

Technical Group Meeting  
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Chatou, France



# Feasibility of CO<sub>2</sub> Storage Reservoir Management Activities

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Australia

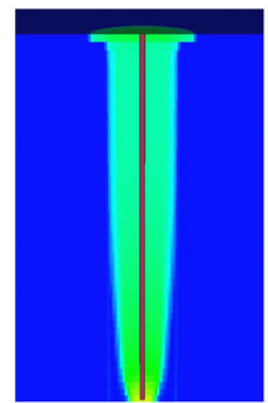
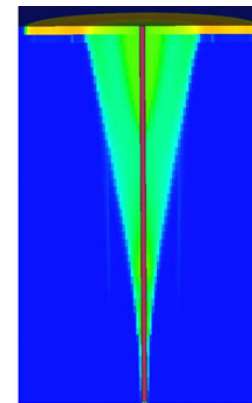
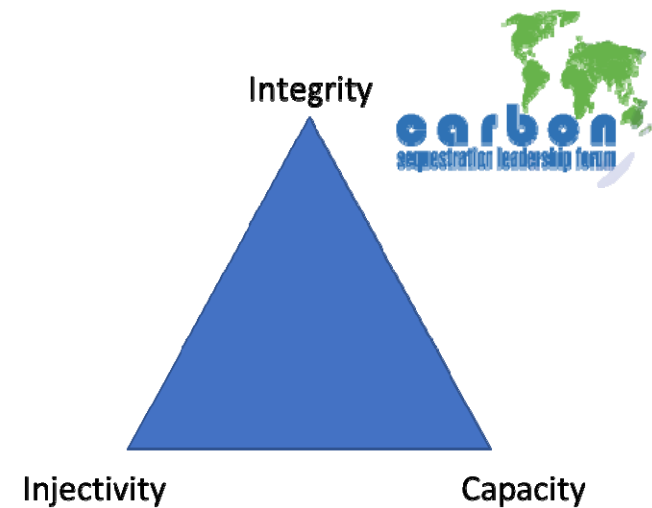
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# Rationale for Storage Reservoir Management

1. Risk management –
  - CO<sub>2</sub> injection-related reservoir pressure management
  - CO<sub>2</sub> plume migration direction control
2. Increased pore space utilisation –
  - Improved CO<sub>2</sub> sweep efficiency
  - Increased secondary trapping of CO<sub>2</sub>
  - Limitation of CO<sub>2</sub> plume's lateral spread

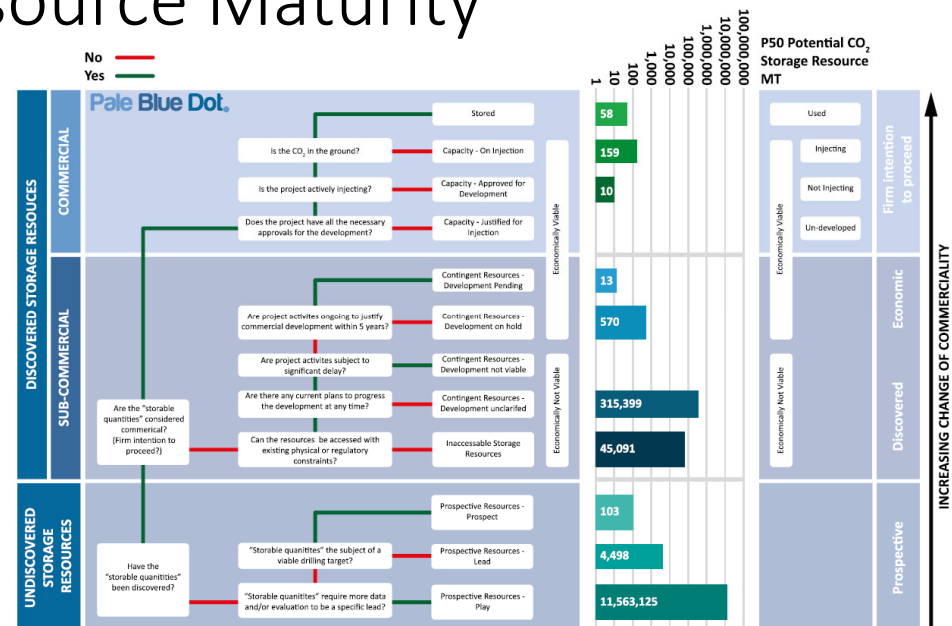
## Issue:

- Pilot scale studies limitations
- Limited commercial scale demonstration

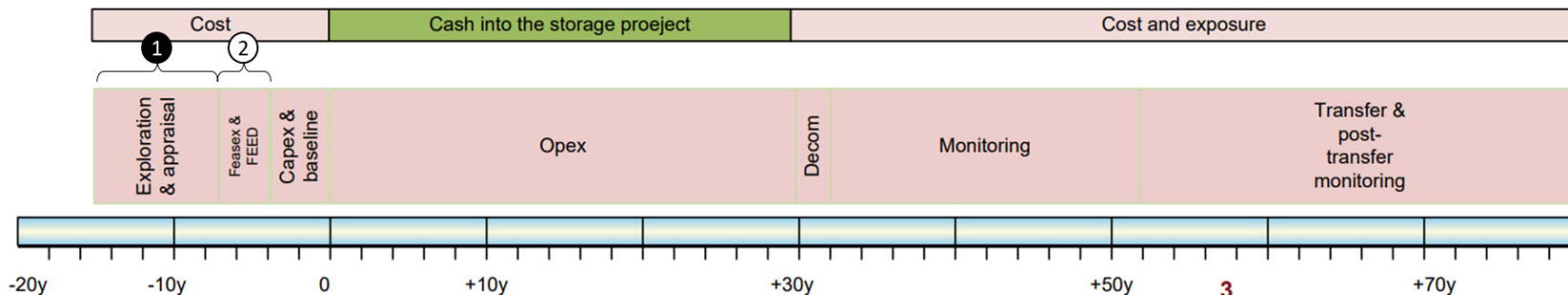


# CO<sub>2</sub> Storage Targets and Resource Maturity

- CSLF Technology Roadmap Targets:
  - 2025: 1,800 Mt (400Mtpa), and
  - 2035: 16,000 Mt (2,400Mtpa)
- Internationally estimated storage resource: ~12,000,000 Mt
- Investment ready storage resources: ~750 Mt
- Challenge to increase resource:
  - Geographically - Increase effort in exploration & appraisal urgently required
  - Site specific - Improved pore space utilisation in the feasibility and design



OGCI: Multinational CO<sub>2</sub> Storage Resource Assessment, 2017



ZEP: The case of a 'market maker' and a business model for CO<sub>2</sub> storage, 2016

# CSLF's Improved Pore Space Utilisation (IPSU) Task Force Summary



P	Technology Type	Prior R&D and application	Technology Readiness Level (TRL) <sup>2</sup>	Technology Prospectively	Core Recommended Action
1	Microbubble CO <sub>2</sub> Injection	Laboratory and Modelled, prototype	TRL 4	High potential	Trial at in field research facility
2	Swing Injection	Laboratory and Modelled	TRL 3	High potential	Validate technology at lab scale
3	Increased Injection Pressure	Laboratory and Modelled	IHL 3	High potential	Validate technology at lab scale to assess sweep effectiveness in heterogeneous reservoirs
4	Active Pressure Relief (increase sweep & reduce lateral spread)	EOR, planned for Gorgon CO <sub>2</sub> injection project	TRL 6	High potential	Pressure relief - Key lessons drawn from active commercial project using pressure relief wells as a risk mitigation technique
5	Foams (block high permeability pathways)	EOR	TRL 6	Reasonably well understood	Modelling of application effectiveness prior to Demonstration at commercial scale
6	Passive Pressure Relief	Modelled	TRL 4	Limited effectiveness	Trial at field research facility. Consideration around long-term fluid management
7	Polymers (increase formation water viscosity)	EOR	TRL 7	Reasonably well understood	Cost effectiveness investigations.
8	Surfactants (reduce residual saturation of formation water)	EOR	TRL 7	Reasonably well understood	Demonstration at commercial scale <sup>3</sup>
9	CO <sub>2</sub> saturated water injection & geothermal energy	Laboratory and Modelled	TRL 3	Site specific & lower volume	Seek opportunity to trial PI-CO <sub>2</sub> technology at lab scale

## Not addressed in the IPSU TF:

Reservoir Management from a risk basis:

- Pressure relief\*
- Plume steering
- other pressure management techniques



IEAGHG report, 2012

## Well Engineering

- Reservoir access for optimised sweep
- Flow control, utilisation of heterogeneity\*
- other well engineering practices

## Barriers to flow

- Physical
- Chemical
- Biological

# Example: Emerging Activities – Commercial CCS

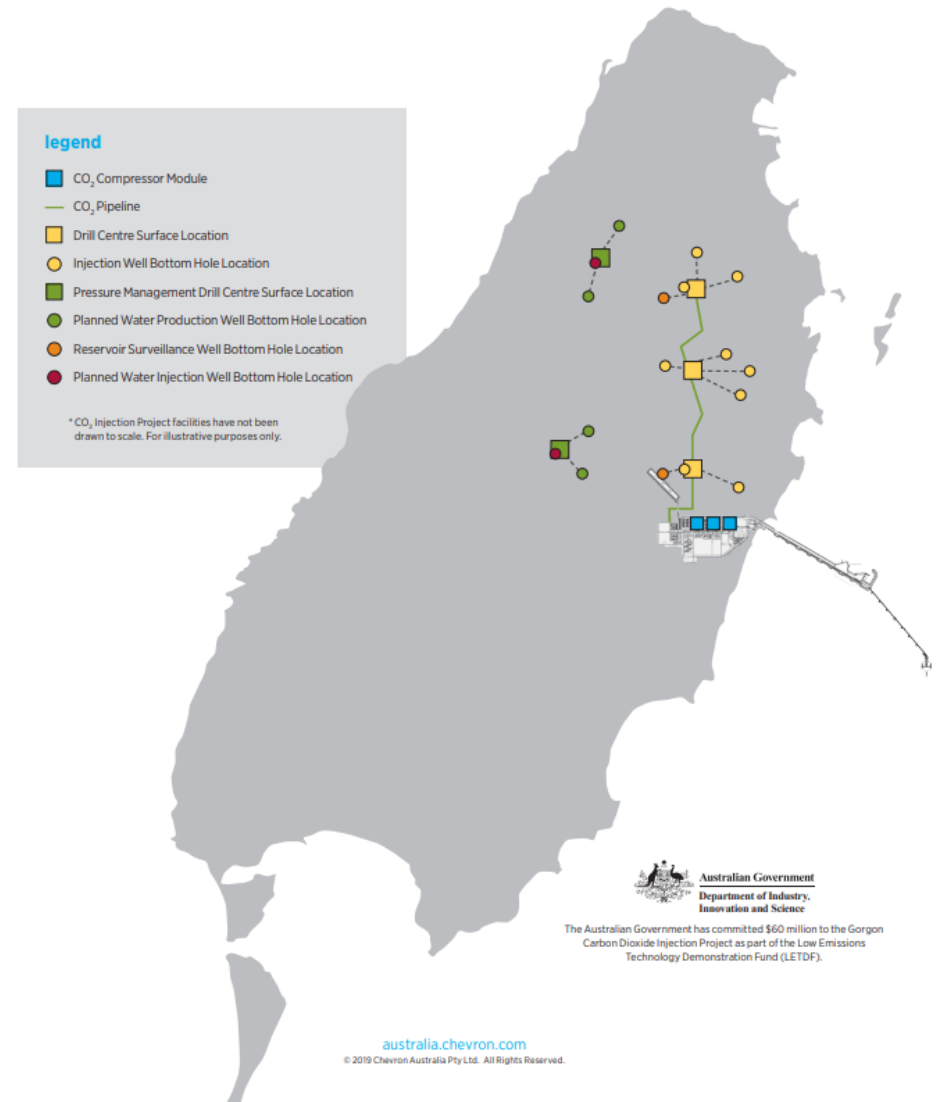
Gorgon's CO<sub>2</sub> Injection Project presents a future opportunity to understand the 'pressure management' operation, which is likely to be a common form of storage management for CCS into the future

## Project Summary

Gorgon's CO<sub>2</sub> Injection Project is the largest GHG abatement project undertaken by industry. The project will inject between 3.4 and 4 Mtpa of CO<sub>2</sub> and is expected to store 100 Mt of CO<sub>2</sub> in the Dupuy Formation over the life of the Gorgon Project.

CO<sub>2</sub> Injection Project facilities on Barrow Island include:

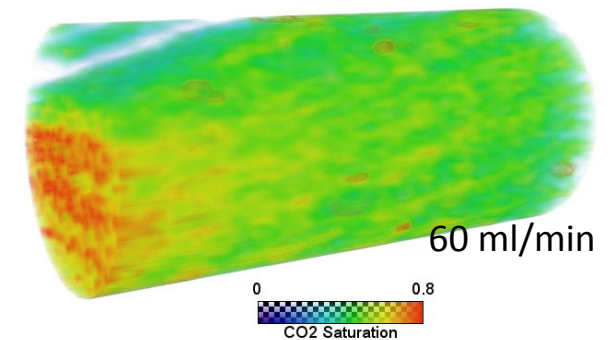
- Nine CO<sub>2</sub> injection wells at three drill centres
- **Two pressure management drill centres - Four water production wells - Two water injection wells**
- Two reservoir surveillance wells



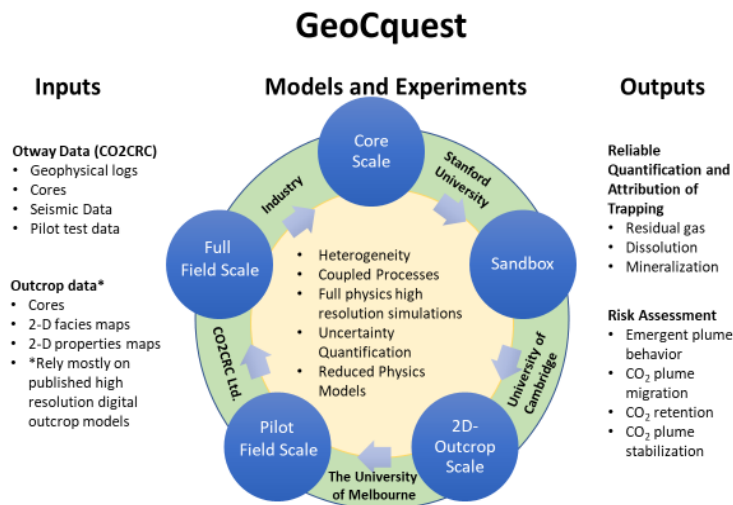
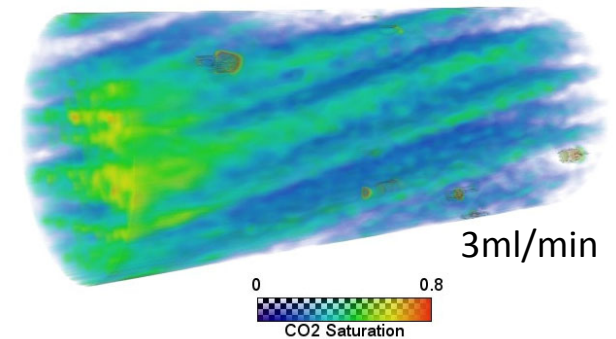
# Emerging Activities – R&D

- GeoCquest: BHP-supported collaborative of the Universities of Cambridge, Melbourne & Stanford in association with CO2CRC Ltd.
- GeoCquest was established to understand cm to metre-scale heterogeneities, not normally incorporated into flow models.
- GeoCquest at a bench scale has demonstrated the impacts of heterogeneity to plume migration and trapping processes.
- Field scale testing is currently being assessed to validate bench scale observations through the CO2CRC's Otway Stage 3 experiment

High Flow: Viscous dominated



Low Flow: Capillary dominated



# Summary & Recommendations

- Outcomes from the recent “OGCI: Multinational CO<sub>2</sub> Storage Resource Assessment” illustrates the near-term action required for continued safe CO<sub>2</sub> storage operations, whilst enhancing storage efficiency
- CSLF can flag the importance of effective storage reservoir management by leveraging international activities:
  - Engaging commercial CCS projects (CSLF-recognised) with synergies & complementarities in the effective storage reservoir management and provide feedback to CSLF delegates, observers and CEM.
  - Engaging R&D organisations, through the Academic TF & Council, with synergies & complementarities in the effective storage reservoir management and promote their efforts to CSLF delegates, observers and CEM.
  - Continue actively soliciting CSLF’s recommendations for improved pore space utilization.
- It is recommended that CSLF continue to follow this topic and note any updates through future TG meetings. A future review of the topic would be useful as commercial data is generated.