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Methodological issues under the Kyoto Protocol

**Carbon dioxide capture and storage in geological formations as
clean development mechanism project activities**

Report on the technical workshop on modalities and procedures for carbon dioxide capture and storage in geological formations as clean development mechanism project activities

Note by the secretariat

Summary

This report presents a summary of the technical workshop held in Abu Dhabi, United Arab Emirates, on 7 and 8 September 2011 on technical and legal issues related to modalities and procedures for carbon dioxide capture and storage in geological formations as clean development mechanism project activities. The workshop was held with a view to facilitating the drafting by the secretariat of modalities and procedures for consideration by the Subsidiary Body for Scientific and Technological Advice at its thirty-fifth session.

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I. Introduction

A. Mandate

1. The Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP), by its decision 7/CMP.6:

(a) Decided that carbon dioxide (CO₂) capture and storage (CCS) in geological formations is eligible as project activities under the clean development mechanism (CDM), provided that the issues identified in decision 2/CMP.5, paragraph 29, are addressed and resolved in a satisfactory manner;¹

(b) Requested the Subsidiary Body for Scientific and Technological Advice (SBSTA), at its thirty-fifth session, to elaborate modalities and procedures for the inclusion of CCS as project activities under the CDM, with a view to recommending a decision to the CMP at its seventh session;

(c) Decided that these modalities and procedures shall address a specific list of issues;

(d) Invited Parties and admitted observer organizations to submit to the secretariat their views on how that list of issues can be addressed in modalities and procedures, and requested the secretariat to prepare a synthesis report based on those submissions (the synthesis report);²

(e) Requested the secretariat to conduct a technical workshop with technical and legal experts, after the thirty-fourth session of the SBSTA but prior to its thirty-fifth session, to consider the submissions and the synthesis report and to discuss how the list of issues can be addressed in modalities and procedures;

(f) Requested the secretariat to prepare draft modalities and procedures, based on the submissions and the technical workshop, for consideration by the SBSTA at its thirty-fifth session.

B. Scope of the report

2. This report presents a summary of the workshop referred to in paragraph 1(e) above.

3. This report and the synthesis report referred to in paragraph 1(d) above provide the basis for the secretariat to prepare draft modalities and procedures for consideration by the SBSTA at its thirty-fifth session, as referred to in paragraph 1(f) above.

¹ Decision 2/CMP.5, paragraph 29, specified the following issues: non-permanence, including long-term permanence; measuring, reporting and verification; environmental impacts; project activity boundaries; international law; liability; the potential for perverse outcomes; safety; and insurance coverage and compensation for damages caused due to seepage or leakage.

² FCCC/SBSTA/2011/INF.7. The submissions by Parties are contained in document FCCC/SBSTA/2011/MISC.10. The submissions by admitted observer organizations are listed in document FCCC/SBSTA/2011/MISC.11, and the texts of these submissions are published on the UNFCCC website (the submissions by intergovernmental organizations are available at <http://unfccc.int/parties_observers/igo/submissions/items/3714.php> and the submissions by non-governmental organizations are available at <http://unfccc.int/parties_observers/ngo/submissions/items/3689.php>).

C. Possible action by the Subsidiary Body for Scientific and Technological Advice

4. The SBSTA may wish to take note of the information contained in this report in the context of elaborating modalities and procedures for the inclusion of CCS as project activities under the CDM, with a view to recommending a decision to the CMP at its seventh session.

II. Workshop structure and participation

5. The workshop was held at the Crowne Plaza Yas Island Hotel, Abu Dhabi, United Arab Emirates, on 7 and 8 September 2011. The meeting was opened by Dr. Sultan Al Jaber from the United Arab Emirates. The meeting was co-chaired by Mr. Hugh Sealy (Grenada) and Mr. Pedro Martins Barata (Portugal).

6. The workshop agenda consisted of sessions structured according to the technical and legal issues outlined in the synthesis report, namely the following: site selection; project boundaries, accounting and transboundary issues; risk and safety assessment; monitoring; and permanence and liability. Each of these sessions consisted of two to four speakers from academia, business groups, non-governmental organizations and Parties, who provided technical and legal presentations on the substantive issues, after which time was allocated for questions and answers. The end of each session provided time for general discussion on the specific topic, at which the co-chairs focused on the issues that the secretariat ought to take into account in preparing the draft modalities and procedures. The workshop also featured sessions that provided participants with an overview of the CCS landscape, an opportunity to consider further the submissions that had been made, a brief update on current developments in national CCS programmes and frameworks and information on implications for modalities and procedures.

7. The workshop was attended by 93 participants: 58 representing 37 Parties (including 24 Parties not included in Annex I to the Convention), 31 from intergovernmental and non-governmental organizations and four staff of the secretariat. Thirty presentations were made in total: three by the co-chairs and the secretariat and 27 by technical and legal experts.

8. The following chapter provides a summary of the discussions at the workshop, structured according to the five substantive sections referred to in paragraph 6 above and including other matters arising over the course of the workshop. It serves to provide additional information to that set out in the synthesis report and further indicates the main areas of agreement and divergence on the issues under consideration. The workshop agenda, list of participants and workshop presentations are available on the UNFCCC website.³

III. Workshop discussions

A. Site selection

9. Participants noted that the selection of appropriate CO₂ storage sites should be achievable, although the procedures for doing so may be complex and challenging. It was recognized that the ultimate aim is to ensure the permanent and safe retention of the stored CO₂ and any displaced brine in deep geological formations, avoiding any impacts on

³ <http://unfccc.int/methods_and_science/other_methodological_issues/items/6144.php>.

human health, the environment and the climate. The issue of site selection in the context of open-ended aquifers with hydraulic connectivity to the atmosphere or surface waters was discussed, and it was suggested that these should be excluded where it is considered that CO₂ could migrate out and acidify waters and the surroundings.

10. During the discussion it was noted that several guidelines for site selection and characterization exist already, such as the following:

(a) The 2006 IPCC Guidelines for National Greenhouse Gas Inventories (the 2006 IPCC Guidelines);

(b) Directive 2009/31/EC of the European Parliament and of the Council on the geological storage of carbon dioxide (the EU directive);

(c) The *CO₂QUALSTORE: Guideline for Selection and Qualification of Sites and Projects for Geological Storage of CO₂* developed by Det Norske Veritas, a designated operational entity (DOE), which structures CO₂ storage site selection. It was noted that this guideline does not include public participation but that there are other guidelines that could cover this.

11. There was a fairly broad convergence of views that no size threshold should be applied to CCS project activities under the CDM. Concerns were raised about the required competencies of DOEs to validate and verify CCS projects given the complexity of site selection and characterization processes, and that the modalities and procedures would need to address them. The issue of demonstrating additionality was also raised in relation to concerns over the potential long time frames and high costs involved in storage site selection and characterization prior to requesting registration of a project activity under the CDM, although some participants suggested that the 'first of a kind' nature of CCS projects means that less emphasis should be placed on this issue.

B. Project boundaries, accounting and transboundary issues

12. With regard to the project boundary for a CCS project activity, it was generally held that this determination should be linked to site characterization and risk assessment procedures so that it shall include all subsurface components (e.g. the CO₂ storage formations) and all potential direct seepage pathways. There was also agreement that the project boundaries should be reviewed periodically in order to take account of deviations between the predicted behaviour of CO₂ in the subsurface (as determined through forward modelling) and the observed behaviour (as measured through monitoring), a process known as 'history matching'.

13. In terms of additionality, there was broad agreement that CCS projects are, in many cases, 'first of a kind' and therefore additional, although it was suggested by some participants that the additionality of enhanced oil recovery (EOR) projects may require further consideration.

14. On the subject of greenhouse gas (GHG) emissions accounting for CCS projects, it was outlined that the 2006 IPCC Guidelines allow for the accounting of CO₂ captured and injected by excluding it from a Party's GHG emissions.

15. Discussions also took place on the accounting of emissions from the burning of incremental oil produced through EOR using CCS. Concerns were raised several times in discussions regarding what have been broadly labelled as 'perverse outcomes' relating to CCS projects, such as the additional energy requirements associated with capturing CO₂, any emissions associated with additional oil produced through EOR using CCS, and the diversion of investment in CCS at the expense of renewable energy technologies. Some

Parties and observers raised the concern that using CCS today on fossil fuel emissions would reduce the storage capacity available for undertaking projects involving bioenergy and CCS in the future. It was recommended that these issues be reflected in modalities and procedures. Some participants suggested that, with regard to CCS in developing countries, an alternative mechanism, rather than the CDM, may be more appropriate. That said, on this issue no firm conclusions on the most appropriate approach were reached during the session, and a divergence of opinion was apparent.

16. Participants discussed various scenarios for transboundary movements of CO₂, as well as the legality of such movements. It was broadly agreed that the 2006 IPCC Guidelines provide a useful outline of approaches for the reporting of emissions. It was also mentioned that there are few current legal impediments in international law to the transboundary movement of CO₂ (e.g. per the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) and the Protocol thereto, or the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention)), and that such movements are generally allowable where they have been mutually agreed by all Parties involved. In terms of allowing transboundary CCS projects under the CDM, there was no clear agreement, although Parties tended towards not allowing, at least at first, transboundary projects in the CDM, as they pose significant cross-border and regulatory challenges. One suggestion was made that transboundary issues could be handled as and when required, rather than attempting to address all the issues in modalities and procedures *ex ante*.

C. Risk and safety assessment

17. It was generally held that an assessment of risk and safety needs to be matched to a geological storage site and project. In addition, it was observed that, while it is possible to define general principles and steps, risk assessment should not be overly prescriptive, as each geological storage site is different. A risk assessment should account for possible variations in the composition of the CO₂ stream and is essential to obtain information on the risks of, for example, seepage of CO₂ into nearby groundwater. It was suggested by technical experts that risk assessment has subjective elements and that risk is not the same as uncertainty. It was observed that there are always ‘unknown unknowns’ and that while risk perception decreases when more is known, the risk itself inherently does not. When numerically calculating probabilities, difficulties arise, for example because in natural systems phenomena may be very infrequent, meaning that data cannot be collected. It was highlighted that numerous standards for risk assessment already exist in the oil and gas industry and can be applied to CCS projects, especially during the operational phase of a project, where risk will be the greatest. It was generally noted that risk assessments need to be carried out before a project starts, potentially as part of an environmental impact assessment, and that there may be reasons for re-assessing risks continually throughout the CCS project life cycle.

D. Monitoring

18. The invited experts expressed the view that monitoring for CCS projects is needed for the following three purposes:

- (a) To calibrate and verify the performance of a geological storage site;
- (b) To detect and measure seepage or behaviour divergent from that forecast by models;

(c) To demonstrate long-term stabilization and permanent containment of the injected CO₂.

19. To achieve this, it was suggested that monitoring techniques do not necessarily need to be prescribed, but rather that the approach to monitoring should be driven by the fulfilment of the purposes outlined above. The expert view was that there is no 'one size fits all' suite of monitoring techniques that can be applied to each and every geological storage site, but instead that monitoring techniques, locations and frequencies need to be tailored on a site-specific basis according to the location, geology and other factors present at the site. A baseline measurement of conditions prior to the implementation of the project activity was deemed to be a very important aspect to facilitate the calibration of monitoring results and needs to be undertaken rigorously in order to establish natural variation; such measurement can take several years to complete but can be undertaken in parallel with site characterization. It was noted that some reservoirs, such as shallower geological formations, are easier to monitor than others. In reservoirs that are difficult to monitor, increased use could be made of wellbore and shallow overburden monitoring. There was no conclusion on the number of years that monitoring should continue after site closure; the EU directive states 20 years, while the 2006 IPCC Guidelines suggest the following approach to post-injection monitoring (volume 2, chapter 5, pp.5.15–5.16):

“The plan should provide for monitoring of the site after the injection phase. The post-injection phase of monitoring should take account of the results of the forward modelling of CO₂ distribution to ensure that monitoring equipment is deployed at appropriate places and appropriate times. Once the CO₂ approaches its predicted long-term distribution within the reservoir and there is agreement between the models of CO₂ distribution and measurements made in accordance with the monitoring plan, it may be appropriate to decrease the frequency of (or discontinue) monitoring. Monitoring may need to be resumed if the storage site is affected by unexpected events, for example seismic events.”

20. There was general agreement that modelling has an important role to play in geological storage site selection and performance assessment. Several experts suggested that modelling is an essential complement to measurement and can be used in assessing risks for the geological storage of CO₂. One expert provided extensive information regarding the role of modelling in the process of site selection, where it is an essential component but one that must be supplemented with other observational information, such as well logs and seismic surveys.

E. Permanence and liability

21. With regard to issues of liability for CO₂ storage sites, it was broadly agreed that arrangements have to ensure that any seepage event is mitigated and that damage is remedied even in the far future. Options for allocating liability over the long term were discussed, covering, inter alia, the option of buyer liability (i.e. liability residing with the certified emission reductions (CERs) buyer), project operator liability, discounting of CERs issued for CCS projects and host country liability. It was also suggested that the best way to manage liability is to ensure that, in the site selection process, only appropriate sites are selected. It was also noted that in countries with existing regulations for CCS projects, the most common approach is the transfer of the storage site ownership to the State after an agreed period of time and when pre-determined conditions have been met. It was mentioned that the way in which liability is structured affects the behaviour of different stakeholders, and that the incentives have to be designed accordingly. Some participants seemed to favour long-term liability allocation to the host country after site closure and

when the risks of seepage are deemed very low, and according to strict criteria in order to minimize seepage risk. It was also suggested that host country liability could be combined with the establishment of a compensation fund that can provide additional cover in the event of an accident, and in particular to cover the costs associated with ecosystem damage. On the other hand, some participants were of the view that the host country should not be required to take on liability for a geological storage site, even in the long term.

22. The concepts of discounting and the issuance of temporary CERs (tCERs) or long-term CERs (lCERs) were also discussed. Regarding discounting, several participants held that the setting of discount rates would be arbitrary and could not be established using any scientific basis. Regarding the use of tCERs and/or lCERs, several participants were of the view that these approaches may be undesirable as the use of these types of units may inhibit fungibility and, by extension, investment, favouring instead the issuance of regular CERs on the basis that a CCS project activity, if undertaken correctly, involves the permanent removal of CO₂ from the atmosphere. On this note, several Parties and observers reaffirmed their view that the route of tCERs and lCERs applied in afforestation and reforestation projects should not be taken because of fungibility issues. However, in accordance with previous comments, some Parties and observers suggested that the host country should not be required to take on liability for a geological storage site, even in the long term. In general, there was no broad agreement on how best to approach the issue of long-term liability, with some participants noting the scope for variations in approach on a country-specific and/or project-specific basis, according to the host countries' national priorities and circumstances.

23. The question of whether insurance could play a role in managing liabilities was also discussed. In this context, it was highlighted that insurance policies are available for CCS in respect of operational activities relating to bodily injury and property damage, but not for other aspects or over the long term. Such policies could potentially be developed, but given the uncertainties about the technology and the long-term nature of the risk, the basis for the indemnity would be unclear and would thus probably require the scope to be limited and the presence of some form of risk-sharing facility such as a government fund or cap on liability, at least in early projects.

F. Other matters

24. On the subject of institutional matters, there was broad agreement that a CCS working group or panel would need to be established to support the CDM Executive Board in assessing and approving CCS project activities, as well as providing other types of guidance. In terms of host country capacity, it was mentioned that procedures for evaluating host country capacity should not only be about post-closure stewardship but should also consider routine oversight during operation. It was remarked that the In Salah project in Algeria is regulated through Algerian hydrocarbon law, not CCS-specific regulation, meaning that, in some cases, existing laws may already address issues related to CCS projects. For various aspects of CCS project activities in the CDM, it was widely held that transparency is very important. Also, with regard to long-term liability, documents indicating that a transfer of liability has been carried out appropriately may be needed. There was also broad agreement that a new sectoral scope for CCS against which DOEs could be accredited before validating and verifying CCS project activities would be necessary.

25. Several Parties enquired about assistance to developing countries to fulfil the complex and demanding requirements that CCS in the CDM would entail. In response to this point, several Annex I Parties indicated that they are already supporting capacity-building in developing countries in relation to the regulation of CCS.

IV. Implications for modalities and procedures

26. The final session of the workshop was aimed at discussing ways forward on the modalities and procedures for CCS project activities. It was broadly agreed that the existing CDM modalities and procedures⁴ should be used as a basis, and that a *mutatis mutandis* approach should be taken as most of those provisions are also applicable to CCS projects, meaning that changes or additions should be made only where necessary. It was highlighted that most of the issues discussed at the workshop are technical requirements and are therefore likely to be presented in appendices to the modalities and procedures, probably in the form of a new technical appendix that could set out “project requirements”.

27. It was suggested that some of the more challenging issues for drafting modalities and procedures include approaches to the use of a financial provision, the allocation of liability, conditions for the transfer of liability and governance arrangements for transboundary projects. The issue of short-, medium- and long-term liability was also discussed in the context of global emission impacts in the event of seepage over the medium to long term, highlighting that compensation may have to be made well into the future. It was also noted that a number of modifications may have to be made to section G of the CDM guidelines, which relates to validation and registration. The topic of “definitions” within the modalities and procedures was also raised, and it was suggested that they need to be updated in order to ensure that a common language is used.

⁴ Decision 3/CMP.1.