M any experts in the field of climate change maintain that carbon capture and storage (CCS) could become one of the most important tools for mitigating the effects of climate change. Despite this fact, and although relevant technologies are readily available, only a few CCS projects have been implemented on a commercial scale. The main barriers to CCS projects are large capital requirements for carbon dioxide (CO₂) capture and transport facilities as well as the cost of injecting the gas and monitoring its storage.

Additional revenues generated by carbon credits through the Clean Development Mechanism (CDM) could help overcome barriers to CCS project implementation. To promote CCS in the CDM framework, Mitsubishi UFJ Securities submitted the first methodology for CCS to the CDM Methodology Panel in September 2005. It is applicable to projects that capture CO₂ from sources such as power plants and store it underground in existing or depleted oil wells.

Although the methodology received a favourable judgement by the CDM Secretariat about its completeness, it was put “on hold” at the 21st CDM Executive Board meeting in November, over concerns about the eligibility of CCS activities in the CDM. This matter was referred to the COP/MOP meeting in Montreal, which, following much debate, requested the Board to consider proposals for new CDM methodologies for CCS and make a recommendation to the COP/MOP meeting at the end of 2006.

The Montreal meeting also decided to invite comments from its Party governments and requested the CDM Secretariat and Subsidiary Body for Scientific and Technological Advice to hold a workshop in May 2006 on CCS as a CDM project activity. These decisions are welcome in establishing a well-defined process and schedule for rational and transparent discussions on CCS projects in terms of the CDM.

This article attempts to explain our CDM methodology for CCS, with a view to providing a basis for discussion before the 13 February deadline for government comments.

CCS eligibility
The eligibility of CCS as a CDM project activity should not be in question because the promotion and increased use of this technology is encouraged in the Kyoto Protocol Article 2, Paragraph 1 (a)(iv) of the Protocol refers to “research on, and promotion, development and increased use of new and renewable forms of energy, of carbon dioxide sequestration technologies and of advanced and innovative environmentally sound technologies”.

The question of CCS eligibility in the CDM seems to be linked closely with the issue of permanence. That is to say, whether the CO₂ stored by a CCS project will eventually be emitted to the atmosphere. The Intergovernmental Panel on Climate Change (IPCC) special report on CCS has served to allay fears about this point (see Carbon Finance, September 2005, e-mail update). The report states that when CO₂ is stored in appropriately selected and managed geological reservoirs, the ratio of retained CO₂ is likely to exceed 99% over 1,000 years.

To ensure a high ratio of retention for the stored CO₂ through appropriate selection and management of geological reservoirs, we have incorporated a detailed set of applicability conditions into our CDM methodology. These include minimum standards for site selection and rules on how the CCS operation is to be conducted. Only the projects that undertake CCS in compliance with these strict applicability conditions will be able to use the methodology.

Given the critical importance of reservoir integrity for an effective CCS project, the methodology requires project participants to submit detailed information/data on the site to the Designated Operational Entity (DOE) – the UN-appointed project validator and verifier – at the time of validation (see Figure 1). A reservoir model (including 3-D seismic data) should be produced and a simulation carried out. Any abandoned wells in the area that are likely to be affected by the injection of CO₂ are required to be properly sealed. We believe that an overwhelming majority of experts agree that the risk of stored CO₂ escaping is minimal if the project is carried out in conformity with the methodology’s applicability conditions.

To determine the baseline scenario, the methodology examines whether anthropogenic CO₂ from the source is currently emitted into the atmosphere without being captured, and whether the current situation is likely to continue in the absence of a CDM project. The methodology also makes use of the “additionality tool” to ascertain that the project is additional, that is to say, CDM status is essential for the implementation of the project.

If the assessment is in the affirmative on both of the two points mentioned above, the project’s baseline emissions will be equivalent to the total amount of CO₂ currently emitted at the source. This amount will be calculated from the monitored volume of the baseline gas and its fraction of CO₂ [1]

Project emissions considered in the methodology consist principally of:
- GHGs associated with energy (both fossil fuel and electricity consumption) used by the project equipment and machinery; and
- CO₂ losses during the capture, transfer or recycling processes.

The issue of seepage is dealt with through appropriate monitoring, and is described below.

Monitoring
Monitoring, which plays a vital role in the methodology, consists of three elements. The first involves constant metering at various points of the CCS operation to collect the data that enables transparent and accurate determination of the baseline emissions and project emissions. Figure 2 provides a diagrammatic summary.
of a CCS project and shows the principal monitoring points the methodology requires.

The letters A – E represent major monitoring points.

Secondly, the methodology requires regular monitoring of the project's conformity to the operational rules set forth as part of the applicability conditions. For instance, the methodology prescribes a minimum injection depth and a maximum injection pressure to control the risk of seepage. Figure 3 lists major monitoring requirements to ensure adherence to applicability conditions.

The third part of the monitoring methodology pertains to seepage or escape of the stored CO₂. As stated above, most experts agree that CCS projects undertaken at a carefully selected site under conservative management rules can safely assume that there is little risk of seepage. Nevertheless, the methodology stipulates, for the sake of conservatism, a set of precise monitoring procedures to ascertain that no seepage is in fact occurring. This includes monitoring to detect any presence of CO₂ seepage from the reservoir through techniques such as soil gas analysis (onshore projects) or direct water analysis (offshore) and 3-D seismic surveys. As long as CO₂ seepage from the reservoir does not exceed an annual average of 0.1%, the methodology assumes loss of stored CO₂ to be negligible. At this level, the CO₂ will take a minimum of 1,000 years to disappear. If this maximum seepage amount is exceeded for any crediting period during the project life, Certified Emission Reductions (CERs) equivalent to the estimated amount of CO₂ released – verified by a third party – should be replaced by the project participant.

Figure 4 enumerates the major procedures and timetable for seepage monitoring.

Conclusion
One of the biggest challenges for CCS in the CDM is the development of a methodology that secures the authenticity of GHG emission reductions, while at the same time avoiding the imposition of prohibitively cumbersome and expensive rules. We hope this methodology has succeeded in striking a good balance between environmental integrity on the one hand and practicality on the other. Stakeholders' comments are most welcome to assist in improving on the methodology. The new baseline methodology and monitoring methodology, together with an illustrative CDM Project Design Document to show how the methodologies are applied to a specific CCS project, will be made available upon request by e-mail to adrian-stott@sc.mufg.jp.

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3. Monitoring for adherence to applicability conditions

- Actual well-head injection pressure to ensure that the maximum injection pressure is not exceeded (weekly)
- Temperature and pressure of the reservoir (weekly)
- Annular pressure (monthly)
- Tubing pressure (monthly)
- Map the location of surface monitoring sample points, location/number, etc. (First year and at the end of each crediting period)
- Well abandonment carried out in strict compliance to regulations

4. Monitoring for CO₂ seepage from the reservoir

- Soil gas analysis or direct water analysis (first year and at the end of each crediting period)
- Time-lapse 3D seismic data for updating the reservoir model (end of each crediting period)
- Vertical seismic profile of injection/production well (end of each crediting period)
- Gas ‘bubble’ using repeat 4D seismic surveys (end of each crediting period)