

April 2012

Tracking Progress in Carbon Capture and Storage

International Energy Agency/Global CCS Institute
report to the third Clean Energy Ministerial



Carbon Capture, Use and Storage Action Group recommendations to CEM 2, April 2011

At the second Clean Energy Ministerial (CEM 2, Abu Dhabi, April 2011), the Carbon Capture, Use and Storage Action Group (CCUS AG) presented seven substantive recommendations to Energy Ministers on concrete, near-term actions to accelerate global carbon capture and storage (CCS) deployment. The recommendations set out key actions in CCS financing, industrial applications, CO₂ storage, regulation and knowledge-sharing, aimed at closing the gap between current CCS development and deployment and the progress required to achieve the level of ambition associated with CCS technologies. Twelve CCUS AG governments agreed to advance progress against the 2011 recommendations by the third CEM in London, April 2012 (CEM 3),¹ with supporting actions to be undertaken by CCS organisations and industry.

Following CEM 2, the CCUS Action Group requested the International Energy Agency (IEA) and the Global CCS Institute to report on progress made against the 2011 recommendations at CEM 3, reflecting an eighth, reporting recommendation endorsed by Energy Ministers at CEM 2. This report responds to that request. Section 1 provides an overarching analysis of progress made by committed governments across the 2011 recommendations since CEM 2, building on CCS analysis contained in the IEA's broader *Tracking clean energy progress: Energy Technology Perspectives 2012 excerpt as IEA input to the Clean Energy Ministerial*² and the Global CCS Institute's *Global status of CCS update to 3rd Clean Energy Ministerial*³ report. Section 2 provides a detailed account of developments against each recommendation. In addition to progress by committed governments, relevant CCS organisation and industry developments are also set out. Developments prior to CEM 2 are not addressed, given this report is focussed on advancements since CEM 2 (*i.e.* April 2011) specifically.

To produce this report, the IEA and Global CCS Institute conducted formal interviews with committed governments in January and February 2012, building on informal consultation and progress tracking throughout 2011.

The seven substantive recommendations endorsed by Energy Ministers at CEM 2 include, by CEM 3:

- **Recommendation 1: Reduce the financial gap.** Advance policies that address the financial gap and risk associated with early mover CCS demonstration and deployment.
- **Recommendation 2: Funding support in developing economies.** Identify and advance appropriate funding mechanisms to support the demonstration of large-scale CCS projects in developing economies.
- **Recommendation 3: Develop legal and regulatory frameworks.** Advance the development of legal and regulatory frameworks for CCS demonstration and deployment.
- **Recommendation 4: Acknowledge importance of marine treaty amendments.** Promote the importance to global CCS deployment of ratifying key international marine treaty amendments.
- **Recommendation 5: Share knowledge.** Support and encourage the development of best practice knowledge sharing from early mover projects, in particular those with public funding.
- **Recommendation 6: Investigate CO₂ storage.** Review key gaps in storage data coverage and knowledge, and progress storage exploration and capacity assessment.
- **Recommendation 7: Support CCS in industry.** Recognise the potential of CCS for industrial emission sources and review demonstration opportunities.

¹ Australia, Canada, France, Germany, Japan, Republic of Korea, Mexico, Norway, South Africa, the United Arab Emirates, the United Kingdom and the United States. China did not formally sign up to the 2011 recommendations but participated in the reporting process and therefore this report also addresses relevant developments in China. The Republic of Korea did not participate in the reporting process and consequently this report does not address developments that may have occurred in that country.

² IEA (2012), *Tracking clean energy progress: Energy Technology Perspectives 2012 excerpt as IEA input to the Clean Energy Ministerial*, OECD/IEA, Paris (www.iea.org).

³ Global CCS Institute (2012), *Global status of CCS update to 3rd Clean Energy Ministerial*, Global CCS Institute, Canberra (www.globalccsinstitute.com).

SECTION 1

Tracking progress in carbon capture and storage

The IEA's *Tracking clean energy progress* report, which looks at progress towards a low-carbon energy system across clean energy technologies, singles CCS out in its recommendations to CEM 3 Energy Ministers.⁴ Despite being amongst the technologies with the greatest potential for carbon dioxide (CO₂) emissions savings, considerable work remains to be done. Deployment rates for large-scale integrated projects (LSIPs) are off pace;⁵ CCS is not seeing the necessary rate of investment into full-scale demonstration projects; incentives are lacking for deployment beyond demonstration; and attention to CCS applications in industries other than the power sector is inadequate. In short, current global efforts do not match the significant emission reduction ambitions associated with CCS.

The CCUS AG recommendations to CEM 2 were aimed at assisting Energy Ministers in identifying key actions to undertake in the near term to step up to the CCS challenge. Taken as a whole, what advancements have committed CCUS AG governments made against the 2011 recommendations since CEM 2?⁶ How can Energy Ministers continue to drive progress to enable CCS to fully contribute to climate change mitigation? While urgent further action is required in all areas, are there particular areas that are currently receiving less policy attention than others, where efforts could be redoubled? These are the key questions this report aims to address.

Consistent with the broader findings in the IEA's *Tracking clean energy progress* report, despite developments in some areas, significant further work is required. CCS financing and industrial applications continue to represent a particularly serious challenge.

■ Financial and policy support for demonstration and deployment

Financial and policy support for CCS demonstration and future deployment remains perhaps the most critical challenge to development of CCS technologies (Recommendation 1). Globally, approximately USD 21.4 billion is currently available to support large-scale CCS demonstration. This amount would be sufficient to cover the incremental capital cost of capture, transport and storage for a portfolio of up to approximately 20 commercial-scale power plants. Of that amount, only 60% has been allocated; additional funding has also been limited since 2008, when new funding peaked as part of economic stimulus plans.⁷

In line with this broader picture, committed governments with technology demonstration programmes in place (six of twelve committed governments) reported support within the scope of existing programmes only (*i.e.* with no additional funding committed since CEM 2).

Beyond demonstration, the UK government's proposed Electricity Market Reform – announced July 2011 – is significant, in that it represents the first comprehensive attempt globally to set policy to drive CCS deployment beyond demonstration. There has however been limited movement otherwise in developing targeted deployment programmes, although countries including Australia, Canada and the United States have advanced broader emissions reductions initiatives that could in the future provide incentives for CCS installations.

⁴ At page 8 of the report, available at www.iea.org/.

⁵ The Global CCS Institute's *Global status of CCS update* to CEM 3 provides a comprehensive update on the status of LSIPs globally, available at www.globalccsinstitute.com.

⁶ Detailed developments as against each recommendation are set out in Part 2 of this report.

⁷ The mechanisms by which governments can support large-scale demonstrations vary and support of incremental capital costs is only one approach. Furthermore, capital cost support may not be sufficient to incentivise commercial development of demonstration projects as, in many markets, these projects still compete on the basis of operating cost.

Strong government support through both demonstration funding and CO₂ emissions-reduction policies is critical for CCS deployment, to address both early mover technology costs and risks, and reflect the fact that CCS is motivated primarily by climate policy.⁸ The near-term actions under Recommendation 1 of the 2011 CCUS Action Group report, related to identifying shortfalls in existing CCS or climate change policies and assessing appropriate policies to reduce the financial gap, remain relevant to driving progress in this area. The Clinton Climate Initiative undertook a preliminary gap analysis of existing policy support in committed governments in November 2011. The IEA also released *A policy strategy for carbon capture and storage* information paper in January 2012, to advise governments of available policy options to reduce the financial gap and address early-mover technology risks.⁹ This work may assist committed governments in driving progress against Recommendation 1. In addition, the Global CCS Institute, in conjunction with the Program Managers Network (PMN) (a network of governments that are involved in the management of large scale demonstration programs) will conduct a project to map and analyse the financial and commercial risks that exist along the CCS supply chain through examining lessons learnt around international demonstration programs. The project will aim to work with jurisdictions, project proponents and the investment community to develop policy options to address the main impediments to CCS demonstration.

Key point

CCS deployment will not happen without additional demonstration funding and policy incentives for deployment beyond demonstration, including strong and credible emission reduction policies. The 2011 near-term actions under Recommendation 1 remain relevant to driving progress, but require real commitment by governments to drive progress.

■ Funding mechanisms to support demonstration in developing countries

Implementing appropriate funding mechanisms to support large-scale CCS demonstration projects in developing economies also remains a significant challenge (Recommendation 2). Following CEM 2, the Australian and UK Energy Ministers requested the Global CCS Institute to establish a working group to identify and advance appropriate funding mechanisms. The working group has delivered a separate report on its findings to CEM 3, *Funding CCS in Developing Countries*.¹⁰

The report makes a number of recommendations. In the short term (to 2015), it recommends, amongst other things, that additional funding of USD 150-200 million be made available for CCS enabling and pre-investment activities in developing countries. This is to enable between 5-10 demonstration projects to proceed to final investment decision by around 2015. The report identifies a number of potential funding vehicles that could be used to deliver these funds. In the medium term, it recommends that dedicated CCS funding in the order of USD 5 billion be made available for the “extra” CCS costs of construction and operation of demonstration projects.

IEA analysis sees non-OECD regions capturing cumulatively more CO₂ than the OECD from 2015-2050; it is therefore essential that effective mechanisms for the transfer of funding from developed to developing countries support required levels of deployment in these regions. Energy

⁸ The *Global status of CCS update* reports that the most frequently cited reasons for project cancellations or delay include lack of government funding and uncertainty regarding future carbon abatement policies.

⁹ IEA (2012), *A Policy Strategy for Carbon Capture and Storage*, OECD/IEA, Paris (www.iea.org/papers/2012/policy_strategy_for_ccs.pdf).

¹⁰ Available at www.globalccsinstitute.com/

Ministers should work within their respective governments to drive progress toward the proposals put forward by the working group and consider any further recommendations made to CEM 4.¹¹

A significant advancement was made in this area at the Durban Climate Change Conference (CMP7/COP17) in November/ December 2011, where agreement was reached on inclusion of CCS projects in the Clean Development Mechanism (CDM) with finalisation of modalities and procedures for CCS. This represents a critical development towards an internationally-agreed approach to CCS deployment in developing countries, and may facilitate inclusion of CCS in other international funding mechanisms. Several committed governments actively supported this process. In terms of developments relevant to bilateral support, the Japanese government proposed a bilateral offset credit mechanism in 2011, in order to introduce low-carbon technologies, including CCS, into developing countries. It proposes to develop methodologies cooperatively with relevant partner countries.

Key point

Non-OECD regions will need to capture cumulatively more CO₂ than the OECD from 2015-2050; significant funding support will be required to achieve this level of deployment. Energy Ministers should work within their respective governments to drive progress in implementing the proposals put forward in *Funding CCS in Developing Countries*.

■ CCS applications in industry

Current government efforts to support CCS in industry (Recommendation 7) do not match the significant potential highlighted by the IEA/UNIDO *Technology Roadmap: Carbon Capture and Storage in Industrial Applications* publication, launched in September 2011.¹² By 2050, around 4Gt of global CO₂ emissions could be cut per year by using CCS in industry. This represents approximately half of total emissions reductions that IEA analysis attributes to CCS by 2050.

There have been some developments at a high- or individual project-level since CEM 2. For example, the UK's CCS Roadmap addresses CCS in industry at a broader level, highlighting intended future work and potential clusters of power and industrial plant. Funding announcements by the Australian government for the Collie South-West Hub and CarbonNet projects are examples of developments at the project level; the UAE's Emirates Steel Industries project, which is currently going into tender, is another. France and Japan have also made progress in this area; in France, the ArcelorMittal project, which has applied for funding under the European Commission's NER 300 programme, is of particular note. Despite these developments, there has been little progress by committed governments towards comprehensively recognising the potential of CCS for industrial emission sources and reviewing demonstration opportunities. CCS in industry continues to receive significantly less policy attention than CCS in the power sector.

¹¹ The working group is proposing to consult further with relevant governments on which funding vehicle they prefer and why; key principles and funding criteria under each funding vehicle; identify any barriers preventing implementation of the recommendations; and if applicable, make further recommendations to address these barriers.

¹² IEA/UNIDO (2011), *Technology Roadmap: Carbon Capture and Storage in Industrial Applications*, OECD/IEA; UNIDO, Paris (www.iea.org/Papers/roadmaps/ccs_industry.pdf). It is generally understood that "industrial" CCS refers to all applications other than in the power sector. These industrial sectors include inter alia gas processing and other high-purity sources, iron and steel production, cement manufacturing, biofuel production and the refining industry.

To help drive progress, the CCUS AG is proposing to establish an industry-CCS working group, led by the IEA and the UK-based Carbon Capture & Storage Association, to: identify key technical and policy barriers to developing industry CCS projects in CCUS AG countries; identify policies necessary to advance industrial CCS; and report back to Energy Ministers at CEM 4.

Key point

CCS in industry could contribute approximately half of emissions reductions from CCS in 2050, but greater policy focus on opportunities for CCS applications in industry is required. Energy Ministers should work within their respective governments to support the CCS in industry working group up to CEM 4 and accelerate progress against the 2011 near-term actions under Recommendation 7.

■ Enabling legal and regulatory frameworks

In contrast to Recommendations 1, 2 and 7, progress has been made across committed governments against Recommendation 3: advance development of legal and regulatory frameworks for demonstration and deployment. All but one government has progressed in developing CCS regulations since CEM 2, and several committed governments which are advanced in framework development are now trying to finalise regulatory detail on complex issues such as third party access to CCS infrastructure, competition between resources, and methodology for determining financial contributions to long-term stewardship. The Canadian province of Alberta, Australia and the United Kingdom are examples. Committed governments that are at earlier stages of framework development have also made progress. South Africa, for example, established an Interdepartmental Task Team on CCS in October 2011, to drive framework development.

In 2009, the IEA recommended that OECD countries develop frameworks for CCS demonstration by 2011, early-mover non-OECD countries by 2013, and other non-OECD countries with CCS potential by 2015. Committed governments must continue in their efforts to develop enabling frameworks, to ensure that the absence or incomplete implementation of laws and regulation does not unnecessarily impede or slow deployment.

There has also been progress in ratifying key international marine treaty amendments (Recommendation 4). In October 2011, the OSPAR Secretariat advised that the 2007 OSPAR Convention¹³ amendment had formally entered into force as of 23 July 2011, for contracting parties to have ratified as of that date. This means that, for those countries that have ratified the 2007 amendment, sub-seabed injection of CO₂ for the purposes of storage is now formally enabled under the Convention.¹⁴ The 2009 London Protocol amendment, which will allow for transboundary movement of CO₂ for the purposes of sub-seabed storage, is likely to take significantly more time to enter into force. The United Kingdom became the second contracting party out of a required 27 to ratify in November 2011; Australia and Canada have also made progress against this recommendation since CEM 2, but are yet to ratify. The London Protocol is likely to constrain contracting parties that want to co-operate on offshore storage for the foreseeable future, and committed governments should accelerate efforts to raise awareness on the need to make progress toward ratification. To promote dialogue on this issue, the IEA released a working paper on

¹³ Convention for the Protection of the Marine Environment of the North-East Atlantic.

¹⁴ 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.

13 October 2011 on options under international law to enable transboundary movement of CO₂ for sub-seabed storage while ratification of the 2009 amendment progresses.¹⁵

Key points

- Great strides are being made in regulating CO₂ storage; committed governments must continue these efforts so that lack of regulation does not necessarily impede or slow deployment.
- Committed governments should accelerate efforts to raise awareness on the need to make progress toward ratification of the 2009 London Protocol amendment, consistent with the 2011 near-term action under Recommendation 4.

■ Storage

The majority of committed governments have also advanced efforts to review key gaps in storage data coverage and knowledge, and make progress toward storage exploration and capacity assessment (Recommendation 6). Two governments – Mexico and Norway – have published storage atlases over the past year; the UK's CCS Roadmap publishes the results of a recent study of technical storage capacity in the United Kingdom; storage capacity estimates for all relevant basins across Canada – which currently only has estimates for select provinces – will be made available as part of the North American Carbon Atlas Partnership in 2012; and Germany has undertaken a *Storage Catalogue of Germany* project. Committed governments that had already completed national storage assessments at CEM 2 have also made further progress, including Australia and Japan.

To gain a clear and accurate understanding of national-level storage potential, governments and project developers need to understand the geographical distribution and magnitude of economically available CO₂ storage capacity (*i.e.* usable CO₂ storage capacity or storage resources that can be developed at an acceptable price), and not just theoretical storage resources. The 2011 near-term actions under Recommendation 6 have ongoing relevance to drive progress in investigating CO₂ storage; committed governments should continue efforts to make advancements against them.

Key point

Committed governments are making progress toward investigation of CO₂ storage, but better understanding of the distribution and magnitude of economically available CO₂ storage capacity, and not just theoretical storage resources, is required. The 2011 near-term actions under Recommendation 6 remain relevant to driving progress.

■ Knowledge sharing

In terms of efforts to support and encourage the development of best practice knowledge sharing from early mover projects (Recommendation 5), a number of committed governments reported knowledge sharing requirements as part of existing demonstration funding programmes, including Australia, Canada, Norway and the United Kingdom. The UK government's new CCS competition,

¹⁵ IEA (2011), *Carbon Capture and Storage and the London Protocol: Options for Enabling Transboundary CO₂ Transfer*, OECD/IEA, Paris (www.iea.org/publications/free_new_Desc.asp?PUBS_ID=2446).

launched 3 April 2012, will favour projects offering strong and proactive knowledge transfer provisions.¹⁶ Several governments have engaged in knowledge sharing activities at a broader level, for example through collaboration with other countries and national level workshops, since CEM 2. The Global CCS Institute has also undertaken a number of initiatives to disseminate project-level information and coordinate global collaboration on CCS knowledge since CEM 2, as part of its core work programme. Knowledge exchange has the ability to drive technology efficiencies, reduce project costs, and assist in overcoming barriers to CCS deployment; committed governments should continue to advance progress against the 2011 near-term actions under Recommendation 5.

Key point

Knowledge sharing can help to accelerate deployment. The 2011 near-term actions under Recommendation 5 remain relevant.

■ Stepping-up to the CCS challenge: next steps for scaling up CCS deployment

Consistent with the conclusions of the IEA's broader *Tracking clean energy progress* report, while the period since CEM 2 has seen some progress by committed governments against the 2011 CCUS AG recommendations, particularly in areas such as CCS regulation, overall substantially more effort is required across all areas.

In particular, for CCS to remain an option for reducing CO₂ emissions from power and industry, governments must urgently scale-up financial and policy support for CCS technology demonstration and deployment, including in developing countries. This is an area that has remained largely stagnant since CEM 2, despite some positive developments with the UK's proposed Electricity Market Reform and broader emissions reduction initiatives by certain committed governments. Progress in building commercial scale demonstration projects remains painfully slow; private entities will not invest in CCS technology absent sufficient demonstration funding and clear policy signals from government for broader deployment.

CCS applications in industry is another area requiring additional policy focus, despite some progress by committed governments at a high- or individual project-level since CEM 2.

Key point

To continue to drive progress in these areas and across the board, key next steps include:

- Aggressive pursuit of further progress against the seven CEM 2 recommendations, which remain relevant to accelerating the uptake of CCS technologies;
- Implementation of the proposals on funding support in developing economies delivered to CEM 3;
- Supporting the work of the Program Managers Network on lessons learnt from demonstration programs up to CEM 4; and
- Supporting the work of the CCS in industry working group up to CEM 4.

¹⁶ www.decc.gov.uk/assets/decc/11/cutting-emissions/carbon-capture-storage/4900-ccs-roadmap-ccs-commercialisation-programme.pdf

SECTION 2

Developments against 2011 recommendations

■ Recommendation 1: Reduce the financial gap

By CEM 3: Advance policies that address the financial gap and risk associated with early-mover CCS demonstration and deployment.

- Undertake a gap analysis to identify shortfalls in existing CCS or climate change policies;
- Establish or identify a structure and resources to support jurisdictions with assessment of the appropriate policy set to meet this recommendation; and
- Develop policy frameworks to encourage and facilitate the deployment of the second wave of CCS projects.

Gap analysis and identification of structures/resources to support appropriate policy set assessment

The Clinton Climate Initiative (CCI) conducted a preliminary gap analysis of shortfalls in existing CCS or climate change policies in November 2011. This work maps out existing support provided through various policy instruments (*e.g.* grants, carbon prices) across committed governments, highlighting relevant gaps. To advise governments of available policy options to reduce the financial gap and address early-mover technology risks, in January 2012 the IEA released *A Policy Strategy for Carbon Capture and Storage*.¹⁷ The paper explores how policy can support CCS technology uptake, from demonstration to wide-scale deployment. There has otherwise been limited progress across committed governments and supporting CCS organisations on these near-term actions.

Policy action in support of CCS demonstration

Consistent with global CCS demonstration funding having peaked around 2008 as part of economic stimulus plans, the majority of committed governments reported technology demonstration support within the scope of existing demonstration programmes only, *i.e.* there have been no additional commitments since CEM 2 (Australia, Canada, France,¹⁸ Japan, Norway and the United States).

Following a decision in October 2011 not to proceed with the first candidate project of the UK's CCS Demonstration Competition (Longannet Power Station, Scotland),¹⁹ on 3 April 2012 the UK government announced a new competition: the CCS Commercialisation Programme. The programme will provide GBP 1 billion in capital funding to support demonstration of CCS at scale.²⁰ In the United Arab Emirates, the government expects that a CO₂ injection programme to boost oil production will drive CCS demonstration. The first CCS demonstration project, which is currently going out to tender, could inject 800 000 tons of CO₂ per year from the state-owned Emirates Steel Industries plant. The Executive Affairs Authority of Abu Dhabi commenced a *CCS Value Proposition* study in late-2011; this work will also consider CCS policy.

¹⁷ IEA (2012), *A Policy Strategy for Carbon Capture and Storage*, OECD/IEA, Paris (www.iea.org/papers/2012/policy_strategy_for_ccs.pdf).

¹⁸ The French Environment and Energy Management Agency, which has provided EUR 38 million for 3 on-going small to medium scale demonstration plants (including specific work tasks of the ArcelorMittal project), is however currently selecting candidates for additional funding following a further call for proposals (closed November 2011).

¹⁹ Agreement could not be reached between the UK government and the project proponents on the level of support to be provided by government.

²⁰ www.decc.gov.uk/assets/decc/11/cutting-emissions/carbon-capture-storage/4899-the-ccs-roadmap.pdf

Mexico and South Africa do not currently have funding programmes for CCS. Conventional CO₂-EOR (*i.e.* EOR without the aim of storing CO₂) is however currently being explored in Mexico, which could potentially facilitate CCS deployment in the future. The South African government named CCS as one of eight Near-term Priority Flagship Programmes in its National Climate Change Response White Paper, released in October 2011.²¹ The Programme includes development of a CCS Demonstration Plant to store the process emissions from an existing high carbon emissions facility, but it is not yet clear how this will be financed. The South African CCS Roadmap aims for demonstration to occur in 2020, following a proposed test injection in 2016. China and Germany currently have R&D support only.

Development of policy frameworks to encourage and facilitate second wave CCS projects

The United Kingdom published an Electricity Market Reform paper on 12 July 2011, setting out reforms intended to drive decarbonisation of the electricity sector, including through CCS:

- Long-term contracts (in the form of a feed-in tariff, based on a contract for difference);
- An additional option for supporting CCS demonstrations with contracts that are designed to recognise the uncertainties of these early projects;
- An emissions performance standard set at 450g CO₂/kWh to limit the CO₂ emissions allowed from new coal-fired power plants; and
- A carbon price floor that will further incentivise investment in low-carbon generation, whilst also giving appropriate exemptions for CCS generators.

The proposed reforms are significant in that they constitute the first comprehensive attempt globally to set policy – as part of the broader reform package – to drive CCS deployment beyond the first demonstration facilities.²²

Otherwise there has been limited movement across committed governments in developing policy frameworks to support CCS through targeted deployment programmes. Some committed governments have however made progress with broader emissions reductions initiatives that may in the future also provide incentives for CCS installations. Australia introduced on 8 November 2011 an AUD 23 per tonne carbon price from 1 July 2012, which will move to an emissions trading scheme from 1 July 2015. Australia does not have a technology-specific program in place to support CCS deployment beyond demonstration. It anticipates that an Energy White Paper released by the Australian government for public consultation on 13 December 2011 will provide the framework for future policy developments once finalised.²³

Canada published proposed “Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations” on August 27, 2011 (to come into effect on July 1, 2015). The regulations will require all new coal-fired units and units reaching the end of their economic life to meet a performance standard based on the emissions performance of high-efficiency natural gas combined cycle generation; a temporary exception would be provided for those that incorporate CCS, to 2025.

China’s 12th Five Year Plan on Greenhouse Gas Emission Control, released November 2011, plans to establish a voluntary emissions trading scheme and carbon markets pilot by 2015. In addition, China released a *Technology Roadmap Study on Carbon Capture, Utilization and Storage in China* in September 2011, which sets out key milestones for CCS technology development out to 2030.

²¹ www.environment.gov.za/PolLeg/WhitePapers/national_climatechange_response_whitepaper.pdf

²² Norway also has sector-specific policy support for certain industrial applications of CCS, in the form of its tax on offshore CO₂ emissions. Two large-scale CCS projects (Sleipner and Snøhvit) are currently incentivised exclusively by this tax and the EU ETS (*i.e.* they receive no government support).

²³ The draft Energy White Paper addresses, amongst other things, acceleration of clean energy technologies, including CCS. See www.ret.gov.au/energy/facts/white_paper/Pages/energy_white_paper.aspx

In Norway, Gassnova, a state-owned company that advises the Norwegian government on and manages the country's interest in CCS, is currently looking at possible policy frameworks to facilitate deployment in power and other industrial sectors (*i.e.* beyond Norway's offshore gas projects); the government is also developing a new white paper on climate change that will address CCS policy (to be presented to parliament around mid-2012).

The United States proposed a Carbon Pollution Standard for New Power Plants on 27 March 2012.²⁴ Under the proposal, power plants incorporating CCS would have the option to average CO₂ emissions over a 30-year period to meet the proposed standard, rather than having to meet the standard each year.

■ Recommendation 2: Funding support in developing economies

By CEM3: Identify and advance appropriate funding mechanisms to support the demonstration of large-scale CCS projects in developing economies.

- Request an international CCS body such as the CSLF or Global CCS Institute to recommend a preferred funding mechanism for projects in developing countries;
- Work to establish a preferred funding mechanism and a process for project solicitation and support in developing countries;
- Support and encourage the UNFCCC work program in 2011 on CCS in the CDM to seek agreement on its inclusion at CMP7;
- Support and encourage CCS in other UNFCCC processes, including but not limited to the Global Climate Fund;
- Collaborate to enable the production of roadmaps for CCS in developing countries;
- Collaborate and support funding mechanisms that enable joint research and development towards commercial scale CCS; and
- Urge multilateral development banks to support CCS as an effective low emission technology in developing countries and to introduce mechanisms to address institutional and financial barriers.

Financial mechanisms to support demonstration in developing economies

Following CEM 2 the Global CCS Institute agreed to coordinate with the Asian Development Bank, World Bank and World Resources Institute to drive progress under this recommendation.

The working group, which also includes the Australian government, the Clinton Climate Initiative, the IEA and the UK government, has tabled a separate report at CEM 3: *Funding Carbon Capture and Storage in Developing Countries*.²⁵ This report sets out key messages and recommendations on financial mechanisms to support demonstration in developing economies.

Support for UNFCCC processes

At the Durban Climate Change Conference (CMP7/COP17) in November/ December 2011, hosted by the South African government, agreement was reached on modalities and procedures for conducting CCS projects in developing countries under the Clean Development Mechanism (CDM). CCS CDM modalities and procedures represent a significant development as CCS is now part of the portfolio of low-carbon technologies eligible to receive carbon finance under the mechanism. This development should also help facilitate inclusion of CCS in other international funding mechanisms such as the

²⁴ Output-based standard of 1 000 lb CO₂/MWh. See <http://epa.gov/carbonpollutionstandard/pdfs/20120327factsheet.pdf>

²⁵ The report is also available at www.globalccsinstitute.com/

UN Green Climate Fund and the Clean Technology Fund. Certain residual issues related to transboundary movement of CO₂ and establishment of a global reserve of certified emission reduction units for CCS project activities remain for resolution at CMP8/COP18.

Nine committed governments supported inclusion of CCS in the CDM. Prior to the Durban conference, the UAE also hosted, with co-funding from Norway, a UNFCCC technical workshop on the inclusion of CCS into the CDM (Abu Dhabi, September 2011).

Production of roadmaps for CCS in developing countries

China released its *Technology Roadmap Study on Carbon Capture, Utilization and Storage in China* in September 2011.

General committed government support for activities in developing economies

Many committed governments reported in-kind or financial support for developing countries, through both contributions to multilateral organisations such as APEC, CSLF, the Global CCS Institute and the World Bank (Australia, Canada, Norway, United States, United Kingdom) and direct bilateral initiatives (Australia, Norway, United States, United Kingdom). The majority of this support is being provided in the context of existing programmes or previous grants.

In terms of additional developments since CEM 2, the Australia-China Joint Coordination Group on Clean Coal Technology (JCG) endorsed three proposals at its annual meeting in September 2011, building on projects conducted between Australia and China under the Asia-Pacific Partnership on Clean Development and Climate.²⁶ Financial support will be made available for these projects. Japan proposed a bilateral offset credit mechanism in 2011, in order to introduce low carbon technologies, including CCS, into developing countries. Technical issues of linking this scheme to UNFCCC mechanisms will need to be resolved. The United States provided a grant of USD 500 thousand to the Global CCS Institute to support financing, policy and regulatory, and capacity development initiatives in India, Malaysia, South Africa and Mexico in 2011. It also commenced dialogue with Brazil on possible engagement.

■ Recommendation 3: Develop legal and regulatory frameworks

By CEM3: Advance the development of legal and regulatory frameworks for CCS demonstration and deployment.

- Development of CCS legal and regulatory frameworks relevant to current status;
- Engaging in greater collaboration and capacity building on framework development, in particular with developing countries; and
- Considering the development of a national definition for “CCS-ready”.

Legal and regulatory framework development

There has been progress in advancing framework development across committed governments. CEM governments in Australia, Europe and North America, traditionally at the forefront of developments, have seen ongoing developments.

The Australian federal government now has all elements of its CO₂ injection and storage framework in place, with secondary legislation in force since June 2011.

²⁶ Stage two of a post-combustion capture pilot project conducted by Australia’s CSIRO and China’s Clean Energy Research Institute; an extension of the China-Australia Geological Storage project conducted by Geoscience Australia and the Administrative Centre for China’s Agenda 21 (ACCA21); and an enhanced coal bed methane project conducted by CSIRO and China United Coal Bed Methane.

The 25 June 2011 deadline for transposition of the EU CO₂ Storage Directive generated substantial movement in Europe: France notified the European Commission of full transposition following finalisation of relevant secondary legislation in October 2011; the United Kingdom expects final, minor transposition measures to draw to a close by mid-2012, following developments over the past year; Norway (which regulates current projects under existing petroleum laws) continued development of new regulations to reflect the EU CO₂ Storage Directive;²⁷ and Germany continues efforts to make progress toward transposition legislation – side-lined for the past few years due to public opposition – with a formal conciliation procedure in the federal Parliament.

In North America, the Canadian provinces have continued to make significant headway. Alberta has built on its substantial work to date, publishing secondary legislation in the second quarter of 2011 and made progress on its Regulatory Framework Assessment process, due for completion end-2012. In August 2011, the US Environmental Protection Agency built on its 2010 Safe Drinking Water Act geological storage rule, proposing to conditionally exclude CO₂ streams injected for geological storage into Class VI wells – a new well class established for wells used to inject CO₂ for geological storage – from federal hazardous waste regulations.

Regions at earlier stages of CCS framework development have also made progress. South Africa established an Interdepartmental Task Team on CCS in October 2011, to drive framework development. The UAE's *CCS Value Proposition* study that commenced in late-2011 is expected to result in a recommendation to develop a CCS policy framework. In Asia, Japan continued work to develop understanding of the marine ecosystem in waters around the country (which will provide technical input into environmental impact assessment and monitoring requirements for offshore storage); and China has undertaken preliminary research to understand the required framework and current gaps and barriers.

Mexico has not made progress on framework development since CEM 2; however the country plans to draft a reference and regulatory framework for the development of CCUS in the coming months, which will include as a key component a proposed pathway for framework development.

Following release of the second edition in May 2011, the IEA will release the third edition of its *CCS Legal and Regulatory Review* in April 2012.²⁸ This sets out developments across CCUS AG and other countries in detail.

Collaboration and capacity building in framework development

Many committed governments reported support for capacity building in framework development through contributions to multilateral organisations such as the Asian Development Bank, APEC, CSLF, the Global CCS Institute and the World Bank. The majority of this support is being provided in the context of existing programmes or previous grants. In terms of developments since CEM 2, Australia, Canada, China, France, Germany, the UK and the US have participated in collaborative or capacity building initiatives organised by various organisations (*i.e.* APEC, European Commission, IEA) since CEM 2.

Committed governments also undertook a number of bilateral initiatives: for example, Australia and China have collaborated on framework development in the context of the China-Australia Geological Storage project; the United Kingdom (Scotland) provided in-kind support for roll-out of the Global CCS Institute's Regulatory Test Toolkit in Romania; Norway arranged and financed study trips for researchers and officials from countries such as Brazil and South Africa to visit its full-scale CCS projects and discuss framework development with government counterparts; and South African government officials undertook a number of international visits (to the UK, Norway and Australia).

²⁷ Norway is not a member state of the European Union, but is implementing the EU CO₂ Storage Directive as part of the European Economic Area.

²⁸ www.iea.org/ccs/legal/review.asp

Following on from an IEA-South African Department of Energy-South African Centre for CCS *legal and regulatory workshop* on 7 April 2011, South Africa held a further workshop in October 2011 to continue to explore how framework development might proceed. Mexico also held an IEA-SENER Joint Workshop on *CCS in Mexico: Policy Strategy Options for CCS* on 7-8 March 2012, which addressed regulation amongst other issues, and plans to undertake further capacity building initiatives with various international CCS organisations over the coming months.

Development of national definitions of CCS ready²⁹

Mexico will consider implementation of CCS ready requirements over coming months, as part of development of its reference and regulatory framework; similarly, the United Arab Emirates will consider this issue following completion of its value proposition (from April 2012). South Africa, which imposed a CCS ready requirement on the Eskom Kusile power plant in 2007, is currently undertaking a study to consider future application of CCS ready policy. Germany also intends to implement CCS ready requirements, consistent with the EU CO₂ Storage Directive; this will depend on successful passage of its transposition bill through parliament.

Australia and Norway do not intend to develop national definitions of CCS ready. Following enactment of Australia's carbon pricing legislation, the government announced in December 2011 that it will not pursue CCS ready requirements for new coal-fired power stations (*i.e.* in the interest of having low-carbon investment decisions being market driven). Norway requires all new fossil-fuelled power plants to incorporate CCS and CCS ready requirements are therefore not required. Canada, China and the United States have not progressed this issue. Japan decided to consider this issue in its 2010 Basic Energy Plan but no further progress has been made.

The Global CCS Institute hosted a CCS-ready forum as part of the Asian Development Bank's 6th Asia Clean Energy Forum (July 2011, Manila).

■ Recommendation 4: Acknowledge importance of marine treaty amendments

By CEM 3: Promote the importance to global CCS deployment of ratifying key international marine treaty amendments.

Two near-term actions were included under this recommendation, related to raising awareness amongst relevant government ministries of the importance to global CCS deployment of ratifying:

- The 2009 London Protocol³⁰ amendment (to enable transboundary movement of CO₂ for the purposes of sub-seabed storage); and
- The 2007 OSPAR Convention³¹ amendment (to enable the sub-seabed injection of CO₂ for the purposes of storage).

2009 London Protocol amendment

The 2009 amendment must be ratified by two thirds of contracting parties to enter into force (currently 27 contracting parties out of 41). At CEM 2, Norway was the only contracting party to have ratified the amendment. Since CEM 2, the United Kingdom has become the second country to ratify, providing formal notification of ratification to the International Maritime Organisation on 29 November 2011. Australia has also initiated cross-government cooperation to move toward ratification, and Canada has been making progress on amendments to relevant domestic legislation to ensure that it can accommodate ratification. It is unclear when these processes will be finalised.

²⁹ A number of governments already had CCS ready requirements in place prior to CEM 2, including the United Kingdom and France.

³⁰ 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.

³¹ Convention for the Protection of the Marine Environment of the North-East Atlantic.

France, Germany, Korea, Mexico, South Africa and Japan have not made progress against this recommendation.³² With the Netherlands the only other contracting party understood to be taking steps to ratify the amendment, it is unlikely that 27 ratifications will be reached in the near term.

To promote dialogue within London Protocol contracting parties on this issue, on 13 October 2011 the IEA released a working paper on options under international law to enable transboundary movement of CO₂ for sub-seabed storage while ratification of the 2009 amendment progresses.³³ The paper was presented in plenary at the sixth meeting of London Protocol contracting parties (London, 17-21 October 2011). Given the current rate of ratifications, consideration of interim options will be required to facilitate export of CO₂ for offshore storage in the near- to mid-term.

2007 OSPAR Convention amendment

Of the committed governments, France, Germany, Norway and the United Kingdom are Contracting Parties to the OSPAR Convention; all except France have ratified the 2007 amendment.

At CEM 2, six out of a required seven contracting parties had ratified the amendment. Since CEM 2, the OSPAR Secretariat advised on 28 October 2011 that the 2007 amendment had formally entered into force as of 23 July 2011 for contracting parties to have ratified as at that date, following ratification by Denmark. The French Ministry of Environment has been progressing toward ratification since CEM 2, and hopes to have ratified the amendment by end-2012.

■ Recommendation 5: Knowledge sharing

By CEM3: Support and encourage the development of best practice knowledge sharing from early mover projects, in particular those with public funding.

- Encourage the development of a national knowledge sharing framework and principles for publicly funded CCS demonstration projects, building on the Global CCS Institute's Knowledge Sharing Framework;
- Encourage CCS project proponents, government bodies, and publicly-funded regional initiatives to work with international organisations, such as the Global CCS Institute, to coordinate global collaboration around CCS knowledge; and
- Request international CCS organisations, such as the Global CCS Institute, CSLF and IEAGHG, to undertake an annual review of existing best practice guidelines and facilitate capacity building in key regions to ensure the sharing of experience.

Knowledge sharing requirements on publicly funded CCS demonstration projects

A number of committed governments reported knowledge sharing requirements as part of existing demonstration funding programmes. Australia, for example, has included knowledge sharing provisions in funding agreements for short-listed projects undertaking pre-feasibility studies for the CCS Flagships Program, building on the Global CCS Institute's Knowledge Sharing Framework. Canada requires operators receiving public funding to provide quarterly updates and presentations to government, as well as yearly progress reports. This information is currently used for internal purposes only, but the Canadian government is considering developing an external platform for collaboration and knowledge sharing. Norway imposes extensive knowledge sharing requirements on project operators through bilateral agreements. All project documentation for Sleipner, for

³² The United Arab Emirates did not sign up to this recommendation as it is not a contracting party to the London Protocol. The United States of America has signed but is not yet a contracting party to the London Protocol.

³³ IEA (2011), *Carbon Capture and Storage and the London Protocol: Options for Enabling Transboundary CO₂ Transfer*, OECD/IEA, Paris (www.iea.org/publications/free_new_Desc.asp?PUBS_ID=2446).

example, is freely available on the internet. The UK government imposed extensive knowledge sharing requirements in awarding funding for front-end engineering and design (FEED) studies as part of the UK's first CCS competition. This information is freely available on the Department of Energy and Climate Change's website.³⁴ France also requires knowledge sharing as part of public funding support for projects.

In terms of developments since CEM 2, the UK government has reiterated its commitment to knowledge sharing to accelerate potential cost reductions as part of the launch of its new CCS competition, the CCS Commercialisation Programme, on 3 April 2012. The competition documentation states that the UK government will favour projects offering strong and proactive knowledge transfer provisions.³⁵

Global collaboration on CCS knowledge

One of the core functions of the Global CCS Institute is to connect projects around the world and coordinate global collaboration on CCS knowledge by, for example, gathering comprehensive information on global project progress and challenges and leveraging key knowledge sharing products for wider dissemination.³⁶ The Institute has undertaken a number of initiatives in this area since CEM 2 as part of its core work programme. For example, the Institute conducted a number of "road shows" to share lessons-learned across projects, including in North America (Austin, Texas, 8 November 2011; Calgary, Canada, 10 November 2011, Washington, D.C., 19 January 2012). These focussed on the experience of North American projects but also brought in projects from Europe (Don Valley) and Australia (Callide).

General knowledge-sharing initiatives across committed governments

Several committed governments reported broader knowledge-sharing initiatives since CEM 2 (*i.e.* not strictly linked to knowledge sharing from early mover projects), such as knowledge-sharing requirements in the context of R&D funding, collaboration with other countries, national level workshops, associations and organisations, public CCS websites, etc. For example, China's Ministry of Science and Technology is coordinating with industrial and academic stakeholders to establish a *Chinese Alliance on CCUS Technology and Innovation*. This will be a platform for exchanging knowledge and promoting collaboration and is expected to be formed in 2012. Canada and the United States share knowledge on CCS in the context of the United States-Canada Clean Energy Dialogue CCS Clean Energy Technology Working Group, which collaborates on areas such as storage, next-generation technology, injection and storage-testing and public outreach strategies. Japan has held a number of CCS workshops to disseminate information on CCS to industry, academia and the general public. The Global CCS Institute is also working with JGC Corporation and other entities to examine public communication of CCS and ways of distilling detailed expert knowledge from within the CCS community and repackaging it to make it easily understood by diverse stakeholders.

■ Recommendation 6: Investigate CO₂ storage

By CEM3: Review key gaps in storage data coverage and knowledge, and progress storage exploration and capacity assessment.

- Request international CCS organisations, such as the Global CCS Institute, CSLF and IEAGHG, to facilitate CO₂ storage capacity building in key regions including developing countries.

³⁴www.decc.gov.uk/en/content/cms/emissions/ccs/demo_prog/feed/feed.aspx

³⁵www.decc.gov.uk/assets/decc/11/cutting-emissions/carbon-capture-storage/4900-ccs-roadmap-ccs-commercialisation-programme.pdf

³⁶Including through the Global CCS Institute's website (www.globalccsinstitute.com), web conferences, workshops and "road shows".

For governments that had not completed a national storage atlas as at CEM 2:

- Produce a national CO₂ storage atlas, identifying focus areas for potential CO₂ storage and mapping potential storage against CO₂ sources; and
- Identify key gaps in storage data coverage, and actions and resources to fill those gaps. This should include establishing regional priorities and programs for storage data acquisition, and commencing exploration to obtain that data where required.

For governments that had already completed a national storage atlas as at CEM 2:

- Continue investigation and characterisation of high potential CO₂ storage areas, including by exploration, in order to facilitate private investment and detailed site-specific characterisation required by projects; and
- Strive to establish bilateral and multilateral partnerships with countries that are not as advanced in this area in order to expedite progress in storage mapping, analysis and exploration as appropriate.

Developments by governments without CO₂ storage atlases as at CEM 2

Two committed governments have completed national-level CO₂ storage atlases since CEM 2: Norway and Mexico. Norway published a storage atlas for the Norwegian continental shelf in the North Sea in December 2011,³⁷ estimating storage capacity to be approximately 70Gt CO₂. In addition, the government invited nominations from industry for areas in the North Sea and Norwegian Sea that might be suitable for exploration (by October 2011), to which it received multiple nominations. Mexico published its national storage atlas in March 2012.³⁸ This incorporates a basin level assessment based on saline formations and un-minable coal seams only. The Mexican government is planning to release a more comprehensive national atlas later this year, as access to information on oil and gas reservoirs is facilitated by the involvement of Pemex, Mexico's state-owned petroleum company, and other relevant entities.

In addition, Canada, Mexico and the United States are currently developing a North American Carbon Storage Atlas, which will provide storage capacity estimates for all relevant basins across the three countries. Canada currently has estimates of storage capacity in select Canadian provinces only, through the 2010 National Energy Technology Laboratory (NETL) Carbon Sequestration Atlas of the United States and Canada.

The UK's CCS Roadmap, released 3 April 2012,³⁹ outlines details of a recent study of the technical CO₂ storage capacity of the United Kingdom. The study estimates potential storage capacity on the UK's continental shelf at up to 70 Gt CO₂ and highlights a number of focus areas for further work, in particular to assess saline aquifer stores.

Germany has undertaken a *Storage Catalogue of Germany* project in cooperation with the geological surveys of the *Länder*.⁴⁰ The project's final report is forthcoming.

Developments by governments that had already completed CO₂ storage atlases at CEM 2

Committed governments that had already completed national storage assessments at CEM 2 have also made progress. In June 2011, the Australian Government announced the creation of an AUD 60.9 million *National CO₂ Infrastructure Plan*, to accelerate the development and identification of suitable long-term storage sites within reasonable distances of major energy and industrial CO₂

³⁷ www.npd.no/en/news/News/2011/Nomination-of-areas-for-storage-of-CO2/. Norway also established a Norwegian storage forum at this time.

³⁸ <http://co2.energia.gob.mx/portal/default.aspx?id=2166>

³⁹ www.decc.gov.uk/assets/decc/11/cutting-emissions/carbon-capture-storage/4899-the-ccs-roadmap.pdf

⁴⁰ The German states.

emissions sources. This funding supplements funding previously provided under the National Low Emissions Coal Initiative. From these sources, Australia is directing a total of AUD 120 million to precompetitive assessments of offshore and onshore areas. The onshore component is being undertaken in partnership with Australian state governments and industry. Building on a 2005/2006 nation-wide, high-level storage capacity evaluation, Japan is currently investigating sites suitable for CCS demonstration. It carried out a detailed assessment of the Tomakomai region in 2011, which resulted in a decision to start work on a demonstration project in the region in 2012.

In terms of partnerships to expedite progress in storage mapping, analysis and exploration, as noted above the United States has been collaborating with Canada and Mexico to develop a North American Carbon Storage Atlas.

Capacity building by international CCS organisations in CO₂ storage exploration and capacity assessment

In March 2012, the Global CCS Institute held a two-day course on CO₂ storage and EOR in China for government, academia, NGOs and industry. The aim of the course was to build China's technical capacity in these areas. The IEA held two storage capacity estimation workshops with key geological surveys in 2011 (April and November), to start building progress towards an internationally agreed CO₂ storage capacity estimation methodology. The CO₂CRC and IEAGHG held their respective annual CCS summer schools, which look at storage exploration and capacity assessment amongst other issues, in 2011.

■ Recommendation 7: Support CCS in industry

By CEM3: Recognise the potential of CCS for industrial emission sources and review demonstration opportunities.

- Review opportunities for industrial CCS in sectors such as gas processing, refineries, iron and steel, cement, ethanol production and emerging coal to liquids industries;
- Explore the development of "clusters" for CO₂ capture from industry to reduce costs and promote synergy between emission sources; and
- Identify and encourage possible demonstration opportunities for low cost CCS in relevant industry sectors.

Review opportunities for CCS in industry and explore development of industry CO₂ capture clusters

There has been limited progress across committed governments in reviewing opportunities for CCS in key industry sectors and the development of "clusters" for industry CO₂ capture since CEM 2. The UK government's CCS Roadmap addresses industrial applications of CCS at a broader level. The roadmap focuses government action on facilitating CCS in the power sector first (the UK's largest source of emissions), but highlights intended future work to identify the current state of innovation in industry CCS; barriers to and opportunities for industrial CCS applications; and incentives to drive deployment of industrial CCS. It also identifies at a broad level potential clusters of power and industrial plant, noting that the UK will be considering projects to stimulate development of these clusters. Ability to link up multiple emitters across power and industry through shared infrastructure is addressed in the eligibility criteria for the new UK CCS Competition, launched together with the roadmap on 3 April 2012.

South Africa was due to commence a techno-economic study for CCS quarter one of 2012, which will consider how CCS in industry relates to CCS in power generation in South Africa more broadly.

At the global level, the IEA and United Nations Industrial Development Organization released a *Technology Roadmap: Carbon Capture and Storage in Industrial Applications* (IEA/UNIDO CCS in Industry Roadmap) in September 2011, which provides a broad vision for deploying CCS in industrial applications up to 2050.⁴¹ This work was co-funded by Norway and the Global CCS Institute.

Identify and encourage low-cost industry demonstration opportunities

While all operating CCS projects today and five of the seven projects in construction are industrial applications of the technology, there has also been limited movement across committed governments in terms of comprehensively identifying and encouraging demonstration opportunities. There have been developments at a project level in some countries, however. On 11 June 2011, the Australian government announced up to AUD 52 million in additional funding to undertake site characterisation for the Collie South-West Hub project. The project plans to initially capture CO₂ from an existing fertilizer plant which will be used to neutralize red mud at alumina refineries and for injection testing in the target saline reservoir. The Australian government also confirmed CCS Flagships status for the CarbonNet Project in Victoria on 10 February 2012, announcing with the Victorian government combined funding of AUD 100 million to further progress the feasibility phase of the project. These projects have the potential to transport and store CO₂ captured from multiple industrial processes and power generation over the long-term. Canada has also made progress in advancing large scale demonstration projects in the industry sector.

The French government is supporting a feasibility study in the Port de Marseilles region, launched in end-2011 and a project in Le Havre region, examining transport and storage infrastructure for industry and power generation (the European Cocate project); it has also committed to co-funding the ArcelorMittal project (an integrated CCS project applied to steelmaking in Florange, northern France) up to EUR 150 million, if the project successfully obtains funding under the European Commission's NER 300 programme. The UAE's Emirates Steel Industries project is going into tender stage and is expected to transition into execution in 2013. Japan has also approached the market on its Tomakomai oil refinery project in Hokkaido with a view to launching design of the project in the 2012 financial year.

⁴¹ IEA/UNIDO (2011), *Technology Roadmap: Carbon Capture and Storage in Industrial Applications*, OECD/IEA; UNIDO, Paris (www.iea.org/Papers/roadmaps/ccs_industry.pdf).



© OECD/International Energy Agency and Global CCS Institute, 2012
No reproduction or translation of this publication, or any portion thereof, may be made without prior written permission. Applications should be sent to: rights@iea.org