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Development and distribution of the IEA CCS Model Regulatory Framework

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Abstract

The IEA CCS Roadmap highlights the significance that CCS will play in achieving an atmospheric CO_2 stabilisation of 450ppm. In the scenario it is based on, CCS will provide approximately 20% of the total CO_2 emissions reductions out to 2050. To achieve this contribution, an ambitious CCS growth path will be required, with around 100 projects needed globally by 2020, and over 3000 by 2050.

As a result of the required CCS expansion, a number of regulatory issues associated with protecting public health, safety and the environment, as well as ensuring stewardship for permanent CO_2 storage, will need to be addressed. There is also a need to provide flexible, adaptive regulations for the first set of demonstration projects. To address these issues, governments are amending existing resource extraction or environmental impact frameworks to allow the first demonstration projects to move forward, while at the same time developing dedicated legal frameworks to facilitate CCS commercialisation for the longer-term. In some cases, project-specific regulations may also be needed.

In recent years, the international community has amended a number of legal instruments to advance CCS development. The London Protocol was amended in 2006 to allow for offshore CO_2 storage and in 2009 to allow for cross-border transport of CO_2; in 2007, the OSPAR Convention adopted similar provisions. The UNFCCC does not include a firm commitment for parties with regard to CCS; however, in 2006, the IPCC released the revised *Guidelines for National Greenhouse Gas Inventories*, which are used for calculating and reporting national GHG emissions and removals. Although not yet officially sanctioned for use, these guidelines include a complete methodology for the treatment of CCS under the Kyoto Protocol to the UNFCCC and currently have to be used in Kyoto Protocol Annex 1 countries (industrialised), but not yet by non-Annex 1 countries (developing).

In parallel, many countries are developing comprehensive domestic regulatory frameworks for CCS. Dedicated legal frameworks enable CCS activities either through licensing regimes or by providing regulatory support for the financing of demonstration projects. The European Commission's 2008 CCS Directive establishes a regulatory framework for the geological storage of CO_2. Australia has also enacted comprehensive state and national CCS regulatory frameworks for CO_2 storage. Additionally, regulations are currently being pursued in the United States, Canada, Norway and Japan.

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To assist in the rapid deployment of CCS in line with the recent findings of the IEA CCS Roadmap, the IEA, with assistance from Carbon Counts, Reed Smith LLP and UCL CCLP, has developed the IEA CCS Model Regulatory Framework, which is intended to serve as a tool to assist governments around the world in the development of national regulatory frameworks. The Model Framework draws from current CCS regulatory developments in Europe, Australia, the USA, and elsewhere, to ensure that the work done in these countries can be leveraged around the world. The IEA, through this analysis, provides non-prescriptive assistance in CCS regulatory development to countries looking to develop their own domestic framework.

This paper discusses the major features of the IEA CCS Model Regulatory Framework and how it can be best distributed and used to assist in the development of regulatory frameworks in all key regions of the world.

Keywords: CCS; CO_2; legal; regulate; international; model; framework

1. Importance of regulating CCS and current status

The recent International Energy Agency (IEA) publication *Energy Technology Perspectives 2010* (ETP) projects that in 2050, energy-related carbon dioxide (CO_2) emissions will be two times 2007 levels in the absence of new energy policies or supply constraints, due primarily to increased fossil fuel demand and a rise in the carbon intensity of primary energy. The ETP BLUE Map scenario provides a cost-optimised strategy for reducing currently projected greenhouse gas (GHG) emissions by half relative to 2005 levels by 2050, in order to achieve CO2 atmospheric concentration stabilisation below 450ppm. It concludes that, in order to achieve the required emissions reductions in the most cost-effective manner, carbon capture and storage (CCS) will need to contribute around one-fifth of total emission reductions in 2050. Importantly, the BLUE Map results identify that if CCS technologies are not available, the overall cost of halving projected 2050 CO_2 emissions rises by 70%. CCS is therefore an essential part of the portfolio of technologies that is needed to achieve deep global emissions reductions. The 2009 IEA publication *Technology Roadmap: Carbon capture and storage* (CCS Roadmap) highlights that if CCS is to fully contribute to the stabilisation of CO_2 concentrations in the atmosphere by 2050, an ambitious CCS growth path is required, with around 100 projects needed globally by 2020, and over 3000 by 2050. Achieving rapid CCS demonstration and deployment is a tremendous global challenge, and the technology must urgently move into a commercial phase of technology deployment in all parts of the world.

The required expansion of CCS gives rise, however, to a number of regulatory issues associated with ensuring effective stewardship of CO_2 storage sites over the long-term, including the protection of public health, safety and the environment. To ensure safe, permanent CO_2 storage, efforts to demonstrate the technical, safety and environmental viability of commercial-scale CCS projects must therefore be accompanied by parallel regulatory developments. In recent years, the international community has amended certain international legal instruments to advance CCS development. The Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1996 (London Protocol) was amended in 2006 to allow for offshore CO_2 storage; it was again amended in 2009 to allow for cross-border transportation of CO_2. In 2007, the Convention for the Protection of the Marine Environment of the North-East Atlantic 1992 (OSPAR Convention) adopted similar provisions[2]. The United Nations Framework Convention on Climate Change, 1992 (UNFCCC), which aims at stabilising GHG concentrations in the atmosphere to a level that will prevent interference with the climate system, does not include a firm commitment for parties with regard to CCS; however, in 2006, the Intergovernmental Panel on Climate Change released the revised *Guidelines for National Greenhouse Gas Inventories* (Guidelines), which are used for calculating and reporting national GHG emissions and removals. Although not yet officially sanctioned for use, the Guidelines include a complete methodology for the treatment of CCS under the Kyoto Protocol to the UNFCCC[3].

[2] Note that the 2009 London Protocol amendment and the OSPAR amendments have not yet entered into force.

[3] Currently the 2006 IPCC GLs have to be used Kyoto Protocol Annex 1 countries (industrialised) but not yet by non-Annex 1 countries (developing).

Currently the Guidelines have to be used in Kyoto Protocol Annex 1 countries (industrialised), but not yet by non-Annex 1 countries (developing).

In parallel with these international efforts, governments around the world have started to amend existing resource extraction or environmental impact frameworks to provide flexible, adaptive regulations to enable early demonstration projects to move forward. At the same time, a number of countries and regions are developing dedicated regulatory frameworks to facilitate large-scale CCS commercialisation over the longer-term, either through licensing regimes or by providing regulatory support for the financing of demonstration projects. For example, the European Commission's 2008 CCS Directive establishes a regulatory framework for the geological storage of CO_2 within the European Union (EU); Australia has enacted comprehensive state and federal CCS regulatory frameworks; and frameworks are currently being developed in the United States, Canada, Norway and Japan. However, despite the progress underway in certain countries, the comprehensive regulatory frameworks necessary to effectively govern CCS and support the technology's deployment are not yet in place in the majority of countries around the world.

To assist the technology to fully contribute to the stabilisation of CO_2 concentrations in the atmosphere by 2050, and in conjunction with the advancement of CCS technology, the CCS Roadmap identifies three key actions for CCS regulatory development as follows:

1. review and adapt existing legal frameworks to regulate CCS demonstration projects by 2011 in OECD countries, 2013 in early-mover non-OECD countries, and 2015 in all non-OECD countries with CCS potential;
2. all countries with CCS activities review existing legal frameworks for their ability to regulate CCS, identify barriers or gaps, and create a comprehensive CCS regulatory framework, if required, by 2020; and
3. address international legal issues, including development of an international monitoring and verification protocol for CO_2 storage and allowance of transboundary CO_2 transfer under the London Protocol by 2012.

2. IEA CCS Model Regulatory Framework

To support the first two actions for CCS regulatory framework development set out in the CCS Roadmap, and in turn the level of CCS deployment required to achieve the emissions reduction potential identified by the ETP BLUE Map scenario, the IEA has developed an IEA CCS Model Regulatory Framework (Model Framework), with assistance from Carbon Counts, Reed Smith LLP and the Carbon Capture Legal Programme of the University College London (UCL CCLP). The Model Framework, which is due for release in October 2010, is intended to serve as a tool to assist governments around the world develop national regulatory frameworks by drawing on existing regulatory frameworks for CCS in Europe, Australia, the USA and elsewhere, to synthesise and propose key principles for dealing with a number of regulatory issues associated with CCS. The Model Framework thereby harnesses the work done in early-mover CCS regions for the benefit of countries looking to develop domestic CCS regulatory frameworks going forward.

The Model Framework is intended to be in a form appropriate to authorities around the world, operating in diverse legal and regulatory environments and in the context of varying existing resource extraction or environmental impact frameworks, and is therefore necessarily high level. It avoids prescribing how any particular issue should be translated into domestic legal systems. Rather, the Model Framework proposes a base, 'starting point' regulatory framework in respect of certain CCS regulatory issues (Model Text), around which jurisdictionally appropriate additions and amendments are intended to be incorporated, and explanatory materials and examples for dealing with regulatory issues across the CCS chain.

3. Scope and structure of Model Framework

While the Model Framework addresses all stages of the CCS chain, including CO_2 capture, transport and geological storage, it focuses primarily on regulatory issues associated with CO_2 storage. This is because CO_2

storage is commonly accepted as presenting the most novel and complex challenges in elaborating regulatory frameworks for CCS; regulatory issues associated with CO_2 capture and transport are generally likely to fall within the scope of existing regulatory frameworks in most regions, including in relation to oil and gas, mining, waste, health and safety, property right and transport, or fall within the scope of these frameworks by virtue of minor modifications only. The majority of CCS regulatory frameworks reviewed in drafting the Model Framework have a similar focus on regulating CO_2 storage: therefore, given that the Model Text included in the Model Framework was derived through a process of review, synthesis and extraction of key principles from these existing frameworks, Model Text is only included on the storage aspects of CO_2.

The Model Framework is structured around twenty nine key CCS regulatory issues, which fall into four broad categories in the Model Framework:

- broad regulatory issues - issues arising from the interaction of CCS regulatory frameworks with pre-existing domestic or international laws;
- existing regulatory issues applied to CCS - domestic regulatory issues that extend beyond CCS operations that should be reflected in CCS regulatory frameworks;
- CCS-specific regulatory issues - issues that are specific to CCS and in particular to CO_2 storage operations;
- emerging CCS regulatory issues - issues that are unique to CCS and have been identified as being significant in regulating CCS activities, but that to date are not well understood in a legal context or addressed in detail in existing CCS regulatory frameworks.

For issues arising under all four categories, the Model Framework includes a general description of the issue, more detailed explanatory material setting out various considerations to be taken into account in designing regulatory approaches to the issue, and examples from existing CCS regulatory frameworks illustrating how the relevant issue has been addressed in given jurisdictions. For CCS-specific regulatory issues, which deal principally with issues arising from CO_2 storage operations, the Model Framework includes Model Text, to provide national authorities with a base regulatory framework to consider in developing domestic CCS regulatory approaches on the issues raised. The key issues falling into each category are listed below:

Broad regulatory issues	1	Classification of CO_2
	2	Property rights
	3	Competition with other users and preferential rights issue
	4	Transboundary movement of CO_2
	5	International laws on protection of the marine environment
	6	Incentivising CCS as part of climate change mitigation strategies
Existing regulatory issues applied to CCS	7	Protecting human health
	8	Composition of the CO_2 stream
	9	The role of environmental impact assessment
	10	Third party access to storage site and transportation infrastructure
	11	Engaging the public in decision-making
CCS specific regulatory issues	12	CO_2 capture
	13	CO_2 transportation
	14	Scope of framework and prohibitions
	15	Definitions and terminology applicable to regulating CO_2 storage
	16	Authorisation of storage site exploration activities
	17	Regulating site selection and characterisation activities
	18	Authorisation of storage activities
	19	Project inspections

	20	Monitoring, reporting and verification requirements
	21	Corrective measures and remediation measures
	22	Liability during the project period
	23	Authorisation for storage site closure
	24	Liability during the post-closure period
	25	Financial contributions to post-closure stewardship
Emerging CCS regulatory issues	26	Sharing knowledge and experience through the demonstration phase
	27	CCS ready
	28	Using CCS for biomass-based sources
	29	Understanding enhanced hydrocarbon recovery with CCS

The CCS Roadmap actions for CCS regulatory framework development build on existing domestic regulatory frameworks in recommending that existing regulatory frameworks be reviewed and adapted to regulate CCS demonstration projects, and in assessing whether comprehensive CCS regulatory frameworks for large-scale CCS deployment are required. The Model Framework also provides guidance on reviewing the international and domestic context related to CCS regulatory regimes. It emphasises that jurisdictions should consider how regulatory issues raised by CCS operations can potentially be regulated by modifying existing regulatory frameworks to cover certain aspects of the CCS chain, whether existing regulatory frameworks pose potential barriers to various aspects of CCS, and whether the introduction of a regulatory regime for CCS could pose unintended consequences or interactions with existing laws.

4. Model Framework development process

The Model Framework was prepared under the supervision of an Advisory Committee made up of key CCS stakeholders, including various governments, industry bodies and non-governmental organisations. The Advisory Committee was assembled to include representatives from countries and regions that are well advanced in developing CCS regulatory approaches, as well as representatives from countries that may be interested in using the Model Framework to assist with the development of regulatory frameworks for CCS in the future.

To commence the Model Framework development process, Advisory Committee members were asked to identify all documents that should be considered in preparing the Model Framework. Documents identified by the Advisory Committee included existing and proposed legal instruments, regulatory guidance documents, and consultation documents. The Advisory Committee was also asked to identify the key regulatory issues to be addressed in the Model Framework: these are reflected in the twenty nine key CCS regulatory issues on which the Model Framework is based. The Model Framework drafting team, which consisted of representatives from the IEA, UCL CCLP, Reed Smith LLP and Carbon Counts, reviewed the documents identified by the Advisory Committee in late January and February 2010, focussing on the key regulatory issues proposed to be addressed in the Model Framework. The Model Framework was reviewed twice by the Advisory Committee during the drafting process, with comments feeding back into subsequent drafts prior to publication.

5. Key CCS regulatory issues addressed by the Model Framework

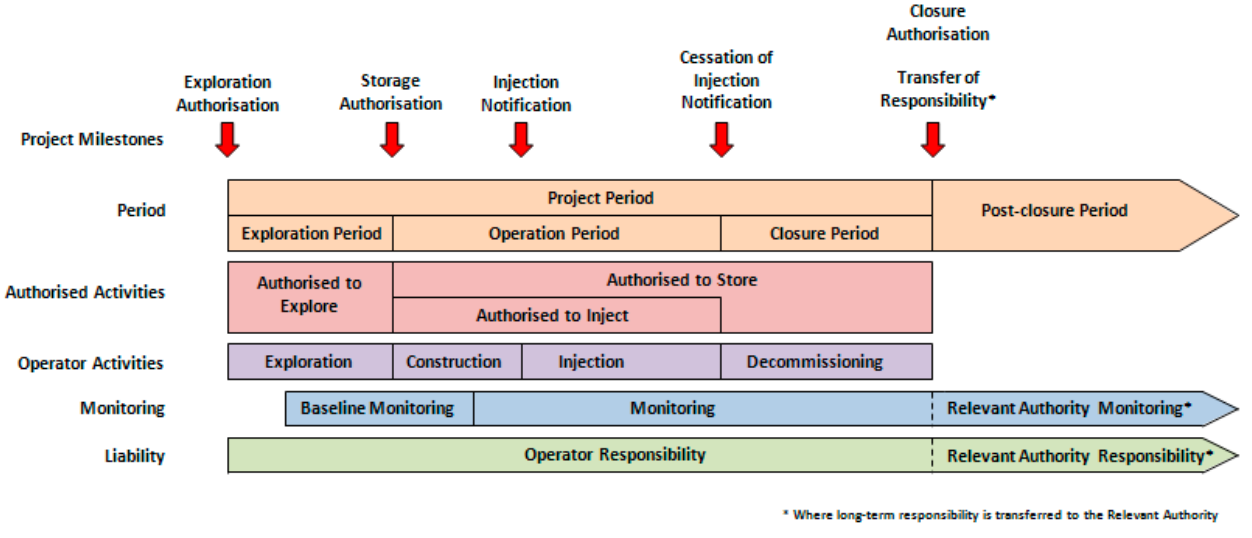
Of the four broad categories of CCS regulatory issues addressed in the Model Framework, the 'CCS-specific regulatory issues' category represents the core focus of the Model Framework, as regulatory issues specific to CCS, and in particular to CO_2 storage operations. It is in respect of these issues that the Model Framework provides Model Text. Fourteen CCS regulatory issues are treated in this category: twelve relating to CO_2 storage, and an additional two issues relating to CO_2 capture and transport respectively. An example of a CO_2 storage regulatory issue addressed in the Model Framework is that of regulating site selection and characterisation activities. The Model Framework highlights appropriate site characterisation and selection as the most critical factor in attempting to ensure the long-term permanence of CO_2 storage, and the consequential importance of incorporating appropriate characterisation and site selection processes into regulatory approval systems for storage site development. It then proposes a generalised methodology that may be adopted in technical guidance for site characterisation, including data collection, undertaking performance assessments in respect of data collected (capacity estimation, CO_2 behaviour and fate analysis, geological features and process analysis), sensitivity analysis, risk analysis, and

determination of appropriate modes of operation drawing on the analysis previously undertaken. The Model Text relating to site characterisation and selection can be seen below:

Regulating site selection activities (Site characterisation and selection)

1. *A site characterisation process as required by the relevant authority must be undertaken in respect of a proposed storage site.*
2. *The results of the site characterisation process must be submitted as part of a storage authorisation application.*
3. *To be a suitable storage site, the site characterisation process must indicate that a proposed storage site:*
    a. *has sufficient storage capacity for the intended quantity of CO_2 to be stored;*
    b. *has sufficient injectivity for the intended rate of CO_2 injection; and*
    c. *is free of faults, fractures, wells or other features that are likely to allow unintended migration*
4. *A proposed storage site is not suitable where the site characterisation process indicates that it poses:*
    a. *significant risk of unintended migration;*
    b. *significant risk of leakage;*
    c. *significant environmental risks;*
    d. *significant health risks; or*
    e. *significant risk to other resources.*
5. *Where the location of a proposed storage site would result in the existence of more than one storage site in the same primary formation, the potential interaction of the sites (including but not limited to interaction of CO_2 plumes and pressure interactions) must be such that both sites will meet, or continue to meet, the requirements of this section.*

A further issue addressed under this category is post-closure liability. The conceptual approach to the various phases of the CCS chain adopted in the Model Framework, including the post-closure phase, is set out in the figure below:



The Model Framework notes that the issue of long-term liability has to date been seen as one of the most challenging and complex issues associated with regulation of CO_2 storage activities. In the documents reviewed in drafting the Model Framework, long-term liability was generally addressed in one of two ways: either provision was made for the transfer of responsibility to the relevant authority, or long-term liability was not discussed. Where the issue of long-term liability is not raised, it is assumed that the operator retains responsibility for a storage site in perpetuity. Where provision is made for the transfer of liability, generally the operator will be required to satisfy the relevant authority that there is negligible risk of future leakage or other irregularity in the storage site before the relevant authority will assume responsibility for the storage site. In certain jurisdictions, operators may be state-owned and there will therefore not be a clear separation of ownership, and therefore responsibility, between the operator and the state: in this situation, the issue of transfer of responsibility will not arise. The Model Framework sets out arguments that have been raised both for and against a transfer of liability from the operator to the relevant authority in the post-closure phase. Where a jurisdiction determines that it is appropriate to provide for a transfer of responsibility, Model Text is provided as an example of how this may be addressed, as set out below. The Model Framework then discusses obligations that may arise following a transfer of responsibility, including monitoring, meeting any costs incurred as a result of leakage or unintended migration and in undertaking corrective or remediation actions, and responsibility for meeting any liabilities arising out of the storage site (including for global effects of leakage, where emission reduction commitments and incentive schemes are in place).

Liability during the post-closure period

1. *Subject to the terms of this section, where a closure authorisation has been issued for a storage site, responsibility for the storage site transfers to the relevant authority.*
2. *On transfer of responsibility for a storage site to the relevant authority, the relevant authority assumes:*
    a. *responsibility for any liabilities for damage caused by the storage site, including but not limited to:*
        i. *damage to the environment;*
        ii. *damage to human health;*
        iii. *damage to other resources;*
        iv. *damage to third party assets;*
        v. *the cost of corrective measures required to limit the extent of the damage; and*
        vi. *the cost of remediation measures associated with the damage;*
    b. *responsibility for:*
        i. *monitoring the storage site;*
        ii. *undertaking any corrective measures; and*
        iii. *undertaking any remediation measures;*
3. *Despite paragraph 2 of this section, in the post-closure phase an operator remains responsible for any liabilities for damage caused by a storage site where that damage results from fault or negligence of the operator during the project period.*

Further to the 'CCS-specific regulatory issues' category, the three additional categories of CCS regulatory issues in the Model Framework merit discussion. With respect to the 'broad regulatory issue' category, this category

addresses issues arising from the interaction of CCS regulatory frameworks with pre-existing domestic or international laws. For example, one of the issues addressed is how regulatory classifications of CO_2 or captured CO_2 (as waste, for example) can potentially impact on the way existing regulatory frameworks might apply to CCS operations. As an example, the Model Framework uses the EU experience with CO_2 classification, in particular Directive 2009/31/EC on the geological storage of CO_2 that excludes CO_2 from the scope of EU waste regulations to avoid the imposition of a host of EU waste regulations on CCS operations. Another issue is the review of international laws on protection of the marine environment, namely the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Convention), the London Protocol and the OSPAR Convention, to remove impediments to undertaking CO_2 storage in sub-seabed geological formations.

Turning to 'existing regulatory issues applied to CCS', the second regulatory issue category, this category addresses domestic regulatory issues that are relevant beyond CCS operations, but that should be reflected in CCS regulatory frameworks. For example, one of the issues discussed under this category is protecting human health. The Model Framework sets out key areas related to human health for consideration in developing CCS regulatory frameworks, including occupational health and safety and civil protection, and suggests that an analysis of existing regulatory measures in these areas be conducted to verify the scope and coverage of existing regulation. The approach adopted in the Australian federal legislation *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Commonwealth), which establishes a scheme to regulate occupational health and safety matters at or near CCS facilities located in Commonwealth waters, is provided as an example.

The final category of regulatory issues addressed in the Model Framework is 'emerging CCS regulatory issues'. These are, as previously noted, issues that are unique to CCS and that have been identified as being significant in regulating CCS activities, but that to date are neither well understood in a legal context, nor addressed in detail in existing CCS regulatory frameworks. These issues include sharing knowledge and experience through the demonstration phase, using CCS for biomass-based sources, and understanding enhanced hydrocarbon recovery with CCS. With respect to sharing knowledge and experience through the demonstration phase, to take an example, the Model Framework addresses the benefits of national level demonstration frameworks and overall country level demonstration strategies, current forums for the dissemination of good practice, and emerging technology transfer processes and technology mechanisms through the United Nations Framework Convention on Climate Change. It also considers intellectual property rights issues, noting the balance required between facilitating knowledge sharing in the context of emerging market players, and providing incentives for innovation.

6. Anticipated Model Framework distribution process

Certain countries and regions have advanced beyond the point where the Model Framework is likely to provide significant assistance to their CCS regulatory development processes: it is these countries and regions whose work to date provides the foundation for the Model Framework. The primary target audience for the Model Framework consists of countries that are currently developing or considering developing near-term regulatory approaches to facilitate CCS demonstration efforts, or comprehensive regulatory frameworks for the large-scale commercial deployment of CCS. In particular, it is countries that are understood to have good potential for CCS deployment that are intended to be the initial focus, and developing countries.

The IEA is currently in discussions with a number of jurisdictions that are interested in participating in case studies for the roll out of the Model Framework following the document's release in October 2010. The idea is that these jurisdictions will use the Model Framework to assist them in canvassing the development of a CCS regulatory framework within their jurisdictions, with any feedback from these processes to input into future updates of the Model Framework. It is also envisaged that the Model Framework will be updated periodically as further experience in regulating CCS activities is gained globally.