Accelerating Australian Demonstration Projects Through Enabling Research & Development

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Australian National Low Emissions Coal Research and Development

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Technical Group Meeting Oct 17 , 2018
Melbourne, Australia

Acknowledgments

ANLEC R&D is a partnership between the Australian Government and the Australian Coal Industry.

It is a National Research Initiative to accelerate deployment of lower emission technology for coal fired power stations in Australia

Founded in 2010, ANLEC R&D deploys a research effort of $200 M+ in over 25 institutions nationwide.

Our current focus is to accelerate the commercial deployment of CO_2 storage across three Australian geological basins

Australian Government
Department of Industry, Innovation and Science

COAL21 FUND

Australian Commonwealth Government

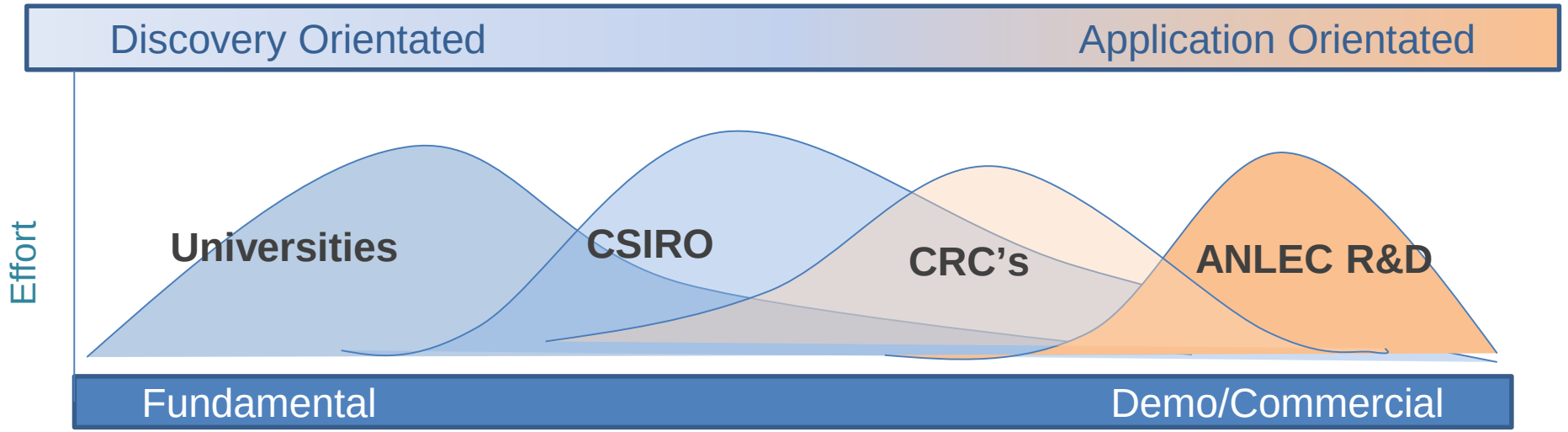
Deployment Orientated Research

Types of Research

Fundamental Research: Capability Maintenance Eg: ARC

Initiative Research: Targeted Objective Eg: Cancer, Genome

Internal Research : Corporate IP - Generation & Exploitation



*For illustrative purposes only

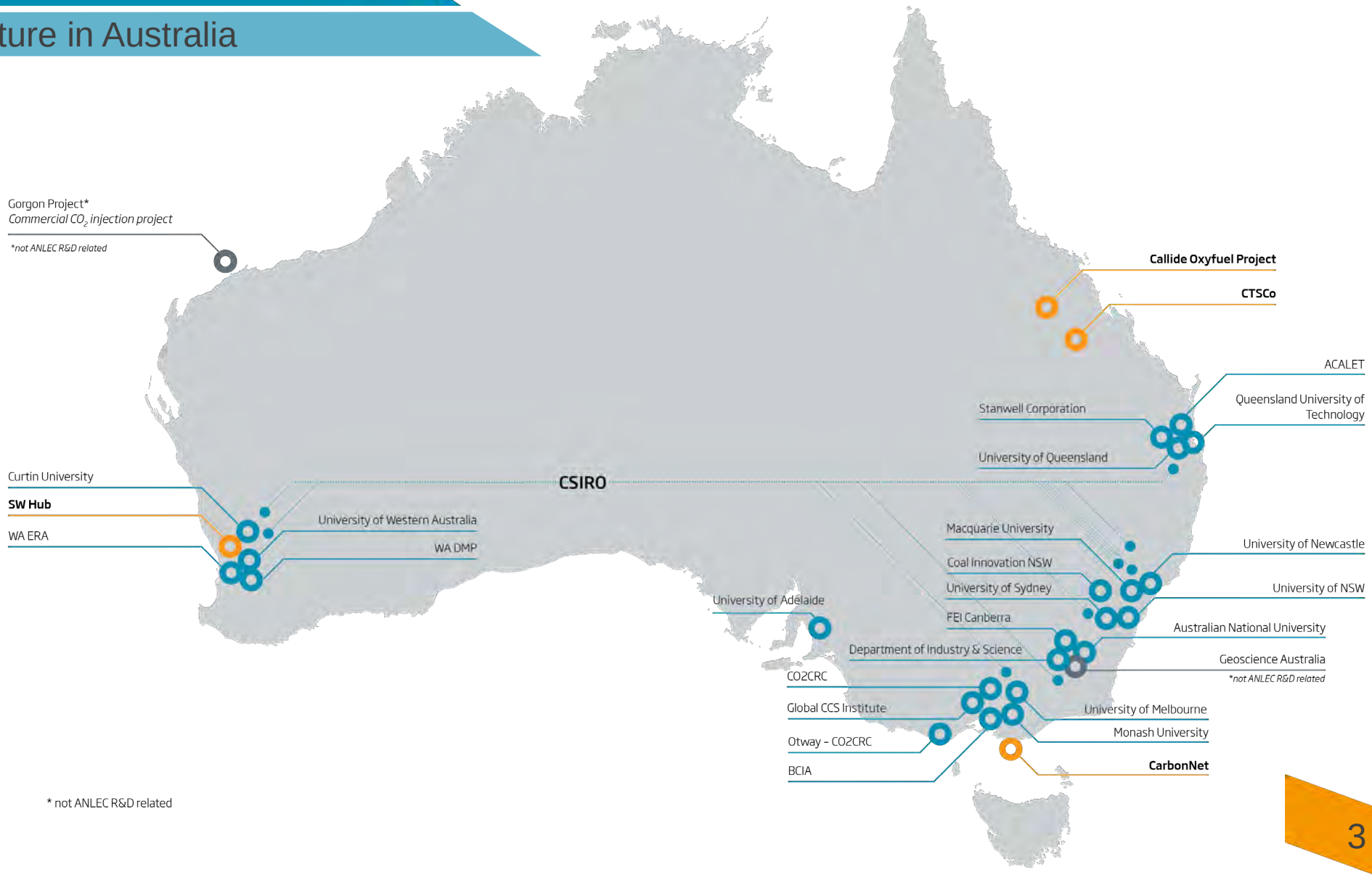
ANLEC R&D
Enabling Low Emissions from Coal

CO_2 Storage and Capture in Australia

Australian CCS Research Services 2009–2016

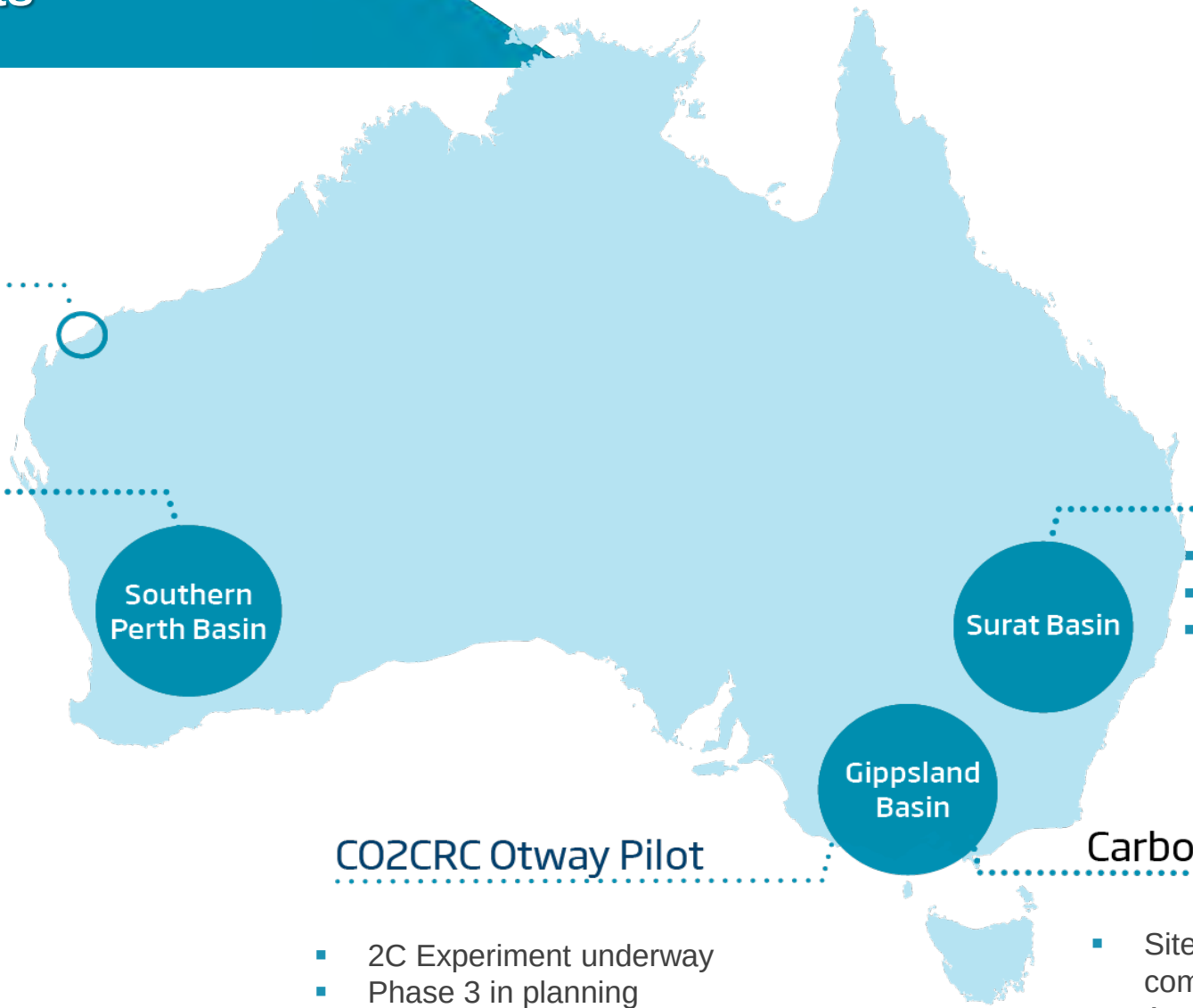
INTERNATIONAL COLLABORATION

Class VI Solutions, USA
EPRI, USA
Lawrence Berkley National Labs, USA
WellDog, USA
IEAGHG, UK
IEACCC, UK
MAN Diesel & Turbo, GERMANY
Simon Fraser University, CANADA
Aquistore, CANADA



* not ANLEC R&D related

Australian CCS Project Proponents



Chevron Gorgon Injection Project

- Planned 3Mt/a

The South West Hub

- 4 Wells Drilled
- 5th Well Planned

CTSCo

- 1 Well Drilled
- 3D Seismic Completed
- Assessment Underway

CO2CRC Otway Pilot

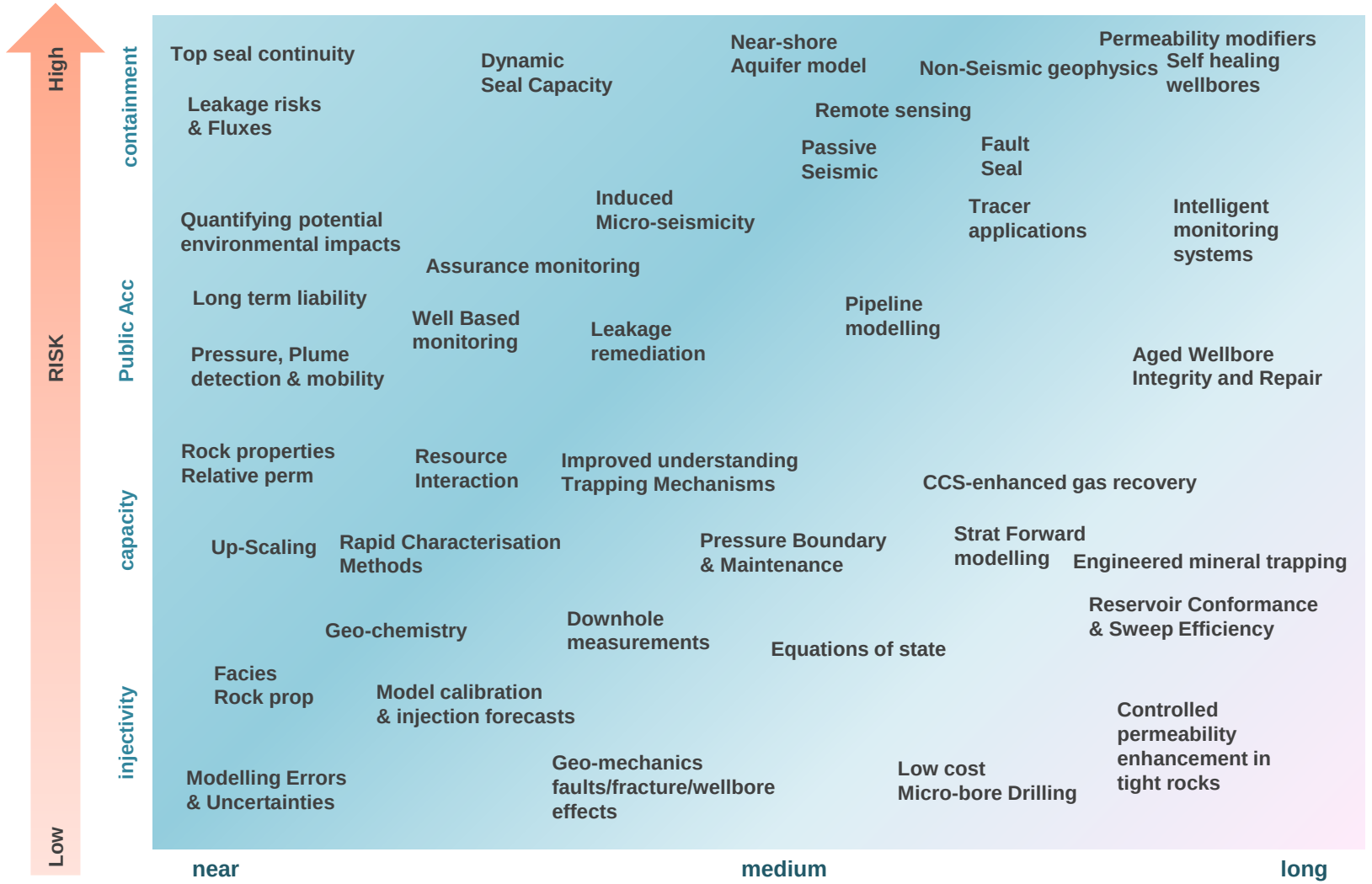
- 2C Experiment underway
- Phase 3 in planning

CarbonNet Flagship

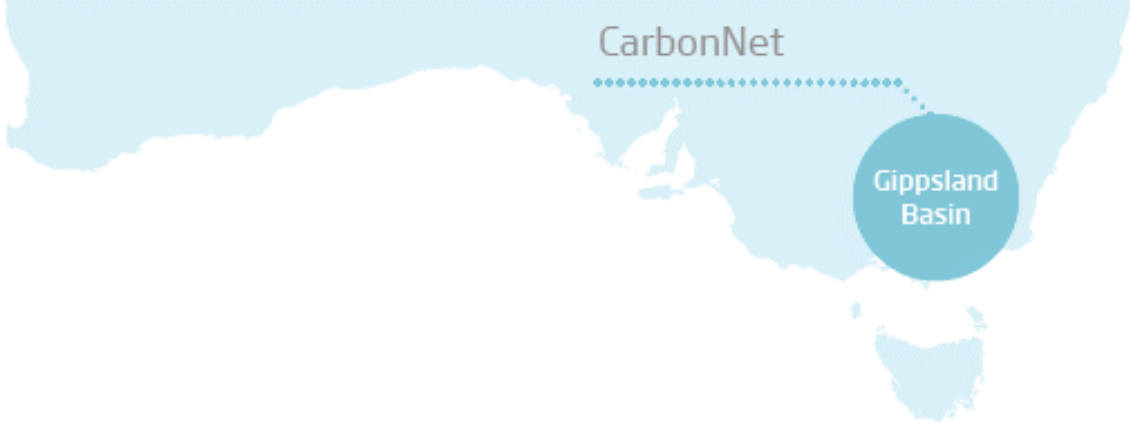
- Site selection completed
- Approvals underway

Know the Research Space

CO_2 Storage Research Selection



Gippsland Basin - CarbonNet



GOAL

To enable CO_2 storage in the offshore Gippsland Basin

Victoria

TARGET AREAS

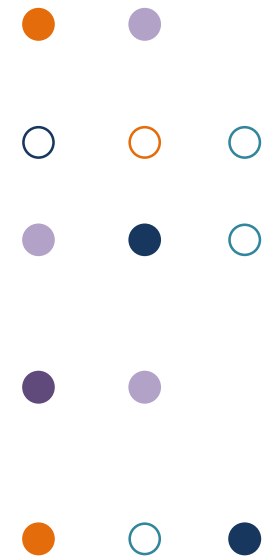
- Reservoir Containment
- Public Acceptance
- Reservoir Capacity
- Reservoir Injectivity

IMPACT STATEMENT

- To deliver an improved understanding of potential interactions between CO_2, oil & gas and water resources
- To recognise and demonstrate state-of-the-art marine monitoring applications for the offshore reservoir applications
- To communicate the science that underpins CO_2 storage in the sub surface for the off shore Gippsland Basin
- Validate rapid innovative characterisation methods at scale
- Deliver new data and fundamental correlations on the CO_2 flooding dynamics of reservoir rocks under in-situ injection conditions

IMPACT DELIVERY STRATEGY

IMPACT DELIVERY



IMPACT DELIVERY KEY

New Data · New Application · Field Validation · New Service · New Correlation · New Software · Public Communication

SCALE KEY

= In Lab · = In Field

Typical Project Overview

Impact of heterogeneity and diagenesis on injectivity and containment Typical project - Perth Basin	Multiscale static and dynamic digital core and modelling of Precipice facies Typical project - Surat Basin
Context	
The capacity of the Wonnerup depends significantly on the residual trapping of this member. Heterogeneity at metre scale can be exploited to enhance capacity and containment	Conventional upscaling does not capture all scales of heterogeneity and flow scenarios.
Gap Description	
Poorly understood potential for migration, lack of knowledge of the diagenesis, and constraints on simulation such as fracture gradient and fluid composition	Qualitative and non-quantitative correlation from core to reservoir upscaling
Risk/Uncertainty	
Residual trapping and vertical flow in the Wonnerup is the most significant uncertainty and risk in the project	Loss of information when moving from high resolution core to lower resolution reservoir scale
Innovation	
Integrated view of injectivity, migration and trapping. Methodology for uncertainty quantification of heterogeneity, diagenesis in context of overall project risk	Digitally quantified upscaling of core properties from core to geocell scale

What follows are just 4 examples of large ANLEC R&D research and technology initiatives being pursued by Australian commercial-scale projects

Micro-measurements Matter:

Maximising the value of Digital Rock Technology

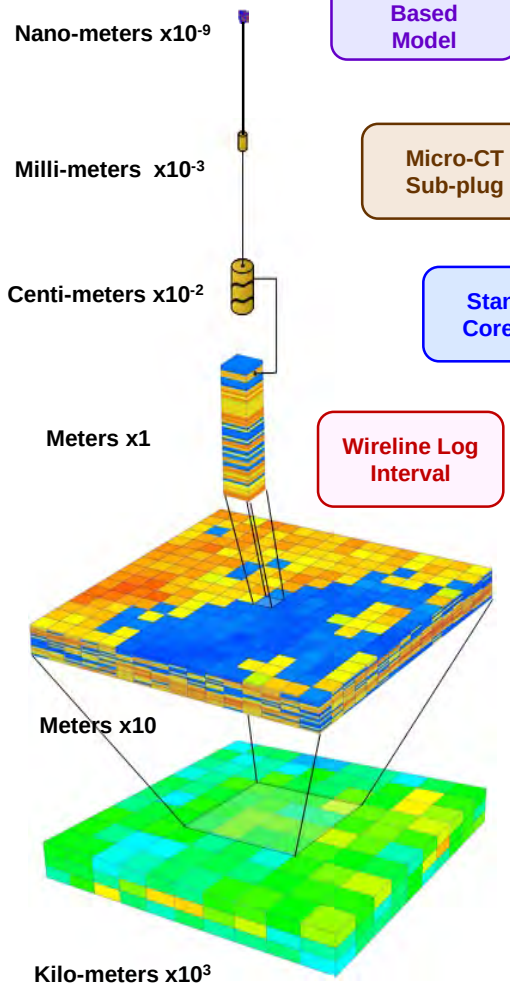
A major ANLEC R&D funded project $5.6 M

- Practical workflow to characterise geological structures at multiple scales from micro-pore scale to geo-cell scale.

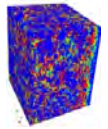
The workflow includes:

- High resolution micro-scan of a continuous 100 meters of core.
- Creating a library of discrete facies-based, reservoir properties.
- Developing dynamic reservoir solvers from microscale to grid block scale.
- Validation in Otway 3.

Multiscale static and dynamic modelling of Precipice Facies - $ 3.92 M (next phase)

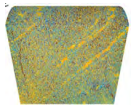


Process Based Model



Model pore-scale processes

Micro-CT Sub-plug



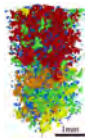


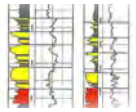
Image & measure at pore-scales

Standard Core Plug

Image & measure at plug-scales

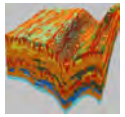
Wireline Log Interval

Whole Core (at Log Interval)



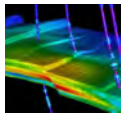
Integrate and correlate with rock types at log-scales

Geomodel Cell



Interpret CO_2 behaviour in geo-cell kilometre blocks

Simulation Grid Block



Apply and simulate over basin scale

Significant Research Results for Callide Oxy-fuel

Low cost de-SOx is viable, even for standard Australian power plants without FGDs

- NaOH scrubber will reduce SOx levels in flue gas
- 4<pH<5.5 is recommended as control regime to avoid caustic waste and for high removal extent
- Caustic consumption and disposal costs are material to the process

Separate de-NOx not required

- NOx and Mercury reactions coupled and synergistic
- Significant Hg0 & NOx captured during compression process -100% Hg, ~90% NOx

Additional mercury capture not required

- Mercury removal can be achieved via ash disposal and liquid waste streams from compression

Surat - Aquifer, near surface and atmospheric portfolio

Major ANLEC R&D Portfolio - $3.68 M

Identify/ Locate

- Remote Pasture Condition Assessment (PSA)/ coupled with a remote leakage signal
- Near surface and atmospheric techniques
- Gas/ water monitoring at “higher risk” locations (proximal to well bores etc)

Attribute

- Process Based methods
- Isotopes
- Tracers

Quantify

- Near surface Flux
- Anomaly threshold assessment and alert system

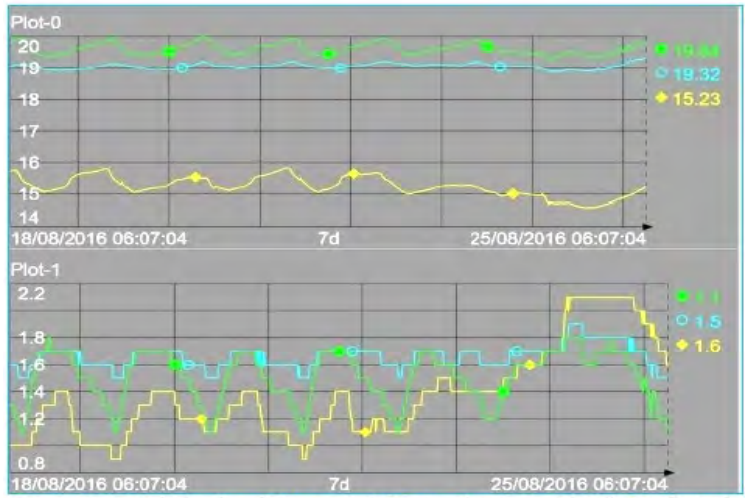


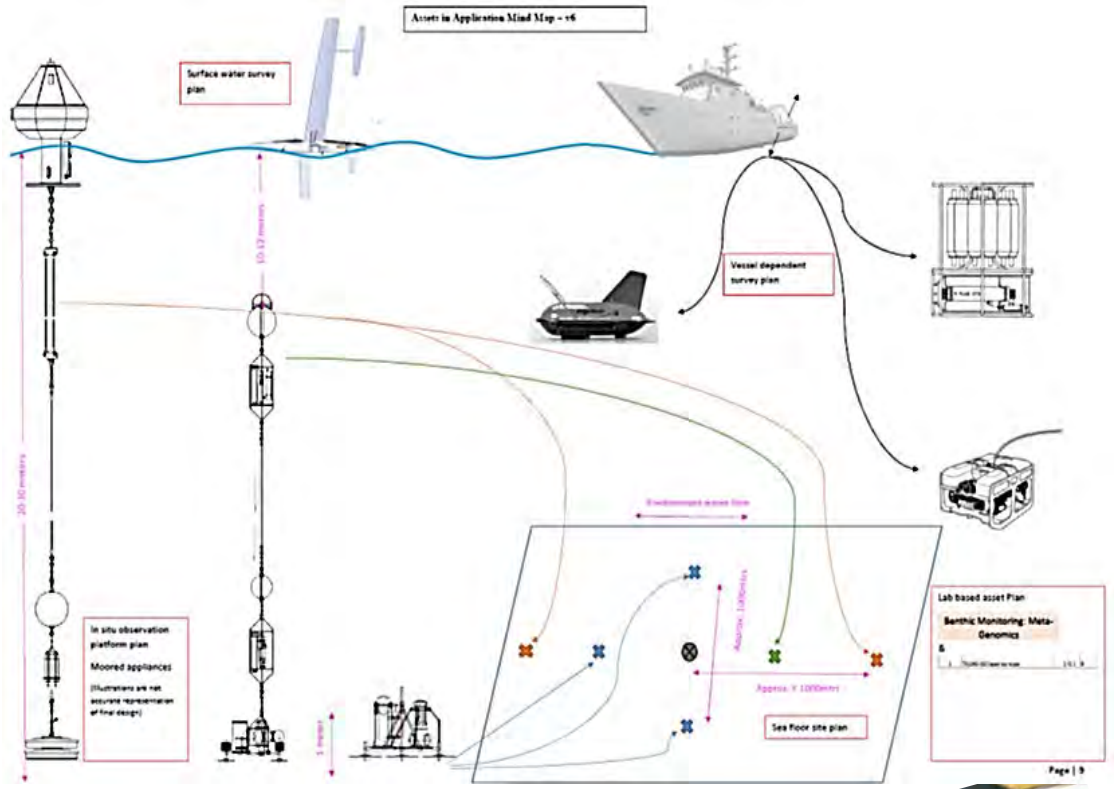
Figure 13-24: Results from Site 5 – Soil Oxygen (upper) and Soil CO_2 (lower)

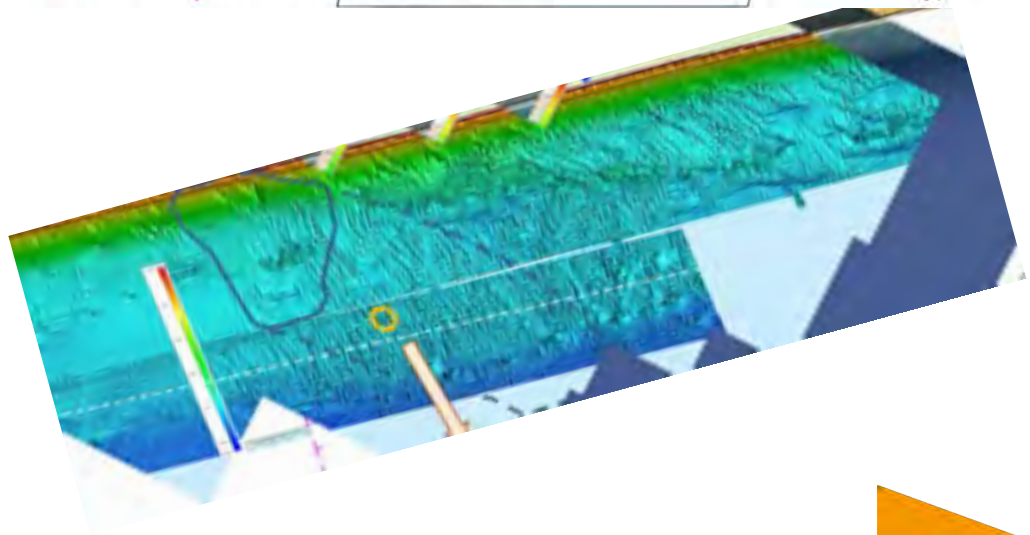
Fig. 1. Three of the sensor platforms, deployed at the Ginninderra test site near Canberra, Australia. The Vaisala GMP343 can be seen on the masts; power is provided by solar panels and all remaining equipment is securely housed in a box on the mast.

Gippsland Marine Monitoring

Major ANLEC R&D Portfolio - $6.63 M

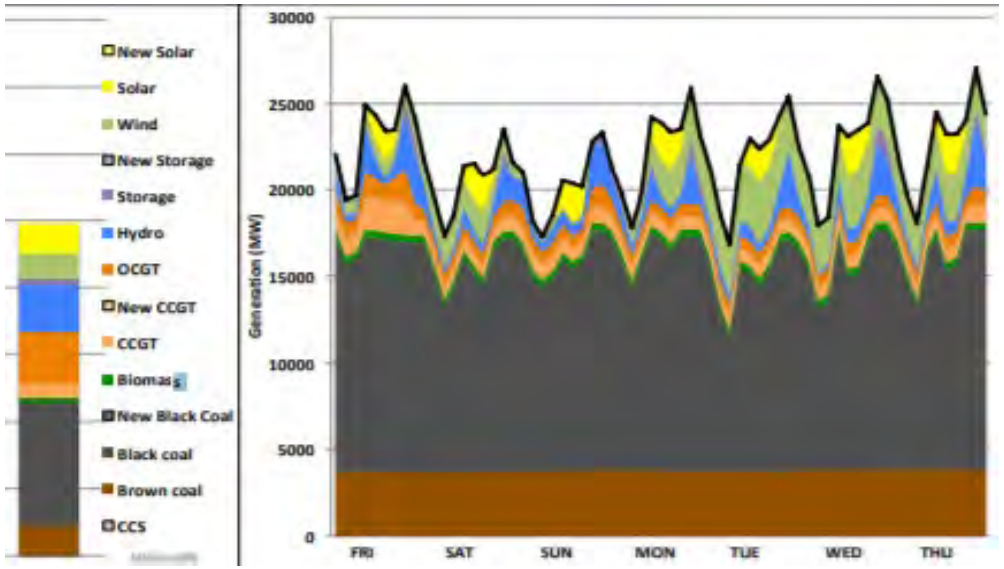
- Assessment of **shallow-focused Marine MMV** methodologies for subsea CCS in Gippsland - $4.4M
- Developing and verifying an **atmospheric assurance system** for the Gippsland near-shore environment - $688K
- Analyse the nature and origin of the **observed seabed features** in the nearshore Gippsland Basin - $890K
- Optimisation of **sea-bed micro-seismic monitoring** for CCS applications in the Gippsland Basin - $658K



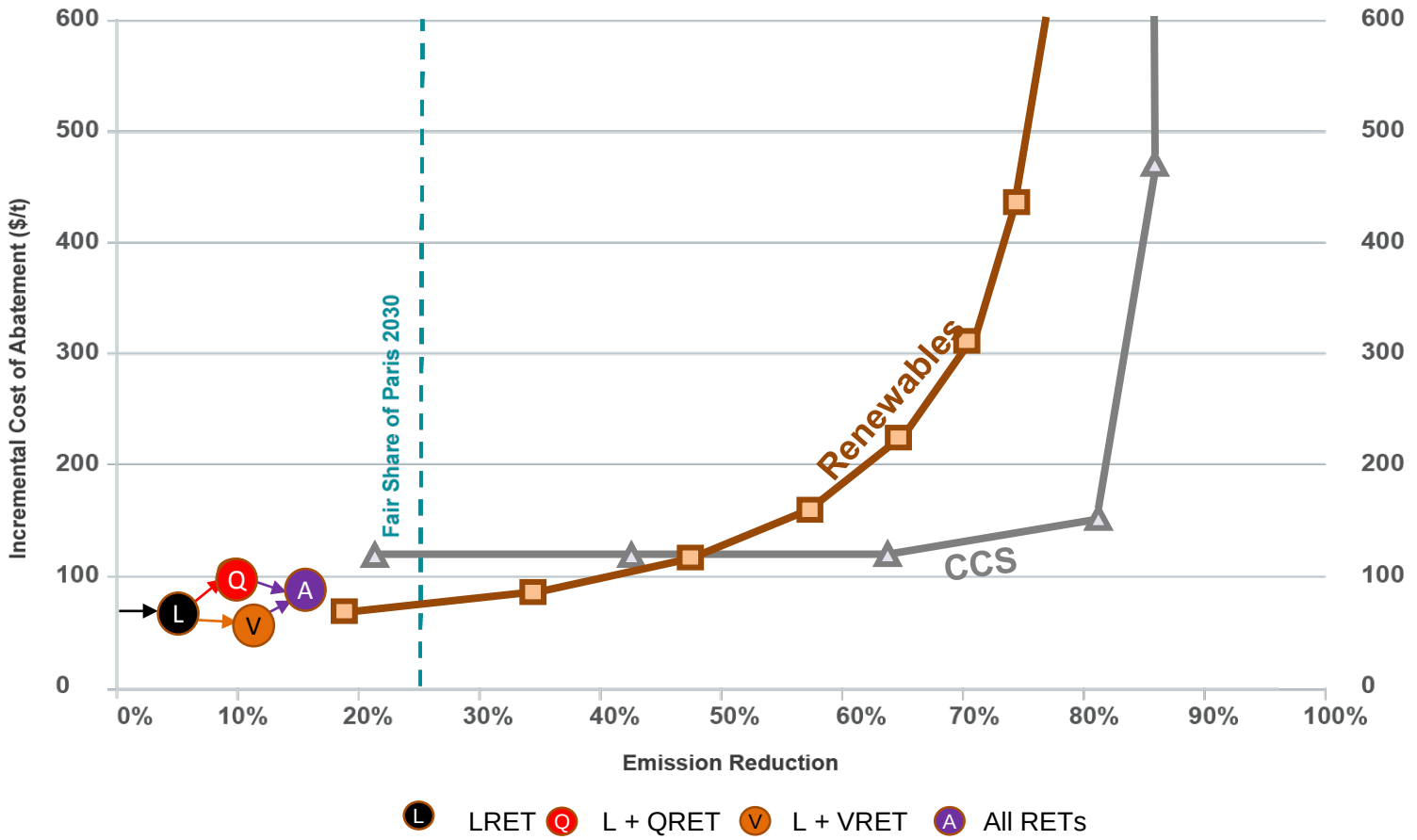


Total Generation System Cost of Abatement vs Emissions Reduction

Total System Model Validated by Typical Daily Supply



- Renewables includes PV, Wind and Batteries.
- Cost of abatement using renewables starts cheaper than CCS but cross over at 45% decarbonisation.
- Renewables can get to 80% but at enormous cost
- LRET, VRET, QRET together do not get to Paris



http://anlecrd.com.au/wp-content/uploads/2017/07/Managing-Flexibility-NEM-2017-Report.pdf

Enabling Research to Reduce Greenhouse Emissions from Coal Technologies

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BIG IDEAS ENERGY

Australian National Low Emissions Coal Research and Development

Summary

Lessons Learned

- Research funding must define “line-of-sight” to Technology
- Technology Deployment discriminates Research Priorities

For ANLEC R&D

- Demonstration Proponents are “customers”
- Research results are anticipated and valued
- Exploitation is immediate
- Impact is tangible and assessable - improved decisions

Dissemination

- Short term through systematic communication
- Long term by website reports: Journals, Webinars, conference

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THANK YOU

Thank you and as a Co-sponsor we welcome you to GHGT-14

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