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# Strategic Analysis of the Global Status of Carbon Capture and Storage

## Report 3: Policies and Legislation Framing Carbon Capture and Storage Globally

Final Report

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# Preface

In May 2009 the Global CCS Institute commissioned a WorleyParsons led consortium comprising of Schlumberger, Baker & McKenzie and the Electric Power Research Institute (EPRI) to undertake a Strategic Analysis of the Global Status of Carbon Capture and Storage (CCS).

The Strategic Analysis of the Global Status of CCS will develop six reports. These are:

- an Early Report presenting a high level overview of the key issues and preliminary findings of the study to inform the 2009 G8 Summit held in L'Aquila, Italy, between 8 to 10 July; and
- four foundation reports and a fifth synthesis report that covers:
  - a comprehensive survey of all CCS projects being undertaken globally;
  - a detailed analysis of the capture, transport and storage costs for power plants and a select range of industrial applications;
  - a detailed assessment of the status of policy supporting CCS development globally;
  - a comprehensive list and analysis of existing Research and Development (R&D) networks (government, academia, industry and institute) involved in CCS; and
  - a comprehensive assessment of the gaps and barriers to the global deployment of large scale CCS projects.

This report presents a detailed assessment of the status of policy supporting CCS development globally (Foundation Report Three).

# Acknowledgements

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Strategic Analysis of the Global Status of Carbon Capture and Storage
Report 3: Policies and legislation framing carbon capture and storage globally.


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# 1. Executive summary

This Third Foundation Report provides an empirical analysis of existing carbon capture and storage (CCS) policies and laws in the jurisdictions surveyed. It provides policymakers with a digest of approaches taken to CCS regulation by identifying approaches which could be replicated or adapted in jurisdictions wishing to promote and facilitate CCS projects. The report also identifies gaps in laws and policies which may impede the development and deployment of commercial scale CCS projects in the near term.

## 1.1 Background

Recognising the adverse environmental effects of greenhouse gases (GHG) in the atmosphere, many governments (both at a State and sub-State level) are taking steps to begin reducing such emissions. Some are taking action in satisfaction of international treaty obligations (such as under the Kyoto Protocol) and some are acting in discharge of domestic goals or in response to domestic political pressures.

In the developed world in particular, many States are putting a price on carbon, either via cap and trade schemes or taxes. These measures are designed to reduce reliance on high GHG emitting fuel sources and to promote both energy efficiency and the development of low emission energy sources.

To achieve the GHG emission reductions identified by the Intergovernmental Panel on Climate Change (IPCC) required to avoid the effects of dangerous climate change will be very challenging. This is especially so because of the relative abundance and cheapness of fossil fuels (and in particular coal), from which much of the world's baseload power is currently derived.

CCS is one of a number of responses available to help reduce GHG emissions. It has the potential to remove significant quantities of $CO_2$ from the atmosphere while allowing economies to continue to use otherwise potentially high GHG-emitting fuel sources which, in the near term at least, are likely to remain generally cheaper than alternative energy sources such as biofuels, solar, wind, wave and geothermal power.

### 1.1.1 An important first step: valuing carbon use

Absent a cost on carbon, it is unlikely that many economies could reduce their GHG emissions to levels which it is now widely accepted must be achieved by 2050. Policies imposing a cost on GHG emissions play an important role in making CCS and other emission reduction responses economically viable.

Mandatory cap and trade and carbon taxation schemes are both underpinned by legal sanctions. By introducing policies imposing a cost on carbon (in combination with other measures), governments can utilise their policy-making power to correct markets which have not internalised the cost of carbon or have only done so in a limited or superficial manner.

Cap and trade schemes impose a carbon cost on GHG emissions and in so doing may help bring down the comparative cost of CCS and other emission reduction responses by diverting capital into new technologies designed to reduce or eliminate those carbon costs. However, the mere existence of a cap and trade scheme may not, of itself, be sufficient to promote CCS projects in the very near term: although the EU has a sophisticated and well established cap and trade scheme, there has not yet been extensive CCS deployment in Europe. Financial incentives or mandatory (non-tradeable)

emission limits may also be needed to help promote deployment of CCS as its cost can vary dramatically depending on the project type and methodologies used.

CCS projects are likely to be easier to facilitate where a combination of incentives and penalties are employed. The role of Norway's complementary carbon tax and its own emissions trading scheme (NETS) in making commercial-scale carbon storage economically viable for the Sleipner Project provides an example of how such policies can, when targeted and well-developed, directly affect the viability of CCS. The price that will make CCS cost-competitive will vary as the cost of capture varies from plant to plant.

The effectiveness of these policies can be maximised by ensuring that their development is as free from rent-seeking as is politically feasible. Governments and regulators should also ensure that the most cost effective means of facilitating CCS projects is explicitly embedded in such policy regimes. In this sense, the experiences of Australian, Canadian and US jurisdictions and the EU are particularly relevant as these could be utilised in other jurisdictions considering implementing policies in this area.

In the absence of economically efficient pricing of GHG emissions set by governments, CCS could potentially remain more costly than other GHG emission reduction schemes in the short to medium term. A range of policy measures will be required to prompt the design, permitting and construction of CCS projects until a sufficiently high price is placed on GHG emissions.

### 1.1.2 The uniqueness and risks of CCS

The aim of the Group of Eight (G8) is to launch 20 large-scale CCS projects globally by 2020. This is a very ambitious target.

Harnessing and deploying the resources required, overcoming the opposition which will emerge (locally and ideologically) and establishing the legal frameworks needed to attract and retain private sector investors will require the immediate expenditure of vast political and financial resources across multiple jurisdictions. It will also necessitate a better and more coordinated public explanation of the long term environmental benefits and risk management strategies which will be employed along CCS project cycle.

In addition to the "timeframe challenge" described in more detail below, there are several other issues which need to be managed immediately and simultaneously.

A sufficient number of geologically adequate sites need to be identified and secured to facilitate CCS projects. Not all States wanting to store captured $CO_2$ (or emitters operating within those States) will have such sites or, even if they do, they may not have immediate access to them or legal rights over them.

Securing sites, compensating land owners and/or negotiating rights of access to sites across State borders will be time consuming even with CCS specific laws in place. Transporting the gas by pipelines over long distances will throw up similar issues (as well as additional issues such as potential prohibitions under International Treaties affecting the transport and storage of certain wastes).

Even if the emission reductions technically capable of being achieved by CCS are widely understood by the public (which at present is not the case), the issue of long term leakage potential and the unknown consequences of that (real or imagined) are likely to delay approvals and may well result in litigation or other time consuming legal challenges.

There is also likely to be very considerable opposition to locating storage sites under lands already given over to productive uses or which are otherwise already environmentally sensitive - this opposition may also be agitated by environmental groups for a variety of reasons.

While the costs of developing CCS projects have been well documented, the long-term costs associated with managing risks associated with leakage liability are less well known. Legal frameworks that apportion liability for leakage from storage sites between project developers, site owners and host country governments vary between States and are likely to change as governments test the appetite for the private sector to accept longer-term risks.

Where CCS specific legal frameworks do exist, in most cases liability for leakage passes to a host country government after a period of between 10-30 years. However, in the interim, the entity with responsibility for the storage site may need to find insurance to cover the potential costs associated with leakage (as may governments if and when they take on the liability risk). Those costs are not only for direct physical harm caused by an escape of $CO_2$, but also for the indirect costs of $CO_2$ leakage to the atmosphere, which may equate to the cost of carbon at the date of escape.

Overcoming the challenges of selecting and securing appropriate sites (including storage), dealing with leakage liability and obtaining the necessary government approvals for CCS projects are just three of the threshold issues that need to be addressed in the project planning phase. Equally important is the ability to secure project funding which will cover not only the infrastructure costs of capture, transportation, injection and storage, but also the long-term costs associated with ensuring permanent storage.

There are over 60 potentially commercial scale CCS projects under development across the world with a total estimated capital requirement of over US$100 Billion. To date, governments and cooperative public-private research projects have committed less than US$10 Billion to these projects. For even a substantial minority of these projects to be implemented, significant levels of new capital raising will be required. While governments may commit more funding, the private sector must become more fully engaged.

CCS is competing with a number of other new technologies for funding in both the public and private arena. Incentives and subsidies for some of these technologies, in particular renewable energy, are rapidly bringing down their costs and making them more attractive as a commercial investment. These technologies are often less controversial from an environmental and social point of view, being seen to be cleaner, more sustainable and less experimental than CCS. It is critical that policy frameworks which provide similar incentives are developed for CCS to enable it to stay within competitive reach of other new technologies.

### 1.1.3 Policies supporting CCS

A variety of funding and support measures have been employed by governments and other agencies which have, and are, contributing to developments in CCS, especially at the "pilot" or demonstration stage. These research funding and related measures generally assist in facilitating what is still a relatively new technology and one which is still not widely applied at a commercial scale.

Without detracting from the important role that the funding of demonstration activities play, one concern is that because of the significant costs and timescales involved in establishing full cycle projects, there is already competition between the different "flag-ships" for funding – in particular for co-financing from the private sector. At present, private sector engagement is led by those companies that have a direct interest in utilising the resulting technologies (e.g., major global coal mining and

energy companies) and which are likely to have their GHG emissions regulated. The number of those companies and their resources are finite and contributions to multiple projects rather than concentrating efforts on one or two could mean that none of the projects are adequately funded.

As well as directly funding a number of demonstration-scale CCS projects, governments in the jurisdictions surveyed have made use of three main forms of domestic policy incentive to encourage the development of CCS.

First, high-level CCS or energy management policies which can provide whole-of-government frameworks for initiatives to develop CCS, such as the US Government's goal of reducing US GHG emissions by 83 percent by 2050.

Second, direct government funding and research support for CCS through cooperative research centres such as Australia's Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC), South Africa's National Centre for Carbon Capture and Storage and the Masdar Institute of Science and Technology in the United Arab Emirates (UAE).

Third, government-business collaboration on demonstration projects such as the FutureGen project in Illinois in the US or the Sleipner project in Norway.

These policy measures have helped facilitate coordination between governments, academia and market participants to achieve concentrations of financial and bureaucratic resources, academic and business knowledge. They have also helped accelerate the commercialisation of CCS by enabling project proponents to access funding which may not otherwise be available on a commercial basis. Measures like this may also provide project participants with high-level political and policy support for their projects and technologies.

In isolation, however, these measures will be counter-productive where R&D projects become too academically biased or not sufficiently focused on reducing the commercial risks and costs of CCS and where a proliferation of competing and overlapping R&D centres and projects occurs. Projects reliant on government funding can also suffer from often protracted delays in approval and funding clearance processes, which in some cases may be significantly longer than typical commercial approval timescales. There is a clear role here for the Global CCS Institute in coordinating research activities and demonstration projects.

To achieve the G8's goals within its stated timeframe means that there should be a real co-ordination (and possibly pooling) of the resources of key international research agencies such as the IEA's Greenhouse Gas R&D Program (IEA GHG), the Carbon Sequestration Leadership Forum (CSLF) and the Asia-Pacific Partnership on Clean Development and Climate (APP). Multilateral funding agencies such as the World Bank and Asian Development Bank have not yet fully engaged in funding CCS projects in any comprehensive way but are considering whether to finance such projects. They should be persuaded to act in concert with those co-ordinating the global drive to commercialise CCS rather than acting in isolation.

### 1.1.4 The timeframe challenge

Contrasted with the stated aim of the G8, industry views the timeframe involved in the CCS project cycle to be in the order of:

- 10 years to design, permit, and build a fossil-fuel power plant and other large industrial facilities such as steel mills and cement factories;
- 20-30 years of operation and injection of CO2 before plant closure is considered; and

- 20-100 years or more to monitor a CCS site post-injection.

As a result there is a need to:

- manage environmental liabilities arising from injected CO2, which could persist for many hundreds, if not thousands, of years;
- regulate site selection, monitoring and verification in ways which ensure that regulatory requirements are appropriate to technology type, geology and topography yet are sufficiently comprehensive to provide certainty;
- ensure that property interests in potential and actual storage formations and injected materials are clearly defined;
- encourage growth in public confidence in, and acceptance of, CCS and ensure adequate (but realistic) stakeholder consultation in the development of CCS projects; and
- manage aspects of CCS projects which could cross jurisdictional borders, not only including environmental liabilities but also transport and ownership of storage formations and injected materials.

Addressing these challenges will be crucial to the efforts of stimulating deployment of CCS.

## 1.2 Laws promoting and facilitating CCS

Developing economies have not yet generally enacted specific CCS laws or taken steps to amend existing legislation to accommodate the CCS project cycle.

It seems likely, however that if CCS is included in a revised version of the Clean Development Mechanism ("CDM") after the Meeting of Parties to the Kyoto Protocol in Copenhagen in late 2009 there may be an acceleration of investment in CCS projects in non-Annex 1 countries.

In the absence of a mechanism such as the CDM it seems unlikely that investment in CCS will be achieved in many developing countries within the timeframe proposed by the G8.

To help promote and facilitate CCS projects in these countries, the Global CCS Institute could assist domestic legislators by providing examples of law reform initiatives from other jurisdictions which have already enacted CCS specific law.

In developed economies, existing legal frameworks designed to deal with waste, transport, property rights and pollution liability do not readily accommodate the whole CCS project cycle. This will hamper investment not only in CCS projects but in the technologies required to achieve scalable projects within the G8's timeframe.

With the exception of the EU, in most jurisdictions surveyed, existing legislative frameworks relating to carbon capture are fragmentary and incomplete. This is the case even in the Australian jurisdictions with dedicated carbon storage legislative frameworks.

The EU regulation envisages the imposition of Carbon Capture Ready (CCR) requirements on new power plant construction. It is likely that in coming years other jurisdictions will implement similar regulations in order to ensure that carbon capture capability is integrated into new power plant construction. The EU approach of imposing CCR obligations through planning permitting processes is a simple, straightforward approach. It is, however, unlikely that any such regulations will be introduced in many jurisdictions until CCS is at or near commercial-scale development.

In addition, few jurisdictions have dealt in any detail with the question of whether captured $CO_2$ should be treated as a waste or pollution and this will need to be clarified. The dedicated storage regulations which have been implemented, notably in Australian jurisdictions and the EU, seem to contemplate that captured $CO_2$ be dealt with as a waste product. This is particularly important in the context of policies and legislation governing transport of $CO_2$.

Only a few jurisdictions have in place dedicated CCS regulatory regimes (or amendments to existing regimes) required to adequately manage the unique legal challenges posed by CCS. These jurisdictions include some Australian and United States (US) jurisdictions, together with the European Union (EU) and some EU Member States. This poses significant barriers for investment in CCS projects in other jurisdictions. Potential investors and project proponents will be reluctant to support CCS projects where potential long-term risks are present due to insufficient or inflexible regulatory frameworks.

The Federal Governments in the US and Australia are developing legislation for national-level schemes. The scheme proposed in the American Clean Energy and Security Act (ACES Act) will provide bonus allowances and other incentives to assist with the funding of CCS facilities. The EU Emissions Trading Scheme (EU ETS) and the scheme proposed in the ACES Act provide direct incentives for CCS operations in the form of staged technological benchmarks or bonus allocations of permits to CCS facilities.

A number of other jurisdictions, including Australia, China, Japan and some States in the US, have introduced, or are considering introducing, complementary policies which have the effect of imposing a cost on carbon, or which provide support in the form of subsidies or enabling frameworks. The complementary laws and policies include mandatory renewable energy targets, emissions reporting, incentives for energy efficiency and feed in tariffs.

Some other jurisdictions, including Norway and Japan, have regulated existing CCS projects through partially integrated CCS schemes or by exception to existing regulations. These approaches can facilitate demonstration-scale projects but are not considered suitable for commercial-scale projects due to potential long-term liabilities.

Integrating carbon capture permitting and regulation with transport and storage legislation will provide CCS project proponents a greater degree of certainty. This will reduce the administrative burden imposed by permitting requirements at various stages of the CCS project cycle.

These regulatory gaps should be addressed in order to encourage the capture of commercial-scale quantities of $CO_2$.

Tailored, end-to-end policies and laws, harmonised across national boundaries, offer the best chance to rapidly and efficiently promote large scale investment in CCS.

There is no one template or single "best practice" for end-to-end CCS regulation with even the most robust existing frameworks having gaps. However, governments should examine these dedicated regimes, and with increases in international harmonisation of CCS regulation, regulatory risks will be minimised for potential market participants.

A "universal" (and jurisdictionally adaptable) CCS regulatory template may emerge from dialogue amongst those governments and international agencies promoting CCS, especially if they agree to act urgently and co-operatively.

### 1.2.1 Capture

Policies designed to impose a cost on carbon emissions could also be accompanied by regimes restricting the construction of new fossil fuel power plants without incorporating CCS or the mandating of CCS retrofits to existing plants. These could include technology standards and planning requirements for new plants to be CCS-ready. Such policies could be a particularly useful complement to carbon cost imposition policies in the initial stages of CCS deployment. CCS-ready policies under development in the US and some EU Member States could provide these frameworks.

There are, however, likely to be significant short term financial ramifications for utilities which may be obliged to retrofit CCS technology to existing plants or budget for CCS capabilities in new plants. Tax incentives or other financial measures are useful policy tools to promote investment in CCS. These incentives not only assist in offsetting capital expenditure in plant and equipment but may also be used to provide companies that are engaged in storage activities with an additional revenue stream for storing $CO_2$. The US Federal government's investment tax credits are one positive example of this approach.

### 1.2.2 $CO_2$ transport and storage

Transportation of captured $CO_2$ by pipeline falls within pipeline permitting regimes. This can potentially add complexity and delay to integrated CCS activities.

In some Australian jurisdictions and the EU, existing pipeline legislation has been well-integrated into CCS legislative schemes, providing a high degree of certainty for market participants. Other jurisdictions, including the US and Canada, have pipelines regulations which could be adapted to $CO_2$ transport. In many other jurisdictions, however, such regulatory integration has not yet occurred. In these jurisdictions, $CO_2$ transportation would generally fall within existing pipeline regulatory regimes. These are not in all cases well-adapted to regulating transportation of $CO_2$.

A further weakness in existing $CO_2$ transport regimes is ambiguity in relation to whether $CO_2$ should be treated as a pollutant or waste. This will dictate which regulatory regimes should apply to $CO_2$ transport. This also poses a challenge for the regulation of CCS transportation, particularly where there are restrictions on the treatment of the substance or where responsibility for leakage and harm does not clearly attach to any one entity.

A further difficulty posed by existing transport regimes is the number of permits required to construct and operate pipelines. This is the case not only in respect of general pipeline regulations but also in respect of those integrated with $CO_2$ storage legislative schemes. This is likely to increase the cost, duration and uncertainty associated with undertaking pipeline activities.

In federated countries such as Australia and the US, lack of integration between State-level pipeline transport regimes will impede the development of national pipeline networks suitable for $CO_2$ transport. These jurisdictions should seek to harmonise sub-national regulation to enhance regulatory efficiency. This would also apply to national policymakers seeking to harmonise regulations in an international context. The EU's experience in pipeline regulation may be useful for the latter.

Finally, transport of $CO_2$ by non-pipeline methods is generally not comprehensively regulated. This poses challenges to small-scale CCS projects and to CCS activities in the exploration and testing phases, where it may not be commercially viable to construct pipeline networks to transport $CO_2$.

These gaps will need to be overcome in order to encourage the investment required to develop commercial-scale $CO_2$ transport networks and this of course needs to take place in an integrated fashion with laws dealing with both capture and storage.

In jurisdictions where CCS exploration regimes have been integrated with $CO_2$ storage regulation, CCS exploration is relatively robustly regulated. This is the case in respect of the Australian Federal jurisdiction and the jurisdictions of Victoria and Queensland, as well as to some extent the EU. Clear and transparent approval regimes with clearly enunciated frameworks of exploration rights are essential and multi-stage permitting which can allow administering authorities to monitor and regulate the environmental impact of exploration activities on the existing and future uses of permit areas is also desirable.

In jurisdictions where CCS exploration has not yet been regulated, a lack of regulation will inevitably delay proponents who may be required to seek permits from multiple government agencies, assuming of course that those agencies themselves are equipped to assess CCS project applications.

The existing regimes in the US and South Africa contain key regulatory components for effective CCS exploration regimes.

In those jurisdictions where specific CCS injection and storage laws have been enacted, there appear to be relatively robust systems in place for regulatory authorities. Proposals for storage typically identify the characteristics of the storage site, access to commercial quantities of $CO_2$, the suitability of the operator (eg, technical and financial criteria) and detailed site management and monitoring plans.

This is notably the case in relation to the EU and Australia at a Federal level and in the States of Victoria and Queensland. The laws in these jurisdictions provide a guide to other countries as they develop their own legal frameworks.

There nonetheless remain some key regulatory gaps in existing dedicated $CO_2$ storage regulatory frameworks. They do not necessarily address comprehensively the question of whether only one operator will be allowed access to a storage site, or whether multiple operators will be able to inject. If multiple operators are using a site, legal frameworks will need to be developed to share or apportion liability and determine, if necessary, how to prioritise access (eg, on a maximum volumetric basis or some other criteria). The difficulties associated with managing multiple uses of land and potential storage formations have resulted in most jurisdictions only granting approval to one operator per site.

A further potential gap relates to activities which might fall under the jurisdiction of multiple governments, either in adjacent jurisdictions or at multiple levels. Where storage sites fall under more than one jurisdiction, regulators from two or more States may apply different criteria in considering CCS project activities. Alternatively, it is conceivable that in federated countries, Federal and State jurisdictions might overlap. In these circumstances, there will be a need for coordination amongst regulators and the development of guidelines for, at a minimum, consultation and ideally a joint approach to approving access to such sites and managing their use.

The absence of adequate regulation of this final stage of the CCS project cycle is perhaps the greatest barrier to the commercial-scale deployment of CCS in jurisdictions without robust regulation of CCS, or where existing regulation can been adapted for CCS.

Where integrated legislation exists, liability for $CO_2$ leakage post-closure is generally well defined and the process for surrendering any access licences is well set out. The laws in relevant jurisdictions in Australia, the EU and the US all address the ownership of injected $CO_2$ post-closure, in most instances with such ownership reverting to the regulating government upon surrender of the relevant

approvals by the operator. This is the key strength of these legislative schemes. By clarifying these matters, governments provide investors with a level of comfort that operators of injection facilities will bear the post-closure liabilities associated with their storage activities to the extent that this is practical but that the liability of such operators is not unlimited.

Pollution and other environmental regulation in most jurisdictions centres on the "polluter pays" principle. It is not unreasonable that potential CCS project developers would delay the development of CCS projects until regulatory frameworks make it possible for them to quantify and manage potential liabilities. Governments which seek to encourage the commercial-scale deployment of CCS within their jurisdictions should seek to address this immediately.

A key concern arising from the assumption that governments will be responsible for stored $CO_2$ is that such governments then themselves face a potentially unlimited liability. This liability can arise both from the potential future cost of carbon escaping into the atmosphere (where an obligation is placed on the State to meet targets to reduce or limit GHG emissions under the Kyoto Protocol) and also where the escape of $CO_2$ causes more localised environmental harm.

To deal with this risk exposure, some governments are looking to extend operator liability for longer periods of time as well as innovative insurance and funding arrangements. Provisions requiring security in the form of insurance and rehabilitation bonds will help to ensure that long-term liabilities arising from injection activities can be funded and that governments are not left with all such liabilities. Governments should prioritise such efforts to develop financial instruments to facilitate efforts to manage these liabilities.

To begin with, models for long-term liability may include, for example both tiered liability insurance and indemnification by the government or a per ton fee paid to the government for $CO_2$ injection, with a “handoff” to the government for monitoring, remediation, and liability. The handoff might occur 10 years after injection ceases, to minimise moral hazard issues.

A further difficult question is whether existing integrated legislative structures are sufficiently flexible to accommodate the evolution in CCS and knowledge of the environmental and social risks associated with CCS activities. As understanding of CCS and the operation of geological storage sites improves, it will be necessary to keep existing laws under periodic review and amend them to accommodate emerging risks and new approaches to manage them.

In those jurisdictions that do not have dedicated CCS legislation, questions of liability remain unclear. Existing mining and environmental pollution legislation is not well suited to the purpose of long-term management for storage sites. Whilst mining laws often provide for rehabilitation bonds, mine-closure plans and the like, the anticipated long-term risks are better understood and more easily quantified. If CCS is to be addressed under these frameworks, issues such as post-closure liability and surrender of that liability to the State will need to be addressed.

Without access to and control over a suitable storage site, no CCS project (no matter how technologically advanced at the capture end of the process) will be likely to attract funding or investors. An absence of, or gaps in, storage laws will make it very difficult to address this risk. The "timeframe challenge" already referred to will also be exacerbated.

Governments should be expending real effort now to deal with the issue of storage if the G8's timeframe is to be achieved.

## 1.3 Key barriers

In summary, in the chapters which follow, we make more detailed observations about what we see as the principal barriers to achieving the G8's goals:

- Employing a mechanism which puts a price on carbon will not of itself promote or facilitate CCS projects: it should be used as part of a suite of measures.
- Delays in increasing the real cost of carbon may, however, retard investment in CCS in the near term.
- A lack of cooperation amongst international agencies with similar objectives supporting a multiplicity of projects will delay development and deployment of CCS technologies.
- Taxpayer funded research into CCS will prove increasingly difficult where broader social and environmental dividends are not adequately articulated.
- Characterising CO2 as a "waste" or a "pollutant" may be required to help facilitate and regulate capture, especially where specific CCS laws have not been enacted.
- Many existing pipeline laws need to be amended to adequately (and expeditiously) accommodate CO2 transport.
- Transport of CO2 by road, rail and ship is inadequately regulated.
- Overly bureaucratic or otherwise inadequate regulations covering access and exploration rights will delay CCS projects.
- Multiple operators' access rules are generally lacking.
- Multiple regulatory regimes are often commonplace.
- Identifying and assigning legal liability for leakage to a suitable party or parties is essential.
- The "storage" dimension of CCS will be the hardest to secure in the short term and it is critical to CCS investment.
- Insurance products need to be developed to accommodate long term environmental liability where governments are not prepared to assume liability.
- CCS is not yet an accepted carbon credit generating mechanism under either of the Kyoto Protocol's Flexible Mechanisms. There are good reasons why it should be, especially so as to promote investment in developing countries.

The London Protocol and the Basel Convention may both need to be amended so as to accommodate key elements of CCS projects.

## 1.4 Recommendations

**The key recommendations are:**

(a) aspects of the CCS specific laws and policies adopted by some governments (including the EU, US, Japan and Australia) should be used as components of a "CCS friendly" legal framework in those countries wanting to host such projects;

(b) where time or other circumstances do not permit the development of integrated or dedicated CCS legal schemes, governments should amend existing legislation applicable to the CCS project cycle with particular emphasis on transport, storage and leakage liability;

(c) all regulatory frameworks need to provide sufficient flexibility to accommodate evolving technological advances in CCS;

(d) all regulatory frameworks need to accommodate the very long time frames associated with storage - without clear allocations of liability for leakage, insurance and investment may not be available or attracted to CCS projects;

(e) planning and environmental laws should be used to compel (or at least make commercially viable) the use of CCS in new or refurbished power plants and other GHG emitting facilities and enterprises; tax or other incentives may be required to address the costs associated with such requirements;

(f) where feasible, CCS enabling laws should be harmonised across national and international borders;

(g) governments should continue to provide incentives for the development of CCS, principally through funding, scientific and bureaucratic support for CCS R&D;

(h) there should be a concerted effort to coordinate current global, national and industry CCS research and promotional activities;

(i) there should be an immediate completion of reviews of, and if necessary, amendments to, international agreements which could govern the transboundary movement of $CO_2$, including the definitions of "waste" under the London Protocol and "hazardous waste" under the Basel Convention;

(j) steps should be taken by those with a vested interest in the future of CCS to advocate its inclusion as a project type capable of generating carbon credits under the Flexible Mechanisms (CDM and JI) under the Kyoto Protocol (or its most relevant post-2012 manifestation); and

(k) in the EU, Member States should implement the CCS Directive as soon as possible.

A key role for the Global CCS Institute will be to help develop and promote CCS project cycle-specific 'best-practice' regulatory principles and model laws which can be used by countries wishing to facilitate, attract and promote CCS projects. Without the certainty of a clear legal framework encompassing the whole project cycle, the ambitious aim of the member States of the G8 is unlikely to be achieved.

# 2. Abbreviations

| | |
|---|---|
| Accsept | Acceptance of $CO_2$ Capture and Storage, Economics, Policy and Technology |
| ACES Act | American Clean Energy and Security Act, HR 2454. |
| ADRET | Australian Government Department of Resources, Energy and Tourism |
| Alberta Climate Change Act | Alberta Climate Change and Emissions Management Amendment Act, C.140/2007 |
| APP | Asia-Pacific Partnership on Clean Development and Climate |
| Barrow Island Act | *Barrow Island Act 2003* (WA) |
| Basel Convention | *Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal*, opened for signature 22 March 1989, 1973 UNTS 57 (entered into force 5 May 1992) |
| BLM | US Bureau of Land Management |
| CBM | coal bed methane |
| CCR | carbon capture readiness |
| CCS | carbon capture and storage |
| CCS Directive | Council Directive 2009/31/EC of 23 April 2009 on the geological storage of $CO_2$ |
| CCX | Chicago Climate Exchange |
| CDM | Clean Development Mechanism (established under Article 12 of the Kyoto Protocol) |
| CER | certified emission reduction |
| CLCS | Commission on the Limits of the Continental Shelf |
| CO2CRC | Cooperative Research Centre for Greenhouse Gas Technologies |
| $CO_2$ | carbon dioxide |
| $CO_2$-e | carbon dioxide equivalent |
| CPRS | Australian government's proposed Carbon Pollution Reduction Scheme |
| CPRS Bill | *Carbon Pollution Reduction Scheme Bill 2009* (Cth) |
| CSLF | Carbon Sequestration Leadership Forum |
| CTF | Clean Technology Funds |
| DCC | Australian Government Department of Climate Change |
| DCEO | Illinois Department of Commerce and Economic Opportunity |
| DOE | US Department of Energy |
| DOI | US Federal Department of Interior |

| | |
|---|---|
| Draft Rule | Proposed Rule, Federal Requirements Under the Underground Injection Control Program for Carbon Dioxide Geologic Sequestration Wells, 73 Fed. Reg. 43, 492 (2008) |
| EC | European Community |
| EES | environmental effects statement |
| EEZ | exclusive economic zone |
| EIS | environmental impact study |
| EITE | emissions intensive trade-exposed industries |
| Environmental Impact Assessment Directive | Council Directive 1985/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment |
| EOR | enhanced oil recovery |
| EPA | US Environment Protection Agency |
| EPBC Act | The Australian government's *Environmental Protection and Biodiversity Conservation Act 1997* (Cth) |
| ERU | emission reduction unit |
| ETS | Emissions Trading Scheme |
| EU ETS | European Union Emissions Trading Scheme |
| EU ETS Directive | EC Directive 2003/87/EC |
| EU | European Union |
| EU Water Framework Directive | Council Directive 2000/60/EC |
| EUA | European Union Allowance |
| FG1 | Generation 1 of the FutureGen project |
| FG2 | Generation 2 of the FutureGen project |
| FWS | US Fish and Wildlife Service |
| Global CCS Institute | Global Carbon Capture and Storage Institute |
| GHG | greenhouse gas (and in the context of "carbon capture and storage" means the capture and $CO_2$ storage of one gas, $CO_2$) |
| GW | gigawatts |
| GWh | gigawatt-hour |
| G8 | Group of Eight |
| IEA | International Energy Agency |

| | |
|---|---|
| IEA GHG | IEA Greenhouse Gas R&D Program |
| IGCC | integrated gasification combined cycle |
| IMO | International Maritime Organisation |
| Indonesian Environmental Regulation | Minister of Environment Regulation No. 13 of 2007 |
| IOGCC | Interstate Oil and Gas Compact Commission |
| IPCC | Intergovernmental Panel on Climate Change |
| IPPC Directive | Council Directive 2008/1/EC on integrated pollution prevention and control |
| JI | Joint Implementation (established under Article 6 of the Kyoto Protocol) |
| Keidanren Scheme | Japan's Federation of Economic Organisations Scheme |
| kt | kilotonne |
| kVA | kilovolt-amps |
| kWh | kilowatt-hour |
| Large Combustion Plants Directive | Council Directive 2001/80/EC of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants |
| LNG | liquefied natural gas |
| London Convention | *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter,* opened for signature 29 December 1972, 1046 UNTS 138 (entered into force 30 August 1975) and 1996 Protocol Thereto |
| London Protocol | 1996 Protocol to the London Convention |
| Marine Pollution Act | Act Pertaining to the Prevention of Marine Pollution and Maritime Disaster, 1970, Law No.49 of 1970 (*kaiyō osen oyobi kaijyō saigai no bōshi ni kansuru hōritsu)* |
| MARPOL | International Convention for the Prevention of Pollution by Ships |
| Masdar | Abu Dhabi Future Energy Company |
| METI | Japanese Ministry of Economy, Trade and Industry |
| MPRDA | South African Mineral and Petroleum Resources Development Act 2002 |
| MRET | Australian Federal Mandatory Renewable Energy Target |
| MW | megawatt |
| MWh | megawatt hour |
| NAAEC | North American Agreement on Environmental Cooperation |
| NEDO | New Energy and Industrial Technology Development Organisation, Japan |
| NEMA | South African National Environmental Management Act 1998 |

| | |
|---|---|
| NEPA | US National Environmental Policy Act |
| NER | EU ETS new entrants' reserve |
| NETL | National Energy Technology Laboratory |
| NETS | Norwegian Emissions Trading Scheme |
| NGER Act | *National Greenhouse and Energy Reporting Act 2007* (Cth) |
| NGO | Non-government organisation |
| NOAA | National Oceanic and Atmospheric Administration |
| NOK | Norwegian Kroner |
| Norwegian Planning Act | *Planning and Building Act* of 14 June 1985 No 77 (as amended 1 April 2005) |
| NZ ETS | New Zealand Emissions Trading Scheme |
| OECD | Organisation for Economic Cooperation and Development |
| OPS | US Office of Pipeline Safety |
| OSPAR Convention | Convention for the Protection of the Marine Environment of the North-East Atlantic |
| PRC | People's Republic of China |
| Queensland GGS Act | *Greenhouse Gas Storage Act 2009* (Qld) |
| R&D | research and development |
| RAMSAR wetlands | Wetlands listed in the RAMSAR Convention on wetlands of international importance especially as waterfowl habitat, opened for signature 2 February 1971, 996 UNTS 245 (entered into force 21 February 1975) |
| RD&D | research, development and demonstration |
| REC | Renewable Energy Certificates |
| RET Act | *Renewable Energy (Electricity) Act 2000* (Cth) |
| RET | National Renewable Energy Target |
| Revised ETS Directive | EC Directive 2009/29/EC |
| RGGI | Regional Greenhouse Gas Initiative |
| RITE | Research Institute of Innovative Technology for the Earth |
| RMB | Renminbi (currency of People's Republic of China) |
| Rp | Indian Rupees |
| SDWA | Safe Drinking Water Act |
| SEMARNAT | Mexican Ministry of Environment and Sustainable Development |

| | |
|---|---|
| The Australian government | The Australian Federal Government |
| The Australian government's GGS Act | *Offshore Petroleum and Greenhouse Gas Storage Act 2008* (Cth) |
| The Australian government's Native Title Act | *Native Title Act 1993* (Cth) |
| TJ | terajoules |
| UAE | United Arab Emirates |
| UIC | underground injection control |
| UK | United Kingdom |
| UNCLOS | *United Nations Convention on the Law of the Sea*, opened for signature 10 December 1982, 1833 UNTS 3 (entered into force 16 November 1994) |
| UNFCCC | *United Nations Framework Convention on Climate Change*, opened for signature 9 May 1992, 1771 UNTS 107 (entered into force 21 March 1994) |
| US | United States of America |
| VCS | Voluntary Carbon Standard |
| VER | Verified Emission Reductions |
| Victorian GGGS Act | *Greenhouse Gas Geological Sequestration Act 2008* (Vic) |
| Victorian Pipelines Act | *Pipelines Act 2005* (Vic) |
| Water Framework Directive | Council Directive 2000/60/EC of 23 October 2000 establishing a framework for the Community action in the field of water policy |
| Western Australian Pipelines Act | *Petroleum Pipelines Act 1969* (WA) |
| WRI | World Resources Institute |
| WRI Guidelines | *Guidelines for Carbon Dioxide Capture, Transport and Storage*, World Resources Institute, October 2008, available from: http://www.wri.org/publication/ccs-guidelines. |
| 2006 IPCC Guidelines | 2006 Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories |

# 3. Introduction

## 3.1 Context

The risk of climate change poses a significant challenge to global and national policy and lawmakers. Significant reductions in greenhouse emissions (GHG) and the removal of $CO_2$ from the atmosphere are considered necessary to address this risk. Ultimately, there will be a need to shift to a new energy economy that involves the use of low or zero emission technologies. The development of such technologies will nonetheless take time and existing reserves of fossil fuels will continue to play an important role in creating the energy needed to drive societies. Carbon capture and storage (CCS) does not reduce the generation of $CO_2$. However, it does provide a means of preventing the release of $CO_2$ that would otherwise be released into, and potentially harm, the atmosphere (Hendriks et al., 2005).

CCS provides an important transitional tool that can operate in parallel with the development and deployment of new low emissions technologies (WRI, 2008: 20). In addition, it accepts the ongoing role that fossil fuel will play during this transitional period. It seeks to responsibly address the impact of emissions whilst not compromising the energy needs of consumers or the very considerable investment in, and employment generated by, fuel producing and consuming businesses.

Existing international and domestic environmental laws designed to suppress climate change caused by the emission of GHGs have not, with the exception of those recently enacted in a handful of countries and trading blocs, been enacted with CCS in mind.

Likewise, although many existing legislative frameworks have their origins in contemporary public international law (and in particular the United Nations Framework Convention on Climate Change (UNFCCC) in 1994), there is no single or coherent international framework promoting or controlling CCS. In addition, although the London Protocol was recently amended in anticipation of widespread $CO_2$ storage under sea bed areas in international waters, there is still considerable uncertainty around very basic questions such as the proper characterisation and legality of transport and storage of $CO_2$ (or other GHGs) and whether it should be treated as a "waste".

Further, difficult questions persist where gases are proposed to be transported across international borders or where liability is to be allocated between the producer of the gas, the owner of the storage site and the authorities authorising or requiring the $CO_2$ storage.

When viewed globally, CCS law and policy has developed both domestically and internationally in a somewhat haphazard fashion. Unsurprisingly given their different histories, legal systems, geographies, natural resources and states of economic development, there is a high degree of variation between the surveyed countries in their responses to CCS, a fact noted in previously conducted studies (IEA, 2008). That said, it is clear that all jurisdictions surveyed now have CCS firmly on their national agendas and many governments are devoting significant resources to the issue notwithstanding the current global recession.

Promoting, facilitating and researching the technologies being developed to enable CCS is now a central concern of many businesses, governments, think tanks, academics and international agencies.

A key risk, however, is that with so many actors engaged in similar enterprises, the opportunity for meaningful policy convergence of real benefit to those with most invested (or proposed to be invested)

in fossil fuels may be diluted, delayed or even lost despite the near unanimous acceptance of the need for urgent action.

On 19 September 2008, the Australian Prime Minister launched the Global Carbon Capture and Storage Institute (Global CCS Institute) to speed up the development of CCS. The Australian government will contribute up to A$100 million (US$81.3 million) annually to the Global CCS Institute. The new Global CCS Institute, to be based in Australia, will work cooperatively with other countries and with industry to develop and commercialise CCS to help reduce global $CO_2$ emissions.

A number of reports have already been produced on policy aspects of CCS. The International Energy Agency (IEA) published in 2008 the seminal *$CO_2$ Capture and Storage – A key carbon abatement option* (IEA, 2008), which argued for government support to encourage the development and deployment of CCS. This followed an earlier IEA report on legal aspects of CCS, which provides a rigorous summary of legal issues associated with carbon storage (IEA, 2007). The World Resources Institute (WRI) has also published a useful set of guidelines for the capture, transport and storage of $CO_2$ (WRI, 2008; the WRI Guidelines) in the United States of America (US) and is expected to soon release similar guidelines for other jurisdictions.

This Third Foundation Report aims to complement this earlier research by providing an empirical analysis of existing CCS policies and legislation in the jurisdictions surveyed. Its purpose is to provide policymakers with a digest of approaches taken to CCS regulation by identifying aspects which could be replicated or adopted in jurisdictions considering to regulate the CCS project cycle. It also identifies gaps in regulation which may impede the development and deployment of commercial-scale CCS projects.

Research for this report was conducted between May and July 2009. This report:

- states the law current as at 31 March 2009;
- does not purport to be legal advice, nor should it be relied upon as a substitute for legal advice;
- assumes, but does not assure the reader of, the currency and accuracy of the links and references referred to and provided throughout; and
- represents the views of Baker & McKenzie only and not of any person or agency that may have contributed to or reviewed any aspect of the report.

## 3.2 Structure and approach

This Third Foundation Report comprises this main synthesis report together with a series of country studies examining CCS-relevant law and policy in a number of developed and developing economies.

In conducting this review, relevant laws and policies have been examined in the following jurisdictions: Australia, Brazil, Canada, China, the European Union (EU), India, Indonesia, Japan, Mexico, New Zealand, Norway, Papua New Guinea, South Africa, South Korea, the United Arab Emirates (UAE), Russia and the US. Other jurisdictions such as Algeria have also been examined.

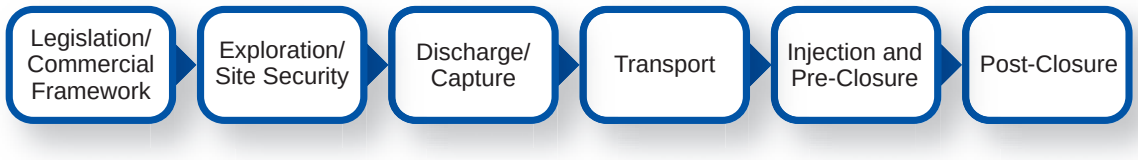
This Foundation Report does not aim to provide an exhaustive digest of CCS policies and legislation in each of the jurisdictions surveyed. Rather, it aims to assemble key insights derived from the experiences of surveyed jurisdictions which may be useful for governments considering promulgating or amending policies and legislation in this area. Readers should turn to the country studies for

comprehensive analysis of the policies and regulation pertaining to CCS in each jurisdictions surveyed.

The approach taken in researching and drafting the country studies has been, as far as possible, to structure the country studies in a way which facilitates comparisons between policy and regulatory approaches adopted in the jurisdictions studied. A similar set of questions was used as the starting point for analysis in each of the jurisdictions studied. As discussed above, however, the capacity of the report to facilitate inter-jurisdictional comparisons is constrained by the high degree of variation between jurisdictions in terms of the level of sophistication and development of their CCS policies and legislation. A number of jurisdictions, including Australian, US the EU and Norwegian jurisdictions have introduced a range of policies and legislative schemes for CCS, and other jurisdictions could learn from their experiences.

The body of this Foundation Report has been structured into three main sections. First, the report discusses policies and legislation which aim to impose a cost on carbon and which could therefore have the effect of improving the viability of CCS as a GHG emission mitigation tool. Second, it discusses policies which aim to provide incentives for the development of CCS and the gaps and barriers in these policies. The third section provides analysis of policies and legislation regulating key stages of the CCS project cycle. The CCS project cycle can be divided into a number of stages. These are set out in Figure 3-1.

**Figure 3-1 CCS project cycle**




*Source: WorleyParsons / Baker & McKenzie*

A number of the legal and policy challenges posed by CCS are common to more than one stage in the project cycle. This poses analytical challenges, particularly in comparison to the thematic approach adopted in IEA 2007. This project cycle-centred approach has been adopted here because it provides the best analytical structure within which to compare regulatory approaches across the jurisdictions surveyed for this report.

This report follows the definitional approach adopted in the WRI Guidelines (WRI, 2008: 54). "Storage" of $CO_2$ refers to geological $CO_2$ storage. The word "closure" used in reference to the closure of a storage formation or $CO_2$ storage well means the cessation of $CO_2$ injection into that formation or well. "Pre-closure" refers to the technical preparations and permitting undertaken before a storage formation can be closed. "Post-closure" refers to the permitting, monitoring, verification and management of injected $CO_2$ which occurs after storage formation closure.

Each of the country studies has also been structured as follows:

- an executive summary;
- a glossary;
- an introduction;
- discussion of policies and legislation designed to impose a price on carbon;

- discussion of policies and legislation which aim to support the deployment of CCS technologies;
- discussion of policies and legislation governing the CCS project cycle, including, as applicable, in relation to:
  - transport;
  - exploration/site selection;
  - injection/pre-closure; and
  - post storage/closure;
- conclusions; and
- references.

Both this report and the country studies also include a number of case studies.

Elements of the commentary on policies and legislation governing the CCS project cycle distinguish between integrated, or dedicated, regulatory frameworks, and non-integrated frameworks.

This distinction reflects the two approaches taken by the governments of jurisdictions which have sought to promote or regulate CCS projects. Governments in some jurisdictions, including Australian jurisdictions and the EU, have introduced integrated legislative frameworks which regulate multiple stages of the CCS project cycle, either through single pieces of legislation or through core legislative instruments which establish a CCS framework and amend existing legislation.

In contrast, governments in most other jurisdictions have either amended or are amending existing legislation to enable the regulation of CCS (eg the US and Japan) or have not yet sought to do so (China, Russia, Papua New Guinea, and Indonesia), with the result that CCS projects in those jurisdictions will be governed by existing mining, gas and petroleum and environmental regulations. Whether the CCS project cycle is regulated through integrated or non-integrated regulatory frameworks will be a matter for governments to determine on the basis of circumstances pertaining in their own jurisdictions, but this research indicates that dedicated or integrated frameworks have the potential to provide innovators, investors and other market participants with the highest degree of regulatory certainty and the lowest degree of bureaucratic impost.

Finally, readers will note that citation styles used for legislation, regulations and cases varies within this Foundation Report. This is reflective of the multiple citation styles used in individual jurisdictions. Currency amounts have been provided in both relevant local currencies and US Dollars. Currency conversions were undertaken on the basis of the most recent US Treasury exchange rates available at the time of publication (30 June 2009).

# 4. The effect of pricing carbon

## 4.1 Introduction

The costing of GHG emissions is of fundamental importance to establishing an economic environment in which CCS becomes cost-competitive with other emission reduction schemes. In microeconomic terms, this refers to the internalisation into purchasing and investment decisions of the environmental cost of GHG emissions. Failure to cost emissions through this approach represents a potential market breakdown.

There is growing recognition that governments play a crucial role in correcting markets and providing the policy and legal frameworks necessary to ensure efficient costing of GHG emissions. If a sufficiently high carbon price can be established, such measures will also drive the deployment of CCS by increasing the economic cost of emitting GHGs and in turn reducing the relative cost of CCS as an emissions reduction mechanism.

Governments have introduced a range of measures to ensure that GHG emissions are priced through purchasing and investment decisions. These can be divided into three main categories:

- emissions trading schemes (ETS);
- carbon taxes; and
- complementary policies which aim to provide incentives for the development and deployment of lower-emissions electricity generation schemes.

In addition, the American Clean Energy and Security Act of 2009 HR 2454 (ACES Act) contemplates performance and technical standards for coal-fired power plants in the US.

Mandatory cap and trade schemes aim to reduce GHG emissions by setting scheme-wide caps on GHG emissions. Regulators set an emissions cap after which the market sets the price of GHG emissions under that cap. Entities in sectors covered by such schemes ("liable entities") purchase (or in certain circumstances may be freely allocated permits) to emit up to the cap. Such permits are tradable and the price of such trades becomes the market price of carbon. Alberta, the EU, Norway and New Zealand have introduced cap and trade emissions trading schemes. Similar schemes are under development at the Federal level in Australia and the US, and Japan is also developing such a scheme. In Australia, New South Wales and the Australian Capital Territory have also implemented emissions trading schemes, although on a baseline credit model, in which liable entities are assigned an emissions baseline and can earn credits for reducing their emissions below this baseline.

In contrast, carbon taxation schemes allow regulators to set an emissions price and this determines the level of emissions. The market price is the quantum of the carbon tax, usually imposed per tonne of $CO_2$ equivalent ($CO_2$-e) emissions. Norway has introduced such a scheme in addition to its ETS.

Complementary policies contribute to the imposition of costs on GHG emissions by encouraging the development of low-emissions electricity sources. Such policies can include feed-in tariffs, portfolio energy standards, and GHG emissions and energy use reporting schemes. A number of governments, including State and Provincial governments in Australia, the US, China and Brazil have introduced such schemes.

Each of these policy types is considered below.

## 4.2 Mandatory cap and trade schemes

Emissions trading schemes aim to reduce GHG emissions by setting caps on emissions which are then reduced over time. The coverage of such schemes is generally determined on a sectoral basis. In such schemes there is an emissions cap and the scheme regulator issues permits equal to the scheme cap. Entities in covered sectors whose emissions exceed mandated thresholds must obtain permits to emit. Such permits may be obtained either by the entity purchasing the permits from a scheme regulator or through free allocations by the regulator. Permits can also be traded between liable entities. The market price for such trades, or for the purchase of permits from scheme regulators, becomes the price of GHG emissions. Emissions that are not accompanied by a permit attract financial or other penalties, providing further incentives for covered entities to limit and reduce their emissions.

Policies introducing GHG cap and trade schemes grew out of the sulphur dioxide and nitrous oxide trading schemes introduced in the US in the mid 1990s. Such schemes proved highly successful because they harnessed the comparative advantages of regulation and the market. While governments established the policy framework to permit trading in emissions and controlled emissions caps, the market provided efficient pricing.

Mandatory ETS introduced to date include the following:

- supranational - the European Union Emissions Trading Scheme (EU ETS) (discussed below);
- national - national emissions trading schemes in New Zealand and Norway (discussed below);
- subnational (multi-state) - the Regional Greenhouse Gas Initiative (RGGI) in ten Northeastern and Mid-Atlantic States of the US; and
- subnational (single state) - a Provincial scheme in Alberta, Canada (discussed below) and the Greenhouse Gas Reduction Scheme in the Australian Capital Territory and New South Wales, Australia.

In addition, mandatory national-level cap and trade schemes are currently under development in a number of jurisdictions. In the US, the ACES Act was passed by the House of Representatives on 26 June 2009 and, at the time of writing, similar legislation was under development in the Senate. In Australia, the Federal Government is developing a national emissions trading scheme, the Carbon Pollution Reduction Scheme (proposed CPRS). Legislation implementing the scheme, the *Carbon Pollution Reduction Scheme Bill 2009* (Cth) (CPRS Bill) is likely to be reintroduced in the Federal Senate later in 2009. South Korea is also considering developing a national mandatory cap and trade scheme.

**Case study: The EU ETS**

The EU ETS is the largest multi-country, multi-sector GHG ETS in the world. It was introduced in 2003 through the European Community (EC) Directive 2003/87/EC (EU ETS Directive), as amended by EC Directive 2009/29/EC (Revised ETS Directive).

The EU ETS covers energy-intensive installations in energy and industrial sectors, such as electricity generation, iron and steel manufacturing and minerals processing. It is divided into three distinct phases:

- Phase I - commenced on 1 January 2005 and ran to the end of 2007;

- Phase II - 2008 to 2012 inclusive; and
- Phase III - 2013 to 2020 inclusive.

During each Phase, operators of installations within the scope of the EU ETS must account for their actual emissions on a yearly basis through the surrender of an equivalent number of "allowances" (European Union Allowances - EUAs). For Phases I and II, each Member State was required to submit a National Allocation Plan, setting an overall emissions "cap" for the sectors covered. This cap is converted into a set number of EUAs, which are distributed in accordance with the National Allocation Plan to individual installations falling within the scope of the EU ETS. For Phase III, the use of Member State National Allocation Plans will be replaced by a single EU-wide cap, distributed according to harmonised rules.

After allocation, EU ETS installations must monitor and report their emissions. They may choose to implement abatement technologies and, by so doing, free up EUAs to sell on the carbon market. Alternatively, they may purchase EUAs to cover any excess emissions (ie emissions that cannot be covered using their initial allocation). The scheme cap covers around 46 percent of CO2 emissions and 40 percent of GHG emissions. The overall number of EUAs allocated will decrease over time and it is expected that this will result in a corresponding reduction in European carbon emissions. The emissions reduction target for sectors covered by the EU ETS is 21 percent below 2005 levels by 2020.

In Alberta, Canada, a Province-wide cap and trade scheme commenced operation in 2007 under the Alberta Climate Change and Emissions Management Amendment Act, C.140/2007 (Alberta Climate Change Act). This scheme applies mandatory cap and trade obligations to all entities in Alberta emitting over 100,000 tonnes of $CO_2$ annually.

In Australia, the Greenhouse Gas Reduction Scheme commenced operation in 2003 and 2005 in New South Wales and the Australian Capital Territory, respectively. The legislation implementing the Greenhouse Gas Reduction Scheme is the *Electricity (Greenhouse Gas Emissions) Act 2004* (ACT) and amendments to the *Electricity Supply Act 1995* (NSW). The Greenhouse Gas Reduction Scheme has the dual purpose of reducing GHG emissions associated with the production and use of electricity as well as encouraging participation in offsetting activities. It is expected to be subsumed into the proposed CPRS when that scheme becomes operational.

Norway's cap and trade scheme was established in 2005 through the *Greenhouse Gas Emission Allowance Trading and the Duty to Surrender Emission Allowances Act* of 17 December 2004 No. 99. In 2007 this scheme was amended when it was linked to the EU ETS. It is expected that the EU ETS, as implemented in Norway, will cover 35 to 40 percent of GHG emissions from Norwegian sources.

The New Zealand Emissions Trading Scheme (NZ ETS) was introduced in September 2008 through a series of amendments to the Climate Change Response Act 2002. Under the Act, the cap and trade scheme will be phased in sector by sector over a period of five years, beginning in 2008 with the forestry sector (which is covered retrospectively from January 2008) and with all major emitting sectors to be covered by 2013. Following the November 2008 election to government in New Zealand of the National Party, a special select committee was formed to review the NZ ETS legislation and this may result in changes to the scheme towards the end of 2009.

### 4.2.1 Application of emission reduction obligations

The extent of coverage of ETSs is a key driver in their efficiency in imposing carbon costs. In general terms, governments and regulators have sought to maximise the effectiveness of ETSs by applying them to as many industry sectors as possible. The intention is to reduce the economy-wide cost of lowering emissions below the scheme cap while maximising the extent to which emission reduction obligations impose price signals.

The importance of maximising the coverage of cap and trade schemes was noted in the Australian Federal Government's White Paper on the proposed CPRS, where it stated that:

> *Broad coverage reduces the overall cost to the Australian economy of achieving emissions reductions by increasing opportunities for firms to access low-cost abatement. Broad coverage also ensures that competing firms and sectors operate within equivalent market rules* (Australian Government Department of Climate Change, 2008).

The NZ ETS has very broad coverage with all emitting industry sectors within the New Zealand economy to be included by 2013. If implemented in its current form, the sectoral coverage of the proposed CPRS will include around 75 percent of economic activity in Australia (DCC, 2008: 6-1). In contrast, the EU ETS covers industrial sectors which are collectively responsible for under half of the EU's emissions of $CO_2$ and 40 percent of total GHG emissions in the EU (Europa, 2008).

Cap and trade schemes can also provide incentives for CCS deployment by integrating carbon capture into assessments of emission reduction liability. This is achieved by enabling liable entities to reduce their assessed emissions using carbon capture methodologies.

This has been anticipated in the EU ETS. In Phase III of the EU ETS coverage will be extended further to cover the capture, transport and geological storage of GHGs. Under the Revised ETS Directive, operators of installations that fall within the scope of the EU ETS from 2013 onwards will not need to surrender EUAs for $CO_2$ that is permanently stored or avoided.

In the ACES Act, a similar but slightly different approach has been taken for CCS activities. Entities covered by the cap and trade program remain liable for their emissions but are provided offsetting credits for $CO_2$ stored via CCS in a manner that complies with regulations to be written by the US Environment Protection Agency (EPA). CCS projects implemented at electricity generating facilities or industrial sources can be awarded emission allowances (known as “bonus allowances”) upon successful capture and $CO_2$ storage. These bonus allowances can be traded or used by a covered entity to satisfy compliance obligations. A total of up to 72 Gigawatts (GW) of capacity is eligible for bonus allowances under the ACES Act

### 4.2.2 Carbon cost pass-through

The effectiveness of cap and trade schemes hinge on their ability to pass carbon costs through value chains so that the market cost of GHG emissions is satisfactorily priced for purchasing and investment decisions. This leads to alterations in consumer behaviour and reductions in emissions.

The capacity of liable entities to pass carbon costs through to their customers is not, in general terms, explicitly regulated in existing cap and trade schemes. As a result, liable entities have few legal impediments for carbon cost pass-through. However, their capacity to do so can be constrained by

obligations under long-term supply contracts or competition in the markets in which they operate. This can result in liable entities sustaining large reductions in profits, threatening their viability. This problem is particularly acute where pass-through-constrained entities are not themselves in a position to significantly reduce or offset their own emissions.

To address this problem, the rules of some ETS permit concessional treatment of some industry sectors over transitional time periods. Such assistance can be provided in the form of freely allocated permits or cash payments. If correctly provided, such assistance can cushion sectors important to economic growth from the economic shock that may be caused by the introduction of a carbon price. This ensures the continuing viability of productive economic sectors and can help to conserve and expand political support for cap and trade schemes. If not applied efficiently, assistance measures can have the economically perverse effect of providing disincentives for emission reduction and carbon price imposition, which may operate as a barrier to the deployment of CCS.

Both the ACES Act and the CPRS Bill include assistance mechanisms for emissions intensive trade-exposed industries (EITEs). The CPRS Bill further provides significant levels of assistance to electrical power generators during the initial years of the Scheme. In general terms, EITEs are those which are high-emitting and therefore are potentially subject to significant emission reduction liabilities but whose ability to pass on the costs of complying with such obligations is limited. This is due to their high exposure to overseas competition in export markets which may not be subject to emission reduction obligations. The policy rationale for assisting EITEs is that failure to do so could simply provide incentives for entities in such sectors to move their emitting activities to jurisdictions subject to less rigorous emission reduction regimes. This is known as carbon "leakage" (Australian Government Department of Climate Change, 2008). There is scant evidence from the EU ETS that emissions trading schemes have resulted in carbon leakage. However, many EITEs in Australia have highlighted competition and costs as critical issues for their domestic operations.

The method used to allocate permits to liable entities is a further important element in carbon cost pass-through. In general, there are two such methods. Permits can be allocated by regulators freely, or without charge. Alternatively, these can be sold to liable entities, often via auctions.

In Phases I and II of the EU ETS, assistance was provided to liable entities in the form of freely allocated permits. While not necessarily intended as an assistance measure, this allocation method has attracted criticism. It has been argued that the operation of secondary EUA markets has allowed many liable entities in the EU ETS to pass on the opportunity cost to them of their holding EUAs for acquittal, even where they have not in fact had to purchase these EUAs. This has allowed some liable entities to realise large windfall profits at the same time as electricity prices increased significantly for their customers. It is arguable that this has reduced community and political support for the EU ETS. The EC has responded to this criticism and in Phase III 100 percent of EUAs allocated for large electricity power generators will be auctioned and other sectors will move to full auctioning by 2027.

### 4.2.3 CCS-specific provisions in mandatory cap and trade schemes

The rules of cap and trade schemes can also provide direct incentives for the development and deployment of CCS by being used to provide policy or financial incentives or support . Both the EU ETS and the scheme proposed in the ACES Act provide for such direct assistance.

During Phase III of the EU ETS, it is intended to introduce an incentive to exempt operators of covered installations from the obligation to surrender EUAs if $CO_2$ emissions are permanently stored or avoided.

To provide further incentives for the development of CCS projects, the Revised ETS Directive provides that:

- up to 300 million EUAs in the new entrants' reserve (NER) will be made available until 31 December 2015 to help stimulate the construction and operation of up to 12 CCS demonstration projects; and
- a portion of the revenue from the auctioning of allowances may be used for promoting CCS projects. Pursuant to the Revised ETS Directive, at least 50 percent of the revenues generated from the auctioning of allowances should be used to reduce GHG emissions in one of a number of ways, including through CCS projects.

Neither the EUAs from the NER nor any auction revenues have yet been set aside for specific CCS projects. In terms of the former, the criteria for selecting the CCS projects that will receive EUAs from the NER are under development at the EU-level. In terms of the latter, it will be for individual Member States to determine the use (at their discretion) of revenues generated from the auctioning of allowances.

The ACES Act potentially provides two incentive approaches for CCS. First, fossil fuel-based electricity providers and State regulatory authorities may choose to form a Carbon Storage Research Corporation. If formed, the entity would be authorised to collect assessments on fossil fuel-based electricity, which is not to be less than US$1 billion in total per year. The corporation may collect such fees annually for 10 years and make these funds available to CCS projects. The second incentive mechanism for CCS development and deployment is much broader. It would include a bonus permit allocation scheme to directly support the commercial deployment of CCS. This could apply to certain coal-fired electricity-generating units and industrial emitters that achieve at least a 50 percent reduction in $CO_2$ emissions at one “emission point” using CCS. Projects would only be eligible for this dispensation during the first 10 years of the project’s operation. The amount of allowances available for this purpose would be equal to 1.75 percent of the total annual allowances issued under the Act from 2014 to 2017. An increase to 5 percent issued between 2020 and 2050 would total 5.4 billion allowances which can be used as an incentive for CCS. It is important to note that although this Act has passed one chamber of the US Congress, it has not yet been enacted into law.

## 4.3 Non-mandatory emission reduction schemes

Non-mandatory emission reduction schemes can also provide incentives for the development and deployment of CCS. In jurisdictions which lack mandatory cap and trade schemes, or where the coverage of such schemes is limited, voluntary emission reduction schemes can contribute to consumer pressure on sellers of goods and services to internalise the environmental cost of GHG emissions. In reality, however, in the absence of legal sanctions this is unlikely in practice and has not occurred on a sufficiently wide basis to produce major changes in business or consumer behaviour.

Japan, for example, has two voluntary carbon emission cap and trade systems, and a voluntary industry initiative for carbon emission reduction, run by the Japan Federation of Economic Organisations (*Keidanren Scheme*).

Currently, there are very few participants in the schemes which limits their effect in contributing to a change in business or consumer behaviour.

Although broad deployment of CCS is not occurring via voluntary programs, Chapter 5 identifies a number of financial assistance programs which are providing significant financial support for demonstration of a limited number of energy systems employing CCS.

### 4.3.1 International voluntary emission reduction schemes

Internationally, the emission reduction schemes considered most robust by market participants is the Clean Development Mechanism (CDM) established under Article 12 of the Kyoto Protocol and the Joint Implementation (JI) mechanism established under Article 6 of the Kyoto Protocol. Both mechanisms are project-based. Under the CDM, Certified Emission Reductions (CERs) can be generated by projects in non-Annex I parties to the Kyoto Protocol (those without emission reduction obligations under Article 4 of the Kyoto Protocol) which have achieved registration under the various methodologies agreed by the CDM Executive Board. Similarly, under JI Emission Reduction Units (ERUs) can be generated by projects in Annex B countries (economies in transition and Annex I (developed) countries). Participation in both schemes is voluntary but CERs and ERUs are accepted in domestic mandatory cap and trade schemes including the EU ETS and the proposed CPRS. Under the Kyoto Protocol, CERs can be used by Annex B countries (those with emission reduction obligations under Article 4 of the Kyoto Protocol) to acquit their emission reduction obligations.

The primary economic driver for CDM and JI projects is that they can provide entities, subjected to ETS obligations, emission reductions at a lower cost than physical abatement or the purchase of offsets or permits within those schemes.

A number of international voluntary standards have also been developed in recent years. These include the Voluntary Carbon Standard, the Gold Standard and a number of offset-sector-specific and biodiversity standards such as the Plan Vivo and the Climate Change and Biodiversity Standards. A feature common to these standards is that emission reduction projects, when validated to the technical requirements of the standard in each case, become eligible to generate Verified Emission Reductions (VERs). To accommodate the proliferation of standards and VER products which have evolved, a number of registries are now operational. These include the Voluntary Carbon Standard (VCS) Registries (APX, Caisse des Depot and the Markit Environmental (TZ1) Registry), the American Carbon Registry and the Blue Next Registry.

### 4.3.2 Domestic voluntary emission reduction schemes

A number of other voluntary emission reduction schemes have also been developed in jurisdictions surveyed. These have taken three forms.

Some jurisdictions have instituted voluntary standards similar to the standards outlined above, which provide a benchmark for verification of emission reductions generated by domestic emission reduction projects. In Australia, the Greenhouse Friendly™ scheme is an Australian Government-mandated scheme providing accreditation of voluntary offsets generated in Australia. To obtain Greenhouse Friendly™ accreditation, offset projects must satisfy a set of criteria similar to those provided under the methodology of the CDM. Greenhouse Friendly™ is expected to be replaced by the proposed CPRS and a voluntary carbon offset standard currently under development by the Australian Government.

The second type of domestic non-mandatory emission reduction scheme involves participants voluntarily accepting emission reduction commitments which then become legally binding. One example is the Chicago Climate Exchange (CCX), a private, voluntary emission reduction scheme in the US which imposes a cost on carbon emissions for CCX members. Members make a voluntary, but legally binding, emission reduction commitment and participate in the CCX cap and trade system.

Finally, some jurisdictions have introduced sectoral voluntary emission reduction plans. Under Japan's Keidanren Scheme, participating industry sectors formulate plans for the reduction of $CO_2$ emissions. These types of policies are relevant in mobilising industry support, raising awareness of

climate change and the need to reduce emissions, but the absence of legal sanction limits their effectiveness as a vehicle to impose a carbon cost.

### 4.3.3 Acceptance of CERs, ERUs and VERs into mandatory emission reduction schemes

As noted above, under the EU ETS, CERs can be converted into EUAs which can then be surrendered so as to discharge emission reduction obligations under that scheme. The proportion of total emission reduction obligations which can be used is set out in National Allocation Plans. The European Commission considers that, as a general rule, this limit should be set at up to 10 percent.

Both the CPRS Bill and the ACES Act provide for CERs to be imported into the schemes they propose in limited circumstances and surrendered to acquit emission reduction obligations. The current draft of the ACES Act also provides for some non-CDM forestry offsets generated in developing countries, which can be used to acquit emission reduction obligations.

### 4.3.4 Sectoral coverage: inclusion of CCS

At present, neither the CDM, JI nor any of the voluntary schemes surveyed above recognises emission reductions generated by CCS projects. However, as discussed below, it has been proposed that CCS be included in the CDM. Further, with CCS to be included in the EU ETS as discussed above, it is becoming more likely that CCS will be included in non-mandatory emission reduction schemes. The sale of emission reductions generated by CCS projects could provide an additional source of funding and investment for CCS projects. This would also firmly situate CCS projects within frameworks designed to internalise the cost of GHG emissions.

## 4.4 Carbon taxation schemes

Like cap and trade schemes, carbon taxation schemes also aim to internalise the environmental cost of GHG emissions. In contrast to cap and trade schemes, the carbon taxation schemes allow regulators to set the price of carbon. This is equivalent to the quantum of tax imposed. The operation of carbon taxes can be similar to that of mandatory cap and trade schemes. However, it can be politically challenging, particularly in economically developed democracies, for governments to impose new taxes, especially where taxes have the potential to significantly affect systemic change to patterns of economic behaviour.

However, a number of jurisdictions (including Indonesia) have considered imposing carbon taxes. Norway introduced a carbon tax scheme in 1991 and this scheme compliments the Norwegian Emissions Trading Scheme (NETS). The tax applies to emissions from oil and gas production operations and is paid per litre of oil or natural gas liquids, and per standard cubic metre of gas burnt off or emitted directly to air on platforms, installations or facilities used in connection with the extraction or transportation of petroleum on the Norwegian continental shelf. As from 1 January 2007, the tax is NOK (Norwegian Kroner) 0.80 per litre of oil or per standard cubic metre of gas.

Installations that were subject to the tax were exempt from the operation of the NETS. However, as Norway has now joined the EU ETS, from 2008 Norwegian installations required to surrender allowances under the trading schemes are exempt from paying the carbon tax. Such installations will, however, be required to pay the general tax rate on heating oils as well as the tax on heavy fuel oils. In addition, taxation of the petroleum industry has been reduced to account for the expected price of carbon emission allowances under the EU ETS.

In Canada, British Columbia and Quebec have both introduced carbon taxation regimes of limited scope. The British Columbian carbon tax was introduced in 2008 and is applicable to most fossil fuels, including gasoline, diesel, natural gas, coal, propane and home heating fuels. It set the base carbon taxation rate at C$10 ($US8.69) per tonne of GHG emission, with an annual increase of C$5 (US$4.32) per tonne over the first four years of the scheme. The Quebecois carbon regime is applicable only to transportation fuels. The present level of the tax is US or C$0.8 cents per litre on automotive gas and US or C$0.9 cents per litre on diesel fuel.

Mandatory cap and trade schemes can also have the effect of carbon taxes if they include price caps. Both the Alberta ETS and the proposed CPRS include price caps. Under the Alberta Climate Change Act, large emitters can avoid or reduce their emission reduction liabilities by making payments into an Alberta technology development fund at a cost of C$15 (US$ 12.96) per tonne of $CO_2$ emitted. Similarly, under the CPRS Bill, the cost of auctioned emission permits is capped at A$10 (US$8.13) per tonne in the first year of the scheme.

**Case study: Norway's carbon tax and the Sleipner Project**

The Sleipner Project, which involves the capture of $CO_2$ from natural gas and injection into a saline formation 1,000 metres below the sea bed, is operated by Statoil, the Norwegian oil and gas company. In the last 13 years over 11 million tonnes of $CO_2$ has been injected at the platform. Statoil's decision to test CCS appears to have been made because of the interplay between natural gas standards and the Norwegian carbon tax. The natural gas extracted from the site needs to be "filtered" to reduce the $CO_2$ content in the raw extraction stream. Without such refinement its $CO_2$ content would be around four times higher than the European commercial export target (EuroActiv.com, 2007).

Since Statoil was already capturing $CO_2$ at the offshore platform, it was faced with the decision whether to release or store it. This decision was influenced by the contemporary level of carbon tax versus the cost of injection. At the time that the storage decision was made, the high Norwegian $CO_2$ tax prompted Statoil to pursue storage as a commercially attractive option (Heiskanen, 2006). Although the injection facility is estimated to have cost $80 million to construct and approximately $5 million per year to operate (Walter, 2008), every year Statoil has avoided paying tax on an estimated 1 million tonnes of injected $CO_2$, which currently costs around $30 per metric ton. No official figures appear to be publicly available, but Olav Kaarstad, special advisor to StatoilHydro, has agreed that carbon storage has proved cost effective for Statoil.

## 4.5 Performance and technical standards

In addition to economy-wide cap and trade or tax mechanisms, use of CCS can also be encouraged with specific performance standards on emitting sources, similar to regulation set for traditional air pollutants.

The ACES Act, if enacted, would create performance standards requiring a percent-reduction in uncontrolled emissions for new coal-based power plants initially permitted after 1 January 2009. The Act links the date for compliance to four years after the demonstration of 4 GW of power output incorporating CCS in the US, but no later than 1 January 2025.

## 4.6 Complementary schemes

Complementary schemes aim to contribute to the internalisation of the environmental costs of GHG emissions by providing direct incentives for the use of electricity generation methods with lower emissions intensity than fossil fuels. Such schemes have generally aimed to provide incentives for the use of electricity generated from renewable sources. These fall into two policy groups: portfolio energy standards and feed-in tariffs. Portfolio energy standards require that electricity generators utilise renewable sources in the proportion of electricity they generate or sell. Feed-in tariffs obligate electricity generators to purchase electricity generated from renewable energy at fixed prices.

Both policies have been widely adopted in the jurisdictions surveyed. Jurisdictions in Australia, the US and South Africa have introduced portfolio energy standards. Jurisdictions in the US, China and Canada have introduced feed-in tariffs and Japan is considering introducing such a scheme.

### 4.6.1 Portfolio energy standards

Australia has introduced comprehensive portfolio energy standards which are currently being updated and expanded. The Federal Mandatory Renewable Energy Target (MRET) operates under the *Renewable Energy (Electricity) Act 2000* (Cth). The MRET aims to encourage the additional generation of electricity from renewable sources, reduce emissions of GHGs and ensure that renewable energy sources are ecologically sustainable. Under MRET wholesale electricity purchasers are required to purchase an increasing percentage of their electricity from renewables-based generation, such that 9,500 gigawatt-hours (GWh) of renewable energy will be generated by 2010. Liable entities can acquire and surrender Renewable Energy Certificates (RECs), each representing one MWh of renewable electricity generated, to demonstrate compliance. This creates a guaranteed market for renewable energy in Australia. The Victorian Government has introduced a similar target, the Victorian Renewable Energy Target; the New South Wales Government has considered introducing such a target but has not yet done so.

On 30 April 2009, the Council of Australian Governments agreed upon the design of an expanded National Renewable Energy Target (RET) scheme. The expanded RET scheme passed, as amended on 20 August 2009. The RET expands the existing MRET and absorbs State and Territory renewable energy targets into a single national scheme. The design of the expanded RET aims to implement the Government's commitment that 20 percent of Australia's electricity supply comes from renewable energy sources by 2020, and includes a legislated target of 45,000 gigawatt-hours (GWh) in 2020, which is more than four times larger than the current target. This scheme will accelerate uptake and prepare the electricity sector for inroads into significant emissions reductions.

The US may introduce similar standards to Australia at a Federal level. The ACES Act includes a provision requiring that a specified portion of US electricity sales, reaching 20 percent in 2020, be provided by renewable energy sources and energy efficiency measures, excluding traditional hydroelectric generation.

### 4.6.2 Feed-in tariffs

Feed-in tariffs have been used in a number of jurisdictions to encourage the generation of electricity from renewable sources. The tariffs ordinarily place an obligation upon regional or national electricity utilities to buy renewable electricity at above-market rates set by the government. This provides an incentive for renewable energy generation by helping generators overcome the higher costs associated with new technologies.

A number of Australian States have enacted legislation implementing feed-in tariffs for small scale renewable power sources. In South Australia and Queensland, feed-in tariffs are provided for solar power. The Australian Capital Territory (ACT) and Victoria extend their schemes to wind power, and in the case of Victoria, also to small hydropower and biomass power. The value of the feed-in tariff varies between the States, ranging from A$0.44/kWh – A$0.60/kWh (US$0.35/kWh – US$0.48/kWh). Each State imposes limitations on when the feed-in tariffs will be payable, usually by reference to the type of customer eligible to access the scheme (eg residential or small scale customers) and the scale of generation (eg systems with a capacity of up to 10 kilo-Volt-Amps (kVA) for single connection). Each scheme also requires distribution entities to allow small customers to connect their qualifying generators to supply networks.

Feed-in tariffs have also been operational in countries such as Brazil and China for a number of years. Brazil introduced feed-in tariffs in 2002. These laws are intended to operate for a period of 20 years and cover a range of renewable energy sources, including wind, small-scale hydro and biomass. Tariffs are set for each renewable energy source, representing a percentage of the production costs for energy generated by these sources (eg 90 percent for wind power). The Brazilian law requires that, under regulated contracts, independent power producers guarantee the purchase of 70 percent of the renewable energy generated during the term of the contract.

China introduced feed-in tariff regulations in 2006. Whilst the People's Republic of China (PRC) government does not require energy suppliers or grid companies to purchase a specific percentage of renewable energy, it generally encourages the increased consumption of renewable energy and provides recommended targets. Grid enterprises are required to enter grid connection agreements with renewable power generators that have been legally approved and to purchase all grid-connected renewable power covered by their grid. In some instances, the National Development and Reform Commission sets on-grid prices for renewable energy. The price reflects the Provincial coal price, plus a subsidy amount. At present the standard subsidy is RMB (Renminbi) 0.25/kWh. From 2010, the subsidy will decrease by 2 percent each year and be cancelled by 2015.

In addition, a number of the EU Member States, such as Germany and Spain have been extremely successful in pricing incentives for renewable energy generation through their use of feed-in tariffs. Other Member States, such as the United Kingdom (UK), are also developing frameworks which will enable feed-in tariffs to be introduced in the future. At the EU level, there is no specific regulation for feed-in tariffs, however, the EU Renewables Directive places a number of obligations on Member States to facilitate access to electricity grids for renewable power generators. Some of the key obligations for the Member States are to ensure that transmission system operators and distribution system operators guarantee the transmission and distribution of electricity generated from renewable sources and that transmission and distribution fees do not discriminate against electricity from renewable energy.

The Japanese Government has announced that it plans to introduce a feed-in tariff system whereby power companies will purchase the unused solar energy from households and business that currently have or install solar panels in the next three to five years . The price for such energy will initially be approximately twice the price of non-renewable energy but will fall gradually over a 10 year period.

A similar "CCS tariff" may be a means of providing incentives to accelerate the deployment of CCS.

## 4.7 GHG emission and energy use reporting schemes

Energy and emission reduction reporting schemes have been used by governments to facilitate and support efforts to impose costs on GHG emissions. In general terms, they require entities whose

energy use or emissions exceed mandated thresholds to report on their energy use and emissions to a regulator. Such schemes can facilitate efforts to price carbon in two ways. First, they enable governments to develop and refine carbon cost imposition policies by providing them with information on energy use and GHG emissions. Second, publication of energy use and emissions information can increase the efficiency of carbon markets by enhancing disclosure, reducing information asymmetries and providing a point of focus for consumer and stakeholder group efforts to persuade businesses to reduce their emissions.

A number of jurisdictions have introduced such schemes. Generally, reporting liability is imposed on the basis of energy use or GHG emissions above mandated thresholds.

In Australia, the Federal Government introduced the National Greenhouse and Energy Reporting Scheme in 2007 through the *National Greenhouse and Energy Reporting Act 2007* (Cth) (NGER Act) and accompanying regulations. The NGER Act imposes mandatory annual reporting obligations on corporations in control of corporate groups or facilities that emit GHGs (which is defined under the NGER Act to include $CO_2$), or produce or consume energy, in volumes that exceed mandated thresholds.

As originally enacted, the NGER Act did not deal specifically with CCS facilities. However, the CPRS Bill will amend the NGER Act specifically to include CCS projects in the scheme.

In more general terms, the NGER Act does, however, provide that corporations subject to NGER obligations may report on activities relating to the reduction of GHG emissions and the removal of GHGs. This would be extended to $CO_2$ storage facilities.

In the EU, reporting obligations are imposed through the following mechanisms:

- the most extensive GHG monitoring and reporting obligations (in terms of volume of GHGs covered) are imposed pursuant to the EU ETS Directive; and
- in addition, monitoring and reporting obligations for GHGs not covered by the EU ETS may be imposed by the Integrated Pollution Prevention and Control (IPPC) Directive 2008/1/EC (IPPC Directive).

Historically (prior to the EU ETS), GHG emissions were potentially subject to regulation through the imposition of emission limits (and corresponding monitoring and reporting obligations) under the IPPC Directive. The introduction of the EU ETS amended this position to ensure that where GHGs are regulated by the EU ETS, then such emissions should not be subject to specific emission limit values (and corresponding monitoring and reporting requirements) under the IPPC permitting regime.

In China, the PRC Government has introduced a gas-specific reporting regime. Nitrous dioxide is regulated in China as an air pollutant and emissions of the gas must be reported by "key consumption entities" and public institutions. The *Law of the People's Republic of China on Energy Saving* (NPCSC, 28 October 2007, in *Standing Committee Gazette, No. 77,* (2008)), requires that energy use be reported by entities that have either an annual energy consumption of more than 10,000 tonnes of standard coal, or an annual energy consumption above 5,000 but below 10,000 tonnes of standard coal, as defined by the relevant department of the State Council.

In the US, continuous monitoring and reporting of $CO_2$ emissions is currently required in the context of the EPA acid rain control program. On 10 April 2009, US EPA proposed a regulation which would greatly expand this reporting and cover GHG emissions from nearly all sectors of the economy. As part of their rulemaking, EPA prepared an extensive report tabulating existing reporting requirements related to GHGs (domestic and international) (USEPA, 2008).

## 4.8 Evaluation and key barriers

Policies imposing a cost on GHG emissions play a crucial role in assisting CCS to be economically competitive with other GHG emission reduction schemes.

Mandatory cap and trade and carbon taxation schemes are underpinned by legal sanction and by introducing such policies, governments can utilise policy making power to correct markets which have led to non-existent or limited carbon price internalisation.

The role of Norway's complementary carbon tax and NETS in making commercial-scale carbon storage economically viable for the Sleipner Project provides an example of how such policies can, when targeted and well-developed, directly affect the viability of CCS. The price that will make CCS cost-competitive will vary as the cost of capture will vary from plant to plant. It is understood that these issues are discussed in more detail in the Second Foundation Report.

Cap and trade systems can drive the deployment of CCS by imposing a carbon cost on GHG emissions to bring down the comparative cost of CCS as an emission reduction scheme. Financial incentives or mandatory (non-tradeable) emission limits may also be needed to deploy CCS, noting that the cost of CCS can vary dramatically depending on the project type and methodologies used. Although the EU has a cap and trade program, there has not been extensive CCS deployment, highlighting the need for a range of policy and legislative measures to facilitate CCS in the early stages of development.

The effectiveness of such policies can be maximised by ensuring that their development is as free from rent-seeking as is politically feasible. Governments and regulators should also ensure that CCS is explicitly embedded in such policy regimes. In this sense the experiences of Australian, Canadian and US jurisdictions and the EU are particularly relevant as these could be utilised in other jurisdictions considering implementing policies in this area.

**Key barriers**

- Employing a mechanism which puts a price on carbon will not of itself promote or facilitate CCS projects: it should be used as part of a suite of measures.
- Delays in increasing the real cost of carbon may, however, retard investment in CCS in the near term.

# 5. Existing CCS research, funding and cooperation initiatives

## 5.1 Introduction

Many governments, multilateral agencies, research institutions and private sector players are contributing to the development of CCS through the provision of funding and other support mechanisms. These initiatives are primarily focussed on establishing demonstration activities that may be scaled up to full commercial CCS operations over the longer term. There are major initiatives underway in the US, China, Japan, Australia and the EU to test various parts of the CCS project cycle. There is no doubt that research and demonstration activities are an essential step in developing CCS technology. However, to achieve the G8's goals within its stated timeframe, better coordination (and possibly pooling) of resources, skills and capital investment may be required.

**The First Foundation Report** examines the various small-scale CCS projects already under development or in operation. This Report does not provide an exhaustive overview of those projects but instead explores the role played by different policy initiatives in promoting and supporting such demonstration activities in the general advancement of CCS development. As there are currently no full-scale CCS projects that traverse the complete CCS project cycle, the key question to consider is what more, in a legal and policy sense, is required to enable the demonstration activities to be scaled up, replicated and commercialised.

The key policy initiatives that support CCS demonstration activities are:

- funding of academic research centres, often through joint ventures and partnerships between government and business;
- funding of small-scale demonstration projects, in many instances these activities will focus on one part of the project cycle rather than the full project cycle; and
- funding "flag-ship" full cycle demonstration projects.

The first two initiatives are already well underway and provide a solid foundation and understanding about the processes involved in individual stages of the CCS project cycle. However, the challenge with CCS is that, although different stages of the project cycle have been tested and in some instances commercially deployed (e.g., $CO_2$ injection as part of enhanced oil recovery) there has not yet been a project undertaken that engages in the full project cycle on a large scale.

A number of full cycle large projects are in the pipeline or in contemplation, including FutureGen in the US, ZeroGen in Australia and GreenGen in China. These projects, once constructed and operational, will provide a useful benchmark to assess not only the success of the technologies involved, but also to establish the reference costs associated with such projects and their economic viability.

Without detracting from the important role that the funding of demonstration activities play, one concern is that because of the significant costs and timescales involved in establishing full cycle projects, there is already competition between the different "flag-ships" for funding – in particular for co-financing from the private sector. At present, private sector engagement is led by those companies that have a direct interest in utilising the resulting technologies (e.g., major global coal mining and energy companies) and which are likely to have their GHG emissions regulated. The number of those

companies and their resources are finite and contributions to multiple projects rather than concentrating efforts on one or two could mean that none of the projects are adequately funded.

A key challenge is to ensure that the range of non legislative initiatives both already implemented and under consideration are not only well-targeted but also well-coordinated, so that duplication can be minimised and scarce resources allocated efficiently and effectively.

For broader private sector investment in CCS, different policy drivers are required, including taxation incentives and a cost of carbon that makes CCS-enabled power stations economically competitive. These policies need to be backed by the confidence that CCS will meet its objectives (i.e. long-term storage of $CO_2$). That confidence is underscored by the success of the various R&D activities described here and in the **First Foundation Report**.

## 5.2 Government R&D, commercialisation and partnerships

Almost every jurisdiction surveyed for this report has established government or government-business organisations to undertake research on CCS or has tasked existing facilities with such research. In general terms, such facilities bring together government funding, bureaucratic support, academic and research resources and business insights. Research institutes in China, Australia, the UAE and US provide examples of how government involvement in CCS research can facilitate the development of new projects and technologies. The **Second Foundation Report** explores R&D and commercialisation initiatives in greater detail.

Japan's New Energy and Industrial Technology Development Organisation (NEDO) is a government R&D organisation established in 1980 to develop new oil-alternative energy technologies. It undertakes research itself and acts as a funding agency for new energy development initiatives by industries. It was the commissioning and funding body for the total CCS system feasibility study at the coal gasification power plant at Iwaki City. It was also the commissioning body for the Research Institute of Innovative Technology for the Earth (RITE) sub-sea bed $CO_2$ storage project, with government subsidies from the Japanese Ministry of Economy, Trade and Industry (METI).

The EU has also directly funded CCS projects in the EU. For example, the European Commission has provided funding to the $CO_2$SINK Ketzin project in Ketzin, Germany. The purpose of the project is to observe the effects of geological storage of $CO_2$. Other funders of the project include the German Ministry of Economics and Technologies and the Ministry of Education, Research and Industry.

The NEDO model could be useful for government research organisations which have some CCS research capability but also wish to facilitate research by other government agencies or private entities with different expertise. The $CO_2$SINK Ketzin project provides an example of how multiple government agencies can pool financial and bureaucratic resources to assist in the development of CCS projects.

In 2006, the Chinese Ministry for Science and Technology (MOST) launched a National Basic Research Program (called “973 Program”) on Geologic Carbon Storage with Enhanced Oil Recovery. The program aims to enhance oil recovery by using $CO_2$ (instead of water) as an oil displacement agent. The program includes four areas of research: (i) reservoir geology for $CO_2$ underground storage and $CO_2$ drive, (ii) physical chemistry in the course of $CO_2$ drive and storage, (iii) nonlinear flow mechanics in the course of $CO_2$ drive, and (iv) capture of $CO_2$ and anti-corrosive technology. The project will end in August 2011.

In 2008, MOST launched a National High-technology Research and Development Program (called “National 863 Program”) on CCS Technology. The program focuses on three technologies: (i) $CO_2$

capture technology using the attraction method, (ii) $CO_2$ capture technology using the adsorption method, and (iii) $CO_2$ storage technology. For these three research areas, the PRC government will make available up to RMB 20 million with a requirement for the research institutes to provide at least RMB 10 million. As part of this program MOST has provided financial support to the GreenGen Tianjin plant, which will operate as an IGCC demonstration project, and which is also being supported by the NDRC and the Asian Development Bank.

The Australian-Government funded Cooperative Research Centre for Greenhouse Gas Technologies ($CO_2$CRC) is an unincorporated joint venture which brings together government agencies at Federal, State and local levels, together with private companies and academic institutions. $CO_2$CRC has contributed to key CCS projects including the Otway Basin CCS demonstration project in Victoria.

The newly formed Australian National Low Emissions Coal R&D (ANLEC R&D) is jointly funded by the Australian Government and the Australian black coal through the COAL 21 fund. ANLEC R&D was established as a needs driven R&D coordination body. Some of the key activities of ANLEC R&D include implementing a national program for low emission coal research and development to address research priorities. This will include applying R&D to help reduce project risk, provide independently validated cost and performance data, and identify research priorities to accelerate deployment of CCS. ANLEC R&D will also look to link in research with demonstration projects around Australia.

The UAE has established the Masdar (Abu Dhabi Future Energy Company) Institute of Science and Technology. The Institute has both research and teaching functions – its purposes include not only research and development (R&D) on CCS, but also graduate education.

The US Department of Energy (DOE) has adopted a slightly different approach. The DOE operates a number of energy research laboratories, one of which, the National Energy Technology Laboratory (NETL), focuses on fossil fuel technologies and CCS. In addition, in 2009 the DOE established the National Carbon Capture Centre to research and develop CCS. It will be established on the site of an existing CCS test site with a coal gasifier and combustor already in place to conduct large scale testing and simulate "real life" CCS operating conditions. Unlike the other institutions surveyed above, this research centre will be managed by a private company, Southern Company Services Inc.

Further detail about the different research institutions is provided in the **Fourth Foundation Report**.

## 5.3 Government funding

Government funding is central to the development of new technologies to facilitate CCS and also to the viability of most of the CCS demonstration projects. However, the scale of funding required for each full scale demonstration projects, in the range of at least US$1-2 billion, means that only a few select initiatives can be directly supported or alternatively, smaller initiatives that focus on discrete parts of the CC project cycle are progressed. Some of these stand-alone initiatives include developing and applying site mapping technologies and projects to observe the effects of $CO_2$ storage. Examples of funding for such projects are described below.

In most instances, governments are also seeking co-funding from either the private sector (particularly in developed countries) or from multilateral agencies such as the World Bank or Asia Development Bank (in developing countries). This is leading to strong competition for funding.

The US Government has been particularly proactive with its funding of CCS activities. The DOE has awarded, or is in the process of awarding, an additional US$2.7 billion to industrial and utility-related CCS demonstration projects in the US, as well as US$8 billion in loan guarantees for advanced coal

systems employing CCS. Other governments, including China and Australia are also investing strongly in R&D.

A criticism sometimes leveled at government funding initiatives is that taxpayers should not be required to support a technology which ultimately will benefit major private sector energy companies. Governments, therefore, need to clearly articulate the broader social and environmental dividends which these funding initiatives may generate over time.

### 5.3.1 Mapping collection and sharing of data

In order to encourage the identification of potential $CO_2$ storage sites and encourage the continuing development of storage site mapping technologies, a number of governments have introduced storage site mapping and data collection initiatives.

The DOE has been particularly proactive in facilitating mapping and data collection and sharing. In Phases I and II of the Regional Carbon Sequestration Program, the DOE worked with regional partners to characterise geological potential for CCS in local land formations and to implement small-scale pilot projects to validate these characterisations. In 2008, the DOE published the second edition of its *Carbon Sequestration Atlas of the United States and Canada*, which provides a coordinated update of CCS potential across the majority of the US and portions of Canada (DOE, 2008). The DOE has also recently announced a US$50 million competitive solicitation to characterise a minimum of 10 geological formations around the US in order to accelerate the identification of potential storage sites.

The governments of other jurisdictions have also been proactive in facilitating mapping and data sharing. The Australian Government in its release of five CCS exploration acreages has also released geological mapping data associated with the sites. It is also supporting initiatives through the $50M National Carbon Mapping and Infrastructure Plan. The Governments of Norway and the UK have agreed to develop the North Sea as a site for $CO_2$ storage and have commissioned a new study to analyse the sea bed of the North Sea for potential storage sites.

## 5.4 Government-business joint projects

A number of governments have engaged in government-business joint ventures in order to demonstrate CCS project technology. The key benefits of such projects include the provision for:

- access for market participants to sources of additional funding for projects whose immediate commercial benefits may not be sufficient to justify commercial investment on sufficiently large scales;
- project proponents with access to high-level political and policy support in order to accelerate project development and assist with project permitting; and
- an enhanced understanding into government research and funding organisations of the commercial needs of CCS market participants.

The FutureGen project is an example of a joint venture between the government and business. This project is detailed below.

**Case study: FutureGen**

In 2003, the US DOE announced a US$1 billion investment in a project known as FutureGen, a government-business joint venture to develop a 275 MW clean coal power plant to produce electricity and hydrogen using CCS technology (FG1). In 2006, the US DOE determined that providing financial assistance for the construction and operation of FG1 would constitute a major Federal action that could significantly affect the quality of the natural and human environment and accordingly prepared an Environmental Impact Study (EIS) for the project in compliance with USA National Environmental Policy Act (NEPA) (FG1 EIS, 2007). After a rigorous nation-wide selection process, the final four sites under consideration to host FG1 were located in Illinois and Texas.

The US DOE decided to restructure the program in late 2007 after the FutureGen Alliance (a consortium of private companies that form half of the government-business joint venture) chose a site in Illinois over a site in Texas to locate the project. The restructured FutureGen Project (FG2) would fund implementation of CCS components at several Integrated Gasification Combined Cycle (IGCC) plants planned to be operational by 2015.

In conjunction with FG2, the agency issued a funding opportunity announcement in autumn 2008 soliciting applications for a commercial scale IGCC power plant or other coal-based power generation technology that can capture and store in a saline formation of at least 1 million metric tons of $CO_2$ per year for three to five years. The USA government announced on 12 June 2009 its commitment to the project, with a contribution of US$1.073 billion, US$1 billion of which will come from USA stimulus package funds.

Industry collaboration has also been central to the approach of the Norwegian Government to CCS project development. The Norwegian Ministry of Petroleum and Energy has cooperated with the Norwegian State oil and gas company Statoil to establish a full-scale CCS facility at the combined heat and power electricity station at Mongstad in Norway. The first stage of the project will include the construction of a carbon capture technology test centre while the second stage will involve a full-scale carbon capture project to be operational at the site from 2014. Similarly, the Sleipner project is operated by Statoil in close cooperation with the Norwegian environmental ministry.

A high proportion of these projects have historically been small in scale but now many governments are committing significant funding to scale up projects, some as part of economic stimulus packages.

## 5.5 International collaboration

International research facilities and networks combine the advantages of national research facilities with the potential to:

- bring together geographically disparate yet overlapping strands of research and regulatory experience;
- minimise duplication in research efforts; and
- more rapidly disseminate new discoveries and existing best-practice.

### 5.5.1 International research facilities and networks

The International Energy Agency (IEA) has made significant contributions to CCS research, principally through its CCS Regulators' Network, International CCS Roadmap process, the IEA Clean Coal Centre and the Greenhouse Gas R&D Program. In particular, the IEA Greenhouse Gas R&D Program (IEA GHG) is a major international research collaboration assessing technologies, including CCS, capable of achieving GHG reductions. It includes among its members both governments and businesses and has established a number of CCS technology research networks.

The IEA Regulators' Network is also supported by the Carbon Capture Legal Program at University College in London, the Carbon Sequestration Leadership Forum (CSLF) and the UN Economic Commission for Europe. Its purpose is to provide a forum for the sharing of experiences and the harmonisation of the efforts contributed by the regulator members.

Acceptance of $CO_2$ Capture and Storage, Economics, Policy and Technology (Accsept) is a research network which aims to contribute to the timely and responsible application of CCS by:

- measuring EU social acceptance of CCS;
- assisting with the establishment of CCS guidelines for the EU ETS; and
- identifying and addressing gaps in existing socio-economic studies on CCS (Accsept, 2009).

### 5.5.2 Multilateral funding

There is a need for increased funding for CCS to become a viable option for GHG reduction. To date, funding for "on-the ground" projects has been left to governments while international or bilateral partnerships and institutions such as the IEA, and the CSLF have focused significant support on the commissioning of studies, public debate and academic research. This has included international research networks such as IEA GHG, the CSLF, and the capacity-building projects by bodies such as the Asia-Pacific Partnership on Clean Development and Climate (APP).

Multilateral funding agencies such as the World Bank and Asian Development Bank have not yet fully engaged in funding CCS projects in any comprehensive way. However, there does appear to be growing momentum towards the development banks supporting CCS projects.

#### UNITED NATIONS

Funding arrangements through the United Nations are currently being debated and are under development in the lead up to climate change talks in Copenhagen at the end of 2009. While the central driver of CCS is likely to be the global price placed on carbon emissions through emission caps agreed under a successor to the Kyoto Protocol, there is debate under the UNFCCC regarding the appropriate mechanism to provide further funding. Such measures being debated include technology transfer, adaptation funds and a possible market based mechanism such as the CDM.

#### WORLD BANK

The World Bank is establishing Climate Investment Funds jointly with regional development banks to promote international cooperation on climate change and support progress towards the future of the climate change regime. The World Bank also appears to be considering funding of CCS projects. For example, it has indicated that its Clean Technology Funds (CTF) may support developing readiness for CCS (World Bank, 2008). Further, in a speech given on 31 March, 2009, Katherine Sierra, the Vice President of Sustainable Development at the World Bank stated that:

*While we expect that the CTF will be focused mainly on energy efficiency, renewables and urban transport programs, the Trust Fund Committee which governs the fund has adopted very high efficiency standards for any coal projects and the requirement that such projects include readiness for CCS.*

*These criteria are met by only a handful of plants in the developed world. The CTF would hope to partner with donors who could provide additional finance to cover the much larger incremental finance to put the actual CCS part into reality, since the cost of this part of the technology puzzle is well beyond the resources under the CTF* (World Bank, 2009).

## ASIA-PACIFIC PARTNERSHIP ON CLEAN DEVELOPMENT AND CLIMATE

The APP brings together government and private sector entities from Australia, Canada, China, India, Japan, Republic of Korea and the US.

The APP seeks to increase investment and trade in cleaner energy technologies, goods and services in key market sectors. The APP is involved in building CCS regulatory capacity. For example, in the first half of 2009 a new Cleaner Fossil Energy Task Force project was endorsed - *Guidelines for Safe and Effective Carbon Capture and Storage: Building Regulatory Capacity*.

Under this project, Tsinghua University in China will partner with the World Resources Institute (WRI) in the US to develop guidelines for China's deployment of CCS technology (see APP, 2009).

## CARBON SEQUESTRATION LEADERSHIP FORUM

The CSLF is a Ministerial-level international climate change initiative on the development of CCS. The Charter for the CSLF states that its purpose is to "facilitate the development of improved cost-effective technologies for the separation and capture of $CO_2$ for its transport and long-term safe storage; to make these technologies broadly available internationally; and to identify and address wider issues relating to carbon capture and storage".

The CSLF currently comprises 22 members, including 21 countries and the European Commission with the aim of achieving a number of goals including (but not limited to):

- identifying key obstacles to achieving improved technological capacity;
- fostering collaborative RD&D projects reflecting Members' priorities;
- establishing guidelines for the collaborations and reporting of their results; and
- assessing regularly the progress of collaborative R&D projects and making recommendations on the direction of such projects.

There is some risk that a lack of coordination between international agencies may result in duplication and a waste of scarce resources. The Global CCS Institute can play an important coordinating role across, for example, the fields of information sharing, the development of "best practices" and lobbying on behalf of its members in international fora.

## 5.6 Taxation incentives

In many jurisdictions CCS R&D may qualify for broader R&D taxation incentives and deductions. Governments in a few jurisdictions have, however, introduced CCS-specific taxation incentives.

As an example, the US Federal Government has introduced investment tax credits for qualifying electricity generating units and industrial gasification projects that employ CCS, as well as a US$20 per ton tax credit for up to 75 million tons of geologically stored $CO_2$ ($10 per ton for projects using enhanced oil recovery (EOR)). In addition, the DOE has solicited CCS project proposals for $8 billion in Federal loan guarantees, which result in lower interest loans. On 13 July 2009, Tenaska Corporation announced that it had been selected by DOE for a US$2.6 billion loan guarantee for the company's proposed US$3.5 billion facility which will gasify coal to produce substitute natural gas and electricity, and which will capture and store at least 50 percent of its generated $CO_2$ (Tenaska, 2009).

## 5.7 Evaluation and key barriers

A variety of policy measures have been widely adopted which have contributed to developments in CCS. These include government and government-business research organisations, government funding and government-business joint projects to establish demonstration-scale CCS projects.

The strengths of these policy measures include their potential to facilitate coordination between governments, academia and market participants to achieve concentrations of financial and bureaucratic resources, academic and business knowledge. They can enable acceleration in the commercialisation of CCS by enabling project proponents to access funding which may not otherwise be available on a commercial basis. Further, they often provide project participants with high-level political and policy support for their projects and technologies.

- These benefits need to be balanced, however, against the risks inherent in these mechanisms where in some cases R&D projects are too academically focused or not sufficiently focused on reducing the commercial risks and costs of CCS.
- There is also a risk that scarce resources may be allocated into commercially unviable technologies and projects especially where there is a proliferation of competing R&D centres and projects with overlapping work programs and objectives.
- Delays in project implementation occasioned by government approval and funding clearance processes may also be significantly longer than typical commercial approval timescales.

**Foundation Reports 2 and 4** examine these issues in greater detail.

**Key barriers**

- A lack of cooperation amongst agencies with similar objectives supporting a multiplicity of projects will delay development and deployment of CCS technologies.
- Taxpayer funded research into CCS will prove increasingly difficult where broader social and environmental dividends are not adequately articulated.

# 6. Capture of $CO_2$

## 6.1 Introduction

The first stage in the CCS cycle is the capture of carbon for transport and $CO_2$ storage.

Few jurisdictions have implemented policies or legislation aimed at providing incentives for the capture of $CO_2$. Alone among the jurisdictions surveyed, the EU has introduced requirements for the capture of $CO_2$, in the context of power station approval processes.

In other jurisdictions, carbon capture activities may be regulated under a combination of mainstream planning regulation as well as environmental and pollution regulations. The key challenge this regulatory gap poses is the creation of a fragmented regulatory landscape where carbon capture is not well-integrated with other stages of the CCS cycle.

As earlier noted, the ACES Act will require carbon capture at power plants through staged technical goals.

## 6.2 Integrated policy and legislation

Carbon capture has not been dealt within integrated policy and legislation in any of the jurisdictions surveyed, except to the extent that the availability of commercial quantities of $CO_2$ must be proven in some jurisdictions in order to obtain retention leases over potential storage sites. This section therefore focuses on general policy and legislation with applicability to carbon capture.

## 6.3 General policy and legislation with applicability to carbon capture

In the absence of a dedicated carbon capture regulation, the installation of carbon capture equipment would be governed by the same mainstream planning regimes governing the implementation of, for example, the electricity generation equipment at power points.

The EU has taken the lead in amending existing general regulations to encourage carbon capture, particularly through its "carbon capture readiness" (CCR) planning requirements. This section also provides a general overview of regulations in other jurisdictions, with the objective of providing insights into how such regulations might frame carbon capture.

In the US, a range of financial incentives have been established for CCS projects, including investment tax credits, tax credits for stored $CO_2$ from CCS projects, and Federal loan guarantees. These provisions provide assistance for both electric power and industrial CCS projects, but only for a limited number of facilities.

### 6.3.1 Planning requirements

In the EC, Council Directive 1985/337/EEC on the assessment of the effects of certain public and private projects on the environment (EU Environmental Impact Assessment Directive) requires that an environmental impact assessment be carried out before development consent is granted for certain types of projects which are likely to have significant environmental effects. Council Directive 2009/31/EC of 23 April 2009 on the geological storage of $CO_2$ (CCS Directive) amends the

Environmental Impact Assessment Directive to include CCS transport pipelines, storage sites and capture installations.

Planning requirements in Norway provide an example of how permitting for carbon capture activities could be dealt with under existing regulation. In Norway, the *Planning and Building Act* of 14 June 1985 No 77 (Norwegian Planning Act) facilitates the coordination of building activity in Norway and provides the basis for decisions concerning the use and protection of resources and development. At a basic level, the Norwegian Planning Act requires that permission be obtained to erect, extend, position or alter buildings, structures or installations.

In the US and Australia, planning requirements are generally imposed through State and local regulation. In the Australian State of New South Wales, the *Environmental Planning and Assessment Act 1979* (NSW) provides a framework for zoning, development permitting and environmental impact assessment. Carbon capture developments would likely be permitted under Part 3A of the Act, which requires that development consent applications for major projects be determined by that State's Planning Minister following assessment by the New South Wales Department of Planning.

### 6.3.2 Retrofitting

The regulatory amendments implemented in the EC by the CCS Directive provide for retrofitting of emitting facilities. Council Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants (the Large Combustion Plants Directive) sets limits on emissions of sulphur dioxide, nitrogen oxides and particulate matter from large combustion plants. It applies primarily to power stations and boilers in petroleum refineries and steelworks, as well as other large industrial boilers. The purpose of the Directive is to reduce acidification, dust/fine particles and ground-level ozone. This could be adapted to tighten restrictions on $CO_2$ emissions.

The CCS Directive amends the Large Combustion Plants Directive by requiring Member States to assess whether - in relation to combustion plants - suitable storage sites are available, transport facilities and/or retrofitting for $CO_2$ capture are technically and economically feasible. It also introduces CCR requirements into the Large Combustion Plants Directive in relation to new-build electricity generating power stations with rated capacity of 300MW or more.

The CCR requirement stipulates that, as a condition of obtaining a construction licence, certain new plants would have to have sufficient space for retrofitting of CCS equipment. There will also be a requirement to carry out an assessment of suitable storage sites and transportation facilities. This will apply to all new applications for certain combustion power stations as well as applications that are currently being considered.

In other jurisdictions, in the absence of regulation to the contrary, retrofitting would be governed by the terms of planning consents granted to the relevant facilities. Where the activities permitted under such consents did not encompass retrofitting, it would be necessary to obtain further approvals.

### 6.3.3 Relevant pollution laws and policies

In general, the jurisdictions surveyed have not determined whether emitted $CO_2$ should be treated as a pollutant within the terms of their pollution legislation, or whether $CO_2$ should be treated as a waste. This is an important distinction because if emitted $CO_2$ was defined as a pollutant, emission of $CO_2$ would attract penalties or criminal sanction.

The EU has commenced the process of situating $CO_2$ within its pollution laws and policies. The IPPC Directive regulates the environmental impact of a wide range of industrial activities. In particular, it

regulates emissions to air, water and land through a permitting regime. The CCS Directive amends the IPPC Directive to include within its scope the capture of $CO_2$ by CCS installations. Council Directive 2000/60/EC (the EU Water Framework Directive) establishes a framework for Community action in the field of water policy. It is designed to improve and integrate water management throughout the EU.

The EU Water Framework Directive, *inter alia*, requires the classification of bodies of water. It is amended by the CCS Directive so that Member States can authorise the injection of $CO_2$ streams into geological formations for storage purposes.

## 6.4 Liability for failure to capture

No jurisdiction surveyed has yet introduced mechanisms for the imposition of liability on operators of installations that fail to capture $CO_2$ emissions, other than the liabilities attaching to failure to acquit emission allowances, as outlined earlier in this section. At this stage, only indirect liability would attach to emitters of $CO_2$. Entities covered by ETSs (such as the EU ETS) could be subject to sanction for failure to capture $CO_2$, but only to the extent that any such failure resulted in such entities exceeding their emission allocations under any such schemes.

## 6.5 Evaluation and key barriers

With the exception of the EU, in most jurisdictions surveyed, existing legislative frameworks relating to $CO_2$ capture are fragmentary and incomplete. This is the case even in respect to the Australian jurisdictions with dedicated carbon storage legislative frameworks. This means that carbon capture is in general not well-integrated with regulation application to other stages of the CCS cycle.

The EU regulation discussed above envisages the imposition of CCR requirements on new power plant construction. It is likely that in coming years other jurisdictions will implement similar regulations in order to ensure that carbon capture capability is integrated into new power plant construction. The EU approach of imposing CCR obligations through planning permitting processes is a simple, straightforward approach. It is, however, unlikely that any such regulations will be introduced in many jurisdictions until CCS is at or near commercial-scale development.

In addition, few jurisdictions have dealt in any detail with the question of whether captured $CO_2$ should be treated as a waste or pollution and this will need to be clarified. The dedicated storage regulations which have been implemented, notably in Australian jurisdictions and the EU, seems to contemplate that captured $CO_2$ be dealt with as a waste product. This is particularly important in the context of policies and legislation governing transport of $CO_2$, which is discussed in Section 7.

Finally, integrating carbon capture permitting and regulation with transport and storage legislation would provide CCS project proponents a greater degree of certainty. This will reduce the administrative burden imposed by permitting requirements at various stages of the CCS project cycle. These regulatory gaps should be addressed in order to encourage the capture of commercial-scale quantities of $CO_2$.

**Key barriers**

- Characterising CO2 as a "waste" or a "pollutant" may be required to help facilitate and regulate capture, especially where specific CCS laws have not been enacted.

# 7. Transportation of $CO_2$

## 7.1 Introduction

$CO_2$ transport is an important element of the CCS project cycle. Safe and cost effective transport regulations will underpin the success of CCS and has the potential to significantly reduce the cost of CCS operations.

As in other elements of the CCS project cycle, transport of $CO_2$ is generally dealt with under legislative schemes. These can be divided into CCS-specific schemes, and non-CCS specific schemes.

Most jurisdictions surveyed have already implemented reasonably robust pipeline licensing regimes developed for the transport of oil, gas, water and other substances. However, in most instances, they address the transport of $CO_2$. Therefore, for those jurisdictions which have not yet legislated for CCS activities, pipelines legislation could be adapted with relatively few amendments to accommodate the transport of $CO_2$.

However, the potential scale and geographic dispersion of CCS transportation activities creates a host of legal challenges unique to this stage in the CCS project cycle.

The first of these is that posed by permitting of, and treatment of liabilities arising from cross-border transport of $CO_2$. General principles of international law provide some guidance as to how this should be dealt with; this is discussed further in Section 11.

A further challenge is posed by the potential community and environmental impacts of $CO_2$ transportation activities. For many community stakeholders, pipelines will be the most visible manifestation of the environmental and social impacts of CCS activities. A number of existing legislative schemes provide rigorous consultation procedures. Over the long term, these mechanisms can make a significant contribution to strengthening community understanding of and acceptance for CCS projects by facilitating robust debate and community involvement in CCS projects. Conversely, in the short term, they can add significant additional cost and delay to CCS project development. This will be important to the achievement of the Group of Eight (G8)'s goal.

Finally, regulation of non-pipeline transportation of $CO_2$ is in general terms comparatively less well-developed. Regulation of $CO_2$ by road, rail or ship is generally fragmentary and incomplete. This provides project proponents with low degrees of regulatory certainty, particularly early in the development of CCS projects, where certain forms of pipeline transport schemes may not yet be commercially viable.

This section focuses particularly on regulation in the EU and in Australian jurisdictions, as these have the most robust and well-integrated pipeline transport schemes.

## 7.2 Licensing of transportation activities

The key issue which remains unresolved in most jurisdictions is whether transported $CO_2$ should be licensed as a waste or pollutant for transport. Clear legislative guidance on this question would reduce regulatory uncertainty for project proponents.

### 7.2.1 General policy and legislation

#### PIPELINES

In the EC, the CCS Directive sets out principles to govern pipeline transportation of $CO_2$. One of these principles is that Member States must take "necessary measures" to ensure that potential users are able to obtain access to transport networks for the purposes of geological storage in their jurisdiction. The detailed rules and modalities required to implement these principles remain under development.

In contrast, in the US there is currently no comprehensive national regulatory scheme for transportation of $CO_2$. The DOE has published a 'best practice' manual for $CO_2$ transportation and storage, which is discussed in Section 9. A range of State laws, as well as certain Federal laws related to pipeline safety and the collateral effects of pipeline development $CO_2$ affect pipeline regulation. In the US, over 6,000 km of $CO_2$ pipelines have already been constructed, principally to connect natural sources of $CO_2$ to EOR producing reservoirs. Siting and licensing of new $CO_2$ pipelines is governed by State law and a number of these State regimes, for example in Texas and New Mexico, require that pipelines owners obtain permits prior to operation. This means that an operator of an interstate pipeline can be required to hold permits in each State through which the pipeline passes. It has been suggested that a single national licensing scheme be introduced, however this appears unlikely at this stage and may present challenges in other federated jurisdictions. A similar State-based approvals process has evolved in Australian jurisdictions.

In Russia, there is presently no comprehensive regulatory scheme for the transport of $CO_2$. Pipelines by which oil, gas and oil products are transported are all State owned and regulated. Private pipelines for other substances are not restricted but such pipelines must be registered with the Unified Register. Approval for private offshore pipelines owned by foreign entities must be through diplomatic channels.

In Norway, there is currently no integrated legislation applying to the operation of CCS pipelines. Norway is one of a number of jurisdictions where the regulatory system established for petroleum operations could be used as a model for $CO_2$ pipeline transport (NMPE, 2008). Another is South Africa, where there is no South African legislation specifically governing the transportation of $CO_2$. There, the Gas Act 2001 has the potential to govern certain aspects of the CCS process, including transportation. The Act governs the transportation of gas by pipeline and sets out licensing requirements. However, the current definition of "gas" does not encompass $CO_2$ and this Act would need to be adapted if it were to cover CCS.

It is also important to note that the 1989 Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention) could in its current form operate to prohibit international transportation of captured $CO_2$. This is discussed in detail in Section 11.5.

#### ROAD AND RAIL TRANSPORT

The contrasting approaches of Japan and the US Federal Government to regulating transportation of $CO_2$ by road and rail is indicative of the variation in approaches to non-pipeline $CO_2$ transportation.

Japan is one of the few jurisdictions to have amended existing road and rail transport regulation explicitly to regulate $CO_2$ transportation. $CO_2$ transported by road or rail is regulated as a high pressure gas. Under the High Pressure Gas Safety Act, Law No.204 of 1951 (*Kōatsu gasu hoan hō)*, $CO_2$, whether at room temperature or in its compressed form, fits within the definition of a "high pressure gas" and is therefore subject to the Act. Under the Act, anyone transporting a high pressure

gas is required take all necessary safety measures. These are set out in the General High Pressure Gas Safety Rules for transportation of gas by a wheeled vehicle.

The US also regulates $CO_2$ transport by road and rail, but as a hazardous substance. $CO_2$ transported by road would be subject to US Department of Transportation's regulations related to the transportation of hazardous materials. Under these regulations, $CO_2$ is considered a Class 2.2 (non-flammable gas) hazardous material (49 C.F.R. § 172.101). Pursuant to these regulations special handling requirements are provided for transport of $CO_2$ by rail (49 C.F.R. § 174) and on highways (49 C.F.R. § 172.101).

#### TRANSPORTATION BY SHIP

As with road and rail transport, most jurisdictions have not directly regulated $CO_2$ transportation by ship. It would be beneficial to the development of CCS to more robustly regulate this form of transportation as it can provide "flexibility with lower upfront capital cost" (IEA, 2008: 85).

In Japan, the Regulations on Shipping and Storage of Dangerous Substances, made under the Ship Safety Law No.11 of 1933 (*Senpaku anzen hō*), set out the necessary measures and requisite standards to be taken for ship transportation of $CO_2$ within Japanese waters. This framework subjects transporters of $CO_2$ to safety measures.

The **First Foundation Report** includes discussion of design standards adopted by the ship building industry for the design and construction of liquefied natural gas (LNG) carriers. This industry-wide approach could lend itself to design specifications for $CO_2$ carriers.

### 7.2.2 Integrated policy and legislation – Australian case study

Some Australian jurisdictions have adopted a different approach to pipeline licensing (though not transportation by other methods), which is integrated with carbon storage regulation. This approach has the advantage of streamlining pipeline licensing, thus allowing project proponents to integrate their permitting activities.

In the Australian jurisdictions of Victoria, Queensland and Western Australia, carbon storage legislation is linked to existing pipelines legislation, and in some cases this legislation has been amended to accommodate $CO_2$ transportation. At a Federal level, Australian pipelines legislation has been included in that jurisdiction's offshore carbon storage legislation. In these jurisdictions, the $CO_2$ storage legislation does not seek to regulate transportation of $CO_2$ by road, rail or ship. This is left to other legislative schemes, which are not well-integrated into the $CO_2$ storage legislative schemes.

The jurisdictions which have integrated $CO_2$ transportation with their carbon storage regulation regimes have only done so in respect of pipeline transport and not transport by road, rail and ship. This section therefore deals with jurisdictions in which pipeline licensing has been integrated with carbon storage legislation.

Pipeline licensing regimes in the Australian jurisdictions of the Australian government, Victoria, Western Australia and Queensland and at a Federal level are rigorous. Table 7-1 sets out the $CO_2$ storage legislation in each jurisdiction and the pipelines legislation with which it is integrated.

**Table 7-1 Treatment of $CO_2$ transportation in key Australian jurisdictions**

| Jurisdiction | Carbon storage legislation | Key pipelines legislation |
|---|---|---|
| Federal | *Offshore Petroleum and Greenhouse Gas Storage Act 2008* (Cth) (The Australian government's GGS Act) | The Australian government's GGS Act |
| Victoria | *Greenhouse Gas Geological Sequestration Act 2008* (Vic) (Victorian GGGS Act) | *Pipelines Act 2005* (Vic) (Victorian Pipelines Act) |
| Queensland | *Greenhouse Gas Storage Act 2009* (Qld) (Queensland GGS Act) | *Petroleum and Gas (Production and Safety) Act 2004* (Qld) (Queensland PG Act) |
| Western Australia | *Barrow Island Act 2003* (WA) (Barrow Island Act) | *Petroleum Pipelines Act 1969* (WA) (Western Australian Pipelines Act) |

The Victorian and Queensland carbon storage legislation provides for $CO_2$ pipelines to be licensed under the Pipelines Acts in those two jurisdictions, as set out above. Both Acts provide that it is an offence to construct or operate a pipeline without the consent of the Minister administering each Act.

The case study below outlines the way in which pipeline licensing is dealt with under the Australian government's GGS Act. This provides insights into how pipeline licensing could be undertaken if it were to be fully integrated into the framework of carbon storage legislation.

**Case study: Pipeline licensing under the Australian government CCS legislation**

Under Chapter 2 Part 2.2 of the government's GGS Act, the pipeline licensing process consists of four main steps:

- the pipeline proponent must apply to the licence determination authority (the Designated Authority), providing information including details of the pipeline's design and construction process, the proponent's technical qualifications, a layout plan for the pipeline and any agreements the proponent has entered into for the procurement or conveyance of CO2;
- if the Designated Authority wishes to approve the licence application it will issue to the proponent an "offer document" indicating its intention to do so;
- if the proponent wishes to accept the Designated Authority's offer, the proponent must within between 90 and 180 days after receiving the offer document provide written notification to the Designated Authority requesting that an issuing authority, the Joint Authority issue the licence; and
- the Joint Authority will issue the pipeline licence if notice has been provided in accordance with the Act.

Section 211 of the Act sets out the rights conferred on pipeline licensees. These include the rights, in accordance with any conditions imposed on the grant of the licence, to:

1) construct in the offshore area specified in the licence a pipeline:

a) of the design, construction, size and capacity specified in the licence;

b) along the route specified in the licence; and

c) in the position, in relation to the sea bed, specified in the licence;

2) construct in the offshore area specified in the licence the pumping stations, tank stations and valve stations specified in the licence in the positions specified in the licence; and

3) to operate:

a) that pipeline; and

b) those pumping stations, tank stations and valve stations; and

4) carry on such operations, to execute such works and to do all such other things in the offshore area specified in the licence as are necessary for, or incidental to, the construction or operation of:

a) that pipeline; and

b) those pumping stations, tank stations and valve stations.

Elements of the pipelines regimes from Queensland, Victoria and Western Australia which could be useful for policymakers in other jurisdictions include:

- in Victoria, a pipeline can be exempted from the operation of the Victorian Pipelines Act if the Minister administering the Act considers the pipeline to be safe, or that there is a minimal risk that it will have a substantial impact on the natural environment;
- the Queensland Pipelines Act provides differentiated licensing regimes for area pipelines (those confined to a particular contiguous area) and point-to-point licences; and
- in Western Australia, the Barrow Island Act amended the Western Australian Pipelines Act to integrate "CO2" into the definition of "petroleum" under that Act, in effect extending its application to include CO2 pipelines.

## 7.3 Planning

With some exceptions, few jurisdictions have implemented CCS-specific planning instruments. In general terms, the operation and construction of CCS transport facilities is subject to the licensing regimes detailed above.

Some jurisdictions have, however, implemented planning instruments in respect of some aspects of $CO_2$ transportation. These are discussed below. Others have introduced general exemptions or obligations in respect to the relationship between transport licensing and planning regulations.

The Western Australian Pipelines Act provides that the Minister assessing a pipeline licence application must have regard to whether the grant of the licence would contravene planning legislation. The Act does not specify whether the grant of a pipeline licence exempts a pipeline from the need to obtain planning consent.

In contrast, in Victoria, if a pipeline licence is issued under the Victorian Pipelines Act, the pipeline will be exempt from the provisions of that State's main planning instrument, the *Planning and Environment Act 1987* (Vic).

In most jurisdictions surveyed, planning aspects of $CO_2$ transport are dealt with under State or regional codes. To the extent that transport facilities are subject to construction and building codes, CCS-specific codes have not been implemented and so the construction of transport facilities is generally subject to requirements set out in transport legislation, which in most cases is pipelines legislation.

### 7.3.1 Construction and building codes

The US has introduced design and construction requirements for $CO_2$ pipelines. There, the US Federal Office of Pipeline Safety (OPS) regulates the design and construction of $CO_2$ pipelines. OPS regulations contain certain pressure and temperature thresholds for $CO_2$ pipelines, as well as requirements for pipes, valves and fittings (49 C.F.R. 195.100). OPS also provides mandatory standards and specifications applicable to $CO_2$ pipeline construction (49 C.F.R. 195.200).

In contrast, in Norway, the Ministry of Petroleum and Energy has indicated that the Norwegian Planning and Building Act, which forms the basis for decisions concerning the use and protection of resources in that country, does not apply to the construction and operation of pipelines for CCS activities.

Various construction regulations and building codes also apply to facilities for the construction of pipelines in China. These require permits to be obtained prior to construction and for the company undertaking the work to have appropriate licences under the *Provisional Regulations for the Supervision and Administration of the Safety of Oil and Natural Gas Pipelines* (State Economic and Trade Commission, 24 April, 2000, State Council Gazette, No. 17 (2000)).

### 7.3.2 Environmental impact assessment

As with other aspects of $CO_2$ transport arrangements, the jurisdictions surveyed have taken a number of contrasting approaches to environmental impact assessment for transport facilitates.

In the US, environmental impact assessment requirements hinge partly on which US government agencies are involved in permitting a pipeline. Where Federal agencies, such as the US Department of Transport or the US Federal Energy Regulatory Commission, are significantly involved with a $CO_2$ pipeline project, an EIS might be required for the project under the NEPA. Since all interstate pipelines in the US are subject to regulation and/or permitting by the Federal government, Federal agencies would likely be required to conduct an initial environmental assessment under NEPA to determine whether or not the project would have a significant effect on the environment. If so, a full EIS would be required.

In Australian jurisdictions, the level of environmental impact assessment required for $CO_2$ transport facilities is dependent on the nature of the development proposed and the magnitude of its potential environmental impacts.

At a Federal level, the Australian government's *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) provides an integrated environmental assessment and approval process for developments of "national environmental significance." This can include actions in the environment (to which the Australian government's GGS Act applies), together with actions impacting wetlands (wetlands listed in the RAMSAR Convention) of international importance, listed migratory species, World Heritage properties and places listed on the National Heritage List. The EPBC Act provides that where an action is likely to have a "significant impact" on a matter of national environmental significance, the action will require the approval of the Federal Environment Minister.

Any such approval would involve an environmental impact assessment. The EPBC Act is applicable to transport activities in areas of both Federal and State or Territory jurisdiction.

In contrast, in Victoria, the *Environmental Effects Act 1978* (Vic) governs the preparation of environmental impact assessments, or Environmental Effects Statements (EES) as defined under that Act. Under the Act, the Minister for Planning has discretion to determine whether an EES is required in respect of, relevantly, public works, any Ministerial decision or action, or any decision by a person or body under Victorian law. If the Planning Minister determines that an EES is required, the responsibility for preparing it lies with the project proponent. Once an EES is prepared, it is publicly displayed and no work can proceed on the development until the Minister has assessed the EES. Even where an EES is not required, an EIS may still be required under the *Environmental Protection Act 1970* (Vic).

### 7.3.3 Stakeholder engagement

Stakeholder engagement obligations in pipeline licensing regimes can add significant delay and expense to pipeline project development. A lesson can be drawn from the opposition which often attends wind farms: society may generally support and approve low emission technologies but local opponents can often delay such developments for many months or years on the basis of perceived adverse environmental impacts or injurious affection.

However, from past experience, Courts (and politicians) are still more likely to favour allowing objection and appeal processes to play out, often over long periods of time.

In the short term proponents of CCS transportation projects (particularly in developed economies) may need to engage in extended periods of community consultation to reduce the risk of community outrage and potential litigation: compare the reasons for the recent delay over a vote on Germany's CCS law (Crampsie, 2009) with the time expended by Total in achieving community support for its demonstration project in Lacq in France (Total, 2009).

Owners of land under which it is proposed to store GHGs will need to be persuaded that carbon storage is safe. They will also need to be satisfied that, in the unlikely event of leakage, there will be a solvent and identifiable party available to carry out necessary remedial works.

In a number of key CCS jurisdictions, indigenous land rights can also circumscribe uses of land for pipeline transportation projects. Where such rights apply, negotiating uses of such lands can also add significant expense and delay to the planning of such projects, adding further unpredictability to project planning. Such rights exist in jurisdictions including Australia, Brazil, Canada and the US. These are discussed in detail in Section 8.2.2.

## 7.4 Access / tenure

### 7.4.1 Nature of property interests conferred

Pipeline licences and other authorisations to transport $CO_2$ do not generally confer property ownership rights on licence holders. In some jurisdictions, securing necessary property rights is a condition of receiving a licence.

In Mexico, where a pipeline passes through Federal land and is licensed, the licensee will be granted a concession for a certain term, which is renewable. Such a concession provides a right analogous to a leasehold right in the land, such that if a concession expires and is not renewed, pipelines built on

the concession area may become the property of the Federal Government or the Federal Government may require its removal from the land.

In other jurisdictions, pipeline licences confer on holders conditional rights to enter the land subject to the licence and to construct, maintain and operate a permitted pipeline on those lands. In Australian jurisdictions, for example, these can include the rights:

- to construct a pipeline on pipeline land, but only along a route specified in the plan approved with the pipeline licence, including authorised lateral deviation limits;
- to operate and maintain the pipeline in accordance with a submitted operations plan and any licence conditions imposed with the grant of the licence; and
- in an emergency situation, for the licensee or any person employed or authorised by it to enter any private or public land to repair a pipeline or damage caused to the natural environment as a result of any incident involving a pipeline.

In Japan, the operation of pipelines to transport gases, including $CO_2$ are regulated via a reporting and notification system, as opposed to the grant of licences.

For new pipelines, construction plans must be submitted to the Minister for Economy, Trade and Industry before construction is begun. It must also pass inspection before they are used to transport gas. For new and existing pipelines, notices must be filed before an entity can supply gas, including $CO_2$, via pipelines it maintains and operates themselves.

Rights of ownership over pipelines, once constructed, vest in the constructing entity (which may not necessarily be the entity using the pipeline to transport $CO_2$). However, as with licensing schemes in other countries, the construction and use of onshore pipelines and property ownership rights over the land on which the pipes are constructed are two distinct issues. To erect a pipeline on or under government land (which is usually land for other public purposes), permission must be obtained in accordance with Article 42 of the Gas Business Act, Law No.51 of 1954 (*Gasu jigyōhō)*, and this permission will usually include the right to carry out maintenance work and regular inspections of the pipeline required under the Act for their operation.

These access rights are limited, however by the proviso that such access will be granted to the extent that it does not interfere with the land's normal public use.

Where pipelines are constructed on private land, as a rule, access and entry onto the land in question for maintenance and inspections requires the consent of the land owner. However, where the land owner does not consent, approval for such land use and access must be obtained under Article 48 of the Compulsory Purchase of Land Act, Law No. 219 of 1951 (*tochi shūyōhō)*, upon payment of due compensation.

### 7.4.2 Establishing priority between transport and existing uses and rights

The need to balance competing uses of land is in practice much more likely to arise for transportation of $CO_2$ by pipeline than by other methods. Few pipeline regimes include provisions explicitly providing for the management of competing uses in pipeline operations. The Australian pipelines legislation surveyed does include such provisions.

Under the Australian government's GGS Act, where land is subject to an existing petroleum or GHG injection licence and a person other than the existing licensee applies for a pipeline licence in a

petroleum production licence area, the existing petroleum licensee has the right to request that a pipeline licence not be granted.

Pipelines legislation in Australian jurisdictions also provide that consents be obtained from other users of land adjacent to, or subject to, a pipeline licence where a pipeline is to be constructed under, along or across public infrastructure such as roads, railways and utility works.

In the absence of special legislation, CCS pipelines transporting $CO_2$ will be subject to laws controlling, restricting or even prohibiting their construction and use across or under certain sensitive lands including, by way of example:

- lands owned by indigenous groups; and
- lands comprising nature reserves, national parks or other restricted State-owned lands (eg military facilities).

Where CCS pipelines are constructed over or under lands and that work constitutes a "taking" of an interest in the land, they may also be subject to obligations to compensate dispossessed landowners.

If the pipeline is privately owned, consideration may also need to be given to either investing the pipeline owner with sufficient statutory power to compulsorily acquire an interest in land or otherwise arranging for the State to acquire that interest on behalf of the pipeline owner.

## 7.5 Environmental and other risks

The primary environmental risks associated with transportation of $CO_2$ relate to leakage and accidental release from pipelines. Where $CO_2$ is transported by other means, such as ships or trucks, additional risks associated with collision may also arise. Most countries have developed comprehensive planning and environmental regulatory frameworks to assess the risks associated with new pipelines. It imposes penalties for the pollution and harm as a result from the escape of substances from pipelines or during other forms of transportation. The appropriate regulatory authorities will depend upon the location or route of the transportation, with Federal governments primarily being responsible for offshore pipelines and transportation by sea, and State or local governments being responsible for onshore pipelines and transportation by road.

If $CO_2$ is treated as a pollutant or waste, such treatment may prohibit or limit the circumstances in which it can be transported. This is particularly the case for transportation by sea. The EC CCS Directive has specifically sought to address these potential barriers by amending other laws, including the Directive 2006/12/EC on waste and Regulation No 1013/2006 on the shipments of waste to exclude the transportation of $CO_2$ captured for the purposes of CCS. It is important to note that the CCS Directive has not been implemented by Member States as they are not required to do so until 2011. The Environmental Liability Directive still operates to ensure the prevention and remedying of environmental damage, particularly to species habitats, as a result of $CO_2$ release. As a result, if an accident or leakage occurs during transportation, the operator of the pipeline or ship will be liable for damages.

Other countries, such as Australia and Canada have not yet resolved whether captured $CO_2$ should be treated as a pollutant or waste. In Canada, for example, a leak of $CO_2$ may be regulated by Provincial ministries, provided it falls within the definition of a pollutant or contaminant or is otherwise treated as waste. Under the Ontario Environment Protection Act R.S.O. 1990, Chap. E.19, whilst $CO_2$ is not listed as a regulated air emission, it may nevertheless be treated as possible air contaminant.

Australian States also adopt very wide definitions of contaminants and wastes which could apply to leaked $CO_2$.

To the extent that existing laws address environmental risks and safety aspects associated with pipeline transportation, those laws are likely to be applicable to $CO_2$ transportation. In Japan, for example, the Japanese CCS Research Group recently concluded that existing regulations for pipelines that carry $CO_2$ under the High Pressure Gas Safety Act, Law No.204 of 1951 (*Kōatsu gasu hoan hō)* were appropriate for application to CCS projects.

In the UAE, legislators have also taken a broad approach to managing environmental risks arising from pipeline transport. The UAE's Environmental Law governs pollution prevention and control both on land and at sea. Such requirements include environmental impact assessments to be conducted for specified projects, liability for land, air and water pollution, and compensation for environmental damages (Federal Law No 24 of 1999 Concerning the Protection and Development of the Environment). A "polluter pays" approach to pollution is also found in a number of other jurisdictions, such as South Africa, New Zealand and Norway.

In addition, most jurisdictions, usually at the State level, will impose occupational health and safety requirements on pipeline operators in order to protect persons from harm resulting from gas leakage or accidents.

## 7.6 Evaluation and key barriers

The key point to note in relation to carbon transport policies and regulatory regimes is that transportation of captured $CO_2$ by pipeline falls within pipeline permitting regimes. This can potentially add complexity and delay to integrated CCS activities.

In some Australian jurisdictions and the EU, existing pipeline legislation has been well-integrated into CCS legislative schemes, providing a high degree of certainty for market participants. Other jurisdictions, including the US and Canada, have pipelines regulations which could be adapted to $CO_2$ transport. In many other jurisdictions, however, such regulatory integration has not yet occurred. In these jurisdictions $CO_2$ transportation would generally fall within existing pipeline regulatory regimes. These are not in all cases well-adapted to regulating transportation of $CO_2$.

A further weakness in existing $CO_2$ transport regimes is ambiguity in relation to whether $CO_2$ should be treated as a pollutant or waste. This will dictate which regulatory regimes should apply to $CO_2$ transport. This also poses a challenge for the regulation of CCS transportation, particularly where there are restrictions on the treatment of the substance or where responsibility for leakage and harm does not clearly attach to any one entity.

A further difficulty posed by existing transport regimes is the number of permits required to construct and operate pipelines. This is the case not only in respect of general pipeline regulations but also in respect of those integrated with carbon storage legislative schemes. This may increase the cost, duration and uncertainty associated with undertaking pipeline activities.

In federated countries such as Australia and the US, lack of integration between State-level pipeline transport regimes could impede the development of national pipeline networks suitable for $CO_2$ transport. These jurisdictions should seek to harmonise sub-national regulation to enhance regulatory efficiency. This would also apply to national policymakers seeking to harmonise regulations in an international context. The EU’s experience in pipeline regulation may be useful for the latter.

Finally, transport of $CO_2$ by non-pipeline methods is generally not comprehensively regulated. This poses challenges to small-scale CCS projects and to CCS activities in the exploration and testing phases, where it may not be commercially viable to construct pipeline networks to transport $CO_2$.

These gaps will need to be overcome in order to encourage the investment required to develop commercial-scale $CO_2$ transport networks.

**Key barriers**

- Many existing pipeline laws need to be amended to adequately (and expeditiously) accommodate CO2 transport.
- Transport of CO2 by road, rail and ship is inadequately regulated.

# 8. Exploration of $CO_2$ storage sites

## 8.1 Introduction

It has long been recognised that the certainty needed for long-term investments in potential oil and gas exploration opportunities is contingent on rigorous permitting regimes for exploration. These regimes also position governments to manage the environmental and social risks arising from such exploration operations. When exploration sites are proven, they can also enable exploration permit holders to transition into full-scale exploitation of the proven resource.

These considerations are of fundamental importance to encouraging exploration for potential commercial-scale $CO_2$ storage formations. A rigorous framework for CCS exploration is important because of the relative infancy of CCS and the potential inexperience of CCS project proponents. Such frameworks can not only provide a crucial link in the CCS project cycle, but can also encourage technological development by expanding the potential commercial applications for CCS exploration technologies.

As with $CO_2$ transport, two approaches have been taken to regulating CCS exploration. Some jurisdictions have integrated exploration licensing with carbon storage legislation. Other jurisdictions have regulated exploration for demonstration projects through ad hoc legislative amendments or administrative decisions. A number of jurisdictions have not yet sought to regulate CCS exploration. In these jurisdictions, integrated legislation could be either introduced or existing oil and gas exploration legislation amended to provide incentives for CCS exploration.

## 8.2 Integrated policy and legislation

The Australian jurisdictions of Victoria, Queensland and at the Federal level have implemented integrated exploration legislation which requires that exploration permits be obtained before exploration can take place. Licences must then be obtained to carry out activities provided for under the permit. This legislation could provide a model for permitting regimes in other jurisdictions.

In the EU, the CCS Directive provides general principles relating to the exploration of potential storage sites. Where Member States determine that exploration is required to assess potential storage sites, they must ensure that any entities undertaking such exploration do so under and in compliance with, the appropriate permit. The EU approach could provide a model for regulating exploration in federated jurisdictions, where a central government provides principles to guide exploration regulation and these are then passed by State or Provincial governments.

### 8.2.1 Exploration licensing

Exploration licensing regimes in Australian jurisdictions could provide a model for CCS exploration licensing regimes in other jurisdictions. In the Australian Federal and Victorian jurisdictions, exploration activities will be unlawful unless carried out in accordance with an exploration permit. This is also implied in the Queensland legislation.

In these jurisdictions carbon storage exploration is licensed under the following process:

- a call for tenders for a potential acreage release;
- applications for exploration permits (on the basis of work-bid or cash-bid tenders); and

- issuance of exploration permits.

The conduct of activities contemplated under exploration permits, particularly in relation to injection testing, is generally subject to separate, subsidiary permitting requirements.

In addition, permits can also be obtained for specified activities in respect to which a framework exploration permit has already been obtained. Under the Australian government's GGS Act, these additional exploration-related permits include GHG search authorities, GHG holding leases and GHG special authorities. It is important to note, however, that these statutory regimes have not yet been completely implemented; subordinate legislation required to make them fully effective have not yet been implemented.

## APPLICATION CRITERIA

In Australian jurisdictions, exploration permits can be granted on "work-bid" or "cash-bid" bases. In general terms, work-bid permit allocations are decided on the basis of the merits of work programs proposed by applicants. Cash-bid permit allocations are decided on the basis of cash bids provided by applicants. The Australian Federal legislation provides a useful example of the information to be provided by bidders under the two processes and the key assessment criteria used in deciding between bids, as described in more detail in the Australian Country Study Report.

In contrast, under the Queensland GGS Act exploration permits are only allocated on the basis of work-bid competitive tenders. This legislation also requires that relatively more information be provided by applicants, including:

- a statement about how and when the tenderer proposes to consult on exploration with relevant landowners and occupiers;
- a proposed work program; and
- an independent statement verifying that the tenderer has the ability as well as the financial and technical resources to carry out the proposed exploration activities.

In the EU, the CCS Directive does not set out detailed rules on application criteria, but does require Member States to ensure that:

- exploration permits are potentially open to all entities possessing the necessary capacities;
- the permits are granted or refused on the basis of objective, published and non-discriminatory criteria (CCS Directive, Article 5(2)); and
- rights conferred by exploration licence.

## EXPLORATION PERMITS

In the EU the CCS Directive states that an exploration permit should be granted in respect of a limited "volume area". Subject to that limitation, the holder of an exploration permit should gain the sole right to explore the potential $CO_2$ storage complex. Member States are required to ensure that no conflicting uses of the site take place during the period of the permit.

In contrast, in the Australian Federal, Victorian and Queensland jurisdictions, exploration permits provide a framework set of rights. Once a project proponent is obtained, an exploration licence must then be obtained for further approval of each activity it proposes to undertake under the permit.

In general terms, the Australian legislation confers on the holder of an exploration licence the right to:

- explore for potential CO2 storage sites;
- evaluate the feasibility of injecting in such sites; and
- activities incidental to exploration, including constructing or operating infrastructure needed for exploration.

These rights can be subject to conditions imposed by permitting authorities or Ministers, and the activity-specific approval is discussed below.

The Australian government's GGS Act provides an example of the detailed rights an exploration licence can provide. It authorises a GHG assessment permittee to, in accordance with conditions imposed on the permit:

- explore in the permit area for a potential GHG storage formation;
- explore in the permit area for a potential GHG injection site;
- on an appraisal basis, inject and store GHG substances, air, petroleum or water in wells situated within the permit area;
- with the consent of the relevant Australian government Minister, recover petroleum for appraisal that was discovered as an incidental consequence of the exercise of the exploration and injection rights above; and
- carry on such operations, and execute such works, in the permit area as necessary for those purposes.

The Queensland GGS Act provides permit holders with a smaller number of more generally defined rights, including the right to carry out the following activities in the permit area:

- GHG storage exploration; and
- evaluating the feasibility of GHG stream storage, including for example, by GHG storage injection testing.

Greenhouse gas permit holders may also carry out "incidental activities", which are defined as "any activity… in the permit's area if carrying it out is reasonably necessary for or is incidental to Greenhouse gas storage exploration." Examples given in the Act of incidental activities are:

- constructing or operating facilities, plant or works, including for example, communication systems, compressors, powerlines, pumping stations, reservoirs, roads, evaporation or storage ponds; and
- constructing or using temporary structures or structures of an industrial or technical nature, including for example, mobile and temporary camps and tanks.

## PERMITTING OF SPECIFIED EXPLORATION ACTIVITIES

The EU regulations do not explicitly require that individual exploration activities be separately permitted.

In the Australian jurisdictions, further permits are required before exploration permit holders can undertake key exploration activities.

Under the Australian government's GGS Act, the exercise of a GHG assessment permit will be subject to a number of limitations, notably the necessity to obtain separate consents to undertake specified

activities. These are defined to include the permittee complying with notices from the Minister; conditions imposed specifically in relation to work-bid and cash-bid GHG permits; and a requirement that the permittee obtain and comply with the consent of the Minister for "key GHG operations" under the permit.

Key GHG operations are defined under the Act to include:

- operations to make wells;
- on an appraisal basis, injection and storage in a formation of GHG substances, air, water or petroleum;
- seismic surveys;
- monitoring operations;
- baseline investigations; and
- operations to take sea bed or subsoil samples.

In Victoria and Queensland, injection testing plans in connection with exploration permits must be approved by the relevant Minister before injection testing can be carried out in an exploration permit area.

## LICENCE TERM

In general terms, carbon storage exploration permits have short terms, and in some jurisdictions, a portion of the permit area must be relinquished in each year of the permit term. This is to ensure that permit areas are fully utilised for exploration in a timely way and that permit holders are not able to use exploration permits as a de facto holding lease in order to tie-up unproven storage areas.

In the EU, the term of an exploration permit is linked to the work program proposed for the work permit. The CCS Directive provides that an exploration permit must not be granted for longer than the "period necessary to carry out the exploration for which it is granted". This period may be extended where it turns out that the original period is insufficient to complete the exploration.

In contrast, in Australia, under the Australian government's GGS Act, GHG assessment permits are valid for six years, unless granted by way of renewal, in which case the permit term is three years. In contrast, under the Queensland GGS Act the nominal term of a GHG permit is the length of the work program submitted with the application, with a maximum period of 12 years. In addition, each four years during the period of a GHG permit, part of the permit area must be relinquished and a permit will end if the whole of the permit area has been relinquished.

## CHALLENGING LICENCES

In the EU, the CCS Directive does not set out a specific mechanism for challenging the grant or refusal of an exploration or storage permit. It does, however, require that Member States set up dispute settlement arrangements, overseen by an independent authority, to enable disputes relating to access to storage sites (including, presumably, potential storage sites) to be settled expeditiously.

In Australia, the legislation in the Federal, Victorian and Queensland jurisdictions provides broad rights to appeal licensing decisions. Under the Australian government's GGS Act, any person affected by the decision of a delegate of the Federal Minister may appeal the decision to the Minister. Ministerial

decisions can be reviewed in the Administrative Appeals Tribunal, which provides independent review of a range of administrative decisions made by the Australian government.

The Queensland GGS Act provides comparatively broad administrative appeal rights. Under the Act a person whose interests are affected by an exploration permit decision may appeal the decision in the Land Court. A person entitled to be given information about a decision is taken under the Act to be a person whose interests are affected by it.

### 8.2.2 Access / tenure / acreage releases

Most jurisdictions in which CCS projects have been or are to be hosted have released land or sea bed for CCS exploration or carbon injection. Such releases have generally taken two forms.

First, governments have released acreages in tranches in order to stimulate exploration interest and encourage the development of exploration technologies. For example, in 2009 the Australian government announced the release of 10 areas located offshore of Australia for exploration as GHG storage areas (DRET, 2009a).

Governments have also released acreage on a project-specific basis, usually in conjunction with existing oil and gas exploration rights. Most acreage releases have occurred in this way.

Access to land or sea bed is the key right granted through exploration permits. In general terms, in most jurisdictions the government has asserted an ownership interest in most subsurface land.

#### NATURE OF PROPERTY INTERESTS CONFERRED

Under the Victorian GGGS Act and the Queensland GGS Act, exploration permits provide exclusive access to the permit area. Conducting the activities countenanced in them is conditional upon obtaining additional, activity-specific permits as discussed above.

#### ESTABLISHING PRIORITY BETWEEN EXPLORATION AND EXISTING USES AND RIGHTS

In the EU, the CCS Directive does not deal specifically with establishing priority between exploration and existing uses and rights of land or sea bed.

In contrast, the three Australian legislative schemes discussed above provide comprehensive mechanisms to establish priority between exploration and existing uses of permit land or sea bed.

For example, under the Australian government's GGS Act, all exploration permit holders are required to ensure that they carry on activities provided for under the Act in a way that they do not interfere with other uses. These include navigation, fishing, conservation of the resources of the sea and sea bed, or any other activities being lawfully carried on by way of exploration for, recovery of or conveyance of a mineral (other than petroleum) or construction or operation of a pipeline, or the enjoyment of native title rights and interests.

A similar approach has been adopted under the Victorian GGGS Act, except that the key assessment criterion under that Act is whether the proposed injection would contaminate or sterilise other resources. If this is likely, the applicant must take all reasonable steps to obtain the consent of any holders of permits or rights in relation to those resources. The relevant Minister may refer the proposed injection testing plan to an independent panel for assessment.

## SUBSEQUENT USES

In Australia, the Australian government's GGS Act provides that if the grant of approval for the carrying out of key GHG operations would affect existing or future petroleum extraction activities, the Minister must have regard to the significance of that risk and the terms of any agreement between the GHG assessment permit holder and the petroleum permit holder. Similar obligations are imposed in the Victorian and Queensland legislation.

## RIGHTS OF INDIGENOUS PEOPLES AND OTHER CUSTOMARY RIGHTS

In many jurisdictions, including Australia, Brazil, Canada and the US, indigenous peoples have well-defined rights which can add complexity, delay and cost to the development of large infrastructure projects, including CCS projects.

In Australian jurisdictions, property rights can be subject to native title rights. Native title refers to rights held by indigenous Australians over their traditional lands and waters. These are established under the provisions of Federal and State native title legislation such as the Australian government's *Native Title Act 1993* (Cth). To successfully assert rights over lands and waters under Australian legislation, indigenous people must prove an ongoing connection to the land or waters. If such claims are recognised, usually in a court or native title tribunal, claimants are afforded protections where a government proposes to take certain actions (for example, the grant of a licence or approval) which may affect native title. These protections typically require that certain procedural steps such as notification and consultation be observed prior to the action being done. The Australian government's *Native Title Act 1993* provides for the negotiation of Indigenous Land Use Agreements, voluntary agreements between native title groups and other entities for the use of land subject to native title.

Even with these relatively robust legislative regimes for determining native title rights, undertaking large infrastructure projects on Australian lands or waters subject to native title rights can lead to significant additional expense and delay.

In Brazil, the rights of indigenous peoples are less clearly defined and this has proven a challenge for businesses wishing to undertake projects on lands which could be subject to indigenous land rights claims.

The rights of Brazilian Indians to lands and waters in Brazil are established in the Brazilian Federal Constitution, issued in 1988, and the Indian Statute, a Federal law issued in 1973 that remains in force to the extent that it does not conflict with the 1988 Constitution. Further requirements are established by Federal laws in connection with the environmental protection of natural resources and, in particular, forest management.

Brazilian Indian land is considered the property of the Federal Union, while the Indians enjoy permanent possession rights. An important proceeding to guarantee the land of Brazilian Indians is the demarcation realised by the Federal Union. According to Article 24 of the Brazilian Indians Statute, the results of the natural resources' exploitation shall belong to the Brazilian Indians. The Brazilian Indians also enjoy exclusive rights to exploit natural resources which fall within their lands, which is consistent with Article 231, first paragraph of the Constitution.

Furthermore, according to the Brazilian Federal Constitution, the land of Brazilian Indians is inalienable and is not disposable, meaning that Brazilian Indians cannot sell, lease or otherwise dispose of their lands and the rights of Brazilian Indians are not prescriptive. This means that, even though the Federal Union has proprietary rights, the lands of Brazilian Indians lands can not be sold or used for other purposes than that established by law.

The experiences of project proponents in jurisdictions in which native title rights are recognised underlines the fact that they can add significant cost and delay to projects involving land or water subject to indigenous rights claims, even at the exploration stage.

For example, in 2008, the Brazilian mining company VALE was ordered by a Federal Court to compensate Indians for the use of their areas, located in the State of Pará. The decision was based on the fact that the exploitation of mining activities impaired the use of the area by Indians for other purposes, such as rural activities. The company was ordered to pay R$650,000 (approximately US$320,000) per month to the Indian Community as compensation.

## COMPULSORY ACQUISITION AND COMPENSATION REGIMES

In the Australian Federal, Victorian and Queensland legislation, compensation is payable by exploration permit holders to other land use right holders where the rights of those entities are affected by the permit holder's activities. The Australian government's GGS Act provides a comprehensive compensation regime which bears closer examination.

**Case study: Compensation mechanisms under the Queensland GGS Act**

Part 10 of the Queensland GGS Act contains general compensation provisions which would apply to compensable events arising from exploration activities. Section 319 imposes a general liability on holders of greenhouse authorities (which includes greenhouse permit holders) to compensate:

Each owner or occupier of private or public land that is in the area of, or is access land for, the GHG authority, for:

(a) any compensable effect the eligible claimant suffers that are caused by:

(i) authorised activities for the GHG authority carried out by or for its holder; and

(ii) the carrying out of an activity by a person authorised by the holder if the holder has represented that the activity is an authorised activity for the GHG authority; and

(b) consequential damages the eligible claimant incurs because of a compensable effect caused by authorised activities for the GHG authority.

A "compensable effect" is defined under Section 319(5) to mean all or any of the following relating to the eligible claimant's land:

(a) deprivation of possession of its surface;

(b) diminution of its value;

(c) diminution of the use made or that may be made of the land or any improvement on it;

(d) severance of any part of the land from other parts of the land or from other land that the eligible claimant owns; and

(e) any cost or loss arising from the carrying out of activities under the GHG authority on the land.

The Act also provides that the GHG authority holder and the eligible claimant may enter into a compensation agreement, which could provide for either or both of monetary and non-monetary compensation (section 320). Under sections 321 and 322 the Land Court may decide and review compensation amounts and agreements. GHG authority holders may not enter into private land to carry out an authorised activity unless, relevantly, where necessary, each eligible claimant is a party to a compensation agreement with the proponent or has agreed to defer the execution of such an agreement (section 324). The Act also provides that compensation agreements run with the land (section 325).

### 8.2.3 Planning and construction regulation applicable to CO2 storage facilities

The EU does not have a direct environment and planning function and planning requirements are not dealt with in the EU CCS Directive.

The Australian legislation does not set out detailed planning provisions and this is generally dealt with at State and local levels. Exploration operations on private lands would be required to local planning codes and would likely be limited to areas zoned for industrial development. This is discussed in Section 7.3.

## 8.3 General policy and legislation

Most jurisdictions surveyed have not yet introduced CCS exploration-specific legislation. In these jurisdictions, exploration has in some cases been permitted on the basis of ad hoc applications of existing oil and petroleum permitting legislation, or through administrative amendments to planning and other laws. In these jurisdictions, regulation is generally fragmentary and obtuse in its application to CCS.

Regulation in the US and South Africa provide examples of how existing legislation in such jurisdictions could be amended to provide for carbon storage site exploration and will provide a focus for discussion in this section.

### 8.3.1 Exploration licensing

In the US, carbon capture exploration rights on privately-owned land would be acquired by contract or deed, while exploration on public lands would be subject to requirements for approvals. US Federal Department of Interior (DOI) has noted that the authority of the US Bureau of Land Management (BLM) under Federal Land Policy and Management Act, 90 Stat. 2743 would enable them to issue leases, permits, and easements to accommodate a wide range of CCS development activity, including surface and subsurface rights-of-way and leases for subsurface storage (DOI, 2009). The regulations implementing this authority are 43 CFR 2920.

Existing legislation in South Africa could also be adapted to enable permitting of CCS exploration activities. The Mineral and Petroleum Resources Development Act 2002 (MPRDA) provides an exploration licensing regime in relation to minerals and it may be suitable to extend this to cover the exploration of potential $CO_2$ storage sites. The South African legislation is provided below to the extent that it deals with these issues.

Subsoil within the territory of the Russian Federation, including the underground space and mineral resources is State property according to the Federal Law on Subsoil No. 2395-1 dated February 21, 1992, as amended. The use of subsoil is legalised by a special State issued licence. This licensing regime would likely apply to $CO_2$ storage, but could be expanded to provide specifically for CCS activities.

#### APPLICATION CRITERIA

Applications for land use authorisations under 43 CFR 2920 (2920 authorisations) would require a description of the proposed exploration activity including:

- a description of all facilities for which authorisation is sought, access needs and special types of easements that may be needed;
- a map of sufficient scale to allow all of the required information to be legible and a legal description of primary and alternative project locations; and
- a schedule for construction of any facilities.

Land use authorisations under this legislation may be offered on a competitive basis.

#### RIGHTS CONFERRED BY EXPLORATION LICENCE

In the US, 43 C.F.R. 2920 authorisations represent transferable land-use interests, which grant the holder a right to use Federal lands for a specified purpose in exchange for rent payments to the Federal government.

#### LICENCE TERM

In the US, the term of use under a 43 C.F.R. 2920 authorisation would be determined during the application process. The government would also have the right to the terminate the authorisation if a holder failed to use the land in accordance with the established terms or purpose of the authorisation, or if the holder failed to pay rent or to comply with applicable laws.

### 8.3.2 Access / tenure

In the US and South Africa, the patchwork of legislation applicable to $CO_2$ storage means that it is difficult to be definitive on what permits would be required to undertake exploration activities in those jurisdictions. This is indicative of difficulties associated with other jurisdictions in which dedicated legislation do not exist.

In the US, exploration rights to potential storage formations could be obtained either through the land use authorisation process described above or through exploration leases for private lands. In either case, the right conferred would be a right to access and a right to explore geological formations. This structure could be adapted to facilitate exploration for potential carbon storage formations.

In the US, establishing priority between exploration and existing rights and uses would also be undertaken on the basis of a patchwork of regulation. In practical terms, depleted oil and gas fields in the US represent primary targets for CCS exploration activities. To the extent mineral resources in these fields have already been exploited, conflict with CCS exploration activities would be limited. In relation to fishing, Regulation 43 USC 1340 provides that offshore exploration can only be undertaken to the extent that the activity is not “unduly harmful to aquatic life in the area.” The effect of exploration

activities on mining would depend on whether or not a site that had extractable resources was ultimately selected for injection. The more likely scenario is that a geological site suitable for carbon storage would underlie a mineral strata and potential interference with and/or contamination of such usable strata would be the concern. This conflict has not been resolved by law or regulation in the US.

In the US, to the extent that exploration activities do not lead to actual injection of $CO_2$, the impact of exploration on subsequent uses of the property would be limited.

In the US, exploration on tribal lands would be subject to approval both by tribal leaders as well as the BLM.

To date, Federal efforts to encourage CCS have not included the use of Federal eminent domain authority to designate private lands for CCS exploration. State level eminent domain authority with respect to CCS operations in general is discussed in Section 9.2.

Existing South African legislation do not provide the same degree of clarity in it's treatment of access and tenure in comparison to US regimes, and this would need to be addressed through dedicated CCS legislation.

### 8.3.3 Planning and construction regulation applicable to CO2 storage facilities

As in the case of the dedicated CCS exploration legislation set out above, planning and construction regulation in relation to exploration activities is in most jurisdictions subject to legislation at a number of levels of government, principally the sub-national.

In the US, the case of wind farms on private lands suggests that CCS exploration operations on private lands would be required to adhere to local zoning codes and would likely be limited to areas zoned for industrial development.

In many cases, the rural nature of suitable CCS sites may require promulgation of new zoning classifications as many local jurisdictions may not have a relevant zoning classification. An environmental assessment and an EIS would likely be required under NEPA for construction of $CO_2$ storage facilities on Federal lands or on private land where the facility requires a permit from the Federal government. This would also usually trigger public consultation obligations.

In South Africa, the existing legislation provides less guidance on how permitting could be dealt with but does provide some indications. Should the MPRDA be extended to cover CCS, an EIS would need to be carried out in respect to the exploration activity and an environmental authorisation obtained under the National Environmental Management Act 1988 (NEMA). The Gas Act 2001 could also be extended to cover potential pipeline licensing in relation to CCS exploration activities, should this be required.

## 8.4 Evaluation and key barriers

In jurisdictions where CCS exploration regimes have been integrated with carbon storage regulation, CCS exploration is relatively robustly regulated. This is the case in respect of the Australian Federal jurisdiction and the jurisdictions of Victoria and Queensland, as well as to a limited extent the EU. Particular strengths of existing regulation in these jurisdictions include:

- clear and transparent approval regimes;
- clearly enunciated frameworks of exploration rights; and

- multi-stage permitting which can allow administering authorities to monitor and regulate the impact of exploration activities on natural resources, human health and existing and future uses of permit areas.

In jurisdictions where CCS exploration has not yet been regulated, this lack of regulation gives rise to the following regulatory weaknesses:

- opaque, fragmentary approval regimes, requiring proponents to seek permits from multiple government agencies;
- loosely-defined frameworks of exploration and other rights; and
- regulation not tailored to CCS and therefore potentially retarding CCS development.

The regimes in some jurisdictions (e.g. in the US and South Africa) may provide some useful templates for other economics.

**Key barriers**

- Overly bureaucratic or otherwise inadequate regulations covering access and exploration rights will delay CCS projects.

# 9. Injection and pre-closure of $CO_2$ storage formations

## 9.1 Introduction

Injection of $CO_2$ poses a host of unique legal challenges. The key legal issues that arise in relation to the injection and pre-closure stages of the CCS cycle relate to First, liability for damage to geological formations other than those subject to injection, in particular, the potential to impact upon other activities that may comprise competing or subsequent uses. Second, risks associated with general environmental damage and damage to human health as a result of the escape of $CO_2$ during the injection process. Third, issues associated with ensuring that there are clear and unambiguous tenure or access rights to the storage site that is being used.

Very few jurisdictions have developed policies or legislation that specifically address the injection of $CO_2$ and management of storage sites prior to their closure. As with exploration and transport, the key jurisdictions with legislation already in place are in Australia, the EU and some States in the US. Regulations in these jurisdictions generally covers licensing of injection activities and approval processes to govern the closure of utilised storage formations.

It is important to note that different regulatory regimes will apply to injection in onshore areas, offshore and international waters. In Australia, States have jurisdiction over the sea bed and water column from the high water mark to the line three nautical miles from the high water mark, while the Australian government has jurisdiction over the area from that line to the edge of the continental shelf, as well as, where appropriate, to the outer limits of Australia's exclusive economic zone. The Australian government and States share jurisdiction over onshore areas. Thus, the Australian government's GGS Act regulates injection and storage in maritime areas subject to Federal jurisdiction, while the Victorian and Queensland legislation regulates these activities in maritime areas under those States, together with onshore areas within their boundaries. Injection and storage in international waters is subject to a range of international legal obligations which are discussed in Section 11. This complicates the regulation of CCS activities.

In the US, jurisdiction for injection activities regulated by the EPA under the Safe Drinking Water Act (SDWA) extends to “any injection well located on a drilling platform inside the State’s territorial waters.” (40 C.F.R. 144.1(g)(1)(i)). Those wells beyond the State’s territorial waters would not be subject to regulation under the SDWA. The Proposed Rule on geological $CO_2$ storage wells would also regulate only those wells within a State’s territorial waters. The preamble to the Proposed Rule notes that wells up to three miles offshore may also be subject to other authorities or may require approval under statutes such as the Marine Protection, Research, and Sanctuaries Act (Proposed Rule, 73 Fed. Reg. 43492 (2008)).

## 9.2 Integrated policy and legislation

### 9.2.1 Injection licensing

#### APPLICATION CRITERIA

When seeking permission to inject $CO_2$ into geological formations, consideration must be given to the potential environmental impacts of that process. Very few jurisdictions have legislation that specifically address permits to inject $CO_2$ into geological formations. However, those that do generally require an

application to be accompanied with the data and information about the geological structure and seismic history of the area. it must address potential interactions with underground aquifers, the extent to which other persons may have interests in the geological formation, and modelling of the expected behaviour of the $CO_2$ after storage.

In the EU the CCS Directive requires the operator of the storage site to undertake the assessment of the site and model its behaviour. Ordinarily this will be the same person who holds the exploration permit for the site. Applications are made to the competent authority of the Member State that has jurisdiction over the site.

The US EPA is in the process of developing a Draft Rule that will govern the application criteria for injection and storage (Proposed Rule, 73 Fed. Reg. 43, 492 (2008)). This will build on a report published by the DOE's NETL which describes potential 'best practice' regulations for transport and injection of $CO_2$ on Federally-administered land, which constitutes a significant portion of the western US (NETL, 2009). Under the Draft Rule the operator must demonstrate that the injection zone is sufficiently porous to receive the $CO_2$e without fracturing and without impacting upon underground sources of drinking water. Existing Underground Injection Control (UIC) regulations also contain extensive rules related to the delineation of the injection zone, monitoring of closure and the requirement to regularly re-evaluate those areas. The ACES Act provides authority to the EPA to promulgate additional environmental protection requirements specific to CCS, which relate particularly to groundwater. The EPA must develop a certification process for geological $CO_2$ storage sites and set forth provisions relating to financial responsibility for geological $CO_2$ storage wells.

Australian jurisdictions have also developed comprehensive legislation that address injection licensing. The Australian government's GGS Act, the Victorian GGGS Act and the Queensland GGS Act all require applicants to:

- demonstrate the existence of a storage formation suitable for permanent storage;
- demonstrate that they have the technical and financial resources necessary to inject carbon in accordance with the terms of any licence granted;
- provide evidence that they have access to a commercial quantity of CO2;
- provide a work or site exploitation plan, including details of the nature and volume of the substance to be injected; and
- provide a plan for consultation with other stakeholders who may be affected by the injection.

In addition, Victoria's legislation also provides a process for addressing competing claims applications for access to the same injection sites.

## RIGHTS CONFERRED BY INJECTION LICENCE

The Australian government has adopted an exhaustive approach to specify the rights conferred by an injection licence and its term. In contrast, Victoria and Queensland, and other jurisdictions such as the EU and States in the US have taken a more general approach. A comparison of the Australian approaches is set out in Table 9-3 below.

In the EU the grant of a storage permit confers an exclusive right on the holder. As such, there may only be one holder of a permit for each storage site. This will avoid conflicting uses of the permitted site. The holder of a permit must comply with the EU CCS Directive, in particular with respect to the closure of the site and transfer of liability to the relevant Member State at the end of the term.

**Table 9–2 Comparison of injection licence rights under the Australian government, Victorian and Queensland legislation**

| Jurisdiction | The Australian government | Victoria | Queensland |
|---|---|---|---|
| **Instrument name** | Injection licence | Injection and monitoring licence | GHG injection and storage lease |
| **Rights conferred** | ▪ inject and permanently store a GHG substance into an identified GHG formation wholly situated within the licence area;<br>▪ explore in the licence area for a potential GHG storage formation;<br>▪ explore in the licence area for a potential GHG injection site;<br>▪ inject and store, on an appraisal basis, air, petroleum, water or a GHG substance into a part of a geological formation, so long as the relevant well is situated in the licence area;<br>▪ inject, on an appraisal basis, a GHG substance in a part of a geological formation, so long as the injection of the stored GHG substance takes place at a well situated in the licence area; and<br>▪ with the consent of the relevant Australian government Minister, recover petroleum for appraisal that was discovered as an incidental consequence of the exercise of the exploration and injection rights above.<br>The Australian government's GGS Act, section 357(1) | ▪ carry out GHG substance injection and monitoring in the licence area;<br>▪ carry out GHG $CO_2$ storage formation exploration in the licence area; and<br>▪ do any thing in the licence area that is necessary for, or incidental to, those purposes.<br>Victorian GGGS Act, section 71 | Allows both “principal authorised activities” and “incidental activities”<br>"Principal authorised activities" defined as:<br>▪ GHG storage exploration;<br>▪ evaluating the feasibility of GHG stream storage, including for example, by GHG storage injection testing;<br>▪ compressing or otherwise processing a GHG stream for GHG stream storage;<br>▪ GHG stream storage; and<br>▪ monitoring and verifying the behaviour of the GHG streams.<br>Queensland GGS Act, section 110<br>"Incidental activities" defined as:<br>▪ any activity that is reasonably necessary for or is incidental to another authorised activity for the lease; and<br>▪ excluding constructing or using a structure other than a temporary structure, for office or residential accommodation.<br>Queensland GGS Act, section 112 |
| **Licence term** | ▪ From the date of issuance until cancelled or surrendered, except that it can be terminated if no injection operation has taken place for a period of 5 years.<br>The Australian government's GGS Act, section 359(1) | ▪ From the date of issuance until cancelled or surrendered, except that it can be terminated if no injection and monitoring has taken place for a period of 2 years.<br>Victorian GGGS Act, sections 175, 176 | ▪ From the date of issuance until cancelled or surrendered.<br>Queensland GGS Act, section 134 |

### LICENCE TERM

As Table 9-3 above demonstrates, licence terms under Australian laws will operate from issuance until the licence is cancelled or surrendered. A similar approach is taken in the US, with licences issued for the operating life of the project, including its post–injection site care period.

The EU CCS Directive takes a slightly different approach, insofar as the term of a storage permit will depend upon the particular circumstances of each site and decisions about when liability for the storage site can be transferred to the Member State.

### CHALLENGING LICENCES

All of the jurisdictions that have established licensing arrangements for CCS injection and storage provide limited opportunities for review of decisions related to the grant or refusal of the licence to be challenged or for public consultation regarding such decisions.

The EU CCS Directive requires Member States to review, update or, as a last resort, withdraw storage permits in a number of situations, including if it becomes aware of any failure by the operator to meet the permit conditions.

Member States must also have dispute settlement arrangements in place, including an independent authority, to enable disputes relating to access to storage sites (including, presumably, potential storage sites) to be settled expeditiously.

In the US, the Draft Rule requires public notice to be given of proposed injection and storage activities and public inputs to be considered.

Similarly, each of the Australian jurisdictions confer broad rights to entities on person affected by the decision to seek a review of the relevant decision in the appropriate Federal or State tribunal.

## 9.2.2 Approval processes for $CO_2$ storage facility closure

The EU CCS Directive provides that the closure of a storage site may occur in three situations:

- if the relevant conditions set out in the permit have been met;
- at the request of the operator, with the authorisation of the competent authority; or
- if the competent authority decides to do so after withdrawal of a storage permit.

The operator of a site must, as part of its original application for a storage permit, prepare a draft post-closure plan. The competent authority will assess, approve and finalise the draft plan before a site may be closed.

A similar site care and site closure plan is also required to be prepared under the US legislation. However, such a plan can be submitted at any time before a well is to be plugged, provided at least 60 days notice is given.

Each of the Australian jurisdictions with CCS legislation have also adopted comprehensive processes for site closure. At an Australian government level, the GGS Act requires a common surrender approval process which involves the holders of all relevant permits and licences applying jointly for site closure. Such an application can only be made once injection operations have ceased and a closure assurance period of at least 15 years has elapsed. The Minister then has five years to determine the application. The Queensland and Victorian Acts also address well closure issues, for example, in

Queensland, a well cannot be decommissioned until the storage reservoir has reached full capacity. In Victoria, there are additional requirements that the Minister must form an opinion that the behaviour of the injected substance is predictable and that the risks associated with the substance are as low as reasonably practicable. Post closure issues are further addressed in Section 10.

### 9.2.3 Access / tenure

#### LEGAL ACCESS TO AND USE OF DEEP GEOLOGICAL FORMATIONS FOR CO2 STORAGE

The rights to ownership of geological storage sites shapes the overall framework for CCS regulation. There are very different approaches to land and sub-surface rights in the jurisdictions surveyed for this report. In some instances, it is clear that the national government retains property in the sub-surface and in geological storage sites. In other jurisdictions, property rights may vest in the land owner or in indigenous groups through traditional land ownership.

For those jurisdictions that have developed comprehensive CCS laws and policies to address storage, two different land tenure situations exist. In the US the surface estate owner is generally viewed not only as the owner of the surface land, but also the land and strata overlying the severed mineral estate.

Most importantly in the context of CCS, the majority view in the US is that the subsurface pore space where $CO_2$ would likely be stored belongs to the surface owner (DOI, 2009). This notwithstanding, property owners are able to split surface land and minerals into different estates. Where estates in land are severed, the mineral estate owner generally retains certain rights to use the surface for access to and enjoyment of the severed estate.

In Australia, the Federal, Victorian and Queensland legislation provides that in each case the State owns the geological storage formation subject to the licence and also the injected $CO_2$. In other words, storage site operators are only entitled to a statutory right to access the site. The Victorian GGGS Act provides that if an injection and monitoring licence is cancelled or surrendered, the Crown becomes the owner of any GHG substance that has been injected into an underground geological formation under that licence.

The law governing land ownership throughout Europe varies from one country to another, but most civil law jurisdictions and the UK operate so that rights in property (as defined by either a Civil Code or the common law in the case of the UK) include the land, buildings and rights to air and minerals.

Zoning and development planning law, together with third party property rights, may then limit or restrict the rights of owners. It is also possible in the UK, for example, to separate rights to minerals from the ownership rights to the surface of the land in private sales.

The civil law systems across Europe generally make it a lot more difficult (as opposed to the US and potentially the UK systems) to bundle all rights to, the land itself so as to create tradable rights.

#### NATURE OF PROPERTY INTERESTS CONFERRED

As described above, the rights of the surface estate owners in the US are generally subject to the rights of a mineral estate owner to access and enjoy their estate.

Therefore, to the extent that CCS activities prevented a mineral owner from accessing their estate, the CCS operator could be liable for property damages.

Given that mineral estates can often be extremely valuable, this reinforces the importance of conducting title searches and determining rights prior to injection.

In Australia the holder of a licence has certain benefits and liabilities conferred upon it.

These rights are statutory rights of access, although, until the storage site is closed and the licence surrendered or cancelled, the operator will retain property in (and liability for) the $CO_2$ stored. Issues related to competing rights are also relevant in Australia, as discussed below.

## ESTABLISHING PRIORITY BETWEEN COMPETING AND EXISTING USES AND RIGHTS

The storage of $CO_2$ in geological formations has the potential to interact with a number of other uses of the geological formation and its surrounding environment. This interaction may arise through competing interests to access the storage site, for example, where:

- there are other valuable mineral resources in or proximate to the storage site;
- the injection into or long-term storage of CO2 may affect other geological formations such as aquifers; and
- the leakage of CO2 may have an adverse effect upon the environment, including ecosystems and species.

Determining how to balance these competing uses is an important part of the approval process for both exploration and for the final approval of geological storage.

Under Australian legislation, the Australian government's GGS Act provides that the Minister may only grant an injection licence if he or she is satisfied that, the registered title holders have agreed in writing to the proposed activities. This must be to the extent that there is no significant risk to any operations that could be carried out under the injection licence.

With specific reference to preserving petroleum interests, the relevant Australian government Minister should, in assessing surrender applications, have regard to the principle that plugging or closing off wells should minimise damage to the petroleum bearing qualities of geological formations. In addition, Australian legislation at both the Australian government and State level requires a rigorous environmental impact assessment to determine whether activities will have a significant effect upon endangered species, ecological communities and the environment.

The CCS specific legislation of other jurisdictions, such as the EU and the US do not expressly refer to competing interests and existing use rights. In the US, $CO_2$ storage would limit all possibility of extracting minerals from the same formation (DOI, 2009). Therefore, in exploring potential $CO_2$ storage sites, title searches and investigation as to ownership of mineral estates in the exploration area would be necessary to limit liability to potential mineral estate owners.

With regards to environmental impacts, in the US, CCS activities must not jeopardise any threatened or endangered species or harm any critical habitat as designated by the US Fish and Wildlife Service (FWS) or National Oceanic and Atmospheric Administration (NOAA). In the EU, the Environmental Impact Assessment Directive requires an environmental impact assessment to be carried out before development consent is granted for certain types of project which are likely to have significant environmental effects. The CCS Directive amends the Environmental Impact Assessment Directive to include, within the scope of that Directive, CCS transport pipelines, storage sites and capture installations.

### SUBSEQUENT USES

The duration of $CO_2$ storage and the impact of $CO_2$ storage on subsequent land uses for thousands of years to come must be taken into account. The existence of subsurface geological storage sites may affect the ability of a person to carry out future activities in those areas (eg mining) that may compromise the integrity of the storage formation. This issue is not expressly dealt with in any of the CCS legislation and represents a gap that needs to be addressed. Lessons may, however, be garnered from treatment of similar storage sites under other legislative frameworks (eg capping oil wells).

### RIGHTS OF INDIGENOUS PEOPLES AND OTHER CUSTOMARY RIGHTS

As noted in Section 8.2, where indigenous landowners have an interest in the land within which geological storage is to take place, it is of critical importance to ensure that their consent or authorisation for the activity is obtained. Under US legislation, CCS operators would need to obtain approval from tribal leaders in addition to EPA prior to injecting $CO_2$ on tribal lands.

### COMPULSORY ACQUISITION AND COMPENSATION REGIMES

To the extent that storage sites are situated on or below private property, legislation may provide for a process whereby the government may acquire the area necessary to either access the site or to establish a buffer to prevent damage or interference as a result of the operation of the storage site. In Australia, there are well established compulsory acquisition and compensation regimes as described in Section 8.2.

In the US, States could potentially invoke eminent domain authority on behalf of CCS operations in the State. In Illinois, for example, the DCEO spent considerable time negotiating with individual landowners that would be affected by the FutureGen project, but the agency's eminent domain authority remained on the table to the extent any landowner refused to consent to the project.

## 9.2.4 Planning and construction regulation applicable to $CO_2$ storage facilities

As noted above, relevant planning and environmental approvals will need to be obtained for additional construction activities associated with the use of geological storage sites. In this regard, there may be a need to construct temporary or permanent injection infrastructure and to carry out works associated with maintaining the geological integrity of the storage sites, such as capping potential escape routes. To date, none of the countries that have enacted CCS-specific legislation have addressed additional authorisations that may be required for these types of activities. There is some consideration of the likely impacts associated with the operation of the $CO_2$ storage site when decisions are made for site selection and for the granting of permission to inject $CO_2$.

However, decisions related to the construction of works may require separate approval from the appropriate regulatory agency. For example, in Australia, the permissibility of activities will be subject to local zoning laws and planning approval for construction will need to be obtained from either a local council, relevant State planning authority, or in some instances, the Australian government. These requirements are discussed in detail in Section 8.

Similar provisions to those outlined for Australia apply in the US and the EU. In the EU, the Environmental Impact Assessment Directive, which has been amended to include CCS transport, pipelines, storage sites and capture installations, requires an environmental impact assessment to be

carried out before development consent is granted for projects which are likely to have significant environmental effects.

### 9.2.5 Leakage liability

A number of risks are associated with both the injection process and the operation of $CO_2$ storage sites. One of the critical risks is associated with the leakage of $CO_2$, either through a slow seepage process or spontaneous escape. Managing leakage requires ongoing monitoring of the performance of the storage site.

Monitoring and verification requirements are integral to the ability of both regulators and project participants to ensure the long-term stability of injected $CO_2$ and to respond to leakage if it occurs.

All of the jurisdictions with CCS-specific legislation require that monitoring and verification plans be submitted as part of the approval processes. Enforcement actions can be taken for departures from or breaches of those plans.

In the EU, the CCS Directive states that a monitoring plan must be in place to verify that the injected $CO_2$ is behaving as expected. If, despite the precautions taken in selecting a site, a leak is identified, corrective measures must be taken to rectify the situation and return the site to a safe state. In addition, in the context of the EU ETS, EUAs must be surrendered for any leaked $CO_2$, to compensate for the fact that the stored emissions were exempted from surrendering obligations under the EU ETS. The requirements of the Environmental Liability Directive on repairing local damage to the environment could also apply in the case of leakage. As discussed in Section 7.5, the CCS Directive has not yet been implemented by EU Member States. This will likely continue to restrain investments in CCS in EU Member State jurisdictions.

Each EU Member State is presently preparing detailed rules relating to corrective measures to respond to leakage. However, as a general principle, competent authorities are entitled to recover the costs incurred in relation to the financial security that an operator may need to provide as part of its application for a storage permit.

Member States must also draw up effective, proportionate and dissuasive penalties for infringements under national provisions that transpose the CCS Directive.

In Australia, legislation in each of the Federal, Victorian and Queensland jurisdictions requires holders of GHG permits to lodge security, which can include insurance with relevant authorities, to protect against costs arising from environmental or other hazards caused by sequestered $CO_2$. These provisions are discussed in Section 10.

## 9.3 General policy and legislation

### 9.3.1 Injection licensing and storage

A number of countries are engaged in CCS demonstration projects without having established comprehensive legislative frameworks. To provide readers with a sense of the diversity of approaches adopted, these are discussed in turn below.

#### US

In the US, injection of $CO_2$ by temporary pilot-scale storage projects is conducted under a regulatory policy designed specifically for such projects within EPA's authority for the UIC program. These

special “Class V well” rules were published in March 2007. For commercial storage projects, regulations that reflect the special attributes of large-scale $CO_2$ injection were proposed by the EPA in July 2008.

In addition, the Interstate Oil and Gas Compact Commission (IOGCC), an association of State governments in the US (and Canadian Provinces), has published model legislation and regulations for States to consider in establishing State oversight of $CO_2$ storage. The IOGCC framework includes approaches to eminent domain, unitisation of reservoirs owned by multiple parties, resolution of subsurface property rights, and assumption of long-term liability by State governments. 16 States and four Canadian Provinces are currently developing, or have adopted, $CO_2$ legislation and regulations (IOGCC, 2008).

## NORWAY

While Norway will now be covered by the EU CCS Directive as a result of the Agreement on the European Economic Area (OJ No L 1, 3.1.1994, 3), it has relied upon existing legislation for projects such as the Sleipner project. The Norwegian Government owns the property rights to all natural underground resources located on the Norwegian continental shelf and land territory. The Government therefore has control over underground storage of $CO_2$. A permit is required in order to use a reservoir and these permits are issued pursuant to the Petroleum Act 1996 and/or the Continental Shelf Act 1963 depending on the activity and type of reservoir. The rights conferred are solely those stated in the licence. This is likely to be fixed on a case-by-case basis, but under the Petroleum Act 1996 production licences are granted for up to 10 years.

## JAPAN

Japan is still in the process of developing a comprehensive framework for CCS. In the interim, it relies upon the Marine Pollution Act 1970, Law No.49 of 1970 (Marine Pollution Act) to govern $CO_2$ injection and storage. The Marine Pollution Act is the implementing legislation for Japan’s international obligations under the London Convention. In May 2007 Japan implemented further amendments to the Marine Pollution Act, in order to reflect the 2006 amendments to the London Protocol, which allowed storage of $CO_2$ under the sea bed from 10 February 2007. The Marine Pollution Act amendments regulate $CO_2$ storage of $CO_2$ streams from $CO_2$ capture processes in sub-sea bed geological formations and provide detailed provisions regulating the sub-sea bed $CO_2$ storage of $CO_2$, as described below. Japan is also working towards the development of an appropriate legal framework to cope with geological $CO_2$ storage on land. The METI Research Group has considered the applicability and appropriateness of existing laws such as the Mining Act and related ordinances, to the implementation of CCS projects.

**Case study: Regulation in Japan of sea-bed $CO_2$ storage**

An individual or entity that wishes to inject $CO_2$ waste into the sub-sea bed must apply for and obtain approval for the "disposal" of $CO_2$ from the Environment Minister.

Applications for sub-sea bed $CO_2$ storage must include information such as:

1) the applicant's name, address, representative's details (for a corporate entity);
2) a $CO_2$ disposal implementation plan including:
    a) the length of time the disposal will take (not to exceed five years);
    b) the amount and characteristics of the $CO_2$;
    c) the estimated amount of $CO_2$ already disposed of at the given site;
    d) where and how the $CO_2$ will be disposed of; and
    e) proposed measures to prevent and contain any damage caused to the marine environment by the dumping;
3) a detailed plan regarding monitoring of any pollution arising from the dumped $CO_2$; and
4) any other information required by Ministry of Environment Ordinances – such as environmental risk assessment survey information.

The standards which must be met for approval of applications by the Environment Minister include:

a finding that the disposal method meets the required standards;

5) a finding that there is no other appropriate means to dispose of the $CO_2$; and,
6) a finding that the applicant is fit to competently dispose of and monitor the $CO_2$ after disposal, in accordance with the implementation plans submitted, including having sufficient financial and technical capabilities.

In accordance with Ministry of Environment Notice No.83, an applicant who is granted a licence has up to five years to dispose of the CO2 in question (Article 10-8-2 of the Marine Pollution Act, as applied correspondingly by Article 18-2).

Other countries that do not have general legislation for $CO_2$ injection may nevertheless look to existing licensing regimes for EOR or underground storage of dangerous goods for guidance.

## NEW ZEALAND

There is no legislation in New Zealand governing the subsurface injection of $CO_2$.

As with the other stages of the CCS process, resource consent may be required under the *Resource Management Act 1991* for activities within territorial waters.

A land use consent is required for the deposit of a substance in, on or under land. A coastal consent is required for the deposit of any substance in, on or under any foreshore or sea bed. Land use consents may have an unlimited duration, whereas coastal permits have a maximum duration of 35 years, with a default duration of five years.

The *Crown Minerals Act 1991* does not currently apply to injection of $CO_2$ but could be amended to do so if the Crown has ownership of storage formations.

### BRAZIL

In Brazil, the majority of the oil and gas prospecting, exploration, processing and transportation activities are subject to licensing and other environmental requirements. CONAMA Resolution No 01/86 lists the following activities subject to the EIS for licensing purposes:

- petroleum activities;
- oil pipeline and gas pipeline;
- fossil fuel extraction; and
- setting up of petrochemical complexes.

It is likely that, if permissible, $CO_2$ injection and storage would also be subjected to EIS requirements.

### CHINA

In China, demonstration projects, thus far, have focused on using $CO_2$ to enhance the recovery of coal-bed methane (CBM)or oil. Such projects and activities, therefore, were conducted under the applicable Chinese regulatory frameworks governing the exploration and production activities involving oil, gas and CBM under the above-mentioned Law of the People's Republic of China on Mineral Resources (NPCSC, 1 January 1997, Standing Committee Gazette, (1996)) and related laws and regulations (including those on land use, production safety).

### INDONESIA

Indonesia also does not have laws that address $CO_2$ injection and storage. However, parallels between CCS and the processes that regulate the injection of waste water in oil fields may be relevant.

In 2007, the Minister of Environment issued Regulation No. 13 of 2007 on Requirements and Procedures of Waste Water Management for Upstream Oil and Gas Activities and Geothermal Activities by way of Injection.

If the waste water injection method is chosen to manage the waste water from upstream oil, gas and geothermal activities, the proponent must obtain a licence from the Minister of Environment. The injection must occur in wells within the same production field and the applicant must also describe, amongst other things, map of the wells, method on choosing the well, geological data of the target injection zone, operational data, formation testing program, injection procedures, construction procedures and well closure plan.

In applying for the licence, the applicant must show that the injection wells fulfil a mechanical integrity test. The mechanical integrity test is performed to observe that there is no significant leakage in the pipelines and there is no significant transfer of water or gas to the underground drinking water resources.

## 9.3.2 Approval processes for $CO_2$ storage facility closure

As noted above, very few countries have general laws that are directly applicable to the operation of $CO_2$ storage sites. As a result, there are also only limited examples of general laws that address site

closure. The one jurisdiction that has contemplated this, in the context of its Marine Pollution Act, is Japan.

In Japan, a plan for the closure of the site must be submitted as part of the application for permission to dispose $CO_2$ under the Marine Pollution Act. The ISTEPB Research Group has also examined the issue from the perspective of onshore $CO_2$ storage and carbon storage. In particular, under existing laws, the provisions of Article 15 of the Mine Safety Act, Law No.70 of 1949 may apply. This provision requires that where a mining entity closes its specified facilities, it must submit a notice to the Director of Regional Industrial Safety and Inspection Department.

Although not directly related to $CO_2$, the Indonesian framework for treating waste water also provides some useful guidance as to how other substances injected into geological formations are regulated. Minister of Environment Regulation No. 13 of 2007 provides that the responsible party for the waste water injection and upstream oil, gas and geothermal activities is obliged to close the injection well after the operational period ends. The closure approval is part of the waste water injection licence. As mentioned above, in applying for a waste water injection licence, the applicant must also set out a well closure plan. The closure plan must describe, relevantly, the type and amount of the plugs used to cap injection sites, the type, quality and quantity of the cement that will be used, and the method of closure.

Existing legislation in other countries, such as South Africa, also provide comparable frameworks for addressing site closure. Whilst the South African MPRDA does not apply to CCS at present, it could possibly be amended to apply. The MPRDA governs the closure of facilities falling under its jurisdiction (mainly minerals-related).

The MPRDA sets out that the holder of a prospecting right, mining right, retention permit or mining permit remains responsible for any environmental liability, pollution or ecological degradation, and the management thereof, until the Minister has issued a closure certificate to the holder concerned.

### 9.3.3 Access / tenure

#### DEEP GEOLOGICAL FORMATIONS

Existing regimes for land tenure, property rights and treatment of the relationship between different rights over natural resources may also provide guidance for the treatment of $CO_2$ storage sites in those countries that do not specifically legislate for CCS.

General land tenure and property rights are discussed in Section 8. With specific reference to the use of geological storage formations, the land rights that are associated with those storage sites will determine who can carry out activities therein.

As an example, although China currently lacks a clear regulatory regime which addresses the use of $CO_2$ storage formations, its regulatory framework concerning the production of oil might be indicative. Under that framework, the specific licensee merely has the right to exploit the licensed area for oil. The licensee has no right to additional minerals found, nor does the licensee have any right to the use of the underground $CO_2$ storage formations. While the PRC's land use rights regulatory regime is likely to govern issues involving access to the $CO_2$ storage sites, there is yet no similar regulatory regime that addresses the use of underground spaces. Thus, it should be assumed that, in the absence of any specific regulation, those such spaces belong to the PRC Government.

## SUBSEQUENT USES

Very few countries have enacted legislation that addresses the subsequent use of geological storage sites. However, the Japanese Marine Pollution Act, provides that once the form and nature of the ocean bed has been altered by carbon storage (disposal) activities, and this poses a risk of damage to the marine environment due to the $CO_2$ stored therein, the area in question will be declared a "designated marine area" by the Minister for Environment.

Once this designation is made, any person who intends to alter the form or nature of the ocean bed or the sub-sea bed in the designated area must first notify the Minister for Environment.

## RIGHTS OF INDIGENOUS PEOPLES AND OTHER CUSTOMARY RIGHTS

As discussed in Section 8, the rights of indigenous peoples to participate in decision making with respect to their land and property is essential. In a number of countries, it is not clear who has ownership of geological storage spaces, in particular, whether those rights vest in the State or whether they vest in land owners, including indigenous or customary land owners.

As an example, the New Zealand government recently passed the *Foreshore and Seabed Act 2004*, which affirmed the ownership of the Crown of the foreshore and sea bed as well as a right of public access to these areas.

However, this ownership maybe subject to a Territorial Customary Right which may be granted by the High Court. A Territorial Customary Right may only be granted to groups continuing to hold ownership of adjoining dry land.

The terms of the right are to be approved by the High Court, and may include the right to oppose the grant of a resource consent under the Land Management Act 1991 and the power to regulate activities on foreshore and sea bed areas.

The Foreshore and Seabed Act 2004 has been considered somewhat controversial in New Zealand and its application to customary land rights still remain unclear.

In many instances, even where rights are granted to indigenous peoples, their exercise may be subject to limitations imposed by the government, or conversely, the ability of the government to carry out activities that affect their land may be circumscribed. In Brazil, the Federal Constitution declares that the Brazilian Indians' land and its fruition belong to the Brazilian Indians, who have the exclusive use of the soil and rivers on those lands.

In this context, the irregular use of the Brazilian Indians' land by unauthorized people is considered invalid. Furthermore, according to the Constitution, the land of Brazilian Indians is inalienable and is not disposable and their rights are not prescriptive.

This means that, even though the Federal Government has proprietary rights, the land of Brazilian Indians can not be sold or used for other purposes than those established by law. In the context of establishing CCS storage sites on or below land that is subject to these rights, it may be that only Brazilian Indians are able to access those storage sites.

## COMPULSORY ACQUISITION AND COMPENSATION REGIMES

Many jurisdictions have laws that enable the government to compulsorily acquire property. Although in many countries, the subsurface geological storage sites will vest in the government, land rights may be required in order to access those sites.

Examples of compulsory acquisition regimes include Canada, which has an “expropriation” right at common law. This has been used to obtain land from existing private landholders for certain projects interests, such as waterways, railways and highways. This right in Canada is often only approved by the Federal Court of Canada following clear evidence of reasonable and timely offers refused by the affected landholders. The Federal Government must still provide “fair market value” compensation for expropriated lands.

### 9.3.4 Planning and construction regulation applicable to $CO_2$ storage facilities

Almost all of the jurisdictions reviewed have stand-alone planning, construction and environmental impact laws that could be applicable to the construction of works and infrastructure associated with CCS storage sites. Overviews of these frameworks have already been discussed in Sections 7 and 8. With regard to development and construction activities associated with the storage of $CO_2$, such activities may be associated with works required to prepare the storage site, for example, capping potential leakage pathways. In most instances, some level of environmental impact assessment will be required along with consents from the appropriate planning and pollution control authorities.

In South Africa, an environmental impact assessment and environmental authorisation would likely be required under NEMA. The South African Department of Environmental Affairs and Tourism has designated the following to be a listed activity under NEMA: "the construction of filling stations, including associated structures and infrastructure, or any other facility for the underground storage of a dangerous good, including petrol, diesel, liquid petroleum gas or paraffin." This could potentially apply to, or be extended to include, the injection and storage of $CO_2$.

Similarly to South Africa, South Korean laws that may be relevant to the injection, storage and pre-closure of $CO_2$ storage formations for purposes other than CCS include the Waste Management Law, Law for Promotion of Recycling of Construction Waste, Radioactive Waste Management Law, and the Hazardous Substance Safety Management Law. These laws provide the framework of rights and obligations which could govern the storage, installation of storage facilities and pre-closure management in relation to CCS projects, but this would require adaptation.

Public participation will also be relevant for decision making under environmental and planning laws that may be extended to activities associated with $CO_2$ storage. As discussed in Section 7.3 in relation to CCS transport projects, extended periods of community consultation can be expected.

While most countries include mechanisms that enable stakeholders to comment upon proposed developments, the extent to which standing is granted to mount legal challenges varies between jurisdictions.

The experience of Australian jurisdictions in regulating wind farm developments (as discussed in Section 7.3) suggests that in the absence of integrated CCS laws, two other issues need to be addressed:

- where local government bodies such as councils or townships control the nature and location of surface development:
  - they will need to be persuaded that subterranean CCS projects do not need approval or, if they do, that the conditions of such approval do not unnecessarily restrict or delay CCS projects (and in the absence of such persuasion, their planning powers may need to be curtailed or controlled); and

  - they will need to be persuaded not to permit surface development in locations which will sterilise or otherwise inhibit land identified as suitable for potential CCS surface works. Also approval of development which might otherwise adversely affect future CCS projects by increasing the prospects of objections, appeals or litigation must be mitigated (and in the absence of such persuasion, their planning powers may need to be curtailed or controlled); and
- insurers will need to be persuaded of the safety of CCS to avoid the denial of cover or uncommercial increases in premiums for insurance of surface assets.

Although not directly analogous, some elements of schemes designed to compensate owners of surface assets which are damaged or whose assets are diminished in value by reason of underground mining activities could be considered when assessing how to assign liability for risk and cost allocation.

Administrative procedure codes for most Brazilian States and certainly for the Federal Government contain mechanisms by which stakeholders can mount a legal challenge to State action with respect to the licensing or permitting of major projects.

In Mexico, legal standing has several limits, unless there is a direct affectation to the potential claimant.

Nonetheless, with the North American Free Trade Agreement, and its side agreement on Environmental Cooperation (NAAEC), new doors are open for claimants to oppose projects which they do not consider to be in compliance with applicable environmental provisions.

This potentially leaves the door open to claims from NGOs, which otherwise would have no or very limited rights to challenge such decisions.

### 9.3.5 Leakage liability

Consideration of how leakage has been treated in other circumstances such as the oil and gas industry may assist in identifying examples of good practice that could be applied to CCS. As noted above, Indonesia's treatment of waste water injection is one such approach.

Under Minister of Environment Regulation No. 13 of 2007 (Indonesian Environmental Regulation), waste water injection licence holders are obliged to perform any action necessary in order to prevent leakage. The applicable regulation also provides technical requirement for preventing leakage. However, if leakage occurs, the licence holder must stop all injection activities and report the situation to the Minister of Environment, other related ministers and to the local government. The licence holder is also obliged to handle the situation by running the stipulated handling procedures, such that the situation will not endanger human health and safety and will not cause environmental pollution and damage.

As a general rule, the Indonesian Environmental Regulation provides that a party will be strictly liable for losses if the party's operation has a significant impact. This also applies if the party's operation uses hazardous and toxic substances, or generates hazardous and toxic waste. The polluter can be released from strict liability if it can prove that the pollution and environmental damage was caused by natural disaster or war, force majeure, or a third party's actions.

The Indonesian Environmental Regulation also provides for the imposition of recovery costs and clean up costs, as well as the revocation of a business licence. Administrative penalties are imposed by the Governor of the affected Province. Criminal penalties may be imposed on a person who has caused

environmental damage or pollution, in the form of imprisonment (up to 10 years) and a fine (up to Rp.750,000,000), and the award of civil penalties for damages suffered by third parties.

Whilst Canada does not have legislation that addresses injection and pre-closure of $CO_2$ storage formations, there is some limited law on underground gas storage which may be instructive. For example, the Ontario Mining Act R.S.O. 1990, Chap. M.14 and Regulation O.Reg. 263/02 contains a set of rules which provide the framework within which a private mining company may store natural and non-natural gas underground. Whilst the Regulations do not specifically address liability for escape of gas, the holder of a storage authorisation is required to comply with the terms of the lease governing the storage area.

## 9.4 Evaluation and key barriers

In those jurisdictions where CCS injection and storage laws have been developed, there appear to be relatively robust systems for appropriate regulatory authorities, having regard to matters including such as:

- the characteristics of the storage site;
- access to commercial quantities of CO2;
- the suitability of the operator (eg meeting technical and financial criteria);
- balancing competing interests on the site; and
- requiring detailed site management and monitoring plans.

This is notably the case in relation to the EU and Australia at a Federal level and in the States of Victoria and Queensland. Existing legislative frameworks in these jurisdictions have the following strengths:

- relatively predictable and transparent licensing regimes for CO2 injection;
- reasonably robust management of competing and subsequent uses of storage formations, including in relation to oil and gas extraction;
- similarities in licensing procedures with those provided for under existing oil and gas exploration and extraction regimes; and
- a high degree of integration for the regulation of injection and pre-closure with exploration and post-closure phases of injection and storage.

The laws in these jurisdictions provide a guide to other countries as they develop their own legal frameworks.

However, there remain some key regulatory gaps in existing dedicated carbon storage regulatory frameworks. They do not necessarily address comprehensively the question of whether only one operator will be allowed access to a storage site, or whether multiple operators will be able to inject. If multiple operators are using a site, legal frameworks will need to be developed to share or apportion liability and determine, if necessary, how to prioritise access (eg on a maximum volumetric basis or some other criteria). The difficulties associated with managing multiple uses of land and potential storage formations have resulted in most jurisdictions only granting approval to one operator per site.

A further potential gap relates to activities which might fall under the jurisdiction of multiple governments, either in adjacent jurisdictions or at multiple levels. Where storage sites fall under more than one jurisdiction, regulators from two or more States may apply different criteria in considering

CCS project activities. Alternatively, it is conceivable that in federated countries, Federal and State jurisdictions might overlap. This is unlikely to arise in Australia, where Federal and State jurisdiction over storage activities is relatively clearly delineated, but may arise in other countries. In these circumstances, there will be a need for coordination amongst regulators and the development of guidelines for, at a minimum, consultation and ideally a joint approach to approving access to such sites and managing their use.

**Key barriers**

- Multiple operators access rules.
- Multiple regulatory regimes.

# 10. Post-closure and long-term storage

## 10.1 Introduction

The closure of $CO_2$ storage facilities after their use and liabilities arising from the long-term storage of injected $CO_2$ also pose a number of legal challenges. Some of the key post-closure issues that arise include:

- who is liable for the stored CO2?
- is their liability for damage caused as a result of escape capped or limited in any way?
- when and how can this liability be transferred or surrendered, in particular, will a State take on liability at a certain point in time?
- what are the requirements for monitoring and verification?

Given the potential long time frames associated with carbon storage, discussions relating to liability for sequestered carbon after well closure have been sensitive in many jurisdictions. This sensitivity has arisen from the need to balance the competing objectives of ensuring that operators of $CO_2$ storage facilities are liable for environmental damage caused by sequestered carbon after well closure, against the practical difficulties arising from attempts to allocate such responsibilities to corporate entities over the time frames associated with $CO_2$ storage.

Further, these timeframes mean that a CCS project may require insurance or some other form of liability coverage for very long periods. Procuring such insurance may create hurdles to CCS implementation.

As a result of the challenges in addressing long-term liability issues, the law and policy associated with this final stage of the CCS project cycle is arguably the least well-developed. However, it is also one of the most important aspects of CCS when considering not only how to encourage industry participation and investment confidence, but to also address civil society concerns over the management of liabilities arising from the long-term storage of $CO_2$.

## 10.2 Integrated policy and legislation

As discussed in preceding sections, the Australian States of Victoria and Queensland and the Federal government have implemented integrated policy and legislation relating to $CO_2$ storage and the EU has also regulated in this area. These regulatory frameworks are discussed below. This section also discusses legislative frameworks considered and implemented in the US, both at the Federal level and also in the States of Illinois and Texas, to manage post-closure liabilities, including in relation to the FutureGen project.

### 10.2.1 Obligations of approval authorities

In general, long-term liability for CCS projects remains a key issue both at the State and Federal level in the US and Australia and at the Member State level in the EU.

The extremely long time frames associated with post-closure responsibility makes it commercially and legally impracticable to merely impose liability onto an operator that may only exist for a limited period of time.

For this reason, many emerging policy models focus on pooled funds and/or State liability in order to address liability for future harm from geological storage operations.

In the US, the EPA's Draft Rule states that permitting authorities would be responsible for approving site closure, but would not accrue any liability or financial responsibility for the site. The Draft Rule would create a series of requirements for post-closure CCS operations, but would not provide a framework for liability beyond financial responsibility for maintenance of the CCS facility for a specified period of time.

As part of the bidding for the FutureGen Alliance, in Illinois and Texas were required to put forward approaches to address the long-term liability associated with the project. Illinois was prepared to provide an indemnification in favour of the Alliance for liability arising from a release of sequestered $CO_2$. It was also prepared to accept title to the sequestered gas post-injection. However, it could then sell carbon offsets associated with the sequestered gas to a willing buyer. In Texas, title to the sequestered gas would be transferred to the Railroad Commission of Texas which would also take on liability once the gas was captured and stored. Liability for pre-injected $CO_2$ and any damages resulting during construction remained with the Alliance.

The EU takes a similar approach whereby the operator of a storage site will remain responsible for maintenance, monitoring and control, reporting, and corrective measures following closure. Eventually, however, these obligations will transfer to the competent authority of the relevant Member State, provided that the following conditions have been met:

- all available evidence indicates that the stored CO2 will be completely and permanently contained;
- a minimum period, to be determined by the competent authority, has elapsed. This minimum period shall be no less than 20 years, unless the competent authority is convinced that the stored CO2 will be completely and permanently contained;
- the operator has provided an adequate financial contribution to the anticipated costs of monitoring for a period of 30 years; and
- the site has been sealed and the injection facilities have been removed.

After the transfer of responsibility to the competent authority, inspections of the site "may be reduced to a level which allows for detection of leakages or significant irregularities." Only if leakages or significant irregularities are detected will increased monitoring and, possibly, corrective measures be required.

Until the CCS Directive is transposed into the national law of Member States, some Member States will have legislation that addresses liability for general environmental damage that could apply to liability for long term harm caused by a CCS project. For example, the UK pollution, prevention and control regime contains post-closure remediation requirements that must be satisfied before a permit terminates. Note also that an analogous discussion over post-closure liability is also taking place in the UK in connection with long-term liability for new nuclear generation projects.

In Australia, the Australian government's approach to the liability of approval authorities is comparatively generous to permit holders. The Australian government can assume long term liability for carbon injected into a formation 15 years after injection operations have ceased, where a "closure assurance period" in respect of the formation has elapsed (see below). The Governments of Victoria and Queensland have not taken on similar indemnities. A provision in the Queensland GGS Act may, however, operate to protect permit holders from liability in some circumstances. The Act provides that

GHG tenure holders will not incur civil liability for an act done, or omission made, honestly and without negligence under this Act if they comply with a direction given by the Minister to alleviate a serious situation.

The advantage of the Australian government's indemnity is that it will facilitate efforts over the long-term to minimise damage to the natural environment or human health caused by sequestered $CO_2$. However, it may expose the Australian government to potentially very large liabilities, particularly if companies seek to avoid their liability through restructuring or insolvency.

There are very few other examples of countries that address long-term liability for $CO_2$ storage. Japan, through its Marine Pollution Act, provides one other notable example.

The Marine Pollution Act provides that applicants who apply for permission to "dispose" of $CO_2$ via $CO_2$ storage in the sub-sea bed must submit a closing implementation plan at the time of application, for review by the Minister for Environment.

However, the provisions of this Act focus on the act of "disposal" or $CO_2$ storage, and the licence provided for this is set at a maximum period of five years. The Act does not provide detailed provisions regarding post-closure and long-term storage obligations, although plans for management of the sequestered $CO_2$ must be submitted. Implementing parties are obliged to report to the Ministry of Environment on the situation and planned corrective measures, and to take mitigating actions, if leakage occurs in the post-closure phase. Long-term storage and post-closure obligations and liability for leaks are issues which are yet to be specifically provided for in Japanese law. These are slated to be the subject of further consideration following practical experience with the government's large scale CCS projects, and prior to commercialisation of CCS in Japan in five to six years time.

**Case study: Post-closure liabilities under the Australian government's GGS Act**

Under the Australian government's GGS Act, a closure assurance period will commence in respect of a formation on the day the Minister is satisfied that injection operations into the formation ceased and will end at least 15 years later, when the Minister is satisfied that:

- the injected substance is behaving as predicted in the approved site plan;
- there is no significant risk that the substance will have a significant adverse impact on:
  - the geotechnical integrity of the whole or part of the geological formation or structure;
  - the environment;
  - human health or safety; and
  - no further injection has taken place since the initial cessation of injection activities.

If a site closing certificate has been issued in respect of a formation and a closure assurance period exists, the Australian government's indemnity is then triggered in respect of the formation when:

- a person who has been the registered holder of the relevant licence has ceased

to exist;

- if the person had continued in existence their liability is:
  - a liability for damages;
  - attributable to an act done or omitted to be done in the carrying out of operations authorised by the licence in relation to the formation; and
  - incurred or accrued after the end of the closure assurance in relation to the formation; and
- apart from this provision, the damages are irrecoverable because the person has ceased to exist.

The section also requires that any further conditions set out in the regulations have been met, however the regulations to the Act have not yet become effective.

### 10.2.2 Monitoring and reporting obligations

All jurisdictions that have adopted comprehensive CCS legislation require monitoring plans to be submitted as part of the application for a storage permit. However, the extent and frequency of monitoring storage sites post-closure varies between jurisdictions.

The EU CCS Directive states that a monitoring plan must be included in the application for a storage permit. This plan should include specific monitoring obligations appropriate to the particular storage site. The monitoring plan must be updated according to the criteria set out in Annex II of the CCS Directive. It must also take into account changes to the assessed risk of leakage, the environment and human health, new scientific knowledge and improvements in best available technology. Updated plans must be re-submitted for approval to the competent authority (CCS Directive, Articles 13, 14). The operator is required to report to the competent authority, *inter alia*, on the results of monitoring at least once a year. In addition, Member States must establish a system of inspections to ensure that the storage site is operated in compliance with the requirements of the CCS Directive.

In Australia, the Federal, Victorian and Queensland legislation includes general provisions requiring $CO_2$ storage operations to be carried out in accordance with approvals and permit obligations. this will in turn give administering authorities monitoring powers in respect of this. In general terms, after well closure and the surrender of relevant permits, the monitoring responsibility passes to the relevant governments. For example, site closing certificate applications under the Australian government's GGS Act are required to include a program of operation for the Australian government to undertake with respect to monitoring.

The EPA has proposed a default post-injection site care period of 50 years. During this period, the owner or operator would be required to submit periodic reports providing monitoring results and updated modelling results as appropriate until a demonstration of non-endangerment can be made. The Draft Rule would require CCS operators to demonstrate financial responsibility for remedial action at a CCS facility, including injection well plugging, post-injection site care and site closure, and emergency and remedial response. Financial mechanisms that might be used for this purpose include trust funds, letters of credit, surety bonds or self-insurance, such as corporate guarantees.

This obligation would terminate after the post-injection site care period has ended. While the EPA has authority under the SDWA 42 USC 300 to require financial responsibility for well plugging and post-

injection site care, the Act does not provide authority for coverage of potential risks to air, ecosystems or public health. Thus, general liability for a CCS site would not terminate at the end of the site care period.

Conscious of the importance of providing a framework for long-term liability in this area, the EPA and other governmental and non-governmental stakeholders in the US are considering policy options that could be used to fill this gap. Examples of these policy options are provided in Case Study 8 below.

Japan, through the Marine Pollution Act, provides one of the only other examples of a comprehensive regime for the monitoring of injected carbon. Under the Act, monitoring is conducted in accordance with the monitoring plan submitted by the applicant as part of its application documents. Once permission is granted for sub-sea bed $CO_2$ disposal, the authorised party is required to report on implementation of its monitoring plan, and its periodic monitoring results to the Minister for the Environment. When leakage is detected, report of the result should be made to the Minister for the Environment based on the prescriptions of each of the following classifications:

1) When there are concerns of contamination: after implementation of the monitoring process, the result should be reported to the Minister for the Environment immediately;
2) When adverse impact is detected: during the term of the monitoring period, the result of monitoring should be reported to the Minister for the Environment periodically, when necessary or when requested to do so; and.
3) Normal monitoring: after implementation of the monitoring process, the result should be reported to the Minister for the Environment.

Main monitoring items are:

- injection pressure and formation pressure;
- $CO_2$ migration in the formation;
- parameters of sea water such as $CO_2$ concentration and pH; and
- impact on marine life.

The actual period of the post-closure monitoring is yet to be finally determined in Japan, and Japan plans to be guided by international trends such as CDM verification methods, when assessing post-closure monitoring needs.

**Case study: Policy options for liability – USA experience**

- Price-Anderson Nuclear Industries Indemnity Act, USC § 2014(hh)
  - The Price Anderson Act created a tiered system of limited liability for nuclear accidents, which essentially divided liability for such accidents between facility owners, the industry as a whole, and the Federal government.
  - The three-tiered coverage system requires licensed nuclear facilities to maintain their own liability insurance, as well as contribute to an industry pool for liability insurance.
  - The Federal Government would provide the licensee with indemnity in case liability exceeded the amount available from these sources (EPA, 2008).

- Illinois and Texas FutureGen Statutes
  - Under these statutes, the States would assume full responsibility for $CO_2$ at a given point in the CCS cycle.
  - While these models are helpful to spur short-term investment, a more strategic government approach to liability assumption based on risk profiles or site performance may be necessary in the future.
- DOE Carbon Capture and $CO_2$ Storage Program Amendments Act of 2009
  - Sponsored by Senator Jeff Bingaman (D-NM), this Bill would enable the DOE to enter into cooperative agreements to provide financial and technical assistance to up to 10 CCS demonstration projects.
  - The Secretary of Energy would also have authority under the Bill to indemnify and hold harmless the recipient of a cooperative agreement from any liability arising out of their CCS demonstration project. The value of this indemnification is tempered by a requirement that the government collect a fee from the project owner equal to the net present value of payments made by the government to cover the liability under the indemnification agreement. In addition, the legislation would prohibit site closure until 10 years after the $CO_2$ plume stabilised.
  - This model provides the government more ability to determine which projects should be insured, rather than more general assumptions of liability for the entire industry, but is limited in scope.
- Interstate Oil & Gas Compact Commission (IOGCC) Model
  - Under the IOGCC Model, State authorities would assume long-term responsibilities for monitoring and remediation activities at CCS sites.
  - This effort would be financed through an industry-funded, State-administered trust fund.
  - While the IOGCC Model insulates a CCS operator from regulatory liability it would not insulate them from long-term general liability.

### 10.2.3 Leakage liability

In addition to monitoring and verification, post-closure regulatory regimes should clearly structure the management of the liabilities arising from leakage of stored $CO_2$. A number of the regimes studied require project proponents to lodge financial security for the costs, not only of long-term monitoring and verification, but also of managing the risks to human health and natural ecosystems arising from leakage of stored $CO_2$. Even in jurisdictions with relatively robust regulation of $CO_2$ storage, this element of post-closure has not yet been dealt with comprehensively. As the WRI has acknowledged, "there are significantly divergent views on the scope, need for, and nature of financial responsibility mechanisms for CCS" (WRI, 2008: 80). This will need to be dealt with in order to provide the level of certainty needed to attract investment to CCS.

## FRAMEWORK FOR POST-CLOSURE LIABILITY

The analysis above provides examples of some of the policy option that the US is considering as models for addressing long-term liability. At present, no decision has been taken on where this liability should fall.

Under the Australian government's GGS Act, GHG permits can include a condition that insurance be maintained against expenses, liabilities or "specified things" arising from work carried out under the permit, or the doing of any other thing under the permit, lease or licence. This can include "insurance against expenses of complying with directions relating to the clean-up or other remediation of the effects of the escape of a GHG substance."

The Queensland legislation adopts a broader approach to the provision of security. The Queensland GGS Act empowers the Minister to require a holder of, or applicant for, a GHG permit to provide the State with security which can be used to meet a range of broadly defined costs. The legislation in Victoria and Queensland also provides for the payment of rehabilitation bonds against the cost of rehabilitating storage sites, including following well closure.

As noted previously, Texas and Illinois were both prepared to take on long-term liability for $CO_2$ sequestered as part of the FutureGen project. However, it is important to note that the laws contemplated were only related to that project and would not necessarily have wider application in those States.

Within the EU, the competent authorities in Member States will be responsible for taking measures to correct any post-closure liability after the transfer of responsibilities. Member States are required to ensure that each operator makes a financial contribution to the competent authority to cover, at a minimum, the anticipated cost of monitoring for a period of 30 years. This financial contribution may also be used to cover the costs borne by the competent authority to ensure that the $CO_2$ is completely and permanently contained. In addition, the Environmental Liability Directive seeks to ensure the prevention and remedying of environmental damage.

Specifically, it seeks to prevent and remedy damage to habitats and species protected by EU law, and to habitats or species on a site of special scientific interest, damage to water resources, and land contamination which presents a threat to human health.

The Environmental Liability Directive reinforces the “polluter pays” principle - making operators financially liable for threats of or actual damage. The CCS Directive amends Directive 2004/35/EC. extending it to cover CCS storage.

## LIABILITY CAPS

As discussed above, in Australia the Federal, Victorian and Queensland legislation provides for debts arising from the damage caused by sequestered carbon to be recovered by relevant governments in courts of competent jurisdiction.

Liability caps have not yet been determined in any of the other jurisdictions with comprehensive CCS legislation. In the EU, this will be a matter for Member States to determine if they implement the EU CCS Directive.

## VICARIOUS LIABILITY

In Australia, approaches of the States and the Australian government to the issue of vicarious liability under CCS legislation differ.

For example, the Queensland GGS Act provides that the State takes on vicarious liability for Ministers, public service officers or employees and persons authorised to carry out activities for the Queensland Government if such persons incur liability from administering the Act.

The Queensland GGS Act also provides that the government of that State is liable for actions of permit holders which incur civil liability for an act done, or omission made, honestly and without negligence, if they are complying with a direction given by the Minister to alleviate a serious situation.

In countries which recognise torts such as negligence and trespass, the general law principles of vicarious liability for tort actions will also apply and allow persons to bring actions in negligence and trespass if their interests or land have been detrimentally impacted.

## CONTRACTUAL ASSIGNMENT OF RESPONSIBILITY

In Australia, none of the Federal, Victorian or Queensland legislation explicitly precludes contractual assignment of responsibility for environmental or other damage arising from storage or injection activities. However, the restrictions on permit transfers outlined below would in practice have a similar effect.

The legality of any contractual assignment of responsibility (and indeed liability) for environmental harm will often depend on whether the laws of a jurisdiction are subject to the general principle voiding such arrangements on the grounds of public policy. Under this principle, a party cannot contract out of criminal liability (and in most jurisdictions serious environmental offences are criminal in nature) as to do so would undermine the bases of the criminal law, including deterrence and punishment of the actual wrongdoer.

## LONG-TERM CORPORATE LIABILITY IN THE EVENT OF CORPORATE RESTRUCTURING

As demonstrated above, the long time frames associated with CCS operations have challenged policy makers in a number of jurisdictions. One area where this is particularly acute is in relation to long-term corporate liability in the event of corporate restructuring.

Where permit holders are corporations and cease to exist, it may be difficult for regulators to enforce permit obligations or for third parties to sue for damages caused by CCS operations. This risk is addressed by the performance bond and security obligations outlined above.

The only jurisdiction that has attempted to address this issue directly is the Australian States of Queensland and Victoria. The GGS Act provide that putative permit transfers have no effect until they are registered. Putative transfers cannot be registered until they have been approved by the Minister (transfers by death or law are excluded from these restrictions). Transferees must be the holders of relevant environmental authorities in respect of the permit and have provided financial assurance where required. The Minister may require security as a condition of giving approval for a transfer. The Victorian legislation includes similar restrictions.

## STANDING TO ENFORCE STORAGE OBLIGATIONS

In Australia, neither the Australian government's, Victorian nor Queensland CCS legislation explicitly provides standing for third parties to bring legal proceedings to enforce storage obligations, beyond the broad rights to challenge the grant of licences.

In jurisdictions where separate planning permission and approvals are required for storage activities, it may be possible for third persons to seek to enforce provisions of planning consents attaching to those activities.

It is also possible that persons may seek to bring actions in negligence or trespass if their land, property or interests are impacted by $CO_2$ leakage and/or migration. In such situations, persons whose interests are impacted may have standing to seek orders such as injunctions to prevent persons carrying out certain activities and claims in damages for any harm caused. Precedent cases include where oil spills have occurred and persons who earn their livelihood fishing have suffered harm and brought tort claims, seeking damages from the shipping and oil companies.

## 10.3 General policy and legislation

### 10.3.1 Leakage liability

Currently, there are no identification of non-integrated legislation which specifically imposes vicarious liability for $CO_2$ leakage. However, in a number of countries, $CO_2$ may be treated as a waste, pollutant or substance that causes harm to the environment.

In such situations there are often vicarious liability provisions in environmental legislation which allow liability to be placed on directors or other companies in a corporate group if harm results.

For example, in Mexico officers within a company may be held liable for the orders or authorisations issued that may cause soil or groundwater contamination or a negative impact to the environment. Although, as for the liability of parent companies regarding the actions taken by their subsidiaries, the same is very limited in Mexican legislation due to the fact that there are very limited provisions that may allow to pierce the corporate veil.

In Brazil there is criminal liability for harming the environment which allows the corporate legal entity to be disregarded (ie the corporate veil to be pierced) in any situation where such entity is a barrier to the recovery of damage to the environment.

General principles of vicarious liability under tort law may also apply, which allow the actions of employees to be imputed to directors and/or the actions of companies to be imputed to directors. For example, negligence or trespass actions may be founded if $CO_2$ leaks and impacts another's property or interests.

As noted above, in States and countries where there is no integrated CCS legislation and separate planning permission and environmental approvals are required for storage activities, it may be possible for third persons to have standing seek to enforce conditions of such planning consents attaching to those activities, depending on the nature of the planning or environmental regime in that particular jurisdiction. For example, in a number of Australian States, planning legislation provides "any person" rights which could be used for this purpose. Section 123 of the New South Wales Environmental Planning and Assessment Act 1979 (NSW) provides that any person may bring proceedings in the New South Wales Land and Environment Court to restrain breaches of the Act, irrespective of whether his or her rights have been infringed by the breach.

Likewise, as discussed above, persons whose land has been impacted or who have suffered harm may have standing to seek to bring actions in tort through negligence or trespass actions. In some jurisdictions, such tort law is codified. For example, in China a person that injects $CO_2$ into $CO_2$ storage may be liable under Article 106 of the General Provisions of the Civil Code of the People's

Republic of China (NPC, January 1, 1987, adopted (1986)) (PRC Civil Code), if it injures a person or damages property negligently or by wilful conduct. If the injection activity would constitute "work with a high degree of danger to the surroundings" under Article 123 of the PRC Civil Code, the relevant entity may be liable for the damage caused, even if not acting negligently. It is unclear whether any principle under PRC law would implicate that the injection of $CO_2$ in any way would amount to “work with a high degree of danger to the surroundings”. However, it is noted that this is a fluid concept and could potentially be applied to the injection of $CO_2$ into geological formations once sufficient evidence becomes available to classify the injection of $CO_2$ into formations as such.

There are also a range of laws that may be relevant to the future development of post-closure and long-term storage. For example, in the Republic of Korea precedent legislation may be found in the Radioactive Waste Management Law and the Nuclear Power Law, which govern the responsibilities for capture, storage and leakage of radioactive substances remaining after nuclear power generation.

## 10.4 Evaluation and key barriers

As noted in Section 10.1, the post-closure CCS project cycle stage poses several legal challenges. The dedicated regulatory frameworks are generally robust in their treatment of the legal risks arising from the long-term storage of $CO_2$, to the extent of present knowledge and understanding of those risks.

The absence of adequate regulation of this final stage of the CCS project cycle is perhaps the greatest barrier to the commercial-scale deployment of CCS in jurisdictions without robust regulation of CCS, or where existing regulation has been adapted for CCS.

Where integrated legislation exists, liability for $CO_2$ leakage post-closure is generally well-defined and the process for surrendering any access licences is well set out. The laws in relevant jurisdictions in Australia, the EU and the US all address the ownership of injected $CO_2$ post-closure, in most instances with such ownership reverting to the regulating government upon surrender of the relevant approvals by the operator. This is the key strength of these legislative schemes. By clarifying these matters, governments will be able to provide investors with a level of comfort that operators of injection facilities will bear the post-closure liabilities associated with their storage activities to the extent that this is practical but that the liability of such operators is not unlimited.

Pollution and other environmental regulation in most jurisdictions centres on the "polluter pays" principle. It is not unreasonable that potential CCS project developers would delay the development of CCS projects until regulatory frameworks make it possible for them to quantify and manage potential liabilities. Governments which seek to encourage the commercial-scale deployment of CCS within their jurisdictions should seek to address this without delay.

A key concern arising from the assumption that governments will be responsible for stored $CO_2$ is that such governments then themselves face a potentially unlimited liability. This liability can arise both from the potential future cost of carbon escaping into the atmosphere (where an obligation is placed on the State to meet targets to reduce or limit GHG emissions under the UNFCCC) and also where the escape of $CO_2$ causes more localised environmental harm. To mitigate against this risk exposure, some governments are looking to, at first instance, extend operator liability for longer periods of time and also through innovative insurance and funding arrangements. Provisions requiring security in the form of insurance and rehabilitation bonds will help to ensure that long-term liabilities arising from injection activities can be funded and that governments are not left with all such liabilities. Governments should prioritise such efforts to develop financial instruments to facilitate efforts to manage these liabilities.

To begin with, models for long-term liability may include, for example:

1) tiered liability insurance and indemnification by the government; or
2) a per tonne fee paid to the government for $CO_2$ injection, with a "handoff" to the government for monitoring, remediation, and liability. The handoff might occur 10 years after injection ceases, to minimise moral hazard issues.

A further difficult question which arises is whether existing integrated legislative structures are sufficiently flexible to accommodate the evolution in CCS and knowledge of the environmental and social risks associated with CCS activities. As understanding of CCS and the operation of geological storage sites improves, it will be necessary to keep existing laws under periodic review and amend them to accommodate emerging risks and new approaches to manage them.

In those jurisdictions that do not have dedicated CCS legislation, questions of liability remain unclear. Existing mining and environmental pollution legislation is not well suited to the purpose of long-term management for storage sites. Whilst mining laws often provide for rehabilitation bonds, mine-closure plans and the like, the anticipated long-term risks are better understood and more easily quantified. If CCS is to be addressed under these frameworks, issues such as post-closure liability and surrender of that liability to the State will need to be addressed.

**Key barriers**

- Identifying and assigning legal liability for leakage to a suitable party or parties.
- Developing insurance products to accommodate long term environmental liability where governments are not prepared to assume liability.

# 11. International legal framework

## 11.1 Introduction

International law is important to encouraging the commercial-scale deployment of CCS because:

- CCS projects may in the future be undertaken in areas beyond the jurisdiction of States;
- international legal principles have informed, and will continue to inform, the development of domestic legal regulation of CCS projects; and
- if CCS is widely deployed, consistency in crediting CCS operations across jurisdictions will be important when linking emissions trading systems.

This section highlights a number of international legal gaps and barriers relevant to CCS. Addressing these gaps and barriers will be beneficial to the substantive development of widespread CCS.

In general terms, public international law regulates the relationships between sovereign States. Of the sources of international law, treaties are the most relevant to CCS. However, existing international environmental treaties were not drafted with CCS activities in mind. At present, there is no single international treaty regulating CCS activities. Instead, different stages of the CCS project cycle are regulated by different sources of international environmental law.

It is true that in recent years the ability to conduct CCS activities under international law has evolved significantly. However, some barriers still remain.

Many of these barriers turn on how $CO_2$ is characterised and defined under international law. There are a number of international conventions that regulate pollution of the marine and land-based environment and the treatment or disposal / dumping of waste, hazardous waste and harmful substances. If a $CO_2$ product falls within one of these definitions, dealing with the $CO_2$ as part of the CCS project cycle may be prohibited, or attract strict regulatory requirements for environmental impact assessment and project management.

For example, until recently, sea bed storage was prohibited under the London Protocol, which regarded the injection of $CO_2$ in the sea bed as waste dumping (1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter). The amendment of these conventions to facilitate CCS is evidence of the strong political will to facilitate CCS activities. However, other restrictions still exist. It is a basic international law principle that States must not export certain wastes, damage or hazards from one area to another or transform one type of pollution to another. Due to the broad definitions of pollution and waste in many international treaties and the environmental uncertainties regarding the stability of long-term storage of $CO_2$ in deep geological formations, some activities are still prohibited.

For example, the export of $CO_2$ is prohibited under Article 6 of the London Protocol, which means that until this Protocol is amended $CO_2$ will stay within national boundaries (this is discussed further below). Likewise, storage of $CO_2$ may be classified as pollution in certain circumstances.

If stages of the CCS project cycle take place in international waters or involve multiple actors from different States, questions arise around which State should take responsibility for any leakage of emissions, on-going monitoring and liability for remediation, and whether such activities can take place at all. For example, as no State is able to assert sovereignty over the sea bed in areas beyond

national jurisdiction, the ability to undertake storage activities in these areas is likely to be limited (discussed further below). In the absence of clear guidance on these issues, most States have avoided projects in these areas. Nevertheless, if CCS becomes a viable mechanism, with potential storage sites in these areas, the international community will need to determine appropriate regulatory frameworks.

## 11.2 United Nations Framework Convention on Climate Change

As a starting point, the UNFCCC and its Kyoto Protocol seek to stabilise $CO_2$ emissions in the atmosphere at levels that will prevent dangerous interference with the climate system. CCS may assist in meeting this objective.

Parties to the UNFCCC must report emissions that are released into the atmosphere. If $CO_2$ is captured and injected before any emissions are released into the atmosphere, then arguably no emission occurs. Yet if $CO_2$ leaks many years after its original storage, the requirement to report on, and account for, emissions liability for those emissions may not crystallise until many years after injection.

If CCS is to be considered a viable mitigation technology in the context of the UNFCCC, it will be important to provide States with guidance on how to measure, monitor, verify, account for and report CCS activities. These accounting issues have been considered in the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines) which now provide a methodology to account for CCS emissions and $CO_2$ storage. However, the 2006 IPCC Guidelines have not been uniformly adopted by Parties to the UNFCCC. Presently, Parties are not compelled to use them for reporting national inventories, although some parties are doing so. In addition, many developing countries are concerned that the standards in the 2006 IPCC Guidelines are too onerous, and therefore, should not be mandated to apply in non-Annex I Parties. Consistent international guidelines on monitoring, verification and reporting are needed for both developed and developing countries that are binding under the UNFCCC.

### 11.2.1 Treatment in the Clean Development Mechanism

There is currently debate as to whether CCS activities should be included within the CDM under the Kyoto Protocol, to provide CCS projects in developing countries with a means to generate CERs, which can be traded in the international carbon market.

Whilst the views of Parties are divergent, particularly as to whether the international rules for the CDM allow such projects to take place, the CDM may provide incentives that would make CCS projects in developing countries viable.

The UNFCCC's Subsidiary Body for Scientific and Technological Advice has been considering issues related to the inclusion of CCS in geological formations as CDM project activities since 2006. As a result of these deliberations, a number of issues have been raised about the appropriateness of CCS in the CDM, including:

- risks and uncertainty of long-term physical leakage levels;
- project boundary issues (such as reservoirs in international waters, several projects using one reservoir);
- long-term responsibility for monitoring the reservoir and any remediation measures that may be necessary after the end of the crediting period; and

- other relevant matters, including environmental impacts.

Under the Kyoto Protocol CDM is a private sector activity. This raises particular issues around the appropriateness of CCS under the CDM given the timelines required for monitoring, reporting and liability for damage and emission units if leakage occurs. Such long timelines raise clear insolvency and financing risks. Ultimately, to resolve these issues, risk transfer of liability and monitoring to the State is to be expected. However, as a pre-requisite to the inclusion of CCS in the CDM, rules will need to be developed regarding the distribution of risk between private entities and States including, standard setting, accounting methodologies, verification and monitoring responsibilities and liability provisions. Decisions regarding accounting methodologies are crucial, as ultimately they will determine the link between liability and any credits created by a CCS project.

### 11.2.2 Post-2012

The Fifteenth Conference of the Parties to the UNFCCC will take place in Copenhagen at the end of 2009 and is intended to be the end of a two year commitment to shape an effective international agreement to guide climate change action beyond 2012. This provides an opportunity for the role of CCS as a climate change mitigation measure and within the CDM to be re-defined. However, notwithstanding general support, States recognise that CDM rules will need to be developed regarding the distribution of risk between private entities and States. There also appears to be general recognition that capacity building is needed in non-Annex I Parties to ensure effective regulation of CCS projects.

## 11.3 Issues associated with CCS offshore

The United Nations Convention on the Law of the Sea 1982 (UNCLOS) is largely a codification of the customary international law of the use of the seas.

Relevantly, UNCLOS separates the sea into a number of jurisdictional zones which are measured from the low water mark of the coastal State (UNCLOS, Article 15). These defined areas of States jurisdiction include the territorial sea, archipelagic waters (UNCLOS, Articles 46-50) and the continental shelf (UNCLOS, Article 76). UNCLOS also allows States to regulate the contiguous zone (UNCLOS, Article 33) and the exclusive economic zone (UNCLOS, Articles 55-75).

Outside these areas of State jurisdiction are the global commons, which are separated into two areas – the "high seas" and "the Area". The sea bed, ocean floor and subsoil beyond the limits of national jurisdiction form a different geographic zone to the high seas under UNCLOS and are defined as the "Area".

### 11.3.1 Territorial sea

Each coastal State may claim a territorial sea that extends seaward up to 12 nautical miles from its baselines (Article 2 and 3 of UNCLOS). This sovereignty over the territorial sea extends to the air space above it, and the sea bed and subsoil beneath it (Article 2, UNCLOS). As such, the domestic laws and consequent, consents and authorisations of each coastal State will be required to the undertaking of CCS activities in each territorial sea.

### 11.3.2 Continental shelf

Under Article 76 of UNCLOS, the continental shelf of a coastal State comprises the sea bed and subsoil of the submarine areas. It extends beyond its territorial sea throughout the natural

prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured (where the outer edge of the continental margin does not extend up to that distance).

A coastal State has exclusive sovereign rights over its continental shelf for the purposes of exploration and exploitation of its natural resources. Natural resources are the mineral and other non-living resources of the sea bed and subsoil together with living organisms belonging to sedentary species, that is to say, organisms which, at the harvestable stage, either are immobile on or under the sea bed or are unable to move except in constant physical contact with the sea bed or the subsoil (Article 77, UNCLOS). Arguably geological formations under the sea bed are a non-living resource of the sea bed and subsoil and as such, the express consent of the coastal State will be applied to undertake CCS activities such as injection and storage.

All States are entitled to lay submarine cables and pipelines on the continental shelf. This is subject to the coastal State's right to take reasonable measures for the exploration of the continental shelf, the exploitation of its natural resources and the prevention, reduction and control of pollution from pipelines. The coastal State must also consent to the 'course' for the laying of such cables but the coastal State may not impede the laying or maintenance of such cables (Article 79, UNCLOS). In relation the CCS, this gives other States a relatively wide discretion to lay pipelines to transport $CO_2$ over the continental shelf of another.

However, coastal States have the exclusive right to authorise and regulate drilling on the continental shelf for all purposes (Article 81, UNCLOS). As such, a coastal State will be able to control injection and storage activities on the continental shelf to the extent that such CCS activities concern drilling.

Areas of the continental shelf that extend seaward of the limits of the 200 nautical mile Exclusive Economic Zone (EEZ) are often referred to as the "outer" continental shelf. Rights to the outer continental shelf are controversial and the Commission on the Limits of the Continental Shelf (CLCS) has been established to facilitate the implementation of the UNCLOS. This is in respect to the establishment of the outer limits of the continental shelf beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured. In accordance with Article 76(8) of UNCLOS, the CLCS makes recommendations to coastal States on matters related to the establishment of the outer limits of their continental shelf.

### 11.3.3 Exclusive Economic Zone

Each coastal State may claim an EEZ beyond and adjacent to its territorial sea up to 200 nautical miles from which the breadth of the territorial sea is measured (Article 57, UNCLOS), although in many situations, States will not be able to claim the full 200 nautical miles due to an adjacent State. In situations where there is a dispute between States, there is a dispute resolution procedure provided for in Article 74 of UNCLOS which requires States to seek an equitable solution. Within its EEZ, a coastal State has:

- sovereign rights for the purpose of exploring, exploiting, conserving and managing natural resources, whether living or nonliving, of the sea bed and subsoil and the superjacent waters, and with regard to other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water, currents and winds;
- jurisdiction as provided for in international law with regard to the establishment and use of artificial islands, installations, and structures, marine scientific research, and the protection and preservation of the marine environment, and

- other rights and duties provided for under UNCLOS.

To the extent that the continental shelf and the EEZ cover the same area, a State's right to lay pipelines and conduct other CCS activities such as drilling in the EEZ will largely be the same as discussed above in relation to the continental shelf.

### 11.3.4 Offshore areas beyond national jurisdiction

The areas outside the territory of any State are referred to as the "global commons". The global commons are separated into two areas – the 'high seas' and 'the Area'. Under international law, the global commons have a special status and are treated as the common heritage of mankind. As such, these areas are vested in the international community as a whole, with no State or person being able to appropriate territory within them, and which are to be preserved and to be freely available for use for the benefit of present and future generations. The key barriers to CCS in the global commons relate to the ability to undertake offshore CCS activities in the high seas, and in particular, in the sea bed and ocean floor and subsoil beyond the limits of national jurisdictions.

### 11.3.5 High seas

The high seas are defined in UNCLOS as being all parts that are not under national jurisdiction. It is noteworthy that the definition of the high sea refers to the water column and not to the sea bed, ocean floor and subsoil underlying high seas.

States enjoy six freedoms within the high seas. These are set out in Article 87 and include: The high seas are open to all States, whether coastal or land-locked. Freedom of the high seas is exercised under the conditions laid down by this Convention and by other rules of international law. It comprises, *inter alia*, both for coastal and land-locked States:

- freedom of navigation;
- freedom of over flight;
- freedom to lay submarine cables and pipelines, subject to Part VI;
- freedom to construct artificial islands and other installations permitted under international law, subject to Part VI;
- freedom of fishing, subject to the conditions laid down in section 2; and
- freedom of scientific research, subject to Parts VI and XIII.

These freedoms shall be exercised by all States with due regard for the interests of other States in their exercise of the freedom of the high seas, and also with due regard for the rights under this Convention with respect to activities in the Area.

#### TRANSPORT OF $CO_2$ IN THE HIGH SEAS

The freedom to lay cables and pipelines and the freedom of scientific research are relevant to CCS activities. Unlike the laying of pipelines in the continental shelf, there is no requirement under UNCLOS to obtain the consent of any particular State to conduct such activities in the high seas.

Further, there are no specific environmental assessment requirements relating to the laying of such pipelines in the high seas. The general provisions in Articles 204-206 of UNCLOS, explains that when States have reasonable grounds for believing that planned activities under their jurisdiction or control

may cause substantial pollution of or significant and harmful changes to the marine environment, they shall, as far as practicable, assess the potential effects of such activities on the marine environment and shall communicate reports of the results of such assessments. States must also "as far as practicable" monitor the effects of any activity they permit or engage in. Together these provisions gives States a wide discretion to lay such pipelines.

### STORAGE IN THE WATER COLUMN IN THE HIGH SEAS

In relation to storage of $CO_2$ in the water column in the high seas, the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) which relates to the North Atlantic was amended in 2007 to specifically prohibit storage of $CO_2$ in the water column. The London Protocol (discussed below) was also amended to allow storage in geological formations in the sea bed (but not the sea column).

Further, storage in the water column must be considered in light of the general provisions of UNCLOS regarding pollution and harmful changes to the marine environment including waste dumping. In practice, these provisions all serve to limit the ability to undertake storage in the water column in the high seas. This issue is discussed in more detail below.

### LIABILITY IN HIGH SEAS

Where activities are undertaken in the high seas, such as the transport by pipeline, under Article 114 of UNCLOS, every State shall adopt the laws and regulations necessary to provide that, if persons subject to its jurisdiction who are the owners of a submarine cable or pipeline beneath the high seas, in laying or repairing that cable or pipeline, cause a break in or injury to another cable or pipeline, they must bear the cost of the repairs. If pipes are damaged by a vessel of another State, the jurisdiction of the vessel (and consequent liability) is determined by the flag State of the offending vessel. However, this can be problematic as the vessel may be flagged in a State with an open registry (ie a "flag of convenience") undermining enforcement action.

Article 286 of UNCLOS also establishes a dispute resolution mechanism where any dispute concerning the interpretation or application of UNCLOS shall, where no settlement has been reached, be submitted at the request of any party to the court or tribunal having jurisdiction. If two States have both chosen different means of dispute settlement under Article 287, then their dispute may only be submitted to arbitration.

## 11.3.6 The Area

The sea bed, ocean floor and subsoil beyond the limits of national jurisdiction form a different geographic zone under UNCLOS defined as the "Area". The provisions relating to the Area are directly relevant to the injection and storage of $CO_2$ in the sea bed.

As the global commons, the Area and its resources are regarded as "the common heritage of mankind", and no State may claim or exercise sovereignty or sovereign rights over any part of the Area or its resources (UNCLOS Article 1(1) and Part XI).

The International Seabed Authority is the intergovernmental organisation that has authority under UNCLOS to coordinate a limited number of activities in the Area including the exploitation of mineral resources and marine scientific research.

Whilst it is arguable that exploration and research may take place in the Area on a temporary basis, States are not able to assert sovereignty over the Area through the permanent occupation of its Territory (including geological storage spaces). This framework may limit the ability to explore for sub-sea bed geological storage sites and, more importantly, prevents the injection of $CO_2$ into the Area by a State or States, and its permanent storage for the benefit of the State or States.

For CCS injection and storage to be permissible in the Area, amendments would be required to be made to UNCLOS in accordance with the amendment and ratification procedures described above. In addition, the International Seabed Authority would need to be given the ability to regulate and set standards in relation to CCS activities, extending its jurisdiction to regulate exploration related to matters other than mineral resources. No information is currently available suggesting any intention to draft amendments to UNCLOS to clarify the ability to undertake CCS activities in the Area. Similarly, there are no signs of there being any international will to allow such activities to take place in the Area.

From a logistical point of view, the geographic distances involved in constructing infrastructure, monitoring, and enforcing CCS projects in the high seas must be also contemplated.

In relation to liability all States have the responsibility to ensure that activities in the Area are effectively controlled by them and without prejudice to the rules of international law, damage caused by the failure of a State party or international organisation to carry out its responsibilities in relation to the Area shall entail liability. State parties or international organisations acting together shall bear joint and several liability (Article 139, UNCLOS).

## 11.4 Other international issues associated with CCS in the marine environment

Article 194 of UNCLOS requires States to take individually or jointly as appropriate, all necessary measures to prevent, reduce and control pollution from any source. Pollution is defined in Article 1(4) of UNCLOS. The definition of pollution is broad and the University College London Carbon Capture Legal Program notes that there is no conclusive opinion as to whether CCS would constitute pollution in accordance with this definition (UCL Carbon Capture Legal Program, 2009). This definition of pollution may limit the ability to store $CO_2$ in the sea column and is also relevant to whether $CO_2$ that seeps from a geological formation will be regarded as pollution. The London Convention was one of the first international conventions regarding the control of marine pollution and dumping of wastes and other matter in the sea and covers all marine areas. In 1996 a Protocol was agreed to update and eventually supersede the London Convention (1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Protocol)).

The London Protocol prohibits the dumping of any wastes or other matter with the exception of those listed in an Annex to the Protocol (London Protocol, Article 4 and Annex 1). The London Protocol was recently amended in 2007 to make clear that $CO_2$ could be stored in the sea bed with a permit. The amendment does not extend to the water column.

To be provided with a permit a proponent must comply with the requirements of Annex 2 which require, amongst other things, an impact assessment to be completed and monitoring requirements to be determined. The amendment to the London Protocol is a positive move towards the underground storage of CCS in the sea bed. Likewise, the OSPAR Convention Annexes were amended in 2007 to allow $CO_2$ to be injected in geological formations under the sea bed. However, a decision was made to prohibit the storage of $CO_2$ in the water column.

Despite the amendments to the London Protocol and OSPAR Convention, which can be seen as a positive move towards offshore CCS activities, there remain barriers to the transboundary export of $CO_2$, which is currently prohibited under Article 6 of the London Protocol. This is discussed further below.

## 11.5 Onshore and offshore cross border transportation and storage

There remain barriers to the transboundary export of $CO_2$ under the London Protocol as such transport is currently prohibited under Article 6 of the London Protocol. In a report dated 3 April 2009, an International Maritime Organisation (IMO) working group noted that the majority of States were of the view that transboundary export of $CO_2$ was prohibited under Article 6 and the London Protocol would need to be amended to allow export (IMO, 2009). The key implication is that until such an amendment is in force it appears that the export of $CO_2$ for sea disposal is prohibited under the London Protocol.

If $CO_2$ which is to be transported across State boundaries falls within the definition of "hazardous waste" under the Basel Convention this could preclude the international transport of $CO_2$ to non-parties and to non-Organisation for Economic Co-operation and Development (OECD) countries for final disposal. The same IMO working group (considering amendments to Article 6 of the London Protocol) also considered whether the Basel Convention applies to such CCS activities. While the majority of respondents were of the view that the Basel Convention does not apply to the transboundary movements of $CO_2$, States such as the Netherlands and groups such as Greenpeace are of the view that the Basel Convention does apply to the transboundary movement of $CO_2$. Until these issues are resolved, CCS activities will likely remain largely confined within national boundaries.

## 11.6 Onshore and offshore general liability

General principles of international liability may apply to CCS projects undertaken both onshore and offshore. There are no agreed international standards which establish a liability threshold for environmental damage which triggers liability and allows claims to be brought (Sands 2003: 879). It is foreseeable that the development of internationally agreed standards relating to CCS will inform any relevant debate as to the standard of care required and when damage has occurred.

In relation to general damage caused by plume carbon, the general international law principles relating to State liability will also inform liability. The *Trail Smelter Case United States v Canada* 3 RIAA 1907 (1941) is commonly referenced as supporting the international law principle that no State has the right to use its territory in such a manner as to cause injury by transboundary pollution into the territory of another. This principle will need to be integrated into approaches to the transboundary liability issues raised by CCS projects, if for example, there is leakage of $CO_2$ that migrates into the jurisdiction of another State and causes harm. Tortious liability regimes including trespass may also apply to the migration of plume carbon many years after initial injection.

However, in relation to compliance and enforcement in the global commons, "international law in this respect is still finding its centre of gravity and States have not generally sought to assert a legal right to act on behalf of the whole international community in the protection of the environmental issues on the basis of customary law or international law" (Sands, 2003: 190).

In relation to consequences, the principle is well established that the perpetrator of an internationally wrongful act is under an obligation to make reparation for the consequences of the violation (Sands,

2003: 882). However, there are no established principals in relation to the quantification of environmental damage in economic terms, due to its nature as a resource that often lacks market value. In response, there are a number of international conventions which seek to allocate liability for certain environmental actions, particularly when the risk of damage is high such as oil spills or nuclear accidents.

Another regime that may also relate to CCS in the future is the 1999 Protocol under the Basel Convention relating to liability for transboundary movements of hazardous wastes. Although this protocol is yet to come into force, Article 5 of the Protocol imposes a strict liability regime which is relevant where there is damage as a result of intentional, reckless, or negligent acts. As noted above there is presently debate as to whether the Basel Convention applies to CCS activities.

There have been a number of "strict liability" regimes developed in the international arena in situations where operations carry a high risk of causing environmental damage. Examples include nuclear conventions such as the Protocol to amend the 1963 Vienna Convention on Civil Liability for Nuclear Damage and the 1997 Convention on Supplementary Compensation for Nuclear Damage and conventions which deal with oil pollution at sea. Often these conventions provide for liability amounts and require the maintenance of adequate insurance or other financial security. If a similar regime was developed for CCS, this may provide a method of addressing a number of liability concerns.

## 11.7 Key barriers

**Key barriers**

- CCS is not yet an accepted carbon credit generating mechanism under either of the Kyoto Protocol's Flexible Mechanisms.
- The London Protocol and the Basel Convention may both need to be amended so as to accommodate key elements of CCS projects.

# 12. Conclusions

Recognising the adverse environmental effects of GHG emissions, most governments are now taking some steps to reduce such emissions either in satisfaction of international treaty obligations or in discharge of domestic goals.

As an initial and widespread response, many are putting a price on carbon, either through cap and trade schemes or taxes. These measures are designed to reduce reliance on high GHG emitting fuel sources and promote energy efficiency and the development of low emission energy sources.

To achieve GHG emission reductions within the timeframes said by the IPCC to be required to avoid the effects of dangerous climate change is, however, a real challenge given the relative abundance and cheapness of fossil fuels (and in particular coal), from which much of the world's base load power is currently derived.

CCS is a technological response available to fossil fuel users which has the potential to remove significant quantities of CO2 from the atmosphere whilst allowing economies to continue to use fuel sources which are still generally cheaper than alternative energy sources such as biofuels, solar, wind, wave and geothermal power.

To identify then effectively plug the policy and legislative gaps needed to rapidly promote and facilitate CCS projects will be a very significant undertaking for all governments wishing to host such projects. This challenge will be particularly acute in developing economies where laws and policies relevant to the CCS project cycle may be non-existent rather than just in need of reform.

As major fossil fuel using economies such as China and India continue to expand, and as the global economy recovers from the recession of 2008-2009, the pressure to develop and deploy commercial scale CCS projects will intensify. The G8's goal of 20 commercial scale CCS projects by 2020 is one which the Global CCS Institute and others are focussed on.

Government funding for pilot projects, research bodies and projects as well as industry associations and groups can only do so much. Clear laws and policies, preferably those operating across national and international borders, can give industry and investors the confidence they need to help push CCS from demonstration facilities and into large scale plants.

With some exceptions, however, very few countries have yet developed policies, or enacted laws, which will readily or rapidly facilitate and regulate commercial scale CCS projects. The elements of gas capture, transport and storage are already capable of regulation in various countries but there is generally a lack of cohesion and there are important gaps in those existing laws which are likely to hamper CCS development, especially in the short term.

Apart from international legal action (such as amendments to the CDM to allow it to encompass CCS projects), CCS-specific law reform programmes, drawing from some of the examples already at hand, are needed by most countries. This will help them make CCS part of their mainstream economies and therefore enable them to make a measurable contribution to reducing the risks of dangerous climate change.

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