



Carbon Capture and Storage

A developer's perspective

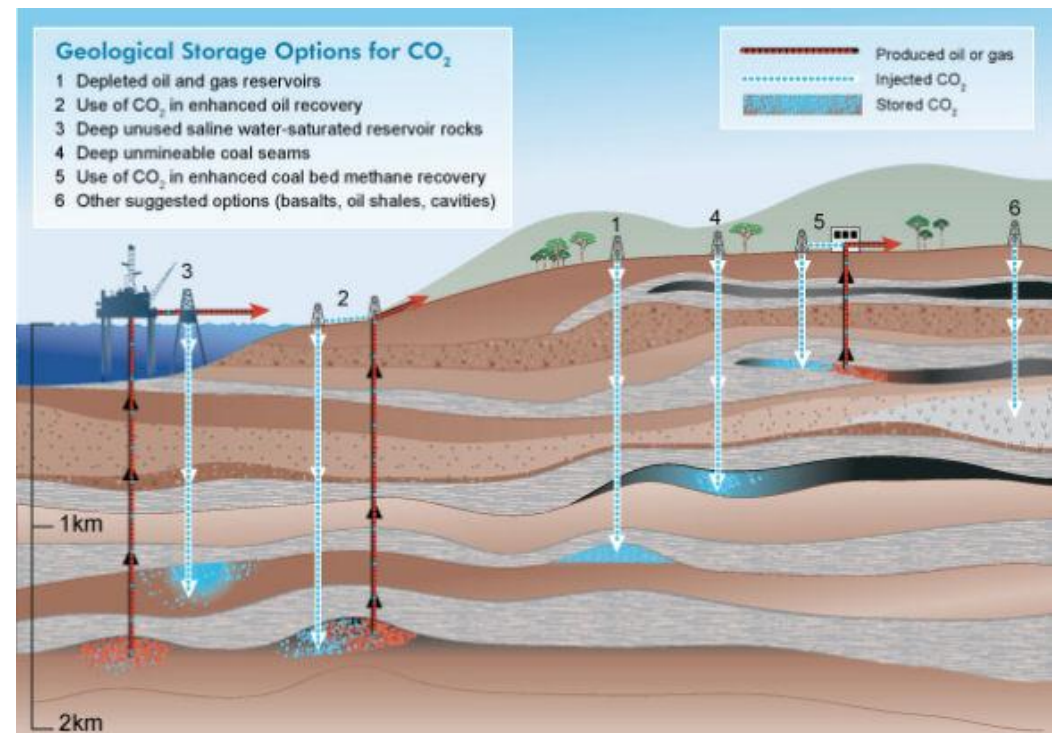
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Types and characteristics of sinks

- Depleted oil / gas fields
- New Enhanced Oil Recovery (EOR)
- Existing EOR, with infrastructure
- Saline formation, anticline
- Saline formation, open
- Onshore / offshore

- Access
- Data acquisition costs and timing
- Volume
- Integrity / storage confidence
- Costs
- Monitoring
- Public perception and acceptance

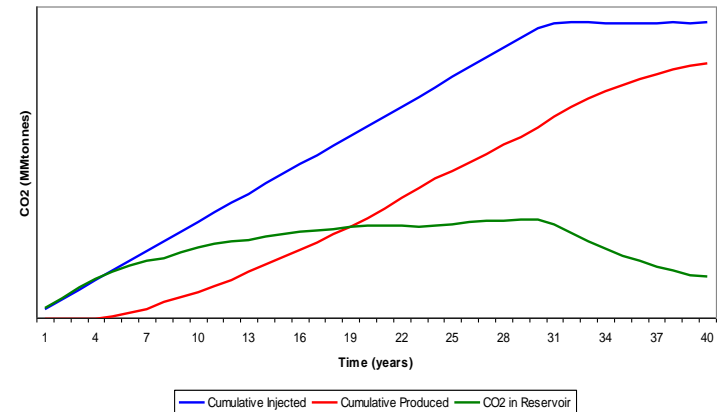
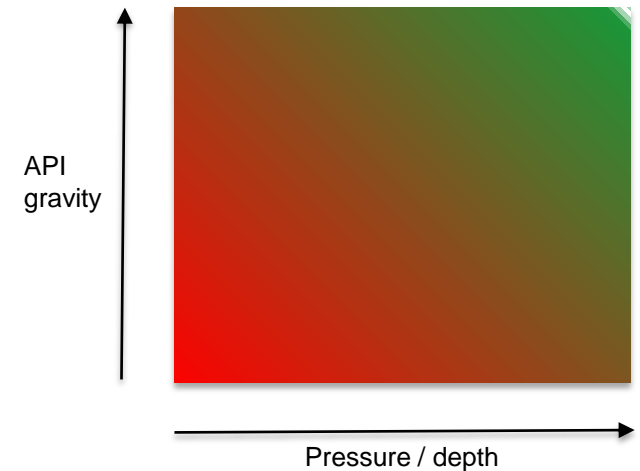


Source CO2CRC



Enhanced Oil Recovery (new)

- Oil in the reservoir must be miscible with CO₂
- “Rule of thumb” 1 tonne of CO₂ yields ~3 bbl oil
- Set up frequently requires detailed study (several years), capital and operating costs.
- Value of CO₂ and lifetime of project dependent on specifics
- EOR operator likely to want reliable steady supply
- CO₂ flashed off during crude processing. Collect and reinject. Needs management to ensure CO₂ is stored long term and to gain credits.
- Lead time required to incorporate into CCS project





Enhanced Oil Recovery (pipeline network)

- Exists when CCS project being considered so appraisal (risk) money avoided.
- Multiple fields can provide longer term certainty for offtake
- Long term offtake agreements can make project bankable.
- CO₂ ownership and management issues
- Changes risk profile of project
- Not common. Exists in parts of USA and Canada. Potential for Middle East?





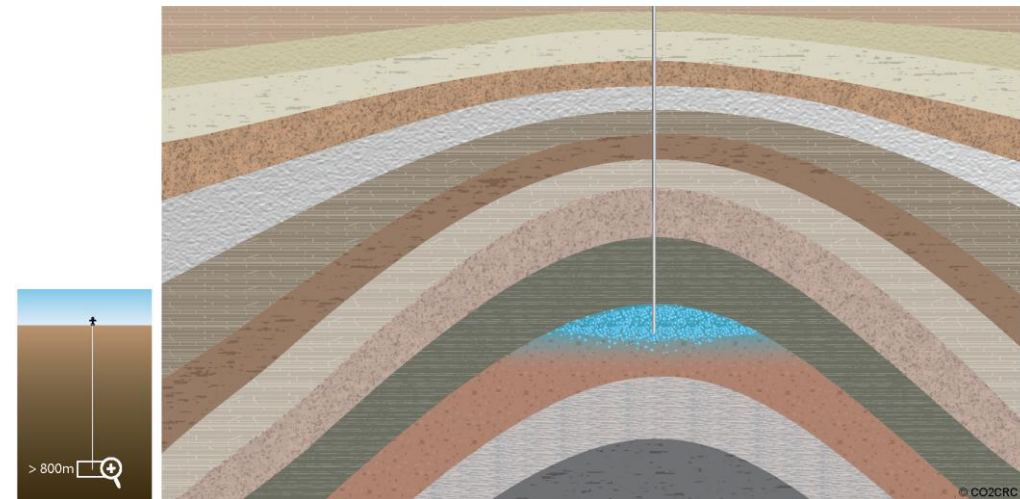
Depleted hydrocarbon fields

- Exists when CCS project being considered so appraisal (risk) money avoided.
- Access by negotiation
- Appraisal costs sunk
- Seal integrity proven
- Storage volume confidence
- Reuse of facilities
- Opportunity for operator to defer abandonment
- Relatively easy to explain to community
- Well integrity?
- Timing critical. Short window of opportunity.
- Not a “pot of gold” at current CO₂ prices



Saline aquifers - anticline

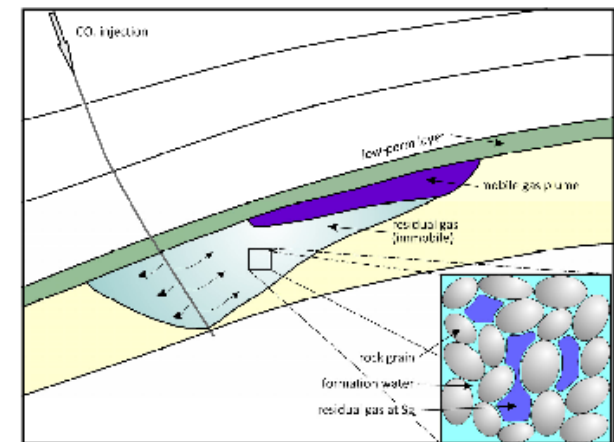
- Initial data is usually sparse.
- Exploration and appraisal effort similar to O&G fields required. ca \$100M before FID
- CO₂ stored against seal layer, ie reliant on seal
- Some CO₂ will dissolve and mineralise in (very) long term.
- Tenure arrangements not finalised everywhere. Probably competitive bid.
- CCS power project has O&G risk and (usually) poor return
- Not the same timing issues as HC fields



Source: CO2CRC

Saline aquifers - open

- Data is usually sparse. Exploration and appraisal required. ca \$100M before FID
- CO₂ trapped within pores. Migration extent depends on volume and rock properties. Not the seal.
- Probably the most secure form of storage
- Probably most difficult to prove
- Some cases require very large quantities of CO₂ to prove. Chicken and egg.
- Storage potential very large. (1000 – 10000Gt IPCC Special Report on CCS)



Source: QLD Carbon Dioxide Geological Storage Atlas 2009

Summary

- Very different project timelines and risk profiles for each type of sink.
- Timing is key for depleted HC
- Vast amounts of storage potential in open saline aquifers

