

# Otway Stage 2C Project Update

An active CSLF recognised project

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CSLF Technical Group Meeting  
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# CO2CRC the leader in Australian CCS research

1. We are the first company in Australia to have undertaken carbon capture and storage end to end, safely injecting, monitoring and containing 80,000 tonnes of CO<sub>2</sub> for more than a decade
2. We design, project manage, and fund in-field and laboratory based CCS projects with the best local and international researchers
3. We test novel technologies to determine their efficiency, accuracy, and confidence. Our work brings confidence to regulators, industry and the community.
4. Our Otway Research Facility has seen \$100m in investment in 10 years, making it the best in-field CCS research centre in the world.

## WHO IS CO2CRC

### CO2CRC SUPPORTS INDUSTRY TO REDUCE GREENHOUSE GAS EMISSIONS THROUGH CARBON CAPTURE & STORAGE RESEARCH

- ◊ We are the first company in Australia to have undertaken carbon capture and storage end to end
- ◊ Our research demonstrates carbon capture and storage in-field using novel technologies. We test their efficiency, accuracy and cost-effectiveness bringing confidence to industry and regulators
- ◊ We have safely injected, monitored and contained 80,000 tonnes of carbon dioxide for more than a decade
- ◊ We design, project manage and fund carbon capture and storage programs utilising the best international and local talent



# CO2CRC strategic direction

## CO2CRC STRATEGIC DIRECTION

### CO2CRC OTWAY STAGE 1

- ▶ CO<sub>2</sub> storage in a depleted gas field
- ▶ Subsurface sampling



### CO2CRC OTWAY STAGE 2

- ▶ Residual trapping in saline formation
- ▶ Validate surface monitoring



### CO2CRC OTWAY STAGE 3

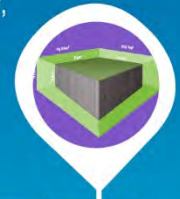
- ▶ Validation of sub-surface fixed array monitoring
- ▶ \$41 m investment



### AUSDEEP

- ▶ Leveraging \$100m in carbon capture and storage investment to develop clean sub-surface energy options by understanding the sub-surface; heat flow, seismicity; fluid flow

- ▶ Engineering the sub-surface reactants; energy resource; biominerals; geothermal; ground water; hydraulics



## STORAGE

2007

2008

2009

2010

2011

2012

2013

2014

2015

2016

2017

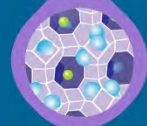
2018

2019

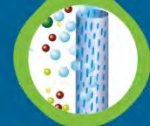
2020



Hazelwood Brown Coal PCC 3 technologies



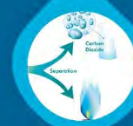
Mulgrave Brown Coal IDGCC 3 technologies



Membrane Vales Point PCC



Hazelwood UNO MK3 PCC



Membrane & Adsorbent Otway Natural Gas



- ▶ A new technology for separating methane from high concentrations of CO<sub>2</sub>
- ▶ A scalable plant for on-shore and off-shore applications

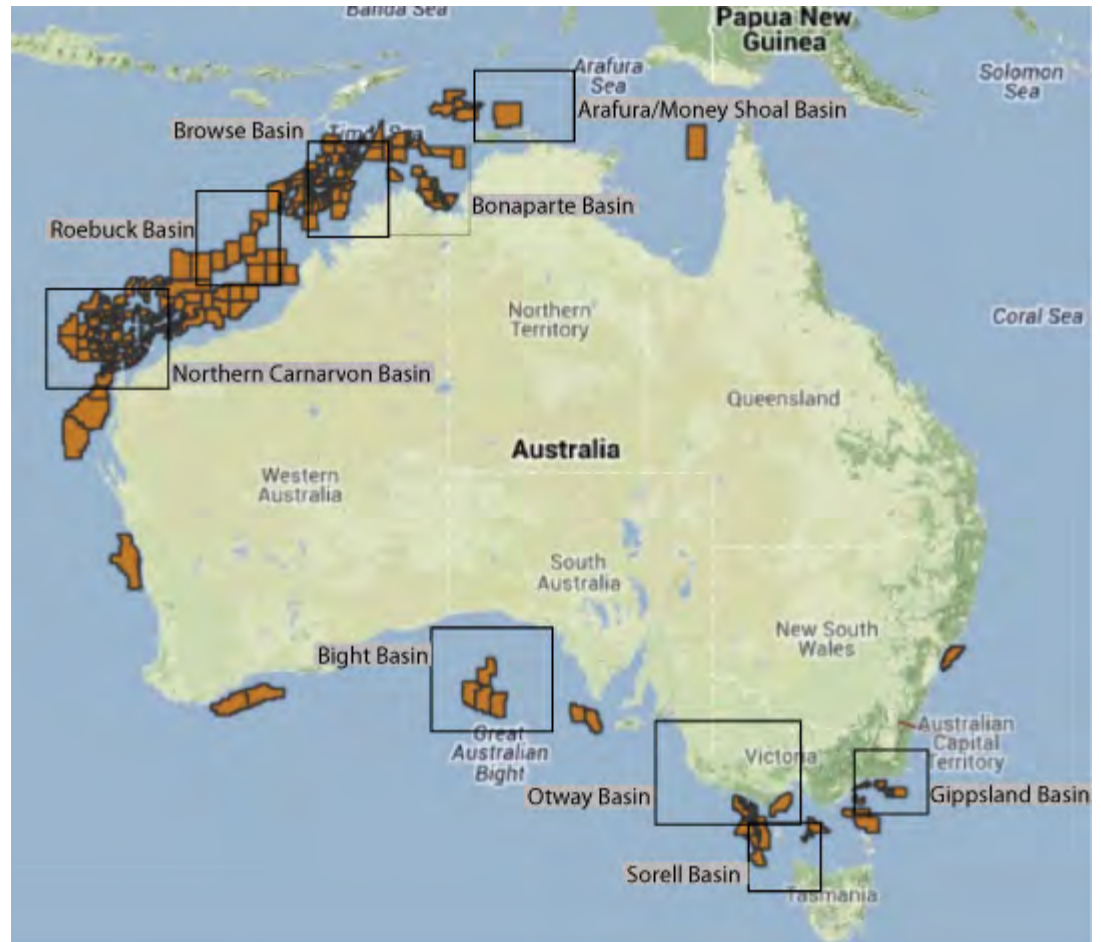
## CAPTURE

# Capture R&D

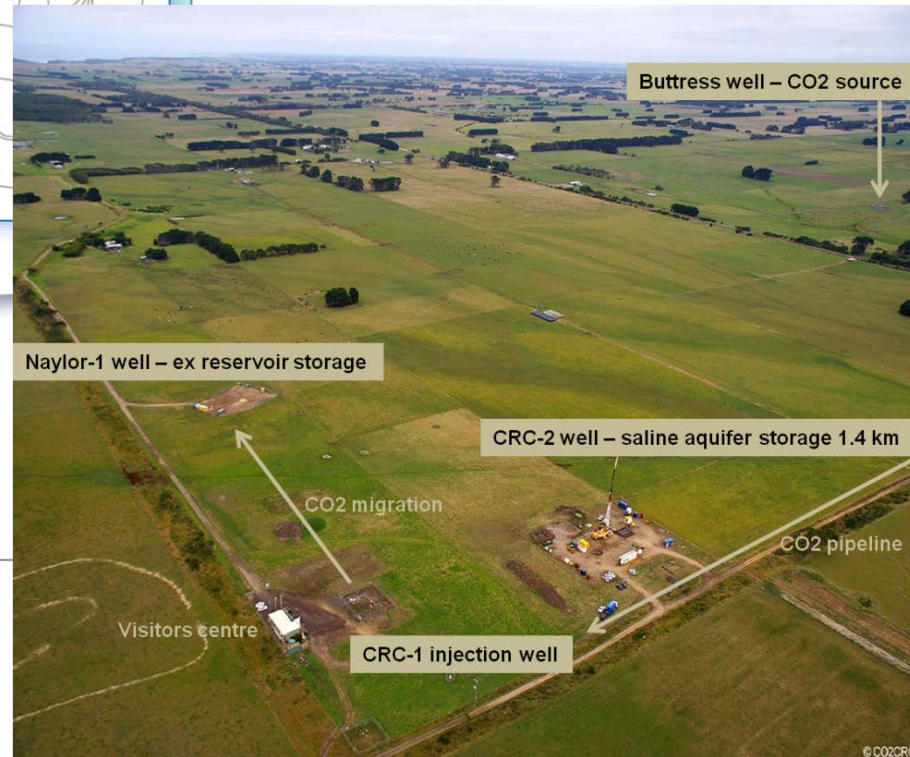
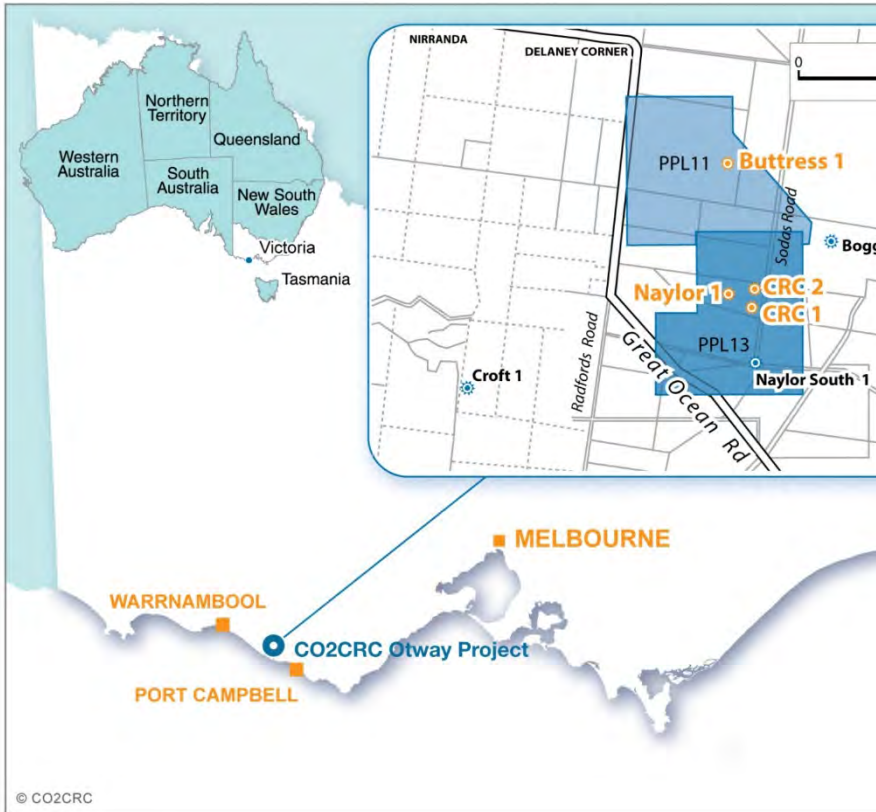
Australia emerging gas fields holding higher levels of CO<sub>2</sub>.

As backfill of gas becomes more urgent CCS presents a key solution to address the CO<sub>2</sub> issue.

To achieve this, technical improvements in CO<sub>2</sub> separation from natural gas is critical



# Location of CO2CRC Otway Facility



# The CO2CRC Otway Project Stage 2

Stage 2: 2007 – 2020

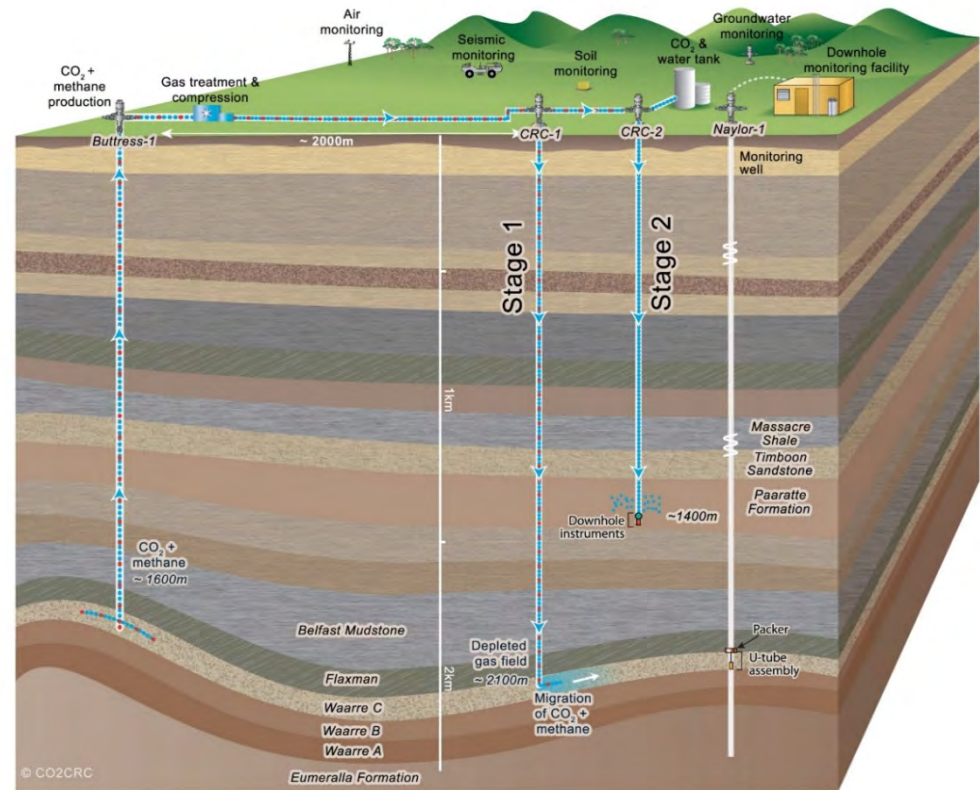
*Demonstrate that CO<sub>2</sub> storage can be safely conducted at scale within a Saline Formation*

Appraisal

- ✓ 2A :Drill CRC-2
- ✓ 2B: Measure parameters affecting residual and dissolution trapping in a saline formation
- ✓ 2B Extension: interactions with impurities & well test refinement

Operation

- 2C: Spatially track injected CO<sub>2</sub> in a saline formation
  - Minimum detection limit
  - Migration behaviour
  - Stabilisation



# Stage 2C Monitoring program

4D seismic with buried receiver array  
acquired concurrently with 4D VSP

- Baseline: March 2015
- Monitor surveys: 5 kt, 10kt, 15 kt of injection (2016), 1&2 years post injection (January 2017 & 2018)

Offset VSPs

Trialing 4D seismic with buried DAS array,  
and continuous seismic sources (LBNL)

Passive seismic using buried receiver  
array

Continuous in- & above-zone pressure  
monitoring

Saturation logging



# Geophone and fiber array installation: Trenches 80 cm deep, PVC cased boreholes 4 m deep





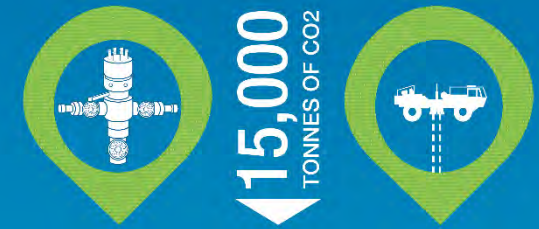
# Otway Stage 2C preliminary results

1. 15,000 tonnes of CO<sub>2</sub>, safely injected into the saline formation, is migrating as predicted.
2. Seismic & pressure monitoring resolution is beyond expectation
3. Minimum detection levels of CO<sub>2</sub> have been identified
4. The combination of these results, with ongoing regular monitoring through to 2019, will de-risk the injection, monitoring and trapping of CO<sub>2</sub> in a saline formation giving confidence to technology users and regulators.

## DE-RISKING THE STORAGE OF CO<sub>2</sub> IN SALINE FORMATIONS

Saline formations have the greatest potential for CO<sub>2</sub> 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 CO<sub>2</sub> WE WILL VALIDATE SALINE ROCK FORMATIONS FOR CARBON CAPTURE AND STORAGE BY:



**VALIDATING THE ACCURATE MODELLING OF CO<sub>2</sub> STABILISATION AND TRAPPING IN A SALINE FORMATION**

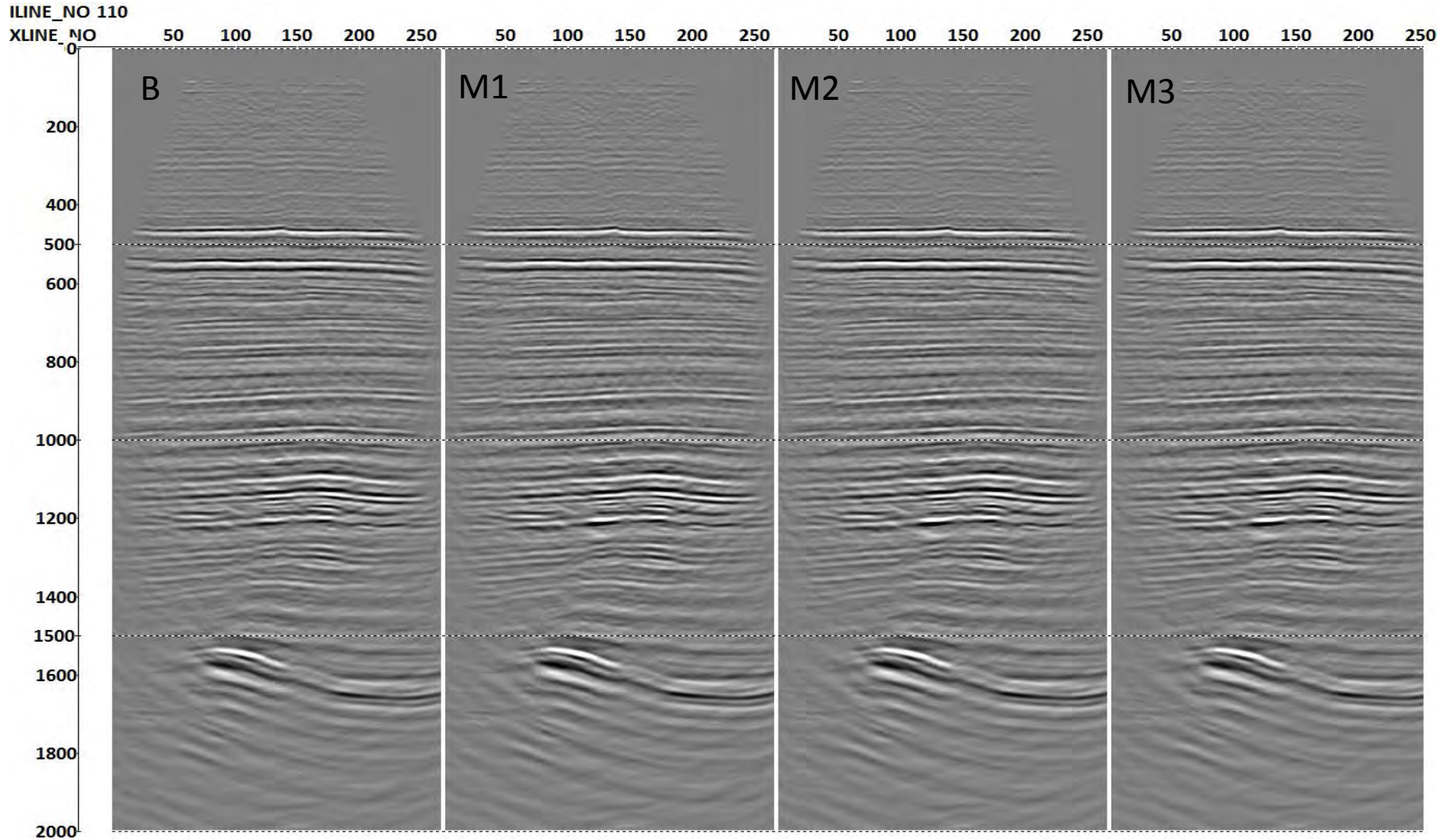


**UNDERSTANDING THE SAFE STORAGE CAPACITIES OF THIS RESOURCE**

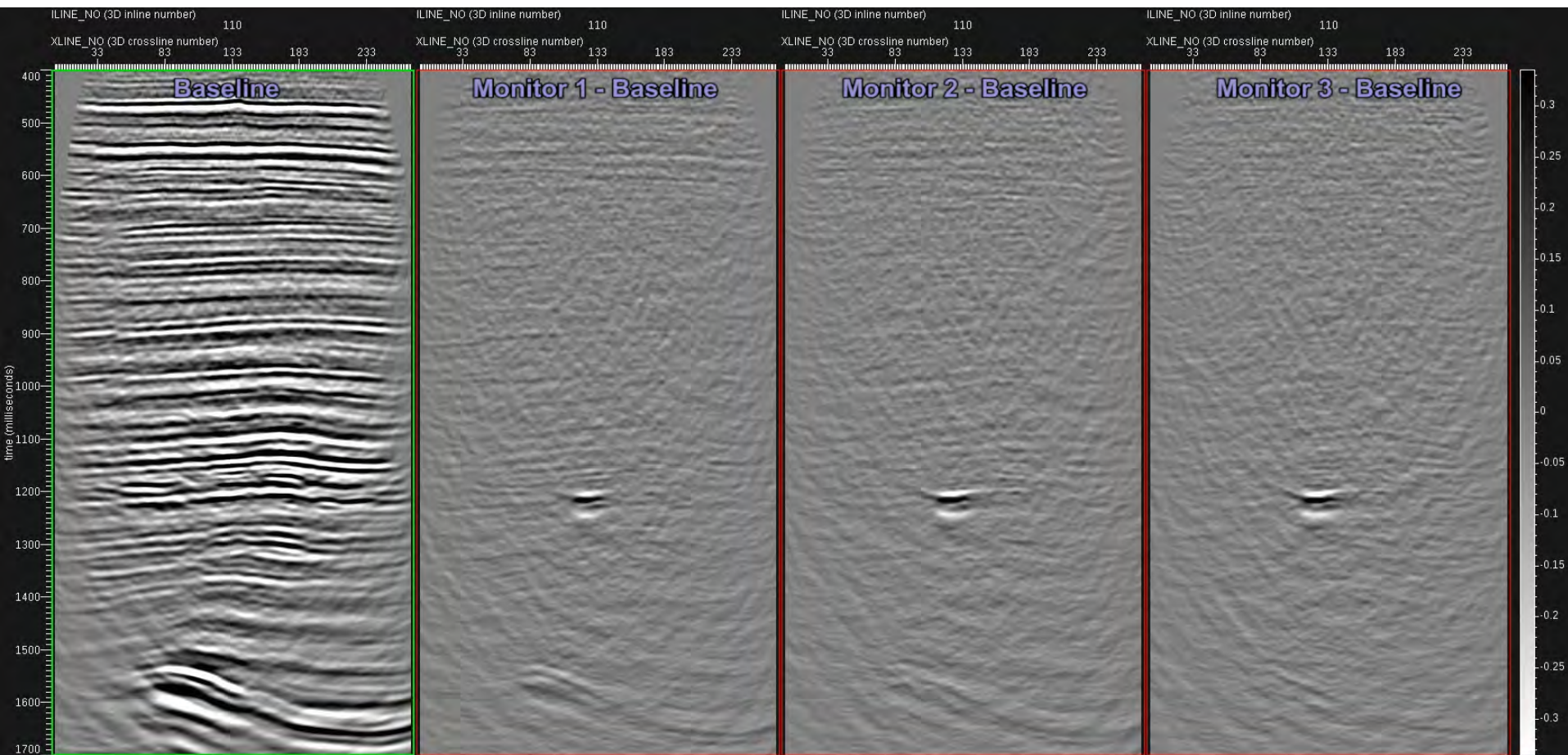


**DEMONSTRATING THE MINIMUM DETECTION LEVEL OF CO<sub>2</sub>**

# Otway Stage 2 – pre 4D

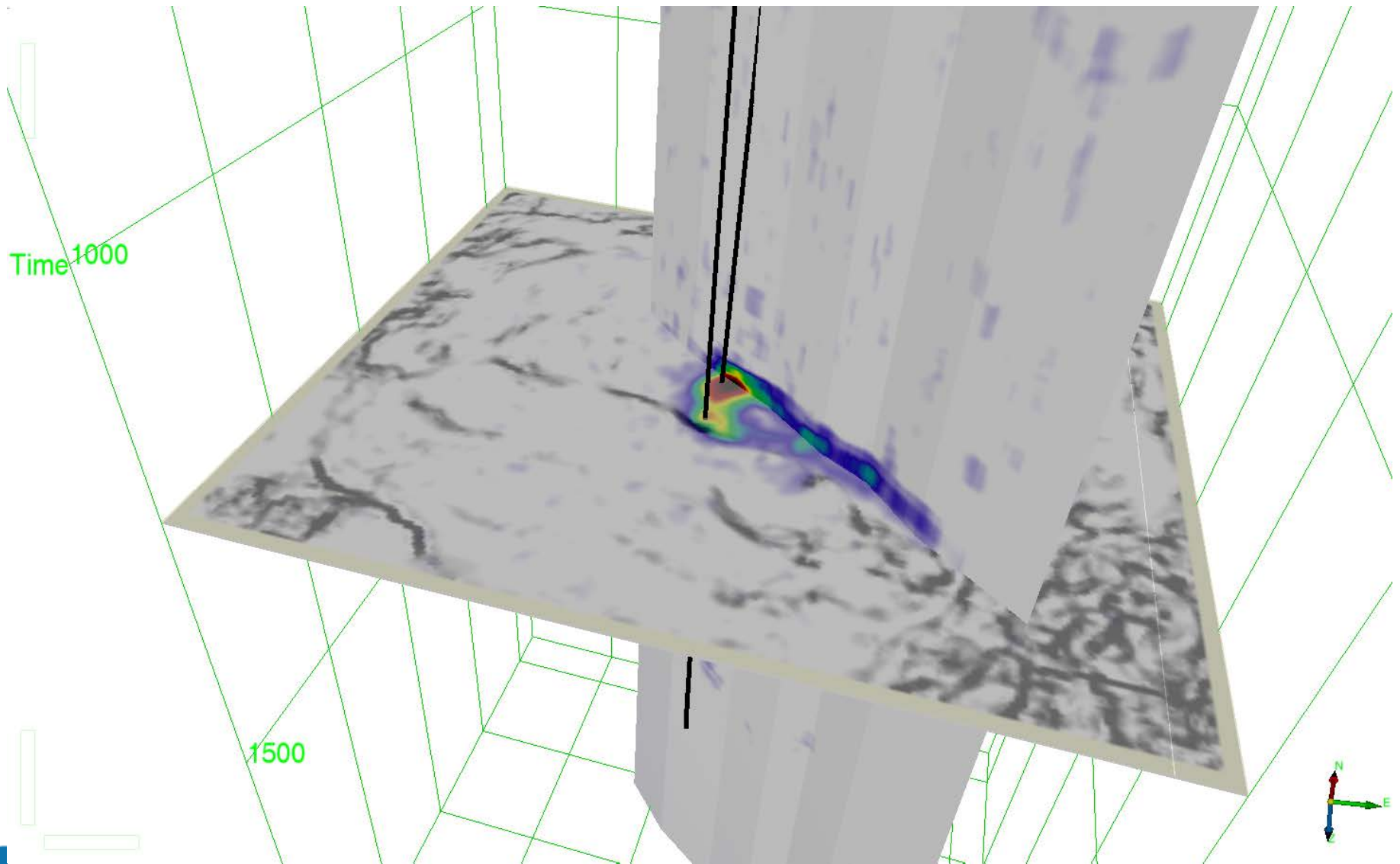


# Otway Stage 2 – 4D change still image



Supplementary video to the article: "4D surface seismic tracks small supercritical CO<sub>2</sub> injection into the subsurface: Otway Project"

# Otway Stage 2



# Next Steps for Otway 2C

## Evolution of monitoring for CCS:

- iDAS (LBNL), permanent source(LBNL) & passive seismic comparisons
- Reservoir zone and above zone pressure monitoring

## Development of 'fit for purpose' M&V guidelines

- Technical capability limit
  - Capabilities in leakage detection
1. Demonstration of plume stabilisation
  2. Workflow for plume behaviour verification

Conformance between M&V and plume models

Monitoring KPAs for liability transfer



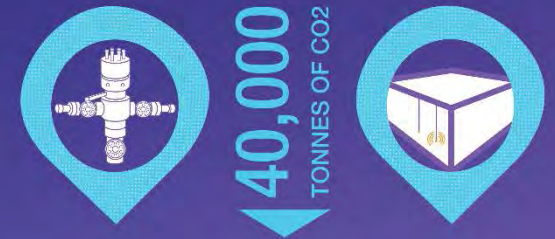
# Otway Stage 3 2016-2020 objectives

1. To deliver a permanently deployed subsurface and cost-effective real-time monitoring solution for industry
2. To increase the efficiency of CO<sub>2</sub> monitoring with new and adapted technologies
3. To reduce the surface footprint and impact of monitoring activities

## REDUCING THE COST OF CO<sub>2</sub> STORAGE

CO<sub>2</sub>CRC aims to accelerate the implementation of commercial carbon capture and storage projects by undertaking the validation of cost-effective subsurface monitoring technologies

# 2016–2020



BY 2020 WE WILL FULFIL THE  
FOLLOWING OBJECTIVES:



DELIVERY OF  
PERMANENTLY  
DEPLOYED,  
COST-EFFECTIVE  
REAL-TIME  
MONITORING  
SOLUTIONS

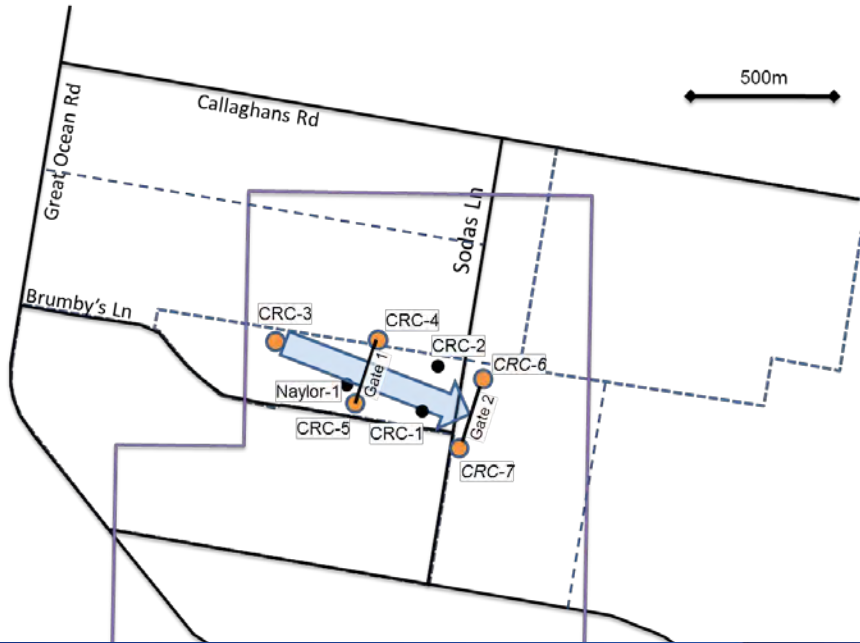


INCREASE  
CO<sub>2</sub> STORAGE  
MONITORING  
EFFICIENCY  
WITH NEW  
TECHNOLOGIES



REDUCE THE  
SURFACE  
FOOTPRINT  
AND IMPACT OF  
MONITORING  
ACTIVITIES

# Otway Stage 3



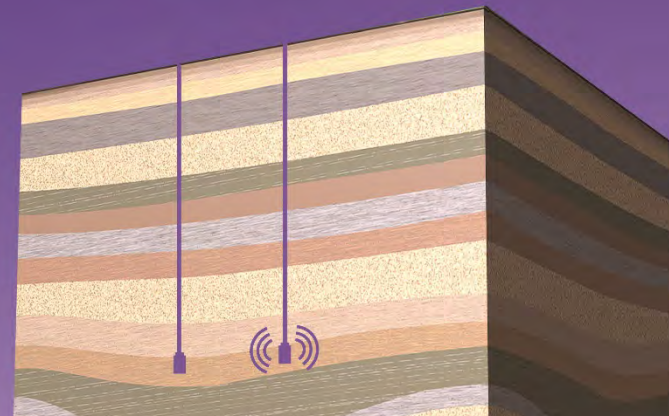
## DELIVERING OUTCOMES

Determine, and demonstrate the most cost-effective subsurface monitoring solutions, saving industry hundreds of millions of dollars in monitoring over the life of a project

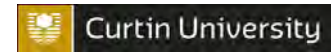
Inject 40,000 tonnes of CO<sub>2</sub> to generate a plume analogous to a leakage event, as well as quantifying the effectiveness of capillary and solution trapping



Expressions of Interest to collaborate in the Evaluate Phase of CO<sub>2</sub>CRC's Otway Stage 3 subsurface monitoring project



# Government, Industry and Research Partners







Thank you