Discussion Paper on CO_2 Storage Capacity Estimation (Phase 1) + *Phase 2 Proposal*

"A taskforce for review and development of standards with regards to storage capacity measurement"

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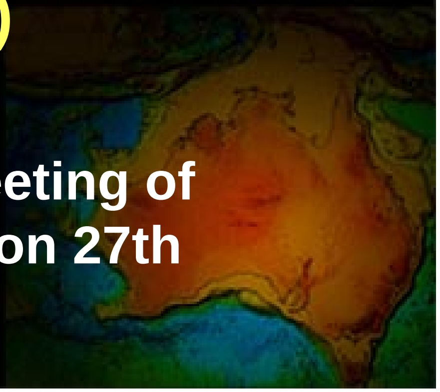

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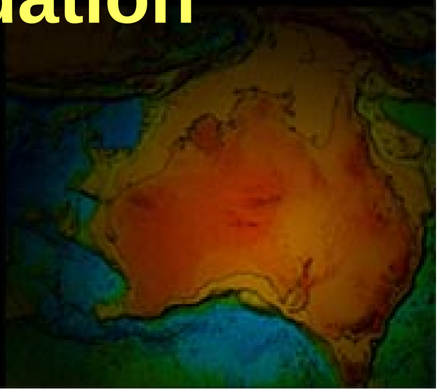
CHARACTERISTICS / TRAPPING MECHANISM	NATURE OF TRAPPING	EFFECTIVE TIMEFRAME	AREAL SIZE	OCCURRENCE IN BASIN	ISSUES	CAPACITY LIMITATION / BENEFITS	POTENT-IAL SIZE	CAPACITY ESTIMATION METHOD / REQUIREMENTS
STRUCTURAL & STRATIGRAPHIC	Anticline, fold, fault block, pinch-out. CO_2 remains as a fluid below physical trap (seal)	Immediate	~ 10s km^2 to 100s km^2	Dependent on basins tectonic evolution. 100s of small traps to single large traps per basin	Faults may be sealed or open, dependant on stress regime and fault orientation and faults could be leak/spill points or compartmentalise trap	If closed hydraulic system then limited by compression of fluid (few percent) in reservoir. If open hydraulic system will have to displace formation fluid.	Significant	Simple volume calculation of available pore space in trap, allowing for factors that inhibit access to all the trap – eg sweep efficiency, residual water saturation
RESIDUAL GAS	CO_2 fills interstices between pores of the grains in rock	Immediate to 1000s years	basin scale - e.g. 10000s km^2	Along migration pathway of CO_2	Will have to displace water in pores. Dependant on CO_2 sweeping through reservoir to trap large volumes.	Can equal 15-20% of reservoir volume. Eventually dissolves into formation water.	Very large	Requires rock property data and reservoir simulation
DISSOLUTION	CO_2 migrates through reservoir beneath seal and eventually dissolves into formation fluid.	100s to 1000s of years if migrating - >10000s years if gas cap in structural trap - and longer if reservoir is thin and has low permeability	basin scale - e.g. 10000s km^2	Along migration pathway of CO_2, both up dip and down dip	Dependant on rate of migration (faster better) and contact with unsaturated water, and pre-existing water chemistry (less saline water better). Rate of migration depends on dip, pressure, injection rate, permeability, fractures, etc.	Once dissolved, CO_2 saturated water may migrate towards the basin centre thus giving very large capacity The limitation is contact between CO_2 and water, and having highly permeable (vertical) and thick reservoirs.	Very large	Requires reservoir simulation and need to know CO_2 supply rate and injection rate
MINERAL PRECIPITATION	CO_2 reacts with existing rock to form new stable minerals	10s to 1000s of years	basin scale - e.g. 10000s km^3	Along migration pathway of CO_2	Dependant on presence of reactive minerals and formation water chemistry. Could precipitate or dissolve.	Rate of reaction slow. Precipitation could "clog" up pore throats reducing injectivity. Approaches "permanent" trapping.	Significant	Requires rock mineralogy
HYDRODYNAMIC	CO_2 migrates through reservoir beneath seal, moving with or against the regional ground water flow system, whilst other physical and chemical trapping mechanisms operate on the CO_2.	Immediate	basin scale - e.g. 10000s km^2	Along migration pathway of CO_2, with or against the direction of the flow system that may move at rates of cm's / year	Dependant on CO_2 migration after the injection period, being so slow that it will not reach the edges of the sedimentary basin where leakage could occur.	No physical trap may exist and thus totally reliant on slow transport mechanism and chemical processes. Can include all other trapping mechanisms along the migration pathway.	Very large	Requires reservoir simulation and regional reservoir flow model
COAL ADSORPTION	CO_2 preferentially adsorbs onto coal surface	Immediate	~ 10km^2 to 100km^2	Limited to extent of thick coal seams in basins that are relatively shallow	Coals can swell reducing injectivity. Difficult to predict permeability trends. CO_2 adsorption not 100% effective which raises issue of leakage if no physical seal is present.	Injectivty poor due to low permeability. Effective at shallower depths than porous sedimentary rocks, but not at deeper depths due to permeability issues. Many injection wells required. If methane liberated might not be net GHG mitigation.	Low	Requires gas sorption data and knowledge of permeability trends and coal "reactivity" to CO_2

Proposal

- Reconfirm Phase 1 acceptance
- Propose continuation of Taskforce
- Have defined Phase 2 report to naturally flow on from initial findings from Phase 1
- Propose to rotate Leadership to Canada
- Acknowledge new participant – UK
  - government reserve/resource validation and regulatory expertise



Phase 2 Report

- **Aim**
  - **To document a descriptive analysis of the way in which storage capacity should/can be estimated / calculated across a range of geological formations and trapping mechanisms?**
- **Outcomes**
  1. **To enable future storage capacity estimations at regional to prospect levels to be more consistent and reliable**
  2. **Commence the process of developing guidelines for storage capacity estimation**
  3. **Propose directions that ultimately might evolve into suggestions of storage capacity estimation validation and certification**
  4. **Incorporate relevant results and learning's from CSLF projects into Taskforce deliberations**
  - **Timing**
  - **Report on status over next two meetings**
  - **Allow for public dissemination and comment on work (external stakeholders – important to get external uptake)**
  - **Draft for CSLF consideration in 18 months**