23 October 2007

ENGLISH ONLY

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE
Twenty-seventh session
Bali, 3–11 December 2007

Item 9 (c) of the provisional agenda
Methodological issues under the Kyoto Protocol
Carbon dioxide capture and storage in geological formations as clean development mechanism project activities

Consideration of carbon dioxide capture and storage as clean development mechanism project activities

Submissions from Parties

Addendum

1. In addition to the two submissions contained in document FCCC/SBSTA/2007/MISC.18, three further submissions have been received.

2. In accordance with the procedure for miscellaneous documents, these submissions are attached and reproduced* in the language in which they were received and without formal editing.

* These submissions have been electronically imported in order to make them available on electronic systems, including the World Wide Web. The secretariat has made every effort to ensure the correct reproduction of the texts as submitted.

FCCC/SBSTA/2007/MISC.18/Add.1

GE.07-64050

CONTENTS

* This submission is supported by Albania, Bosnia and Herzegovina, Croatia, The former Yugoslav Republic of Macedonia, Serbia, Turkey and Ukraine.

PAPER NO. 1: CANADA

Submission by Canada
Consideration of Carbon Dioxide Capture and Storage as Clean Development Mechanism Project Activities

Canada welcomes the United Nations Framework Convention on Climate Change (UNFCCC)'s invitation, as per Decision 1/CMP.2, to provide submissions on the consideration of carbon dioxide capture and storage (CCS) in geological formations as clean development mechanism (CDM) project activities. Building on Canada's previous submission of February 2006 on the consideration of CCS as CDM project activities, as contained in document FCCC/KP/CMP/2006/MISC.2, this submission addresses the issues identified in paragraph 21 of Decision 1/CMP.2, namely:

(a) Long-term physical leakage (seepage) levels of risks and uncertainty;
(b) Project boundary issues (such as reservoirs in international waters, several projects using one reservoir) and projects involving more than one country (projects that cross national boundaries);
(c) Long-term responsibility for monitoring the reservoir and any remediation measures that may be necessary after the end of the crediting period;
(d) Long-term liability for storage sites;
(e) Accounting options for any long-term seepage from reservoirs;
(f) Criteria and steps for the selection of suitable storage sites with respect to the potential for release of greenhouse gases;
(g) Potential leakage paths and site characteristics and monitoring methodologies for physical leakage (seepage) from the storage site and related infrastructure for example, transportation;
(h) Operation of reservoirs (for example, well-sealing and abandonment procedures), dynamics of carbon dioxide distribution within the reservoir and remediation issues; and
(i) Any other relevant matters, including environmental impacts;

These issues are grouped according to methodological and other issues and are addressed in sections 2 and 3 respectively.

1.0 Introduction

CCS is a technology that captures and stores carbon dioxide (CO_2) in geological formations for thousands of years. This technology can serve as a critical bridge towards a low-carbon world, given the forecasted global dependency in fossil fuel use in the near future. The Intergovernmental Panel on Climate Change (IPCC)'s *Carbon Dioxide Capture and Storage Summary for Policy Makers* notes that fossil fuels will continue to be the dominant primary energy supply for both developed and developing countries into the mid-21st century. Applying CCS technology in both developed and developing economies with rapidly growing greenhouse gas (GHG) emissions could therefore have significant positive impacts on reducing global GHG emissions, thus confronting the challenge of climate change.

While deploying CCS technology through the CDM is critical to maximizing GHG mitigation opportunities worldwide, it is also an important element in furthering the transfer of CCS technology and expertise to developing countries. The United Nations Framework Convention on Climate Change paper, *Dialogue on Long-Term Cooperative Action to Address Climate Change by Enhancing Implementation of the Convention*, notes that a significant proportion of additional CCS-related investment will be required in non-Annex I countries. Incorporating CCS projects into the CDM would thus help induce such investment flows in developing countries.

Geological storage of CO_2 may take place onshore or offshore in deep saline formations, depleted or partially depleted oil fields or natural gas fields, and in coal seams. While the IPCC SRCCS highlights the relative economic feasibility of capture and geological storage, it also cites the need for compatible legal and regulatory frameworks to assist in its widespread deployment. Legal and regulatory frameworks should be developed by each host country as a pre-requisite to hosting CCS CDM project activities.

2.0 Methodological Issues

2.1 CDM project boundary issues

As Canada noted in its February 2006 submission (contained in FCCC/KP/CMP/2006/MISC.2), the definition of project boundary for CCS projects under the CDM should accommodate full life cycle analysis of the CCS project. Project boundary should be broad enough to encompass GHG emissions during CO_2 capture, transport and injection. Moreover, a conception of project boundary for CCS CDM projects should be flexible to accommodate disparate storage types, including enhanced resource recovery operations such as Enhanced Oil Recovery and Enhanced Coal Bed Methane Extraction, and straight storage options such as into deep saline aquifers and depleted fields. Flexibility is also required to accommodate differences in geological settings that have distinct characteristics.

The emission sources that should be accounted for within the project boundary include fugitive emissions, indirect emissions resulting from the use of electrical and/or other energy sources required for the project (e.g., natural gas for heat required in amine scrubbing), seepage emissions, and storage site breach (although the latter is highly unlikely if site selection and project design have been correctly applied). With the exception of seepage emissions and storage site breach, these elements do not present any new considerations in the context of the CDM.

Specific components that will need to be considered in the CDM project boundary include:

i) The above ground components, e.g., the industrial installation where the CO_2 is generated, the capture plant, any additional CO_2 treatment facilities, the compression facility, the transportation equipment, and booster stations along a pipeline, any reception facilities or holding tanks at the injection site, and the injection facility.

These components present similar technical elements to any typical CDM project; therefore emissions from these components can be calculated using techniques and approaches applied in other CDM project activities.

ii) Wells and other potential direct seepage pathways, e.g., injection, observation and abandoned wells, mineshafts and boreholes. These potential seepage pathways will need to be monitored as part of the overall project monitoring plan.

iii) The reservoir, where the CO_2 is stored. Site characterization and storage performance assessment studies carried out as part of the feasibility study in advance of CO_2 injection operations will define the project boundary for the reservoir.

iv) The locations around the reservoir such as the caprock or spill points at the lateral edges of a geological structural trap.

v) Emissions associated with enhanced hydrocarbon recovery using CO_2, which may include breakthrough of injected anthropogenic CO_2 at extraction wells, additional energy use for hydrocarbon recovery and for CO_2 stripping and recovery, and any flare or venting emissions.

2.1.2 Other project boundary issues

Projects that cross national boundaries: This circumstance does not pose any additional challenges from a project boundary perspective, as the full life cycle of the CCS project would still need to be accounted for, including GHG emissions during CO_2 capture and transport. As to reporting responsibilities, the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (p. 5.20-5.21) provide guidance for cross-border CCS projects that could be equally applied in the context of CDM project activities.

Reservoirs in international waters: Projects storing CO_2 offshore in geological formations in international waters should follow the international laws related to activities in international waters. From a CDM perspective, host country approval is required for all CDM projects. In this context, host country approval could be interpreted as the developing country in which the non-Annex I partner is located.

2.2 Criteria and steps for the selection of suitable storage sites with respect to the potential for release of greenhouse gases

As Canada noted in its February 2006 submission, CCS projects under the CDM should demonstrate careful site selection, which should include but not be limited to:

- Conducting detailed site characterization that encompasses an assessment of the geological characteristics of the storage reservoir and caprock;
- Understanding the hydrogeology, geochemistry and geomechanics at the site;
- Assessing the volume and permeability of the storage formation;
- Understanding the site's geological trapping mechanisms; and

- Assessing whether abandoned or active oil/gas wells will compromise the integrity of the seal.

The 2006 IPCC Guidelines (p. 5.15) note that site characterization should identify and characterize potential seepage pathways such as faults and pre-existing wells, and quantify the hydrogeological properties of the storage system, particularly with respect to CO_2 migration. Sufficient data should be included to represent these features in a geological model of the site and surrounding area, as well as to create a corresponding numerical model of the site and surrounding area for input into an appropriate numerical reservoir simulator.

Models are able to define the vertical and lateral extent of the formation(s) and the maximum spatial extent of fluid migration, and thus the project boundary. The models will determine the geological, geomechanical and geochemical characteristics of the reservoir, the nature of the CO_2 trapping mechanisms, caprock integrity, lateral sealing, formation permeability and CO_2 migration rate, formation geological homogeneity/heterogeneity, CO_2 delivery, injection rate and total anticipated mass/volume, and the phase state of the CO_2 in the formation(s).

The 2006 IPCC Guidelines (p. 5.15) also state that a determination of the likely timing, location and flux of any fugitive emissions from the storage reservoir, or a demonstration that seepage is not expected to occur, should be done through short and long-term simulations. Short-term simulations of CO_2 injection should be made to predict the performance of the site from the start of injection to a point in time significantly after injection ceases (decades). Long-term simulations should be performed to predict the fate of CO_2 over centuries to millennia.

The models should then be used in the design of the monitoring programme to verify whether the site is performing as predicted. Ongoing monitoring of the formation(s) and CO_2 plume will be necessary to gather data on subsurface plume behaviour (to verify permanence) and for comparison with the projected behaviour of CO_2 undertaken as part of the initial site characterization and storage performance assessment. These results can be used to recalibrate and refine previous model runs and also to assist in identifying seepage from the target formations. The models should also be updated in light of any new data and to account for any new facilities or operational changes.

2.3 Seepage

2.3.1 Long-term physical leakage (seepage) levels of risks and uncertainty

Considerable work undertaken by Canada and other countries over years concludes that geological storage of CO_2 is secure. The IPCC's SRCCS notes, in its comprehensive review of the science, that the fraction of stored CO_2 retained in appropriately selected and managed geological reservoirs is very likely (a probability of 90-99%) to exceed 99% over 100 years, and is likely (a probability of 66-90%) to exceed 99% over 1000 years. The IPCC SRCCS notes as well that the scientific effectiveness of geological storage depends on a combination of naturally occurring physical and geochemical trapping mechanisms. These include:

- Structural trapping;
- Hydrodynamic trapping, whereby CO_2 eventually dissolves into the water of the geological formation; and,
- Geochemical trapping, whereby CO_2 undergoes a sequence of interactions with the rock and formation water.

2.3.2 Potential leakage paths and site characteristics and monitoring methodologies for physical leakage (seepage) from the storage site and related infrastructure

The key element to minimization of potential leakage is careful and appropriate site selection. Site characterization should identify and characterize potential leakage pathways such as fractures and faults, pre-existing wells including injection, observation and abandoned wells, mineshafts and boreholes, and caprock, and quantify the hydrogeological properties of the storage system, particularly with respect to CO_2 migration. As noted in section 2.1 above, these potential leakage pathways will need to be monitored as part of the overall project monitoring plan.

The proper management of CO_2 storage sites is a critical factor in minimizing potential migration of CO_2 to the surface. As Canada noted in its February 2006 submission, a variety of approaches are in use to stop fugitive emissions during the pipeline transport, injection or containment phases. From a methodological perspective, these approaches include:

- The establishment of pressure differences to stop the flow of fluids;
- Plume interception; and,
- In the unlikely event of a breakthrough of stored CO_2, plugging the locations with low permeability materials.

Geological modelling, as noted in section 2.2, is a key tool to understanding and predicting the behaviour of CO_2 and the storage performance of the reservoir. In addition, the 2006 IPCC Guidelines (p. 5.15) note that the following should be monitored:

- Measurement of background fluxes of CO_2 and, if appropriate, methane (CH_4) at the storage site and any likely emission points outside of the storage site;
- Continuous measurement of the mass of CO_2 injected at each well throughout the injection period;
- Monitoring to determine any CO_2 emissions from the injection system;
- Monitoring to determine any CO_2 and, if appropriate, CH_4 fluxes through the seabed or ground surface; periodic investigations of the entire site and any additional area below which monitoring and modelling suggests CO_2 is distributed (to detect any unpredicted leaks);
- Post-injection monitoring of the site, taking account of the results of the modelling of CO_2 distribution to ensure that the monitoring equipment is deployed at the appropriate places and times;

- Incorporating improvements in monitoring techniques and technologies over time;
- Periodic verification of emissions estimates; and
- Continuous monitoring of the injection pressure and periodic monitoring of the distribution of CO_2 in the subsurface (directly or remotely), as this can provide valuable information on the reservoir characteristics, evidence of any migration of CO_2, and early warning of potential seepage.

For Enhanced Oil Recovery the monitoring requirements should also include checking injections rates and CO_2 recycle and re-injection rates.

2.4 Accounting options for any long-term seepage from reservoirs

Careful site selection and appropriate site management practices, including rigorous monitoring procedures as described in section 2.3.2, should ensure that seepage or fugitive emissions are highly unlikely to occur. In the unlikely event of any seepage from the reservoir, these emissions should be subtracted from the overall emission reductions of the project activity.

2.5 Operation of reservoirs

2.5.1. Well-sealing and abandonment procedures

In order to ensure long-term well integrity, the project should identify all old abandoned wells in the vicinity of the storage site, ensure that design and installation of CO_2 injection wells are resistant to CO_2, and ensure the proper closure of the CO_2 storage sites.

2.5.2 Dynamics of carbon dioxide distribution within the reservoir

Geological and geochemical modelling will enable the project proponent to predict the location and behaviour of CO_2 stored within the reservoir. Installing and maintaining a comprehensive monitoring system for the storage site, as outlined in section 2.3.2 above, will serve as an early warning system for any impending seepage and provide ongoing information on the movement of the CO_2.

2.5.3 Remediation issues

Detailed contingency plans for remediation should be established and provided as part of the project documentation. Possible seepage could occur as a result of seal failure, seepage from the storage site due to natural hydrodynamic movement of dissolved CO_2, or due to excess injection past the “spill point” of the formation and seepage as a result of a lack of well integrity. A contingency plan should include remediation options for all the most likely seepage scenarios.

3.0 Other issues

3.1 Long-term responsibility for monitoring the reservoir and any remediation measures that may be necessary after the end of the crediting period and long-term liability for storage sites

From a practical perspective, considering the very long-term nature of storage (i.e., in the order of millennia), post-project closure monitoring and remediation liability would need to rest with the host country. Specific requirements could be determined by each host country in much the same way as each host country is currently required to define its sustainable development criteria for CDM project activities. Project developers of CCS CDM projects would then be required to follow these procedures and other domestic regulatory frameworks for CCS as required by the host country. This could take the form of a "safety fund" (such as the United States Superfund, which addresses heavily contaminated toxic waste sites that have been abandoned), with project proponents paying into a host country to regulate the long-term monitoring and remediation for the site. The International Energy Agency and the Carbon Sequestration Leadership Forum have prepared a study, *Legal Aspects of Storing CO_2: Update and Recommendations*, that examines in greater depth the legal issues affecting the storage of CO_2 as a GHG mitigation strategy.

3.2 Environmental impacts

Environmental impact concerns should be addressed in line with the CDM modalities and procedures. Decision 3/CMP.1 requires project participants to submit an analysis of the environmental (including transboundary) impacts of projects; it further requires an environmental impact assessment should the impacts be considered significant by the project participants or host country. A risk assessment study could be required in addition as part of the project due diligence and submitted with the other project documentation.

4.0 Conclusion

Considerable work undertaken by Canada, other countries and organizations over many years concludes that geological storage of CO_2 is secure. There are decades of experience in developing and deploying technologies applicable to CCS, as well as monitoring geologically stored CO_2. Canada has established world-renowned expertise on the injection and detection of various fluids within the geological subsurface as a result of extensive natural gas storage operations, enhanced petroleum extraction, and other CO_2 geological storage-related activities. The processes used in these operations are very similar in nature to those used for the storage of CO_2 in geological formations. There is also strong scientific understanding on the behaviour and migration of stored CO_2 in the subsurface (in part through modelling expertise), criteria for site selection, and criteria for short-term and long-term monitoring programs. Canada recognizes that all of these elements are crucial to ensure the long-term integrity of safely storing CO_2 in geological formations.

The elements laid out in the sections above provide detailed steps for the consideration of methodological and other issues related to undertaking CCS projects under the CDM. Building on the years of experience with CO_2 geological storage-related activities, and with careful and appropriate site selection and site management, CCS projects can be safely and successfully implemented.

PAPER NO. 2: NORWAY

VIEWS ON CARBON CAPTURE AND STORAGE IN THE CLEAN DEVELOPMENT MECHANISM

SUBMISSION FROM NORWAY, September 2007

Introduction

Through its Decision 1/CMP.2 the COP/MOP 2 invited Parties to submit views to the secretariat on carbon dioxide capture and storage (CCS) as project activities under the Clean Development Mechanism (CDM). Norway welcomes this opportunity to provide views on this important issue.

CCS technology related to CO_2 storage in geological formations is available and has been proven under full scale operational conditions for more than 10 years i.a. at the Sleipner Field in the North Sea. Norway is of the view that this technology, under the right site conditions, will be applicable for project activities under the CDM. The focus of this submission is limited to storage of CO_2 in geological structures. With the present knowledge of the potential for negative impacts to the marine environment, we are of the view that ocean storage projects involving CO_2 injection in the water column should not be considered for CDM activities at this stage.

Norway looks forward to taking part in constructive discussions on how to obtain technically viable and environmentally sound solutions on outstanding issues related to CCS in the CDM. Our aim is to adopt a decision at COP/MOP 4 with the necessary guidance to the Executive Board on how to ensure technically safe and environmentally sound CCS project activities under the CDM.

Reduction in global emissions of greenhouse gases

The IPCC Fourth Assessment Report confirms the need for political decisions on a new and more ambitious climate regime under the UNFCCC after 2012 to ensure sufficient reductions in global emissions of greenhouse gases.

Norway pursues a long term goal of limiting the global temperature increase to a maximum of 2 degrees Celsius compared to pre-industrial level. According to the IPCC, this will imply a peak in global emissions within 2015 and a reduction in these emissions of at least 50 % by 2050 compared to 1990 level. Negotiations on a future climate regime should be guided by this or similar goals.

The main goal for COP 13 at Bali should be to get agreement on a mandate for the negotiation of a new, global climate regime. The negotiations should be given a time frame of 2 years and be finalized at COP 15 in Copenhagen in 2009, parallel with the finalization of the ongoing negotiations on new commitments under the Kyoto Protocol.

To achieve the long term goal, a new, global regime should include emissions from international air and sea transport, as well as emissions from deforestation in developing countries. An enforced effort to stimulate development and implementation of CCS technologies would also be vital in a concerted effort to keep the increase in global mean temperature within 2 degrees.

With its large potential for reduction in CO_2 emissions, Norway considers a broad implementation of CCS technologies as an important, new option in a global strategy to achieve the long term goal of the Convention. Establishing a safe and sound framework for the implementation of CCS projects under the CDM could give an important contribution to a broader dissemination of such technologies.

At national level, the Norwegian government has decided that all new gas fired power plants shall be based on technology for CO_2 capture. The government will cooperate closely with the industry to facilitate the achievement of this goal. The development of the CCS technology is promoted through funding over the national budget. With a combination of tough emission standards and financial support, the government is over the coming years determined to develop CCS technologies which can be available world wide at an affordable cost. Similarly, other countries, including EU countries, Japan, The United States of America, Canada and Australia have implemented, or are in the process of implementing, policies to encourage a further development of CCS technologies.

Norway has extensive experience in storing CO_2 in geological structures. Currently, there are four large scale CCS projects in operation or under development:

- Since 1996, one million tonnes of CO_2 per year have been separated from the gas production on the Sleipner Vest field in the North Sea and stored in a geological formation 1 000 metres below the seabed – the Utsira Formation. Monitoring of the behaviour of the CO_2 storage facility is of vital importance. Multinational research projects supported by the European Union have collected relevant data in the Utsira Formation, and developed and demonstrated prediction methods for the movement of the CO_2 for many years into the future. The data show the precise subsurface location of the CO_2 plume and confirms that the CO_2 is confined securely within the storage reservoir.
- In September 2007, production of natural gas, NGL and condensate commenced from the Snøhvit field in the Barents Sea. 700 000 tonnes of CO_2 will be separated annually from the natural gas and reinjected and stored in a formation 2 600 metres under the seabed.
- The Mongstad Carbon Capture and Storage Project: The Norwegian government and the oil company Statoil have signed an agreement to establish a full-scale CO_2 capture and storage plant in conjunction with a gas-fired power plant at Mongstad at the west coast of Norway. In order to reduce technical and financial risk, the project will progress in two stages. The first stage covers construction and operation of the Mongstad CO_2 capture testing facility, which will be operational at the same time as the co-generation plant starts operation in 2010. The testing facility/pilot plant will have the capacity to capture at least 100 000 tonnes of CO_2 per year. The second

stage, i.e. full-scale capture of approximately 1.5 million tonnes of CO_2 per year, shall be in place by the end of 2014.

- The Kårstø Carbon Capture and Storage Project: The Norwegian government intends to provide a full scale CCS solution for a gas-fired power plant at Kårstø in the South-Western part of Norway.

Energy Demand, Economic Growth & Technology Transfer

Climate change is inextricably connected to development and the challenge of poverty reduction. The effects of climate change will have a disproportionately severe impact on the poorest and most vulnerable of the world's communities, and threaten to put the Millennium Development Goals beyond reach unless action is taken now. However, the links between climate change and development go well beyond adapting to the impacts of climate, and into the need for any solution to be fair and based on developing countries' right to economic growth. Economic growth and poverty reduction in the developing world and a subsequent rise in energy demand are major challenges that must be met. The current pattern of energy supply and demand carries the threat of severe changes to the climate. The pattern must be changed and the technologies exist to make it possible for countries to move straight to a low-carbon economy. CCS is one of the existing technologies that could facilitate such a development.

In the World Energy Outlook 2006 the IEA has constructed a scenario, The Reference Scenario, where no new government action is taken for the period 2004-2030: In this scenario global primary energy demand is expected to increase by 53% between 2004 and 2030. 71% of the rise in demand is expected to stem from developing countries. Almost 50% of the growth in global primary energy use goes to generating electricity. Globally, fossil fuels are expected to remain the dominant source of energy to 2030 and account for 83% of the overall increase in energy demand. As a result, their share of world demand edges up, from 80% to 81%. Coal sees the biggest increase in demand in absolute terms. This is driven mainly by power generation. Non-hydro renewables, including wind, solar and geothermal, are expected to have the strongest growth, but from a small base.

Similar scenarios have been developed by the IPCC: With the current climate change mitigation policies and related sustainable development practices, global greenhouse gas emissions are expected to continue to increase over the next few decades. The "Business as usual" scenarios in the IPCC's Fourth Assessment Report project a 25-90% increase in global greenhouse gas emissions between 2000 and 2030. Fossil fuels are projected to maintain their dominant position in the global energy mix to 2030 and beyond. The CO_2 emissions between 2000 and 2030 from energy use are projected to grow 40-110% over that period. More than two thirds of the increase in energy related emissions is projected to come from non-Annex I countries.

Obviously, the energy consumption trends in these scenarios do not represent a sustainable development, and the existing policies and measures will by no means make it possible to reach a long term goal of limiting the global warming to a maximum of 2 degrees Celsius.

Carbon capture and storage – a complementary measure

However, the current energy use and CO_2 emissions trends can be effectively mitigated through dissemination and implementation of clean-energy technologies and intensified policy actions. In the analysis “Energy Technology Perspectives 2006 – Scenarios & Strategies to 2050”, CCS is assumed to be the second largest contributing factor, after energy efficiency, to reducing CO_2 emissions at a global scale.

In the IPCC Special Report on Carbon Capture and Storage, as well as in the Fourth Assessment Report, the IPCC describes carbon capture and storage as a key technology for CO_2 mitigation. The technology is applicable in the industrial, fuel transformation and power generation sectors, with the greatest potential for low-cost carbon capture and storage in power generation.

Analyses such as those of the IEA and the IPCC illustrate the possible impact of a wide range of policies and measures aimed at overcoming barriers to adoption of these technologies. CCS will complement other climate change mitigation actions by providing an option for using fossil fuels, including coal, during the transition to a low carbon energy system. It offers the potential to reduce CO_2 emissions by between 85% and 95% from coal and gas-fired power plants. Carbon capture and storage in combination with biomass use could go even further and contribute to a net removal of CO_2 from the atmosphere. In combating climate change we have to use all policies and measures we have to be able to limit the global warming to a maximum of 2 degrees Celsius.

Including CCS projects in CDM under environmentally sound conditions could in this respect represent an important step towards a broader implementation of low-carbon economies at a global scale.

Carbon Capture and Storage in the Clean Development Mechanism

CCS technologies can not be expected to be installed in non-Annex I countries unless there are lasting economic incentive to reduce CO_2 emissions. The biggest obstacle today is high costs. An acceptance of CCS projects under the CDM will provide companies and countries with a financial incentive to export the results of know-how and technology on carbon capture and storage to non-Annex I countries. Cooperation on CCS under the CDM may lead to an earlier dissemination of this technology to non-Annex I countries, and through that contribute to mitigation of greenhouse gas emissions in countries without emission targets in the Kyoto Protocol.

Norway is convinced that CO_2 capture and storage in geological reservoirs is a viable option for project activities under the CDM. We realise, however, that there is need for some specific procedures and guidance for such projects to ensure that issues such as leakage/seepage and liability are properly addressed.

For Norway it is important to ensure that Certified Emission Reductions (CER) resulting from CCS project activities under the CDM be considered as solid and viable as CERs from other CDM project activities. To obtain this, it is of utmost importance that the geological storage sites be carefully selected, and that the selection is based on thorough and well documented analyses. Furthermore, proper and long-term monitoring of the reservoir after the CO_2 has been injected should be required, so that leakage from the site will be detected and accounted for. The experience from the Sleipner and Snøhvit CCS projects may give relevant input in this respect:

The CO_2 injected into the Utsira formation below the Sleipner field has been monitored with repeated seismic surveys. A baseline survey was conducted before injection in 1994, followed by repeated surveys in 1999, 2001, 2004 and 2006. In addition pressure and temperature as well as amount of CO_2 injected are measured at the wellhead on the platform. To investigate the potential of monitoring by repeated gravity surveys, such surveys have been performed in 2002 and 2005, and the results are promising as a supplement to the seismic data. Repeated seismic surveys will continue as a part of the regular monitoring. It has been documented that the injected CO_2 can be followed in great detail by the seismic monitoring[1].

The CO_2 injection through a sub-sea well at Snøhvit is scheduled to start in 2007. The well will have down-hole pressure and temperature measurement in the well at the injection point in the Tubåen formation. The injected CO_2 will be monitored by repeated seismic surveys; the first is planned for 2009.

To ensure confidence in the CERs, our view is that the 2006 IPCC Guidelines for National Greenhouse Gas Inventories should be used as a basis for carbon capture and storage project activities under CDM. The 2006 Guidelines contain a chapter on CO_2 capture and storage, and describe agreed methods for estimation of emissions from the capture, transport and injection processes as well as for possible leakage from the reservoirs.

The present modalities and procedures for the CDM cover most issues related to CCS project activities. However, we see that there are some questions that need to be discussed and clarified by the COP/MOP to provide guidance to the CDM Executive Board which can ensure the maximum environmental integrity of the projects. In our opinion these questions primarily relate to the selection and management of storage sites, prevention of leakage, accounting of leakage, issues related to the monitoring plan, and liability questions with regard to the stored CO_2 after the crediting period.

Project boundary

According to the modalities and procedures for the CDM, “the project boundary shall encompass all anthropogenic emissions by sources of greenhouse gases under the control of the project participants that are significant and reasonably attributable to the CDM project activity”. The definition of CCS in the IPCC Special Report is “a process consisting of the separation of CO_2 from industrial and energy-related sources, transport to a storage location and long-term isolation from the atmosphere”. The project

[1] For more detailed information refer to SACS Best Practice Manual, seismic monitoring from page 17 and Best Practice for the Storage of CO2 in Saline Aquifers – Observations and Guidelines from the SACS and CO2STORE Projects.

boundary of the CDM project activity should hence comprise these three separate processes; capture, transport and injection/storage of CO_2.

It is our view that the CERs from the project should be calculated on the basis of the amount of CO_2 produced by the plant (the baseline), minus CO_2 released in relation to the separation (uncaptured CO_2), transport and injection processes. In addition, indirect emissions from energy produced to perform the three processes should be taken into account. If the monitoring of the storage site reveals leakage of CO_2, this must also be subtracted from the CERs. Another way of expressing this is that the emission reductions could be calculated on the basis of the amount stored, minus emissions from producing energy needed for the capturing, transport and injection processes as well as detected leakage from the storage site.

Leakage and permanence

In the modalities and procedures for the CDM, leakage is defined as “the net change of anthropogenic emissions by sources of greenhouse gases which occurs outside the project boundary, and which is measurable and attributable to the CDM project activity”. We suggest that the project boundary encompasses the storage site, and that possible leakage from the storage site should be accounted for. “Leakage” here refers to leakage of CO_2 from the storage site, and not leakage as defined in the COP/MOP-decision. The latter type of leakage is not different for CCS projects compared to other CDM project activities, and thus, will not require new guidance.

The selection of storage sites for CCS projects is of vital importance to prevent leakage and ensure the environmental integrity of the projects. The long term risk for leakage has to be very low, and only projects designed with a high expectation of zero leakage should be approved. It should further be ensured that the storage sites proposed for CCS projects in the CDM have been thoroughly characterized and analysed, and that the documentation is a part of the Project Design Document (PDD). The analyses should include a characterisation of the reservoir, the cap rock/trapping mechanisms, geological stability as well as possible leakage pathways. The examination of possible reservoirs and quality storage should be based on e.g. knowledge obtained by industry and research communities.

One of the options for CDM projects is a crediting period of 7 years which may be renewed twice, according to the modalities and procedures for CDM. If this option is chosen, a thorough analysis of the storage site is required before a renewal is granted. If this analysis shows that direct or indirect leakage has taken place, it could be decided to deny renewal of the project as a CDM project. The rationale is that this could indicate that the reservoir is not safe and that the leakage may continue.

According to the IPCC Special Report on CCS, a retention time of CO_2 for several thousand years can be obtained for well-selected, designed and managed geological storage sites. It is also possible in some cases that the CO_2 may gradually be immobilised by various trapping mechanisms, so that it may be stored for up to millions of years.

Monitoring

The modalities and procedures for the CDM requires that the monitoring plan for a CDM project activity provides for e.g. the collection and archiving of all relevant data necessary for estimating greenhouse gas emissions and determination of baselines. This should include monitoring of the amount of CO_2 injected to the reservoir and the relevant data from the injection project. Identification of all potential sources of increased emissions outside the project boundary that are significant and attributable to the project activity during the crediting period should also be included. A proposed monitoring plan is to be developed by the project participants and submitted together with the application for registration of a CDM project activity.

Norway is of the view that proper and long-term monitoring of the reservoir is required to ensurethat leakage from the site will be detected and accounted for. It is important that the monitoring program covers the CO_2 storage and addresses possible leakage pathways in an appropriate way. These leakage pathways would have been identified during the analysis of the storage site. Monitoring technology and methodology for safe storage of CO_2 are available. This includes known seismic and gravimetric techniques. The monitoring should go beyond the crediting period (10 years or 7 years, with the possibility to be renewed twice). It should be decided who is responsible for the monitoring after the crediting period, the project participants or the host country, and the length of this period.

Liability

The emission reductions resulting from each project activity under the CDM shall, according to the modalities and procedures for the CDM, contribute to real, measurable and long-term benefits to the mitigation of climate change. As stated earlier, it is important for Norway that CERs from CCS projects are considered as solid as CERs from other CDM emission reduction projects. On this basis we see a need for a decision on long-term liability which extends the crediting and project period.

PAPER NO. 3: PORTUGAL ON BEHALF OF THE EUROPEAN COMMUNITY AND ITS MEMBER STATES

SUBMISSION BY PORTUGAL ON BEHALF OF THE EUROPEAN COMMUNITY AND ITS MEMBER STATES

This submission is supported by Bosnia and Herzegovina, Former Yugoslav Republic of Macedonia, Serbia, Turkey and Ukraine

Lisbon, 17 October 2007

Subject: **Carbon dioxide capture and storage as clean development mechanism project activities**

A. Introduction

I. Introduction

1. At COP/MOP 2 in Nairobi, Decision 1/CMP.2 [1] invited Parties to make submissions to the secretariat on carbon dioxide capture and storage (CCS) in geological formations as clean development mechanism (CDM) project activities, addressing a number of different issues, and taking into consideration the submissions of intergovernmental organisations and non-governmental organisations on the same issue. The EU welcomes the opportunity to submit its views on this important issue and looks forward to discussions at COP/MOP 3.

2. For the purposes of this particular submission, CCS refers to the technologies for capturing emissions of CO_2 from large point sources (such as power stations and energy-intensive industrial processes), transporting it to suitable sites, and injecting it into geological formations. The EU does not support CCS projects involving the direct injection of CO_2 into the water column because of high levels of uncertainty about levels of CO_2 retention and the negative effects on ecosystems. For these reasons, such projects are not discussed in this submission. Physical leakage of CO_2, which we refer to as *seepage* throughout, is defined as "a transfer of CO_2 from beneath the ground surface […] to the atmosphere or ocean"[2]. Migration of CO_2 represents "the movement of CO_2 within and out of a geological storage formation, while remaining below the ground surface".[3]

II. Rationale for large-scale deployment of CCS

---

[1] Contained in document FCCC/KP/CMP/2006/10/Add.1

[2] 2006 IPCC Greenhouse Gas Inventory Guidelines, 5.11, hereinafter referred to 2006 IPCC Guidelines

[3] ibid.

3. Meeting the 2 ºC objective will require global greenhouse gas emissions to peak within the next 10 to 15 years, followed by substantial global emission reductions of at least 50% by 2050 compared to 1990.

4. In its recent Working Group III Report "Mitigation of Climate Change", the IPCC projected CO_2 emissions from energy use to grow 40 to 110% between 2000 and 2030 if no additional policies are undertaken. Two thirds to three quarters of that growth will come from non-Annex I regions. But the IPCC also confirmed that low emissions scenarios can be achieved by the deployment of a portfolio of technologies that are currently available and that are expected to be commercialised in coming decades. While energy efficiency measures have the largest greenhouse gas emission reduction potential in the short to medium term, incentives need to be provided for a broad portfolio of renewable and low emission technologies in order to substantially increase their deployment beyond the demonstration phase.

5. The Stern Review [4] estimates that even with strong action on renewables and other low-carbon technologies, fossil fuels may still account for half of the world's energy supply by 2050. The report highlights the potentially important role of CCS alongside other technologies, to achieve stabilisation of CO_2 concentrations at 550ppm by 2050. It estimates that CCS could contribute some 20% of all reductions needed by 2050[5], and that the technology, if proved effective and safe in the medium and long term, might allow many economies to maintain the role of fossil fuels in providing secure and reliable energy, whilst addressing their growing CO_2 emissions.

6. In summary, the EU considers environmentally and health safe CCS involving geological storage as a possible mitigation option in the portfolio of actions for stabilising GHG concentrations in the atmosphere, provided that the necessary technical, economic and regulatory framework exists to provide maximum environmental integrity and ensure that any seepage is avoided.

III. Experience to date

Underground injection of CO_2 has been applied for more than a decade in various applications within the oil and gas industry, most notably in projects aiming at enhanced oil recovery. To date, 70 sites are operated globally by major and independent oil companies, which include the injection of CO_2 for Enhanced Oil Recovery [6]. The IPCC has concluded that ”components of CCS are in various stages of development. Complete CCS systems can be assembled from existing technologies that are mature or economically feasible under specific conditions, although the state of development of

---

4 http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

5 Stern Report P. 222 of the Stern report in Box 9.2

6 See e.g. IEA (2007) “Legal Aspects of Storing CO2” (p. 20)

the overall system may be less than some of its separate components” [7].

The IPCC Special Report on Carbon Dioxide Capture and Storage (IPCC SR) [8](2005) notes that “information and experience gained from the injection and/or storage of CO_2 from a large number of existing enhanced oil recovery (EOR) and acid gas projects, as well as from the Sleipner, Weyburn and In Salah projects, indicate that it is feasible to store CO_2 in geological formations as a CO_2 mitigation option.”[9]. The IPCC further notes that “seepage from offshore geological storage sites may pose a hazard to benthic environments and organisms as the CO_2 moves from deep geological structures through benthic sediments to the ocean” and that “while leaking CO_2 might be hazardous to the benthic environment, the seabed and overlying seawater can also provide a barrier, reducing the escape of seeping CO_2 to the atmosphere. It concludes that “no studies specifically address the environmental effects of seepage from sub-seabed geological storage sites”[10].

7. There is limited experience and uncertainties exist associated with monitoring, verification and reporting, but work is ongoing to address these issues.

IV. EU action

8. There has been a sharp rise in interest in CCS within some EU Member States. Many EU companies are developing plans to demonstrate the full CCS chain of capture, transport and storage for the power generation sector.

9. The EU recognises that full scale deployment of CCS will require strengthened R&D and a regulatory framework that ensures long-term storage integrity, full liability and investment certainty that takes into account all relevant environmental, health, economic, technical and legal aspects.

10. In January 2007, the European Commission adopted an integrated Energy and Climate Change policy package. The main elements of this package were subsequently endorsed by EU Heads of State and government on 9 March 2007. EU Heads of State and government affirmed the need for Member States and the Commission to work towards strengthening R&D and developing the necessary technical, economic and regulatory framework to bring forward environmentally safe CCS to deployment in all new coal power plants, if possible by 2020. They called for a strengthening of partnership and cooperation building with emerging economies, including low-emission energy technologies, notably CCS. EU Heads of State and government also welcomed the Commission's intention to establish a mechanism to stimulate the construction and operation by 2015 of up to 12 demonstration plants of sustainable coal technologies in commercial power generation.

---

[7] IPCC Special Report on Carbon Dioxide Capture and Storage (2005), Summary for Policymakers, p.8

[8] IPCC Special Report on Carbon Dioxide Capture and Storage (2005) – hereafter refereed to as IPCC SR

[9] IPCC SR, Chapter 5 Executive Summary (p.197)

[10] IPCC SR, chapter 5.7.4.4, pg. 249

11. It is in this context that the EU is developing an enabling legal framework for CCS, with the aim of creating the conditions for health and environmentally safe deployment. Although it is being developed for application in Europe, the enabling framework may be useful as a model for enabling CCS in other countries.

V. CCS in CDM

12. Industrialised countries will need to take the lead in developing and deploying CCS. However, in view of the size of the challenge ahead and the projected increase in fossil fuel-powered generation in developing countries, it is important that in the next decade developing countries build capacity to deploy low carbon technologies, including CCS**,** on a commercial scale.

13. The EU is ready to support this capacity building exercise. In this regard, the EU has a political agreement with China to develop and demonstrate near zero emissions coal (NZEC) technology through carbon capture and storage by 2020 and is exploring further cooperation with other key emerging economies. Under the European Commission's 7th Framework Programme for Research, opportunities exist for scientific collaboration between European and non-European researchers on CCS, and the EU is keen to expand this activity. Some European Member States, as well as the European Commission, are also active members of the Carbon Sequestration Leadership Forum (CSLF).

14. The EU is of the view that at present CCS is not yet a mitigation technology that is as safe and cost-efficient as renewables and energy efficiency projects. As such, CDM can only be an additional incentive to further develop and deploy CCS. As noted in our previous EU submission on this issue (6 March 2006), it is important that any CCS project activity should contribute to all of the objectives of the CDM, including assisting non-Annex I Parties in achieving sustainable development, and should not lead to a further distortion of the sectoral and regional distribution of CDM project activities.

15. The EU is of the view that the possible development of offshore CCS projects under the CDM should be subject to the establishment of specific procedures and regulations. Such procedures would need to be assessed under the Kyoto Protocol and regulations could benefit from the legally binding risk assessment framework recently adopted by OSPARCOM**.**

B. Site selection criteria and risks of seepage

(a) Long-term seepage – levels of risks and uncertainty

16. While natural accumulations of CO_2 in underground reservoirs are a common geological phenomenon [11], addressing risks and preventing long-term seepage for engineered sites is key to ensuring the integrity of CCS as a mitigation option and its

[11] IPCC SR, Chapter 5 Executive Summary (p.197)

use under the CDM. It is therefore important to assess site-specific risks of potential long-term seepage and to ensure the long-term CO_2storage integrity.

17. CCS involves injection of CO_2 into geological formations, whether in depleted oil or gas reservoirs or in saline formations. Saline formations, which provide the greatest opportunities for storage, are porous rock formations and composed of rock grains, organic material and minerals, with pores occupied by fluid (generally saline water). CO_2 is injected into the pore space and fractures in permeable formations. Once injected, the CO_2 can displace, dissolve in or mix with formation fluids or react with mineral grains, or some combination of these processes. As the IPCC SR notes, "the effectiveness of geological storage depends on a combination of physical and geochemical trapping mechanisms."[12] The IPCC SR describes these mechanisms in detail in its chapter 5.

18. The geological characteristics of reservoirs differ and their suitability and long-term storage capacity is widely recognised to be heavily dependent on their individual characteristics. For this reason**,** sound characterisation and site selection is key to ensuring long-term integrity of storage.

19. The IPCC SR sets out in broad terms minimum expected levels of retention of well-chosen and well-managed reservoirs: "For large-scale operational CO_2 storage projects, assuming that sites are well selected, designed, operated and appropriately monitored, the balance of available evidence suggests the following:

   - It is very likely that the fraction of stored CO_2 retained is more than 99% over the first 100 years.
   - It is likely the fraction of stored CO_2 retained is more than 99% over the first 1000 years."[13]

20. With regard to experience with existing demonstration sites, the IPCC SR quotes an estimate "that over 5000 years, all the CO_2 injected into the Weyburn Oil Field will dissolve or be converted to carbonate minerals within the storage formation" (noting, significantly, that "the caprock and overlying formations have an even greater capacity for mineralization" making it "unavailable for leakage") [14]. The project has performed largely as predicted with "no indication to date of CO_2 leakage to the surface and near-surface environment."[15]

21. With suitable site characterisation, selection and management, this practical experience supports the notion that the long-term risk of seepage is low. These levels of confidence and the assurance of permanence to be confirmed by ongoing projects, present an argument supporting presumption of long-term retention of CO_2 in well-selected and managed sites (i.e. a permanent emission reduction). Therefore only projects designed in the most secure sites as defined by IPCC-SR could be

---

[12] IPCC SR, 5.2.2 (p.208)
[13] IPCC SR, 5.7.3.5 (p.246)
[14] IPCC SR, 5.2.2.3 (p.209)
[15] IPCC SR, Box 5.3 (p.204)

approved**.** Those projects should employ sound site-selection criteria, proper risk management, good site-maintenance, and put in place appropriate measures to deal both with long-term responsibility for the site (including any necessary remediation in the event of any seepage). This should be done prior to starting the storage operation and requires monitoring and remediation programmes.

(b) Criteria and steps for the selection of suitable storage sites with respect to the potential for release of greenhouse gases

22. The 2006 IPCC Guidelines provide a methodology for the selection of storage sites for National Greenhouse Gas Inventories [16]. This is based on the steps of (a) site characterisation and then (b) CO_2 behaviour modelling and simulation. The London Convention and the OSPAR Convention in their risk assessment and management guidance for CO_2 storage also use this methodology.

23. The European Union has also moved forward with the development of an enabling legal framework for CCS. The European Commission will shortly be making a legal proposal for managing the risks of CCS, covering site-selection criteria, risk management, site-maintenance and abandonment procedures, and appropriate measures to deal both with long-term responsibility for the site (including any necessary remediation in the event of any seepage). These measures will be based on the IPCC Inventory Guidelines, which may also provide a suitable basis for other jurisdictions to establish requirements for health and environmentally safe CCS.

24. The IPCC SR notes that "the most effective sites are those where CO_2 is immobile because it is trapped permanently under a thick, low-permeability seal or is converted to solid minerals or is absorbed on the surfaces of coal micropores or through combination of physical and chemical trapping mechanisms."[17] The aim must therefore be that site selection requirements ensure *ex ante* that projects are not implemented in areas of geological instability or areas with any seepage paths, and allow sufficient trapping mechanisms to ensure stored CO_2 is fully and permanently retained in the long term.

25. Generally, methods for site characterisation are scientifically well established. The IPCC SR already sets out a general framework for the site selection process [18]. The IPCC SR also emphasises the need for good characterisation of sites [19] to determine their integrity and suitability, involving investigation of local geology, hydrogeology, geochemistry and geomechanics, with a particular focus on the reservoir and seal, and detailed computer modelling. The report provides detail on the kind of assessments required for characterisation and selection of sites, including information on needed data. It also looks at experience gained so far in the field. Work by the EU's CO2STORE project has provided quantitative indicators of suitability of aquifers for storage sites, which may be useful to demonstrate the

---

16 2006 IPCC Guidelines, Chapter 5

17 IPCC SR, 5.2.2 (p.208)

18 IPCC SR, 5.3 (pp.213-215 et ff)

19 IPCC SR, 5.4 (pp.225-230)

important properties and values to be assessed. A range of models is available to undertake the CO_2 simulation once the site has been well characterised, and combinations of models may be required for a thorough simulation. These are described in the 2006 IPCC Guidelines (as well as the IPCC SR).

26. In the case of CDM projects it will be important to ensure that criteria are suitably rigorous and applied consistently whatever the location of projects. Should host countries not yet have a suitable national regulatory regime in place, such a regime has to be developed and implemented before the project would be deployed. There is a need to develop clear principles and criteria for site-selection, as well as risk management systems. Moreover, it will be necessary to develop a detailed step-wise procedure to enable consistent and sound development and assessment of individual projects.

27. The EU therefore recommends that COP/MOP tasks the EB with liaising with a number of governmental and non-governmental bodies with suitable knowledge, and identifying experts**,** to draw up guidance, including the development of criteria and a step-wise procedure for the selection of appropriate sites, and guidance on how these criteria and procedures should be applied in the context of CCS projects under the CDM. Guidance should draw on the existing work of the IPCC, on national and regional experience, such as that of the EU, on work undertaken under the London and OSPAR Conventions and the CSLF, and on growing industry experience, and should be updated as new knowledge becomes available.

C. Operation and monitoring of reservoirs

28. The IPCC SR reports that “Observations from engineered and natural analogues as well as models suggest that the fraction retained in appropriately selected and managed geological reservoirs is very likely “to exceed 99% over 100 years and is likely “ to exceed 99% over 1,000 years”[20] In spite of this high expectation, consideration should be given in case of seepage during the pre-injection (CO_2 capture and transportation) and during the post-injection phase of a CCS project (operation, closure, post-closure).

29. In the operation and monitoring of reservoirs, the key issue is the availability of reliable, trustworthy and reproducible methodologies used to determine and verify the efficacy of storage mechanisms and ensure storage integrity. In approving CCS methodologies as CDM projects, the EB must be in a position to assess that good storage site characterisation, the identification of potential seepage paths and the development of a comprehensive monitoring programme have been conducted in order to prevent and to manage the risk of CO_2 seepage and (implement remediation measures in case of seepage)

    In operationalising the IPCC guidelines, the following issues should be considered:

    - **Appropriate site characterisation and selection**

---

20 IPCC SR, SPM, pg.14

Good site selection is fundamental to ensure integrity of the storage complex. The focus should be on site characteristics, the potential impacts in case of seepage, and the design of appropriate risk management and quality assurance systems, (including ready-made remediation plans to address potential seepage pathways)

- **Adequate monitoring plan design**
  Design and implementation of an appropriate monitoring plan program is essential to assess whether the storage site is performing as expected. Hence, progress in the development and application of more detailed quantitative monitoring techniques is important. Detailed monitoring protocols are needed including the operational monitoring during the project phase and monitoring to track the migration of the injected CO_2.

- **Reservoir operation**
  Good design, completion and operation of CO_2 injection wells are fundamental for the environmentally safe operation of CO_2 storage formations. The oil and gas industry has accumulated significant experience with technologies and practices for drilling, injection and construction of CO_2 injection wells. In principle, the design of CO_2 injection wells is similar to that of injection wells for gas used for enhanced oil recovery (EOR) and/or for enhanced gas recovery (EGR) operations. Construction materials that can resist CO_2 degradation will be needed, and appropriate regulations would assist in that respect. A suitable characterisation of injection well technologies is indicated in the IPCC SR [21]. The IPCC SR also provides guidance on safe injection pressure [22].

- **Adequate maintenance procedures**
  Maintenance regulations for injection wells are essential to avoid seepage during project operation and post-closure phases. Monitoring of the sealing performance of wells is necessary after storage operations are completed.

- **Adequate quality control and quality assurance procedures**
  Good quality control and quality assurance regulations are fundamental to ensure sustainable operation of storage sites.

- **Financial and organisational provisions**
  Financial and organisational provisions must be in place to ensure the continuing viability of storage operation, beyond the crediting period.

---

[21] IPCC SR, 5.5, pp.230-233
[22] IPCC SR, 5.5.4, p.233

- **Purity of the CO_2 stream**
  The objective of CCS is to capture CO_2 from the emission streams of large point sources for the purpose of injection and permanent storage; no waste and other matter may be added to a stream for the purpose of discarding those wastes or other matter. However, CO_2 streams may contain incidental associated substances derived from the source material and the capture, transport and storage processes used. In all cases, acceptable concentration of substances should be related to their potential impacts on the integrity of the storage site and relevant transport infrastructure, the risk to the environment, and to requirements of the applicable regulations. Therefore operators should prove that their CO_2 streams are sufficiently pure and that they have adequately considered the relationship between stream purity and the surrounding cap rock including environmental and other risks of CO_2 storage. CCS must not lead to clean air technologies being neglected or not applied anymore.

  These considerations could form the basis of a set of comprehensive criteria against which the EB assesses that proposals for CDM projects involving CCS adequately address issues of reservoir operation and monitoring.

D. Accounting options and long-term liability

30. According to the IPCC 2006 Inventory Guidelines, fugitive emissions of CO_2 from capture processes should be reported under the IPCC sector in which capture takes place. Fugitive emissions of CO_2 from the transportation phase depend on the selected transportation system (i.e. pipeline or ship; significant transport by truck or rail is unlikely) and on whether intermediate storage facilities for CO_2 are used. Potential seepage paths can include the pore system in low-permeability cap rocks, through openings, fractures and/or faults in the cap rock, or through operational or abandoned wells and other man-made pathways [23].

31. Several accounting issues arise from the inclusion of CCS project activities under the CDM. A key challenge is the accounting of any seepage from the reservoir. In addition, accounting questions arise from project boundary issues, as discussed below.

32. As a general principle, the EU believes that accounting rules for CCS project activities under the CDM should be consistent with the current approach under the Kyoto Protocol, which ensures that the actual effect on the atmosphere is reflected in the quantity of Kyoto units issued and accounted over time.

33. The EU believes that the best way to avoid very complex accounting schemes for long-term seepage is to ensure that there is full assurance of permanent storage of CO_2.

---

[23] For a detailed description of individual seepage pathways see the IPCC 2006 Inventory Guidelines, 5.6.1

34. Geological storage of CO_2 for long time intervals is fundamentally different to GHG removals by sinks. The EU therefore does not support the use of temporary Certified Emission Reduction Units (tCERs) or long-term Certified Emission Reduction Units (lCERs) for CCS project activities. These units were specifically developed for afforestation and reforestation project activities to account for the non-permanence of removals by afforestation or reforestation project activities.

35. The accounting of Certified Emission Reduction Units (CERs) from CCS project activities requires the clear assignment of liability and insurance coverage for the risk of emission from a reservoir.

36. There are a number of possible accounting options, which include liability for private or public entities and liability for countries. Liability and accounting options include:

- Buyer/user country liability, under which the holders of the CERs from the CCS project activity, i.e. the Annex I Parties using the CERs for compliance (or companies to which the liability may be transferred), would need to ensure full compensation for any seepage;

- Seller/Host country liability,-under which the country where the storage takes place has the ultimate liability for the storage site and would need to ensure full compensation for any seepage;

- Private entity liability, which could include project owner liability or Designated Operational Entity liability

While there are different ways to make private entities liable for any seepage from the reservoir, the EU believes that the ultimate liability for any seepage emissions needs to be with either the host country, the country using the CERs or both.

With host country liability, the Party that most adequately can ensure the operating conditions of the project is liable. The host country and the project operator have control over the reservoir and any seepage emissions, as the reservoir is under their control, enabling them to manage and mitigate the risk of seepage.

E. Project boundary issues

37. A number of observers, including the CDM EB, CDM Meth Panel and several Parties inputting to the SBSTA24 workshop, have highlighted project boundary issues arising in the case of CCS in the CDM, which need to be addressed.

38. As stressed by the IPCC[24], the project boundary should clearly cover all emissions that are significant and reasonably attributable to any aspects of the project activity, including capture, transport, intermediate storage, injection and storage. It will be

[24] 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2, section 5.10

necessary to ensure that additional energy use as a result of the CCS project activity is included within the project boundary and considered in calculations of net emission reductions resulting from CCS projects.

39. One particular issue is how to deal with the case where several projects use the same reservoir for storage. This raises the question of who should be responsible for monitoring and avoiding any seepage. Project participants from the different projects using a reservoir would need to co-operate on monitoring, preparedness, response, and remediation measures, for instance, via insurance coverage. Project participants would need to ensure that adequate arrangements remain in place. All operators involved must agree upon a monitoring and responsibility concept for the shared storage site in advance.

40. The 2006 IPCC Guidelines [25] provide different scenarios for reporting of cross-border CCS projects. Solutions are put forward there, which the EU supports, for projects where:

- CO_2 is captured in one country and stored in another;
- CO_2 is injected in one country and leaks to another country;
- More than one country uses a common storage site.

When it comes to approving such projects it would make sense for all Parties involved to provide approval.

Conclusions

41. The EU believes that the above mentioned points are some of the key issues that need to be addressed to enable CCS projects to be carried out under the CDM. The EU considers that the IPCC Special Report and the 2006 Inventory Guidelines provide some basis for further addressing these issues. In a number of cases, further work will need to be done, drawing on this material to provide sufficiently clear guidance for the consideration of CCS projects under the CDM. We believe that COP/MOP should instruct the Executive Board to proceed with this work, drawing on the expertise of those in the field.

- - - - -

[25] 2006 IPCC Guidelines (Vol. 2, 5.10)