# CSLF Workshop
# "Overcoming Barriers to Deployment"

# Overview of Technology Gap Analysis PIRT

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# Technology Gap Assessment

- A comprehensive Technology Gap Assessment was initiated to help identify where CSLF projects should be encouraged in relation to the CSLF Charter
- Three focus areas considered;
  - Capture (EC)
  - Storage (Australia)
  - Monitoring, Measurement & Verification (Canada)
- Each focus area identified
  - high level technology gaps sub-headings and then
  - a second tier of specific topics
  - Capture ( 4 sub headings - 20 specific topics)
  - Storage (11 sub headings - 34 specific topics)
  - MMV ( 5 sub headings - 17 specific topics)

# CSLF Projects Interaction and Review Team (PIRT

# CCS Technology Gaps Analysis

## PIRT FORMATION & OBJECTIVES

Following the Technical group meeting in Melbourne, Australia, in September 2004, a recommendation was put forward for a working group which would assess projects proposed for recognition by the CSLF and review the CSLF project portfolio to identify synergies and gaps that would then act as input for any future revision of the CSLF Technology Road map. This working group was endorsed by the Policy Group at the CSFL meeting in New Delhi in April 2006 and is now known as the Projects Interaction and Review Team (PIRT).

**The PIRT has the following tasks:**

- Assess projects proposed for recognition by the CSLF in accordance with the project selection criteria approved by the Policy Group. Based on this assessment, make recommendations to the Technical Group on whether a project should be accepted for recognition by the CSLF.
- Review the CSLF project portfolio and identify synergies, complementarities and gaps, providing feedback to the Technical Group and input for further revisions of the CSLF roadmap.
- Identify technology gaps where further RD&D would be required.
- Foster enhanced international collaboration for CSLF projects, both within individual projects (e.g. expanding partnership to entities from other CSLF members) and between different projects addressing similar issues.
- Promote awareness within the CSLF of new developments in $CO_2$ Capture and Storage by establishing and implementing a framework for periodically reporting to the Technical Group on the progress within CSLF projects and beyond.
- Organize periodic activities to facilitate the fulfilment of the above functions and to give an opportunity to individuals involved in CSLF recognized projects and other relevant individuals invited by the CSLF, to exchange experience and views on issues of common interest and provide feedback to the CSLF.
- Perform other such tasks that may be assigned to it by the CSLF Technical Group.

## TECHNICAL GAPS ANALYSIS

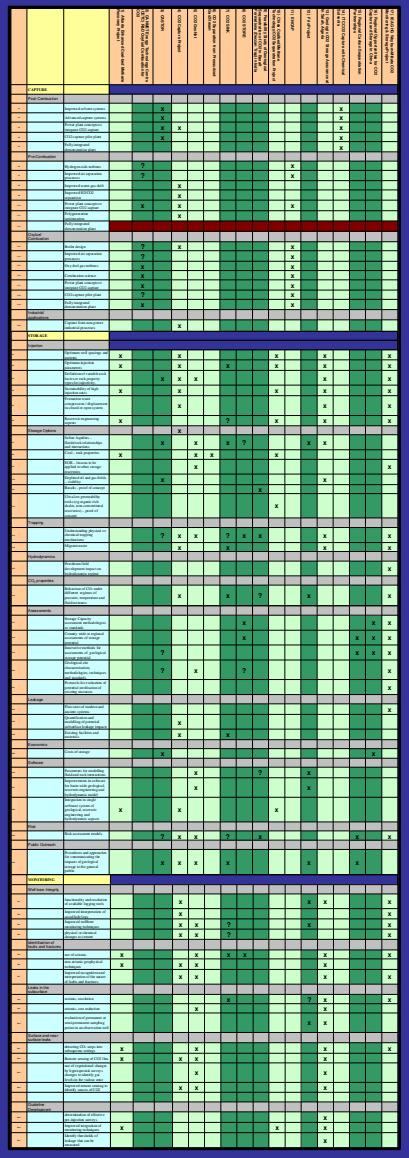
In order to complete the task of identifying technology gaps where further research and development would be required, a comprehensive gap assessment began in 2006. The purpose of this was to identify where projects should be encouraged in the CSLF charter, to promote synergies and inform on new developments.

Single well injection test- Alberta Enhanced Coal-bed Methane Recovery Project

The CSLF Technical Group Gap Analysis work was divided into three components: 1) Capture, 2) Storage and 3) Monitoring and Verification. These were initially instigated by completion of three taskforces examining these topics: Task Force to Identify Gaps in $CO_2$ Capture and Transport, Task Force to Identify Gaps in Measurement, Monitoring and Verification in Storage and the Task Force to Review and Identify Standards for $CO_2$ Storage Capacity Measurement. From the results of these taskforces and by scoping out other gaps from within the Core Group and Floating Group within the PIRT, a list of technology barriers to the CCS deployment were identified and are listed in the adjacent table. These technology gaps were assembled at a high level so that more detailed gaps could be addressed underneath key topics.

The 17 projects recognised within the CSLF were then asked to identify if any of their project outcomes would encompass these issues. Many projects were able to respond in time for this poster and the details of their responses are shown in light green. Those in dark green are taken from the projects descriptions on their websites and information sheets An interactive spreadsheet of these responses is available at http://www.cslforum.org/documents/PIRTGapAnalysis.xls

The aim of this poster session is to highlight aspects of projects that currently or plan to fill these gaps, as well as promote discussion of the areas that are not being addressed by CSLF projects.
If any non-CSLF projects wish to consider applying to be recognised as CSLF project, the submission forms are available at http://cslforum.org/documents/ProjectSubmissionForm.doc



Poster 1 of 3

See Poster for details of technology gaps being addressed in each CSLF recognised Project

More detailed Technology Gaps Analysis spreadsheet now on CSLF website

**http//www.cslforum.org/documents/PIRTGapAnalysis.xls**

# CSLF Gaps Assessment: For Recognised Projects

| Will your project outcomes encompass any of these issues? | Examples; | Project to expand on the specific issues they will address under the relevant gaps and document the levels at which issues are being examined | Reference to relevant work ; Publication or website |
|---|---|---|---|
| | | Project X | |
| | | | |
| | | | |

| Injection | |
|---|---|
| **Optimum** well spacings **and patterns** | **Eg so as to** maximise the access to storage capacity **in a given reservoir,** |
| **Optimum** injection parameters | **Eg to** avoid geomechanical impacts**, or to avoid pressure interference.** |
| **Definition of** variable rock facies **or rock property types for injectivity.** | **Eg the need to** compare **the** injectivity **of thick good reservoir quality (marine deposited sandstone) versus poorer thin bedded (fluvial channel sandstone) reservoirs.** |
| **Sustainability of** high injection rates | **To** match the supply rates and storage volumes **at regional or local basin level eg how many separate injection operations could the North Sea sustainably manage in a single reservoir sequence for the time period required?** |
| Formation water compression / displacement **in closed or open system** | **Eg** impacts **on potentially** compromising groundwater **in open system or pressure build-up in closed system.** |
| Reservoir engineering **aspects** | **Eg** Near well bore formation damage**, hydrate formation, mineral precipitation, effects of impurities in $CO_2$ stream, etc** |

# Technology Gap Assessment
# Focus Area - Capture

| Sub Heading | No. of Specific Topics |
|---|---|
| • Post-Combustion | 5 |
| • Pre-Combustion | 7 |
| • Oxyfuel Combustion | 7 |
| • Industrial applications | 1 |
| | 20 |

# Technology Gap Assessment
# Focus Area - Storage

| Sub Heading | No. of Specific Topics |
|---|---|
| • Injection | 6 |
| • Storage Options | 6 |
| • Trapping | 2 |
| • Hydrodynamics | 1 |
| • $CO_2$ properties | 5 |
| • Assessments | 5 |
| • Leakage | 3 |
| • Economics | 1 |
| • Software | 3 |
| • Risk | 1 |
| • Public Outreach | 1 |
| | 34 |

# Technology Gap Assessment
# Focus Area - MMV

| Sub Heading | No. of Specific Topics |
|---|---|
| • Well bore Integrity | 4 |
| • Identification of faults and fractures | 3 |
| • Leaks in the subsurface | 3 |
| • Surface and near-surface leaks | 4 |
| • Guideline Development | 3 |
| | 17 |

# Technology Gaps : Statistics

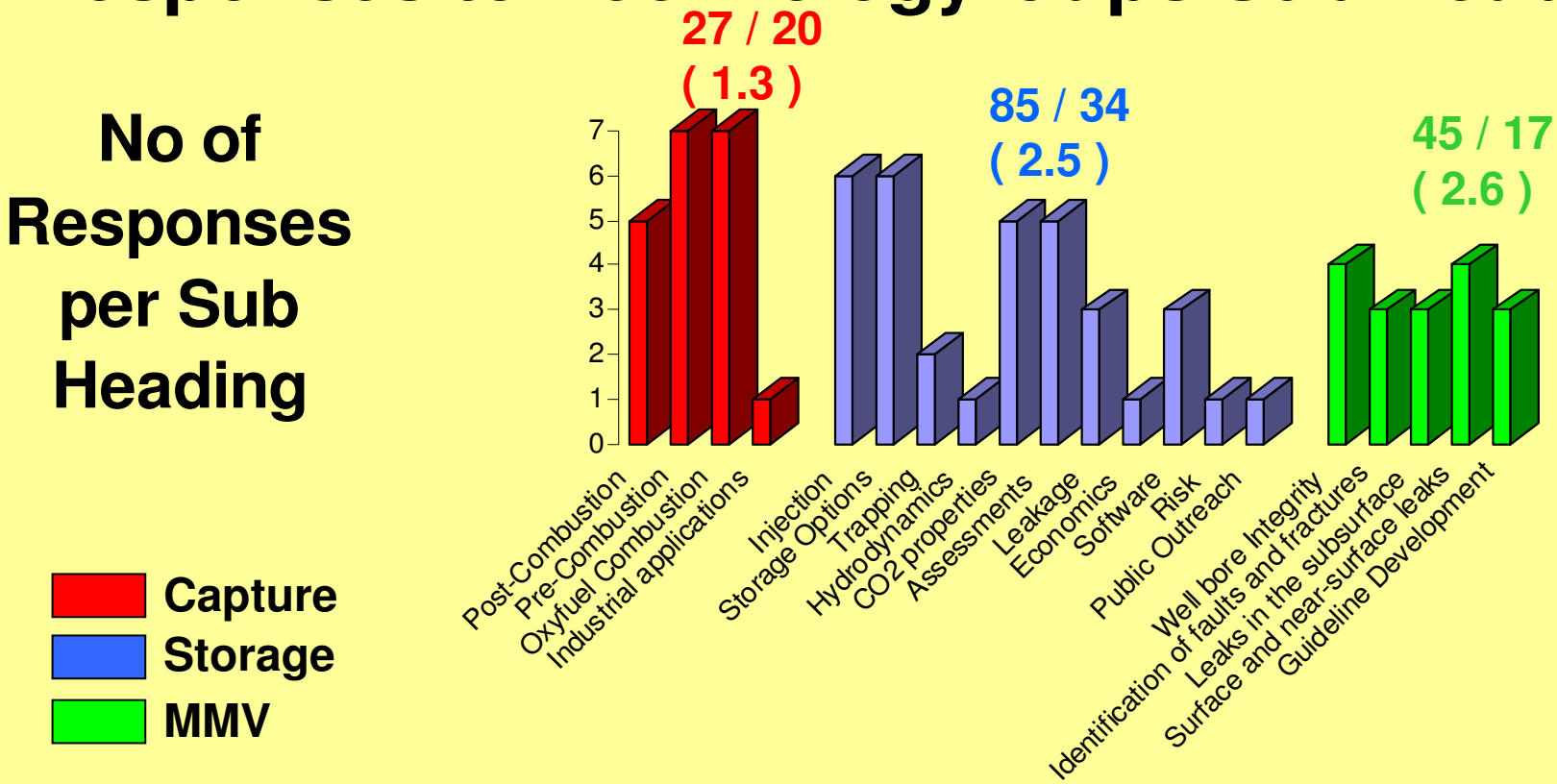
- This Gaps Analysis was circulated to all of the CSLF recognised projects to ascertain areas where work is being undertaken
- 11 out of 17 projects have responded - 65%
  - **Project Responses**
    6 Storage & MMV, 1 Storage, 2 Capture, 1 Capture & Storage & MMV
  - **Project Non-Responses**
    2 Storage & MMV, 3 Storage, 1 Capture, 1 Capture & Storage
- Responses to 19 (out of 20) sub-headings – 95%
- Responses to 157 (out of 71) specific topics
  - Average 2.2 responses per specific topic
  - Average 15.7 specific topic responses per project

| | Responses | Specific Topics | Response/Topic |
|---|---|---|---|
| – **Capture** | **27** | **20** | **1.35** |
| – **Storage** | **85** | **34** | **2.5** |
| – **MMV** | **45** | **17** | **2.6** |

- Estimate for all 17 projects should get 178 specific topic responses covering all 20 sub-headings – average 2.5 responses per specific topic

# Technology Gaps : Summary

## Responses to Technology Gaps Sub Headings



# Technology Gaps : What does it mean?

- Many opportunities for CSLF Projects to collaborate
  (Average 15.7 specific topic responses per project)
- Areas of potential collaboration sometimes thinly spread, or conversely no excessive overlap and duplication
  (Average 2.2 responses per specific topic – range 1.3 – 2.6)
- 3 to 4 times more Storage and MMV Projects than Capture
  - Thus less collaboration potential with Capture
- Capture: (3)
  - Slightly more emphasis on Pre-combustion and Oxyfuel than Post Combustion
- Storage: (8)
  - Emphasis on Injection and Storage Mechanisms, closely followed by $CO_2$ Properties and Assessments
  - Much less emphasis on Hydrodynamics, Risk, Economics and Public Outreach
- MMV (8)
  - Even spread of emphasis

# Technology Gaps : What next

- Encourage remaining CSLF projects to respond
- Consider broadening responses or assessment to include significant non-CSLF Projects
- Ensure each project is aware of potential collaboration opportunities
  - Go to website to get detailed spreadsheet
- Thorough technical analysis after final assembly of responses in terms of Gaps that are ;
  - Most likely to have a significant impact (costs, breakthrough for deployment, risk impact, etc)
  - Likely to be resolved / not resolved with current CSLF projects
- Use the above findings to;
  - guide revised Roadmap
  - Identify projects that will achieve acceleration or improvement of deployment
- Keep Technology Gaps Analysis “evergreen” with help of CSLF Project proponents – whom we gratefully thank

# Technology Gaps : Critical gaps – required developments

- Capture
  - Optimisation & process integration
  - Next generation technologies
- Transport
  - "Critical mass" infrastructure development – how to go about this – "hub network"
  - Ship?
- Storage
  - Long term fate of injected $CO_2$ and containment
  - Comparison on injectivity and predictability between different geological depositional environments (marine and non-marine)
- MMV
  - Regional monitoring technology in offshore environment where seismic reflection technology not viable
  - Resolution of MMV technologies – quantification vs detection.
  - MMV technology tools for specific applications/projects