CSLF Projects Background

Developed, Developing Nations Come Together to Curtail CO$_2$
In Carbon Sequestration Leadership Forum Technology Projects

The 17 projects formally recognized by the international Carbon Sequestration Leadership Forum bring together developed and developing nations in a collaborative quest to curtail manmade emissions of the greenhouse gas CO$_2$. All are aimed at gathering the knowledge and experience required to initiate widespread carbon capture and to conduct safe, secure geologic storage on the order of thousands of years.

On the list are pioneering activities to identify potential storage capacity in China and India, the most populous and fastest-growing developing nations.

Projects in Europe and North America are dedicated to matters such as cutting the costs of CO$_2$ capture technology and developing new methods of combustion; identifying storage capacity and widening the understanding of geologic reservoirs; predicting the behavior of stored carbon in various kinds of reservoirs; and developing technologies for successful, reliable and long-term monitoring, measurement and verification of stored carbon.

Most projects serve several purposes, and a number capitalize on the concept of using CO$_2$ storage to augment energy production as with enhanced oil recovery and methane recovery from unmineable coal seams.

Projects Recognized by the CSLF:

1. **Alberta Enhanced Coal-Bed Methane Recovery Project**
   *Nominators: Canada (lead), United States, and United Kingdom*
   This pilot-scale project is aimed at demonstrating, from both economic and environmental criteria, the overall feasibility of coal bed methane (CBM) production and simultaneous CO$_2$ storage in deep unmineable coal seams. Specific objectives of the project are to determine baseline production of CBM from coals; determine the effect of CO$_2$ injection and storage on CBM production; assess economics; and monitor and trace the path of CO$_2$ movement by geochemical and geophysical methods.
   *Recognized by the CSLF at its Melbourne meeting, September 2004*

2. **CANMET Energy Technology Centre (CETC) R&D Oxyfuel Combustion for CO$_2$**
   *Nominators: Canada (lead) and United States*
   This is a pilot-scale project that will demonstrate oxyfuel combustion technology with CO$_2$ capture. The goal of the project is to develop energy-efficient integrated multi-pollutant control, waste management and CO$_2$ capture technologies for combustion-based applications and to provide information for the scale-up, design and operation of large scale industrial and utility plants based on the oxy-fuel concept.
   *Recognized by the CSLF at its Melbourne meeting, September 2004*
3. **CASTOR**  
*Nominators: European Commission (lead), France, and Norway*  
This is a multifaceted project that has activities in three main areas: strategy for CO2 reduction, post-combustion capture, and CO2 storage performance and risk assessment studies. The goal of the project is to reduce the cost of post-combustion CO2 capture and to develop and validate, in public/private partnerships, all the innovative technologies needed to capture and store CO2 in a reliable and safe way.  
*Recognized by the CSLF at its Melbourne meeting, September 2004*

4. **China Coalbed Methane Technology / CO2 Sequestration Project**  
*Nominators: Canada (lead), United States, and China*  
This is a pilot-scale project that aims to successfully demonstrate that coal seams in this part of China are permeable and stable enough to absorb CO2 and enhance methane production, leading to a clean energy source for China. The project will evaluate reservoir properties of selected coal seams of the Qinshui Basin of eastern China and carry out field testing at relatively low CO2 injection rates.  
*Recognized by the CSLF at its Berlin meeting, September 2005*

5. **CO2 Capture Project**  
*Nominators: United Kingdom (lead), Italy, Norway, and United States*  
This is a pilot-scale project that will continue the development of new technologies to reduce the cost of CO2 separation, capture, and geologic storage from combustion sources such as turbines, heaters and boilers. The goal of the project is to reduce cost of CO2 capture from large fixed combustion sources by 60–80% while addressing critical issues such as storage site/project certification, well integrity, and monitoring.  
*Recognized by the CSLF at its Melbourne meeting, September 2004*

6. **CO2 GeoNet**  
*Nominators: European Commission (lead) and United Kingdom*  
This multifaceted project is focused on geologic storage options for CO2 as a greenhouse gas mitigation option, and on assembling an authoritative body for Europe on geologic sequestration. Major objectives include formation of a partnership consisting, at first, of 13 key European research centers and other expert collaborators in the area of geological storage of CO2, identification of knowledge gaps in the long-term geologic storage of CO2, and formulation of new research projects and tools to eliminate these gaps. This project will result in re-alignment of European national research programs and prevention of duplication of research effort. It will also contribute to the knowledge base for CO2 storage site selection, injection operations, monitoring, verification, safety, environmental protection, and training standards.  
*Recognized by the CSLF at its Berlin meeting, September 2005*

7. **CO2 Separation from Pressurized Gas Stream**  
*Nominators: Japan (lead) and United States*  
This is a small-scale project that will evaluate processes and economics for CO2 separation from pressurized gas streams. The project will evaluate primary promising new gas separation membranes, initially at atmospheric pressure. A subsequent stage of the project will improve the performance of the membranes for CO2 removal from the fuel gas product of coal gasification and other gas streams under high pressure.
8. **CO2 Sink**  
*Nominators: European Commission (lead) and Germany*

This is a pilot-scale project that will test and evaluate CO2 capture and storage at an existing natural gas storage facility and in a deeper land-based saline formation. A key part of the project will be monitoring the migration characteristics of the stored CO2. The goal of the project is to advance understanding of the science and practical processes involved in underground storage of CO2 and to provide real case experience for use in development of future regulatory frameworks for geologic storage of CO2.  
*Recognized by the CSLF at its Melbourne meeting, September 2004*

9. **CO2STORE**  
*Nominators: Norway (lead) and European Commission*

This project is a follow-on to the Sleipner project and involves monitoring of CO2 migration (involving a seismic survey) in an saline formation beneath the North Sea and additional studies to gain further knowledge of geochemistry and dissolution processes. There will also be several preliminary feasibility studies for additional geologic settings of future candidate project sites. The goal of the project is to develop sound scientific-based methodologies for the assessment, planning, and long-term monitoring of underground CO2 storage, both onshore and offshore.  
*Recognized by the CSLF at its Melbourne meeting, September 2004*

10. **ENCAP**  
*Nominators: European Commission (lead), France, and Germany*

This is a multifaceted project consists of six sub-projects: Process and Power Systems, Pre-Combustion Decarbonization Technologies, O2/CO2 Combustion (Oxy-fuel) Boiler Technologies, Chemical Looping Combustion, High-Temperature Oxygen Generation for Power Cycles, and Novel Pre-Combustion Capture Concepts. The goals of the project are to develop promising pre-combustion CO2 capture technologies (including O2/CO2 combustion technologies) and propose the most competitive demonstration plant technology, design, process scheme, and component choices.  
*Recognized by the CSLF at its Berlin meeting, September 2005*

11. **Feasibility Study of Geological Sequestration of CO2 in Basalt Formations (Deccan Trap) in India**  
*Nominators: India (lead) and United States*

The feasibility of CO2 storage in India’s basalt formations will be established using mainly noninvasive technologies like 2D/3D and MT studies, physical and chemical characterization of formations, kinetic studies, wire logging for temperature and pressure profiles, and detailed modeling. Subsequent detailed schemes will be developed for CO2 injection and monitoring in these basalt formations.  
*Recognized by the CSLF at its Berlin meeting, September 2005*

12. **Frio Project**  
*Nominators: United States (lead) and Australia*

This is a pilot-scale project that will demonstrate CO2 sequestration in an on-shore underground saline formation. The project involves injecting relatively small quantities of CO2 into the formation and monitoring its movement for several years thereafter. The
goals of the project are to verify conceptual models of CO2 sequestration in such geologic structures, demonstrate that no adverse health, safety or environmental effects will occur from this kind of sequestration, demonstrate field-test monitoring methods, and develop experience necessary for larger scale CO2 injection experiments.

Recognized by the CSLF at its Melbourne meeting, September 2004

13. **Geologic CO2 Storage Assurance at In Salah, Algeria**
   
   *Nominators: United Kingdom (lead) and Norway*

   This multifaceted project will develop the tools, technologies, techniques and management systems required to cost-effectively demonstrate, safe, secure, and verifiable CO2 storage in conjunction with commercial natural gas production. The goals of the project are to develop a detailed dataset on the performance of CO2 storage; provide a field-scale example on the verification and regulation of geologic storage systems; test technology options for the early detection of low-level seepage of CO2 out of primary containment; evaluate monitoring options and develop guidelines for an appropriate and cost-effective, long-term monitoring methodology; and quantify the interaction of CO2 re-injection and hydrocarbon production for long-term storage in oil and gas fields.

   Recognized by the CSLF at its Berlin meeting, September 2005

14. **IEA GHG Weyburn-Midale CO2 Monitoring and Storage Project**

   *Nominators: Canada and United States (leads) and Japan*

   This is a commercial-scale project that will utilize CO2 for enhanced oil recovery at a Canadian oil field. The goal of the project is to determine the performance and undertake a thorough risk assessment of CO2 storage in conjunction with its use in enhanced oil recovery. The work program will encompass four major technical themes of the project: geological integrity; wellbore injection and integrity; storage monitoring methods; and risk assessment and storage mechanisms. Results from these technical themes, when integrated with policy research, will result in a Best Practices Manual for future CO2 Enhanced Oil Recovery projects.

   Recognized by the CSLF at its Melbourne meeting, September 2004

15. **ITC CO2 Capture with Chemical Solvents**

   *Nominators: Canada (lead) and United States*

   This is a pilot-scale project that will demonstrate CO2 capture using chemical solvents. Supporting activities include bench and lab-scale units that will be used to optimize the entire process using improved solvents and contactors, develop fundamental knowledge of solvent stability, and minimize energy usage requirements. The goal of the project is to develop improved cost-effective technologies for separation and capture of CO2 from flue gas.

   Recognized by the CSLF at its Melbourne meeting, September 2004

16. **Regional Carbon Sequestration Partnerships**

   *Nominators: United States (lead) and Canada*

   This multifaceted project will identify and test the most promising opportunities to implement sequestration technologies in the United States and Canada. There are seven different regional partnerships, each with their own specific program plans, which will conduct field validation tests of specific sequestration technologies and infrastructure concepts; refine and implement (via field tests) appropriate measurement, monitoring and
verification (MMV) protocols for sequestration projects; characterize the regions to
determine the technical and economic storage capacities; implement and continue to
research the regulatory compliance requirements for each type of sequestration technology;
and identify commercially available sequestration technologies ready for large scale
deployment.

*Recognized by the CSLF at its Berlin meeting, September 2005*

17. **Regional Opportunities for CO2 Capture and Storage in China**

*Nominees: United States (lead) and China*

This project will characterize the technical and economic potential of CO2 capture and
storage technologies in China. The goal of the project is to compile key characteristics of
large anthropogenic CO2 sources (including power generation, iron and steel plants,
cement kilns, petroleum and chemical refineries, etc.) as well as candidate geologic storage
formations that exist across China, and to develop estimates of geologic CO2 storage
capacities in China.

*Recognized by the CSLF at its Berlin meeting, September 2005*

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Note: “Lead Nominator” in this usage indicates the CSLF Member which proposed the project.