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Task Force on Review of CO_2 Storage Efficiency in Deep Saline Aquifers

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Origin of the Task Force

The Task Force was established at the CSLF meeting in Washington, D.C., USA, November 5, 2013, to review the published literature since the IPCC Special Report on CCS (2005) and CSLF report (2007) on the efficiency of CO_2 storage in deep saline aquifers

Background of the Task Force

- Various methodologies have been developed since 2007 for estimating CO_2 storage capacity in deep saline aquifers at regional and local scales, the most used being USDOE's, applied mostly in North America, and CSLF's, applied mostly in Europe
- Storage capacity estimates are of two types:
  - Volumetric (or "Static"), based on pore volume
  - Dynamic, based on injectivity and pressure build-up, usually using numerical modelling

Storage Efficiency

- The volumetric, or static CO_2 storage capacity estimates are based on the relationship:

$$M_{CO2} = E \times A \times h \times \phi \times \rho_{CO2}(P, T)$$

- Published values of the Storage Efficiency Coefficient E, defined as ***the amount of CO_2 stored in a unit of aquifer pore volume***, vary in a wide range, from < 1% to > 20%, depending on assessment scale, rock lithology, depositional environment, CO_2 buoyancy and mobility, capillary forces, and other medium and storage characteristics

Task Force Mandate

Critically review, compile and report on published literature since the CSLF (2007) report on "CO_2 Storage Capacity Estimation" on the efficiency of CO_2 storage in deep saline aquifers and applicability of the various published values for the storage efficiency coefficient E

Task Force Timeframe

- November 2013: Task Force established
- Spring 2015 CSLF TG Meeting: Submission of final report

Background to Status

- The International Journal of Greenhouse Gas Control has decided in the summer of 2014 to produce a **Special Issue** marking the ten-years anniversary since the IPCC Special Report on CCS, with publication in volume in **September 2015** (IJGGC Issue #40)
- The Special Issue will be presented at UNFCC COP21 in Paris in December 2015
- One of the review papers is on "CO_2 Storage Efficiency in Deep Saline Aquifers" authored by Stefan Bachu,
- The publication deadline coincides with the Task Force timeframe for completing this action item

Status

- Consequently, the Task Force was disbanded in the fall of 2014
- The CSLF TG Action Plan on this subject has been accomplished through the publication on-line in January 2015 of the review paper in the IJGGC Special Issue

Main Findings - 1

Storage efficiency depends on:

- **Aquifer characteristics: pressure, temperature, water salinity, relative permeability characteristics to CO_2 and water, lithology, porosity, permeability, dip, areal extent, thickness and boundaries;**
- **Operation characteristics: injection rate, duration, and wells number, emplacement and orientation, and water production;**
- **Regulatory constraints such as maximum bottom hole pressure, area of review, area of tenure**

Main Findings - 2

- In closed aquifer systems, storage space is created through medium and water compressibility, with efficiency factors in the order of **0.1% per MPa** pressure increase (~ per 100 m depth)
- For atlas-type estimates of CO_2 storage resource at the aquifer/basin scale, storage efficiency coefficients of **2-3%** should be used for P50 confidence
- For local-scale evaluations of CO_2 storage capacity, numerical (dynamic) estimates should be used, taking into account that storage capacity is pressure limited

Review Paper

"Review of CO_2 Storage Efficiency in Deep Saline Aquifers" by Stefan Bachu, International Journal of Greenhouse Gas Control, v. 40, September 2015, doi:10.1016/j.ijggc.2015.01.07