



Minutes of the Technical Group Meeting

Washington, D.C., USA
Tuesday, 05 November 2013

LIST OF ATTENDEES

Chair Trygve Riis (Norway)

Technical Group Delegates

Australia: Clinton Foster (*Vice Chair*), Richard Aldous
Canada: Stefan Bachu (*Vice Chair*), Eddy Chui
China: Jiutian Zhang, Sizhen Peng
European Commission: Jeroen Schuppers, Stathis Peteves
France: Didier Bonijoly
Italy: Giuseppe Girardi
Japan: Ryozo Tanaka
Korea: Chang-Keun Yi, Chong Kul Ryu
Mexico: Javier Flores, Moisés Dávila
Netherlands: Paul Ramsak
Norway: Jostein Dahl Karlsen, Lars Ingolf Eide
Saudi Arabia: Ali Al-Meshari, Hamoud Al-Otaibi
South Africa: Tony Surridge (*Vice Chair*), Milingoni Robert Phupheli
United Kingdom: Philip Sharman
United States: Mark Ackiewicz, George Guthrie

Representatives of Allied Organizations

IEA GHG: Tim Dixon

CSLF Secretariat

John Panek, Richard Lynch, Steve Geiger

Invited Speakers

Julio Friedmann, Deputy Assistant Secretary for Clean Coal, United States Department of Energy
Kerry Bowers, President and CEO, Southern Generation Technologies, United States
Neeraj Gupta, Senior Research Leader, Battelle Institute, United States
Jerry Hill, Senior Technical Advisor, Southern States Energy Board, United States
Ramón Treviño, Project Manager, Bureau of Economic Geology, University of Texas, United States

Observers

Canada:	Sean McFadden, Jeff Walker, Tim Wiwchar
Chinese Taipei:	Shih Nan Chen, Linda L.H. Chen, Shoung Ouyang, Ren-Chain Wang
France:	Fabio Dinale
Germany:	Peer Hoth
Japan:	Mike Miyagawa
Korea:	Mijeong Han
Norway:	Frank Ellingsen, Bjørn-Erik Haugan
United Kingdom:	Mark Crombie
United States:	Chris Babel, Raj Barua, Jay Braitsch, Steven Carpenter, Martin Considine, Stephen Comello, Jarad Daniels, David Feng, Christopher Garbacz, Joseph Giove, Deborah Harris, Robert Hilton, Llewellyn King, Arthur Lee, Philip Marston, Jeff Price, Katherine Romanak, Kimberly Sams, John Sicilian, Sharon Sjostrom, Judd Swift, James Wood

1. Chairman's Welcome and Opening Remarks

The Chairman of the Technical Group, Trygve Riis, called the meeting to order and welcomed the delegates and observers to Washington.

Mr. Riis provided context for the meeting by mentioning that the Technical Group has completed its work on the 2013 CSLF Technology Roadmap (TRM), which is being launched at this meeting. Four task forces have also been very active since the 2011 CSLF Ministerial Meeting in Beijing, and each has produced a report for this meeting. Three of these task forces have completed their activities, and their final reports have been published and are available at the CSLF website. However, several actions in the Technical Group's Action Plan remain inactive, and one of the items on the meeting agenda is to find ways to move forward on these actions.



Trygve Riis

2. Introduction of Delegates

Technical Group delegates present for the meeting introduced themselves. Fifteen of the twenty-three CSLF Members were present at this meeting, including representatives from Australia, Canada, China, the European Commission, France, Italy, Japan, Korea, Mexico, the Netherlands, Norway, Saudi Arabia, South Africa, the United Kingdom, and the United States. Observers representing Canada, Chinese Taipei, France, Germany, Japan, Korea, Norway, the United Kingdom, and the United States were also present.

3. Adoption of Agenda

The Agenda was adopted with the understanding that that the order of several items might be changed due to schedule conflicts of some of the meeting participants.

4. Approval of Minutes from Rome Meeting

Jostein Dahl Karlsen requested a small adjustment in Item 12 of the Technical Group minutes from the April 2013 meeting in Rome, Italy, which specified that key messages from the 2013 CSLF TRM would be captured into a document for the Ministerial Meeting. Mr. Karlsen was requested to provide a suggested new wording to the Secretariat, and the Rome minutes were approved as final with the understanding that the Secretariat would make this change.

5. Review of Action Items from Rome Meeting

John Panek provided a brief summary of the seven action items resulting from the Rome meeting. All have been completed or are in progress. For one of the action items, Tony Surridge stated that a study, conducted by the South African Center for Carbon Capture & Storage (SACCCS), on the impacts of CCS on South African national priorities beyond climate change had been completed but was still undergoing evaluation. Dr. Surridge will alert the Secretariat when a final version is available, and the Secretariat will pass this information on to the Technical Group.

6. Report from CSLF Secretariat

John Panek gave a presentation that briefly reported on the outcomes of the April 2013 Technical Group meeting in Rome, including the two projects that were recommended by the Technical Group for CSLF recognition. Three other projects are up for recognition at the current meeting. A CO₂ Monitoring Interactive Workshop was held as part of the Rome meeting; presentations and conclusions from the workshop are now online at the CSLF website (there is a link at the “Meetings / Workshops” page).



John Panek

Mr. Panek noted that the 2013 CSLF Technology Roadmap (TRM) had been completed by the TRM Committee and congratulated the TRM editor, Lars Ingolf Eide, for his work on what is an outstanding document. Mr. Panek also pointed out the existence of two web-based booklets that had been prepared by the Secretariat for this Ministerial Meeting. Information and photos from several of the CSLF-recognized projects have been incorporated into an “Updates from CSLF Recognized Projects” book, and five briefing papers from the Technical Group have been incorporated into the Ministerial Conference Briefing Documents book. Both of these can be downloaded from the Washington pre-meeting page of the CSLF website.

7. Update from the IEA Greenhouse Gas R&D Programme

Tim Dixon gave a presentation about the IEA GHG and its ongoing collaboration with the CSLF’s Technical Group. The two organizations have mutual representation (without voting rights) at Technical Group and IEA GHG Executive Committee meetings, and the IEA GHG has liaison with the CSLF’s Projects Interaction and Review Team in a two-way process for discussing potential activities and projects.

Based on an agreement made back in 2008, the Technical Group is offered the opportunity to propose studies to be undertaken by the IEA GHG. These, along with other proposals from IEA GHG Executive Committee (ExCo) members, go through a selection process at semiannual ExCo meetings. So far there have been three IEA GHG studies that originated from the CSLF Technical Group:

“Development of Storage Coefficients for CO₂ Storage in Deep Saline Formations” (March 2010), “Geological Storage of CO₂ in Basalts” (September 2011), and “Potential Implications of Gas Production from Shales and Coal for CO₂ Geological Storage” (November 2013).

The next deadline for proposal outlines is in January 2014.

Concerning the study on “Potential Implications of Gas Production from Shales and Coal for CO₂ Geological Storage”, Mr. Dixon stated that the aim of the study was to assess the potential for geological storage for CO₂ in shale and coal formations and the impact of gas production on CO₂ storage capacity from storage sites whose caprock might have been compromised due to hydraulic fracturing (“fracking”). A key conclusion from the study was that while the fracking process for releasing hydrocarbons from shale and coal seams can potentially decrease storage security, this can be avoided with appropriate reservoir selection and management. The overall estimated CO₂ storage capacity in shale is approximately 740 gigatonnes with a somewhat lesser amount for coal seams. The study uncovered some knowledge gaps that need to be addressed, and in general research is less advanced for CO₂ storage in shales than for coal seams.



Tim Dixon

8. Report on Activities of the United Kingdom’s CCS Cost Reduction Task Force

Activity had been deferred on the “Energy Penalty Reduction” action of the Technical Group Action Plan pending review of the final report from the United Kingdom’s Cost Reduction Task Force. This task force was established in March 2012 by the United Kingdom’s Department of Energy and Climate Change (DECC) to advise government and industry on the potential for reducing the costs of CCS, so that CCS power projects are financeable and competitive with other low-carbon technologies in the early 2020s.

Philip Sharman gave a presentation that summarized the conclusions from this report. The main finding was that United Kingdom gas and coal power stations equipped with CCS have clear potential to be cost competitive with other forms of low-carbon power generation, delivering electricity at a levelized cost approaching £100 per megawatt-hour (MWh) by the early 2020s, and at a cost significantly below £100 per MWh soon thereafter. A short summary of this report has been incorporated into the Ministerial Briefing Documents Book. (Note: the book is available at the Washington meeting page of the CSLF website.)



Philip Sharman

Ensuing discussion revisited the option for forming a Technical Group task force on “Energy Penalty Reduction”. Mr. Sharman stated that this report represents a good starting point, but since it represented mainly United Kingdom perspectives a wider initiative would be needed to more inclusively investigate this area. Further action on this item was deferred until later in the meeting when the Technical Group discussed the need for new task forces.

9. CCS in the USA

Julio Friedmann, Deputy Assistant Secretary for Clean Coal in the United States Department of Energy’s Office of Fossil Energy, gave a presentation that described the status of CCS policy, research, development, and demonstration activities in the United States. Dr. Friedmann began by stating that this has been a good decade for R&D advancements. New designs are benefitting from larger economies of scale, process enhancements, and process integration, and these have all helped to reduce the cost of CO₂ capture, which has decreased from about \$150 per tonne (in 2005) to about \$60 per tonne. A near term goal is to further reduce this cost to about \$40 per tonne by the year 2020.



Julio Friedmann

Dr. Friedmann stated that the United States Climate Action Plan focuses on power sector CO₂ emissions. This includes about 20 directives and initiatives that collectively aim to reduce United States greenhouse gas emissions, with the most noteworthy element being the development of CO₂ performance standards for stationary power plants. The plan is for these to be promulgated by about the middle of 2016. Looking forward, it may be possible for the United States to reduce its carbon emissions by more than 80% by the year 2050, and to do this CCS would be required for both coal and natural gas power plants.

Dr. Friedmann provided information about the U.S. Department of Energy’s Clean Coal Program. The four major areas are: advanced combustion; advanced energy systems; advanced CO₂ capture and compression; and CO₂ storage. The overall goal is to increase net efficiency for power production to greater than 45%, reduce capital costs by 50%, and achieve a \$40 per ton CO₂ capture cost with near-zero emissions of airborne pollutants and greenhouse gases and with near-zero net water usage. First generation CCS technologies are now being demonstrated, and pilot-scale tests are starting to occur for second-generation technologies. Currently there are eight major CCS demonstration projects in various stages of development in the United States, including one in operation and two under construction.

Dr. Friedmann stated that eight large-scale tests of CO₂ injection and storage are also ongoing or in the planning stages as part of the Regional Carbon Sequestration Partnerships Program. Seven of these tests will inject between 1-3 million tons of CO₂ over the duration of the test periods. All of these tests will have extensive measurement, monitoring and verification of storage (MMV) components, and information collected will be used as inputs into a series of CCS Best Practices Manuals. Dr. Friedmann concluded his presentation by offering that the future for CCS looks bright, and that there

are important new opportunities that need to be pursued. CCS is entering the commercial realm and there will be in some interesting and exciting times ahead.

10. Report from the CSLF Projects Interaction and Review Team (PIRT)

The PIRT Chair, Clinton Foster, gave a short presentation that summarized the previous day's PIRT meeting. Outcomes from the meeting were:

- Three projects were approved by the PIRT for Technical Group action: the Kemper County Energy Facility (nominated by the United States and Canada), the Southeast Regional Carbon Sequestration Partnership (SECARB) Phase III Anthropogenic Test and Plant Barry CCS Project (nominated by the United States, Japan, and Canada), and the Midwest Regional Carbon Sequestration Partnership (MRCSP) Development Phase Project (nominated by the United States and Canada).
- The PIRT Terms of Reference and the CSLF Project Submission Form were both updated.
- The PIRT will obtain further information from the Global Carbon Capture and Storage Institute (GCCSI) about its proposal for a co-branded CSLF-GCCSI Knowledge Hub website.



Clinton Foster

11. Approval of Projects Nominated for CSLF Recognition

Kemper County Energy Facility *(nominated by the United States and Canada)*

Kerry Bowers, President and CEO of Southern Generation Technologies, gave a presentation about the Kemper project. This commercial-scale CCS project, located in east-central Mississippi in the United States, will capture approximately 3 million tonnes of CO₂ per year from an integrated gasification combined cycle (IGCC) power



Kerry Bowers

plant, and will include pipeline transportation of approximately 60 miles to an oil field where the CO₂ will be sold for enhanced oil recovery (EOR). The commercial objectives of the project are large-scale demonstration of a next-generation gasifier technology for power production and utilization of a plentiful nearby lignite coal reserve. Approximately 65% of the CO₂ produced by the plant will be captured and utilized.

Construction of the project, including the pipeline, is complete and commercial operation will begin in 2014.

After brief discussion, there was consensus by the Technical Group to recommend to the Policy Group that the Kemper County Energy Facility receive CSLF recognition.

Southeast Regional Carbon Sequestration Partnership (SECARB) Phase III Anthropogenic Test and Plant Barry CCS Project *(nominated by the United States, Japan, and Canada)*

Jerry Hill, Senior Technical Advisor at the Southern States Energy Board, gave a presentation about the SECARB project. This large-scale fully-integrated CCS project, located in southeastern Alabama in the United States, brings together components of



Jerry Hill

CO₂ capture, transport, and geologic storage, including monitoring, verification, and accounting of the stored CO₂. A flue gas slipstream from a power plant equivalent to approximately 25 megawatts of power production is being diverted to allow large-scale demonstration of a new amine-based process that can capture approximately 550 tonnes of CO₂ per day. A new 19 kilometer pipeline has also been constructed, as part of the project, for transporting the CO₂ to a deep saline storage site. Objectives of the project are to gain knowledge and experience in operation of a fully integrated CCS large-scale process, to conduct reservoir modeling and test CO₂ storage mechanisms for the types of geologic storage formations that exist along the Gulf Coast of the United States, and to test experimental CO₂ monitoring technologies.

After brief discussion, there was consensus by the Technical Group to recommend to the Policy Group that the SECARB Phase III Anthropogenic Test and Plant Barry CCS Project receive CSLF recognition.

Midwest Regional Carbon Sequestration Partnership (MRCSP) Development Phase Project *(nominated by the United States and Canada)*

Neeraj Gupta, Senior Research Leader at Battelle, gave a presentation about the MRCSP project. This is a large-scale CO₂ storage project, located in Michigan and nearby states in the northern United States that will, over its four-year duration, inject a total of one million tonnes of CO₂ into different types of oil and gas fields in various lifecycle stages. The project will include collection of fluid chemistry data to better understand geochemical interactions, development of conceptual geologic models for this type of CO₂ storage, and a detailed accounting of the CO₂ injected and recycled. Project objectives are to assess the



Neeraj Gupta

storage capacity of these oil and gas fields, validate volumetric estimates and numerical models, identify cost-effective monitoring techniques, and develop system-wide information for further understanding of similar geologic formations. Site characterizations are now underway, with long-term CO₂ injection and monitoring to begin in 2015. A final topical report is expected in 2019. Results obtained during this project are expected to provide a foundation for validating that CCS technologies can be commercially deployed in the northern United States.

After brief discussion, there was consensus by the Technical Group to recommend to the Policy Group that the MRCSP Development Phase Project receive CSLF recognition.

12. Update on the 2013 CSLF Technology Roadmap

Trygve Riis, as Chair of the TRM Committee, expanded on his opening remarks concerning the launch of the 2013 CSLF TRM. The TRM was a product of much behind-the-scenes work involving frequent teleconferences between TRM Committee members and ever-evolving versions of the document. Mr. Riis thanked TRM editor Lars Ingolf Eide, the CSLF delegates who provided comments on the drafts of the TRM, and also the Norwegian Ministry of Petroleum and Energy which provided resources in support of the development of the document.

John Panek also offered the CSLF Secretariat's congratulations to TRM editor Eide and mentioned that the 2013 TRM is an online-only document that can be downloaded from the CSLF website. (*Note: the 2013 TRM is available at the Washington meeting page, the "Technology Roadmap" page, and the "Publications" page of the CSLF website.*)

13. Report from Technical Challenges for Conversion of CO₂-EOR to CCS Task Force

The Task Force Chair, Stefan Bachu, gave a brief update on the task force and its final report. The task force's mandate was to review, compile and report on technical challenges that may constitute a barrier to the broad use of CO₂ for enhanced oil recovery (EOR) and to the conversion of CO₂-EOR operations to CCS operations. Economic and policy barriers were outside the scope of the task force. Dr. Bachu stated that the task force's final report contains several key findings:

- There is sufficient operational and regulatory experience for this technology to be considered as being mature, with an associated CO₂ storage rate of the purchased CO₂ greater than 90%.
- The main reason CO₂-EOR is not applied on a large scale outside west Texas in the United States is the unavailability of high-purity CO₂ in the amounts and at the cost needed for this technology to be deployed on a large scale.
- The absence of infrastructure to both capture the CO₂ and transport it from CO₂ sources to oil fields suitable for CO₂-EOR is also a key reason for the lack of large scale deployment of CO₂-EOR.



Stefan Bachu

- There are a number of commonalities between CO₂-EOR and pure CO₂ storage operations, both at the operational and regulatory levels, which create a good basis for transitioning from CO₂-EOR to CO₂ storage in oil fields.
- There are no specific technological barriers or challenges per se in transitioning and converting a pure CO₂-EOR operation into a CO₂ storage operation. The main differences between the two types of operations stem from legal, regulatory and economic differences between the two.
- A challenge for CO₂-EOR operations which may, in the future, convert to CO₂ storage operations is the lack of baseline data for monitoring, and generally monitoring requirements for CCS which are broader and more encompassing than for CO₂-EOR.

Dr. Bachu stated that because there were obvious policy implications in these findings, the CSLF Policy Group should consider establishing a new task force on “Policy, Legal and Regulatory Challenges in the Transitioning from CO₂-EOR to CCS” to examine and address these issues. Dr. Bachu also stated that the Technical Challenges for Conversion of CO₂-EOR to CCS Task Force has accomplished its mandate and is ending its activities, and there was consensus that this task force has concluded its work. *(Note: the task force final report is available at the “Publications” page of the CSLF website.)*

14. Report from CO₂ Utilization Options Task Force

The Task Force Chair, Mark Ackiewicz, gave a brief summary of the task force and its Phase 2 final report. The task force was focused on all forms of CO₂ utilization except CO₂-EOR, and its mission was to identify/study the most economically promising CO₂ utilization options that have the potential to yield a meaningful, net reduction of CO₂ emissions, or facilitate the development and/or deployment of other CCS technologies. Mr. Ackiewicz stated that the task force’s Phase 2 final report is complete and represents a “snapshot in time” – the status of CO₂ utilization will obviously continue to



Mark Ackiewicz

evolve over time. Options evaluated by the Phase 2 final report included enhanced natural gas recovery (CO₂-EGR), CO₂ for shale gas/oil recovery, urea manufacture, algal fuels, greenhouse utilization, CO₂-assisted geothermal power production, and use of CO₂ in production of aggregate materials for construction. For each option, the task force examined the current state of technology, the current and potential economics, regulatory requirements, technology advancement gaps and research needs, and the potential for co-production. The task force also did an overview survey of any active or planned international projects involving these options.

Mr. Ackiewicz stated that the task force’s Phase 2 final report contains several key findings / messages:

- A number of CO₂ utilization options are available which can serve as a mechanism for deployment and commercialization of CCS.

- EOR is the most near-term CO₂ utilization option. Non-EOR CO₂ utilization options are at varying degrees of commercial readiness and technical maturity.
- For mature non-EOR CO₂ utilization options, efforts should be on demonstration projects and on the use of non-traditional feedstocks or polygeneration concepts.
- Efforts that are focused on hydrocarbon recovery other than EOR should focus on field tests.
- Efforts that are in early R&D or pilot-scale stages should focus on addressing key techno-economic challenges, independent tests to verify the performance, and support of small and/or pilot-scale tests of first generation technologies and designs.
- More detailed technical, economic, and environmental analyses should be conducted on these options.

Mr. Ackiewicz stated that the CO₂ Utilization Options Task Force has accomplished its mandate and is ending its activities, and there was consensus that this task force has concluded its work. (*Note: the task force Phase 2 final report is available at the “Publications” page of the CSLF website.*) Sizhen Peng noted that China has completed a new assessment report on CO₂ utilization technology, and agreed to provide a web link for the report.

15. Report from Reviewing Best Practices and Standards for Geologic Storage and Monitoring of CO₂ Task Force

The Task Force Chair, Lars Ingolf Eide, gave a brief update on the task force and its 2013 Annual Report. The task force mandate is to perform initial identification and review of standards for storage and monitoring of injected CO₂. The application of such standards should inform CO₂ crediting mechanisms, but economic and policy/regulatory issues are outside the scope of the task force.

Mr. Eide stated that the ongoing task force work plan includes identification and review of existing standards for geological CO₂ storage and monitoring (on an annual basis); identification of shortcomings and/or weaknesses in standards/guidelines; communication of findings to the ISO/TC 265; producing annual summaries of new as well as updated standards, guidelines and best practice documents regarding geological storage of CO₂ and monitoring of CO₂ sites; and following the work of other organizations related to CO₂ storage.

Mr. Eide stated that the task force’s 2013 Annual Report lists more than twenty Best Practices Manuals (BPMs) that now exist (ranging from relatively non-technical to comprehensively technical in scope) with more expected to be published in the coming years. This compilation has shown that site selection, MMV, and risk assessment are well covered by several existing BPMs.

Mr. Eide mentioned that as of 2014 the task force will be moving onto Phase 2 activities, which will have a focus of outlining/designing a web-based solution that can be used for future annual updates. Resources permitting, the task force will also identify the applicability and shortcomings of various BPMs and communicate these results to the



Lars Ingolf Eide

ISO/TC 265 for use in future development of CCS standards in this area. There was consensus that this task force will continue and work toward creating a web-based system (*Note: the task force 2013 Annual Report is available at the “Publications” page of the CSLF website.*)

16. Report from CCS Technology Opportunities and Gaps Task Force

The Task Force Chair, Richard Aldous, gave a brief update on the task force and its final report. The task force mandate was to identify and monitor key CCS technology gaps and related issues, to determine the effectiveness of ongoing CCS RD&D for addressing these gaps, and to recommend any RD&D that would address CCS gaps and other issues. The final report covers capture / integrated combustion, CO₂ transport, CO₂ storage, MMV, knowledge / capacity building, and industry dynamics / technology development.



Richard Aldous

Dr. Aldous stated that there are several key high level observations in the report:

- At a high level there are no major technology gaps. CCS technologies are ready and available, and are being deployed today.
- There are many contending capture technologies, in both current technologies and 2nd & 3rd generation technologies.
- Next generation technologies are vital for substantial cost reduction.
- However, there is no strong market pull for new technologies at the moment.
- There is a need to continue work towards low cost, high resolution MMV, particularly in the offshore environment.
- The lack of exploration for CO₂ storage sites is a significant barrier to rapid deployment of CCS and, thus, learning by doing.

Dr. Aldous stated that it is clearly important that new projects move forward in order to realize projected cost reductions in CCS technologies and it is vital that next generation technologies make it through their development cycles. A key conclusion in the report is that further improvements in CCS technologies will therefore most likely need to be incentivized. Dr. Aldous stated that the CCS Technologies and Gaps Task Force has accomplished its mandate and is ending its activities, and there was consensus that this task force has concluded its work. (*Note: the task force final report is available at the “Publications” page of the CSLF website.*)

17. Report on Technical Group Recommendations and Messages to the Policy Group

Trygve Riis reported that the key messages and recommendations from the task forces have been collected into a room document for the November 6th Policy Group meeting. There is also a similar document for the Policy Group meeting on key messages and recommendations from the 2013 CSLF TRM. Both of these are included in the Documents Book, and Mr. Riis will summarize this information in a presentation at the Policy Group meeting. (*Note: the Documents Book is available at the Washington meeting page of the CSLF website.*)

Mr. Riis also mentioned that separate documents from the Technical Group task forces, as well as a document on key messages and recommendations from the 2013 CSLF TRM, are included in the Ministerial Conference Briefing Documents book. (*Note: the Ministerial Conference Briefing Documents Book is also available at the Washington meeting page of the CSLF website.*)

18. Status of Activities / Discussion of the Need for New Technical Group Task Forces

Trygve Riis thanked the Secretariat for preparing an update on the status of the Technical Group Action Plan. (*Note: the Action Plan Update document is appended to these Minutes.*) Mr. Riis stated that of the twelve actions originally identified, only four have so far resulted in formation of Technical Group task forces, with one other action being assigned to the PIRT and another canceled due to Policy Group activity in that area. However, several other actions are being addressed, at least in part, by other organizations, and there are three actions where there has not yet been any activity.

Mr. Riis suggested that the Technical Group form a review group to appraise all unaddressed items in the Action Plan. This group would review any existing documents and other materials relevant to the unaddressed actions and then recommend (at the next Technical Group meeting) what if any activities are worth pursuing for these actions. After ensuing discussion, there was agreement to create this new working group. Specifics are as follows:

- Action #3: Energy Penalty Reduction. United Kingdom (Philip Sharman) was asked to be lead. Mr. Sharman will discuss this action with the United Kingdom's Department of Energy and Climate Change.
- Action #4: CCS with Industrial Emissions Sources. South Africa (Tony Surridge) was asked to be lead, with support from the United States and the IEA GHG.
- Action #5: CO₂ Compression and Transport. Japan (Ryozo Tanaka) was asked to be lead. Mr. Tanaka will discuss the possibility of leading this action with Japan's Ministry of Economy, Trade and Industry.
- Action #8: Competition of CCS with Other Resources. France (Didier Bonijoly) was asked to be lead.
- Action #9: Lifecycle Assessment and Environmental Footprint of CCS. Norway (Lars Ingolf Eide) was asked to be lead, with support from the United States and the IEA GHG.
- Action #11: Carbon Neutral / Carbon Negative CCS. United Kingdom (Philip Sharman) was asked to be lead. Mr. Sharman will discuss this action with the IEA GHG and the United Kingdom's Department of Energy and Climate Change. The Netherlands (Paul Ramsak) may also participate.

In addition to these existing actions, Stefan Bachu also suggested that the Technical Group add a new item to the Action Plan, for "Review of CO₂ Storage Efficiency in Deep Saline Aquifers". There was consensus to form this new task force and the Secretariat was requested to update the Action Plan. Dr. Bachu volunteered that Canada (himself) would be the task force chair. Other members will be France (Didier Bonijoly), the United States (Angela Goodman and Charles Gorecki, both from the United States Department of Energy's National Energy Technology Laboratory), and Australia (Clinton Foster). The IEA GHG also expressed an interest in this new task force.

Also, Ramón Treviño of the Bureau of Economic Geology at the University of Texas gave a brief presentation that proposed forming a new task force for investigating sub-seabed CO₂ storage possibilities. The projected scope would include technical issues such as geologic characterization and monitoring, viability of offshore CO₂-EOR, and possible collaboration opportunities with existing projects, and also policy-related issues such as cost, economic drivers, and strategic deployment optimization. One of the goals of the proposed task force would be to support and develop field tests in order to demonstrate global feasibility for offshore sub-seabed CO₂ storage. However, Stefan Bachu stated that supporting and developing a field test was beyond what the CSLF could accomplish due to lack of resources, and suggested that a better mandate for such a task force would be to assess barriers and technical needs for sub-seabed CO₂ storage. There was some support for this revised concept from Norway, South Africa, and the United States, but in the end there were no volunteers to lead a new task force and no consensus to move forward in this area. This may be revisited at the next Technical Group meeting.



Ramón Treviño

19. New Business

The delegation from Korea provided some preliminary information about the next CSLF Technical Group meeting. Chong Kul Ryu stated that the meeting would be held the week of March 24-27, 2014. The first two days of the meeting will be in Seoul and the last two days at a different location. The meeting will include both a technology workshop and a site visit.

20. Review of Consensuses Reached and Action Items

Consensus was reached for the following:

- The Kemper County Energy Facility, the SECARB Phase III Anthropogenic Test and Plant Barry CCS Project, and the MRCSP Development Phase Project are recommended by the Technical Group to the Policy Group for CSLF recognition.
- The Technical Group will further defer addressing the Action Plan on “Energy Penalty Reduction” pending review of the final report by the United Kingdom’s Cost Reduction Task Force on this topic.
- The Technical Challenges for Conversion of CO₂-EOR to CCS Task Force has concluded its work.
- The CO₂ Utilization Options Task Force has concluded its work.
- The Technology Opportunities and Gaps Task Force has concluded its work.
- The Task Force on Best Practices and Standards for Geologic Storage and Monitoring of CO₂ will continue and work toward creating a web-based system.
- The Technical Group will create a new working group to appraise all unaddressed items in the Technical Group Action Plan.
- Canada will lead a new task force for “Review of CO₂ Storage Efficiency in Deep Saline Aquifers”.

Action items from the meeting are as follows:

Item	Lead	Action
1	Technical Group Chair	Provide the Technical Group's recommendation to the Policy Group that the Kemper County Energy Facility, the SECARB Phase III Anthropogenic Test and Plant Barry CCS Project, and the MRCSP Development Phase Project be recognized by the CSLF. <i>(Note: this was done at the November 6th Policy Group meeting.)</i>
2	Norway	Provide suggested text for correction to Rome Technical Group minutes to the CSLF Secretariat for incorporation into final version of minutes. <i>(Note: correction has been provided.)</i>
3	South Africa	Alert the Secretariat when the final version is available for the SACCCS report concerning impacts of CCS on South African national priorities beyond climate change.
4	United Kingdom	Send Secretariat the link to the United Kingdom's Needs Assessment Report.
5	Technical Group Chair	Recommend that Policy Group form a new Task Force on "Policy, Legal and Regulatory Challenges in the Transitioning from CO ₂ -EOR to CCS". <i>(Note: this was done at the November 6th Policy Group meeting.)</i>
6	China	Send Secretariat the link to China's assessment report on CO ₂ utilization technology. <i>(Note: link has been provided.)</i>
7	Canada	Create and lead a new task force for "Review of CO ₂ Storage Efficiency in Deep Saline Aquifers". <i>(Members: Canada, France, United States, and Australia)</i>
8	Technical Group Action Plan Working Group	Review any existing documents and other materials relevant to the unaddressed Actions Plan items and recommend (at the next Technical Group meeting) what activities are worth pursuing for these actions.
9	CSLF Secretariat	Update the Technical Group Action Plan.

21. Closing Remarks / Adjourn

Trygve Riis thanked the delegates, observers, and Secretariat for their hard work and active participation, and adjourned the meeting.



CSLF Technical Group Action Plan Update (as of October 2013)

Action Plan 1: Technology Gaps Closure

Action: The Technical Group will identify and monitor key CCS technology gaps and related issues and recommend any R&D and demonstration activities that address these gaps and issues.

Outcome: Identification of all key technology gaps/issues and determination of the effectiveness of ongoing CCS RD&D for addressing these gaps/issues.

Status: Technology Opportunities and Gaps Task Force (*led by Australia*) active since June 2012. **Final Report issued.**

Action Plan 2: Best-Practice Knowledge Sharing

Action: The Technical Group will facilitate the sharing of knowledge, information, and lessons learned from CSLF-recognized projects and other CCS RD&D.

Outcome: Development of interactive references for assisting next-generation commercial CCS projects, which will include links with other CCS entities.

Status: Activity assigned to Projects Interaction and Review Team (*led by Australia*).

Action Plan 3: Energy Penalty Reduction

Action: The Technical Group will identify technological progress and any new research needs for reducing the energy penalty for CCS, both for traditional CO₂ capture processes and new breakthrough technologies.

Outcome: Identification of opportunities for process improvements and increased efficiency from experiences of “early mover” projects.

Status: United Kingdom (DECC) final report in this area sent to Technical Group delegates on 23 May 2013. **Possible activity in this area to be addressed at Technical Group meeting.**

Action Plan 4: CCS with Industrial Emissions Sources

Action: The Technical Group will document the progress and application of CCS for industrial emissions sources and will identify demonstration opportunities for CSLF Members.

Outcome: Identification of opportunities for CCS with industrial sources. Identification and attempted resolution of technology-related issues (including integration) unique to this type of application.

Status: Clean Energy Ministerial / IEA report issued. **Possible activity in this area to be addressed at Technical Group meeting.**

Action Plan 5: CO₂ Compression and Transport

Action: The Technical Group will review technologies and assess pipeline standards for CO₂ transport, in particular in relation to impurities in the CO₂ stream. Issues such as thermodynamics, fluid dynamics, and materials of construction, will be considered. Alternatives to pipelines, such as ship transport, will also be assessed.

Outcome: Identification of optimum technical CO₂ transport strategies, both for pipeline and non-pipeline alternatives. Assessment of purity issues as they apply to CO₂ transport. Identification of optimal compression options and alternatives.

Status: No activity yet.

Action Plan 6: Reviewing Best Practices and Standards for Geologic Storage and Monitoring of CO₂

Action: The Technical Group will identify and review standards for CO₂ storage and monitoring.

Outcome: Identification of best practices and standards for storage and monitoring of injected CO₂. The application of such standards should inform CO₂ crediting mechanisms.

Status: Reviewing Best Practices and Standards for Geologic Storage and Monitoring of CO₂ Task Force (led by Norway) active since June 2012. Reports for Years 2012 and 2013 issued. **Continuation of Task Force an option.**

Action Plan 7: Technical Challenges for Conversion of CO₂-EOR to CCS

Action: The Technical Group will determine technical and economic aspects that can affect moving from enhanced oil recovery (EOR) to carbon storage.

Outcome: Identification of permitting, monitoring, and reporting requirements for CO₂ EOR applications that apply for CO₂ credits.

Status: Technical Challenges for Conversion of CO₂-EOR to CCS Task Force (led by Canada) active since June 2012. **Final Report issued.**

Action Plan 8: Competition of CCS with Other Resources

Action: The Technical Group will examine criteria for assessing competing development priorities between CCS (particularly CO₂ storage) and other economic resources.

Outcome: Identification of criteria for determining relative economic viability of CO₂ storage sites.

Status: **Deferred** pending review of IEA GHG report in this area.

Action Plan 9: Life Cycle Assessment and Environmental Footprint of CCS

Action: The Technical Group will identify and review methodologies for Life Cycle Assessment (LCA) for CCS, including life cycle inventory analysis, life cycle impact assessment, and interpretation of results.

Outcome: Identification of criteria for determining the full range of environmental effects for CCS technologies.

Status: No activity yet.

Action Plan 10: Risk and Liability

Action: The Technical Group will identify and assess links between technology-related risks and liability.

Outcome: Identification of guidelines for addressing long-term technology-related risks with respect to potential liabilities.

Status: Canceled. Policy Group task force formed to investigate this area.

Action Plan 11: Carbon-neutral and Carbon-negative CCS

Action: The Technical Group will investigate technical challenges in use of CCS with power plants that utilize biomass (either pure or co-fired), to determine a pathway toward carbon-neutral or carbon-negative functionality.

Outcomes: Identification of issues and challenges for use of CCS with biomass-fueled power plants.

Status: No activity yet.

Action Plan 12: CO₂ Utilization Options

Action: The Technical Group will investigate CO₂ utilization options.

Outcome: Identification of most economically attractive CO₂ utilization options.

Status: CO₂ Utilization Options Task Force (*led by United States*) active since June 2012. Final report issued.