

State of Play of CCS and where to from here?

A regulator's perspective

Michael Malavazos

Director Energy Regulation

Department for Energy and Mining

South Australia

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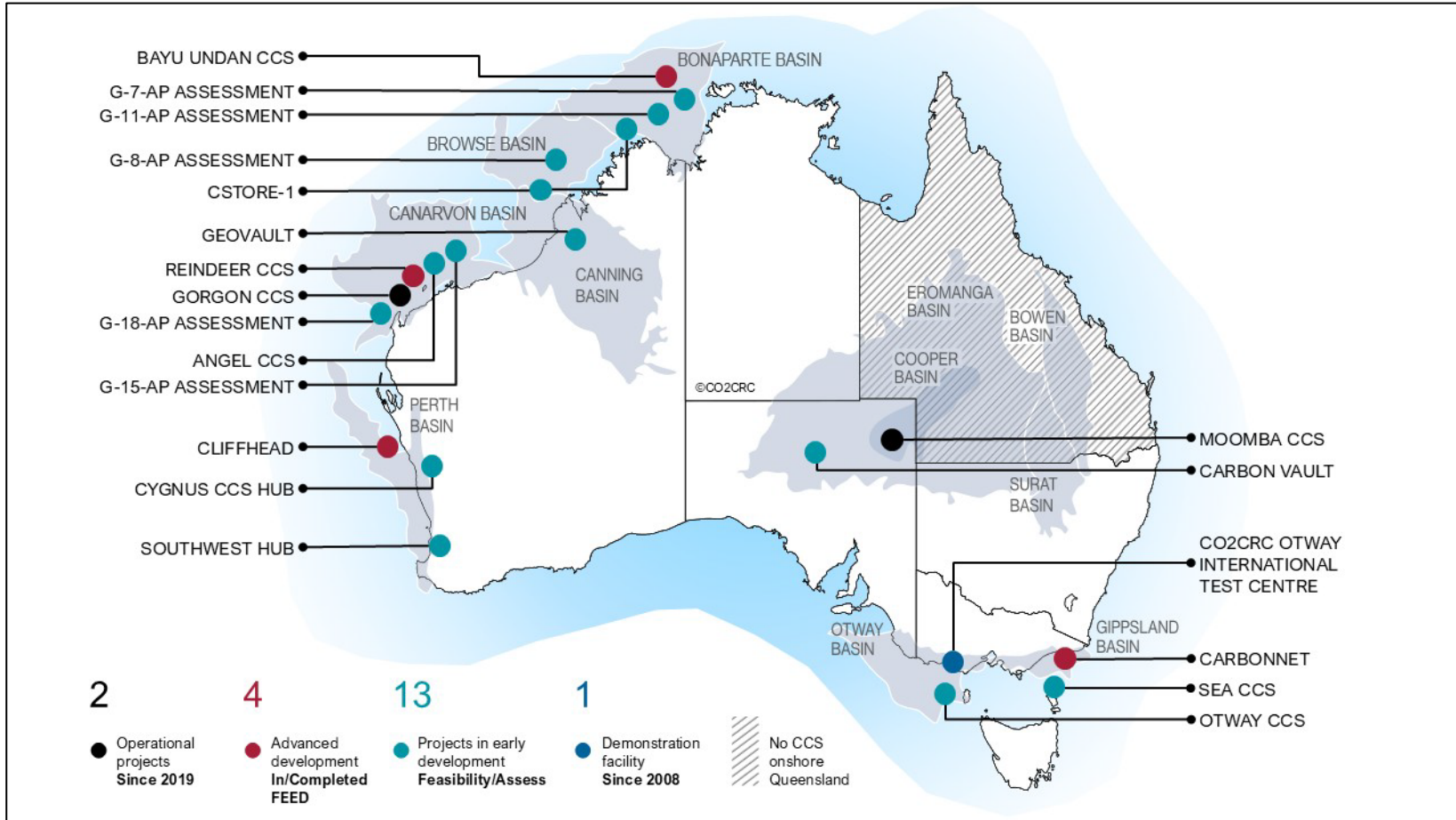


Content



- Status of CCS interest in Australia
- Background on CCS legislation in Australia;
- Example of CCS project regulated under such legislation;
- Role of regulation for community confidence in CCS:
 - Monitoring & Verification;
 - Transparency – publish and explain M&V results
- Important technical challenges with CCS; and
- Where to from here with CCS deployment.

CCS Operations in Australia



Source: co2crc

CCS Offshore Permits in Australia

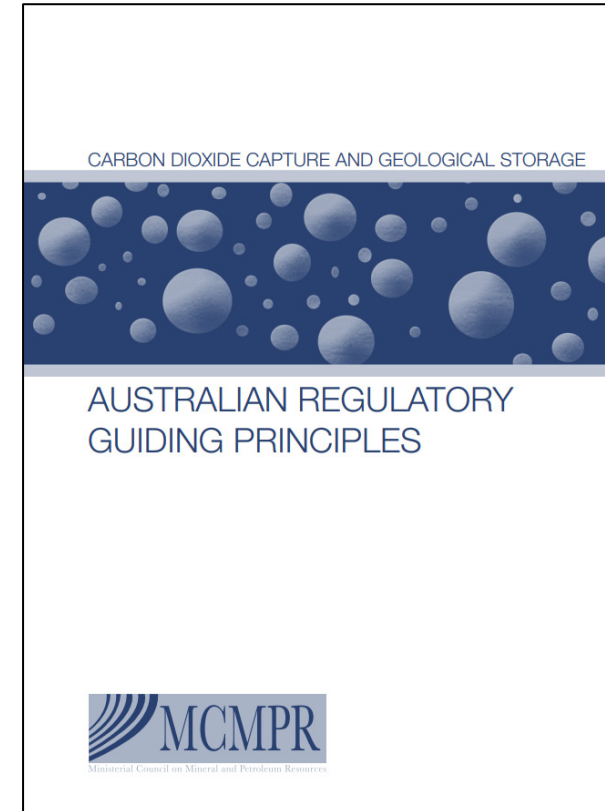


Source: NOPTA

Effective CCS Legislation – historical context

In 2005 COAG/MCMPR published guiding regulatory principles for CCS, calling for:

- Effective resource access and property rights
 - *Secure CCS storage rights – industry investment certainty*
- Nationally consistent assessment and approval processes
 - *Risk based regulation – Process Safety Management framework*
- Effective Monitoring and Verification
 - *Demonstrate CCS is working*
- Long term liability post closure
 - *Once secure storage is demonstrated – liability reverts to state*



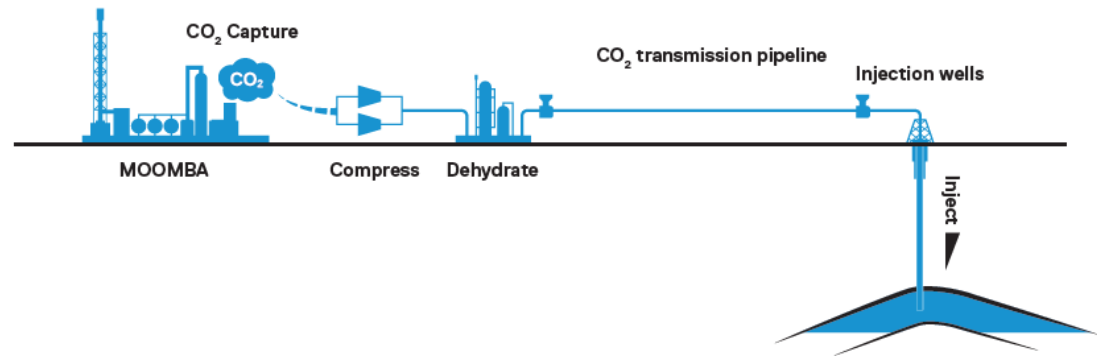
Example: Regulatory Framework

- South Australian *Energy Resources Act 2000* covers all CCS stages - established in 2009 in response to the 2005 COAG/MCMPR guiding regulatory principles
- Why regulate CCS:
 1. Underground resources in Australia belong to the Crown – including the pore space for CCS.
 2. Licensing – secure rights and tenure
 3. Environmental assessment –
 - a) focussing on risks and objectives to address those risks
[Moomba CCS Project EIR](#) and [Moomba CCS SEO](#)
 - b) early stakeholder engagement
 - c) adoption of relevant and recognised standards
 4. Efficient and effective approvals and surveillance
 5. Effective and transparent Monitoring and Verification
[Monitoring and Verification Plan](#)
 6. Rental payments for use of pore space
 7. Minimise risks of long-term liability

Version: 11.7.2024	
South Australia	
Energy Resources Act 2000	
An Act to regulate exploration for, and the recovery, production, transmission, storage and management of, certain energy resources, and for other purposes.	
Contents	
Part 1—Preliminary	
Division 1—Formal	
1	Short title
Division 2—Objects of Act	
3	Objects
Division 3—Interpretation	
4	Interpretation
Division 4—Rights of the Crown	
5	Rights of the Crown
Part 2—Administration	
Division 1—The Minister	
6	Administration
6A	Interaction with other legislation
7	Delegation
Division 2—Authorised officers	
8	Authorised officers
9	Identity cards
Division 3—Authorised investigation or survey	
9A	Authorised investigation or survey
Part 3—Licensing regulated activities	
Division 1—Requirement for licence	
10	Regulated activities
11	Requirement for licence
Published under the <i>Legislation Revision and Publication Act 2002</i>	
1	

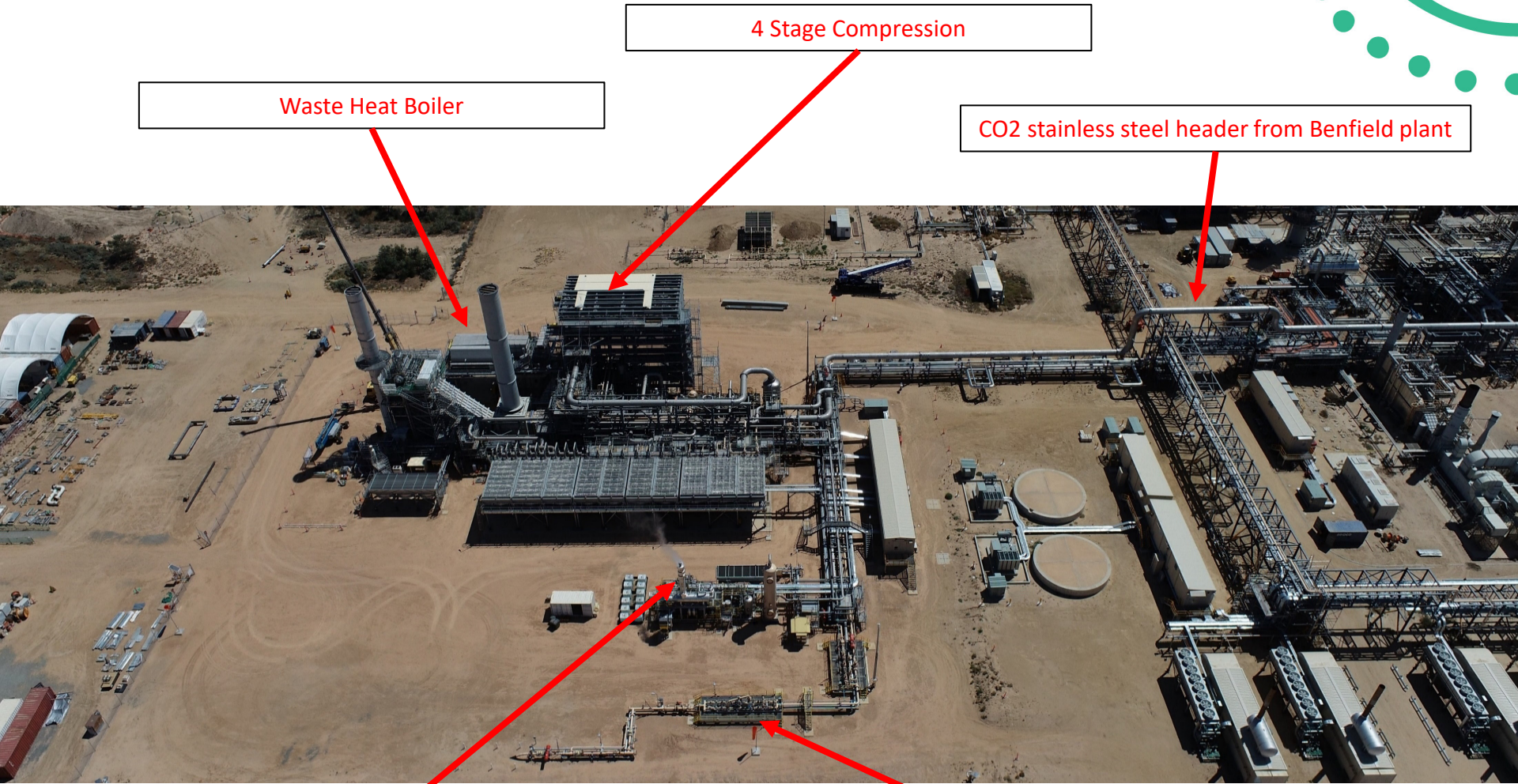
Moomba Carbon Capture and Storage Project

- First phase operational since 30 September 2024.
- Current injection of 1.7 Mtpa CO₂ from Moomba processing plant to depleted fields.
- 1.7 Mtpa represents approximately **7% of South Australia's total emissions**.
- Future phases target injection of 20 Mtpa from other local and international sources.
- Direct air capture trials planned at Moomba.



Source: Santos Ltd.

Moomba CCS Facility



4 Stage Compression

Waste Heat Boiler

CO2 stainless steel header from Benfield plant

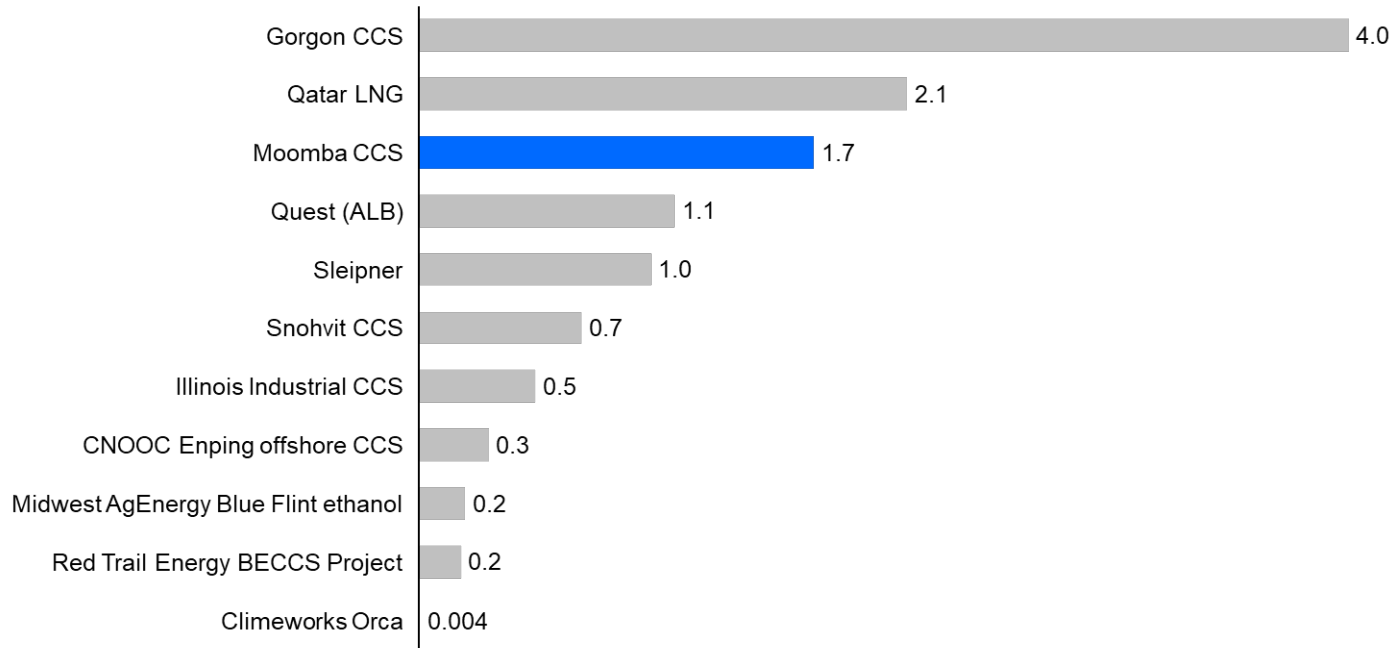
TEG Dehydration Unit

Metering and Pipeline Export

Source: Santos Ltd.

CCS Facilities Globally

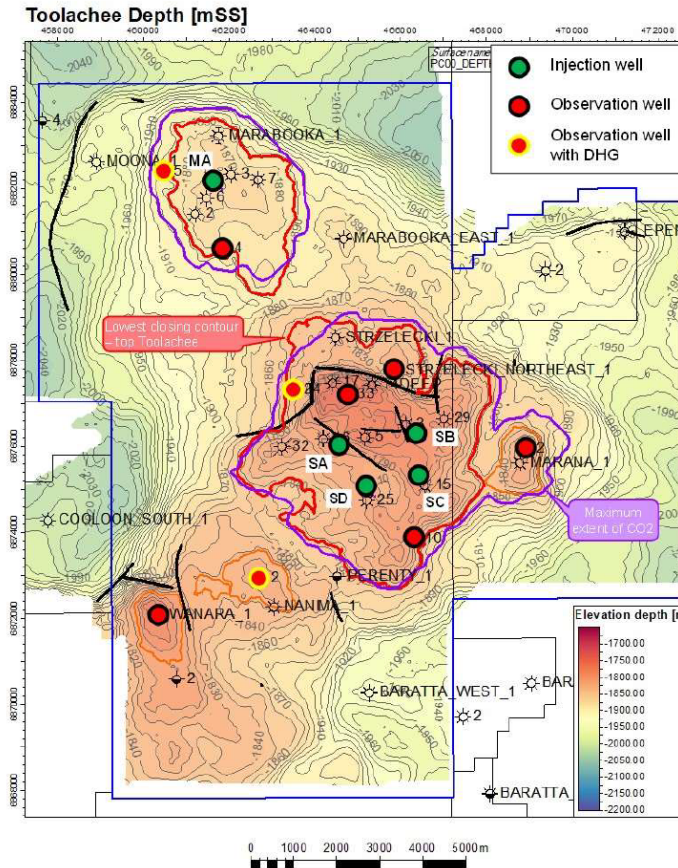
Announced capacity of dedicated storage CCS projects mtpa, IEA database



<https://www.iea.org/data-and-statistics/data-product/ccus-projects-database>, accessed 16th July 2024 by Santos Ltd.



Moomba CCS Injection Site



Moomba CCS Cross Section

- Storage formation at ~2km depth.
- Multiple overlying sealing formations.
- Storage formation previously contained gas for ~85 million years.

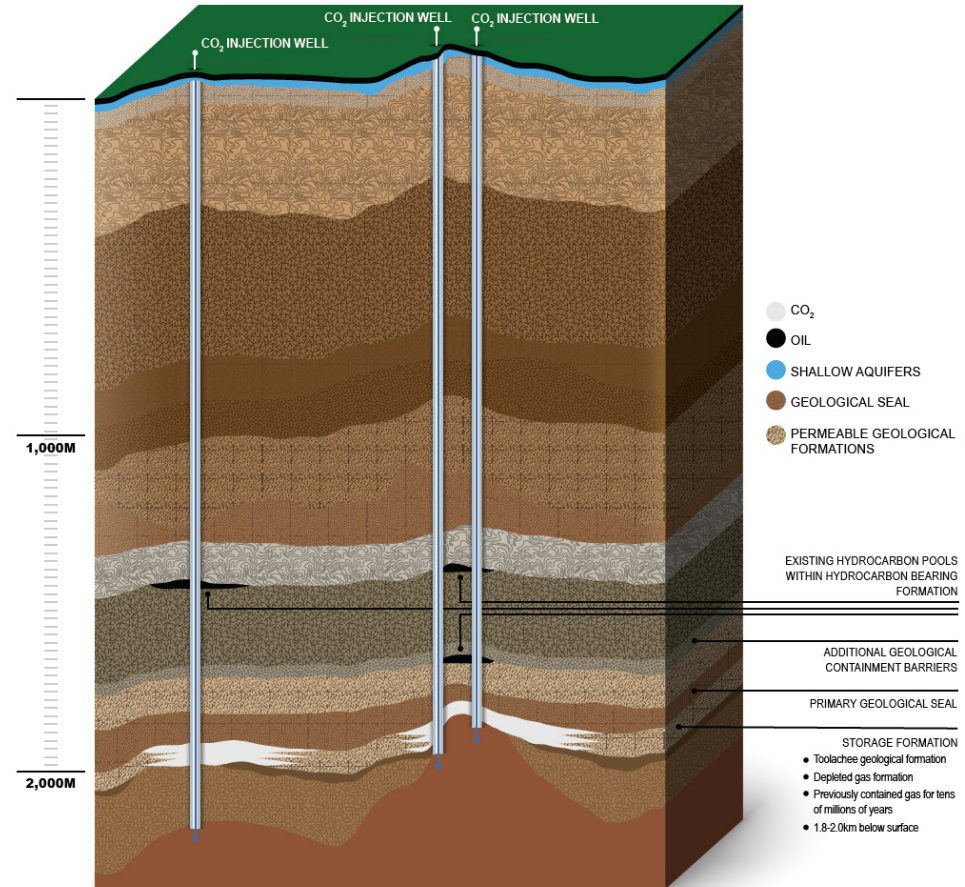


Figure 2 Strzelecki and Marabooka CCS Storage Complex

Source: Department for Energy and Mining

Moomba CCS Environmental Approval



- Objective/Risk based approach
- Environmental Impact Report (EIR)
 - Addresses all environment risks (natural/social/economic) and how risks will be managed to ALARP. – [Moomba CCS Project EIR](#)
- Statement of Environmental Objectives (SEO)
 - Prepared on the basis of addressing relevant risks detailed in the EIR:
 - Environmental objectives to be achieved
 - Assessment criteria to measure objectives
 - Gazette – activity and location specific regulation
 - [Moomba CCS SEO](#)
 - Key SEO requirement: approved public [Monitoring and Verification Plan](#)



MOOMBA MONITORING AND VERIFICATION PLAN

<https://www.energymining.sa.gov.au/industry/energy-resources/regulation/projects-of-public-interest/cooper-basin-carbon-storage>

Santos

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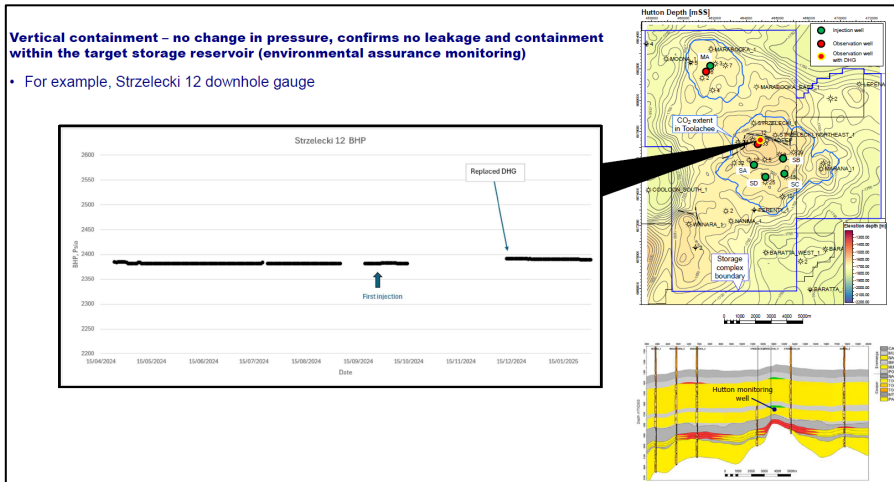
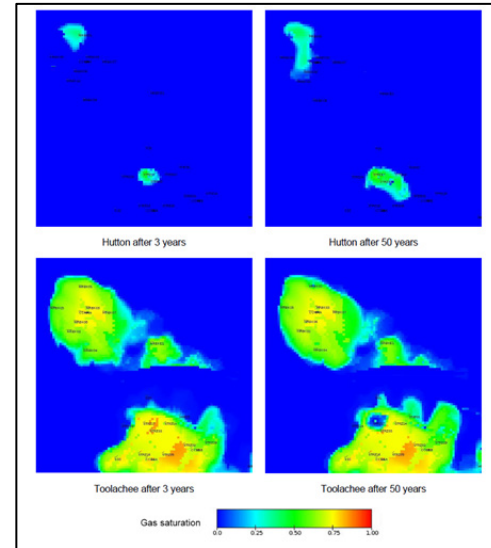
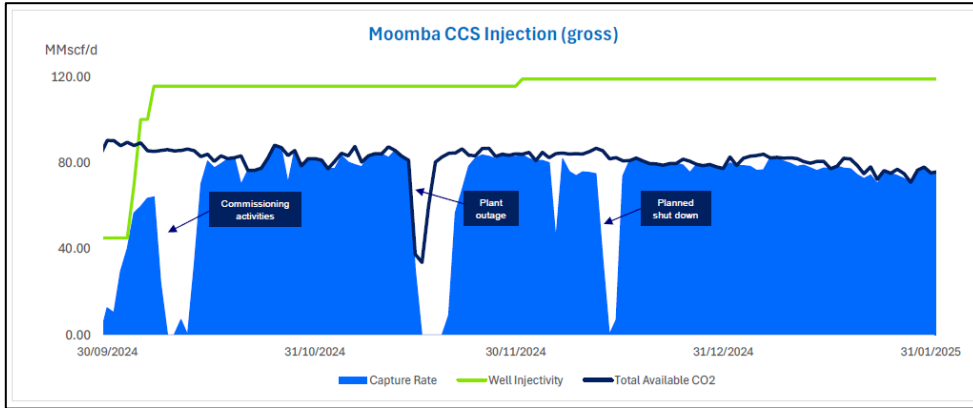
**Moomba CCS project – Strzelecki
and Marabooka Toolachee
monitoring and verification plan**



Santos



- Establish community confidence in CCS by proving that CCS works – tell and show the world why CCS projects are proving to be successful e.g. Gorgon and Moomba – sell the wins!



[Link to public report](#)

Important technical CCS matters



- Above all, objective is to maintain greater than 95% CCS network availability – community confidence
- Understand the underground geology and hydrodynamic behaviour of CO₂ plume
- Understand CO₂ phase behaviour (gas vs dense phase) for a particular CO₂ Stream specification
- Know your CO₂ stream specification/composition – establish what impurities are present
- Impurities affect phase behaviour – in turn can lead to uncontrollable corrosion
- Expected phases of operation, pressure and temperature variations due to:
 - Start-ups: – incl. commissioning
 - Shut-downs: planned and unplanned
 - Depressurisation events: planned and unplanned
- Material selection and dehydration: addressing corrosion risks – don't forget what happened at Gorgon!



Where to from here for CCS?

Some observations to progress CCS:



- Above all: must have consistent federal government CO₂ abatement policy, best to be technologically agnostic – don't pick winners – allow all technologies to serve their purpose
- Remove potential policy barriers to CCS deployment
- Best achieved through an effective financial incentive framework – e.g. ACCUs/carbon price/effective safe-guard mechanism?
- Recognise and acknowledge that CCS is “a” CO₂ abatement technology not “the” abatement technology
- Won't be long before narrative moves from “net-zero” to “net-negative” – hence importance of CCS
- Efficient, effective and practical regulation premised on:
 - Continuing development and implementation of best practice CCS standards including (M&V)

Some observations to progress CCS:



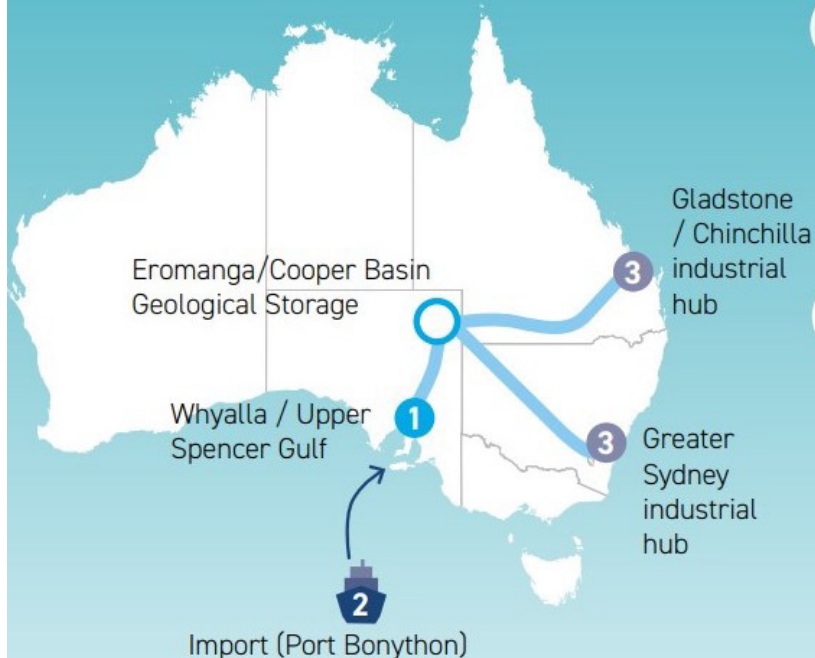
- Need economies of scale: establish CCS hubs – adjacent to point sources – e.g. steel/cement/power plants
- Viable Ship transport – Australia has potential to become Asia’s CCS hub!
- Regional hub maybe? Australia/Indonesia work together?
- Government/industry partnerships
– particularly for key infrastructure ([SA Government CCUS Infrastructure Report](#))
- Establish community confidence in CCS by proving that CCS works – tell and show the world why Gorgon and Moomba CCS projects are proving to be successful – sell the wins!



South Australian CCUS Infrastructure Report

Next Steps

ISA undertook this study to understand the potential establishment of a CCUS industry in SA and the ability to address local, national and international opportunities. This study indicates that a range of opportunities exist for SA and presents one potential scenario for infrastructure and partnerships. The next steps will further explore the opportunities and feasibility of CCUS for SA.



1

CCUS Partnerships – Establish a holistic CCUS forum (network or similar) across all elements of the supply chain, including regulators, industrial emitters, technology partners, potential owners/operators, and research and development partners.

2

Development Pathway – Undertake a strategic assessment of the frameworks under which a CCUS ecosystem would be developed, regulatory approvals, engage with supply chain operators, and undertake analysis of discrete project elements and business models

3

Detailed Business Case – A detailed business case will be developed for feasible opportunities identified as part of Step 2, including preferred operating model and underpinning infrastructure

Contacts

Michael Malavazos

Department for Energy and Mining

11 Waymouth Street,
Adelaide, South Australia 5000
GPO Box 320
Adelaide, South Australia 5001
T: +61 8 8463 3000
E: demreception@sa.gov.au

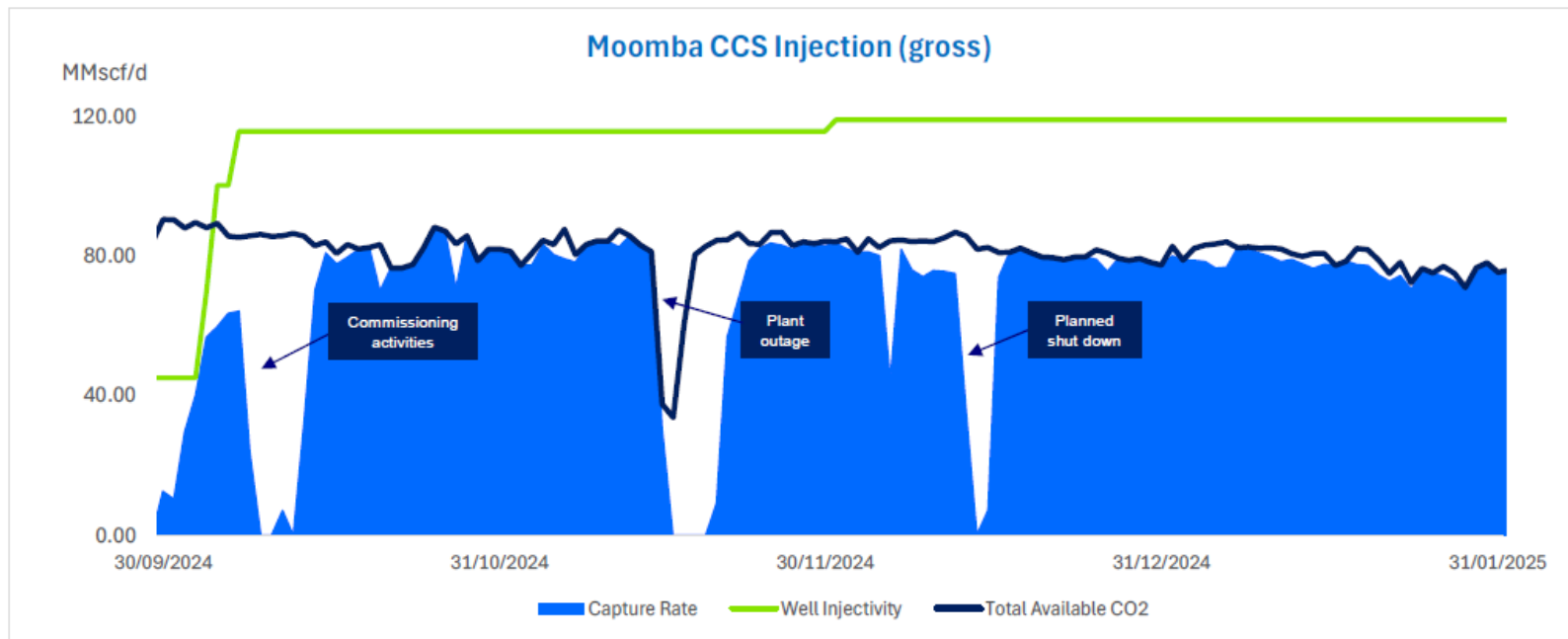


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Additional Slides for Moomba M&V



Moomba CCS Operation

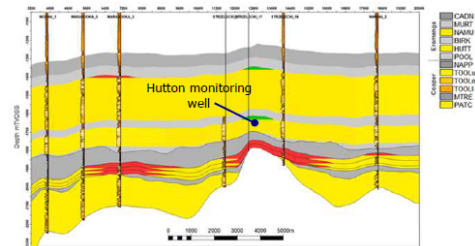
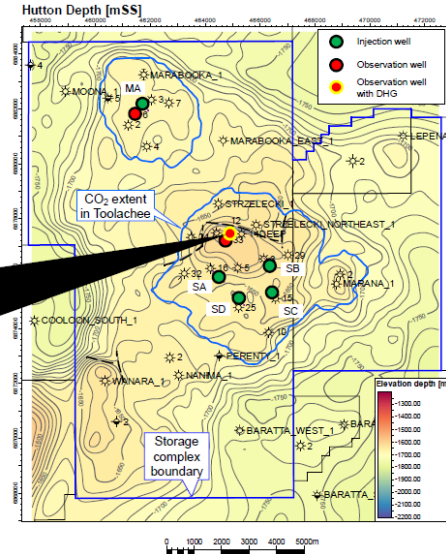
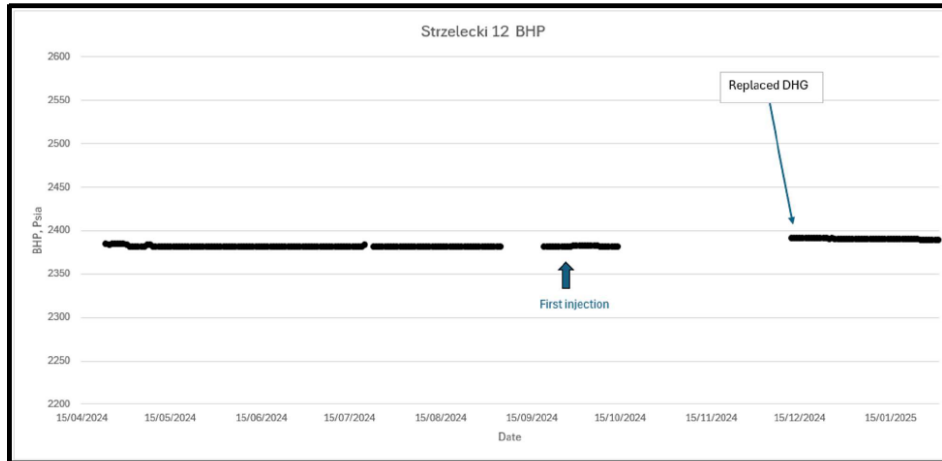


Monitoring Data



Vertical containment – no change in pressure, confirms no leakage and containment within the target storage reservoir (environmental assurance monitoring)

- For example, Strzelecki 12 downhole gauge

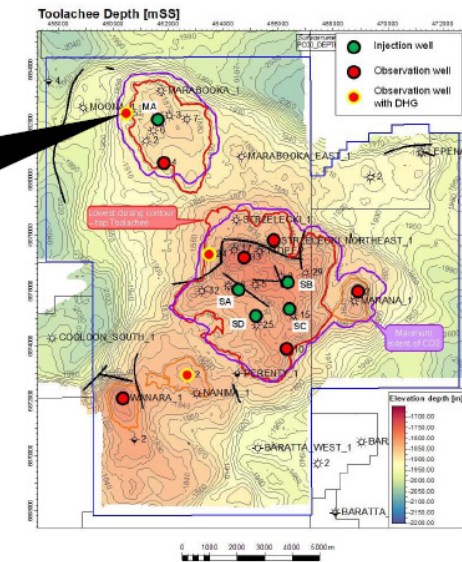
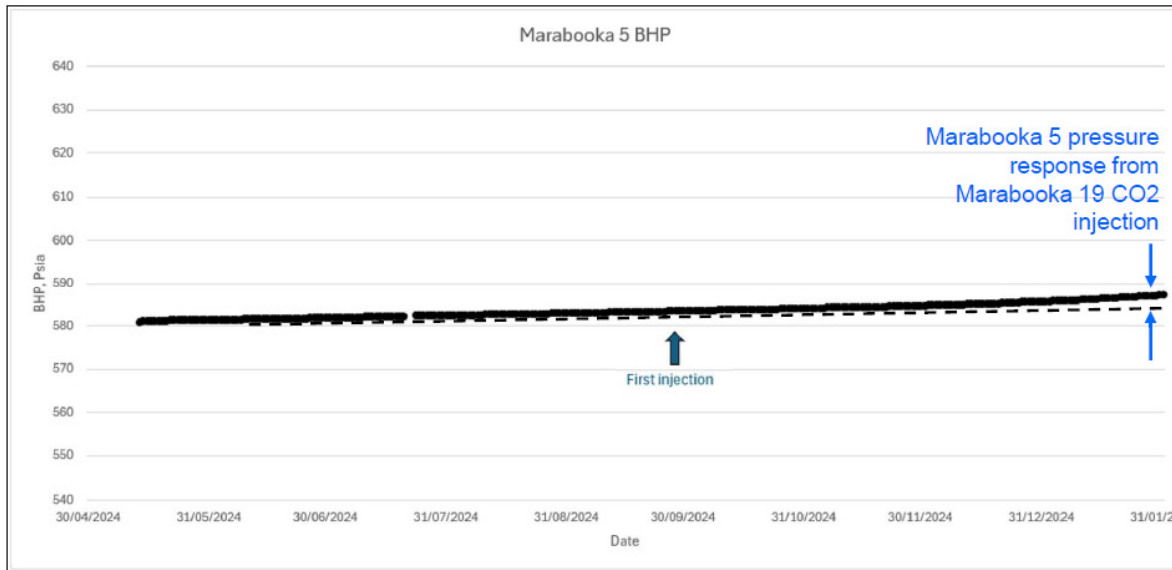


Monitoring Data

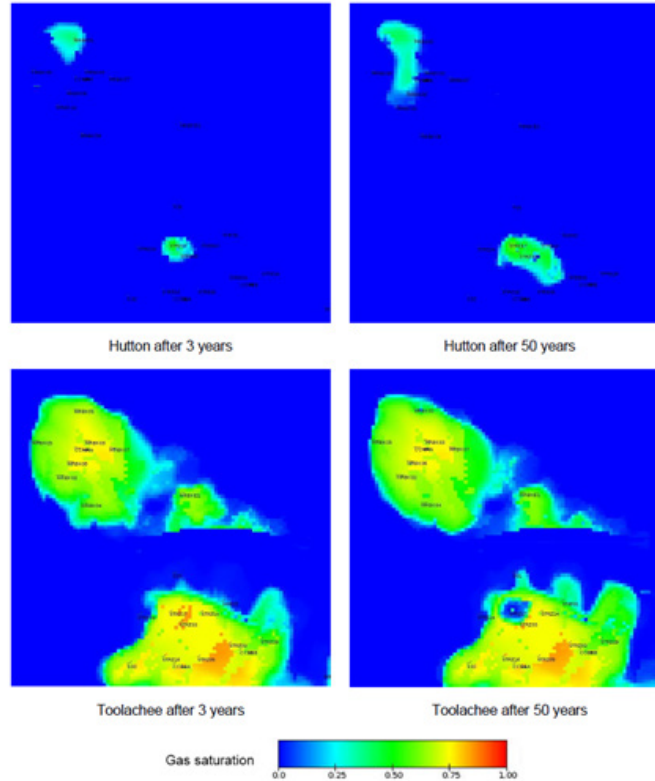


Lateral containment – pressure response to CO2 injection is consistent with modelled containment within the target storage reservoir

- For example, Marabooka 5 downhole gauge



Moomba CCS Reservoir Model



Source: Santos Ltd

