



## **CSLF Technology Roadmap (TRM) 2017**

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# Outline of presentation

- Acknowledgements
- Process
- Major changes from TRM 2013
- Findings and recommendations
- Next steps
- Points for discussion



## Acknowledgements

- TRM responsibility: CSLF Project Interaction and Review Team (PIRT).
- TRM was prepared by an editorial committee with the following members:
  - Andrew Barrett, Australia (Chair)
  - Brian Allison, UK
  - Eddy Chui, Canada
  - Tony SurrIDGE, South Africa
  - John Litynski, USA
  - Tim Dixon, IEAGHG
  - Richard Lynch, (CSLF Secretariat)
  - Åse Slagtern, Norway, CSLF Technical Group Chair
  - Lars Ingolf Eide, Norway (editor).
- Valuable input on the Executive Summary was received from Sallie Greenberg, University of Illinois, and Communications Task Force members Jeff Erikson, Tom Howard-Vyse, Ron Munson and Hamoud Otaibi.
- Amy Cutter, BEIS, UK, and Valerie Riedel, Energetics, suggested valuable improvements to language.
- A number of international experts and TG delegates have commented on and made contributions to the TRM.



# The Update Process

The approach for the update was:

- The CSLF Technical Group (TG) chair, co-chairs, task force leaders and Secretariat identified where changes from the TRM 2013 were needed
- The editorial group divided the work:
  - Capture – Norway
  - Transport and infrastructure – Norway
  - Storage – Australia
  - Monitoring – IEAGHG
  - Regulations - IEAGHG
  - Utilisation - USA
  - The first draft was sent to experts worldwide for comments and input



# Main changes from TRM 2013

## General

- New time horizon for medium- and long-term recommendations and targets,
  - 2025 and 2035 vs. earlier 2030 and 2050
  - Kept 2020 to emphasise the need for immediate acceleration
- Revised background chapter to reflect COP21 targets
- Introduced quantitative targets that meet IEA 2 °C scenario
- Added section on non-technical measures, including regulations
- Defined CCUS as subset of CCS



# Main changes from TRM 2013

## Capture (3.1)

- Less detailed on technology types and fundamentals
  - RD&D on novel, emerging, innovative or transformational technologies: Matter for Mission Innovation
- More emphasis on industrial and biomass CCS
- Separate section on sectors other than power
  - Industry and biomass
  - Hydrogen production w/CCS only topic so far
- Identified actions to meet technology needs:
  - Learning from experience (capture works)
  - RD&D on novel, emerging, innovative or transformational technologies



# Main changes from TRM 2013

## Transport and infrastructure (3.2)

- Expanded on ship transport
- More emphasis on development of clusters and hubs
- Few, if any, technology show-stoppers
- Technology needs
  - Most gaps, risks and challenges of commercial and policy nature
  - Must move from project-by-project to system thinking



# Main changes from TRM 2013

## Storage (3.3)

- Added recent reference projects and activities
- Additional actions to meet technology needs:
  - Expanded Monitoring, Offshore CO<sub>2</sub>-EOR, Storage integrity and Storage closure, including post-injection monitoring and liability
  - Methods and protocols: Changed from “development” to “demonstration”
  - Risk elements and needs are essentially still valid



# Main changes from TRM 2013

## Utilisation (3.4)

- Expanded and updated text, particularly on offshore CO<sub>2</sub>-EOR, geothermal energy systems, water recovery, bio-plastics and animal feed
- More detailed differentiation between the options that lead to permanent storage and those that do not
- Barriers added: Lack of scalability and the economic challenges
- Additional technology needs:
  - Large scale processes for conversion of CO<sub>2</sub> directly to fuels or other products, e.g. based on electro or photo catalysts



## Main Findings (1)

**Based on reviews of several status reports on CCS and technical papers, as well as comments and input from international experts, the main findings of this *Technology Roadmap 2017* are as follows:**

- CCS has been proven to work and has been implemented in the power and industrial sectors.
- The coming years is a critical period for CCS; therefore, a sense of urgency must be built to drive action.
- Substantial, and perhaps, unprecedented investment in CCS and other low-carbon technologies is needed to achieve the targets of the Paris Agreement.
- The main barriers to implementation are inadequate government investment and policy support/incentives, challenging project economics, and uncertainties and risk that stifle private sector investment.



## Main Findings (2)

**Based on reviews of several status reports on CCS and technical papers, as well as comments and input from international experts, the main findings of this *Technology Roadmap 2017* are as follows:**

- Rapid deployment of CCS is critical in the industry and power sectors, especially in those industries for which CCS is the most realistic path to decarbonization.
- Negative CO<sub>2</sub> emissions can be achieved by using a combination of biomass and CCS.
- Costs and implementation risks can be reduced by developing industrial clusters and CO<sub>2</sub> transport and storage hubs.
- Members of the CSLF consider it critical that public-private partnerships facilitate material and timely cost reductions and accelerated implementation of CCS.



## Priority Recommendations (1)

**Governments and industries must collaborate to ensure that CCS contributes its share to the Paris Agreement's aim to keep the global temperature increase from anthropogenic CO<sub>2</sub> emissions to 2°C or below by implementing sufficient large-scale projects in the power and industry sectors to achieve the following:**

- **Long-term isolation from the atmosphere of at least 400 megatonnes (Mt) CO<sub>2</sub> per year by 2025 (or permanent capture and storage of in total 1,800 Mt CO<sub>2</sub>).**
- **Long-term isolation from the atmosphere of at least 2,400 Mt CO<sub>2</sub> per year by 2035 (or permanent capture and storage of in total 16,000 Mt CO<sub>2</sub>).**



## Priority Recommendations (2)

**To this end, CSLF members recommend the following actions to the CSLF Ministers:**

- **Promote the value of CCS in achieving domestic energy goals and global climate goals.**
- **Incentivize investments in CCS by developing and implementing policy frameworks.**
- **Facilitate innovative business models for CCS projects.**
- **Implement legal and regulatory frameworks for CCS.**
- **Facilitate CCS infrastructure development.**



## Priority Recommendations (3)

- **Build trust and engage stakeholders through CCS public outreach and education.**
- **Leverage existing large-scale projects to promote knowledge-exchange opportunities.**
- **Drive costs down along the whole CCS chain through RD&D.**
- **Accelerate CCS in developing countries by funding storage appraisals and technology readiness assessments.**
- **Facilitate implementation of CO<sub>2</sub> utilization**



**Governments have a critical role in accelerating the deployment of CCS.**



## Follow-up (1)

- The CSLF should
  - Continue to be a platform for an international coordinated effort to commercialize CCS technology working with, amongst others, the IEA, the GCCSI, the IEAGHG, and Mission Innovation.
  - Through its Projects Interaction and Review Team (PIRT), monitor the progress in CCS in relation to the Recommended Priority Action, report the findings at the Ministerial meetings and suggest adjustments and updates of the Technology Roadmap.



## Follow-up (2)

- Through the CSLF Secretariat, the PIRT will:
  - Solicit input with respect to progress of CCS from all members of the CSLF
  - Gather information from a wide range of sources on the global progress of CCS, including collaboration partners
  - Prepare a simple reporting template that highlights the progress of the Priority Actions
  - Report annually to the CSLF Technical Group
  - Report biennially, or as required, to the CSLF Ministerial Meetings.



Thank you for your attention!