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TECHNICAL GROUP

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REPORT ON THE IEA–CSLF WORKSHOP ON NEAR-TERM OPPORTUNITIES FOR CARBON CAPTURE AND STORAGE SAN FRANCISCO, CALIFORNIA, 3-4 AUGUST 2006

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Note by the Secretariat

Background

The International Energy Agency (IEA) - Carbon Sequestration Leadership Forum (CSLF) Workshop on Near-Term Opportunities for Carbon Capture and Storage was held in San Francisco, California, United States on 3-4 August 2006. This Workshop was held in response to a request from the G8 to the IEA and CSLF and is the first in a series of three planned workshops.

This report by the Secretariat describes the Workshop, with emphasis on the results of most interest to the CSLF Technical Group.

Action Requested

None.

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In its final Gleneagles Plan of Action of 7-8 July 2005, the G8 stated that:

> *We will work to accelerate the development and commercialization of Carbon Capture and Storage [CCS] technology by:*
>
> > *…inviting the IEA [International Energy Agency] to work with the CSLF [Carbon Sequestration Leadership Forum] to hold a workshop on short term opportunities for CCS in the fossil fuel sector, including from Enhanced Oil Recovery and CO_2 removal from natural gas production.*

The IEA and the CSLF agreed to work together to hold a series of three workshops on this topic. The first workshop was held in San Francisco, California on August 22 and 23, 2006. This report summarizes the important results of this workshop that are of most interest to the CSLF Technical Group. For the most part, these are the results of a Breakout Group on Technical Issues.

The second workshop will be held in Oslo, Norway in June 2007 and the third in Canada in late 2007.

Objective

The objective of these workshops is to help achieve the G8 goal of accelerating the development and commercialization of CCS by providing recommendations that will facilitate near-term CCS opportunities. Near-term opportunities are those opportunities for CCS that are technically and economically viable or ready for demonstration or commercialization in the near-term and include both sources and sinks and all fossil fuels (coal, oil and gas). Examples may include:

- High concentration sources,
- Hydrogen production,
- Enhanced oil recovery,
- Gas Production,
- "Capture ready" power plants and other facilities, and
- Early demonstrations.

A somewhat different terminology from that of the G8 is used; that is, "near-term opportunities." This term is used to make it clear that these are not just opportunities that may only last a short time, as "short-term" might imply. These opportunities may start soon, but they hopefully will last for a long period of time.

These workshops raise relevant policy, technical and commercial issues, facilitate a dialog among stakeholders, and provide the basis for a report with specific recommendations to the G8 that will make acceleration achievable.

Approach

These workshops are intended to be a collaborative and consultative process over an adequate period of time to enable a consensus to emerge among the various stakeholders. Three workshops are planned, the first of which has already been held:

1. Issues and Opportunities Workshop. This is the workshop being reported in this document. The workshop was held in San Francisco, California, United States and defined the issues and opportunities related to near-term opportunities. Breakout sessions were held on the following topics:

   - Technical Issues
   - Commercial/Financial Issues
   - Legal and Regulatory Issues
   - Public Education and Outreach Issues
   - International Mechanisms

   The deliverable from this workshop will be a discussion paper based on the findings of the workshop, particularly the breakout sessions. The IEA will provide the first draft, organize and manage the review process, and publish the paper. This discussion paper will be a primary input to the next workshop. Depending on the findings, the discussion paper may also identify analyses that should be performed prior to the next workshop.

2. Assessment Workshop. This event will be held in Oslo, Norway in June 2007. The objective will be to continue the dialog started in San Francisco and assess the specific issues and opportunities identified in the first workshop. The assessment will consider the options for embarking on and advancing near-term opportunities and the suite of conditions necessary for deployment of CCS. The Assessment Workshop will:

   - Review the findings regarding the issues,
   - Develop options to address these issues, and
   - Provide timeframes for feasible implementation of these options.

   The deliverable from this second workshop will also be a discussion paper based on its findings and drafted in a similar manner to the first discussion paper. The discussion papers from the first and second workshops will be primary inputs to the final workshop. Depending on the findings, the discussion paper from this second workshop may also identify analyses to be performed prior to that final workshop.

3. Recommendations Workshop. This workshop will be held in Canada later in 2007. The findings of the previous two workshops will be considered in developing proposed final recommendations for presentation by the IEA and CSLF to the G8 meeting scheduled for Japan in 2008. The workshop will lay out the technical, economic, regulatory and fiscal conditions necessary for near-term deployment of CCS, and provide policy recommendations on how to create these

conditions, including further international collaboration needed for effective early deployment. The workshop will:

- Consider, evaluate and compare the findings, options and timeframes developed in the earlier workshops from a variety of policy and stakeholder perspectives;
- Attempt to facilitate grounds for consensus among the different perspectives; and
- Provide policy recommendations for early implementation of CCS, including further international collaboration.

Final Report. IEA will report on the results to the G8 at its 2008 summit in Japan. This final report will describe the process used to develop the report and cover the results of all three workshops and any related analyses. It will make specific policy recommendations to accelerate the development and commercialization of CCS.

Conduct of the First Workshop, San Francisco, August 22-23, 2006

Annex A contains an overview of the schedule for the San Francisco Workshop. This agenda was organized to provide a logical procedure to identify, organize, prioritize and evaluate the issues that needed to be addressed. It was intended to provide the necessary input to the next workshop in Oslo, where alternative solutions to the issues will be analyzed.

After a series of scene-setting presentations, most of the discussion took place in the breakout group sessions. The breakout groups had the following tasks:

- Identify near-term opportunities relevant to the group's area;
- Identify perceived issues/barriers to commercialization;
- Describe how the issues affect the opportunities;
- Indicate cross-cutting issues for other breakout groups;
- Define gaps in international cooperative activities; and
- Indicate needs for the second workshop.

The breakout groups reported their results in a plenary session the final afternoon of the Workshop.

Results of the Workshop

The various breakout groups carried out the tasks described above. The focus of the Breakout Group on Technical Issues was closely aligned with and relevant to the activities of the CSLF Technical Group. Annex B contains the presentation given by the chairman of the Breakout Group on Technical Issues. This presentation contained the results of the Breakout Group on Technical Issues.

The four other breakout groups also identified cross-cutting technical issues for the Breakout Group on Technical Issues. These issues may also be of interest to the CSLF Technical Group:

- Commercial/Financial Issues
  - Closing the gap in government funding
  - Enabling the linking of sources and sinks
  - Addressing long-term liability for storage
  - Cost reduction to make projects economically viable
  - Incentives to learn by doing

- Legal and Regulatory Issues
  - Insurance for earliest projects
  - Need to protect other resources (e.g., minerals, risk of CO_2 seepage)
  - Tolerance for contaminants (cost and technologies to reduce)
  - Need for system to monitor possible seepage over time
  - Need for regulation to cover technology development and be based on scientific knowledge
  - Need for tight linkage between regulatory and technical programs

- Public Education and Outreach Issues
  - Need for early demonstrations and driving the cost down
  - How failures are handled and adverse impact could permanently damage prospects

- International Mechanisms
  - No incentives for CCS

Presentations given at the Workshop, including those of each of the five breakout groups, are posted on the CSLF website at http://www.cslforum.org/aug222006.htm.

Annex A

Workshop Agenda

Tuesday, August 22

Start 8:00

Plenary
Early Markets for CCS:
Setting the Scene

Coffee Break

11:35 **Breakout Sessions**
Scene Setting and Issue Framing

12:10 ***Lunch***

13:00 **Breakout Sessions**
Issue Raising and Prioritization

Coffee Break

15:10 **Plenary**
•Panel 1: Emerging Economies
•Panel2: Developed Economies

Adjourn 17:30

18:00 ***Welcome Reception***

Wednesday, August 23

Start 8:50 **Breakout Sessions**
Discussion of Issues Raised

Coffee Break

10:45 **Breakout Sessions**
Bridging to the Next Workshop

12:15 ***Lunch/Speaker***

14:00 **Plenary**
Reports from Breakout Chairs

Coffee Break

15:30 **Plenary**
Conclusions, Key Issues and
Tasks for Following Workshops

Adjourn 17:15

Annex B
Presentation of the Technical Issues Breakout Group

IEA CSLF Workshop on Near Term Opportunities for Carbon Capture and Storage

Presentation to the Breakout Session 2

Technical Issues

Co-Chairs: Kelly Thambimuthu, Australia
Victor Der, USA

Facilitated by: John Cain, Chevron & John Rezaiyan, PERI

San Francisco, CA
August 22, 2006

Technical Issues

What are technical issues?

- CO2 transport (early opportunity: existing infrastructure)
- Availability and capacity of long-term storage possibilities (early opportunity: proximity to source, EOR, EGR perhaps ECBM)
- Potential leakage pathways
- Monitoring for leakage
- Remediation methods
- Technical aspects of safety risks and risk reduction
- Capture costs (early opportunity: high purity sources)

Technical Issues

Near term opportunities

- EOR, combining storage
  - 40 Mt/y globally, most without storage
- High purity CO2 sources globally
  - Current global sources 360 Mt/y
  - H2, ammonia plants
  - Opportunities in developed and developing countries
- Emerging projects
  - Oil and gas sector
  - Power projects
- Near term opportunities put in place learning/systems that eventual address CCS for the power generation and industrial sectors

Technical Issues

External Cross Cutting Issues

- Financing Issues
  - Addressing long-term liabilities
  - Facilitating commercialization
- Communication – risk, standards, costs & benefits
- Permitting processes

Technical Issues

Technical Cross Cutting Issues

- Permanence
- Standard costing methodology
- Finance – value chain characterization
- Sustainable development
  - Environmental
  - Water Usage

Technical Issues

Storage Issues

- Subsurface characterization – integrity
- Credible risk assessments
- Best practices for monitoring and verification
- Well bore integrity – field data vs modeling

Capture Issues

- System integration / optimization
  - Compatibility – power generation versus CCS
  - Source to sink

Technical Issues

List of stakeholders

Industry:
Oil and Gas
Power
Coal
Technology and Service providers
Other CO2 Emitting Industries
Financial Community:
Multilateral/Bilateral Institutions
Insurance Co.
Others:
Environmental NGOs
Regulators/Policymakers
International Organizations
R&D Communities including Educational

Key Issues for Next Workshop

- Addressing long-term liabilities
- Facilitating commercialization
- Separation of Technical Issues Group into Capture and Transport/Storage Groups
  - Group was too large (33 participants)
- We have a list of key actions associated with the critical issues (e.g., case studies, models, systems analyses)