CSLF Projects Interaction and Review Team (PIRT)

Clinton Foster

Chair, Australia

Agenda Item 3

Review of Consensus Reached and Action Items from Washington PIRT Meeting

Clinton Foster

Seoul, Korea

March 24-27, 2014

Summary Washington PIRT Meeting

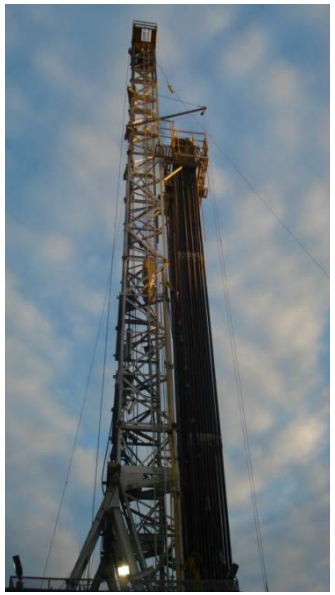
Consensus reached on three projects

Kemper County Energy Facility (nominated by the United States and Canada)

Plant and Mine View

Southeast Regional Carbon Sequestration Partnership (SECARB) Phase III Anthropogenic Test and Plant Barry Carbon Dioxide (CO2) Capture and Storage (CCS) Project (nominated by the United States, Japan, and Canada)

Well D9-8 #2
(Citronelle Field)



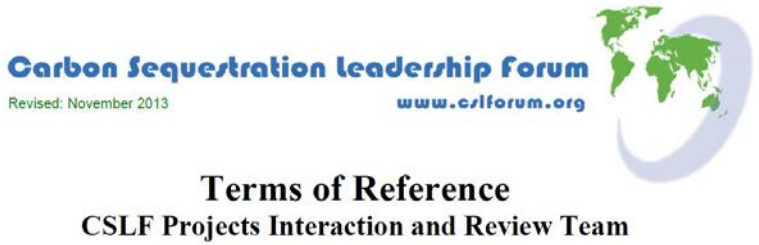
Midwest Regional Carbon Sequestration Partnership (MRCSP) Development Phase Project (nominated by the United States and Canada)

MRCSP
MIDWEST REGIONAL
CARBON SEQUESTRATION
PARTNERSHIP

Summary Washington PIRT Meeting

Consensus reached on:

- Updated PIRT Terms of Reference document (ToR) was adopted
- Updated CSLF Project Submission Form was adopted



Action items:

- CSLF Secretariat will prepare newly updated versions of the PIRT Terms of Reference and the CSLF Project Submission Form √
- PIRT Chair will obtain further information from the GCCSI about its proposal for a co-branded CSLF-GCCSI Knowledge Hub √ **(Agenda 6)**

Agenda Item 5

Update on PIRT Membership

Clinton Foster

Seoul, Korea

March 24-27, 2014

PIRT Active Members Invite

invitation to join the Projects Interaction and Review Team (PIRT) [DLM=For-Official-Use-Only]

Foster Clinton

Sent: Thu 23/01/2014 10:09 AM
To: 'CSLF Secretariat'; Panek, John; 'Lynch, Richard'

Dear Delegates,

I am writing to you as Chair of the Projects Interaction and Review Team to invite CSLF Delegates to the Technical Group to nominate for membership of the PIRT.

At the recent Ministerial meeting in Washington, the Terms of Reference of the PIRT, which effectively is a standing Taskforce of the Technical Group, were, by consensus, emended to better define the role and governance of the PIRT. Important changes include the introduction of Active Membership of the PIRT and that, in the case of a vote, there is one vote per Delegation (see http://www.cslforum.org/publications/documents/Washington2013/DraftPIRTSummaryWashington1113.pdf).

Let me stress that, in addition to nominated members of the PIRT, *ALL Technical Group delegates* are welcome to attend PIRT meetings, and in particular the technical presentations that accompany the project submissions for CSLF recognition.

I look forward to welcoming those Delegates who want to join the PIRT as Active Members, and Delegates who wish to attend the next technical presentation of the PIRT.

Kind regards

Clinton Foster

Chair, CSLF Projects Interaction and Review Team (PIRT)
Vice Chair (Australia) CSLF Technical Group

Dr Clinton Foster
Chief Scientist | **GEOSCIENCE AUSTRALIA**
Adjunct Professor, School of Earth and Environment | The University of Western Australia

PIRT Active members to date

COUNTRY	MEMBER DELEGATE
Australia	Clinton Foster
	Chris Consoli
Canada	Eddy Chui
EU	Jeroen Schuppers
France	Didier Bonjoly
Italy	Sergio Persoglia
Norway	Trygve Riis
	Lars Ingolf Eide
Saudi Arabia	Ahmed Eidan
South Africa	Tony Surridge
UK	Philip Sharman
USA	Mark Ackiweicz
IEAGHG	Tim Dixon

Agenda Item 6

Knowledge-Sharing from CSLF-Recognized Projects – with GCCSI

Clinton Foster

Seoul, Korea

March 24-27, 2014

Agenda Items 7 & 8

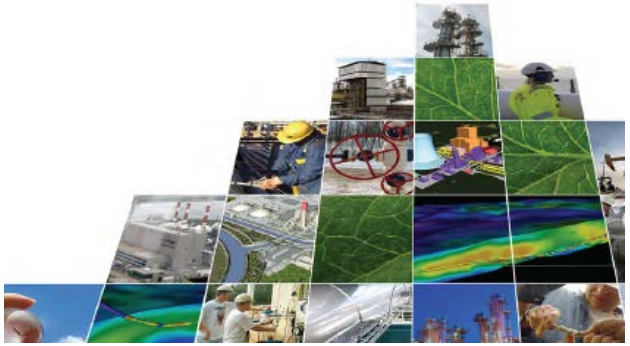
Plan for CSLF Technology Roadmap

Development of PIRT Action Plan

Clinton Foster

Seoul, Korea

March 24-27, 2014



TRM Activities

Through the CSLF Secretariat, the PIRT will:

- solicit input with respect to progress of CCS from all members of the CSLF; (BAU, greater focus)
- gather information from a wide range of sources on the global progress of CCS; (BAU, wide ranging resources)
- prepare a simple reporting template that relates the progress of the **Priority Actions**; (New activity)
- report annually to the CSLF TG; (BAU)
- report biennially, or as required, to the CSLF Ministerial Meetings (BAU)
- updates of the CSLF TRM (New activity)

PIRT Two Functions

Business as Usual	New Activities from Technical Roadmap (TRM)

• Project recognition
• Project monitoring
  • Workshop
	• Collaboration with CCS organisations
	• Monitoring TRM priority actions
	  • Summarise CCS progress
	• TRM publication

Priority Actions: 2020

- Recommendation 1: CO2 Capture Technologies in Power Generation
- Recommendation 2: CO2 Capture in Industrial Sector
- Recommendation 3: CO2 Transport
- Recommendation 4: Large-Scale CO2 Storage
- Recommendation 5: Monitoring and Mitigation/Remediation
- Recommendation 6: Understanding the Storage Reservoirs
- Recommendation 7: Infrastructure
- Recommendation 8: CO2 Utilization

Capture

Transport

Storage

Infrastructure & Integrated

Utilization

Priority Actions: Collaboration- avoiding duplication

TRM Priority Actions		CCS Organisations * *Based on reports published/ Active Projects								CSLF Active Member
		CCSA	CCS TLM	NETL	GCCSI	ICO2N	IEGHG	World Bank	ZEP	
Capture	Recommendation 1	✓	✓	✓	✓	✓	✓		✓	
	Recommendation 2								✓	
Transport	Recommendation 3								✓	
Storage	Recommendation 4								✓	
	Recommendation 5								✓	
	Recommendation 6								✓	
I & I	Recommendation 7	✓	✓		✓		✓	✓	✓	
Utilization	Recommendation 8		✓	✓	✓	✓	✓		✓	

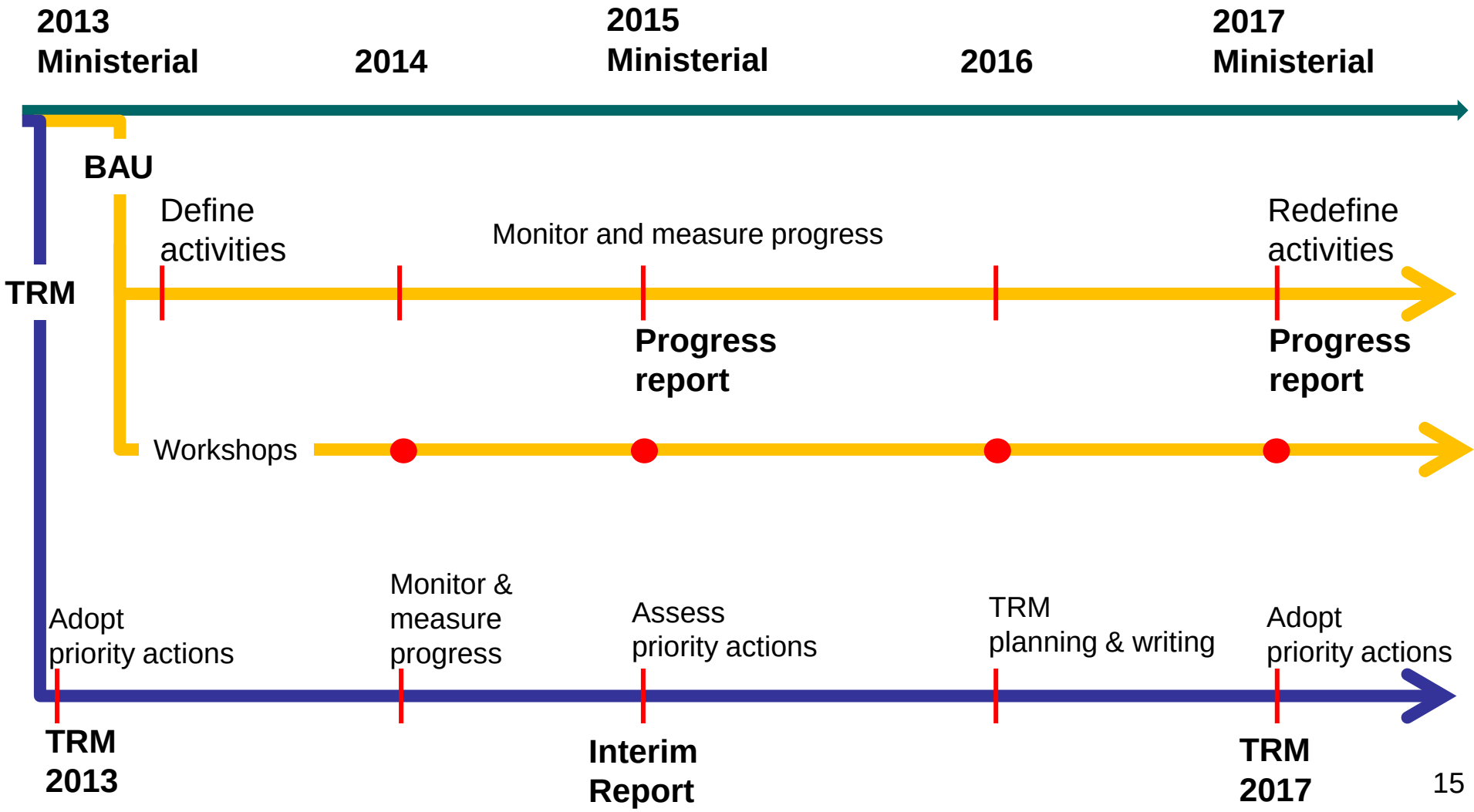
How do these groups either reflect CSLF or help the CSLF?

Proposition: scorecard against priority actions

Completion Date	Priority Action	Recommendation			CSLF Active Member
		R&D	Pilot	Comm	
Recommendation 4: Large-Scale Storage					
2020	Demonstrate CO2 storage in a wide range of sizes and geological settings.				
	Improve the understanding of the effects of impurities in the CO2 stream.				
Recommendation 5: MMV & Remediation					
2020	Monitoring technologies in large-scale CO2 storage projects.				
	Develop mitigation and remediation methods for leakage.				
	Validate mitigation technologies on a large scale, including well leakage.				
	Demonstrate safe and long-term CO2 storage.				

Red: no activity; Yellow: some activity; Green: projects underway/completed

PIRT Action Time Line



Agenda Item 9

Closing Comments / Adjourn

Clinton Foster

Seoul, Korea

March 24-27, 2014

4.1.1. Recommendation 1: CO2 Capture Technologies in Power Generation

Towards 2020: Implement a sufficient number of large-scale capture plants and sizeable pilots to:

- Increase understanding of the scale-up risks. Lessons learned will be used to generate new understanding and concepts complying with 2nd generation CCS.
- Gain experience in the integration of CO2 capture systems with the power or processing plant, including heat integration and other environmental control systems (SOx, NOx).
- Gain experience in part-load operations and daily cycling flexibility, as well as in the impacts of CO2 composition and impurities.
- Gain experience in the integration of power plants with CCS into electricity grids utilizing renewable energy sources.

Towards 2030:

- Develop 2nd generation CO2 capture technologies with energy penalties and avoidance costs well below that of 1st generation technologies. Possible targets for 2nd generation capture technology for power generation and industrial applications are a 30% reduction of the each of the following the energy penalty, normalized capital cost, and normalized operational and maintenance (O&M) costs (fixed and non-fuel variable costs) compared to 1st generation technologies.

Towards 2050:

- Possible targets for 3rd generation CO2 capture technology for power generation and industrial applications are a 50% reduction of each of the following: the energy penalty, normalized capital cost, and normalized O&M costs (fixed and non-fuel variable costs) compared to 1st generation technologies.

4.1.2. Recommendation 2: CO2 Capture in the Industrial Sector

Towards 2020:

- Further develop CO2 capture technologies for industrial applications and implement pilot-plants and demonstrations for these.

Towards 2030:

- Implement the full-scale CCS chain in cement, iron and steel and other industrial plants.

4.2.1. Recommendation 3: CO2 Transport

Towards 2020:

- Acquire data for, and understand the effects of, impurities on the thermodynamics of CO2 streams and on pipeline materials, and establish and validate flow models that include such effects.
- Establish and validate dispersion models for the impact assessment of incidents pursuant to leakage of CO2 from the CO2 transport system (pipelines, ships, rail and trucks).
- Develop common specifications for pipelines and the CO2 stream and its components.
- Qualify pipeline materials for use in CO2 pipes with impurities.

4.3.1. Recommendation 4: Large-Scale CO2 Storage

Towards 2020:

- Demonstrate CO2 storage in a wide range of sizes and geological settings, including deep saline formations, depleted oil and gas fields and producing oil and gas fields (EOR and EGR) around the world.
- Improve the understanding of the effects of impurities in the CO2 stream, including their phase behaviour, on the capacity and integrity of the CO2 storage site, with emphasis on well facilities.

Towards 2030:

- Qualify CO2 storage sites for safe and long-term storage in the scale of tens of millions of tonnes of CO2 annually per storage site from clusters of CO2 transport systems.

Towards 2050:

- Have stored over 120 GtCO2 in geological storage sites around the world.

4.3.2. Recommendation 5: Monitoring and Mitigation/Remediation

Towards 2020:

- Further testing, validation and commercialization of monitoring technologies in large-scale CO2 storage projects, onshore and offshore, to prove that monitoring works and leaks can be prevented or detected, and to make monitoring cost-efficient.
- Develop mitigation and remediation methods for leakage, including well leakage, and test in small-scale, controlled settings.
- Validate mitigation technologies on a large scale, including well leakage.
- Demonstrate safe and long-term CO2 storage.

Towards 2030:

- Develop a complete set of monitoring and mitigation technologies to commercial availability.

4.3.3 Recommendation 6: Understanding the Storage Reservoirs

Towards 2020:

- Further advance the simulation tools.
- Develop and agree on consistent methods for determining CO2 storage capacity reserves at various scales (as opposed to storage resources) and global distribution of this capacity (important for policy makers).

4.4.1. Recommendation 7: Infrastructure

- Towards 2020:
- Design large-scale CO2 transport networks that integrate capture, transport and storage, including matching of sources and sinks, particularly in non-OECD countries.
- Map the competing demands for steel and pipes and secure the manufacturing capacity for the required pipe volumes and other transport items.
- Develop systems for metering and monitoring CO2 from different sources with varying purity and composition that feed into a common collection and distribution system.
- Start the identification, characterization and qualification of CO2 storage sites for the large-scale systems.

Towards 2030:

- Implement large-scale CO2 transport networks that integrate CO2 capture, transport and storage, including matching of sources and sinks, particularly in non-OECD countries.

4.5.1. Recommendation 8: CO2 Utilization

Towards 2020:

- Resolve technical challenges for the transition from CO2-EOR operations to CO2 storage operations.
- Establish methods and standards that will increase and prove the permanent storage of CO2 in EGR, ECBM, EGHR and other geological applications if CO2 injection becomes more prevalent in these applications.
- Research, evaluate and demonstrate carbonation approaches, in particular for mining residue carbonation and concrete curing, but also other carbonate mineralization that may lead to useful products (e.g. secondary construction materials), including environmental barriers such as the consequences of large mining operations and the disposal of carbonates.
- Map opportunities, conduct technology readiness assessments and resolve main barriers for the implementation of the CO2 utilization family of technologies including life-cycle assessments and CO2 and energy balances.
- Increase the understanding of CO2 energy balances for each potential CO2 re-use pathways and the energy requirement of each technology using technological modelling.
- Address policy and regulatory issues related to CO2 utilization, particularly in enhanced hydrocarbon recovery.

TRM Priority Actions

- Towards 2020 nations should work together to:
  - Maintain and increase commitment to CCS as a viable greenhouse gas (GHG) mitigation option
  - Establish international networks, test centres and comprehensive RD&D programmes to verify, qualify and facilitate demonstration of CCS technologies
  - Gain experience with 1st generation CO2 capture technologies and their integration into power plants
  - Encourage and support the first industrial demonstration plants for CO2 capture
  - Develop sizeable pilot-scale projects for storage
  - Design large-scale, regional CO2 transport networks and infrastructure
  - Agree on common standards, best practices and specifications for all parts of the CCS chain
  - Map regional opportunities for CO2 utilization, addressing the different priorities, technical developments and needs of developed and developing countries.

TRM Priority Actions

- Towards 2030 nations should work together to:
  - Move 2nd generation CO2 capture technologies for power generation and industrial applications through demonstration and commercialisation, with possible targets of 30% reduction of energy
  - penalty, normalized capital cost, and normalized operational and maintenance (O&M) costs compared to 1st generation technologies
  - Implement large-scale national and international CO2 transport networks and infrastructure
  - Demonstrate safe, large-scale CO2 storage and monitoring
  - Qualify regional, and potentially cross-border, clusters of CO2 storage reservoirs with sufficient capacity
  - Ensure sufficient resource capacity for a large-scale CCS industry
  - Scale-up and demonstrate non-EOR CO2 utilization options.

TRM Priority Actions

- Towards 2050 nations should work together to:
  - Develop and progress to commercialisation 3rd generation CO2 capture technologies with energy penalties and avoidance costs well below that of 1st generation technologies. Possible targets for 3rd generation CO2 capture technology for power generation and industrial applications are a 50% reduction from 1st generation levels of each of the following: the energy penalty, capital cost, and O&M costs (fixed and non-fuel variable costs) compared to 2013 first generation technologies costs.