



DRAFT

Minutes of the Technical Group Meeting

London, United Kingdom

Tuesday, 28 June 2016

LIST OF ATTENDEES

Chair

Åse Slagtern (Norway)

Delegates

Australia: Andrew Barrett (*Vice Chair*), Max Watson
Canada: Eddy Chui (*Vice Chair*), Michael Monea
European Commission: Jeroen Schuppers
France: Didier Bonijoly, David Savary
Germany: Jürgen-Friedrich Hake
Italy: Paolo Deiana
Japan: Ryoza Tanaka, Takeshi Kawabata
Korea: Chang Keun Yi, Chong Kul Ryu
Mexico: Jazmín Mota
Netherlands: Paul Ramsak
Norway: Jostein Dahl Karlsen, Lars Ingolf Eide
Poland: Mateusz Głogowski
Saudi Arabia: Hamoud AlOtaibi, Ahmed AlEidan
South Africa: Tony Surrige (*Vice Chair*)
United Kingdom: Brian Allison, Eva Stepniewska
United States: Mark Ackiewicz

Representatives of Allied Organizations

Global CCS Institute: Andrew Purvis, Victor Der
IEA: Tristan Stanley
IEAGHG: Tim Dixon, James Craig, Jasmin Kemper

CSLF Secretariat

Richard Lynch, Adam Wong, Stephanie Duran, Stephanie Hutson

Invited Speakers

Australia: Max Watson, Program Manager - CO₂ Storage, CO2CRC
United Kingdom: Steve Widdicombe, Strategic Sciences Lead, Marine Ecology and Biodiversity Section, Plymouth Marine Laboratory

Observers

Australia:	Paul Trotman*
Canada:	Naoko Ellis, Kathryn Gagnon*, Christine Lazaruk, Simon O'Brien, Jeremy Rayner
Czech Republic:	Pavel Kavina
Japan:	Kimiko Nakanishi, Takuro Okajima*
Norway:	Mohsen Assadi, Britta Paasch, Olav Skalmaraas
Saudi Arabia:	Wolfgang Heidug
United Kingdom:	Bruce Adderley, Mark Crombie, Jon Gibbins, M. Pourkashanian, Cosimo Sbano, Matt Wills
United States:	Jarad Daniels*, Bill Elliott, Amishi Kumar, Scott McDonald, Ed Rubin, Judd Swift

* CSLF Policy Group delegate

1. Chairman's Welcome and Opening Remarks

The Chairman of the Technical Group, Åse Slagtern, called the meeting to order and welcomed the delegates and observers to London. Ms. Slagtern mentioning that this would be a busy meeting, with updates from several task forces as well as the working group that is updating the CSLF Technology Roadmap. In addition there would be discussion on possible future Technical Group activities.

Ms. Slagtern also mentioned that the current meeting would be, as usual, very content-rich, with many items of interest to attendees. This includes presentations on the CSLF-recognized CO2CRC Otway Project and on CCS in the United Kingdom, a report on a sub-seabed controlled release experiment by the United Kingdom's Plymouth Marine Laboratory, and several presentations by the IEA Greenhouse Gas R&D Programme (IEAGHG).

2. Meeting Host's Welcome

Brian Allison, representing the United Kingdom's Department of Energy and Climate Change (DECC) [since 16 July 2016 the Department of Business, Energy and Industrial Strategy (DBEIS)], welcomed the meeting attendees to London. Mr. Allison thanked the sponsors for the four-day meeting and hoped that meeting attendees would have a pleasant stay in London.

3. Introduction of Delegates

Technical Group delegates present for the meeting introduced themselves. Sixteen of the twenty-five CSLF Members were represented. Observers from eight countries were also present.

4. Adoption of Agenda

The Agenda was adopted with the addition of short talks, near the end of the meeting, from the Global Carbon Capture and Storage Institute's Andrew Purvis, and from Wolfgang Heidug about methodology for the United Nations Framework Classification for carbon capture and storage (CCS).

5. Approval of Minutes from Riyadh Meeting

The Minutes from the November 2015 Technical Group Meeting in Riyadh, Saudi Arabia were approved with no changes.

6. Report from CSLF Secretariat

Richard Lynch provided a report from the CSLF Secretariat which covered the status of action items from the November 2015 Technical Group Meeting and some of the highlights from the overall Ministerial Meeting. This was a five-day event, including the Conference of Ministers and the Ministers' site visit to Saudi Aramco's Dhahran Facility.

Mr. Lynch summarized some of the key actions identified by CSLF Ministers that were needed to accelerate large-scale deployment of CCS. These included advocating for clean energy policies that support CCS alongside other clean energy technologies, fostering international collaboration for large-scale CCS projects, removing barriers for private sector investment in CCS, giving CCS fair consideration in clean energy policies while supporting development of comprehensive CCS policy frameworks, supporting industrial CCS applications, and continuing to explore the potential of CO₂ utilization technology. Highlights from the overall Ministerial Meeting included CSLF recognition of five projects (see below) and presentation of CSLF Global Achievement Awards to three completed CSLF-recognized projects (the CO₂ Capture Project Phase 3, the CO₂CRC Otway Project Stage 1, and the CGS Europe Project). And also, the CSLF is now larger, with the addition of Romania and Serbia as new members.

Mr. Lynch stated that there were five Action Items from the November 2015 meeting, four of which are now complete. Still pending is a request for the IEAGHG to determine a way to allow access to a journal paper that is also the final report from the CSLF Task Force on CO₂ Storage Efficiency in Deep Saline Aquifers. Tim Dixon responded that the journal containing the report was published by Elsevier and that it could not be freely downloaded. Mr. Dixon offered that instead, the Technical Group use the presentation from the Task Force Chair at the June 2015 CSLF Meeting as the final report. The Technical Group accepted this suggestion.

Mr. Lynch closed his presentation by summarizing the outcomes from the Riyadh Technical Group Meeting:

- Five projects were recommended by the Technical Group to the Policy Group for CSLF recognition.
 - CO₂ Capture Project Phase 4
 - CO₂CRC Otway Project Stage 2
 - Oxy-Combustion of Heavy Liquid Fuels Project
 - Carbon Capture and Utilization Project / CO₂ Network Project
 - Dry Solid Sorbent CO₂ Capture Project
- The Technical Group formed a new Task Force on Offshore CO₂-EOR.
- The Technical Group formed a new Task Force on Bioenergy with CCS
- The Technical Group formed a new Task Force on Improved Pore Space Utilisation.
- The Technical Group temporarily postponed decisions on forming other new task forces.

7. Overview of CCS Activities in the United Kingdom

Eva Stepniewska, representing DECC, briefed the Technical Group on policy developments in the United Kingdom related to CCS. She stated that the cancellation of the two large-scale CCS projects, Peterhead and White Rose, should not be taken as a sign that the United Kingdom has written off CCS. Instead, there are a range of options being considered that would move CCS forward. These include developing an action plan for industrial CCS, supporting the development of new technologies, and knowledge transfer of key learnings from Peterhead and White Rose. Ms. Stepniewska also stated that there are several policy questions to be addressed as the United Kingdom considers its options in regards to CCS, concerning CO₂ transport infrastructure and its cost, industrial CCS, creating markets for CO₂ to aid CO₂ utilization, innovation and its role in reducing the overall cost of CCS, and what can be learned from other countries which are engaged in large-scale CCS.

Brian Allison then gave a presentation about the various CCS technical developments being supported by the United Kingdom Government. The CO₂ Storage Appraisal Project is bringing to maturity a portfolio of five storage sites and will thus simplify commercial discussions toward CO₂ geologic storage. Mr. Allison stated that the five sites selected are all offshore sub-seabed and are geographically and technically diverse (including deep saline aquifers and depleted oil and gas fields). In all, the five sites within the selected portfolio represent a total of 1.6 gigatonnes (GT) storage. A key finding of the project has been that the national offshore sub-seabed storage resource is upwards of 75 GT, key components of which can be brought into service readiness without extensive appraisal programs.

Four other United Kingdom Government-supported initiatives were briefly described by Mr. Allison. The Boulby Underground Laboratory, located 1100 meters below ground on the northeast coast of England, has been home for the investigation into use of cosmic ray muon detection technology for deep geological monitoring of CO₂ within a storage site. Carbon Clean Solutions, whose United Kingdom office is located in the city of Reading, is developing a low cost energy efficient solvent-based technology for separating CO₂ from flue gas of power plants and industrial utilities. C-Capture, located in the city of Leeds, is developing a low-energy approach for removal of CO₂ from methane gas streams, in particular biogas from anaerobic processes and landfills. The United Kingdom Government has also worked with the Scottish Government to provide an early stage R&D grant totaling £4.2 million to Summit Power to help advance the proposed Caledonia Clean Energy Project, to be located at the city of Grangemouth. This project would be based on coal gasification, generating 570 megawatts (net) of electricity with 90% CO₂ capture. This would be the first carbon capture power plant designed to compress and deliver CO₂ at intermediate rather than high pressure.

Mr. Allison closed his presentation by briefly describing the European “Accelerating CCS Technologies” (ACT) initiative for funding CCS-related RD&D innovation across the ACT partnership (e.g., Norway, Germany, the Netherlands, Switzerland, Spain, and the United Kingdom). The goal of the initiative is to “facilitate the emergence of CCS via transnational funding aimed at accelerating and maturing CCS technology through targeted innovation and research activities”. The United Kingdom Government has contributed £5.5 million to a fund currently totaling nearly £42 million. The initiative is beginning in 2016, and successful projects will run for a maximum of three years. A transnational call for proposals was issued in early June, and each country involved will

fund its own partners. Details of the call, managed by the Norwegian Research Council and the ACT partners, can be found at the ACT website (<http://www.act-ccs.eu/>).

8. Update from the IEA Greenhouse Gas R&D Programme (IEAGHG)

Tim Dixon gave a presentation about the IEAGHG and its continuing collaboration with the CSLF's Technical Group. The IEAGHG was founded in 1991 with the mission to provide information about the role of technology in reducing greenhouse gas emissions from use of fossil fuels. The focus is on CCS, and the goal of the organization is to produce information that is objective, trustworthy, and independent, while also being policy relevant but not policy prescriptive. The "flagship" activities of the IEAGHG are the technical studies and reports it publishes on all aspects of CCS, the eight international research networks about various topics related to CCS, and the biennial GHGT conferences, the next one in November 2016 in Lausanne, Switzerland. Other IEAGHG activities include its annual International CCS Summer School, peer reviews with other organizations, activity in international regulatory organizations such as the ISO and the London Convention, and collaboration with other organizations, including the CSLF.

Mr. Dixon mentioned that since 2008 the IEAGHG and CSLF Technical Group have enjoyed a mutually beneficial relationship which allows each organization to cooperatively participate in the other's activities. This has included mutual representation of each at CSLF Technical Group and IEAGHG Executive Committee (ExCo) meetings, and also the opportunity for the Technical Group to propose studies to be undertaken by the IEAGHG. These, along with proposals from IEAGHG ExCo members, go through a selection process at semiannual ExCo meetings. So far there have been four IEAGHG 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), "Potential Implications of Gas Production from Shales and Coal for CO₂ Geological Storage" (November 2013), and "Life Cycle Assessment of Carbon Capture, Utilization and Storage (CCUS) – Benchmarking". For the current year, the IEAGHG has already published eight new reports with many other studies underway or awaiting start that will eventually lead to other reports.

Mr. Dixon closed his presentation with a short description of outcomes from the 2015 COP21 meeting in Paris. Article 2 of the COP21 Agreement states that the purpose of the agreement is to limit global warming to "well below" 2.0 degrees C (by the year 2100) and to pursue 1.5 degrees C. Articles 3 and 4 of the agreement indicate that developed countries should take the lead toward this goal, and to update their Nationally Determined Contributions (NDCs) every five years. Other articles in the COP21 Agreement concern cooperative approaches, finance, technology development, capacity building, education, and transparency. Mr. Dixon stated that the International Panel on Climate Change (IPCC) will be examining the 1.5 degrees C scenarios and will issue a special report by the year 2018. For the 2.0 degrees C scenario, CCS will enable access to significant quantities of fossil fuels that would otherwise have to remain unburnable.

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

The PIRT Chair, Andrew Barrett, gave a short presentation which summarized PIRT activities and the previous day's meeting. The PIRT is currently involved in four main activities: reviewing projects nominated for CSLF recognition (however, there were none for this meeting), updating the CSLF Technology Roadmap (reported in the next item), organizing technical workshops for future CSLF meetings, and finding ways to better

engage sponsors of CSLF-recognized projects. Mr. Barrett stated that much of the PIRT meeting was taken up by discussion of the fourth activity, with two resulting action items:

- The CSLF Secretariat, working with the sponsor of the Illinois Basin – Decatur Project, will develop a useful format for CSLF-recognized projects to report their status.
- PIRT delegates from Australia, Canada, and the United States will use the new project reporting format to engage projects located in their countries (approx. 4-8 projects in total) and prepare short status summaries in time for the 2016 CSLF Annual Meeting.

Concerning technical workshops, there was one other action item: the Secretariat and the PIRT delegate from Japan (Ryozo Tanaka) will develop a structure for a technical workshop to be organized as part of the upcoming CSLF Annual Meeting. Japan's delegation will have the overall ownership of the event, including inviting participants.

10. Progress Report on next CSLF Technology Roadmap (TRM)

The Chair of the TRM working group, Andrew Barrett, gave a short progress report presentation about the 2017 TRM. The TRM working group had been formed at the 2015 Technical Group meeting in Riyadh with the mandate to produce a new TRM in time for the anticipated Ministerial Meeting near the end of 2017. The process chosen for the rewrite was to use the 2013 TRM as a basis and refresh its content as needed. Mr. Barrett stated that there have been three teleconferences of the working group and that the current focus was on Section 4, "Technical Needs".

At the previous day's PIRT meeting, there had been consensus that the timeline for the rewrite should be advanced so that a final draft would be complete in time for the 2017 Mid-Year Meeting. There was also consensus that outcomes from the COP21 meeting should be incorporated as should technologies such as bioenergy with CCS that were only briefly mentioned in the 2013 TRM. To assist in the rewrite process, the working group will create a "technical needs" survey for obtaining pertinent information from existing projects.

11. Report from Offshore CO₂-EOR Task Force

Task Force Chair Lars Ingolf Eide gave a brief update on the task force, which was established at the November 2015 meeting in Riyadh. The purpose of the task force is to highlight differences and issues between onshore and offshore CO₂-EOR as well as offshore CO₂-EOR and pure offshore CO₂ storage. The task force will also highlight any technical solutions which benefit both pure offshore CO₂ storage and offshore CO₂-EOR.

Mr. Eide stated that the task force has held one preliminary meeting, in April in the United States. The task force timeline calls for completion of the first draft of the final report in time for the 2017 CSLF Mid-Year Meeting and a finalized report, as well as findings and conclusions, at the 2017 CSLF Ministerial Meeting. The contents of the report will include sections on the current status and future potential for offshore CO₂-EOR, a summary of emerging technical solutions for offshore CO₂ storage and EOR, descriptions of potential CO₂ supply chain issues and infrastructure needs, a description of regulatory requirements for offshore CO₂ utilization and storage, and recommendations for overcoming any barriers to accomplishing offshore projects. Mr. Eide stated that current task force members include Norway (as chair), Brazil, Canada, the United States,

and the IEAGHG, and that more participation from other CSLF members and outside organizations would be welcome.

12. Report from Bioenergy with CCS (BECCS) Task Force

Task Force Chair Mark Ackiewicz gave a brief update on the task force, which was established at the November 2015 meeting in Riyadh. The focus of the task force is to identify and summarize global efforts, successes, and challenges to deployment for BECCS. Current task force members include the United States (as chair), Italy, Norway, and the IEAGHG. Others expressing interest in either joining the task force or providing input for the task force's final report included the Netherlands, the European Commission, and the United Kingdom. Mr. Ackiewicz stated that a technical focus of the task force would be to look at the unique challenges for CO₂ capture technologies to be deployed at bio-power, biofuels, and other bio-industry facilities. This would include both current projects and also business cases for possible future projects – the task force will summarize current finding and identify any technology gaps. The list of projects to be examined by the task force is not yet final, but will include the ADM ethanol facility in the United States and the Klemetsrud waste-to-energy facility in Norway.

Mr. Ackiewicz provided the timeline for the task force. There will be a status update at the 2016 CSLF Annual Meeting in Tokyo, and a first draft of the final report will be completed prior to the 2017 CSLF Mid-Year Meeting. A finalized version of the report is expected in time for the 2017 CSLF Ministerial Meeting.

13. Report from Improved Pore Space Utilisation Task Force

Task Force Co-Chairs Brian Allison and Max Watson along with Task Force member Ryozo Tanaka gave a brief update on the task force, which was established at the November 2015 meeting in Riyadh. The purpose of the task force is to investigate the existing capabilities in improved pore space utilisation for CO₂ storage. This includes summarizing the effectiveness and readiness of various techniques and developing ideas for necessary R&D to develop capability in the most opportune technologies. Current task force members include Australia and the United Kingdom (as co-chairs), France, Japan, the United Arab Emirates, and the IEAGHG.

Mr. Allison and Dr. Watson briefly described the expected task force report contents. Included will be sections on well design (including flow control), injection operations (including pressure management and plume steering), and reservoir simulation (including geochemically enhanced injectivity). Mr. Tanaka gave a brief presentation about another section of the report, modified injection, which would include micro-bubble injection. Micro-bubbles of CO₂ are much smaller than ordinary macro-bubbles, and dissolve much more readily into saline brine as would be found in a geologic storage site.

The task force timeline will result in a final report by the 2017 CSLF Ministerial Meeting. Prior to that, the task force will be very active with its technical reviews and expects to have a draft of its final report in time for the 2017 CSLF Mid-Year Meeting. Following the presentation, a representative of Statoil, in Norway, expressed interest and was added to the task force.

14. Review of Technical Group Action Plan and Possible New Technical Group Activities

Technical Group Chair Åse Slagtern provided a brief update on the Technical Group Action Plan. Over the past three years, six Technical Group task forces have completed final reports. Last year, at the Riyadh meeting, three new task forces were formed. A special working group had identified many other possible areas of Technical Group activity, but decisions concerning these had been postponed. There had been some interest in two of these areas, Industrial CCS and Geo-steering / Pressure Management Techniques, but not quite enough to form task forces.

Ms. Slagtern stated that a preliminary discussion about future Technical Group activities had been done at the previous day's PIRT meeting. There had been agreement that the existing Advanced Pore Space Utilisation Task Force would take on the geo-steering activity, but not the pressure management part which would need to be part of a future activity on Storage Mitigation. There was consensus for the task force to take on geo-steering as a new focal area. Also, France had expressed an interest in the Industrial CCS activity. After a short discussion, Didier Bonijoly was requested to determine if France would be able to lead a new task force in that area. In the end, no new task forces were formed but there was agreement that the Technical Group would re-evaluate task force options at its next meeting.

15. Update on the ISO TC265 Committee

Tim Dixon gave a presentation about the International Organization for Standardization's Technical Committee on CO₂ Capture, Transportation and Geological Storage (ISO TC265). This committee was convened in 2011 with the mission of preparing standards for the design, construction, operation, environmental planning, risk management, monitoring and verification, and other activities related to CCS. Mr. Dixon stated that there are currently six working groups, each with its own set of activities. The standards development procedure works through consensus and is a multi-stage process. New work item proposals are first made into a working draft, and those that gain consensus from the working group are made into a committee draft. At that point a greater degree of working group consensus is required to move the proposal into the "draft international standard" phase, which then requires a comments period and consensus of the working group's panel of experts to become an ISO standard.

Mr. Dixon stated that the ISO TC265 currently includes twenty participating countries, eight observer countries, and also seven liaison organizations (including the CSLF). The committee as a whole has met seven previous times since its formation with the seventh meeting taking place in May 2016 in the United States. The next meeting will be in late November 2016 in Japan.

16. Report on the IEAGHG-CSLF Life Cycle Assessment (LCA) Workshop

Jasmin Kemper gave a short presentation about the IEAGHG-CSLF LCA Workshop, which was held in London in November 2015. The IEAGHG had, in 2010, published a report on "Environmental Evaluation of CCS Using Life Cycle Assessment", which described challenges surrounding use of LCA methodology in the context of carbon capture, utilization and storage (CCUS). Subsequent to the report there had been a request from the CSLF to do further work on this topic so the workshop was organized instead of a follow-up study. There were 23 participants with varying levels of LCA experience that represented different backgrounds (academia, industry, and NGOs). The

workshop scope was focused on exploring the possible need for setting up guidelines for benchmarking and transparency of LCAs for CCUS.

Ms. Kemper stated that the workshop consisted of five sessions: Scene-setting, Goal and scope, Inventory analysis, Impact assessment, and Life cycle costing. There were several significant conclusions:

- Transparency about LCA methodology is essential and must be improved.
- There is a need to communicate how and why differences in LCAs come about.
- It is important to clearly distinguish LCA from carbon / greenhouse gas accounting and footprinting.
- Social LCA (which is somewhat subjective and involves issues such as health and safety) is an emerging area but is less mature and quantifiable than environmental LCA.

Ms. Kemper stated that based on the outcomes from this workshop, there appeared to be no need to update the 2010 IEAGHG report, though another LCA workshop might be a good idea in a few years. Other recommendations from the workshop were that awareness on this topic could be heightened by keynote or plenary presentations at conferences, and that it might be useful to develop a guidance / good practice document about LCA in collaboration with outside experts in this area.

17. Report on the International Workshop on Offshore CO₂ Storage

Tim Dixon gave a short presentation about the Offshore CO₂ Storage Workshop, which was held in April in the United States and was organized by the Bureau of Economic Geology (BEG) at the University of Texas. Other collaborators were the Centre for CCS at the South African National Energy Development Institute (SANEDI) and the IEAGHG, with support from the United Nations Framework Convention on Climate Change (UNFCCC) Climate Technology Centre & Network (CTCN) and the CSLF. The workshop was attended by representatives from thirteen countries, including seven developing countries.

Mr. Dixon stated that the goal of the workshop was to facilitate the sharing of knowledge and experiences among those who are currently involved in offshore CO₂ storage and those who are or may be interested. The first day of the workshop consisted of targeted plenary talks by experts (“What we know that you need to know”), while the second day featured country status and needs assessment reports, and also a guided discussion which came up with conclusions and recommendations:

- A follow-on workshop with deeper and more specific technical content is desirable.
- Other workshops – on infrastructure, storage resource assessment, and aimed more directly at developing countries – are also needed.
- There is a great need for international collaboration and a funding mechanism for a high-visibility pilot or demonstration project.
- An online resource page is needed with links to key information sources.
- Creation of an ongoing Offshore Network, perhaps by the IEAGHG, would be useful.

Mr. Dixon closed his presentation by mentioning that the CTCN had covered the cost for delegates from Nigeria and Ghana to attend the workshop, and this was the first ever

funding by CTCN on a CCS activity. An IEAGHG report on the workshop was published in May 2016, and presentations from the workshop are available at the BEG website. The Secretariat was requested to make the Workshop summary and presentations also available at the CSLF website.

18. Otway Stage 2C Project Update

Max Watson provided an update on the CSLF-recognized CO₂CRC Stage 2 Otway Project, located in Victoria, Australia. CO₂CRC is the first company in Australia to have undertaken CO₂ geological storage, safely injecting, monitoring and containing more than 80,000 tonnes of CO₂ into varying rock formations.

Since its inception, the broader Stage 2 research program has intended to demonstrate that CO₂ storage can be safely conducted at scale within a geologic saline formation. Otway Stages 2A and 2B were a pre-operation appraisal that measured parameters affecting residual and dissolution CO₂ trapping in a saline formation. Stage 2C, launched in late 2015 and set to expand through to 2019, is the operational phase, and is monitoring 15,000 tonnes of injected CO₂ to obtain information on minimum detection limits, migration behavior, and determine the timing of plume stabilization.

Dr. Watson stated that the Stage 2C monitoring program is utilizing a 1x1 kilometer buried seismic receiver array for both active and passive 4D seismic monitoring of the injected CO₂. Preliminary results show that the CO₂ is safely migrating as predicted, seismic and pressure monitoring resolution is beyond expectation, and minimum detection levels of CO₂ have been identified. Next steps in the project are to continue monitoring the injected plume through to stabilization, including reservoir zone and above-zone pressure monitoring. CO₂CRC, along with Lawrence Berkley National Laboratories and Curtin University will also assess the performance of fiber-optics as a less invasive alternative to geophones in seismic monitoring. With this small, short-term empirical trial at the Otway Project, a generic and validated workflow will be developed by CO₂CRC for conforming long term plume predictions (including stabilization) through the use of early monitoring observations.

Dr. Watson concluded his presentation by providing a preview of the CO₂CRC Otway Stage 3 program, which has the overall goal of delivering a permanently deployed subsurface and cost-effective real-time monitoring solution for industry. This will include increasing the efficiency of CO₂ monitoring with new and adapted technologies and finding ways to reduce the surface footprint and impact of monitoring activities. Dr. Watson stated that Stage 3 is open to international collaboration, and that expressions of interest in project participation have been strong and more are welcome.

19. Overview of the QICS Project: a Sub-Seabed Controlled Release Experiment

Steve Widdicombe, representing the United Kingdom's Plymouth Marine Laboratory, presented a summary of findings from the QICS Project, located on the west coast of Scotland, which monitored the release of 4.2 tonnes of CO₂ in an abandoned wellbore scenario. The CO₂ was injected over a 37 day period approx. 50 meters below the seabed into unconsolidated mud and silt beneath 11 meters of water. Dr. Widdicombe stated that results from the experiment indicated that a very complex CO₂ migration had occurred, with eventual creation of a chimney through the sediments. Gas plumes were readily revealed by acoustic monitoring, and quantified by use of hydrophones. The gas flow was heavily influenced by the tidal state, almost ceasing at high tide.

Dr. Widdicombe stated that an analysis of the results had indicated that approx. 15% of the injected CO₂ had been re-emitted as bubbles, approx. 35% had been re-emitted in a dissolved phase, and approx. 50% had been retained in the sediments. It was not yet known how much of the CO₂ retained in the sediments was physically trapped and how much was chemically bound. Biological response to the CO₂ release was limited to the release site, and both the number of species and the number of individuals recovered to pre-release levels within approx. three weeks. Dr. Widdicombe closed his presentation by mentioning that a larger controlled release experiment is part of the European Union's STEMM-CCS Project. For that experiment, there would be a deeper CO₂ release and results would be used to characterize a biogeochemical baseline at the Goldeneye sub-seabed storage formation in the North Sea off the northeast coast of Scotland.

20. Evaluation of Barriers to CO₂ Geological Storage Assessments

James Craig gave a short presentation about an initiative by the Clean Energy Ministerial CCUS Action Group to evaluate barriers to national storage assessments. A survey was done, covered 25 countries, that explored the extent of high-level assessments of geological CO₂ storage capacity, exposed potential barriers in determining these assessments, and learned how these barriers have been overcome for some countries. The survey questionnaire received 29 responses from 15 countries, with all respondents indicating that some level of storage assessment had been undertaken in their countries. The most common barriers reported involved data availability and quality, lack of policy and regulatory support for CCS, lack of industry support for CCS, and lack of funding for storage assessments.

Mr. Craig stated that a conclusion from this initiative was that unless CCS is on the political agenda, it is very unlikely that a national storage assessment or implementation of CCS will move forward. Developing countries, particularly where oil and gas resource development is still maturing, may have difficulties in finding the expertise for CO₂ storage assessments, but with international collaboration this can be overcome. Mr. Craig closed his presentation by stating the recommendation that a technical guide be produced for officials and organizations in developing countries on the implementation, structure, and approach for compiling a CO₂ storage resource. An IEAGHG report on this topic was published in February 2016.

21. Update from the Global Carbon Capture and Storage Institute (GCCSI)

Andrew Purvis provided a brief report about the GCCSI and its current priorities. Priority outcomes for 2016-2017 fall into two categories: fact-based influential advice / advocacy and authoritative knowledge sharing. For the former, it is important that CCS be increasingly portrayed as an emissions reduction technology that must be deployed to achieve a low-carbon future. Further, CCS must be positioned as a necessary technology for closing the gap between global climate ambitions (i.e., the 1.5 degrees C scenario) and current mitigation plans. To that end, key national and regional governments will need to confirm the important role of CCS in their carbon mitigation planning by implementing policy drivers that will encourage use of CCS. Concerning knowledge sharing, developing and sharing information that encourages the deployment of CCS will need to be an ongoing and necessary collaborative effort.

Mr. Purvis concluded his report by mentioning that the GCCSI recently published two special reports on the global status of CCS: "Introduction to Industrial CCS" and "Understanding Industrial CCS Hubs and Clusters".

22. Methodology for the United Nations Framework Classification (UNFC) for CCS

Wolfgang Heidug provided a brief report about the UNFC and its activities concerning CO₂ storage. The UNFC is a universally accepted and internationally applicable scheme for classification and reporting of fossil energy and mineral reserves and resources. Pore space is also a mineral resource, so the UNFC, through a task force, is working to develop a set of specifications for applying UNFC methodology to CO₂ storage. Dr. Heidug stated that he is a member of this UNFC task force (being chaired by Statoil in Norway), which has recently published a report on this topic that has been submitted to the United Nations Economic Commission for Europe (UNECE) for approval (the UNECE holds the pen on this activity). If accepted, this document could form the basis for comparison of CO₂ storage reserves worldwide.

23. Update on Future CSLF Meetings

Richard Lynch provided a short summary of upcoming CSLF events, including a preview of the next day's joint CCSA-CSLF Workshop on "CCS Post-Paris: Realising Global Ambitions". As for upcoming CSLF meetings, the 2016 CSLF Annual Meeting is being hosted by Japan during the week of October 3-7, and will include a day trip to the Tomakomai CCS Project. The Tokyo meeting page on the CSLF website is expected to be online by early August with meeting registration scheduled to open about mid-August. Mr. Lynch stated that no information is available yet for 2017 CSLF meetings.

24. Open Discussion and New Business

No additional new activities were proposed.

25. Review of Consensuses Reached and Action Items

Consensus was reached on the following items:

- The Technical Group will consider the presentation at the June 2015 meeting by the Chairman of the Task Force on CO₂ Storage Efficiency in Deep Saline Aquifers as the task force's final report.
- The Advanced Pore Space Utilisation Task Force will incorporate geo-steering into its activities as a new focal area.
- The Technical Group will re-evaluate possibilities for new task forces at the next meeting.

Action items from the meeting are as follows:

Item	Lead	Action
1	France	Determine if it can lead a new task force on Industrial CCS.
2	Secretariat	Make the summary and presentations from the CSLF Offshore Workshop (of April 2016) available at the CSLF website.

26. Closing Remarks / Adjourn

Åse Slagtern thanked the meeting host and sponsors, the Secretariat for its support, and the delegates for their active participation. She then adjourned the meeting.