Measuring progress on Recommendations from 2017 CSLF Technology Roadmap Report from Ad Hoc Committee

Sallie Greenberg, USA, & Lars Ingolf Eide, Norway

Champaign, Illinois, USA
26 April, 2018
Background

Obligations from the TRM:

- Monitor the progress of the Recommended Priority Actions.
- Report the findings at Ministerial meetings.
- Suggest adjustments and updates for the TRM.

Venice April 2018: A small working group was formed to start work on monitoring. Volunteers included Australia, Canada, the United Kingdom, the United States, Norway, the Technical Group Chair, and the CSLF Secretariat.
The objective of monitoring

• Find and implement corrective actions where progress is slow

Progress of *ad hoc* committee

• Questionnaire distributed
• Results presented in Melbourne
• Template developed for reporting on progress
• Members of *ad hoc* committee prepared background information
• Members of *ad hoc* committee agreed on progress status
What was monitored

Target

- Long-term isolation from the atmosphere of at least 400 megatonnes (Mt) CO₂ per year by 2025 (or have permanently captured and stored of 1,800 Mt CO₂).
- Long-term isolation from the atmosphere of at least 2,400 Mt CO₂ per year by 2035 (or have permanently captured and stored of 16,000 Mt CO₂).

Four priority recommendations

1. Facilitate CCS infrastructure development.
2. Leverage existing large-scale projects to promote knowledge-exchange opportunities.
3. Drive costs down along the whole CCS chain through RD&D (including more detailed technical recommendations in Annex B).
4. Facilitate innovative business models for CCS projects.
Ratings

Good, the progress contributes to reaching the Target

Room for improvement, progress registered but insufficient to reach target unless new actions are initiated

Poor progress, target will not be reached. Strong actions required
Result Target

• Each recommendation is in itself not sufficient for the target to be reached. Thus the target may still be red even though none of the priority recommendations are.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term isolation from the atmosphere of at least 400 megatonnes (Mt) ( \text{CO}_2 ) per year by 2025 (or have permanently captured and stored of 1,800 Mt ( \text{CO}_2 ))</td>
<td>Need 10-fold increase in annual storage capacity next six years. Only one plant came online in 2018 (CNCP Jilin, China), increasing capacity by 1 Mt ( \text{CO}_2 )/y to 38 Mt ( \text{CO}_2 )/y. Projects in construction may add 7+ Mt ( \text{CO}_2 )/y in 2019. Projects in advanced or early development will not add sufficient capacity by 2025, only 35 - 40 Mt ( \text{CO}_2 )/y.</td>
</tr>
</tbody>
</table>
### Results on Priority Recommendations

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Rating</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Facilitate CCS infrastructure development.</td>
<td>![Red Light]</td>
<td>Many good plans and studies but no infrastructure/network projects on line the last years; no project passed the Final Investment Decision (FID) gate in 2018</td>
</tr>
<tr>
<td>2. Leverage existing large-scale projects</td>
<td>![Green Light]</td>
<td>Active leveraging through CSLF meetings, International Knowledge-Sharing Center, conferences, and reports. Not known which projects have used experience/knowledge from other projects.</td>
</tr>
<tr>
<td>3. Drive costs down along the whole CCS chain through RD&amp;D.</td>
<td>![Yellow Light]</td>
<td>Much good research going on that progress CCUS technologies but no break-through technologies reported or identified that at TRL 6 or higher have convincing evidence of significant cost reductions</td>
</tr>
<tr>
<td>4. Facilitate innovative business models for CCS projects</td>
<td>![Yellow Light]</td>
<td>Many good plans and studies but progress on development of bussiness models have not been implemented, except 45Q in the US, perhaps due to lack of policy and regulatory environment</td>
</tr>
</tbody>
</table>
Recommendations to Ministers

• **Foster a predictable business environment for development of large-scale CCUS projects.** Include policy and financial incentives, a practical regulatory environment, cost- or risk-sharing for early stage demonstration or commercial-scale projects, and stimulating cross-business and cross-border cooperation.

• **Facilitate (e.g., through co-funding) cross-industry projects** to ensure lowest total cost for the combined capture, transportation, utilization and/or storage infrastructure and networks.

• **Continue to promote RD&D investments in CCUS to drive down costs:**
  – Continue to fund early stage R&D and encourage transformative technologies as well as incremental advancement to progress technologies to the pilot-scale.
  – Support continued RD&D efforts that promote commercial deployment and business opportunities for more advanced carbon utilization, in particular for early-stage technologies. Lifecycle analyses should continue to ensure that technologies result in net greenhouse gas emissions reductions.
  – Continue to promote global RD&D collaboration that leverages knowledge, capabilities, facilities and funding that further drives down costs and increases the availability of CCUS as a greenhouse gas mitigation option around the world.

• **Continue to promote knowledge-sharing from large-scale projects.** This is important in framing continued RD&D and informing the development and refinement of business models for CCUS deployment.
Possible future work mode

• Small groups of TG delegate (task forces?), each responsible for following up and reporting on one of priority recommendations

• Approach should include:
  • Involving CSLF members Cooperation with allied organizations and others (GCCSI, IEAGHG, International CCS Knowledge Center, IEA, CO2GeoNet,Mission Innovation), recognized CSLF projects
Possible future work mode

• Possible groups
  • Task Force on hubs and clusters follow up recommendations
  • Business models
  • Leveraging large scale
  • RD&D

• Reporting on status
  • Annually, or as required, to the CEM/ CSLF Ministerial Meetings
  • Results distributed to delegates at 1-2 months ahead of CSLF Technical Group spring meetings.
  • Delegates to give comments/supplements in writing ahead of meeting or orally at the meeting.
Information Sharing

• Clean Energy Ministerial Solutions website dedicated to CCUS
  • https://cleanenergysolutions.org/topic/carbon-capture

• Ask an Expert
• Reviewed Published CCUS Resources
• Attend a Webinar
  – Framework for CCUS in CEM
  – CCUS in Mexico for a Low Carbon Economy
Back up

Two examples
Target

• **Increase in storage capacity last year:**
  • ~ 1 Mt CO₂/year
• **Number of projects that came on line last year:**
  • One – 1.
• **Conclusion**
  • Need 10-fold increase in annual storage capacity next six years. Only one plant came online in 2018 (CNCP Jilin, China), increasing capacity by 1 Mt CO₂/y to 38 Mt CO₂/y. Gorgon and ACTL are delayed but may add 6 Mt CO₂/y in 2019. Only two other are in construction, both in China, total capacity 1+ Mt CO₂/y. Even projects in advanced or early development will not add sufficient capacity by 2025, only 35 -40 Mt CO₂/y.
• **Recommended actions to speed up:**
  • Increased efforts to get projects into planning, incentives must be put in place. International cooperation required
• **Sources:**
  • GCCSI
  • The Global Status of CCS, 2017
  • The Global Status of CCS, 2018
• **Reported by:**
  • Lars Ingolf Eide
2. Leverage existing large-scale projects to promote knowledge-exchange opportunities.

Actions during reporting period to leverage knowledge and experience from large scale projects

- The CSLF Technical Group is active in leveraging knowledge and experience from large-scale projects. From the past 5 years alone, CSLF Technical Group meetings or workshops have included the following activities to leverage knowledge and experience from large-scale projects:
  - April 2019 TG Meeting: Presentations from Project Tundra, ADM; Additionally, CSLF members are invited to attend the MGSC Annual Meeting, which includes discussion of the ADM project, including other activities such as CarbonSAFE projects in the region.
  - October 2018 CSLF Meeting in Melbourne, Australia: Gorgon, CarbonNET, Southwest Hub. Policy meeting also included an update on the Hydrogen Energy Supply Chain Project between Australia and Japan.
  - April 2018 CSLF Meeting in Venice, Italy: Update on MHI’s CDR process and commercial experience; Update on Fort Nelson Project; Norcem Carbon Capture Project.
  - December 2017 meeting in Abu Dhabi, UAE: Update on ROAD Project, Uthmaniyah project, Emirates Steel Project.
  - May 2017 CSLF meeting in Abu Dhabi, UAE: Emirates Steel Project, Uthmaniyah, ADM; Workshop in conjunction with that meeting: Emirates Steel, Shell Quest, Petra Nova, Boundary Dam; SABIC; Discussion of Full-scale CCUS activities in Norway.
  - October 2016 in Tokyo, Japan: More focused on large pilot/demo projects such as Tomokamai and NetPower.
  - November 2015 meeting in Riyadh, KSA: SABIC; Ministerial Meeting – Panel on large-scale CCUS projects: ADM, ROAD, Uthmaniyah, Occidental Petroleum’s CO2-EOR business case.
  - June 2015 meeting in Regina, Saskatchewan: Workshop on Lessons Learned from Large-scale projects: Presentations were from ROAD, ADM, Kemper, Quest; PCOR Bell Creek Project; Equinor (Statoil at that time); Boundary Dam (SaskPower); Dakota Gasification.
  - Highlight workshops from CSLF that had large-scale project engagement.

- In addition to the CSLF, there are numerous other activities that focus on leveraging knowledge and experience from large-scale CCUS projects.
  - International Knowledge-Sharing Center (SaskPower/Canada). Their entire mission is to support new global CCS projects with business development, operations, and technological improvements to advance the deployment of CCS facilities around the world.
  - CLIMIT Summit: Includes significant number or presentations on Norwegian projects such as Sleipner, Snohvit, and the full-scale CCS projects. Also includes broader global participation, which touches upon large-scale projects.
  - IEAGHG/GHGT Conferences. The GHGT-14 conference in Melbourne, Australia included the following sessions: Session 1C: Large-scale Integrated Projects Experience; Session 2C: Regional Projects (this session included Boundary Dam and also a previous US project: AEP’s Mountaineer Power Plant – Stratigraphic Test Well to Site Closure); Session 5C: Panel Discussion 3: From Projects to Infinity: Large-scale project experiences to be shared; Session 6C: Panel discussion 4: The status and potential of the Norwegian-EU CCS Project; There were also numerous other sessions that included results from large-scale projects, some very technical.

Projects that have used the experience

Conclusions

Identified bottlenecks for knowledge exchange

Corrective actions, if any, by CSLF to facilitate exchange of experiences between large-scale projects

Sources

Impact on TRM

Reported by