

# **Workshop on**

## **Sub-Seabed Carbon Dioxide Storage**

### **Berlin, 16 to 17 June 2008**

#### **How to store CO<sub>2</sub> safely for the marine environment - from planning to eternity ?**

In order to facilitate the exchange of experiences between experts involved in sub-seabed storage of captured CO<sub>2</sub>, the German Federal Environment Agency invited to this international workshop. The workshop dealt with both, legal and scientific aspects of the storage of CO<sub>2</sub> in sub-seabed geological formations. Focus was on requirements on CO<sub>2</sub> storage in geological formations and deep sea sediments effectively avoiding intensified climate change and protecting also the marine environment.

The first day of the workshop concentrated on legal questions comprising developments in international law, presentations on national and regional approaches to regulate offshore-CCS-measures and talks about liability aspects and Emission Trading Systems.

The day after, presentations were about the risks of offshore CCS measures (risks to the benthic biosphere, maximal allowable leakage rates), plans and experiences with specific projects focussing on monitoring aspects and finally other options of offshore-storage of CO<sub>2</sub>.

Speakers came from Germany, Italy, Norway, Spain, Sweden, the US and Japan. About fifty experts (lawyers, scientists, regulators, representatives of energy enterprises and of NGOs) attended the workshop.

Main matters of debate and conclusions of the workshop:

#### **Requirements for storage sites**

- It is clear that according to international law there are already qualitative requirements for offshore CCS measures. London Protocol (LP) and the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) demand *inter alia* a permanent storage. Risks have to be avoided and substances added to the CO<sub>2</sub> stream should be minimized.

Due to the fact that the technique is under development and due to the lack of knowledge, precise and quantitative requirements can not be stipulated for the time being. However, such forms of requirement should be developed, as far as appropriate, according to the increase of knowledge.

- A certain degree of flexibility may be necessary while regulating off-shore CCS measures. Different approaches were identified by the workshop participants: stipulation of specific standards by the governments or development of best available techniques by the industry concerned. No agreement was reached on which approach would be preferable.
- It was clear to the workshop participants that the basic risks of off-shore CCS measures to the marine environment are connected with potential leakages. It was also clear that CO<sub>2</sub> as well as substances added to the CO<sub>2</sub> stream and substances mobilised by the CO<sub>2</sub> stream from the surrounding material must be considered.
- The workshop welcomed the proposal of Prof. Wallmann (Leibnitz-Institut für Meereswissenschaften, IFM-GEOMAR, Kiel) to identify allowable CO<sub>2</sub>-leakage rates for the protection of the marine environment. The maximum permissible leakage flux from submarine storage should be defined as less than 10 % of the normal flux rates which generally corresponds to a rate smaller than 10 t of CO<sub>2</sub> per km<sup>2</sup> per year. The limit of maximum allowable leakage rates should at least implicate the obligation to provide for financial security.

### **Long-term responsibility for storage sites**

- Generally, it is not clear how long industry should be responsible for storage sites. In this context, participants discussed the necessity to transfer responsibility to the government, taking into account the need of CCS for climate change mitigation as a problem of the whole society, participants discussed

### **Monitoring strategy for storage sites**

- No agreement was reached about the requirements with regard to monitoring. Firstly, there was disagreement about the required monitoring methods. It was mentioned that it would be inadequate to base monitoring solely on seismic techniques. Secondly, there was a dispute about the right "place of assessment". Arguments were brought up that the link between subsoil and water column should be monitored. This approach was considered to be the most practicable option.. Moreover, the „real risks“ are supposed to result therefrom, However, it was also stressed that according to international requirements leakages from storage sites have to be monitored.
- Thirdly, a monitoring concept was promoted focussing on the monitoring of natural gases and formation waters within the geological formation which are displaced by the storage of CO<sub>2</sub>. Thereby, faults of the storage sites could be identified.
- No final opinion was reached on whether it is technically feasible to identify all faults of a storage site before the injection takes place. It was accepted, however, that at least after the start of the inject-

tion faults could be determined by the monitoring of leakages of natural gases and formation waters.

- Moreover, no answer was given whether faults identified after the injection could be mended.

### **Effectiveness of CO<sub>2</sub>-storage: requirements of the Kyoto Protocol**

- The point was raised that the Kyoto Protocol sets requirements to prove the effectiveness of offshore CCS measures to really mitigate climate change effects.