CCS-CDM: Methodology proposal

Based on preparation of PDD for CO2-EOR project

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Table of contents

1. Proposed principles for new Baseline Methodology
2. Proposed principles for new Monitoring Methodology
3. CCS-CDM project cycle; input to discussion
Baseline Methodology

**Working title:**
- Baseline methodology for permanent geological storage of CO2 in connection with enhanced oil recovery (EOR) activities

**Purpose:**
- To determine the emissions of GHGs in the baseline scenario
- To establish additionality
Before project implementation

Gas to refinery
Oil to refinery
Production stream
Separation Oil/ass. gas
Separation NG/CO2
Venting With pilot flame
Production wells
Oil to refinery
Oil/gas
Oil to refinery
CO2
After project implementation

Baseline GHG emissions: vented CO2

CERs

Crediting period

Loss of CO2 in transport/process
Emissions from incremental energy usage inside boundary

PROJECT BOUNDARY

Gas to refinery

Oil to refinery

Production stream

Separation Oil/ass. gas

Separation NG/CO2

Venting With pilot flame

Compression

Recycled associated gas

Oil to refinery

Oil/gas

Injection wells

Production wells

CO2

CO2

CO2

CO2
Additionality test

A. Laws/regulation/policies
   - YES
   - Economically attractive
     - NO
     - C. Common practice contradicting additionality
       - NO
       - NO
       - CDM Activity
       - NO CDM Activity

   - B.i. Economically most attractive
     - NO
     - B.ii. Financial/institutional/technological barriers
       - YES
       - NO CDM Activity

   - B.ii. Economical attractiveness
Monitoring

• The Clean Development Mechanism demands real, measurable, and long-term benefits related to the mitigation of climate change.

• Geological storage will only satisfy these requirements if the injected GHGs remain in the geological formation for a sufficiently long period of time.

• HOW LONG IS LONG ENOUGH?
Permanence/ Long term

- CDM Project  
  \( \text{(max 21 years)} \)

- Geological storage  
  \( \text{(1000 years ?)} \)

- A monitoring methodology is usually designed to monitor the CDM project activity during the crediting period.

- In the case of permanent geological storage, monitoring has to continue also after the termination of the EOR project.
Possible solution

"normal"

New Monitoring Methodology

Time scope
• Crediting period

System scope
• Subsurface is treated as a container for the injected gas
• Assumed that injected gas will not leak into the atmosphere
• The subsurface is penetrated only by the injection well(s) and the production well(s) associated with the CDM activity

Sub-surface Monitoring

Time scope
• In principle defined by international criteria for CCS
• Could be shortened depending on the performance of the storage

System scope
• Emphasizes the subsurface only
• Thus, the cap-rock, the overburden, cracks, folds and fractures, and all penetrations including the injection and the production well(s) associated with the CDM project activity
Monitoring

New Monitoring Methodology

\[ t = \text{crediting period} \]

Sub-surface monitoring

\[ t = \text{depending on international criteria} \]
Storage Performance Assessment (SPA)

Environmental criteria

Storage performance criteria

Site assessment

Scenario Analysis → Model development → Consequence analysis

Sub-surface Monitoring

Monitoring plan

Abandonment & Remedy

Abandonment procedure → Remedy actions

HSE Criteria (local)

Environmental Impact Assessment (Section F in CDM-PDD)
Connection PDD – SPA

Documents

Methodologies

PDD

SPA

NM-B

NM-M

NM-SPA
Possible process for CCS as CDM project

**Before project**
- SPA
- PDD (SPA)
- DOE (CCS)

**Registration**
- Project (crediting period)
  - Normal monitoring, verification, certification and issuance
  - Subsurface monitoring

**End**
- Intermediate
  - DOE (CCS) or the CCS-panel of EB
  - % of CERs to insurance
  - Remedies and CER replacement funded by insurance

**Transfer of liability**
- Host country monitoring & reporting to UNFCCC

**Long term**
- DOE (CCS)
- EB

- Host country CCS approval

*Note: DO and EB stand for different entities involved in the process.*
FINE

Thank you for the attention!
Storage performance assessment

Part I – The storage performance criteria

• Defining a storage effectiveness metric:
  
  – **Storage effectiveness**: The fraction of the cumulative injection of CO2 that is retained underground after 1000 (?) years.

  – **Geologic Storage**: Storage of CO2 in underground geological formations with storage effectiveness greater than 90%.

• The storage performance criterion for this project activity is Geological Storage as defined above.
Storage performance assessment

Part II – Site Assessment

- Scenario analysis
  - The assessment is initiated with a description and classification of non-specific features, events and processes (FEPs) relevant to CO2 storage.
  - The FEPs are then ranked for probability and consequences associated with the specific storage site.
  - Scenarios are developed by combination of critical FEPs.

- Model development
  - When the scenarios have been defined they will be evaluated through mathematical modelling and simulations.

- Consequence analysis
  - The results of the modelling and simulations are then made subject to a consequence analysis with respect to leakage from the reservoir and eventually to the atmosphere.

The Site Assessment is based on the Safety Assessment Methodology for Underground CO2 Storage developed by the Netherlands Institute of Applied Geoscience TNO and joint partners, funded via the joint industry project named the CO2 Capture Project (CCP).
Storage performance assessment

Part III – Monitoring plan

- The primary purpose of the monitoring plan is to confirm and assure that the CO2 storage satisfies the storage performance criterion.
- The monitoring system is restricted to cover the subsurface-part of the system,
- The question of durability of the monitoring system and what kind of technology that should be applied, must be answered on the basis of the site assessment and the experiences from the monitoring accumulated during the operation phase. It is assumed that the long term monitoring program will be more extensive in the first years.
Storage performance assessment

Part IV a – Abandonment procedure

• The development of a field abandonment procedure catering for plugging, restoration and maintenance of wells must be based on standard procedures in the oil and gas industry, but with modifications as to the regards of the issue of permanency and the results of the storage performance analysis.

• The abandonment procedure must describe the point in time, relative to the termination of the project activity, that is ideal for transferring liabilities, and specify explicitly the liabilities concerning the monitoring activities.
Storage performance assessment

Part IV b – Remedy actions

- Remedies must be established for each possible case that the project does not meet the storage performance criteria during the project operation period.
Liability

- The abandonment procedure represents the transfer of responsibility from the operating company to the National Authorities.

- Since a Host Country to CDM projects does not have commitments to reduce emissions of GHGs, and therefore is not obliged to report emissions on a regular basis, some kind of agreement needs to be made between the Host Country Authorities and the National Authorities representing the entity that buys the CERs.

- It is suggested that the Host Country is responsible for the long term monitoring and that potential emissions of injected GHGs are reported to the Designated National Authority (DNA) of the National Authorities of the entity buying the CERs.

- The potential emissions are then reported on a regular basis, as part of the National Inventory, to the UNFCCC. The two National Authorities must agree on which of them that will be responsible for accounting for the potential leakages during the monitoring period.
Baseline emissions (tCO2e)

1. Baseline GHG emissions: vented CO2
2. Emissions from incremental energy usage inside boundary: transport/ process
3. Loss of CO2 in transport/process