2nd International Workshop on Offshore Geologic CO_2 Storage

International updates from Norway, UK, Japan, Netherlands, Australia, South Africa, and USA

Hosted by Bureau of Economic Geology University of Texas Austin at Lamar University, Beaumont, Texas, 19–20 June 2017

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CSLF Report on Offshore Geologic CO2 Storage

"There is a growing wealth of research, development and practical experiences that are relevant to CO_2 storage offshore, but this expertise is familiar only to a few specific countries around the world. However there is also significant global potential for offshore CO_2 storage, and countries who are not yet active but may become interested in offshore storage, would benefit from knowledge sharing from these existing experiences and expertise. Such international knowledge sharing would be facilitated by international workshops and by international collaborative projects."

(CSLF Ministerial Nov 2015: CSLF-T-2015-06)

2nd Workshop

Aim: To address and build on the recommendations and topics raised at the first workshop to take offshore storage forward. Continuing theme of 'how to do'.

Objectives: Technical 'deeper-dive' into key topics:

- How to find storage offshore;
- Technical aspects and experiences of offshore monitoring;
- CO2-EOR offshore;
- Infrastructure developments and decisions
- U.S. developments in offshore storage assessment
- Conclusions and recommendations
- Field Trip

Conclusions 1

- Site selection methods are becoming mature:
- Examples from different regions show some similarities as well as methods for adapting to regional geologic conditions, source distribution, and national goals and policies.
- Case studies at South Africa and Australia show methods of systematic refinement and down selecting.
- Lowering risk for roject include favoring denser data about the subsurface, known injectivity, proximity sink to source.
- Conservative approach favors assessing multiple sinks and multiple sources, so that one no-go does not derail whole
- Using current best geologic practices – ie chronostratigraphic instead of lithostratigraphic.
- Not just based on geological characteristic – needs to be large enough to be a business case.

Conclusions 2

- Deep dive into Monitoring plans shows that they are now successfully passing through negotiation with regulators.
- Pragmatism in balancing risk reduction with cost management is illustrated in cases from Peterhead, ROADS, and Norway, although different monitoring approaches are still seen.
- AUV environmental monitoring reduces cost and reduces human safety issues.
- Multiple approaches to overburden and water column monitoring are demonstrated.
- Overburden - ability to characterize and monitor in time-lapse.
- Sensitivity of data and density of data to demonstrate no leakage are beginning to be considered.

Conclusions 3

- CO_2 EOR continues to be considered as a prospective part of storage in Norwegian and UK north Sea, GoM, and basins globally. Information and analysis continues to increase (see major summary by CSLF task force),
- However the business case that would allow EOR to be profitable remains elusive: - competition for capital – onshore first in USA, or other potential energy projects or alternative ways of recovery; delay in payback
- Timing/cost issues with re-use of infrastructure offshore – eg Norway
- Access to CO_2 will stimulate EOR projects

Conclusions 4

- Policy approach to shift from individual projects to infrastructure, eg Alberta Carbon Trunk Line
- Infrastructure economies of scale – cost reductions
- Subsea solutions are coming for adding CO2-EOR to existing platforms. Components exist, need to qualify for CO2
- Salt and shale ductility, and bentonite plugs, sealing to P&A wells
- A lot of options for infrastructure new and reuse – very site specific

Recommendations

- Design for research purposes wells made to leak CO_2
- We can learn from USA re-use of wells for CO2-EOR
- Tools for assessing infrastructure
- Communication with offshore infrastructure owners
- More communication on infrastructure with institutions eg governments
- Communicating developing country importance, eg to Green Climate Fund – learn from good example in South Africa
- Address data gaps
- Qualify subsea systems for CO_2

International Steering Committee

Tim Dixon, IEAGHG (Chair)
Katherine Romanak, BEG (Co-Chair, Host)
Susan Hovorka, BEG (Host)
Tip Meckel, BEG (Host)
Anthony Surridge / Noel Kamrajh, SANEDI (host)
John Litynski / Traci Rodosta, US DOE
Lars Ingolf Eide, Research Council of Norway
Di Zhou, China Academy of Sciences
Filip Neele, TNO
Paulo Negrais Seabra-Independent Consultant (formerly Petrobras)
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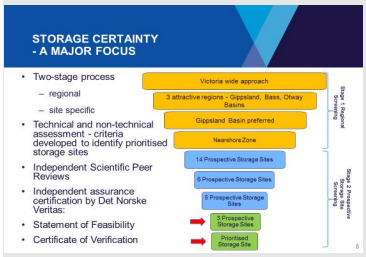
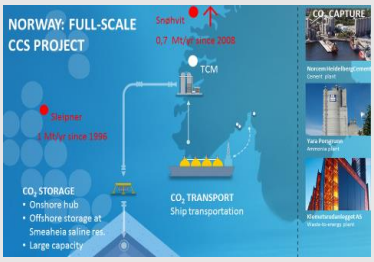
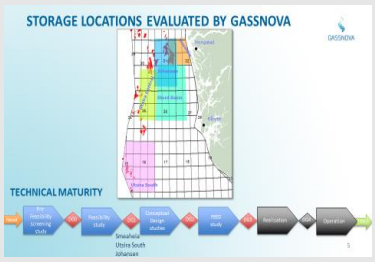
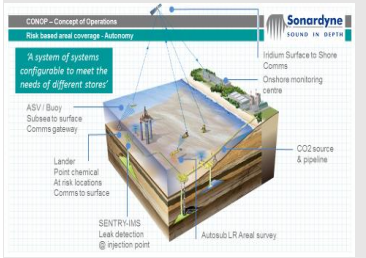
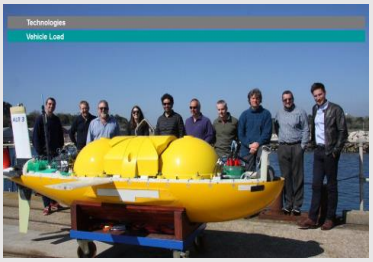
Owain Tucker, Shell
Philip Ringrose, Statoil
Michael Carpenter, Gassnova
Paul Latiolais, Lamar University

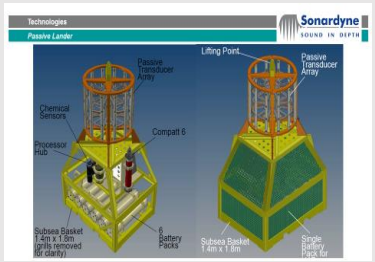


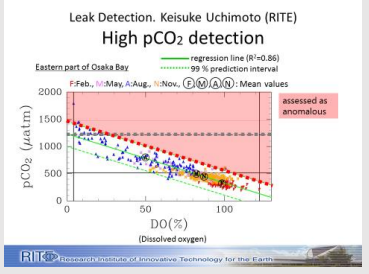


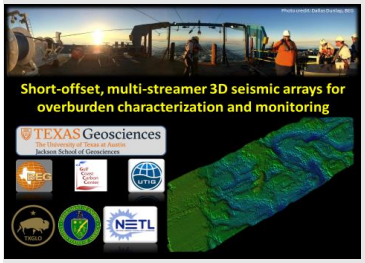












Carbon Sequestration Leadership Forum

Status
CSLF TASK FORCE ON OFFSHORE CO_2-EOR

Enabling Large-scale CCS using Offshore CO_2 Utilization and Storage Infrastructure Developments

Lars Ingolf Eide
2nd International Workshop on Offshore CO_2 Geologic Storage
Beaumont, Texas, USA
19-20 June, 2017

Carbon Sequestration Leadership Forum

Lula Project

- Reservoir well suited for miscible gas EOR
- CO_2 content in gas ≈ 11 %
- Extensive reservoir characteriztion
- Robust and fexible development strategy
- Careful choice of topside solution and materials
- Membranes used for CO_2 separation
- WAG solution with six producers, two WAG injectors, one CO_2 injector
- No major operational or reservoir problems
- Monitoring with downhole pressure gauges and tracers

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Approaches for enabling offshore CO_2-EOR

- Using late-life oilfield infrastructure
- Using oilfield satellite projects
- Focusing CO-EOR on the residual oil zone (ROZ)
- Reservoir modelling: Issues particular to CO2-EOR
  - Phase behaviour
  - Reactions with rocks
  - Multiphase flow in porous media
  - Oil instability

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Available Subsea Processing Building Blocks

Fast processing of reservoir

- Comparing onshore and offshore well spacing- link to rate of reservoir processing

Typical 5-spot pattern
400 m 6- 15 months CO_2 + oil to producers
Well emplaced from a platform commonly use long laterals
Long laterals more time for CO_2 + oil to reach producers

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