Carbon Sequestration leadership forum

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CSLF Recognized Projects

(as of February 2010)

1. **Alberta Enhanced Coal-Bed Methane Recovery Project *(Completed)***
   Nominators: Canada (lead), United States, and United Kingdom
   This pilot-scale project, located in Alberta, Canada, 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 Capture**
   Nominators: Canada (lead) and United States
   This is a pilot-scale project, located in Ontario, Canada, that will demonstrate oxy-fuel 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 *(Completed)***
   Nominators: European Commission (lead), France, and Norway
   This is a multifaceted project that has activities, at various sites in Europe, in three main areas: strategy for CO_2 reduction, post-combustion capture, and CO_2 storage performance and risk assessment studies. The goal of the project is to reduce the cost of post-combustion CO_2 capture and to develop and validate, in public/private partnerships, all the innovative technologies needed to capture and store CO_2 in a reliable and safe way.
   Recognized by the CSLF at its Melbourne meeting, September 2004

4. **CCS Northern Netherlands Project**
   Nominators: Netherlands (lead) and Norway
   This project will implement a large-scale regional plan for capture, transport and storage of CO_2 around the Eemsharbor complex in Groningen province in the northern part of the Netherlands. The project will capture CO_2 from existing and planned power plants, transport the CO_2 to the storage location, and store the CO_2 safely underground in on-shore and off-shore natural gas fields. The project represents all elements of the CCS chain (capture, transport, reuse and storage), as well as including all CO_2 capture

techniques (pre-combustion, post-combustion and oxyfuel combustion). Additionally, the project will develop a communication strategy, engage stakeholders, and work toward developing a legal framework for CCS in the region.
Recognized by the CSLF at its London meeting, October 2009

5. **CCS Rotterdam Project**
Nominators: Netherlands (lead) and Germany
This project will implement a large-scale "CO_2 Hub" for capture, transport, utilization, and storage of CO_2 in the Rotterdam metropolitan area. The project is part of the Rotterdam Climate Initiative (RCI), which has a goal of reducing Rotterdam's CO_2 emissions by 50% by 2025 (as compared to 1990 levels). A "CO_2 cluster approach" will be utilized, with various point sources (e.g., CO_2 captured from power plants) connected via a hub / manifold arrangement to multiple storage sites such as depleted gas fields under the North Sea. This will reduce the costs for capture, transport and storage compared to individual CCS chains. The project will also work toward developing a policy and enabling framework for CCS in the region.
Recognized by the CSLF at its London meeting, October 2009

6. **China Coalbed Methane Technology/CO_2 Sequestration Project** ***(Completed)***
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 CO_2 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 CO_2 injection rates.
Recognized by the CSLF at its Berlin meeting, September 2005

7. **CO_2 Capture Project, Phase 2** ***(Completed)***
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 CO_2 separation, capture, and geologic storage from combustion sources such as turbines, heaters and boilers. The goal of the project is to reduce cost of CO_2 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

8. **CO2CRC Otway Project**
Nominators: Australia (lead) and United States
This is a pilot-scale project, located in southwestern Victoria, Australia, that involves transport and injection of approximately 100,000 tons of CO_2 over a two year period into a depleted natural gas well. Besides the operational aspects of processing, transport and injection of a CO_2-containing gas stream, the project also includes development and testing of new and enhanced monitoring, and verification of storage (MMV) technologies, modeling of post-injection CO_2 behavior, and implementation of an outreach program for stakeholders and nearby communities. Data from the project will be used in developing a future regulatory regime for CO_2 capture and storage (CCS) in Australia.
Recognized by the CSLF at its Paris meeting, March 2007

9. CO_2 GeoNet

Nominators: European Commission (lead) and United Kingdom

This multifaceted project is focused on geologic storage options for CO_2 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 CO_2, identification of knowledge gaps in the long-term geologic storage of CO_2, 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 site selection, injection operations, monitoring, verification, safety, environmental protection, and training standards.

Recognized by the CSLF at its Berlin meeting, September 2005

10. CO_2 Separation from Pressurized Gas Stream

Nominators: Japan (lead) and United States

This is a small-scale project that will evaluate processes and economics for CO_2 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 CO_2 removal from the fuel gas product of coal gasification and other gas streams under high pressure.

Recognized by the CSLF at its Melbourne meeting, September 2004

11. CO2 SINK

Nominators: European Commission (lead) and Germany

This is a pilot-scale project that will test and evaluate CO_2 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 CO_2. The goal of the project is to advance understanding of the science and practical processes involved in underground storage of CO_2 and to provide real case experience for use in development of future regulatory frameworks for geological storage of CO_2.

Recognized by the CSLF at its Melbourne meeting, September 2004

12. CO_2 Storage in Limburg Coal and Sandstone Layers

Nominators: Netherlands (lead) and France

This is a combined pilot- and large-scale project that will determine the viability of deep underground coal-bearing sandstone layers for large-scale CO_2 storage. The goal of the pilot-scale component of the project is to store 10,000 tonnes of CO_2 in sandstones that underlay and intercalate with coal strata in the southern part of the Netherlands, in order to evaluate the containment and storage concept. If this is successful, the large-scale component of the project will store 250,000 tonnes of CO_2 per year (up to two million tonnes total) from nearby chemicals plants that is now being vented to the atmosphere. The limited amounts of desorbed methane released from the coal seams can be captured and used directly in the industrial processes on-site.

Recognized by the CSLF at its London meeting, October 2009

13. CO_2 STORE *(Completed)*

Nominators: Norway (lead) and European Commission

This project is a follow-on to the Sleipner project and involves monitoring of CO_2 migration (involving a seismic survey) in a 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 CO_2 storage, both onshore and offshore.

Recognized by the CSLF at its Melbourne meeting, September 2004

14. Demonstration of an Oxyfuel Combustion System

Nominators: United Kingdom (lead) and France

This project, located at Renfrew, Scotland, UK, will demonstrate oxyfuel technology on a full-scale 40-megawatt burner. The goal of the project is to gather sufficient data to establish the operational envelope of a full-scale oxyfuel burner and to determine the performance characteristics of the oxyfuel combustion process at such a scale and across a range of operating conditions. Data from the project will be used to develop advanced computer models of the oxyfuel combustion process, which will be utilized in the design of large oxyfuel boilers.

Recognized by the CSLF at its London meeting, October 2009

15. Dynamis *(Completed)*

Nominators: European Commission (lead), and Norway

This is the first phase of the multifaceted European Hypogen program, which will result in construction and operation of an advanced commercial-scale power plant with hydrogen production and CO_2 management, with the goal of operation and validation in the 2012-2015 timeframe. The Dynamis project will assess the various options for large-scale hydrogen production, focusing on the technological, economic and societal issues.

Recognized by the CSLF at its Cape Town meeting, April 2008

16. ENCAP *(Completed)*

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, O_2/ CO_2 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 CO_2 capture technologies (including O_2/ CO_2 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

17. European CO_2 Technology Centre Mongstad (TCM) Project

Nominators: Norway (lead) and Netherlands

This is a large-scale project (100,000 tonnes per year CO_2 capacity) that will establish a facility for parallel testing of amine-based and chilled ammonia CO_2 capture technologies from two flue gas sources with different CO_2 contents. The goal of the project is to reduce cost and technical, environmental, and financial risks related to large scale CO_2 capture, while allowing evaluation of equipment, materials, process configurations, different capture solvents, and different operating conditions. The project will result in validation of process and engineering design for full-scale application and will provide insight into other aspects such as thermodynamics, kinetics, engineering, materials of construction, and health / safety / environmental (HSE).

Recognized by the CSLF at its London meeting, October 2009

18. Feasibility Study of Geologic Sequestration of CO_2 in Basalt Formations of (Deccan Trap) in India

Nominators: India (lead) and United States

The feasibility of CO_2 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 CO_2 injection and monitoring in these basalt formations.

Recognized by the CSLF at its Berlin meeting, September 2005

19. Fort Nelson Carbon Capture and Storage Project

Nominators: Canada (lead) and United States

This is a large-scale project in northeastern British Columbia, Canada, which will permanently sequester approximately two million tonnes per year CO_2 emissions from a large natural gas-processing plant into deep saline formations of the Western Canadian Sedimentary Basin (WCSB). Goals of the project are to verify and validate the technical and economic feasibility of using brine-saturated carbonate formations for large-scale CO_2 injection and demonstrate that robust monitoring, verification, and accounting (MVA) of a brine-saturated CO_2 sequestration project can be conducted cost-effectively. The project will also develop appropriate tenure, regulations, and MVA technologies to support the implementation of future large-scale sour CO_2 injection into saline-filled deep carbonate reservoirs in the northeast British Columbia area of the WCSB.

Recognized by the CSLF at its London meeting, October 2009

20. Frio Project *(Completed)*

Nominators: United States (lead) and Australia

This is a pilot-scale project that will demonstrate CO_2 sequestration in an on-shore underground saline formation in eastern Texas, USA. The project involves injecting relatively small quantities of CO_2 into the formation and monitoring its movement for several years thereafter. The goals of the project are to verify conceptual models of CO_2 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 CO_2 injection experiments.

Recognized by the CSLF at its Melbourne meeting, September 2004

21. Geologic CO_2 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 CO_2 storage in conjunction with commercial natural gas production. The goals of the project are to develop a detailed dataset on the performance of CO_2 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 CO_2 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 CO_2 re-injection and hydrocarbon production for long-term storage in oil and gas fields.

Recognized by the CSLF at its Berlin meeting, September 2005

22. Heartland Area Redwater Project (HARP)

Nominators: Canada (lead) and United States

This is a combined pilot- and large-scale project that will, after initial pilot-scale operations, permanently sequester at least one million tonnes per year CO_2 emissions from multiple large industrial sources near Edmonton, Alberta, Canada. The goal of the project is to demonstrate feasibility of CO_2 storage in onshore consolidated carbonate rocks with characteristics representative of North America, and the project will also include long-term monitoring and public outreach components. The storage target is a very large carbonate reef with a storage capacity of several hundred million tonnes of CO_2; this type of formation presents different challenges than other geologic storage options because of its mineralogy (which affects geochemical processes) and its geometry / structure and porosity / permeability (which affect the spread of injected CO_2).

Recognized by the CSLF at its London meeting, October 2009

23. IEA GHG Weyburn-Midale CO_2 Monitoring and Storage Project

Nominators: Canada and United States (leads) and Japan

This is a large-scale project that will utilize CO_2 for enhanced oil recovery (EOR) at a Canadian oil field. The goal of the project is to determine the performance and undertake a thorough risk assessment of CO_2 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 CO_2 Enhanced Oil Recovery projects.

Recognized by the CSLF at its Melbourne meeting, September 2004

24. ITC CO_2 Capture with Chemical Solvents Project

Nominators: Canada (lead) and United States

This is a pilot-scale project that will demonstrate CO_2 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 CO_2 from flue gas.

Recognized by the CSLF at its Melbourne meeting, September 2004

25. Lacq Integrated CCS Project

Nominators: France (lead) and Canada

This is an intermediate-scale project that will test and demonstrate an entire integrated CCS process, from emissions source to underground storage in a depleted gas field. The project will capture and store 60,000 tonnes per year of CO_2 for two years from an oxyfuel industrial boiler in the Lacq industrial complex in southwestern France. The goal is demonstrate the technical feasibility and reliability of the integrated process, including the oxyfuel boiler, at an intermediate scale before proceeding to a large-scale demonstration. The project will also include geological storage qualification methodologies, as well as monitoring and verification techniques, to prepare future larger-scale long term CO_2 storage projects.

Recognized by the CSLF at its London meeting, October 2009

26. 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

27. Regional Opportunities for CO_2 Capture and Storage in China *(Completed)*

Nominators: United States (lead) and China

This project will characterize the technical and economic potential of CO_2 capture and storage technologies in China. The goal of the project is to compile key characteristics of large anthropogenic CO_2 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 CO_2 storage capacities in China.

Recognized by the CSLF at its Berlin meeting, September 2005

28. TX Energy Carbon Management and Gasification Project

Nominators: United States (Lead), Canada, and France

This project is a large-scale demonstration of CCS utilizing CO_2 produced by polygeneration industrial gasification. The project will capture about five million tons per year of CO_2 from an industrial petroleum coke gasification facility near Beaumont, Texas, USA, for use in EOR or other geologic sequestration applications. Goals of the project include demonstration of integrated CCS at very large scale and low incremental cost, and demonstration of technologies, equipment, procedures, methodologies, operations, and supporting infrastructure for each step of the industrial gasification and CCS processes at such a scale.

Recognized by the CSLF at its London meeting, October 2009

29. Zama Acid Gas EOR, CO_2 Sequestration, and Monitoring Project

Nominators: Canada (lead) and United States

This is a pilot-scale project that involves utilization of acid gas (approximately 70% CO_2 and 30% hydrogen sulfide) derived from natural gas extraction for enhanced oil recovery. Project objectives are to predict, monitor, and evaluate the fate of the injected acid gas; to determine the effect of hydrogen sulfide on CO_2 sequestration; and to develop a "best practices manual" for measurement, monitoring, and verification of storage (MMV) of the acid gas. Acid gas injection was initiated in December 2006 and will result in sequestration of about 25,000 tons (or 375 million cubic feet) of CO_2 per year.

Recognized by the CSLF at its Paris meeting, March 2007

30. ZeroGen

Nominators: Australia (lead) and Japan

This is a large-scale project that will construct and operate a fully-integrated, commercial IGCC power station with CCS in central Queensland, Australia. The project will initially capture 65% of CO_2 emissions, moving towards 90% as the project proceeds, and will include transport and storage, in underground saline aquifers, of at least two million tonnes per year of CO_2 for the expected 30 year life of project. The goals of the project are to prove the effectiveness, safety and permanence of CO_2 geosequestration; validate the engineering, economic, and environmental viability of advanced, coal based, low emission technologies so that similar industrial-scale facilities will be bankable technically; and to standardize technologies and protocols for CO_2 measuring, monitoring and verification of storage (MMV).

Recognized by the CSLF at its London meeting, October 2009

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