



Summary of the Technical Group Videoconference Meeting

Hosted by Delegation of Norway
28 April 2021

*(note: PDFs of all presentations are available at the CSLF website:
<https://www.cslforum.org/cslf/Events/VirtualTGMeeting2021>)*

1. Welcome and Opening Remarks

The Chair of the Technical Group, Åse Slagtern (representing Norway), called the videoconference meeting to order, described protocols on how the meeting would be conducted, and welcomed the CSLF delegates and stakeholders. In all, there were 41 people who registered to attend this meeting. This includes 21 Technical Group delegates representing 17 CSLF member governments. There was a total of 36 people who attended all or part of this videoconference meeting.

2. Update on Longship and Other Norwegian CCS Activities

William Christensen, representing Norway's Ministry of Petroleum and Energy, gave a short presentation which described the Longship Project as well as other related activities in Norway. Longship, whose funding was approved by the Norwegian Parliament in December 2020, is a commercial carbon capture and storage (CCS) project which will incorporate large-scale capture, transport, and storage of CO₂. The overall objective is to assist Norway and the European Union in achieving their long-term climate goals, cost-efficiently. Included into the overall project is the Northern Lights component, which will be responsible for developing and operating CO₂ transport and storage facilities and which will be open to third parties. CO₂ will be captured from two industrial sources in the Oslo region (the Norcem cement-producing plant and the Fortum Oslo Varme waste-to-energy facility) and transported by ship to an onshore terminal on Norway's west coast, north of Bergen. From there, the liquefied CO₂ will be transported by pipeline to a subsea offshore location in the North Sea for permanent storage.

Mr. Christensen stated that the project is estimated to cost €2.5 billion, with the industrial partners covering approx. 21% of that total cost. Funding has been approved for Norcem's CO₂ capture plant, while funding for Fortum Oslo Varme is conditional upon it receiving additional funds from other sources such as the European Union's Innovation Fund. Construction is now underway on the onshore portion of the storage infrastructure with total pipeline transport capacity designed at 5 million tonnes per year. This leaves room for much additional CO₂ capture in Norway and other countries in northern Europe, as the two industries near Oslo are expected to capture in total about 0.8 million tonnes per year. However, looking ahead, there could be opportunity for storage of CO₂ captured from other sources in continental Europe which could amount to 50 million tonnes or more per year. If this occurs, there would be a need for additional pipeline capacity with a possible need for additional offshore storage sites.

Mr. Christensen concluded his presentation by briefly describing Norway's CCS research policies. These include support for small-scale research (through the CLIMIT initiative)

and the large pilot-scale capture facility at Mongstad (which is administered by Gassnova). Additionally, Norway is involved in many other bilateral and multilateral initiatives on CCS. These include Horizon Europe, Mission Innovation, ACT, the European Strategic Energy Technology (SET) Plan, the CEM CCUS Initiative, and the Carbon Sequestration Leadership Forum.

During ensuing discussion, Jarad Daniels (co-lead of the CEM CCUS Initiative from the United States) asked why there was a need for bilateral agreements between Norway and countries where the stored CO₂ originates. Mr. Christensen replied that one important reason for such agreements was long-term liability – at some point, years or decades down the road, governments will need to take responsibility for the CO₂ stored.

3. Status for Accelerating CCS Technologies (ACT) and Update on the Clean Energy Transition Partnership (CETP)

ACT coordinator Ragnhild Rønneberg at the Research Council of Norway gave a presentation about the ACT and CETP programs. ACT is an international initiative for funding research and innovation projects that can lead to safe and cost-effective carbon capture, utilization and storage (CCUS) technology development. An objective of the initiative is to establish international cooperation for accelerated CCUS deployment in the power and industry sectors. ACT issues calls for project proposals (“Calls”) with a multinational technical committee deciding which projects receive funding, which is provided from agencies in 16 countries, regions, and provinces. A project proposed in response to a Call must show significant industrial involvement and there must be strong indications that the project can support higher technology readiness levels (TRLs) and lead to future full-scale CCUS projects. Dr. Rønneberg stated that so far there have been three ACT Calls (in 2016, 2018, and 2020). ACT1, with €36 million available (including €11.8 million from the European Commission) has resulted in eight projects that were all completed in 2020. ACT2, with €32 million available, has funded twelve projects that are all still in progress. Evaluations are still underway for the 36 proposals received under the ACT3 Call, which has €36-38 million available.

Dr. Rønneberg stated that an important component for all ACT projects is knowledge sharing. Funded projects should not only lead to accelerated CCUS deployment, they should also, in an open approach, learn from each other and find synergies. To that end there have been four ACT knowledge-sharing workshop: in Romania in 2017, in Germany in 2018, in Greece in 2019, and (due to the ongoing pandemic) a ‘virtual’ one via videoconference near the end of 2020. The overall focus of these events is on communication of results to other project sponsors and also to CCUS stakeholders, industry, and decision makers.

Before proceeding on to the CETP part of the presentation, Dr. Rønneberg provided a short status update on Horizon Europe. This is the European Union’s key funding vehicle for research and innovation. One of the three ‘Pillars’ of the program is “Global Challenges and European Industrial Competitiveness”, within which there is a “Climate, Energy and Mobility” cluster of areas of intervention including CCUS-related research such as CCUS combined with sustainable biomass, low-carbon hydrogen from natural gas with CCUS, conversion of captured CO₂ to useful products, and demonstration of the full CCUS chain. Dr. Rønneberg described CCUS’s overall importance within the Horizon Europe program as playing a crucial role for the transition of energy-intensive industries and the power sector towards climate neutrality, in particular for those industries where other alternatives do not yet exist.

Concerning CETP, Dr. Rønneberg stated that it is coming into existence this year and will stay active through 2027. CETP is being set out in the context of the Climate, Energy and Mobility cluster of Horizon Europe and will contribute to that initiative's objectives, where transitions of energy systems are concerned, by mobilizing and aligning national and regional research and innovation funding programs. So far, 30 European countries have indicated their interests to participate in and allocate budget to the CETP. Total pledged funding contributions from the countries involved countries are approx. €500 million as of November 2020. Dr. Rønneberg stated that of the several challenges formalized in the CETP, the one relevant to CCUS is "Enabling Climate Neutrality with Storage Technologies, Renewable Fuels and CCU/CCS". In particular, CCU/CCS technologies will need to be deployed and scaled to maximize carbon reuse and to remove carbon from the energy system, especially from hard-to-decarbonize sectors. Dr. Rønneberg concluded her presentation by providing an overall timeline for the CETP. An initial work plan will be developed this year (June-August time frame) and the consortium agreement finalized for member country signing by about October. Concurrently, development of the CETP implementation plan is scheduled to start in August with a formal proposal to the European Commission for its formation, followed by its first joint Call (set for early 2022). There will also be several milestones for financial contributions from member countries, with the first of them anticipated to occur in the 3rd quarter of 2021.

During ensuing discussion, CEM CCUS Initiative Secretariat Juho Lipponen inquired if collaboration with India had occurred under ACT or similar initiatives. Dr. Rønneberg replied that India has been engaging the CCS community and they are a welcome presence. Mark Ackiewicz, Technical Group delegate from the United States, then complimented Dr. Rønneberg and the Research Council of Norway for their leadership on the ACT program and stated that participation in it has been a positive experience for the United States.

4. Carbon Capture, Usage and Storage in the United Kingdom

Ed Howe, representing the United Kingdom's Department for Business, Energy & Industrial Strategy (BEIS), provided a high-level overview of UK Government's support for current CCUS activities and its proposed next steps. Earlier in April, the UK Government committed to set into law a climate change target that would, by 2035, cut its greenhouse gas emissions by 78% as compared to 1990 levels. For CCUS in the UK, the government's current ambition is to capture and store 10 million tonnes of CO₂ per year by 2030. Mr. Howe stated that there is a commitment to invest up to £1 billion within the next several years to facilitate the deployment of CCUS in two industrial clusters by the mid-2020s and a further two clusters by 2030, in areas such as the North East, the Humber, the North West, Scotland, and Wales. There is also a new £240 million Net Zero Hydrogen Fund to support the UK's ambition of producing 5 GW of low-carbon hydrogen production capacity by 2030.

Concerning CCUS, Mr. Howe stated that there were three program objectives: establishing a new CCUS sector, enabling low-cost decarbonization in multiple sectors, and developing a market for carbon capture. To enable this, it was stated that the UK is developing a specifically-tailored set of business models and mechanisms for support of different areas within CCUS: CO₂ transport and storage, industrial CCUS, hydrogen production, CCS in the power sector, and bioenergy with CCS. To that end, in March 2021 the UK Government announced £171 million to fund front-end engineering design (FEED) studies for nine projects as part of an "Industrial Decarbonisation

Challenge”. Three of these projects are offshore storage sites for CO₂ (in the North West, the North East, and Scotland). The others are CO₂ capture and/or hydrogen production projects in the North West, Scotland, Teesside, Humberside (two projects), and South Wales. Mr. Howe stated that the Industrial Decarbonisation Challenge is part of the Industrial Strategy Challenge Fund (ISCF), which aims to reduce the carbon footprint of heavy and energy-intensive industries such as iron and steel, cement, refining, and chemicals.

As for investment models for implementing transport and storage (T&S) networks within the CCUS chain, Mr. Howe described a proposed “User Pays” system which would provide a stable and predictable revenue stream. Under this “T&S Regulatory Investment (TRI) Model”, T&S fees would be paid by users to a proposed T&S entity, T&SCo, for use of a T&S network. Additional funds in support of this system would be obtained from consumer fees and/or through tax revenue. There would also be a separate Government Support Package (GSP) to address market failure for investing in the T&S network due to high-impact low-probability risks that the private sector would not be able to bear, or where commercial insurance is either unavailable or at not available at an efficient price. GSP should act as last-resort protection for two limited scenarios: remote leakage events and stranded assets (should T&S network assets someday become redundant or be deemed uneconomic).

Mr. Howe also provided information about CCUS investment business models specific to power and industrial applications, based on Contract for Differences (CfD) concepts. For the power sector, a Dispatchable Power Agreement (DPA) would be established between the CCUS utility-based project and a government-owned Low Carbon Contracts Company (LCCC). Some of the revenue to the utility company would come from the LCCC based on the availability of low-carbon generation capacity. For the industrial sector, the objective for developing a CCUS business model is to incentivize investment in carbon capture technologies for both new and existing industrial facilities. To achieve this, the UK Government is proposing support via capital grants partially funded by government and private investment, and also via operating revenue support which would subsidize over the lifetime of an Industrial Carbon Capture (ICC) contract as carbon prices increase and a low carbon products market develops. Mr. Howe also stated that the UK Government intends to create a business environment for a future low-carbon hydrogen economy as well, as this will be necessary in order to achieve net-zero carbon by the year 2050. For that to occur, broad policy frameworks will be needed to support hydrogen production technologies and projects, and also to develop a supply chain.

Mr. Howe ended his presentation by describing near-term policy-related actions being taken by the UK Government concerning CCUS. Some of these are to update existing TRI and DPA models, and to begin consultations toward an initial Hydrogen Business Model and T&S decommissioning.

During ensuing discussion, there was an inquiry by Ryozi Tanaka, Technical Group delegate from Japan, that in light of the recent Brexit from the European Union, would the United Kingdom still be able to access EU funding mechanisms in support of its CCUS-related activities. Mr. Howe replied that he could not at present provide an answer.

(Note: Subsequent to the meeting, Mr. Howe informed the Technical Group of a UK Government website which provides guidance concerning EU funding for UK projects and activities: <https://www.gov.uk/guidance/getting-eu-funding>)

5. Update from the Clean Energy Ministerial (CEM) CCUS Initiative

Juho Lipponen, Secretariat of the CEM CCUS Initiative, made a short presentation which described recent and upcoming activities of the organization, and also gave a preview of the upcoming 12th CEM meeting to be hosted by the Government of Chile from 31 May through 04 June 2021. Concerning the 12th CEM meeting, Mr. Lipponen stated that there will be three side events of interest to the CCUS community:

- “CCUS Basics” will provide the current status of CCUS technologies and projects for a generalist clean energy audience. This will consist of pre-recorded briefings (10 minutes) followed by a live panel (20 minutes).
- “Ministerial Fireside Chat” will be moderated by CEM CCS Initiative co-lead Jarad Daniels of the United States delegation. This will be a pre-recorded panel (30-40 minutes in duration) with 3-4 CEM Ministers which will discuss leading CCUS policy developments and ambitions going forward.
- “Testimonies” will consist of three brief testimonies (15 minutes total duration) from senior executives of leading financial institutions and industry on the role of CCUS in their clean energy investment portfolio, including key recommendations for policy makers.

Besides these, there will be several other inputs to attendees of the meeting including an update about the new 2021 CSLF Technology Roadmap (TRM), a briefing about the TRM for policy-makers, and a progress report on the CEM CCUS Initiative.

Mr. Lipponen then gave a short summary of recent CEM CCUS Initiative activities. Virtual events where the organization has had a presence or active role have included an Asia CCUS Network / ERIA event (November 2020), the CCUS2020 conference (December 2020), the Society of Petroleum Engineers South East Asia Carbon Management Conference (December 2020), the CEM CCUS OGCI Finance Sector Convention (January 2021), and a South Africa focus meeting (April 2021). Recent webinars have included “CCUS in the Netherlands” (December 2020), “CCUS for the Cement Sector” (January 2021), “CCUS in the EU Green Deal” (February 2021), and “CCUS & Environmental, Social and Governance (ESG)” (April 2021). Mr. Lipponen also cited two ongoing industry and finance collaborations that the CEM CCUS Initiative is involved in. One of them is with the OGCI, which has resulted in the aforementioned Finance Sector Convention that was attended by more than 70 representatives from governments, industry, and the finance sector and had a focus on investment opportunities in Canada and Europe. There is also the “Finance Sector Lead Group for CCUS” that the CEM CCUS Initiative launched last year which is involved in active dialogs with about 25 banks and financial institutions. This group was the organizer of the aforementioned webinar on “CCUS & ESG”.

Mr. Lipponen concluded his presentation by providing a brief look ahead at some of the CEM CCUS Initiative’s upcoming events and activities. One of them is the “Global CO₂ Storage Capacity Assessment” which is intended as a broad analysis and will be undertaken by geological survey organizations and experts. The CEM CCUS Initiative will facilitate, promote, and ‘spearhead’ the project. There will also be a second OGCI Finance Sector Convention, this time focused on Asia and co-hosted with the Asian Development Bank, which has been tentatively scheduled in June alongside the upcoming Asia Clean Energy Forum 2021 event. Other upcoming events include a “Carbon Pricing Conference” scheduled for June, a CCUS side event (co-sponsored with the Asian Development Bank) at the Asia Clean Energy Forum 2021, and another Society of

Petroleum Engineers symposium on CCUS, scheduled for September 2021. There will also be several more webinars on topics related to CCUS.

During ensuing discussion, Technical Group Chair Åse Slagtern noted that a two-page summary of the TRM was very recently prepared by the CEM CCUS Initiative in collaboration with the Technical Group, but it has not yet been shown to Technical Group delegates. Sallie Greenberg, Technical Group delegate from the United States, followed up on the proposed “Global CO₂ Storage Capacity Assessment” by mentioning that this would be a good example of an activity where Technical Group and CEM CCUS Initiative could work together. Jarad Daniels then stated that it might be useful to hold an informal scoping meeting on this topic, which could perhaps be organized by the IEAGHG.

6. Update on the CSLF Projects Interaction and Review Team (PIRT)

United States delegate and PIRT Co-Chair Sallie Greenberg gave a short progress report about the PIRT and how it will function as a permanent standing committee of the Technical Group. At the previous videoconference meeting of the Technical Group, in September 2020, there had been agreement on five newly-formulated objectives for the PIRT:

- Revitalize and increase momentum for the PIRT;
- Facilitate the next set of projects by providing resources and connections with previous/current projects;
- Leverage learnings from R&D and commercial projects;
- Align projects with CSLF knowledge sharing platform; and
- Act as a resource and facilitator for newly joined projects.

The PIRT Co-Chairs have also developed three broad and near-term intended actions which will assist in realizing those objectives:

- Review the projects the CSLF recognizes and improve the process for how projects are recognized.
- Reinforce the value of projects to CSLF and its stakeholders (in particular the CEM).
- Reinvigorate project recognition within the CSLF.

For the “Review” action, Dr. Greenberg stated that in the months following the September 2020 Technical Group videoconference meeting, a review was conducted (with the assistance of the CSLF Secretariat) on the portfolio of current CSLF-recognized projects. The findings were that a total of 65 Projects recognized from 2004-2018, of which 23 (or 35%) are complete, 30 (or 46%) are active or near completion, and 12 (or 18%) were discontinued or otherwise ended without completion. Based on this compilation, Dr. Greenberg stated that several things can be done to improve the project recognition process in terms of its overall value to the Technical Group. This “Reinforce” action would introduce seven “Criteria Categories” to the project selection process: Stage of Completion; Region; Scale; Technology; Technology Readiness Level (TRL); Commercial Contribution; and Unique Characteristics. Additionally, the project recognition process should result in future CSLF-recognized projects being ‘aligned’ more closely to the CSLF Technology Roadmap. To that end, the PIRT Co-Chairs are recommending that the CSLF Project Submission Form be revised by requesting additional information in three specific areas:

- Project Description and Relevance:
 - How is your project adding to the global body of CCUS knowledge?
 - What do you anticipate learning from this project?
 - How is this project leading toward commercialization of CCUS?
- Project Description (Technical):
 - What stage is this project at? [prefer FEED or later]
 - What TRL is this project demonstrating?
- Novel Aspects of Project
 - What, if any, new or novel project aspects are you anticipating in the policy, legal, or regulatory arenas?
 - What, if any, new or novel project financing mechanisms or business models are you engaging?
 - What technological contribution is this project making?

Dr. Greenberg stated that these proposed changes were part of the “Reinvigorate” action which would make the PIRT a more streamlined activity going forward in terms of its focus. The PIRT would more actively manage the project recognition process by proactively inviting projects to apply (though self-nomination by project sponsors, as has been past practice, will still be very much welcome). To that end, CSLF delegates will be encouraged to seek out and propose projects for CSLF recognition, using a targeted approach that aligns with the CSLF Technology Roadmap.

Dr. Greenberg ended her presentation by stating that the Co-Chairs are not recommending any changes to the existing PIRT Terms of Reference. As for next steps, the existing Project Submission Form will be updated and sent out to Technical Group delegates for review and comment. As for projects that have already been recognized by the CSLF, a new “Exit Interview” strategy will be established to gain insights into learnings, pitfalls, and successes, even for projects which do not go to completion.

During ensuing discussion there was consensus for the PIRT to proceed with its activities plan as outlined in Dr. Greenberg’s presentation. There was also agreement that the Secretariat would send the updated Project Submission Form to Technical Group delegates for review and comment.

7. The New CSLF Technology Roadmap (TRM)

Norway delegate and TRM editor Lars Ingolf Eide gave a detailed presentation about the new version of the TRM, which had been completed in the months following the September 2020 Technical Group videoconference meeting. Mr. Eide began by describing the reasoning for why a TRM revision was deemed necessary. It had been four years since the previous version was published, and since then advancements and general progress have created new areas of focus and emphasis for CCUS. Specifically:

- Several documents that emphasize the importance of CCUS have been issued.
- A large number of reports and peer reviewed articles have been published.
- The interest in CCUS has shifted from pure technology development to integration, scaling up, utilization issues, as well as CO₂ removal.
- Clean hydrogen has emerged as an important factor to reduce CO₂ emissions.
- Governments are ready to invest in CCUS, as seen in the United Kingdom, Norway, the Netherlands, and other countries.

Mr. Eide then described what was new in the 2021 TRM. There have been many significant changes:

- Time horizons were changed from 2025 and 2035 to 2030 and 2050, as these are the timelines that are now being used in policy documents globally.
- Targets for CO₂ storage are now more qualitative than exact quantitative.
- Section 2 has been updated with new scenarios from the International Energy Agency (IEA).
- Definitions of CCS, CCU, and CCUS have been adjusted for consistency with IEA.
- Chapter 3 includes updated sections on power, industry, and RD&D as well as expanded sections on hydrogen with CCUS, CO₂ hubs, industrial CCUS, and CO₂ utilization. There is also a new section on negative emission technologies (NETs).
- The Policy and Incentives section has been expanded.
- Some relevant national CCUS strategies have been added as Appendix B.

Mr. Eide proceeded to briefly describe the main findings from the TRM:

- Many countries have reported ambitious plans to achieve new net zero emissions targets. However, analyses by the United Nations in February 2021 show that the world is not on track to reach the targets of the Paris Agreement of keeping the anthropogenic temperature rise to well below 2°C, and preferably close to 1.5°C, by the end of the 21st century.
- CCUS will absolutely be necessary in order to meet the targets of the Paris Agreement.
- CCUS is proven technology, and there has been progress in many aspects of CCUS since the 2017 edition of the TRM.
- The deployment of CCUS lags behind what is required even in the scenarios of IPCC and IEA with highest ambitions on the implementation of other sustainable measures.

Additionally, Mr. Eide stated that the TRM emphasizes concern for the challenging deployment pathway for CCUS in the coming decades, based on the IEA Sustainable Development Scenario (SDS) which aims for net zero emissions by 2070. Specifically, by 2030 the isolation of CO₂ from the atmosphere via CCS should increase by a multiplication factor of about 10-15 from the 2020 level of 40 million tonnes of CO₂ per year. And by 2050 the isolation of CO₂ from the atmosphere via CCS should increase by a factor of 100 or more from the 2020 level of 40 million tonnes of CO₂ per year. To achieve net zero by 2050 instead of 2070, the overall annual CCS amount will need to be 40% greater yet.

Mr. Eide closed his presentation by describing the TRM's recommendations, which fall under three broad categories:

Technology Development, Innovation and Cost Reduction

- Investing heavily in transformational RD&D to:
 - Reduce capture costs by 25% from the 2020 benchmark;
 - Bring enabling and emerging capture technologies to Technology Readiness Level 7 or above (i.e., pilot and demonstration scales);
 - Reduce storage monitoring and verification costs by 25% relative to 2020;

- Mature sustainable utilization and negative emission technologies to meet a low carbon or “green” standard; and
- Develop novel, emerging and enabling technologies along the whole CCUS chain.
- Making investments in public private partnerships or projects that continue to develop and mature promising CO₂ utilization technologies.
- Continuously transferring knowledge from existing large-scale projects to new projects.

Strategic Build-out of CCUS Projects and Hubs

- Bringing into operation all projects under development today, or an equivalent volume of carbon capture capacity.
- Rapidly identifying, planning, and building out of strategic power and industrial CO₂ capture clusters, to ensure a 10-fold increase of industrial production facilities and power and heat plants.
- Continue to identify and mature hubs.
- Implementing CCUS at a substantial fraction of fossil fuel hydrogen production facilities.
- Ensuring that sufficient CO₂ storage sites be characterized and developed, and necessary permits obtained.

Development of Strategy, Policy, Legal, and Financial Frameworks

- Implementing policies to mitigate the impacts of climate change.
- Ideally defining the role that CCUS can hold in a portfolio of responses.
- Developing national or regional CCUS strategies and implementation plans.
- Developing incentive frameworks, business models and risk sharing mechanisms that will enable CCUS projects to be financeable.
- Implementing legal, regulatory, and accounting frameworks to ensure safety and environmental integrity of CCUS.
- Implementing frameworks to enable cross border transport of CO₂ for storage purposes.
- Communicating the importance of CCUS.
- Sharing of best practices to foster cost reduction and to help countries and industries accelerate CCUS investment.

Mr. Eide ended by acknowledging the many people who had contributed to this new version of the TRM. During ensuing discussion, Mr. Eide stated that the document had been previewed a few days earlier at the CEM CCUS Initiative videoconference meeting and that as a result, there would be a few changes based on suggestions received. Once those are incorporated, the TRM will be declared final and closed to any further changes. The Secretariat will post the TRM to the CSLF website once it is ready.

8. Technical Group Strategic Planning

United States delegate Mark Ackiewicz gave a brief presentation that described the results of a recent survey of Technical Group delegates and Allied Organization representatives. The purpose was to gather information that could assist the Technical Group in strategizing where and how it can be most impactful in its activities. At the

September 2020 Technical Group videoconference meeting, discussion had centered around three specific areas:

- How can the Technical Group contribute to broader CCUS discussions?
- What can the Technical Group do to facilitate advancement of CCUS by industry and governments?
- To those ends, what new Technical Group activities would be useful? What and where are the opportunities?

Mr. Ackiewicz stated that there had been much discussion which emphasized the two areas of knowledge sharing and increasing technical expertise via capacity building. As a follow-up, the survey was formulated as an information request, and was comprised of nine questions. The Secretariat sent it out via email to delegates for all CSLF members (25 countries and the European Commission) as well as representatives of the three Allied Organizations (the CO₂GeoNet Association, the IEAGHG, and the Global CCS Institute), and there were 15 responses received which represent the views of 11 countries. A summary of these questions and their responses is as follows:

Q1. Does your country have regulations or incentives to curb CO₂ emissions?

There were 13 ‘yes’ and 2 ‘no’ responses. The ‘yes’ responders cited several different examples: Emissions Trading Scheme, Economy wide or semi economy wide; Tax incentives; Regulations or standards.

Q2. Does your country have a regulatory framework in place for CO₂ injection into the subsurface?

There were 10 ‘yes’ and 5 ‘no’ responses.

Q3. What CCUS R&D or technical capabilities exist within your country?

Nearly all responses mentioned university or industry-level R&D. Various cited were pilots, test facilities, and commercial or demonstration projects.

Q4. Which technical topics are of most interest to your country?

There were 10 choices available and respondents were requested to choose up to 5 of them. Results fell into three ‘tiers’, ranked by popularity. Tier 1 included CO₂ capture at industrial facilities and carbon utilization. Tier 2 included negative emissions technologies, CO₂ storage in offshore saline formations, CO₂ storage in onshore saline formations, and CO₂ storage monitoring and verification (M&V). Tier 3 included capture at power generation facilities, enhanced offshore oil and gas (O&G) production, enhanced onshore O&G production, and CO₂ storage modeling / simulation.

Q5. Which impediments exist to successful deployment of CCUS in your country?

This was also a multiple-choice question, and once again the responses fell into three ranked tiers. ‘No market/demand for CO₂’ was such a prevalent response that it was the only entry into Tier 1. Tier 2 included lack of government support for demonstration projects and R&D; lack of educational opportunities at universities and academic institutions; and “other” (which includes lack of general technology awareness, lack of government willingness to deploy technologies and its role in greenhouse gas mitigation). Tier 3 included lack of public acceptance; insufficient human resource capabilities; insufficient technical capabilities; no CO₂ emissions regulations; and no CO₂ storage regulatory framework.

Q6. Which CSLF activities do you find most useful?

‘Workshops’ was the most common response. The TRM, task force activities and reports, and updates from CSLF-recognized projects were also mentioned.

Q7. How would you like to engage with other CSLF member countries?

This was another multiple-choice question, and once again the most common answer was ‘workshops’, as these have been very popular the times they have been staged alongside Technical Group meetings. Other responses were collaboration via CSLF task forces; jointly-funded R&D; more interactive technical exchanges between CSLF member countries for the benefit of researchers, policymakers, etc.; and engagement of academic institutions in CSLF member countries. In particular, academic engagements have been found to be helpful in terms of building the capacity within countries but need to be targeted efforts. Also, updates on CCUS activities from CSLF member countries, which are agenda items in every Technical Group meeting, are very useful in terms of knowledge sharing.

Q8. For R&D or technical capabilities of interest to you, please provide comments on how CSLF can further help you and/or your country accelerate CCUS development and deployment within your country.

There were many different ideas proposed, including: Linking with storage infrastructure projects such as Longship. Leveraging research/laboratory infrastructure, as an example the European Carbon Dioxide Capture and Storage Laboratory Infrastructure (ECCSEL). The CSLF organization has considerable knowledge that needs to be transferred to CEM Ministers. The CSLF can be a platform to share knowledge and experience, for instance via lessons learned from large-scale projects, standardization or results from test facilities, and more time at meetings devoted to discussion time on CSLF members’ CCUS activities. Stronger influence on the CSLF Policy Group/CEM CCUS Initiative. Regionally-focused workshops as well as local events for policymakers, industry, academia, and governments.

Q9. Does the CSLF provide you enough opportunities to participate and contribute? How can the CSLF help to enhance your membership experience?

There were several responses, and they covered a broad cross-section of Technical Group interests: “It would be good for the CSLF to push for projects rather than just wait for projects to happen.” “Guiding/feedback on how to engage more active member countries would be beneficial.” “More discussion time amongst members is needed to help understand key issues, resources, etc.” “Yes, it is an excellent opportunity for international discussion on topical strategic issues including research community, industry, academia, governments.” “CSLF provides the opportunities but needs more active involvement from all. That would help to enhance the membership experience.” “More engagement with stakeholders.”

Mr. Ackiewicz ended his presentation by stating that the information received in responses to the survey has been very insightful and much appreciated, and invited delegates who had not answered the survey to add their own responses. The next step will be to develop a brief summary paper with recommendations for future Technical Group actions. The work on this activity was done by the two co-chairs: Mr. Ackiewicz and Canada delegate Eddy Chui. There was an invitation for others to join, and as a result United States delegate Sallie Greenberg and Norway delegate Lars Ingolf Eide both volunteered to participate.

9. Updates from Allied Organizations

Ceri Vincent, President of the CO₂GeoNet Association, gave a short presentation about the organization and its activities. CO₂GeoNet is a pan-European research association for advancing geological storage of CO₂. Ms. Vincent stated that membership is now comprised of 27 research institutes from 21 countries, uniting more than 300 researchers having multidisciplinary expertise needed to address all aspects of CO₂ storage. These include research & networking, scientific advice & international collaboration, training & capacity building, and information & communication. Ms. Vincent stated that the CO₂GeoNet Winter Webinar was held at the beginning of February and included sessions on the status of European forerunner projects, emerging CCUS technologies, and the ongoing Enabling Onshore CO₂ Storage in Europe (ENOS) project. There were several key messages that resulted, including one which specifically resonates with the new CSLF TRM: “Increased ambition (2030) and long term perspective (2050): zero or very low carbon technologies and business concepts need to be developed and tested at scale in this decade.” Ms. Vincent then informed the Technical Group that CO₂GeoNet is working on a “State of Play on CCS” document which will be forthcoming soon and will have contributions from 32 European countries. There will be chapters on national policies and climate strategies, national legislation and regulations with respect to CO₂ geological storage, CCUS projects and test sites in Europe, research activities with respect to CCS, and public engagement. Ms. Vincent also briefly mentioned CO₂GeoNet’s involvement in the Hydrogen Storage in European Subsurface (HyStorIES) project and that through the ENOS project, CO₂GeoNet members had initiated a MSc program in CO₂ Storage which is now open for applications for the next academic year.

Tim Dixon, General Manager of the IEAGHG, then gave a short presentation about the organization and its continuing collaboration with the CSLF’s Technical Group. The IEAGHG was founded in 1991 as an independent technical organization with the mission to provide information about the role of technology in reducing greenhouse gas emissions from use of fossil fuels. The IEAGHG’s 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 (more than 350 reports published on all aspects of CCS), the six international research networks about various topics related to CCS, and the Greenhouse Gas Control Technologies (GHGT) conferences. The most recent GHGT conference was staged entirely online in March 2021, had 956 delegates from 41 countries, and included more than 500 presentations. Papers from the conference will be made available online soon, and summary report is being prepared. Mr. Dixon stated that other IEAGHG activities include its annual International CCS Summer School (the one for 2021 will be conducted entirely via the Internet due to the continuing world health crisis; the next in-person one is now scheduled for 2022, in Indonesia), webinars on various aspects of CCS, and peer reviews with other organizations. The IEAGHG is also actively participating in international regulatory organizations such as the UNFCCC, the ISO TC265, and the London Convention, and has been involved as an expert reviewer for Intergovernmental Panel on Climate Change 6th Assessment Report (IPCC AR6). Besides these, the IEAGHG has ongoing collaborations 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. Two recent IEAGHG reports related to the Technical Group were on the Hydrogen Production with CCS workshop (which was held alongside the Technical Group's November 2019 meeting in France) and on the CSLF-cosponsored 4th International Workshop on Offshore CCS (which was held in Norway in February 2020). Mr. Dixon concluded his presentation by showing lists of reports recently published as well as recent webinars and information papers.

Dominic Rassool, Senior Consultant – Policy and Finance for the Global Carbon Capture and Storage Institute (GCCSI), concluded this agenda item by providing a brief summary of the global status of CCUS. Currently there are 66 commercial facilities including 26 that are operating, four under construction, 34 under development, and two that have suspended operations. Collectively, the 26 operating projects capture approx. 40 million tonnes of CO₂ annually. Concerning CO₂ transport infrastructure, the total pipeline capacity has been steadily increasing over the past decade, from about 13 million tonnes of CO₂ annually in 2010 to nearly 40 million tonnes of CO₂ in 2020. There are several drivers which are giving enhanced importance to CCUS, one of them being the expectation that there will be more stringent climate policies in many if not most countries of the world. Mr. Rassool then briefly described recent GCCSI activities, which include publication of three new reports: “Financing CCS in Developing Countries”, “Technology Readiness and Costs of CCS”, and “Blue Hydrogen”. Other reports still in preparation are on the topics of “Preliminary Global CCS Hub Opportunity Identification & Hub Optimisation Case Study”, “CCS Policy & Regulation Recommendations”, and “Funding CCS at scale”. Mr. Rassool stated the GCCSI has held five recent ‘virtual’ events, including one on “Building Momentum for CCS in the GCC and around the World”, and is preparing for several others which will be held in the near future (including a multi-part series on “UK CCS Hubs and Clusters”). Mr. Rassool concluded his presentation by briefly describing several of the GCCSI's member services which include quarterly updates on the global status of CCUS, hosting the SE Asia Roundtable and Australia CCS Working Group, and maintaining / enhancing CO₂RE (a database which contains key information and data related to the global deployment of CCS). The GCCSI has welcomed 12 new members since January 1, which reflects the burgeoning diversity of CCS ecosystem, and has announced that it will soon be opening an office in Abu Dhabi.

10. Summary of Meeting Outcomes

The CSLF Secretariat, Richard Lynch, provided a brief summarization of the five outcomes from the meeting. They are listed below.

11. Closing Remarks / Adjourn

Technical Group Chair Åse Slagtern thanked the invited speakers for their presentations, the delegates and other attendees for their active participation, and the Secretariat for its pre- and post-meeting support. She then adjourned the meeting.

Summary of Meeting Outcomes

- The PIRT will implement new procedures concerning project recognition and proceed with proposed activities as described in its presentation.
- The Secretariat will send a draft of the revised Project Submission Form to Technical Group delegates for review and comment.

- The TRM will be slightly revised based on comments received from the CEM CCUS Initiative when it was previewed at their meeting.
- Once final adjustments are complete, the Secretariat will post the TRM to the CSLF website.
- The Strategic Planning Committee (co-chaired by the United States and Canada) will prepare a summary of information received from its survey of Technical Group delegates.