CCS in Australia's transition to a low emissions future

Enabling industrial scale emission abatement

Dr Matthias Raab

Chief Executive Officer

CCS Technical Workshop, Tokyo, Japan

24 January 2024

CO2CRC is a world leader in applied CCUS research

We do research and commercially relevant demonstrations in CCUS applications.

We build and operate first of a kind plant and equipment.

We develop industry led technology options to accelerate commercial deployment.

We own and operate the Otway International Test Centre in South-West Victoria, Australia.

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Collaborative Research at the Otway International Test Centre

Trained over 60 PhDs

Published more than 400 peer reviewed journal papers

Between 40 – 180 researchers participating in our research program at any one time

'CO2CRC is a very successful model for organising a broad group of research providers and industry to accelerate the development of CCS. It has been particularly effective at establishing unique world-class research sites such as the Otway Project. The UKCCSRC values international partnerships, such as the links it has with CO2CRC.'

Prof Jon Gibbins Director, UKCCSRC

Research

Industry

Government

Carbon capture and geological carbon storage (CCS)

is

Proven – Safe – Reliable - Necessary

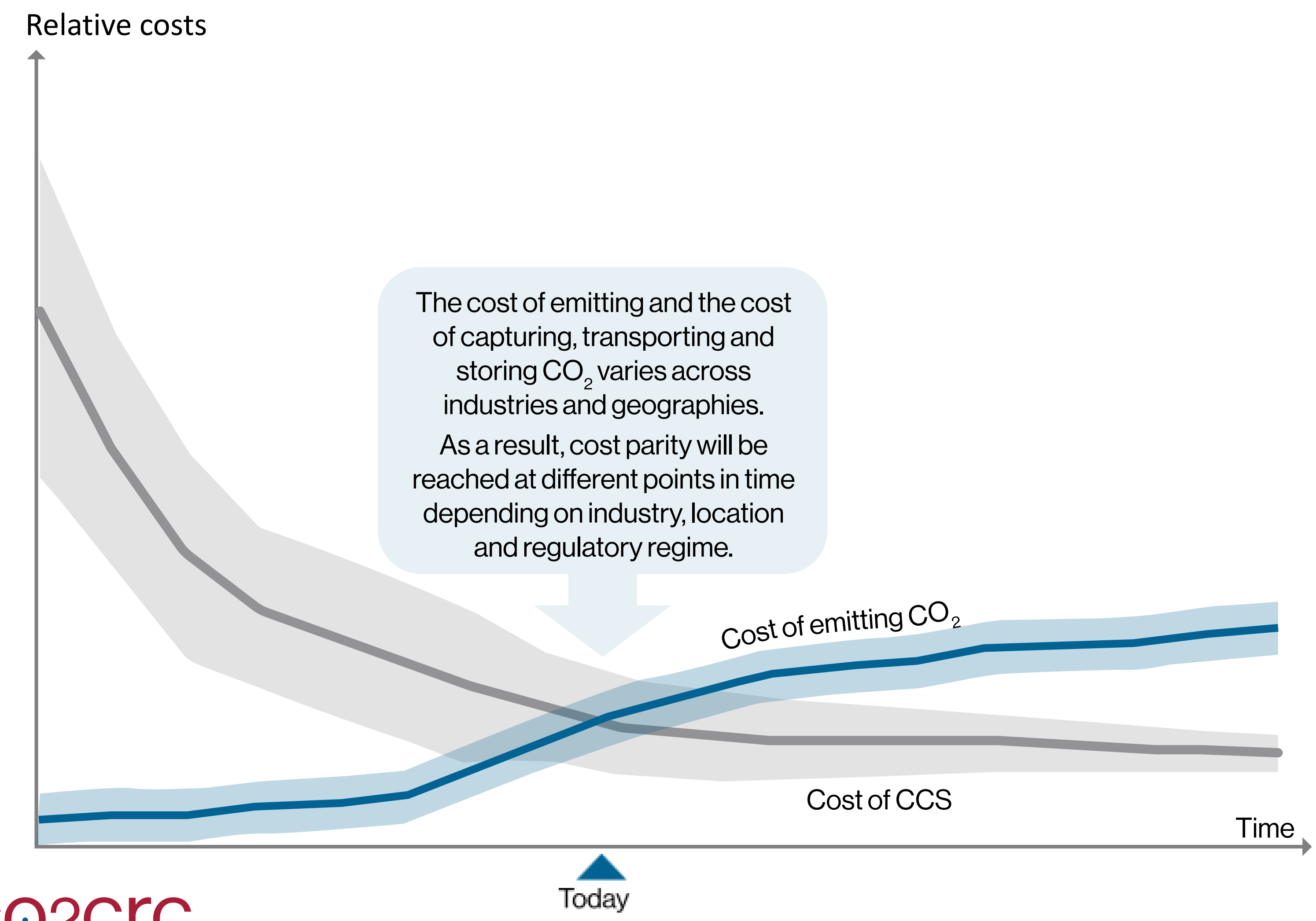
Carbon abatement or climate benefits

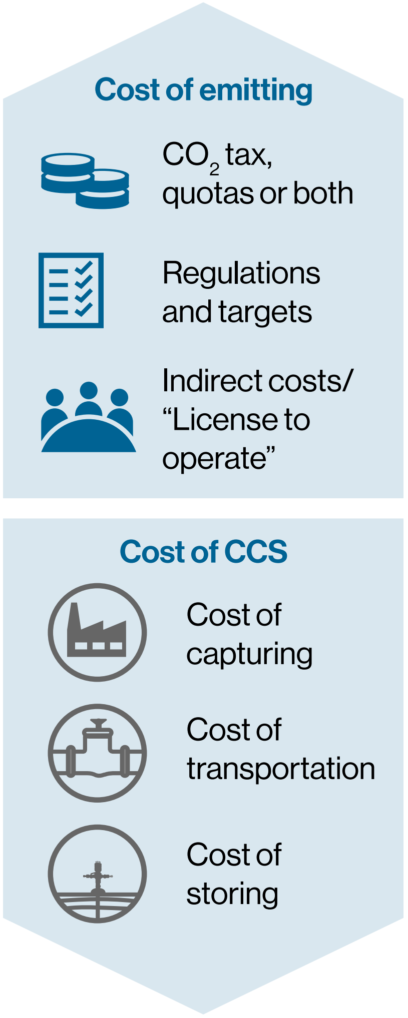
are

Immediate – Permanent – Large Scale

Recognising economic value of CCS

Cost of emitting CO_2 vs cost of CCS





Modified after Rystad Energy and analysis

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CCUS: lowest entry cost vs highest impact

	Example facilities emitting CO_2	Share of total global CO_2 emissions	Estimated cost range for captured CO_2
Concentrated CO_2 Streams	Ammonia **Natural gas processing** Petro chemical Ethanol	**<10%** Emitters of concentrated CO_2 streams exist across 100+ potential sites	✓ **~$15-50/ton** Lower-cost due to direct compression of CO_2 stream
Dilute CO_2 Streams	Petroleum refining Steel production Cement **Coal and gas to power**	✓ **~90%** Largest emitters, incl. electricity generation facilities across 1000+ potential sites	**~$45-200+/ton** Additional step to separate CO_2 from stream prior to compression

Source: OGCI and US Dept. of Energy (DOE)

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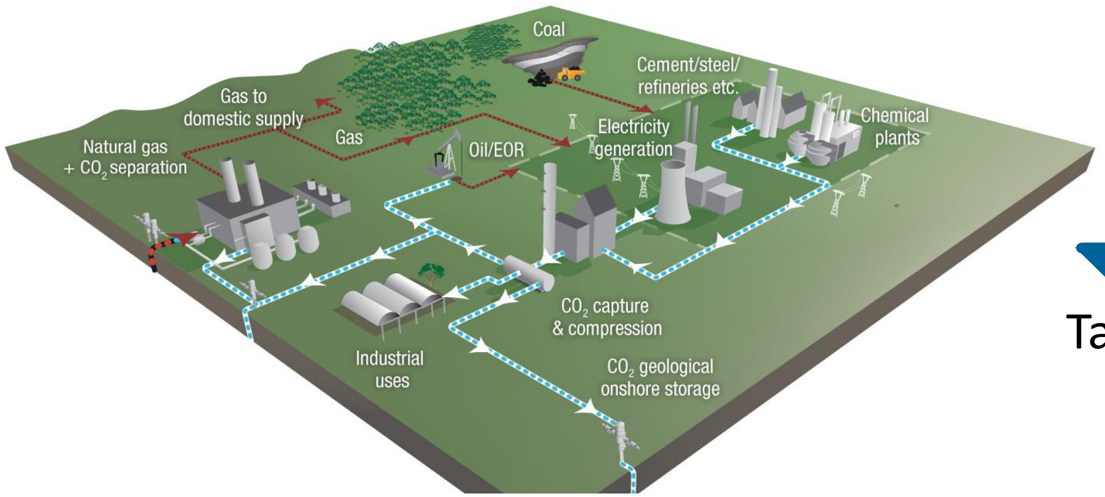
Enabling factors for Australia

Invest into Research & Development in CCS



CCS is an essential technology in Australia's Low Emissions Technology Statement

CCS policy

- Incentives to accelerate CCS projects
- Principles for an Australian CCS Policy Framework
- Specific proposals for Australian CCS

Tax Credits

Australian Carbon Credit Units (ACCUs)

Project Finance

Hard to Reduce Risks (Government)

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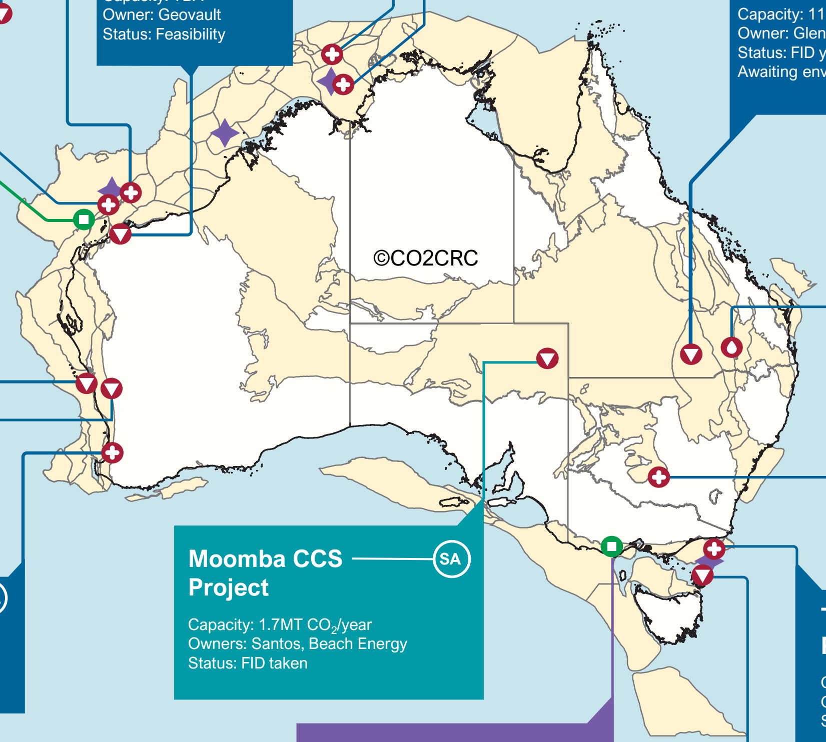
CCS projects 2021

CCUS Projects in Australia 2023

1 Operational Project

1 Final Investment Decision taken

14 Projects in feasibility



DeepCstore 1 (WA)
Capacity: TBA
Owner: DeepCstore
Status: Feasibility

Karratha CCS Project (WA)
Capacity: TBA
Owners: Woodside, BHP, BP, Chevron, Shell, MIMI
Status: Feasibility

Bayu Undan CCS Project (NT)
Capacity: 10MT CO_2/year
Owners: Santos, Timor Leste, Inpex, Eni, SK E&S and Tokyo Timor Resources
Status: FEED

Petrel CCS (NT)
Capacity: TBA
Owners: NT Gov, CSIRO, Santos, INPEX, Woodside, Eni, Origin Energy and Xodus
Status: Research phase

Gorgon (WA)
Capacity: 4MT CO_2/year
Owner: Chevron, ExxonMobil, Shell, Osaka Gas, Tokyo Gas, JERA
Status: Operational

Reindeer (WA)
Capacity:TBA
Owner: Santos
Status: Feasibility

Geovault (WA)
Carnarvon Basin
Capacity: TBA
Owner: Geovault
Status: Feasibility

CTSCo Project (QLD)
Capacity: 110,000 T CO_2/year
Owner: Glencore
Status: FID yet to be taken. Awaiting environmental approvals

Moonie CCUS Project (QLD)
Capacity: 10MT CO_2/year
Owner: Bridgeport Energy
Status: Early development

Midwest Clean Energy (WA)
Capacity: 500,000T CO_2/yr
Owners: Pilot Energy & Triangle Energy
Status: Feasibility

NSW CO2 SAP (NSW)
Capacity: TBA
Owner: Coal Innovation NSW
Status: Assess

Low Carbon Ammonia Development (LCAD) (WA)
Capacity: TBA
Owners: Mitsui/Wesfarmers & JOGMEC
Status: Feasibility

Moomba CCS Project (SA)
Capacity: 1.7MT CO_2/year
Owners: Santos, Beach Energy
Status: FID taken

South West Hub (WA)
Capacity: 800,000 T CO_2/year
Owner: Western Australian Government
Status: Research phase

The CarbonNet Project (VIC)
Capacity: 5MT CO_2/yr
Owner: DJPR
Status: Pre-FEED

CO2CRC Otway International Test Centre (VIC)
Capacity: Demonstration facility
Owner: CO2CRC
Status: Commercial demonstrations

The SEA CCS Hub (VIC)
Capacity: 2MT CO_2/yr
Owner: ExxonMobil
Status: Feasibility

Legend

- Operational
- CO2-EOR
- CCS
- Storage hub
- Offshore CCS permits
- Geological Basins

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What Does (Or Could) The Future Look Like?

- CCS-CCUS is in a great place in Australia and the future looks bright, with a large number of new and substantial projects in the early to mature phases of evaluation
  - Driven by the wide acknowledgement within industry about the need to decarbonize and more recently by the 43% reduction by 2030 and by the net-zero 2050 targets
  - Most of the projects in the North West Shelf and Timor Sea are driven by LNG (a high-value product)
  - Projects in the South West of WA are mostly driven by the needs of the onshore heavy industrial emitters
  - Projects in southeastern Australia are a hybrid (SEA CCS at Bream and CarbonNet)
  - Substantial projects onshore in eastern Australia (Moomba CCS; Moonie CCUS etc, also hybrids)

- The next 5-15 years will probably represent the major "project roll-out" phase for CCS-CCUS, with a growing number of large projects coming on-stream

- But nothing is guaranteed, and major speed humps exist

What Could (Possibly) Go Wrong?

- The short answer is lots, including the following:
  - The regulatory framework is a genuine mixed bag
    - Varies state by state, and some states have no framework as yet; South Australia is the best
    - The Federal framework is comprehensive but is over 15 years old (when Windows XP reigned) and is not particularly fit for purpose contains lots of issues and inconsistencies which can produce genuinely perverse outcomes (examples to follow)
  - There are glaring omissions concerning ACCU credits (e.g., for CO2-EOR; Direct Air Capture or DAC), which are counter-intuitive and encourage higher emissions and poorer economic outcomes in some geologic settings
  - The regulators know all about petroleum but not necessarily CCS-CCUS
    - Some *"like DAC but not CCS"* (which suggests that tag and release is the goal) and so education is critical
  - The science supporting CCS (e.g., monitoring and verification) is moving fast and is not reflected in the regulations (e.g., "old school" emphasis on 4D seismic for plume monitoring etc.)

CO2CRC's Otway International Test Centre

CO2CRC's Otway International Test Centre enables field scale research and development of CCUS technologies for commercial deployment.

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Otway International Test Centre

Key Success Factors

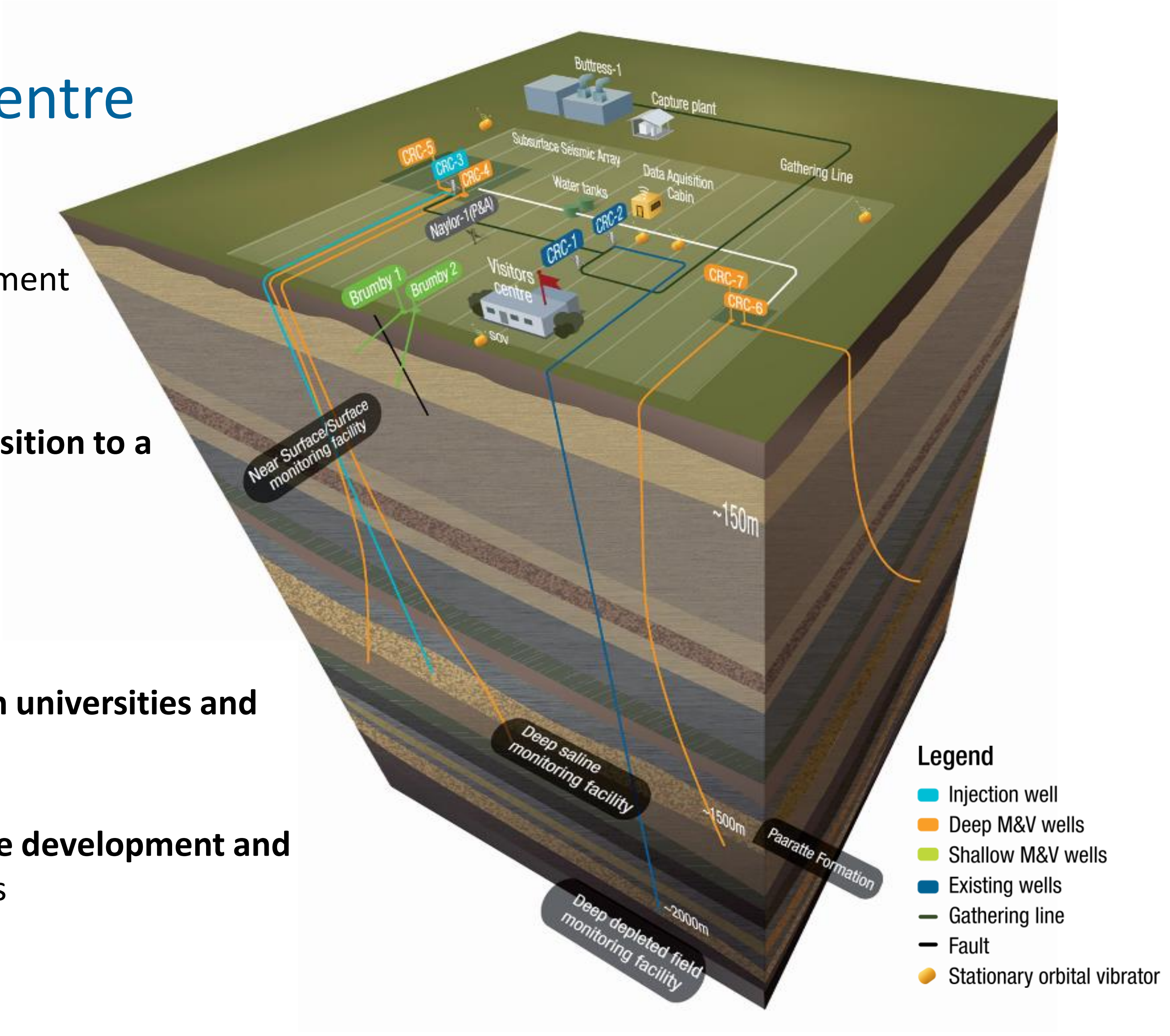
At scale investment - Long term Government and Industry funding

Focused on **accelerating Australia's transition to a low emissions future**

Industry led Research

Well-established **collaboration between universities and industry**, nationally and internationally

Globally unique test centre to **accelerate development and commercial deployment** of technologies



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Otway International Test Centre

Otway Stage 1 (Concept): 2004 – 2009

- ✓ Demonstrated safe transport, injection and storage of CO_2 into a depleted gas reservoir

Otway Stage 2 (Risk Reduction): 2009 – 2019

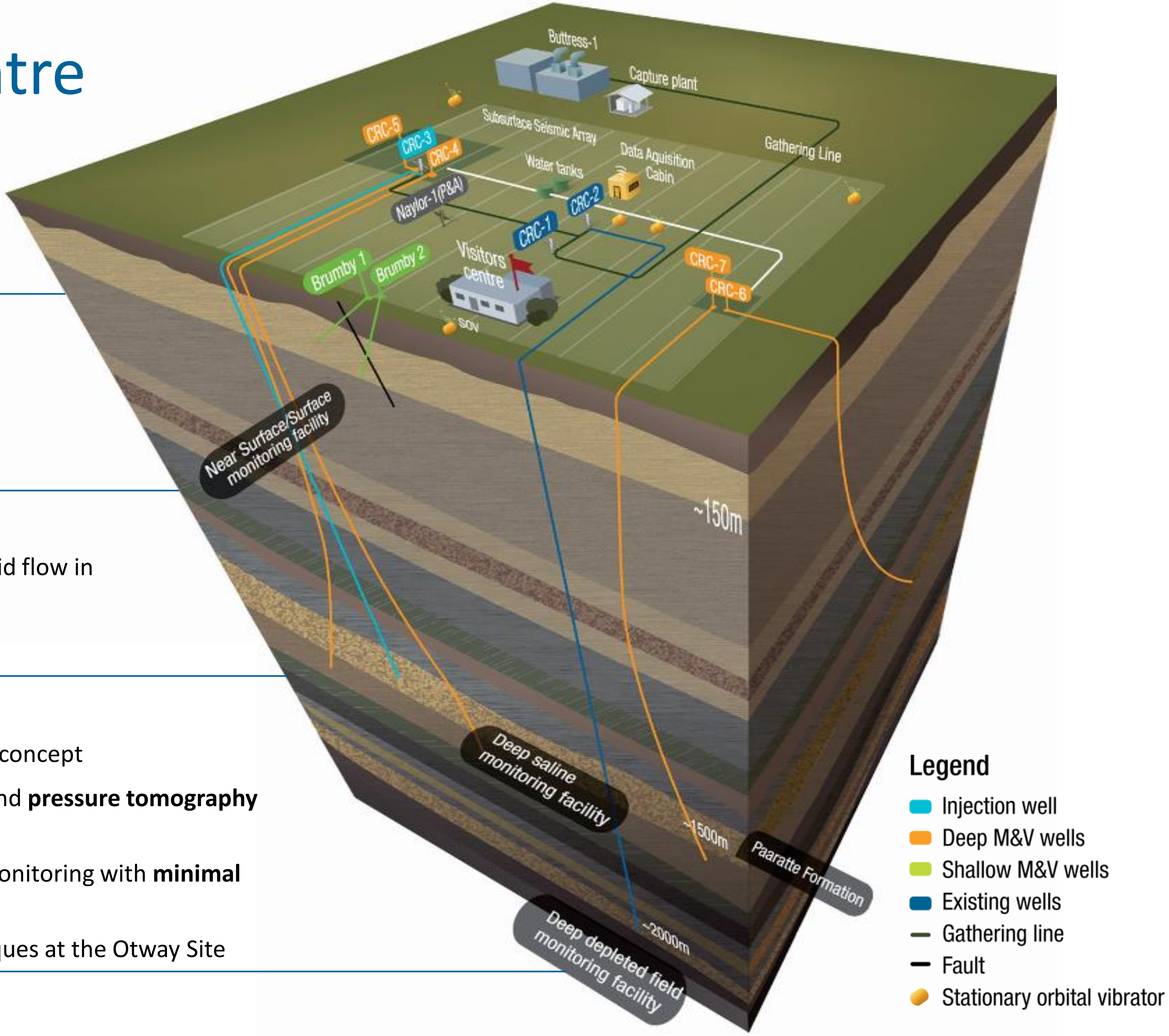
- ✓ Demonstrate safe injection of CO_2 into a saline formation
- ✓ Stage 2B – Near well residual & solution trapping characterisation
- ✓ Stage 2C – Minimum detection, 4D M&V & Plume stabilisation

Otway Shallow CO_2 Migration

- ✓ Improve capability to predict the role of faults in controlling CO_2 fluid flow in the near surface;
- ✓ Improve near surface monitoring capabilities

Otway Stage 3: 2012 – 2022

- ✓ Develop an **"on-demand", sub-surface and permanent** monitoring concept
- ✓ Two primary technologies - **sub-surface seismic data acquisition** and **pressure tomography** (4 new monitoring wells)
- ✓ Field test the various techniques to demonstrate **lower cost CO_2** monitoring with **minimal surface and environmental impact**
- ✓ Demonstrate **regulatory and community acceptance** of the techniques at the Otway Site



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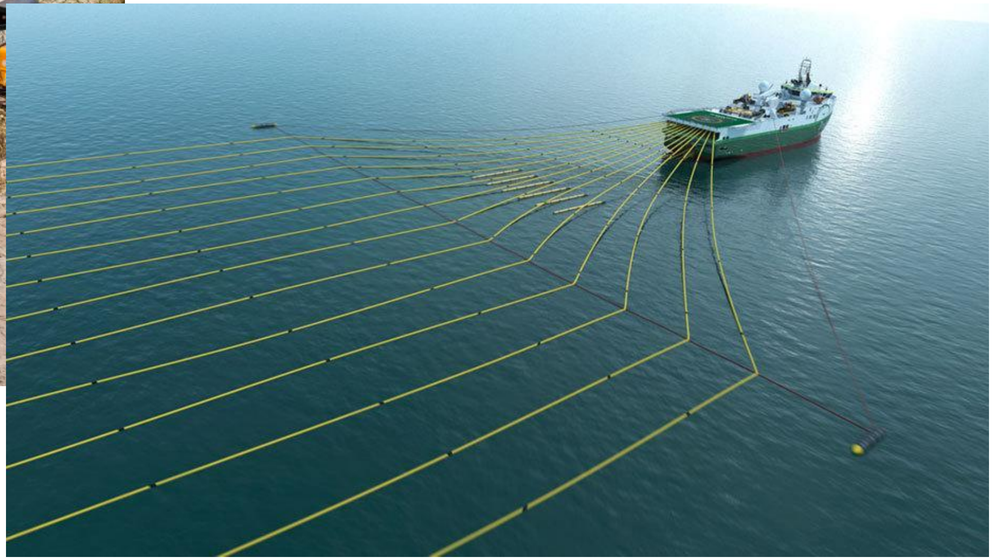
Breakthrough technologies

In order to see, the industry needed:



DE-RISKING THE STORAGE OF CO2 IN SALINE FORMATIONS

Saline formations have the greatest potential for CO_2 storage globally. Their utilisation will be necessary to ensure we remain within the COP21 2C target.

2015–2019

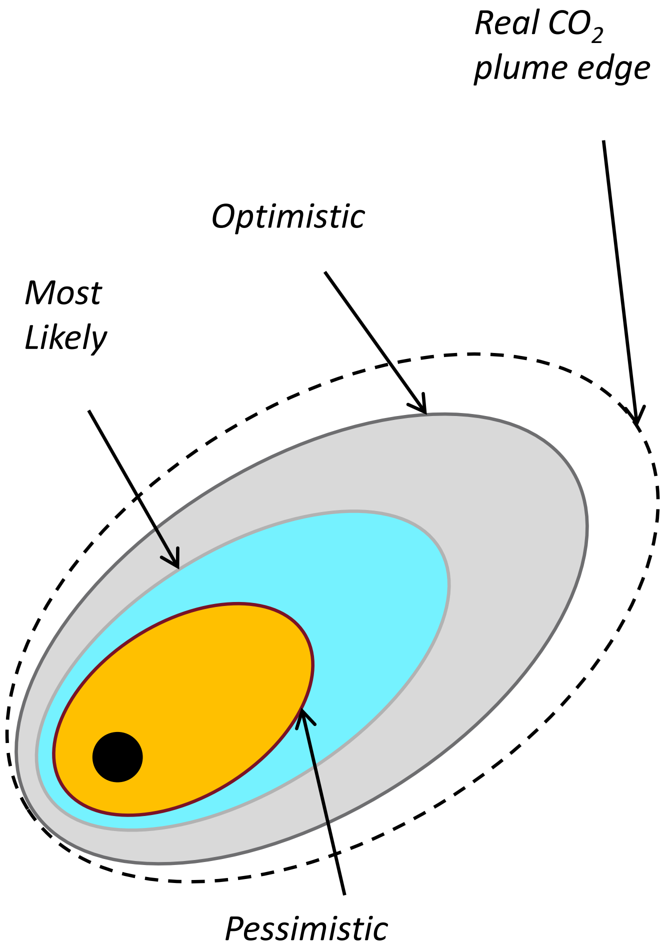
THROUGH THE MONITORING AND VERIFICATION OF 15,000 TONNES OF INJECTED CO2 WE WILL VALIDATE SALINE ROCK FORMATIONS FOR CARBON CAPTURE AND STORAGE BY:

A – VALIDATING THE ACCURATE MODELLING OF CO2 STABILISATION AND TRAPPING IN A SALINE FORMATION

B – UNDERSTANDING THE SAFE STORAGE CAPACITIES OF THIS RESOURCE

C – DEMONSTRATING THE MINIMUM DETECTION LEVEL OF CO2

Stage 2 Objectives



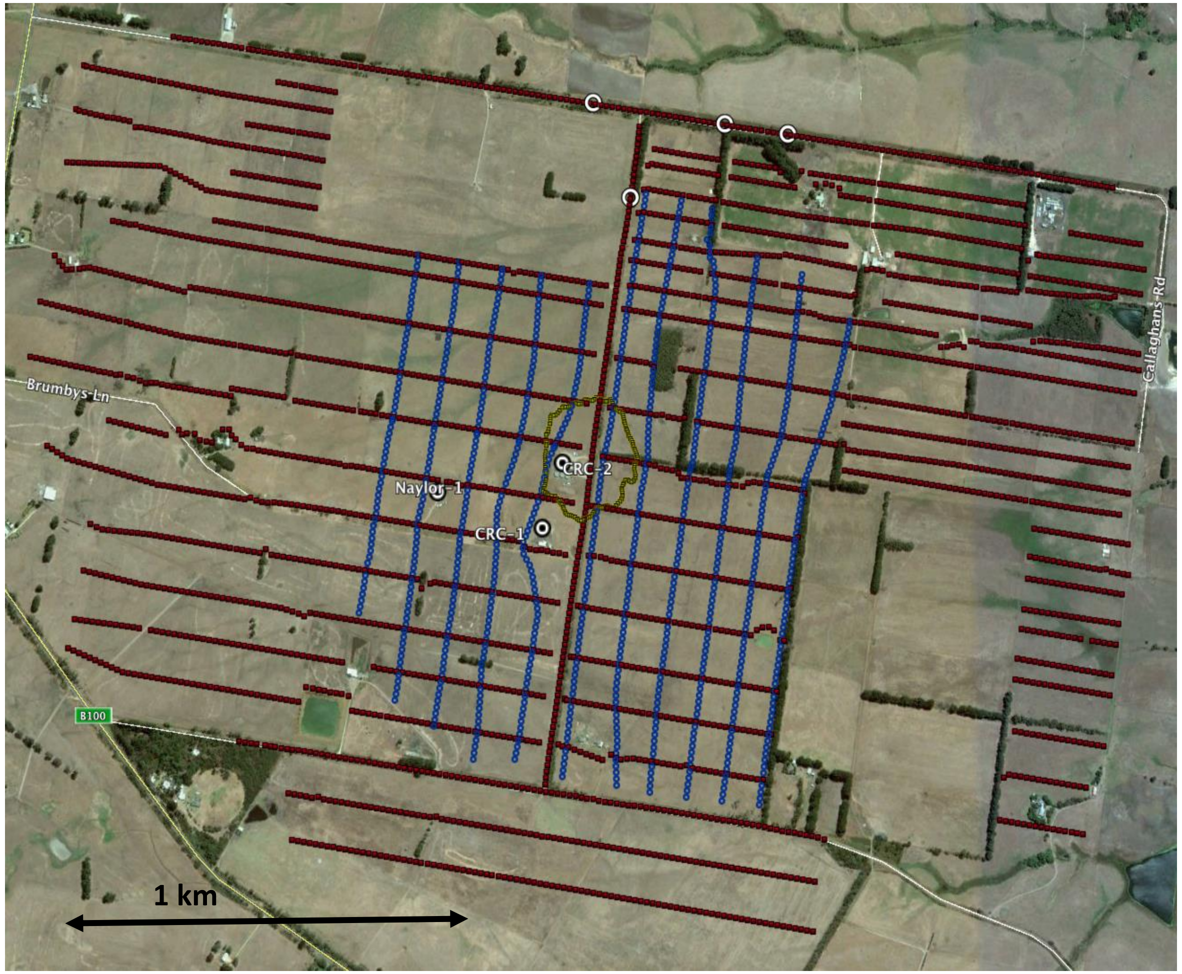
Demonstrate safe saline formation storage

Characterise saline formation processes

Main injection phase objectives:

- **Detect injected CO_2 and establish minimum detection threshold**
- **Observe gas plume development in TL**
- **Verify stabilisation of the injected plume**

Monitoring Program

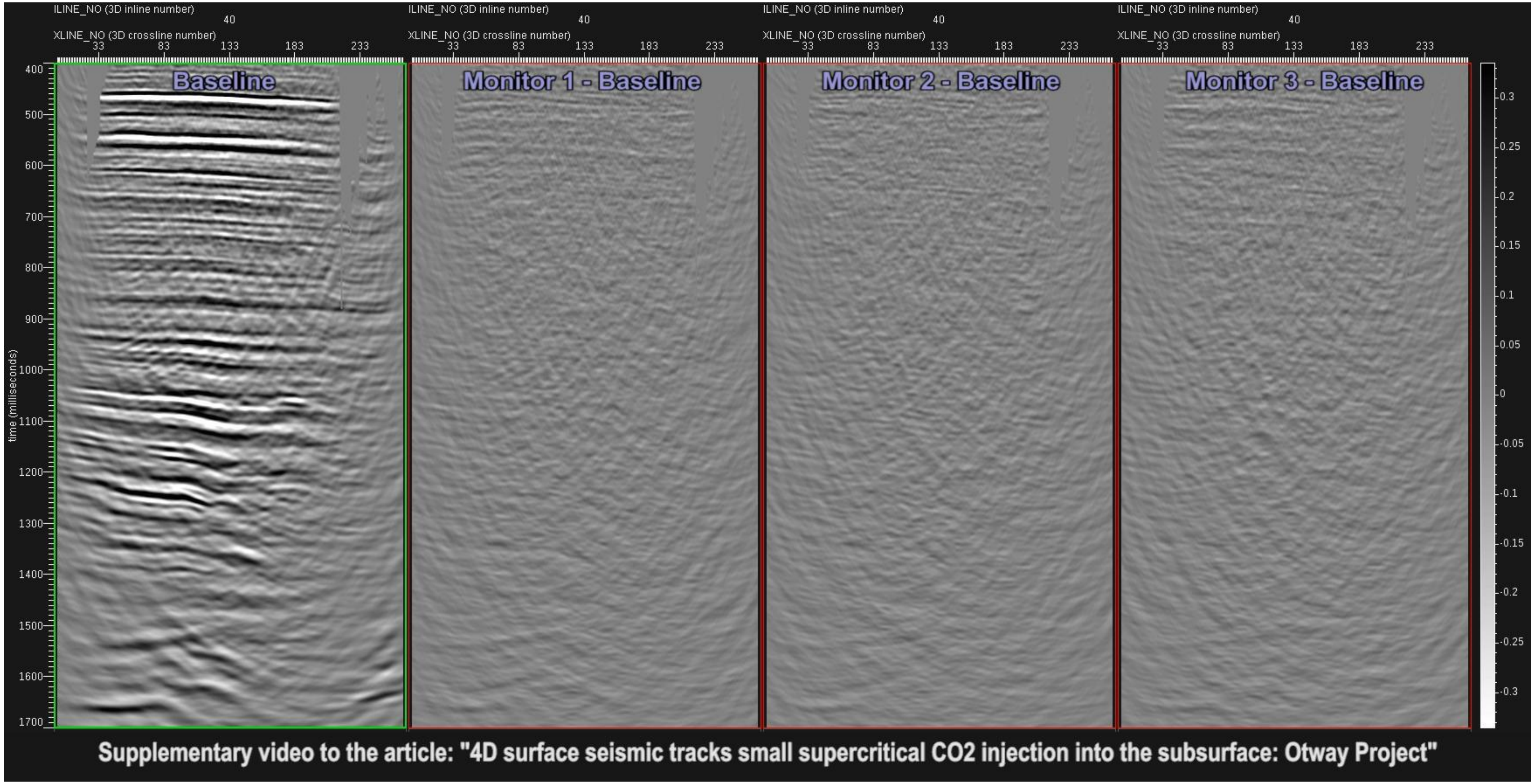


Geophones

Fibre optic cable

Deployed in Trench

How confident can we be?



Pevzner et al.

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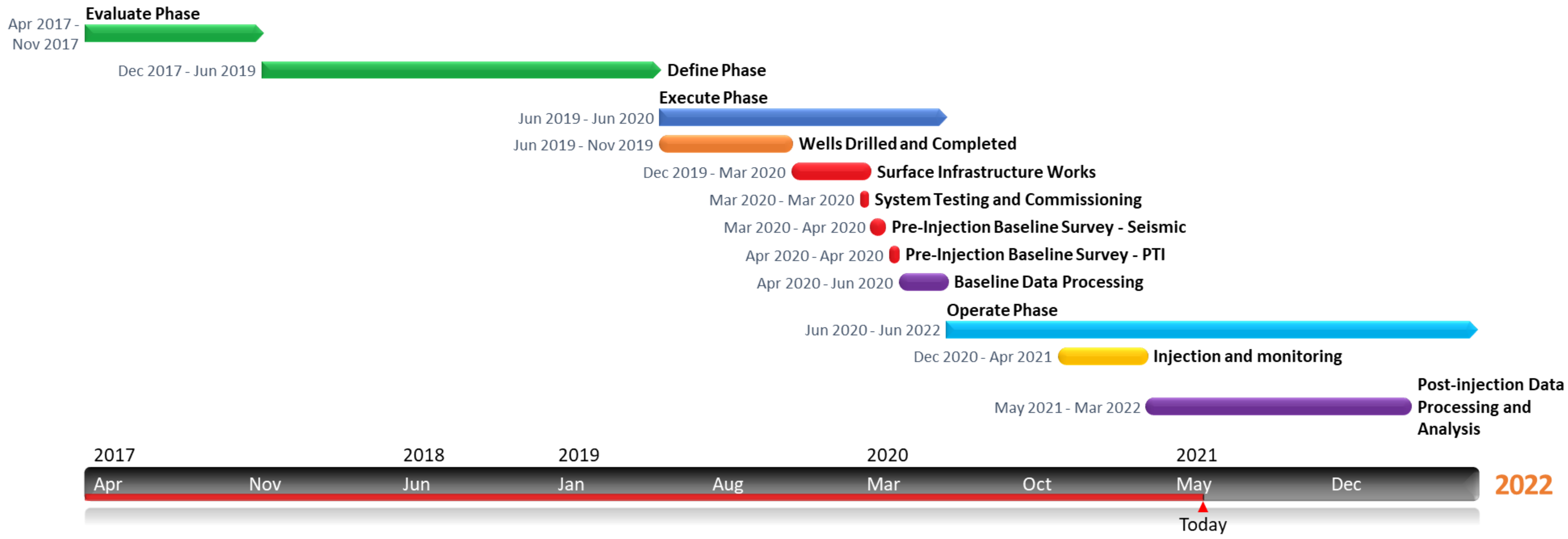
Stage 3 Overall Project Timeline



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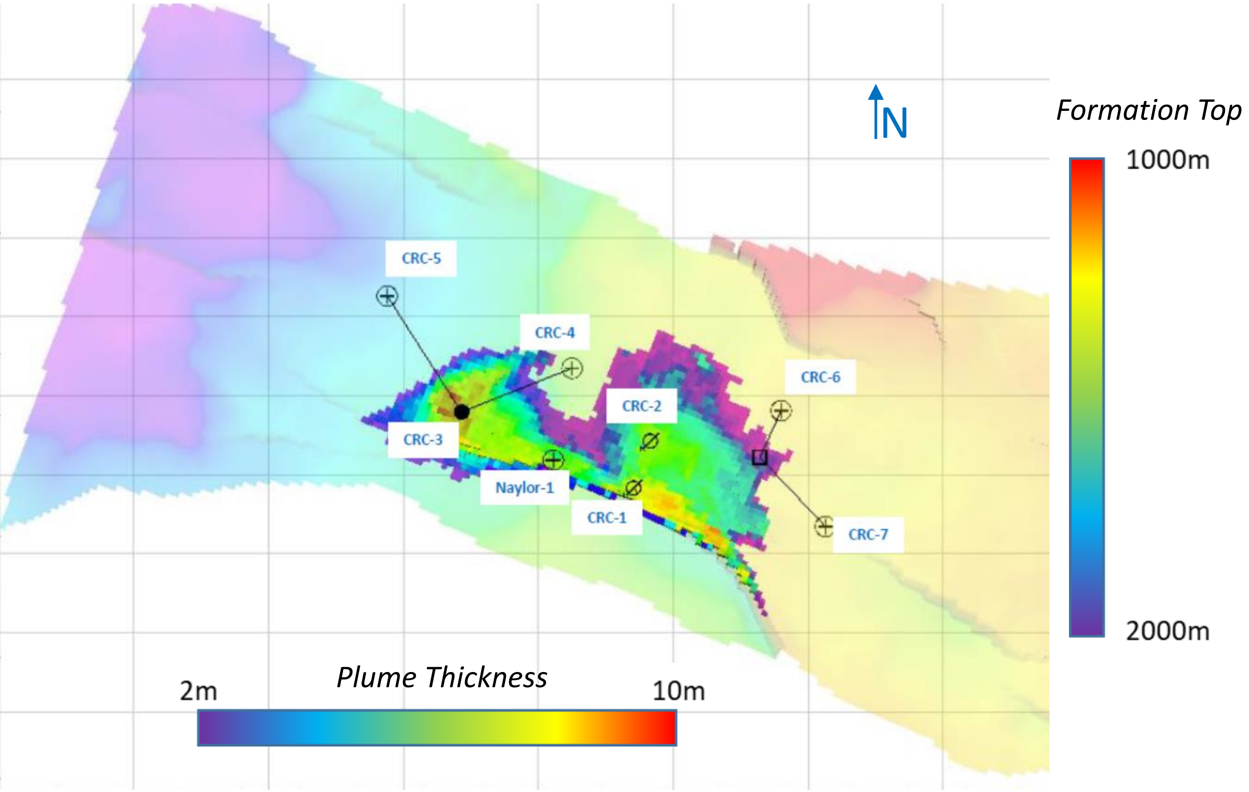
Plume Modelling

- Paaratte formation is know to "up-dip" from West to East
- Prior movement of the Stage 2C Plume
- Known impermeable fault south of CRC-3
- Various dynamic model probability realisations
- Desire to keep monitoring wells out of the plume

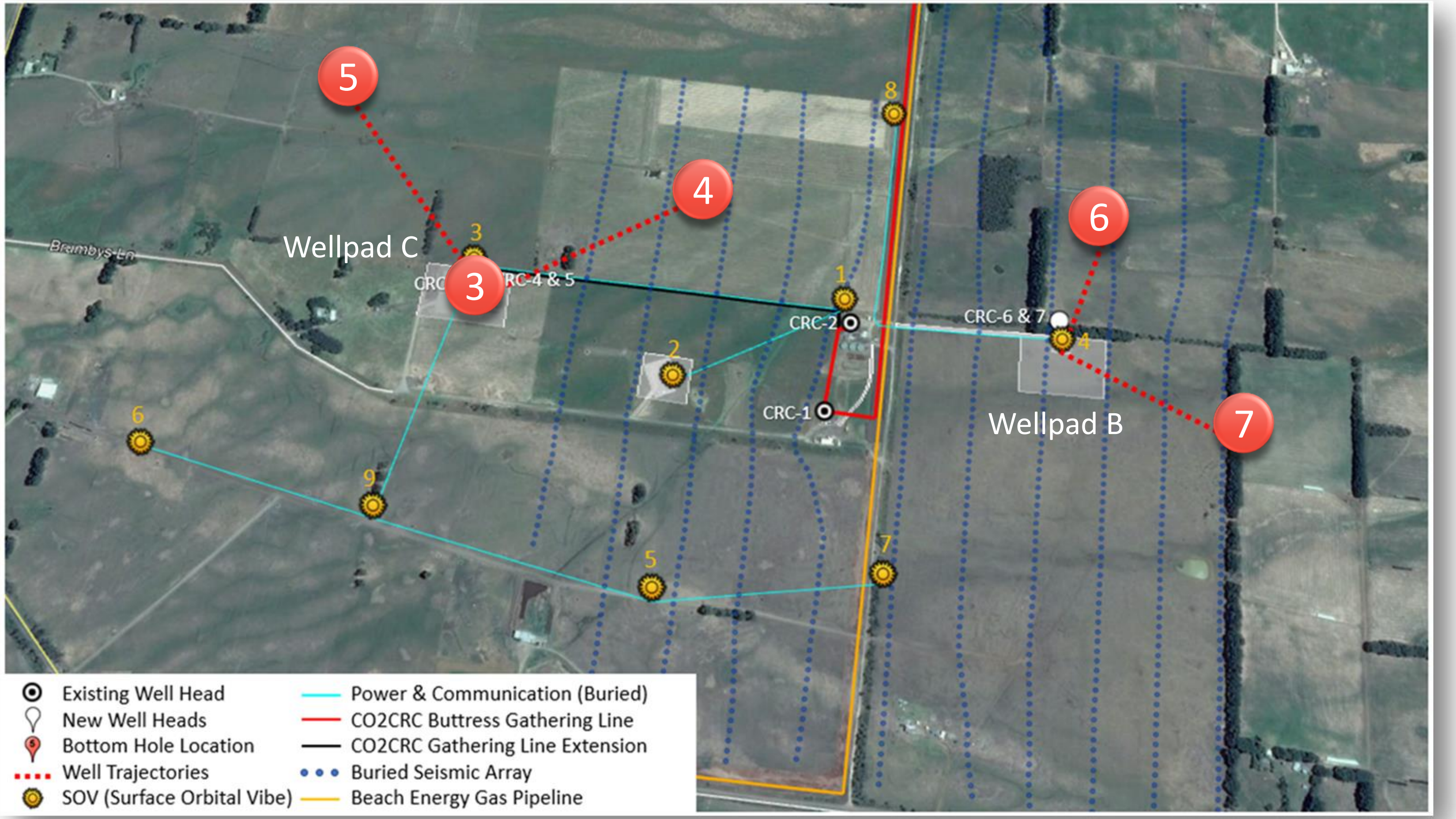


100yrs Stage 3 plume image – 15 ktonnes injected CO2CRC Ltd

Stage 3 Execution – Wells Infrastructure

Project Technical Objective: *to be able to observe the growing gas plume in the reservoir using the innovative technologies of Downhole Seismic and Pressure Tomography*

- Wells drilled directionally from 2 x wellpads
- Positioned specifically to monitor the injection
- One Vertical Injection Well – CRC-3
  - Tubing and packer completion
  - 1,650m depth
  - 15,000t injection CO2 supercritical condition
- 4 directional monitoring wells – CRC 4,5,6,7
  - 2 close monitors; 2 "far field" monitors
  - CO2 compliant metals and cement
  - Water injection capable



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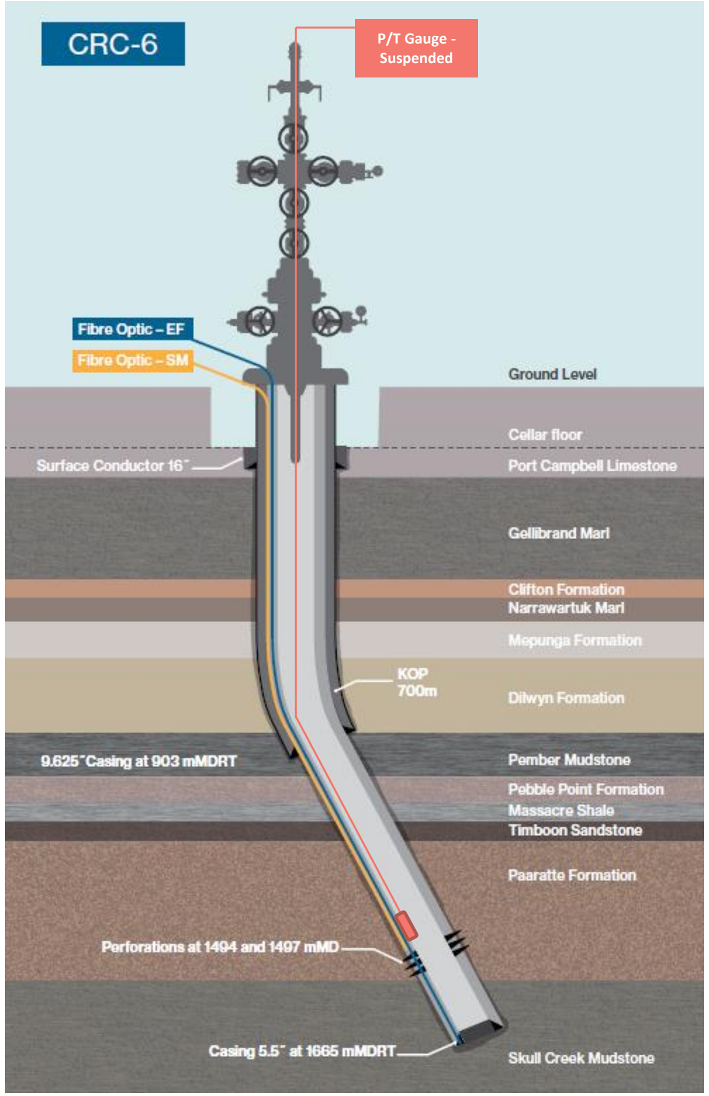
Wells Design for Injection and Monitoring

- June to October 2019, 4 wells drilled for monitoring and 1 appraisal well completed for injection
- **CRC-3** Injection well was completed for full CO_2 contact with a tubing and packer, single zone perforated completion;
- **CRC-4 to 7** Monitoring wells (see image) were deviated wells; monobore, single zone perforated completions with suspended instrumentation; designed for CO_2 contact but are operationally water injector wells



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Well Instrumentation

Injection Well

- 2 x Engineered TEF* cemented outside of casing and looped at TD
- 1 x Engineered TEF clamped to tubing and looped at TD
- P&T gauges at reservoir depth (positioned above and below injection zone)
- Wellhead P&T
- Injection line P&T

Monitoring Well

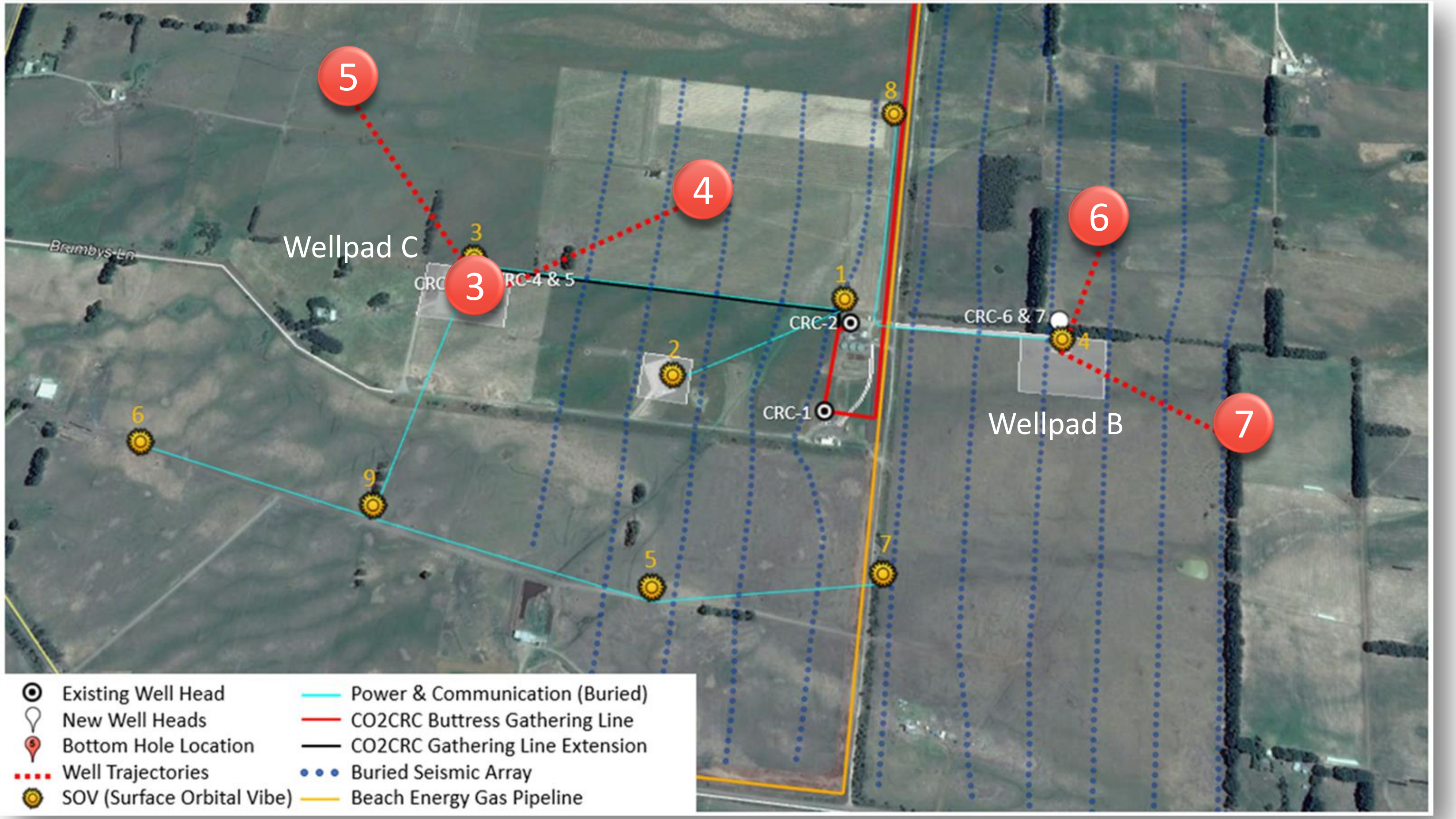
- 2 x Engineered TEF* cemented outside of casing and looped at TD
- P&T gauge at reservoir depth suspended from wellhead (TEC clamped to suspension cable)
- CRC-4: 1 x SM/MM TEF suspended from wellhead (clamped to suspension cable)
- Wellhead Pressure

**TEF: Tubing Encapsulated Fibre – a multi-core hybrid fibre combination of EF, SM and MMF housed in an Inconel sheath*

Stage 3 Execution – Surface Infrastructure

Project Technical Objective: *to be able to observe the growing gas plume in the reservoir using the innovative technologies of Downhole Seismic and Pressure Tomography*

- Buttress Gas Plant located 2km north of the site – Source of CO2 for the experiment
- Gathering pipeline from Buttress Plant through to CRC-3 (~3.5km total length)
- 9 permanent vibrators (replacing vibroseis trucks) (7 new)
- Legacy water injection facility with new water distribution system



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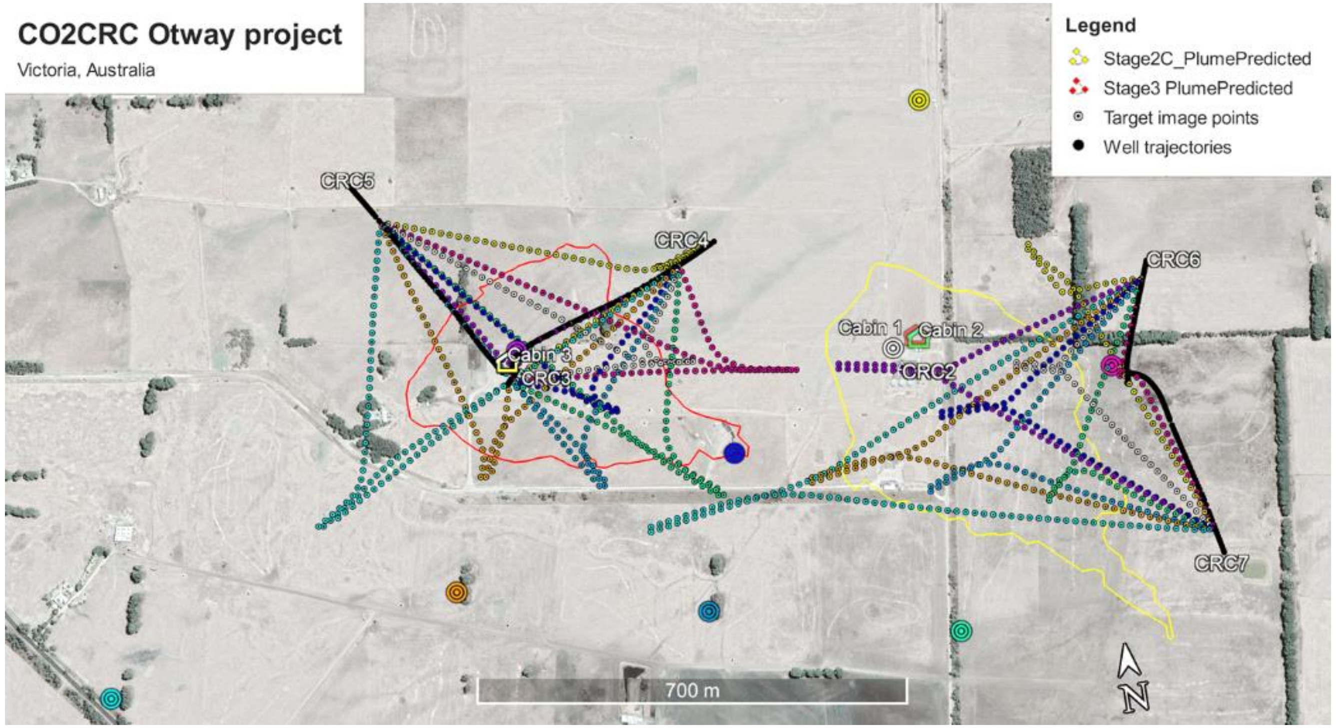
Stage 3 Operational Summary

1. **Gas Injection Operation** – provide a plume for testing of innovative monitoring techniques
   - Commenced on 2nd December 2021 and utilised Buttress for injection to well CRC-3
   - Injection of ~15,000 tonnes to a saline aquifer at ~140 tonnes per day
   - 3 intervals: 4,400 tonnes; 8,100 tonnes; 2,550 tonnes = total injection of 15,050 tonnes
   - Paused injection used to perform monitoring activities
2. **Seismic Surveys** – Benchmarking of the plume using accepted techniques
   - Baseline (pre-injection survey) M6 in March and April 2020
   - Monitor surveys at 4,4000 tonnes (Jan21, M7) and 12,500 tonnes (Mar21, M8)
3. Pressure Monitoring Activities - Testing Stage 3 Technologies and Techniques
4. Seismic Monitoring Activities - Testing Stage 3 Technologies and Techniques

Risk based monitoring through downhole seismic and SOV/DAS

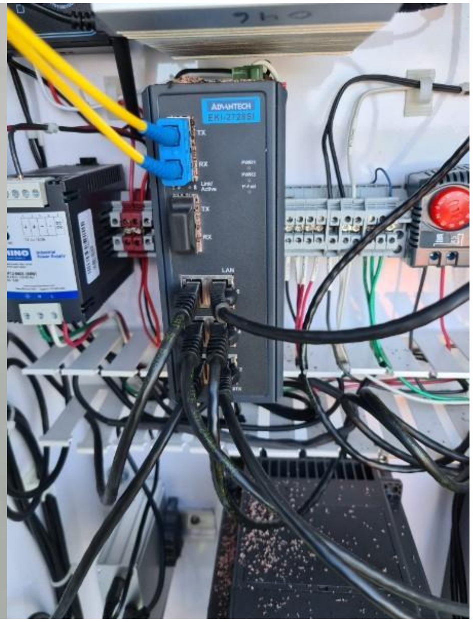
- To use permanent sources and in well fibre optics to provide multiple transects throughout the injection area and monitor plume evolution.
- **The system was configured to provide a new image of the site every 2 days.**
- The system commenced data acquisition in Jun 2020.
- **It first detected the gas plume on the 2nd day of injection with ~300 tonnes injected.**



Seismic Operations

Learnings and Challenges

- The system operated with limited operator contact as required
- It first detected the gas plume on the 2nd day of injection with ~300 tonnes injected
- Processing the seismic data onsite and reducing data volume (~1GB/day) for offsite data transfer and final processing was critical
- Significant learning were taken from how the fibre optics performed during the operations – particularly in conjunction with water injections
- Passive seismic monitoring has proven to be a useful complement to monitor the injection and unlocks new possibility for using natural seismicity for plume identification



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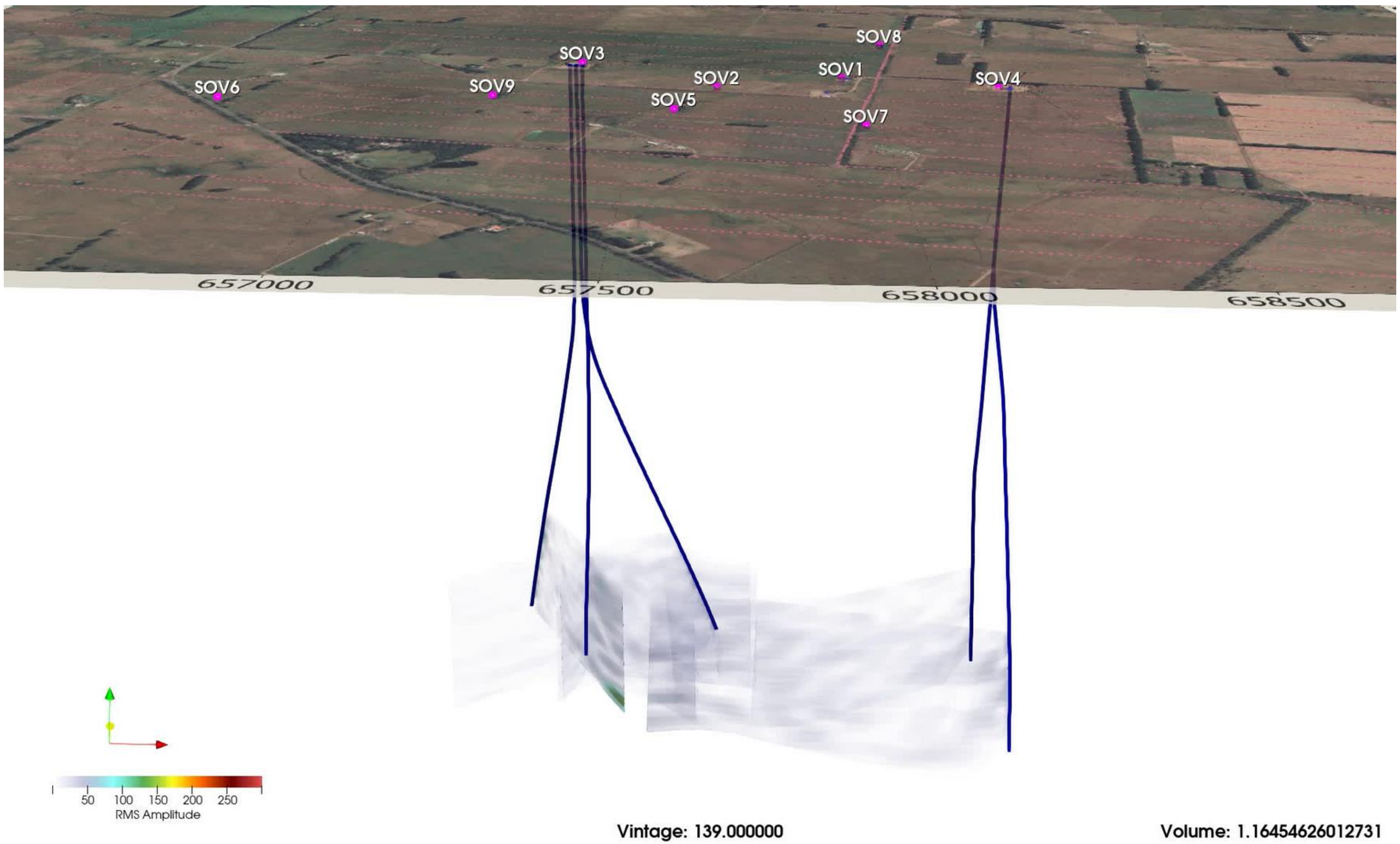
Curtin University



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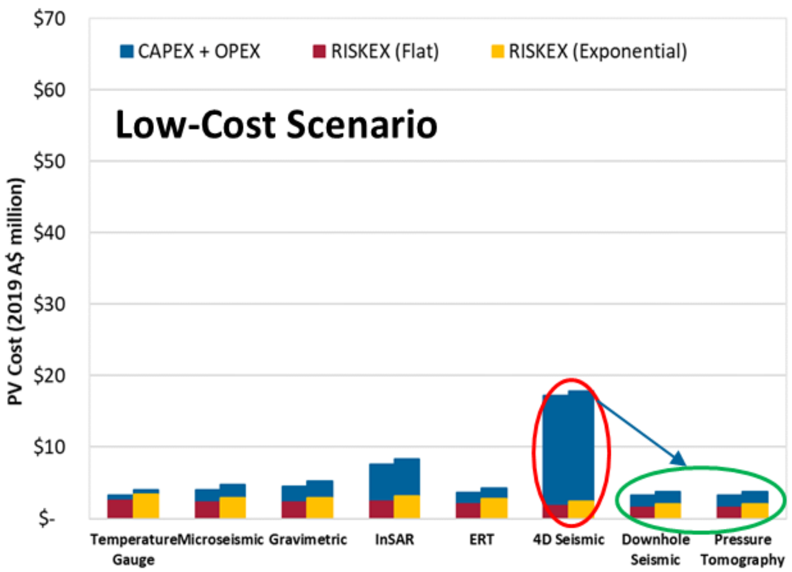
Development of cost-effective monitoring technologies

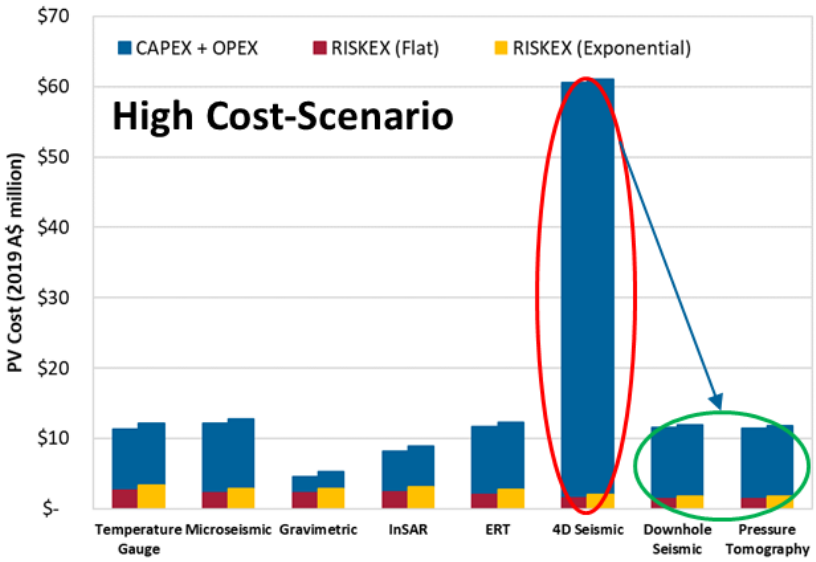
- CO2CRC has trialled cost effective monitoring technologies as part of Otway Stage 3 project.
- Both probabilistic and risk based methodologies were deployed to perform techno economic analysis
- The analysis shows the CO2CRC novel technologies can save up to 85% of the monitoring cost

85%



- Using existing wells as monitoring wells
- 3D seismic is required every 5 years
- A baseline 3D seismic does already exist

75%



- New monitoring wells are required to be drilled
- 3D seismic is required every 2 years
- A baseline 3D seismic needs to be acquired

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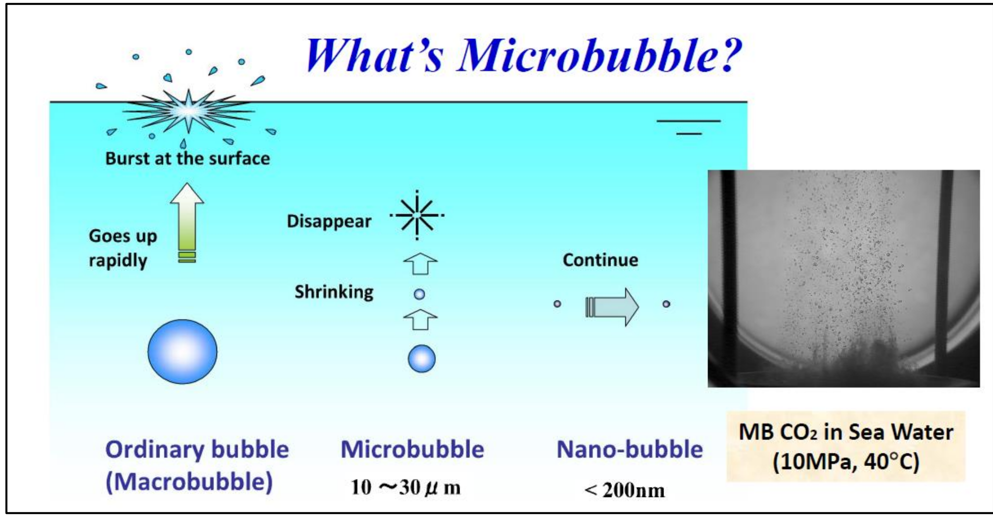
Next: Advancing novel injection technology

through international collaboration with Japan's with Research Institute of Innovative Technology for the Earth (RITE)

Improve sweep efficiency and enhance the storage capacity.

Figure from RITE's presentation



- The main advantages of MB CO_2 injection are:
  - Higher dissolution into the oil/water
  - better penetration into smaller pore spaces which allow more storage of CO_2 in same reservoirs
  - reduce preferential CO_2 flow into high permeable streaks which delays CO_2 breakthrough time
  - Lower injection pressure at the bottomhole helping to achieve higher gas injection rate in the same injection well

Otway Stage 4

The next major international research program at

The Otway International Test Centre in Australia

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Otway Stage 4 Goal & Outcomes

Otway 4 Program Goal

Demonstrate commercially-focused reservoir management technologies to improve injection, storage, and monitoring efficiencies, and thereby materially lower project costs.

Otway 4 Program Outcomes

- Provide a minimum 20% increase in CO_2 storage efficiency for commercial storage.
- Unlock poorer quality storage systems' capacity for commercial CO_2 storage.
- Improved modelling workflow, with sufficient predictive capacity to support performance-based closure.
- Storage 'performance' monitoring which is fit-for-purpose and low cost.
- A suite of technologies and workflows that can be selected to create bespoke solutions which optimise the use of CO_2 storage capacity while minimising capital and operating costs.

OITC Forward plans – 2028+

Otway Stage 4: 2020 – 2026

- Demonstrate commercially-focused reservoir management technologies to improve injection, storage, and monitoring efficiencies, and thereby materially lower project costs.

Otway Shallow CO_2 Migration (Injection) 2022 - 2025

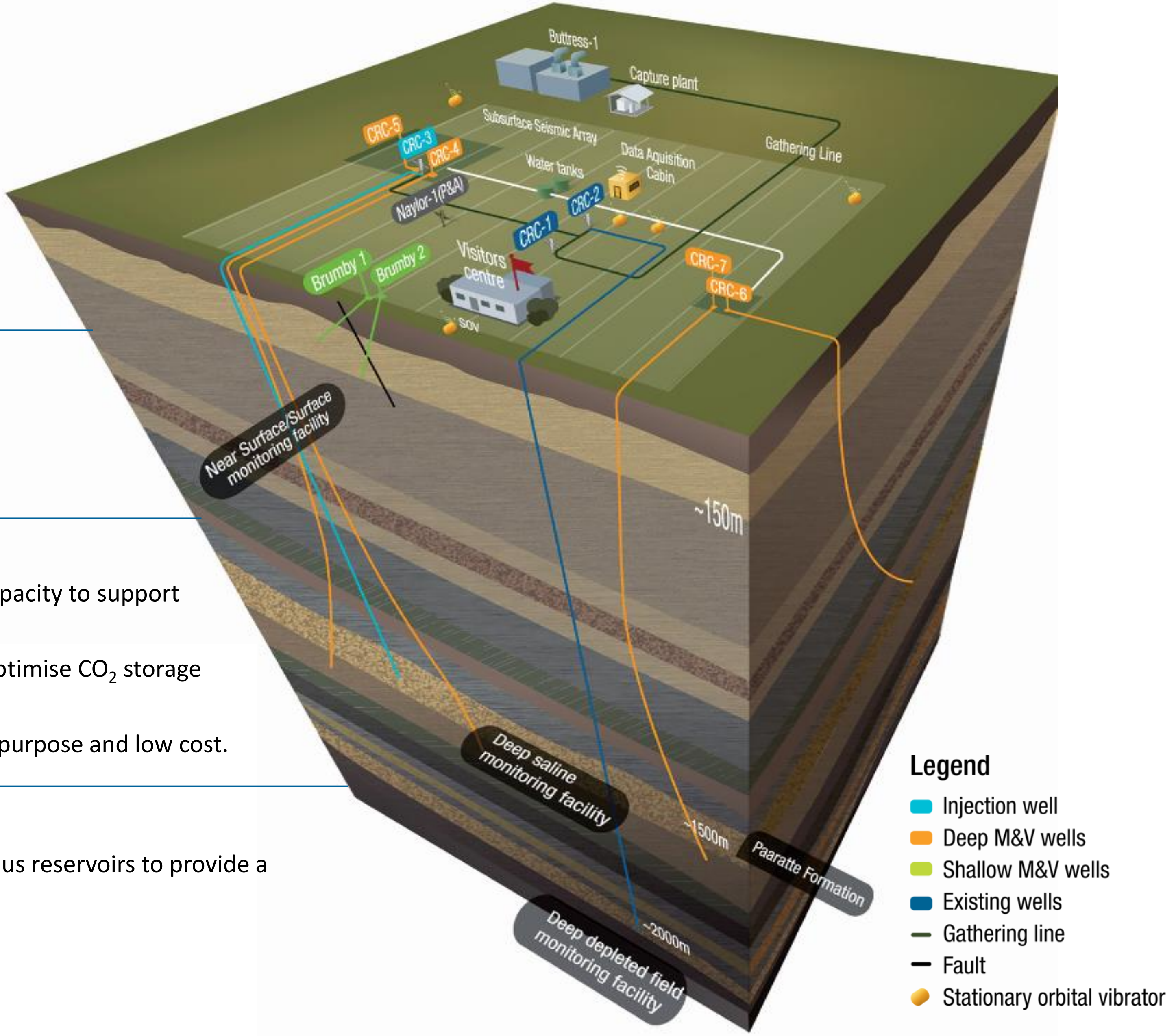
- Distributed Strain Sensing and Reverse VSP trials
- Assessment of capability to predict the role of faults in controlling CO_2 fluid flow in the near surface

Otway Deep Projects (Optimisation): 2020 – 2027

- Improved modelling workflow, with sufficient predictive capacity to support performance-based closure.
- Demonstrate a suite of technologies and workflows that optimise CO_2 storage usage while minimising capital and operating costs.
- Develop storage ‘performance’ monitoring which is fit-for-purpose and low cost.

Underground Hydrogen Storage Demonstration: 2021 – 2028

- Field scale demonstration of underground hydrogen storage in porous reservoirs to provide a platform for technology development.



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Nuancing the energy transition with

CO_2-EOR

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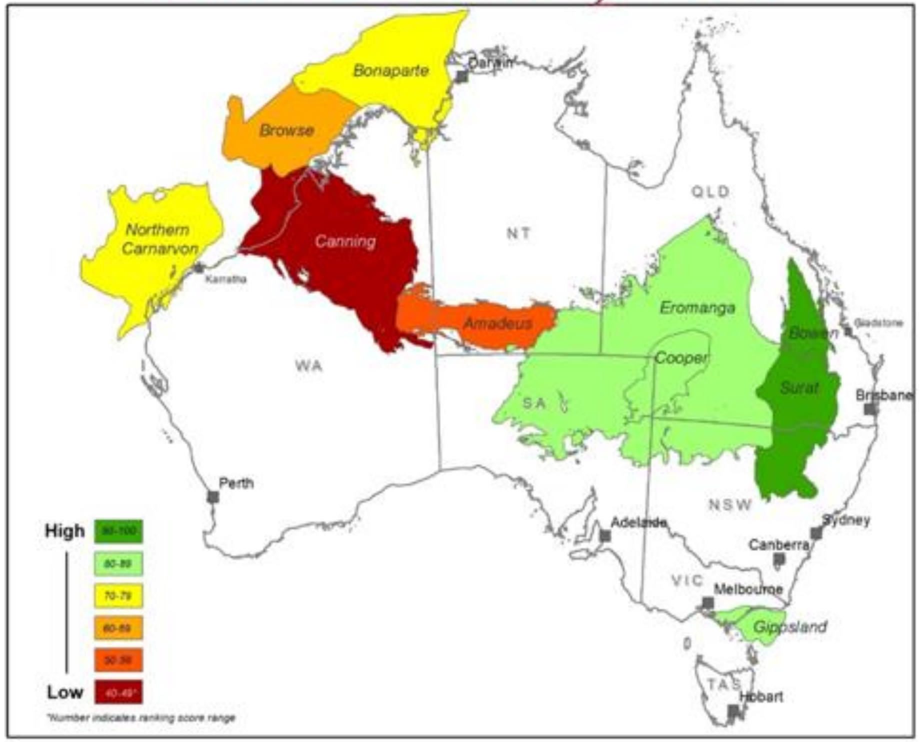
CO_2 Utilisation : CO_2-EOR Potential in Australia

CO_2 EOR potential in Key Australian basins

Basin	PRO (mmbbl)	PR Condensate (mmbbl)	kgCO_2/bbl oil 300	600	900
			million tonnes of CO_2 required		
Cooper/Eromanga	145	32	53	106	160
Bowen/Surat	13	2	5	9	14
Gippsland	945	80	308	615	923
Carnarvon	809	340	345	690	1035
Bonaparte	209	120	99	198	296
Canning	11	6	5	10	16
Amadeus	9	1	3	6	8
Browse	11	243	76	152	228

The ranking above is based on subsurface and infrastructure properties and recoverable oil and associated CO_2 storage is not included

Ranking of Australian basins for CO_2 EOR



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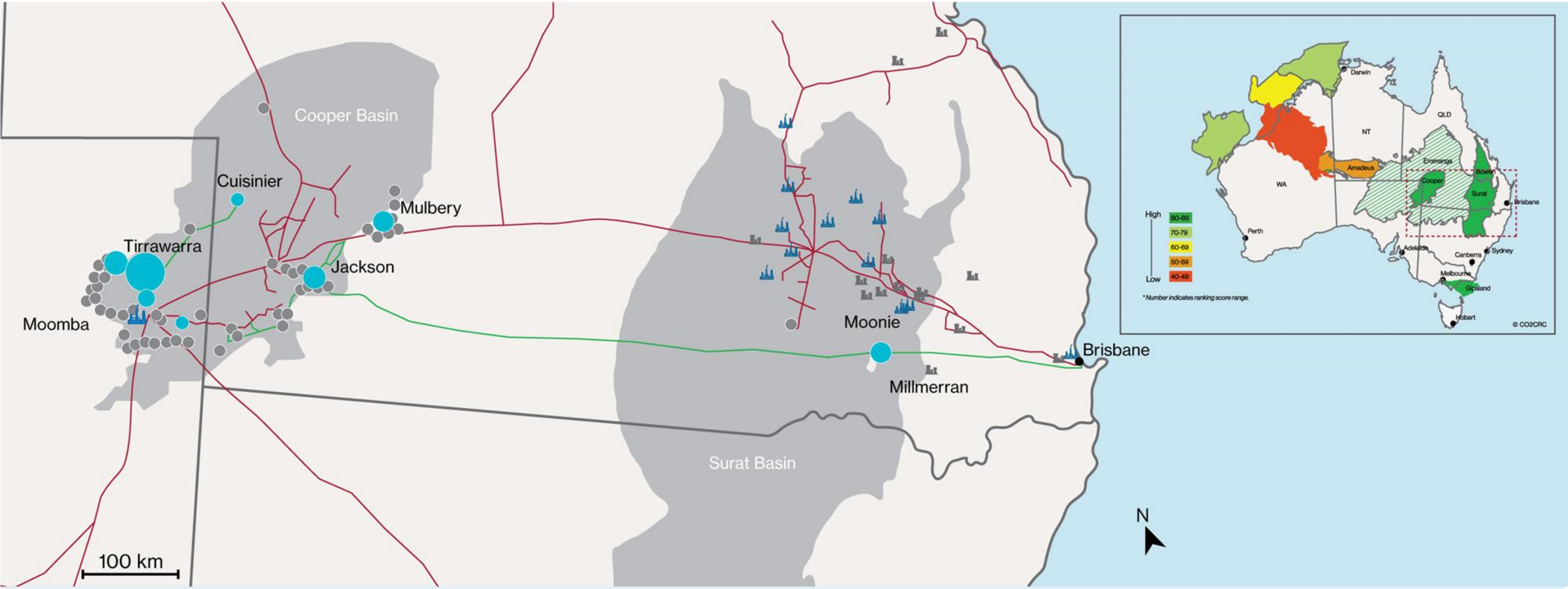
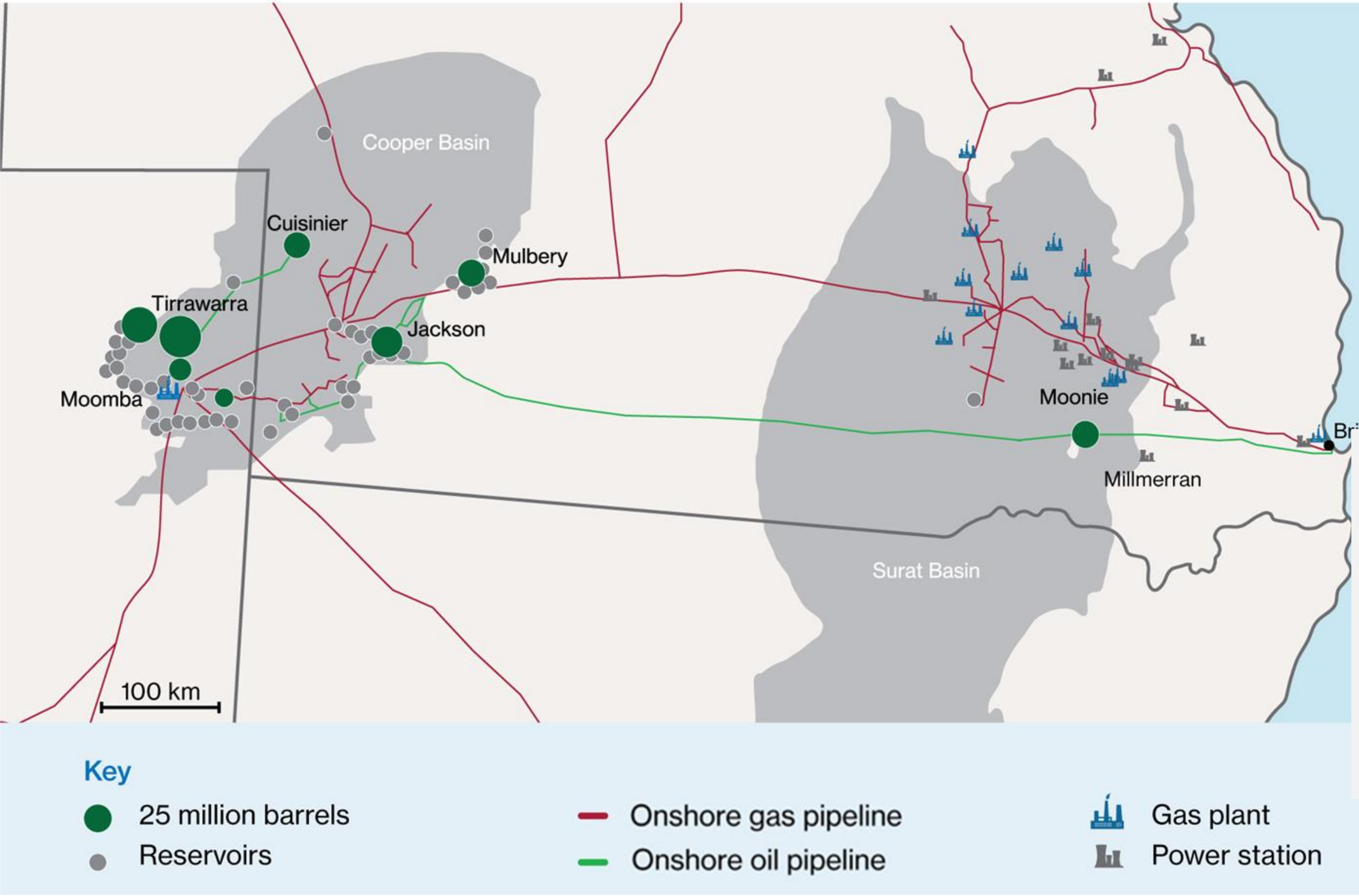
CO_2 storage potential during EOR

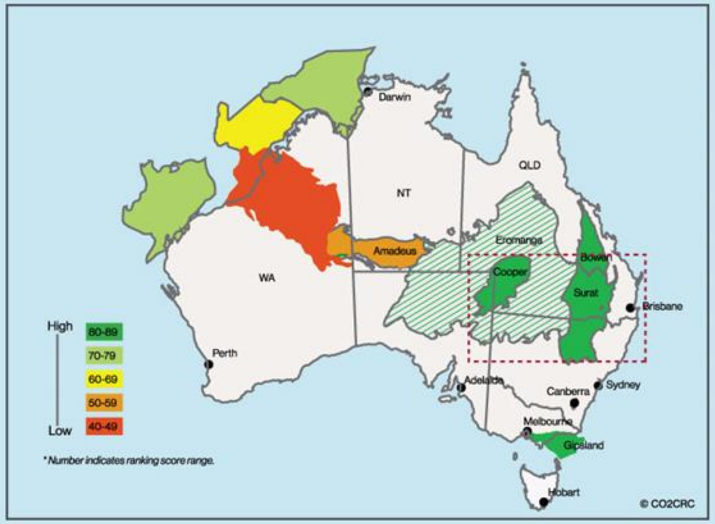


Key

- 15 million tonnes CO_2
- Reservoirs
- Onshore gas pipeline
- Onshore oil pipeline
- Gas plant
- Power station

Potential of enhanced oil recovery using CO_2





- 120 million metric tons of CO_2 could be stored in the Cooper-Eromanga and the Bowen-Surat Basins, and
- an additional 250 million barrels of crude oil could be technically recovered through applying CO_2-EOR.

A reality check
or
The reality challenge

Technology, policy, London Protocol, economics and legislation

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CCUS Projects in Australia 2022

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Legend

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- CCS
- Storage hub
- Offshore CCS permits
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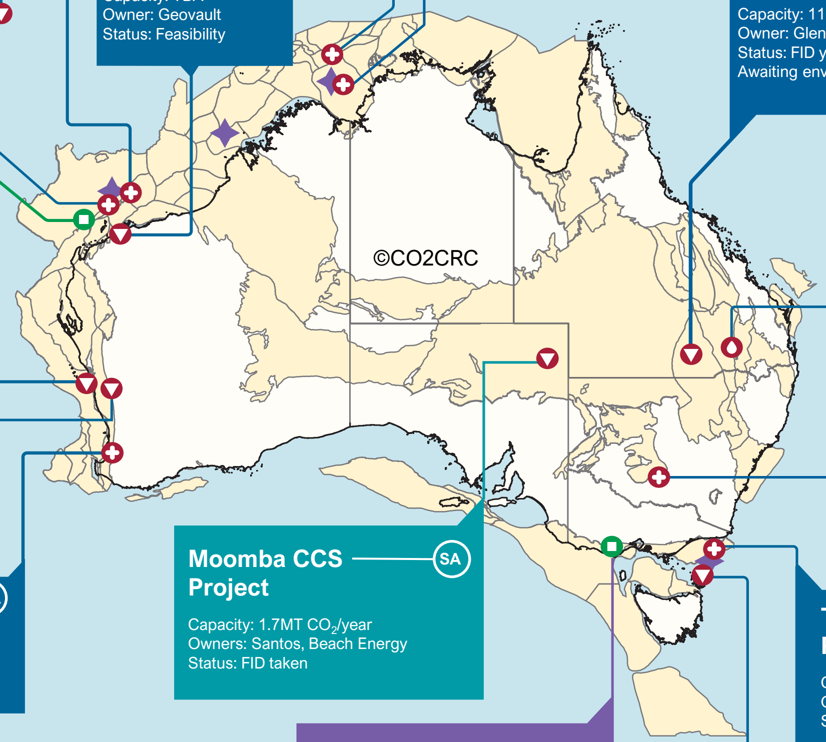

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Petrel CCS (NT)
Capacity: TBA
Owners: NT Gov, CSIRO, Santos, INPEX, Woodside, Eni, Origin Energy and Xodus
Status: Research phase

Gorgon (WA)
Capacity: 4MT CO_2/year
Owner: Chevron, ExxonMobil, Shell, Osaka Gas, Tokyo Gas, JERA
Status: Operational

Reindeer (WA)
Capacity:TBA
Owner: Santos
Status: Feasibility

Geovault (WA)
Carnarvon Basin
Capacity: TBA
Owner: Geovault
Status: Feasibility

CTSCo Project (QLD)
Capacity: 110,000 T CO_2/year
Owner: Glencore
Status: FID yet to be taken. Awaiting environmental approvals

Moonie CCUS Project (QLD)
Capacity: 10MT CO_2/year
Owner: Bridgeport Energy
Status: Early development

Midwest Clean Energy (WA)
Capacity: 500,000T CO_2/yr
Owners: Pilot Energy & Triangle Energy
Status: Feasibility

NSW CO2 SAP (NSW)
Capacity: TBA
Owner: Coal Innovation NSW
Status: Assess

Low Carbon Ammonia Development (LCAD) (WA)
Capacity: TBA
Owners: Mitsui/Wesfarmers & JOGMEC
Status: Feasibility

South West Hub (WA)
Capacity: 800,000 T CO_2/year
Owner: Western Australian Government
Status: Research phase

Moomba CCS Project (SA)
Capacity: 1.7MT CO_2/year
Owners: Santos, Beach Energy
Status: FID taken

The CarbonNet Project (VIC)
Capacity: 5MT CO_2/yr
Owner: DJPR
Status: Pre-FEED

CO2CRC Otway International Test Centre (VIC)
Capacity: Demonstration facility
Owner: CO2CRC
Status: Commercial demonstrations

The SEA CCS Hub (VIC)
Capacity: 2MT CO_2/yr
Owner: ExxonMobil
Status: Feasibility

Building a low emissions future

Collaboration between Australia and Japan

RITE and CO2CRC signed an MOU in June 2021 to collaborate and **accelerate CCUS technology advancements**.

In detail:

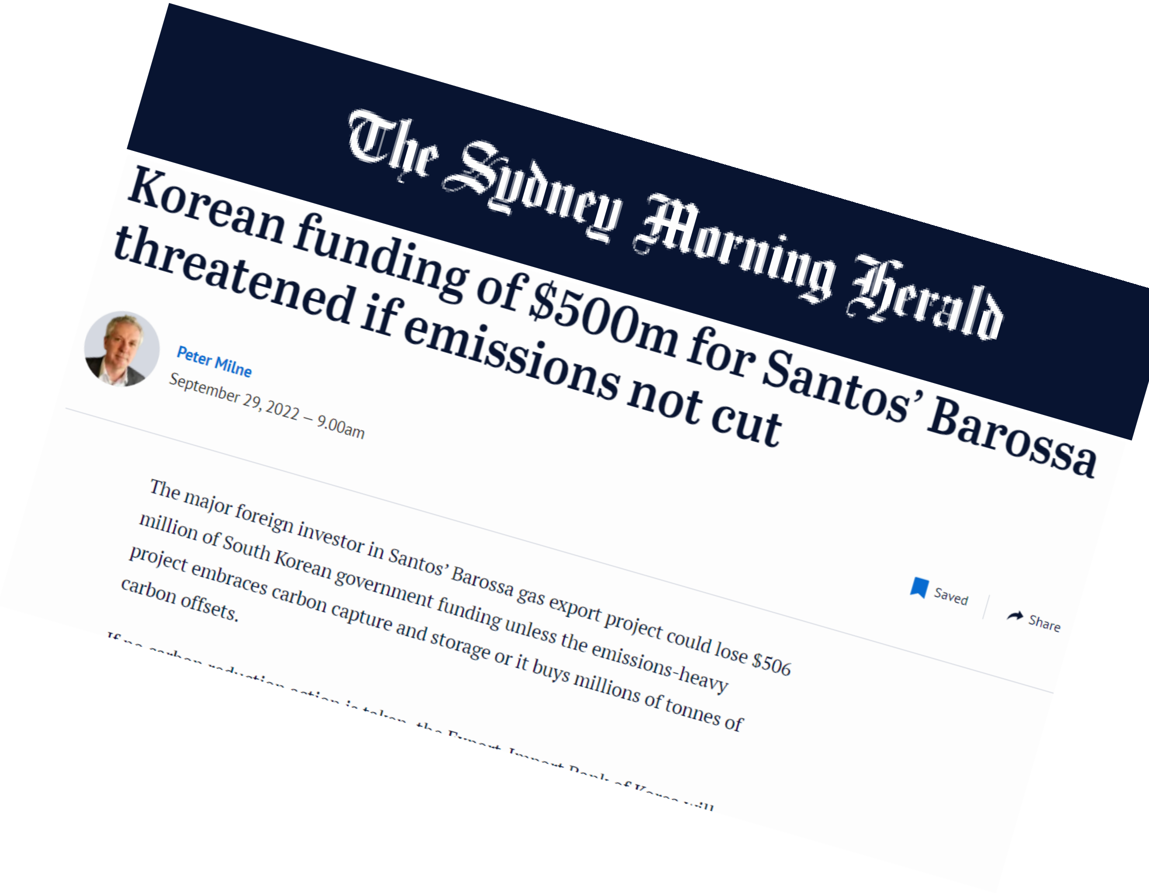
- Australia and Japan have ambitious 2030 emission reduction targets; CCUS is a key technology
- To trial RITE's microbubble CO_2 injection for both CCS and CO2 EOR,
- To trial fibre optic sensing for near surface CO2 leakage monitoring,
- To trial pressure measurement through fibre optic sensing,
- To develop Geological Modelling Techniques for Geological CO_2 Storage and to propose those projects for funding to the respective governments.

From Recent News closer to home

KEXIM reported to be reconsidering $500m loan to SK E&S project if emissions not cut

- Barossa gas export project could lose $506 million of South Korean government funding unless the emissions-heavy project embraces carbon capture and storage or it buys millions of tonnes of carbon offsets.

- If no carbon reduction action is taken, the Export-Import Bank of Korea will consider it a **breach of contract** and take action to recover the $US330 million it loaned SK, which owns 37.5 per cent of Barossa, according to a response from the bank to a question from a South Korean parliamentary representative.



The Sydney Morning Herald

Korean funding of $500m for Santos' Barossa threatened if emissions not cut

Peter Milne

September 29, 2022 – 9.00am

Saved

Share

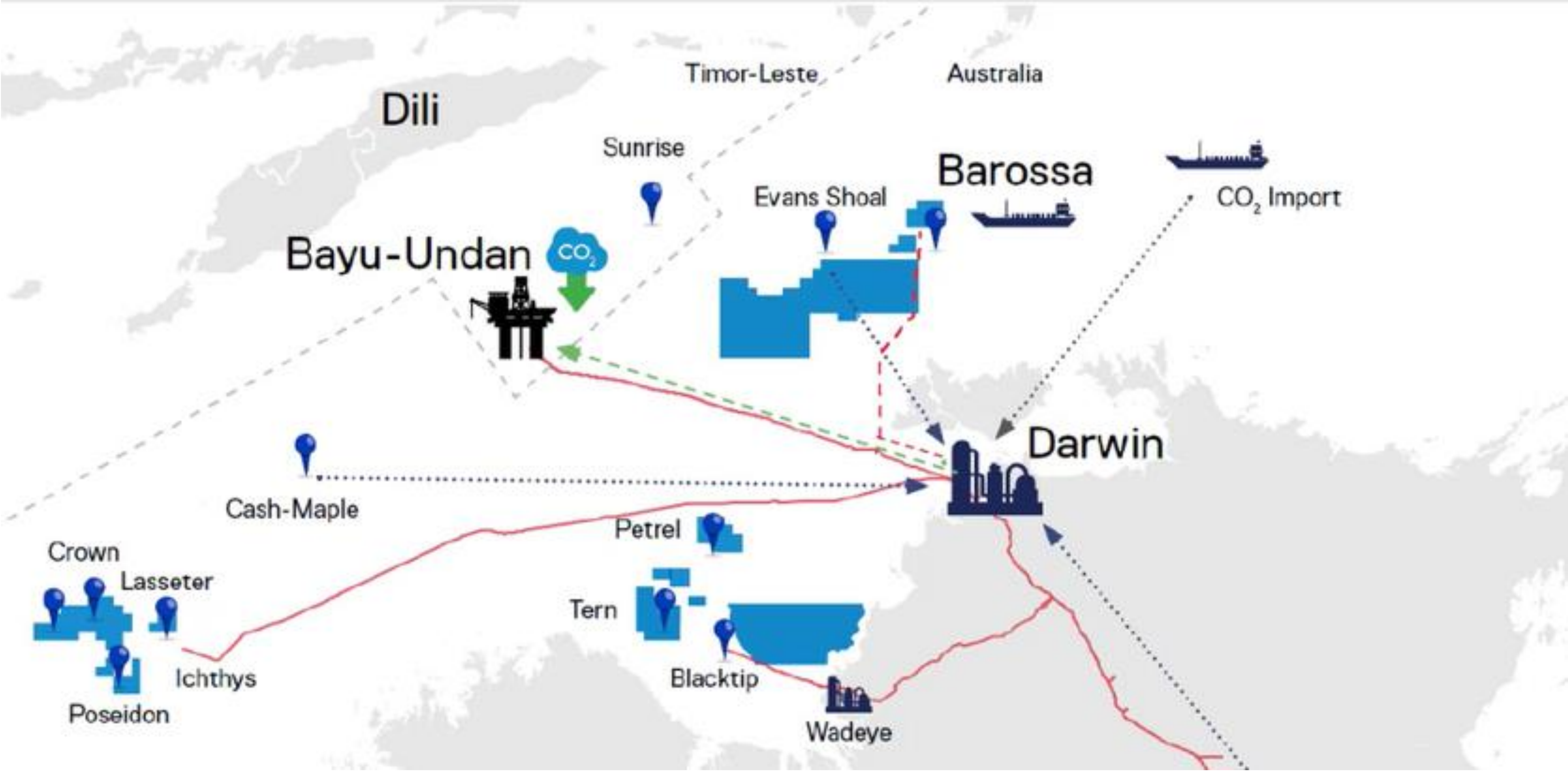
The major foreign investor in Santos' Barossa gas export project could lose $506 million of South Korean government funding unless the emissions-heavy project embraces carbon capture and storage or it buys millions of tonnes of carbon offsets.

Source: https://www.smh.com.au/business/companies/korean-funding-of-500m-for-santos-barossa-threatened-if-emissions-not-cut-20220928-p5blob.html

The opportunities for Transboundary CCS

- There are several new gas developments/expansions in Northern Australia which are looking to utilise offshore CCS in order to be consistent with commitments to meet net zero emission goals in Australia and in Japan.
- This is the future for new gas/LNG and for blue hydrogen in the Asia Pacific region.
- This would be a world-first, CCS and Clean Energy Hub based around Darwin.
- It would provide clean energy to the Republic of Korea.
- It would unlock billions of dollars of investment for Northern Australia and critically, provide a significant long-term revenue stream for Timor Leste to supplement its rapidly declining petroleum revenue.
- Critically, the Bayu Undan CCS Project will also act as the cornerstone of a CCS infrastructure and skills hub that will facilitate the development of many other gas fields in northern Australia and the Timor Sea

Northwest shelf assets



The potential for transboundary CCS

- Estimated total storage capacity of more than 250 Mt of CO_2
- Estimated injection rate of more than 10 $MtCO_2$ pa
- Existing wells, platforms and pipelines for potential CCS use
- Based on production data, the Bayu Undan reservoir has a proven seal and high injectivity
- CO2 from the Barossa field could be the foundation customer with 2$MtCO_2$+ pa, enabling
  - CO2 from other Australian assets, such as Barossa and Ichtys via new pipelines, **and**
  - Transboundary CCS via ships e.g. from Japan

The challenges for transboundary CCS

- Transboundary shipment of CO_2 is currently banned under Australian domestic legislation (Sea Dumping Act), in line with the original provisions of the London Protocol.
- In 2009, the Contracting Parties to the Protocol agreed to an amendment to Article 6 to provide for transboundary shipment, recognising the essential role international CCS projects can play in meeting global climate objectives.
- Australia supported the amendment but has yet to formally ratify the change and enact its provisions through modification of its domestic legislation.
- The legislative amendments to the Sea Dumping Act are drafted, and they are waiting on the authority to introduce it into Parliament in 2022.
- However, before they can take a final investment decision, it is imperative that Australia ratifies the 2009 amendment to the London Protocol and align/amend its domestic legislation to allow for the transboundary shipment of CO_2.

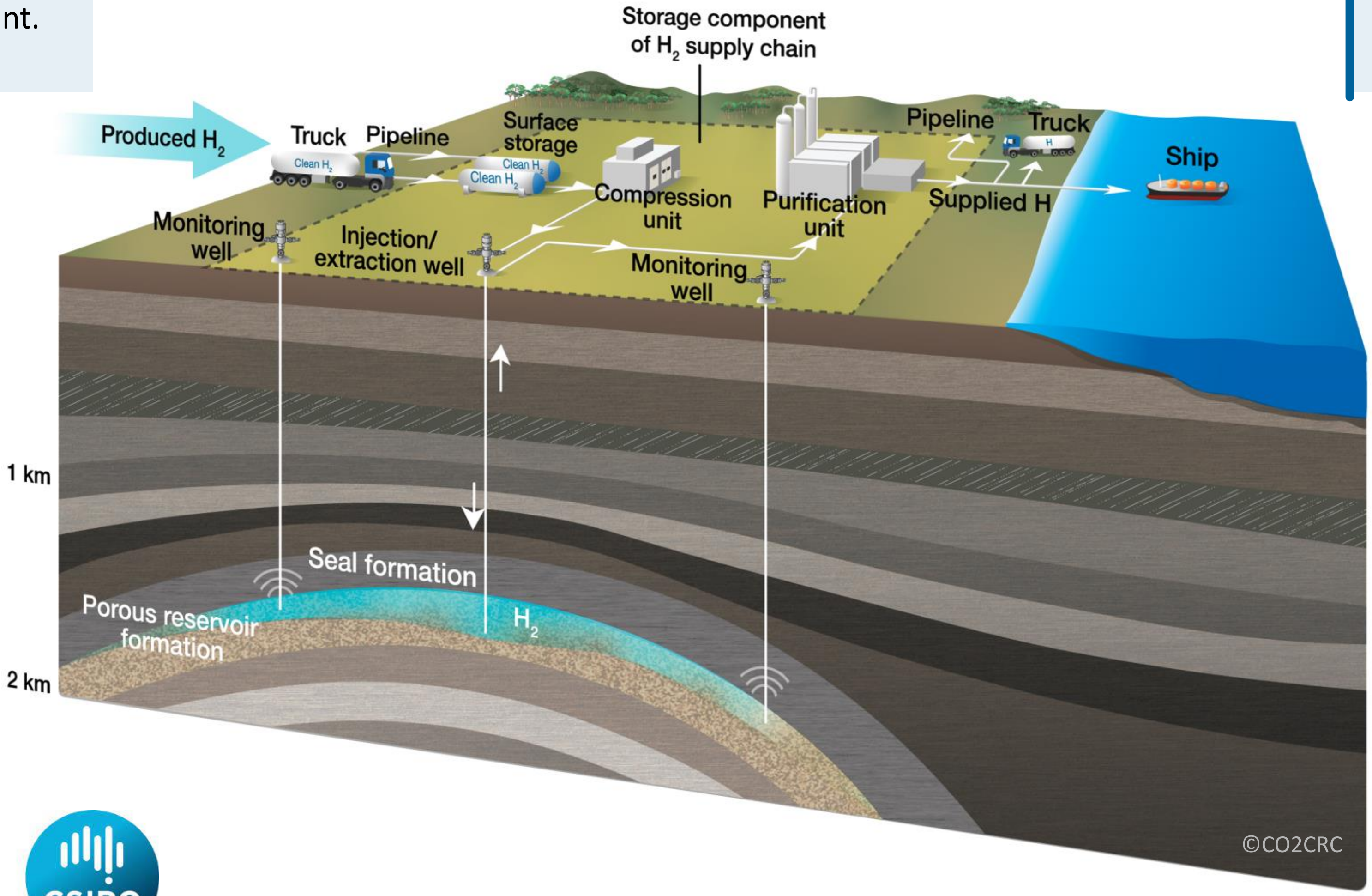
Australia is an innovation powerhouse to trial novel technologies

Next: testing the feasibility of underground Hydrogen storage for Australia

Storing large volumes of hydrogen becomes increasingly important.

Large fluctuations between supply and demand need balancing.

Large scale underground hydrogen storage could provide an attractive option.



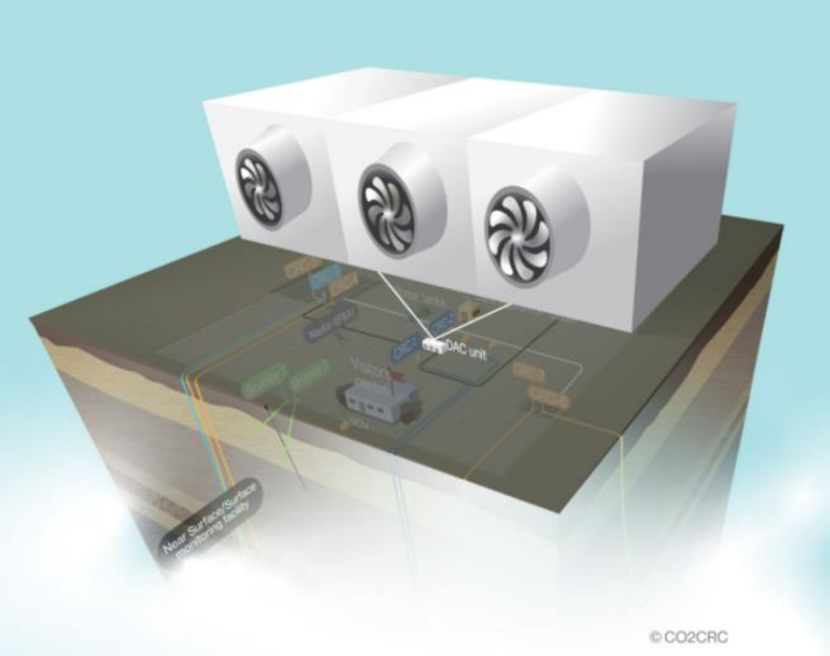
Australia can move quickly to a field scale demonstration of the technology.

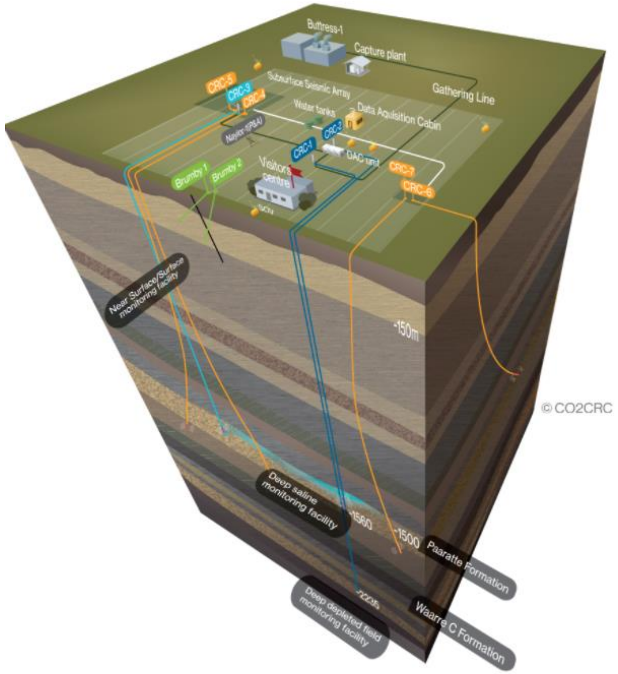
A successful trial could accelerate the uptake of this technology in Australia.

Building a low emissions future

Direct Air Capture (DAC)

Overarching Objective: Field testing and demonstration of Direct Air Capture (DAC) to support of DAC development and reduction of capture cost. Potentially FOAK - DACCS (end to end) demonstration in OITC.





Key Value Propositions & Benefits:

•The OITC infrastructure has been & ideal for DACCS pilot testing and demonstrating.

•Highly instrumented subsurface facilities; CO_2 injection can commence within 6-9 months of project start-up**.**

•Potentially 1st of its kind DAC-CCS (end to end) pilot test for CO_2 storage in a porous reservoir.

•Full operational support tailored to customer requirements.

•OITC can support multiple DAC units with fully flexible operation, can be tailored for either short or long-term operation.

•Potential to support continuous DAC-CCU R&D in the future to increase carbon utilisation besides sequestration.

•Optimising DAC and CO_2 sequestration operation to reduce the cost of DACCS

co2crc
Building a low emissions future

What Do We Need To Fix And Why Does It Matter?

- Without CCS-CCUS, it will be impossible for the world to reach net-zero by 2050 and indeed, impossible for Australia to reach a 43% reduction by 2030; we must choose *Glory Over Death!*
- GHG storage is moving from the R&D (which has a low regulatory impact) to the major roll-out phase for multiple projects, wherein both the Australian GHG regulatory system and its regulators are going to be stress-tested within a charged political and social environment
- Our science is advancing rapidly (especially in MMV) but the regulations are static and so there is a potential disconnect between regulatory expectations and the industry's technical capacity and capability, now and into the future, which will require a high level of communication between all of the interested parties (in effect, mutual, continuous education and feedback)

CO2CRC acknowledges and appreciates the strong relationships it has with industry, community, government, research organisations, and agencies in Australia and around the world

Australian Government
Department of Industry, Science, Energy and Resources

Australian Government
Department of Education, Skills and Employment

Australian Government
Geoscience Australia

NSW Government | Planning & Environment

Victoria State Government

anlecr&d

BHP

bp

CarbonNet Project
Enabling a Net Zero Future

Chevron

ConocoPhillips

CSIRO

eni

ExxonMobil

Global CCS Institute

J-POWER EPDC

KIGAM Korea Institute of Geoscience and Mineral Resources

LETA
Low Emission Technology Australia

RITE
Research Institute of Innovative Technology for the Earth

Santos

TotalEnergies

woodside

The University of Melbourne

The University of Adelaide

Australian National University

Curtin University

The University of Western Australia
Achieve International Excellence

UNSW Australia

Federation University Australia

The University of Edinburgh

Berkeley Lab

UKCCS Research Centre

University of Cambridge

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Stanford University

GFZ
Helmholtz Centre Potsdam

University of Wollongong Australia

Deakin University

King Abdullah University of Science and Technology