



Monitoring Progress on Recommendations from 2017 CSLF Technology Roadmap

**Status Report from
Ad Hoc Committee**

Lars Ingolf Eide, Norway

Chatou, Paris, France

November 5, 2019

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).

Five 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.
5. Facilitate Implementation of CO₂ Utilization

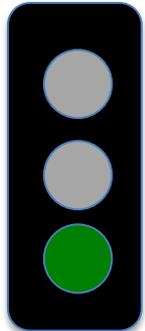
Champaign meeting



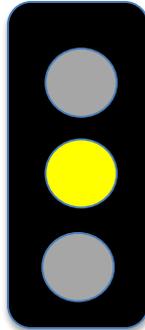
The overall objective is to identify and recommend corrective actions in areas where progress is slow and to report findings to CSLF Ministers.

- CCS infrastructure development. (Norway, with Lars Ingolf Eide as lead. Brian Allison [United Kingdom], Eddy Chui [Canada], Harry Schreurs [Netherlands], and Max Watson [Australia] also volunteered to assist.)
- Leverage existing large-scale projects. (PIRT, with Martine Woolf as lead. Max Watson [Australia], Eddy Chui [Canada], and the IEAGHG also volunteered to assist.)
- RD&D to drive down costs along the entire CCS chain. (Canada, with Mike Monea as lead. Eddy Chui [Canada], Pieter Smeets [Saudi Arabia], Max Watson [Australia], the CO2GeoNet Association, and the IEAGHG also volunteered to assist.)
- Innovative business models for CCS projects. (China, with Xian Zhang as lead. Mark Ackiewicz [United States], Eddy Chui [Canada], Lars Ingolf Eide [Norway], and Pieter Smeets [Saudi Arabia] also volunteered to assist.)
- Facilitate implementation of CO2 utilization. (United States, with Mark Ackiewicz as lead. Eddy Chui [Canada] and Pieter Smeets [Saudi Arabia] also volunteered to assist.)

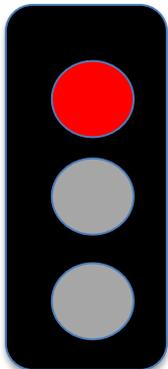
Ratings



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

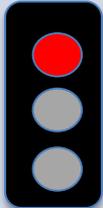
Result Target



	Rating	Comments
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)	A vertical traffic light with three circular lights. The top light is illuminated in red, while the middle and bottom lights are unlit and grey.	Need 10-fold increase in annual storage capacity next six years. Only one plant have come online since March 2019, the Gorgon project in Australia, increasing capacity by 4 Mt CO₂/y to 42 Mt CO₂/y. Projects in construction (Alberta CO₂ Trunk Line, ACTL) may add 2+ Mt CO₂/y in 2019. Projects in advanced or early development will not add sufficient capacity by 2025, only 35 -40 Mt CO₂/y.

Results on Priority Recommendation 1



Recommendation	Rating	Comment
<p>1. Facilitate CCS infrastructure development.</p>		<ul style="list-style-type: none"> • One CCUS network still in construction (ACTL), anticipated start up in late 2019, increasing capacity by 2 Mt CO₂ • No new projects passed the Final Investment Decision (FID) gate so far in 2019 • Some projects have received funding (Humber region/Drax; Clean Gas project/Teesside, Hynet) • A few projects have received funding for parts of the infrastructure chain, mainly to confirm feasibility of capture technology (Dunkirk, H21) or storage (Norwegian Full-scale) • New as well as continued interest in hubs, clusters and infrastructure is noted through new studies and workshops projects are still in the late pre-FEED phase, at best. <p><i>It is still possible that the TRM recommendation for 2025 for <u>infrastructure</u> may be achieved.</i></p> <p><i>The conclusion and recommendations from April 2019 report remain unchanged:</i> Progress on infrastructure development and expected contribution from infrastructure projects is lacking far behind what is necessary to reach the <u>storage</u> target for 2025. Strong action is required.</p> <ol style="list-style-type: none"> 1. The one infrastructure project in construction (ACTL) may add a capacity 2 Mt CO₂/y in the beginning of operation 2. Projects in advanced or early development may add up to 100 Mt CO₂/y by 2030 at best, but most likely less

Results on Priority Recommendation 2

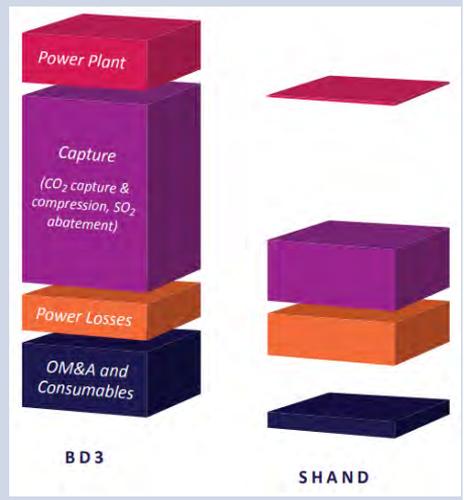


Recommendation	Rating	Comment
----------------	--------	---------

2. Leverage existing large-scale projects



Keep up the good work



Active leveraging through CSLF meetings and the International Knowledge-Sharing Centre. A report by the Centre shows that the Shand 2nd generation CCS facility will be able to reduce capture cost on a per tonne basis by 67% from the Boundary Dam 3 facility.

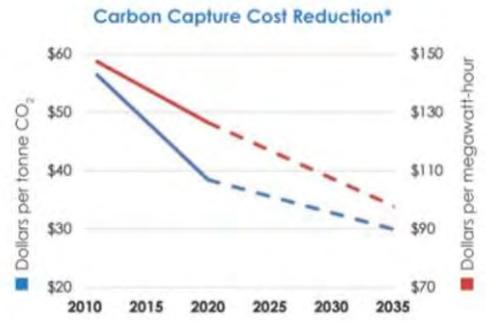
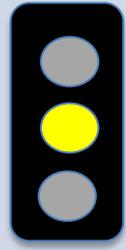
- Contingencies reduced future projects
- Some savings only realized after first of a kind
- Larger scales
- Modularisations
- Integration: The Shand 2nd Generation CCS study integration 92% less than for the BD3 project.
- Picking right plant, e.g. One that already have emission control equipment for SO_x etc
- Balancing cost and efficiency
- Amines: better understanding of health issues

Results on Priority Recommendation 3



Recommendation	Rating	Comment
----------------	--------	---------

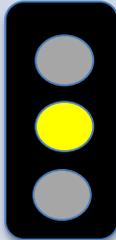
3. Drive costs down along the whole CCS chain through RD&D.



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.

- ITCN expanding
- Improvements under development by CCUS R&D community and private partners moving forward with commercial designs
- Cost of avoided carbon reduced projected cost of carbon capture from fossil generation by 1/3 using NCCC results
- NetPower has been demonstrating key components in the Allam Cycle in their 50 MWth Demonstration Plant in La Porte, Texas
- Oxyfuel: Some good reports from the Callide project in Australia, which was a small demonstration project. some progress on oxyfuel
- Carbon Engineering has received funds for demonstration and FEED work but once again there have been only smaller demonstrations of key portions of the technology
- More efforts needed to increase possibilities for testing at the large pilot and demonstration scale
- Funding is available for small projects, but not enough available for large scale.
- Emirates Steel is considering additional industrial carbon capture projects to add CO₂ to their EOR project.

Results on Priority Recommendation 4

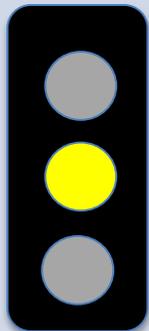
Recommendation	Rating	Comment
4. Facilitate innovative business models for CCS projects		<p>Initiative taken by China through CEM CCUS to map business models and incentive policies in member states. Excel template distributed.</p> <p>Other activities and documents:</p> <ol style="list-style-type: none"> 1. Consultation from UK BEIS on Business models for CCUS [1] 2. Market based frameworks for CCUS in the power sector. Report by Cornwall Insight [2] 3. Policy priorities to incentivise large scale deployment of CCS. Report from GCCSI [3]

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/819648/ccus-business-models-consultation.pdf

[2] [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/819348/Cornwall_Insight_WSP - Market based frameworks power CCUS.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/819348/Cornwall_Insight_WSP_-_Market_based_frameworks_power_CCUS.pdf)

[3] <https://www.globalccsinstitute.com/resources/publications-reports-research/policy-priorities-to-incentivise-large-scale-deployment-of-ccs/>

Results on Priority Recommendation 5

Recommendation	Rating	Comment
5. Facilitate Implementation of CO₂ Utilization		<ul style="list-style-type: none"> • Over 70 projects ranging from pilot to full-scale commercial operations. • Several of these projects have been completed while others are under construction. Further, these projects range in their scope of technologies from biological conversion of CO₂ (e.g., algae or other microorganisms) to mineralization and fuels and chemicals production via catalytic methods. • Some markets exist (e.g. EOR, fire suppression, urea). 45Q example of financial incentive. • Extensive interest from industry and governments. <p>CSLF take a more interactive approach between task force members and CSLF delegates/member countries, focusing on understanding:</p> <ul style="list-style-type: none"> • R&D (lab, bench, pilot-scale) interests and status within member countries • Commercial development/industrial-scale activities; and • Business development opportunities/mechanisms/incentives to facilitate utilization of anthropogenic CO₂ at commercial scale. To be cross-referenced with the Business Models Task Force.

Overall conclusion



- Update of the TRM monitoring shows no fundamental change in the conclusion from April 2019:
 - Only one priority recommendations is showing good progress, and the 2025 target will not be reached.
- 2035 target can still be reached BUT an extensive build out of CO₂ networks of hubs, clusters, utilization and transport infrastructure
 - This will require public-private co-funding of cross-industry projects



Role and future work of Ad Hoc Committee

Ad Hoc Committee Melbourne meeting Main areas of examination



1. Task Force utilization analysis (**1st step done**);
2. TRM recommendation analysis (**Champaign, Chatoux**);
3. Knowledge sharing recommendations (**part of 2, PIRT?**); and
4. Potential alignment of Task Forces with Academic, Communication, other, and outside organizations (**Done by TG proper**)

Ad Hoc Committee Melbourne meeting



- Collaborate with allied organizations, would be to jointly produce overview reports, hold workshops, and engage in other similar activities (**done, Venice may and this meeting**)
- The Ad Hoc Committee should continue its activities for the foreseeable future, as this is a very important Technical Group function.

Next steps



- Ad Hoc Committee carries on at least through May 2020 (CEM CCUS meeting) to learn impact we have
- TG reviews/defines mandate for Ad Hoc Committee
 - Only monitoring progress on the overall goals from the 2017 TRM?? Or also include
 - Knowledge sharing and assessment (new questionnaire?)
 - Other??
- TG reviews name of Ad Hoc Committee in light of mandate (Task Force Maximation =??)
- Ad Hoc Committee evaluates its working mode

Further work by Ad Hoc Committee



- Prepare annual updates and recommendations to the Policy Group and the CEM CCUS for their meetings in Abu Dhabi mid-January and the CEM Ministerial in Chile end May 2020
- Timeline:
 - Mid-December Draft for January status to CEM CCUS
 - January 14-15: Presentation to CEM CCUS
 - Mid-March 2020: Input from groups
 - Last week March/first week April 2020: Drafts of discussion paper and letter to the Policy Group and the CEM CCUS distributed to members
 - Third week April 2020: Annual update discussed and finalised at the April 2020 meeting
- Coordinate and cross-reference within the groups, in particular R&D, business models and utilization, before annual update