate through the subsurface fluids in a permeable reservoir sequence (eg sandstone) beneath an impermeable seal (eg shale). If the migration of the CO_2 is physically impeded in a horizontal and vertical direction by impermeable seals in the geological strata it will not move far from the injection point in the well bore. It thus could be constrained physically within a lease boundary. However, some extremely important trapping mechanisms (such as dissolution of the CO_2 in the reservoir formation water (saline water) and residual gas saturation (trapping of the CO_2 into residual locations around the pores of the reservoir rock)) will only be efficient if the injected CO_2 does migrate laterally below an overlying impermeable seal, but still within the surrounding reservoir sequences. The effectiveness of these trapping mechanisms (percentage trapped) will change over time as the CO_2 migrates, until all the CO_2 is trapped physically, is dissolved into the formation water or trapped as residual gas. The potential storage capacity of dissolution and residual gas trapping mechanisms greatly exceeds that which can be physically trapped in a rock sequence making these mechanisms particularly attractive technical options to include in a geological storage regime.

It is this time and transitory aspect of geological storage of CO_2 that will require the legislative and regulatory system for geological storage of CO_2 to vary markedly in some ways from conventional petroleum and mining leases. It also impacts on the way leases would be designed and considered in the granting of the leases.

At a societal level, the concept of potential impacts on resources (oil, gas, water and coal) of a transitory and buoyant substance needs to be expressed clearly to other users of the subsurface, and provided for in regulations for the safe operation and management of CO_2 geological storage sites. Whilst resource industry operators may be comfortable at a technical level with such co-use of the subsurface, public perception of such interactions are likely to be less technically knowledgeable and the community will need to be informed and educated, and their opinions appropriately considered. Where geological storage is considered in a near urban environment, such considerations and understanding of stakeholder perspectives will be critical to successful deployment of geological storage operations.

Impacts

CCS projects will likely trigger State or Commonwealth environmental approval processes involving public review and the preparation of comprehensive environmental management programs. Many of the issues relevant to CCS projects are likely to be similar to those for other major mining and infrastructure projects. Sites will, however, need to be subject to long term monitoring to confirm the absence of leakage and the first few projects may require additional studies and verification to assist understanding of the factors affecting CCS storage. Remediation plans will need to be developed to proactively consider potential leak points (abandoned wells) and to deal with unexpected leaks and other impacts. While the risks related to CO_2 and its interaction with the environment are relatively well understood, the public will need to be assured that all risk factors have been adequately accounted for including the impacts of a catastrophic leakage. There may also be specific impacts arising from the interaction of the injected CCS stream with the surrounding storage area. Further work may be required to identify and evaluate the significance of these specific impacts.

Responsibilities for remediation will need to be clearly defined particularly where there are shared user arrangements and different entities are involved in various stages of the process

chain. (This issue has presumably been addressed in other industries where there is joint access to infrastructure.)

The interaction between CCS operations and petroleum and mining projects raises a number of issues. The potential for CCS activities to lead to sterilisation of mineral and/or petroleum resources will need to be considered both at the time of project approval and in the event a mineral or petroleum resource is discovered during the course of geological storage operations, either by the CCS title holder or other resource title holder. Regulators will need to balance the potential public benefits arising from further evaluation and extraction of the resource against the rights of the CCS title holder. The enforcement by the regulator of practices to minimise resource sterilisation may need to be considered. Regulators should also consider the possibility of future technical developments that could improve the recoverability of mineral and petroleum resources.
CCS projects could also affect the rate of recovery of oil and gas from adjoining petroleum leases due to pressure changes. These changes could raise safety issues for mining and petroleum projects operating nearby, and also impact substantially on other storage operations within the sedimentary basin by changing the pressure regime regionally thereby affecting their resource storage capacity or safety of the injection operations.

Pressure changes could also lead to displacement of fluids thereby enhancing or impeding access to subterranean water resources. Impacts on water quality may also need to be considered.

The limited number of CCS projects to date and the varying geology of different storage formations will inevitably lead to some uncertainties about the behaviour of the CCS stream once it is under the ground. While these uncertainties can be further evaluated by monitoring during the operational phase, the regulator will need to be able stop injection or require an alteration to the injection plan if the behaviour of the injected plume does not conform with expectations. The need for financial security to cover remediation will need to be considered. This could be effected through a financial instrument similar to a minesite rehabilitation bond.

Long Term Liability and Monitoring

Long term liabilities arising from CCS projects are likely to be a disincentive to investment in new projects. Liability to pay monetary compensation could potentially arise from a leak of the CCS stream during any part of the CCS process, including after injection. Potential sources of common law liability for CCS include public health impacts, environmental and ecosystem damage and injury to persons or damage to property. These liabilities exist in perpetuity.

It is proposed that the regulatory framework (OPA) and its regulations will establish comprehensive statutory responsibilities for greenhouse gas title-holders with respect to protection of the environment, other seabed resources, and human health and safety similar to those currently applying to the petroleum industry. The OPA does not exclude, limit or allocate common law liability of title-holders or others engaged in offshore petroleum operations and greenhouse gas industry participants will therefore need to make their own arrangements to deal with potential common law lability as an ordinary cost of doing business. This approach is likely to conflict with industry views that governments should assume long term liability for injected greenhouse gases.

Monitoring arrangements will need to meet accepted performance standards and enable the generation of timely and accurate information that can be used to mange environmental and other risks. It will be important to ensure reporting arrangements are sufficiently flexible to accommodate changes in technologies and that they minimise impacts on other site users.

Given the likely need for ongoing long term monitoring, the possible establishment of trust accounts to cover long term monitoring post-closure is being considered. Long term monitoring will assist understanding of the issues associated with geological storage including the likelihood and types of risk associated with CCS. Industry has suggested that full cost recovery for long term monitoring may not be appropriate in all cases given the public benefit of CO_2 emissions avoided. This issue needs further consideration.

Public Perceptions

Public acceptance of CCS as a safe and effective greenhouse mitigation tool is essential to gaining public support for new projects. Recent work undertaken in Australia by the Centre for Low Emissions Technology showed that over 90% of people considered climate change to be an important issue to Australia. However, the majority did not know what CCS was or understand its potential to mitigate climate change (Ashworth et al., 2006).

The degree of public ignorance about CCS highlights the importance of ensuring that factual information from credible sources is publicly available (Wright, et al., 2007). A communication strategy aimed at a range of stakeholders is essential to avoid the debate being captured by extreme environmental (anti-CCS) interests, to address the particular needs of communities likely to be affected by CCS operations and to consider the CCS acreage release process under the OPA (to both encourage companies to apply for greenhouse gas assessment permits and to raise public awareness of the benefits of CCS). Research has shown that once formed opinions can be slow to change (Cormick, 2004). Therefore, early communication on CCS can only help to ensure a more positive and balanced view of the technology is developed across the wider society.

Early research suggests that public acceptance of projects is more likely when individuals understand what CCS is and why it is required (Ashworth et al., 2006). As with any new technology with perceived risks, demonstrating the potential benefits of CCS and highlighting existing projects, such as those that have been developed overseas, will also help to temper potential concerns of stakeholders (Wright et al., 2007). The proposed regulatory arrangements, including project approvals, safeguards to meet health, safety and environmental requirements, monitoring and public reporting are also key to overcoming potential barriers to the technology (Slovic, 1993).

Based on a range of international research activities, other common issues which require careful consideration include whether CCS is seen as a bridge to a future technology or is a technology to sustain the life of fossil fuels (Wright et al, 2007). This is particularly of important to environmental groups who may be supportive of CCS as a transitioning technology but less so if they believe its sole purpose is to extend fossil fuel extraction. Will it leak into groundwater or into the atmosphere with adverse effects? This question arises from a range of stakeholders and demonstrates the lack of understanding individuals have about CCS and its potential adverse effects (Benson et al, 2002).

In areas where earlier resource extraction projects have been left unsatisfactorily, there is often a legacy which results in communities having a genuine distrust in any new project proponents because of their previous bad experiences. Finally, the socio economic status of communities' i.e. low socio economic versus well educated and affluent, has impacted on individual community's levels of empowerment and ability to actively engage in discussion around proposed projects. This was particularly noticed in the recent objections of the environmental organisation, Coalition for a safe environment. All of these issues are important considerations for the approach that is adopted for the acreage release process under the OPA.

A Plausible Way Forward for Communication

To date, there has been much debate as to who should have responsibility for funding communication efforts, government or industry. This has resulted in limited communication efforts of the topic, not only in Australia but in other countries across the world. As a result the progression of CCS is currently somewhat tenuous. There is a genuine need to undertake a proactive approach to communication to ensure an enhanced understanding is developed across society. So far, the majority of communication and engagement efforts around the CCS have been directed to stakeholders with a vested interest in the technology, be they positive (potential project proponents) or negative (some environmental NGOs) with little effort to engage wider communities. The release of the OPA in Australia suggests a perfect opportunity to ramp up the process of communicating about CCS to support the impending demonstration projects and create wider acceptance.

Depending on their level of experience with CCS and their ongoing interest in the technology, each individual stakeholder group will have a different attitude towards CCS. For example, the risk of contamination of an existing or potential resource is likely to be perceived extremely high for oil and gas companies operating in the area a CCS project is proposed. Whereas, the risk to a community member who has a CCS project proposed near to where they live may also be perceived as high depending on the information they have to hand about CCS. Regardless of the stakeholder group it is imperative that the perceived risks and concerns are identified through dialogue, rather that intuitively, to ensure accuracy (Fischhoff and Fischhoff, 2001). A true dialogue will also allow all parties to work towards a common solution and overcome any barriers that may exist.

The recent social research workshop held in Banff, Canada hosted by Climate Change Central in September, 2008 identified a number of key considerations for communicating CCS. These included:

- trust and honesty is essential to the process;
- there is a need to provide balanced, valid and accessible information from a range of sources;
- dialogue and true discussion is far more effective than just one way information sharing;
- the context CCS is presented in matters;
- acceptance will not be enhanced by advocating or persuading;
- CCS should not be seen as being implemented at the expense of renewable energy technologies; and finally,
- demonstration of a strong regulatory and monitoring process will also enhance its likely acceptance.

The quote below from, Adler and Kranowitz's (2005) paper "A primer on perceptions of risk, risk communication and building trust" summarise many of these considerations.

> *Risk communication includes the open sharing of information and acknowledgement of concerns. It incorporates and appreciates diverse opinions and perspective in an atmosphere of consensus building. It accepts that the dialogue sometimes may be more about feelings than facts. If messages are consistent, if the process is open and accountable, the success of the planned project increases dramatically*

They suggest that addressing these factors will help to increase trust, reduce the likelihood of protracted controversies and therefore enhance the probability of project success.

Therefore, the key to successful communication of CCS will be to involve all stakeholders from the beginning. For example, where issues of multi-use are likely, bringing the parties together early will allow them to identify potential problems and at the same time work to generate potential solutions to alleviate the potential for conflict (Webler, 2005). In communities where projects are proposed, ensuring adequate opportunity for public consultation to inform them about the impacts and environmental performance of CCS will allow them to voice concerns. If the concerns are heard and efforts made to overcome them it is less likely that project will be opposed. In general, people like to be asked about issues that impact on them and involving them from the beginning helps to gain support as they become part of the solution. In addition to these, a concentrated effort to raise awareness of CCS with the general public will help to increase acceptance across wider society.

Focusing efforts across the members of CSLF to proactively work on these issues in this way will provide valuable information and help to create a positive acceptance and awareness of CCS.

Recommendation

The issues highlighted in this paper are not intended to be comprehensive. They should instead serve as an informed guide to influence a considerable body of work that should be undertaken to further explore in greater detail the technical (legal) and societal impacts of developing storage sites for CCS.

Sharing our experiences, policy directions and proposed legal frameworks offers opportunities to harmonise strategic approaches where possible and can help to facilitate early identification of common emerging issues and provide insights into CCS policy implications for other countries. With increasing cases of countries/states and counties dealing with trans-boundary CCS issues, all parties would benefit from further sharing of experiences of policymakers or regulators dealing with such interactions.

The CSLF should consider whether a Task Force needs to be established. There are further opportunities for this information sharing to link with the soon to be launched IEA Network of Regulators.

References

Ashworth, P., Pisarski, A. & Littleboy, A.. (2006). *Social and Economic Integration Final Report: Understanding and incorporating stakeholder perspectives to low emission technologies in Queensland.* Pullenvale: Centre for Low Emission Technology.

Ashworth, P., Littleboy, A., Pisarski, A, Beath, A., & Thambimuthu, K. (2006). *Understanding and incorporating stakeholder perspectives to low emission technologies in Australia.* Paper presented at the 8th International Conference on Greenhouse Gas Control Technologies, 19-22 June 2006, Trondheim

Benson, S., Hepple. R., Apps, P., Tsang, C.F., & Lippmann M., (2002) *Lessons learned from Natural and Industrial Analogues for Storage of Carbon Dioxide in Deep Geological Formations.* E.O. Laurence Berkeley National Laboratory, Berkeley, CA.

Adler, Peter S, Kranowitz, Jeremy L, (2005), *Perceptions of Risk, Risk Communication and Building Trust.* U.S. Department of Energy National Energy Technology Laboratory (NETL): The Keystone Center.

Cormick, C. (2004). *Personal Communication*. Canberra, Biotechnology Australia

Fischhoff, B. and B. Fischhoff (2001). *Public's opinions about biotechnologies.* AgBioForum.

Ministerial Council on Mineral and Petroleum Resources, 2005. *Carbon Dioxide Capture and Geological Storage, Australian Regulatory Guiding Principles*, Canberra

Slovic, P. (1993). *Perceived risk, trust and democracy"* Risk Analysis 13.

Webler, T. (1995). *"Right" discourse in citizen participation: an evaluative yardstick. Fairness and competence in citizen participation: evaluating models for environmental discourse*. O. Renn, T. Webler and P. Wiedemann. Dordrecht, Kluwer Academic Publishers.

Wright, I., Ashworth, P., Anderson, J., Shackley, S., Itaoka, K., Wade, S., Asamoah, J., & Reiner, D. (2007) *Public Perception of Carbon Dioxide Capture and Storage: Prioritised Assessment of Issues and Concerns.* C02 Capture Project IEA Working Party on Fossil Fuels, ZETS Phase 2: Communication Strategy. London: DTI.