



Australian Government
Geoscience Australia



An overview of CCS in Australia

Andrew Feitz

CAGS II Workshop

Wuhan, 19-20 November 2014

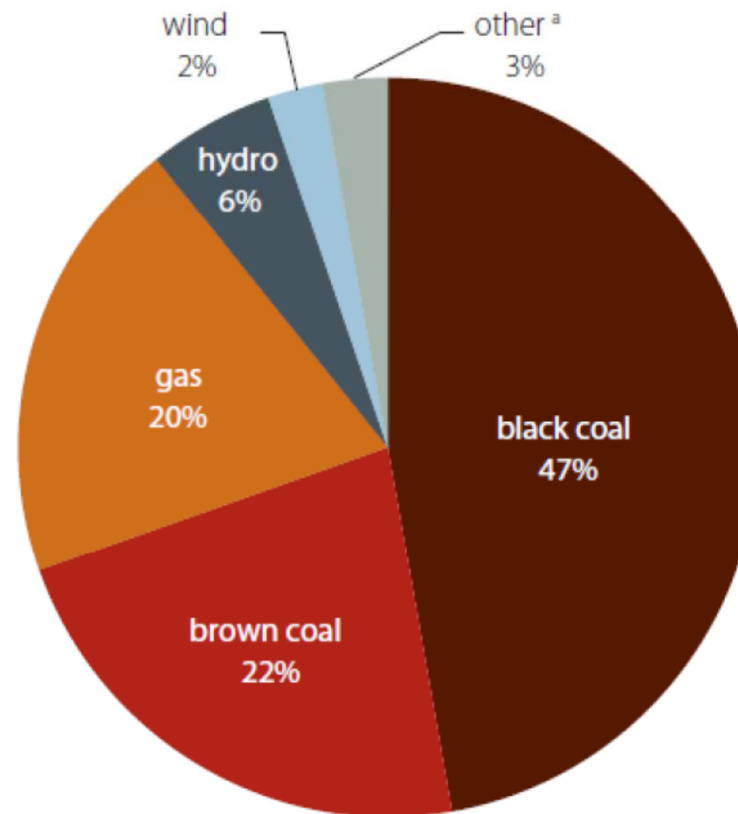
Drivers for CCS in Australia

Greenhouse gas reduction
5% below 2000 levels by 2020

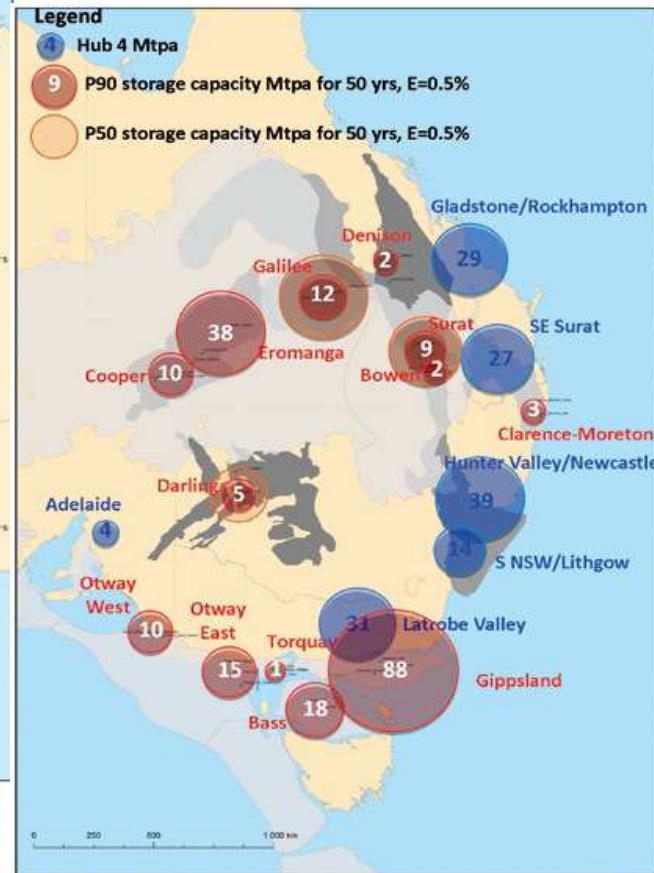
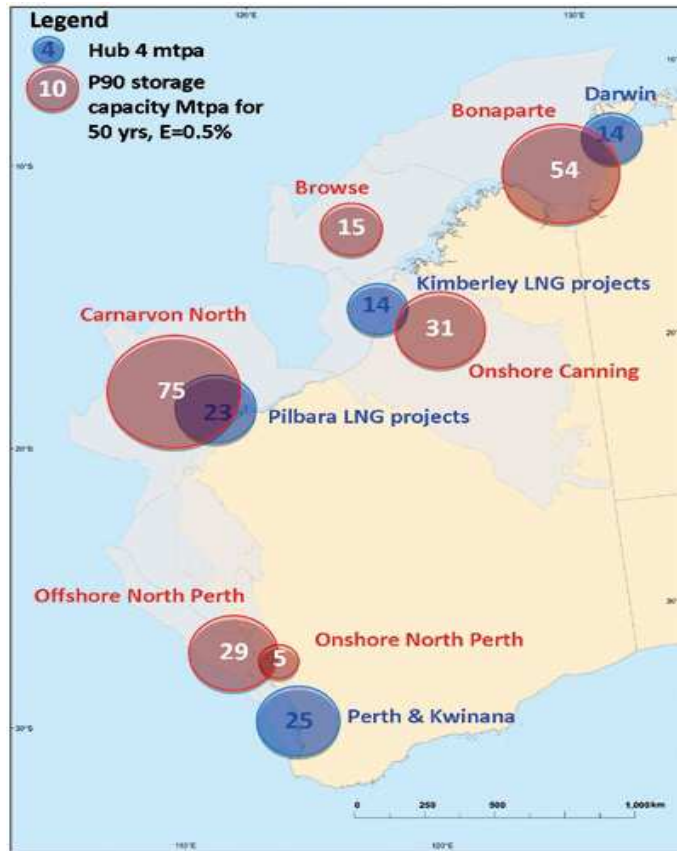
Electricity generation
is Australia's **largest source** of
greenhouse gas emissions.

Heavy reliance on coal
- **27%** world coal trade
- Emissions intensive **industry**

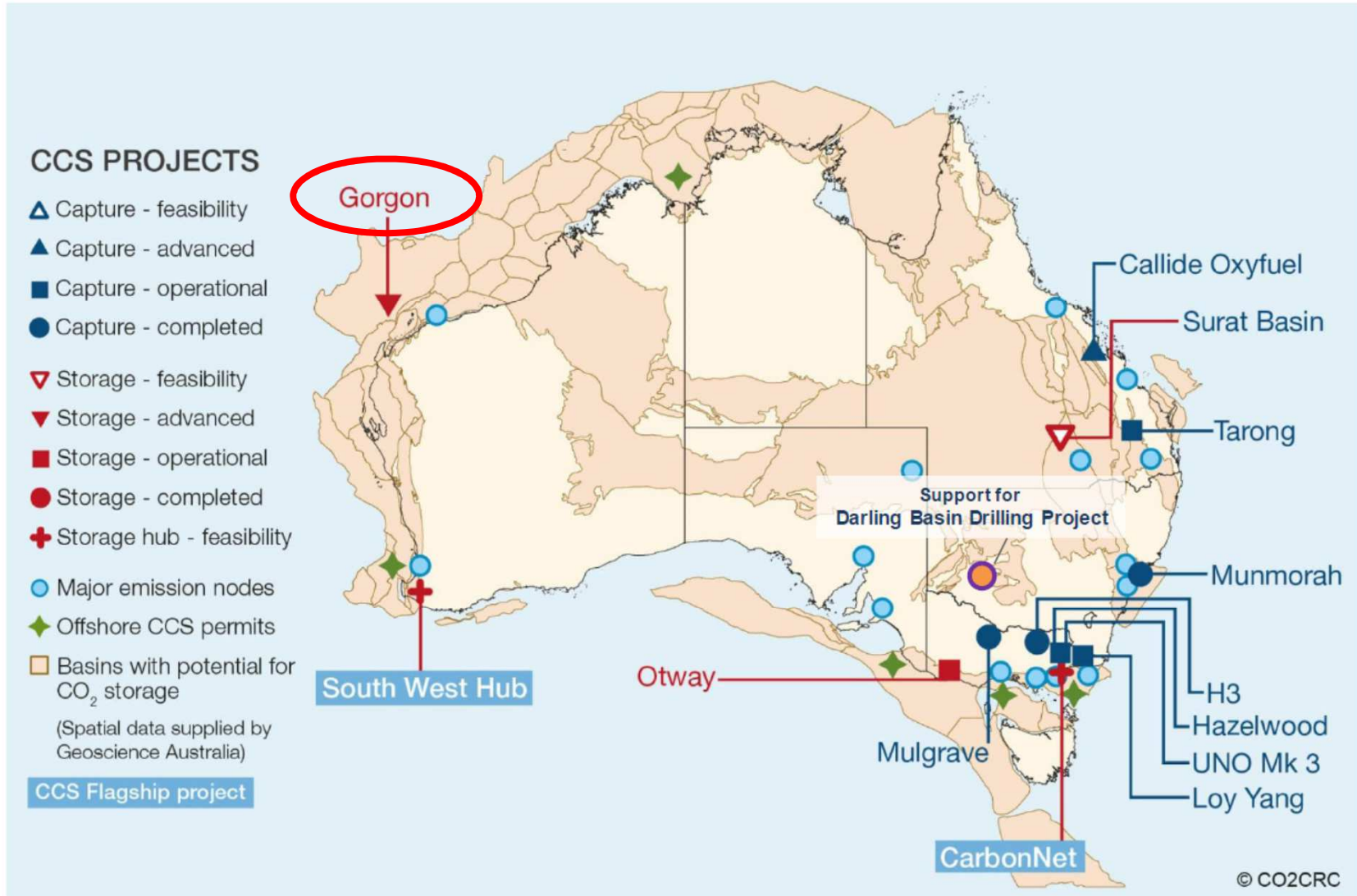
Electricity generation by energy source, 2011-12



Emissions nodes vs geological storage basins



CCS projects in Australia

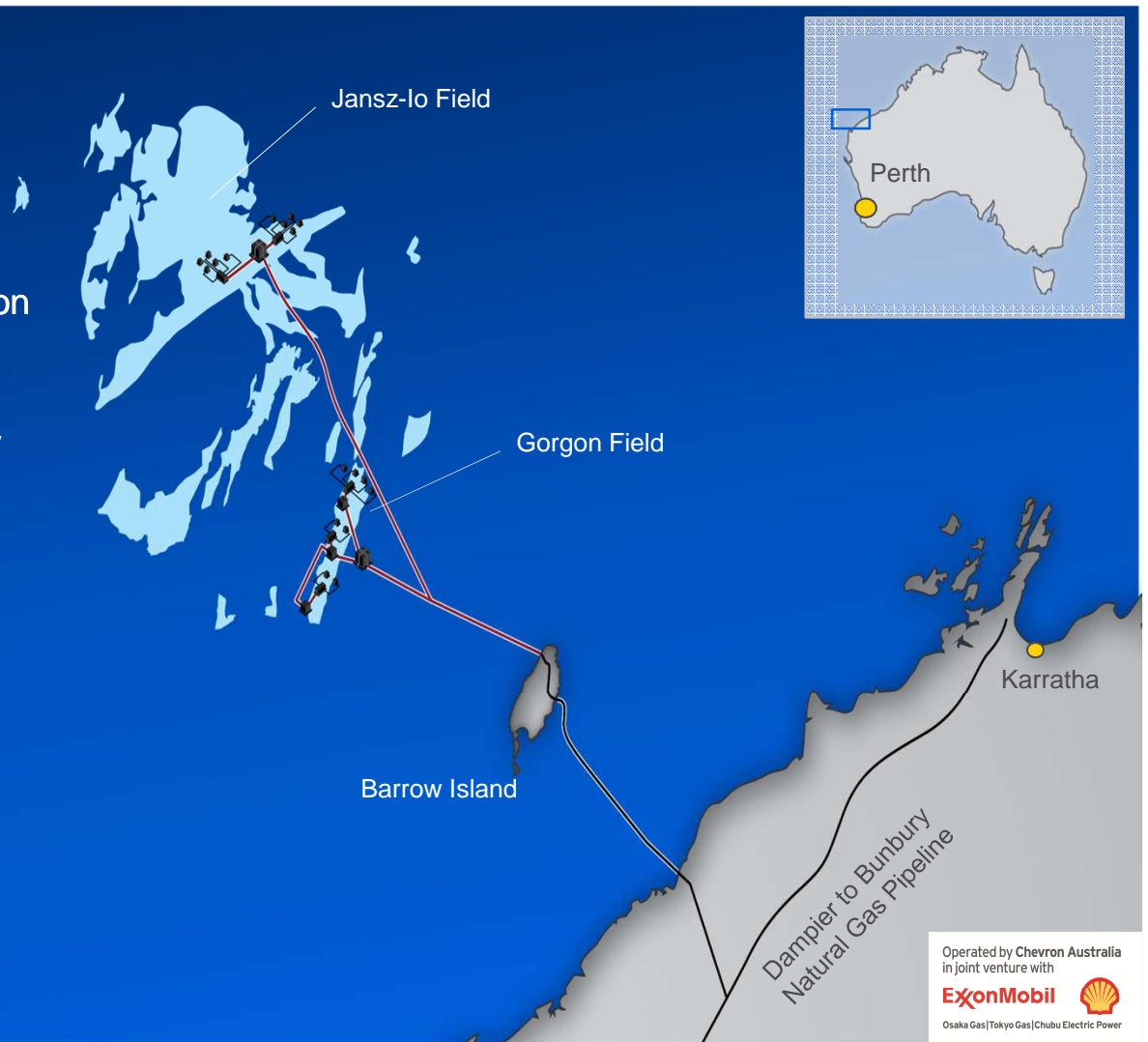


Gorgon Project Overview

- AUD \$52 billion investment
- Sub sea development of the Gorgon and Jansz-lo gas fields
- 3 x 5.2 MTPA LNG trains
- A domestic gas plant with capacity of 300 terajoules per day
- Carbon dioxide injection project

Joint Venture Participants

- Chevron (47.3%)
- ExxonMobil (25%)
- Shell (25%)
- Osaka Gas (1.25%)
- Tokyo Gas (1%)
- Chubu Electric Power (0.417%)

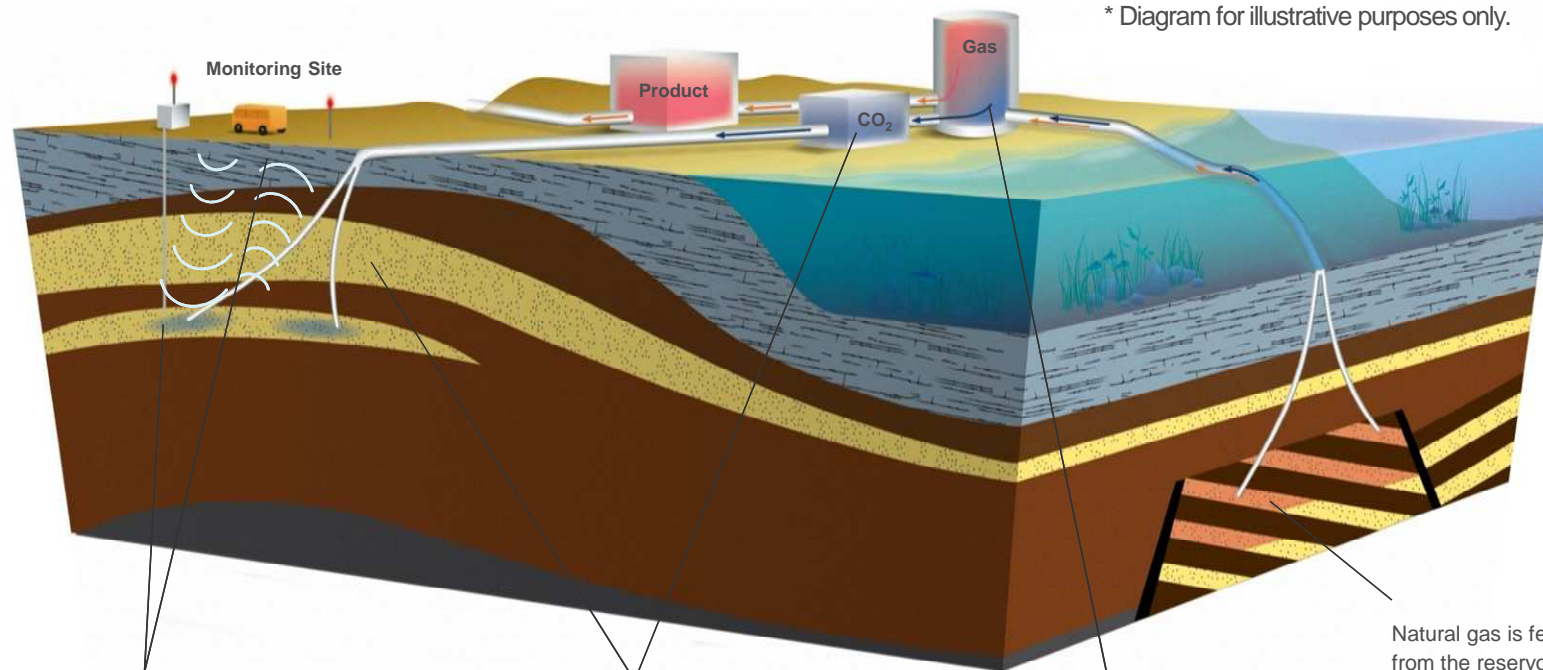




Chevron-operated Gorgon Project

Carbon Dioxide (CO₂) Injection Project

* Diagram for illustrative purposes only.



Movement of the CO₂ underground is monitored by repeated seismic surveys and surveillance wells.

CO₂ is compressed and transported by pipeline to one of three drill centres where it is injected more than 2 kilometres into the Dupuy Formation beneath Barrow Island.

Naturally occurring CO₂ is separated from the inlet gas.

Natural gas is fed from the reservoir to the plant.



Australian Government
Department of Resources,
Energy and Tourism

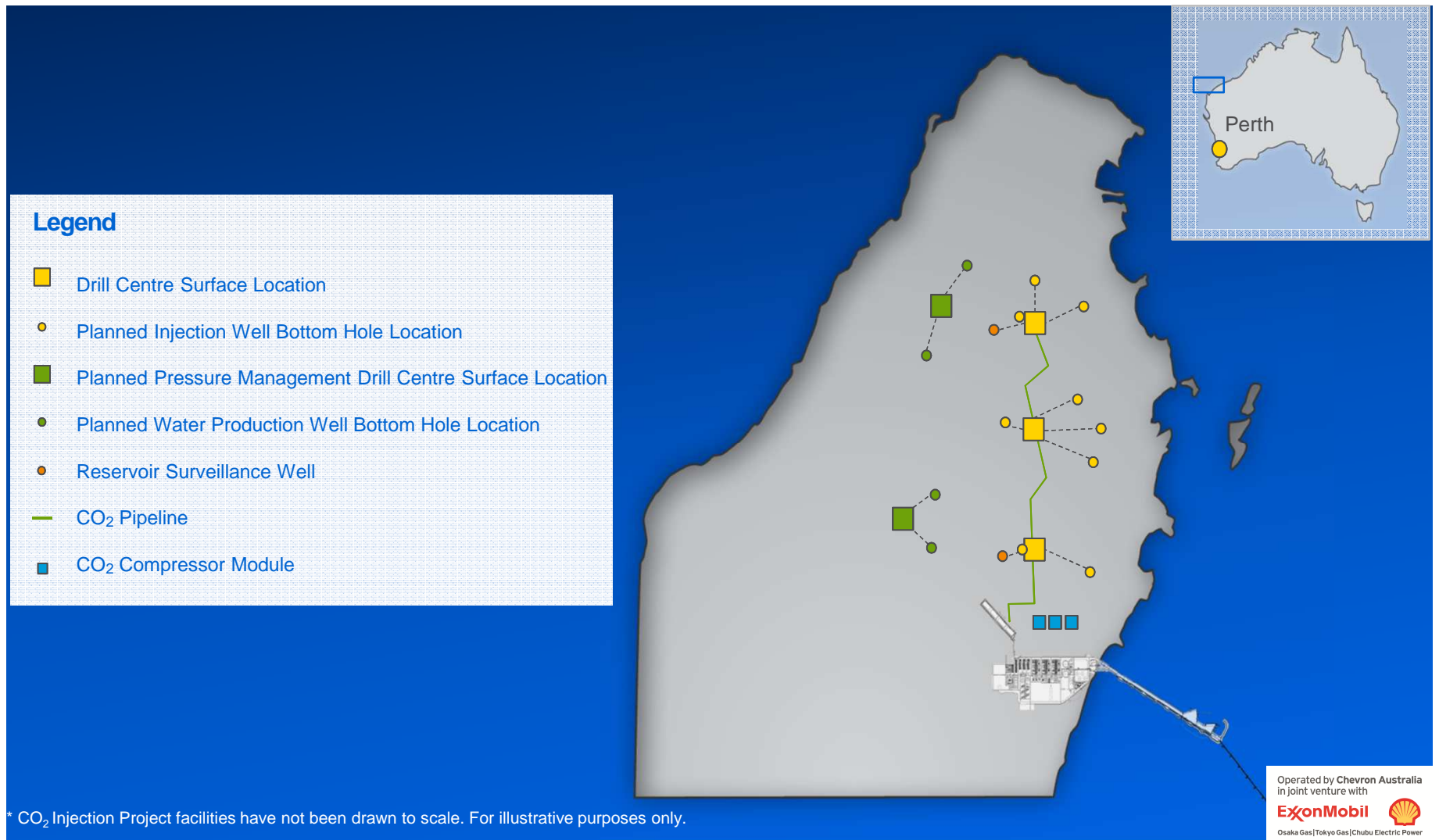
The Australian Government has committed \$60 million to the Gorgon Carbon Dioxide Injection Project as part of the Low Emissions Technology Demonstration Fund (LETDF).

Operated by Chevron Australia
in joint venture with
ExxonMobil
Osaka Gas | Tokyo Gas | Chubu Electric Power



Carbon Dioxide Injection Project

Project Facilities



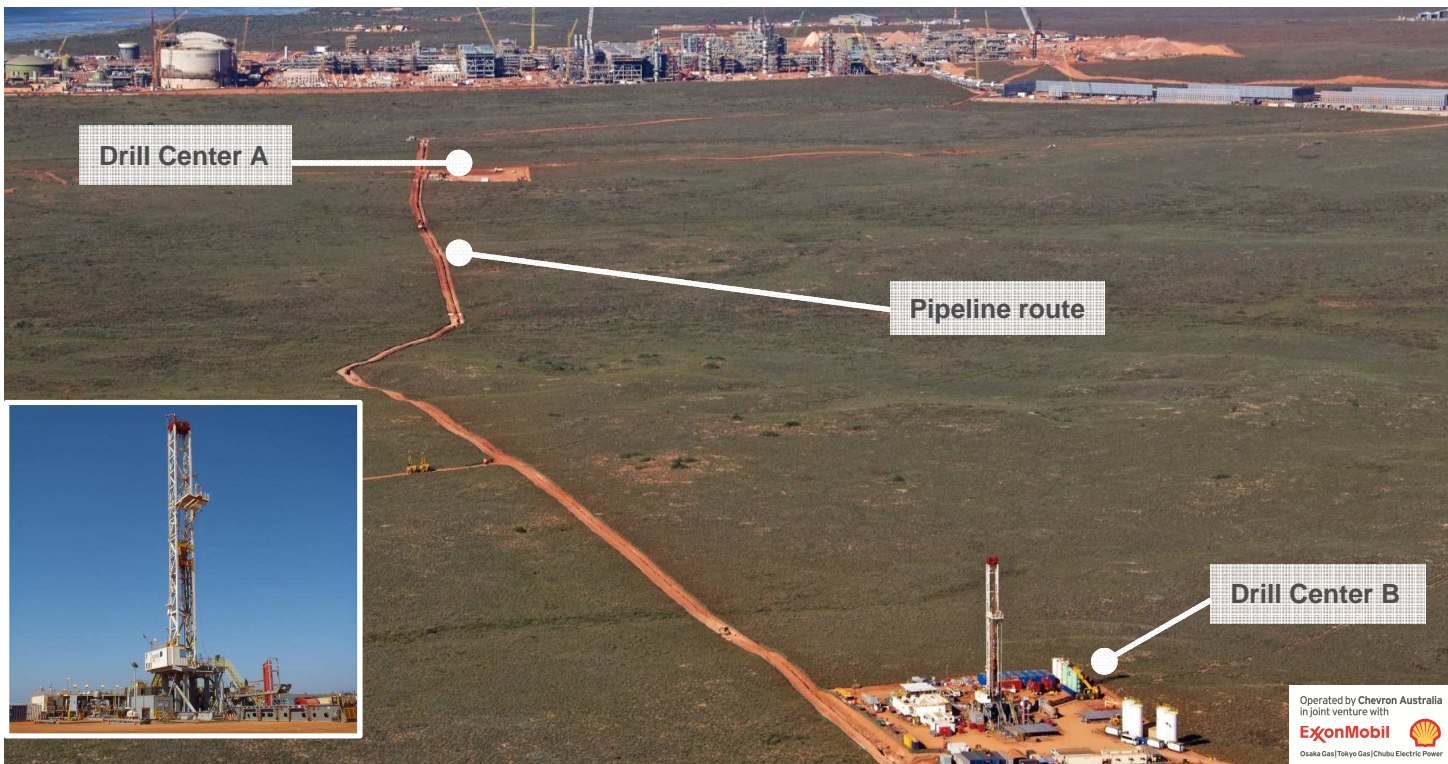
Gorgon Project Plant Site



Carbon Dioxide Injection Project



- 7 of 9 CO₂ injection wells, 1 of 2 reservoir monitoring wells drilled
- 7km CO₂ injection flowline completed
- Anticipated injection CO₂ volumes range between 3.4 - 4.0 million tonnes per year



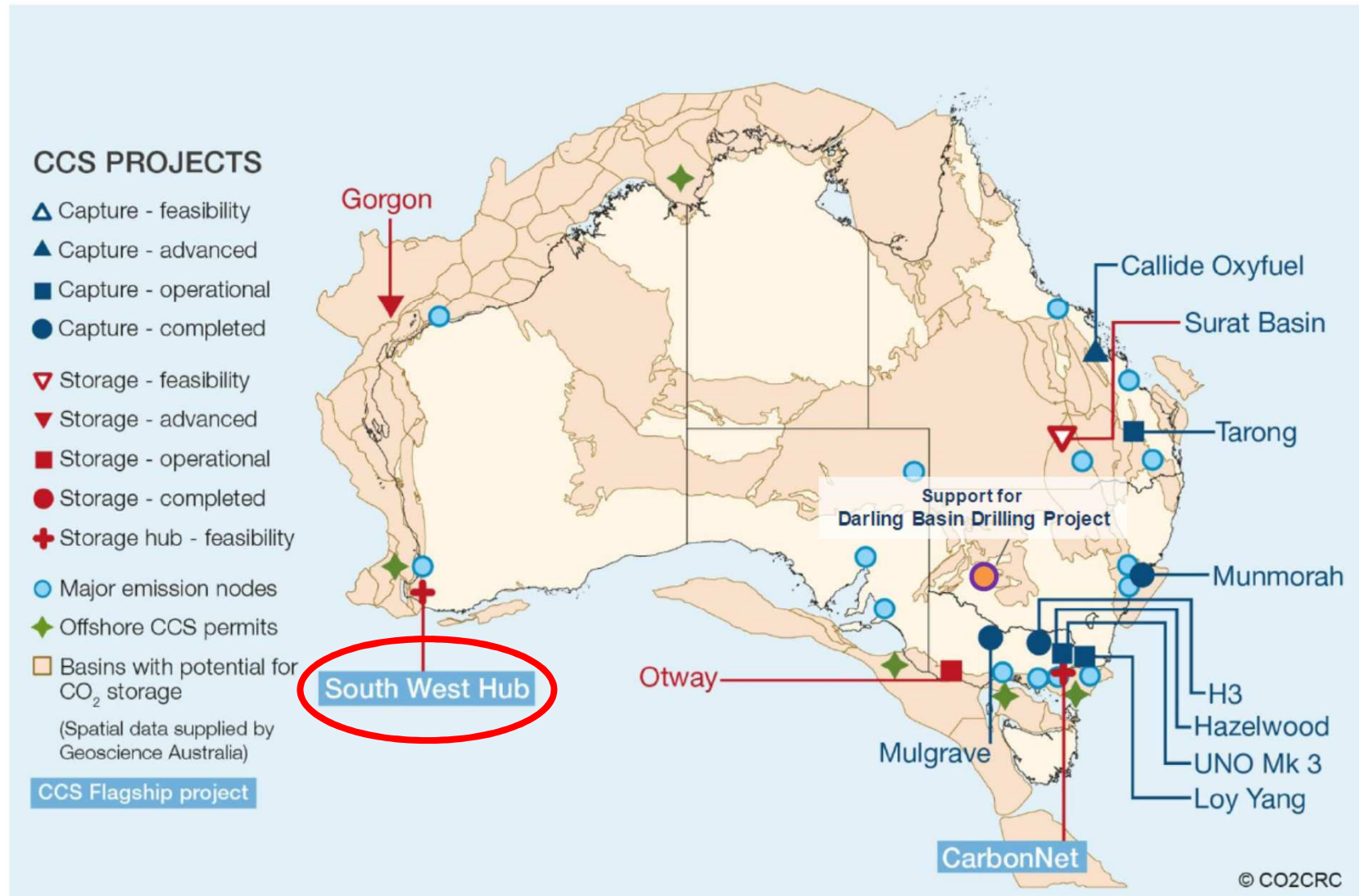
Gorgon LNG Project

- After four years of execution, the Gorgon Project is about 87 percent complete (at early Nov 2014)
- Plant start up and first gas is planned for mid-2015

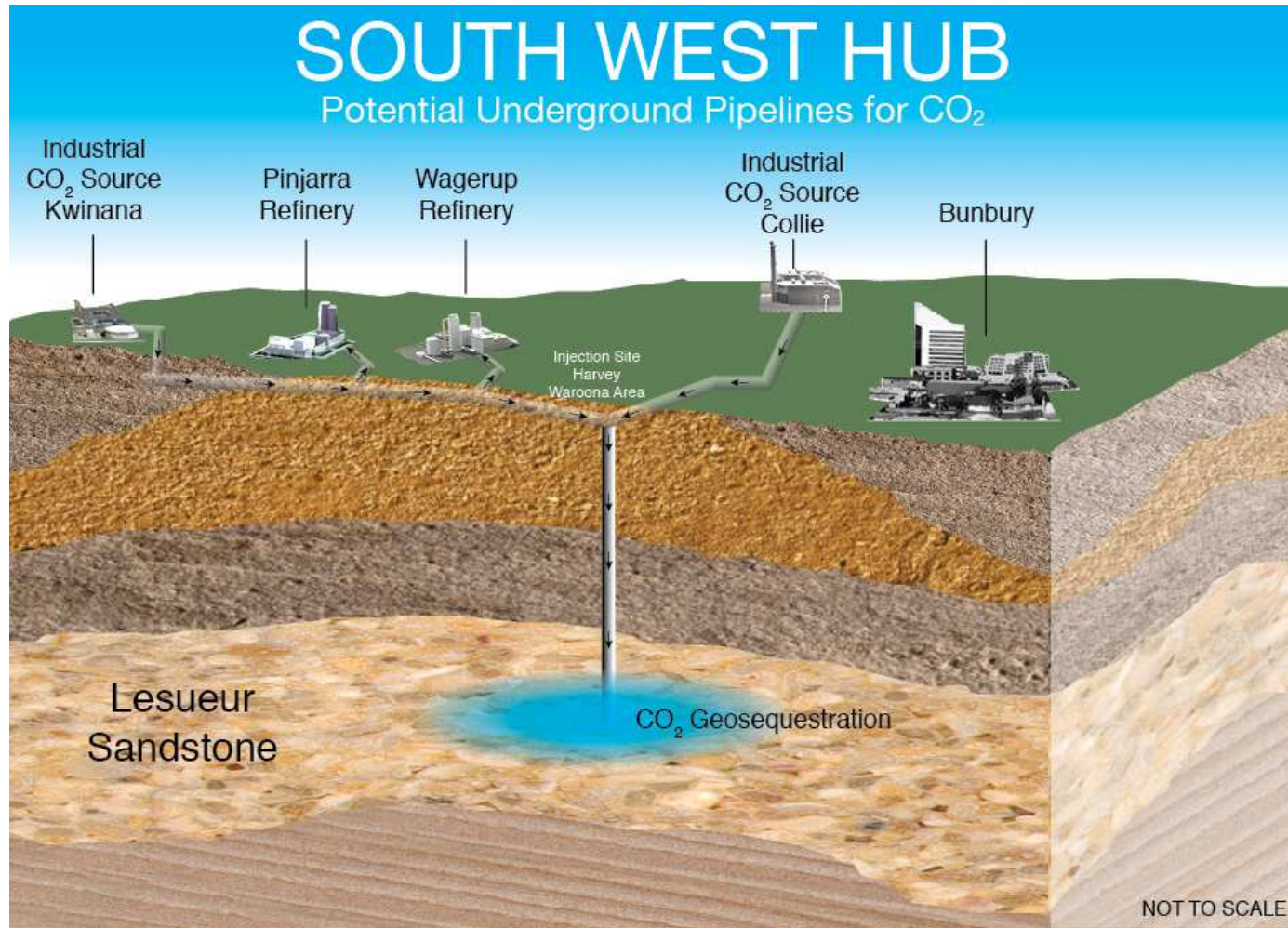


Time-lapse images of the LNG plant on Barrow Island

CCS projects in Australia

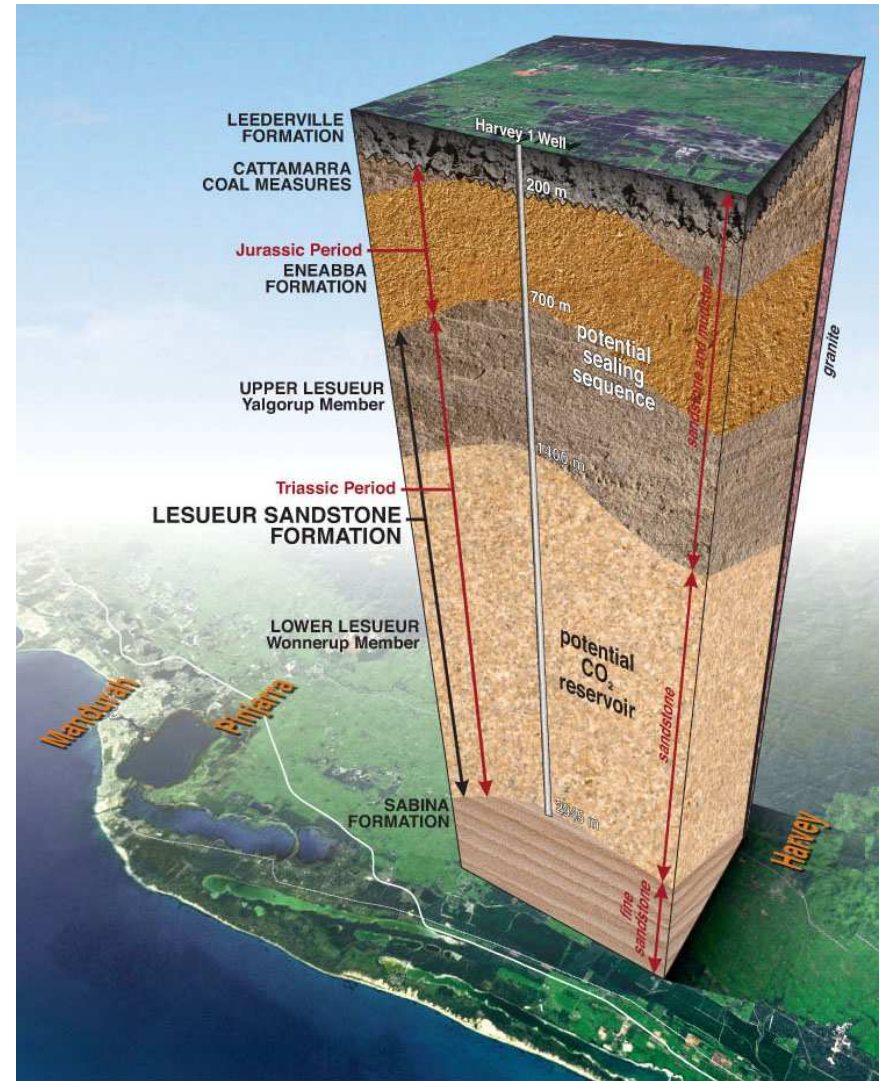


South West Hub concept



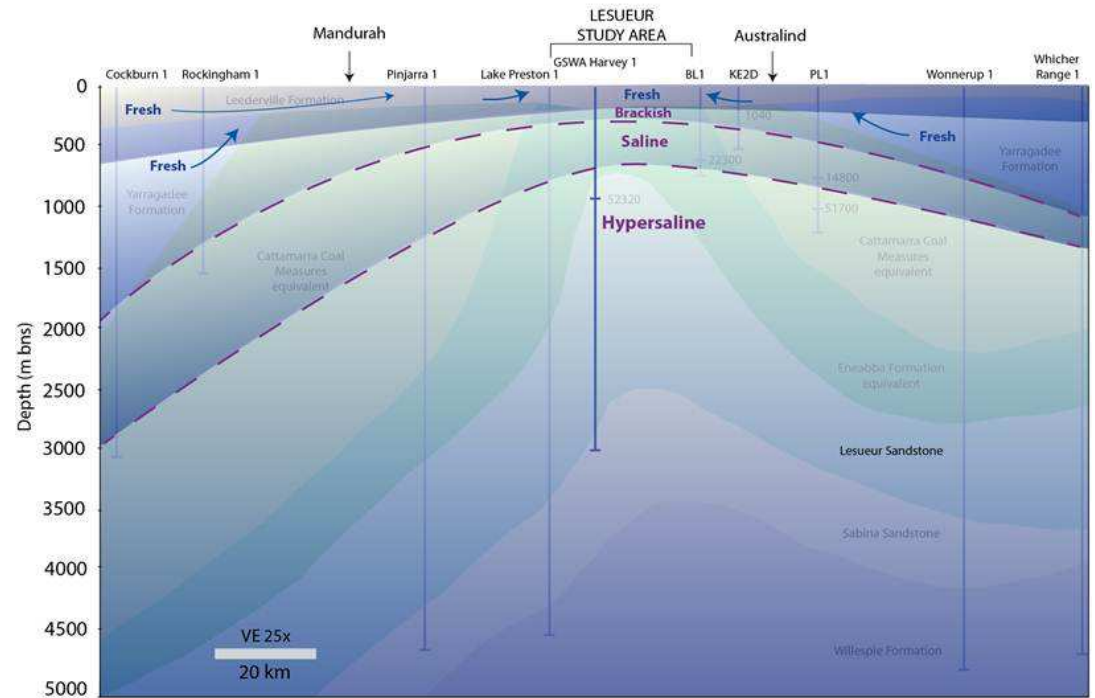
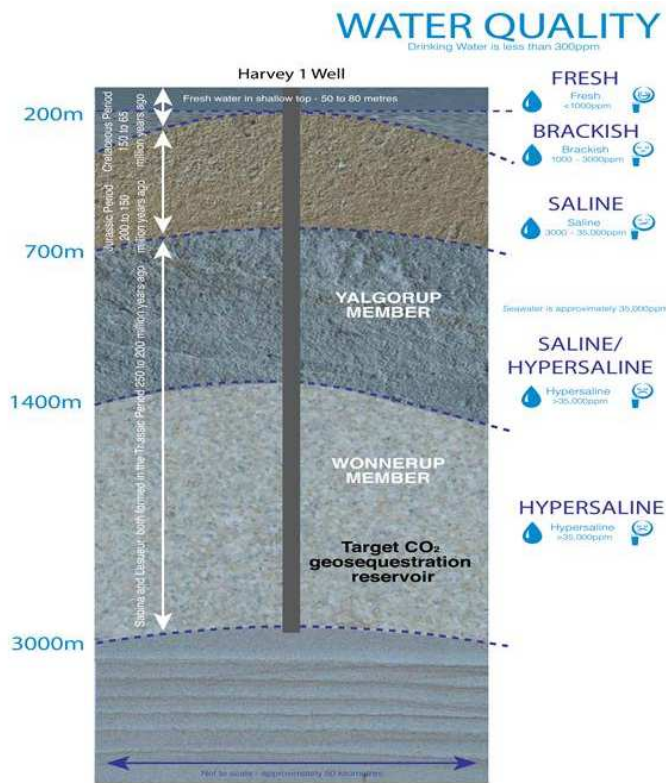
South-West Hub

- CO₂ from coal-based urea plant, alumina production and power generation.
- Pipeline network is proposed to connect the large stationary sources of CO₂
- Base case 2.5 Mtpa, 7.5 Mtpa in some scenarios
- CCS Flagship Project (\$52m)
- Target formation is the Leseuer sandstone (Wonnerup member)



South West Hub's formation trapping

- Eneabba formation -Feldspathic sandstone interbedded with local minor conglomerate and multicoloured claystone and siltstone
- Contamination of potable Yarragadee groundwater not possible



DRILLING PROGRAM

THREE WELLS

Dec 2014 – March 2015

Two wells for core and data logging using mineral rigs

- 1,200 metres
- 1,500 metres

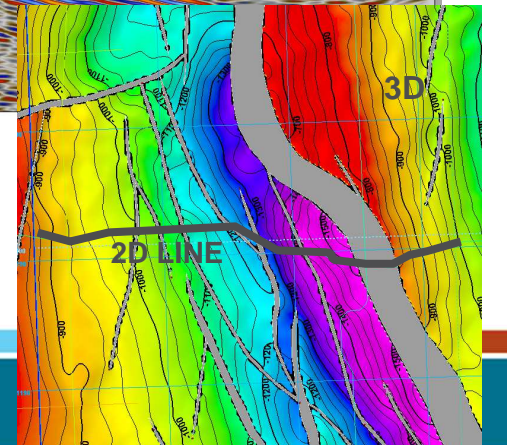
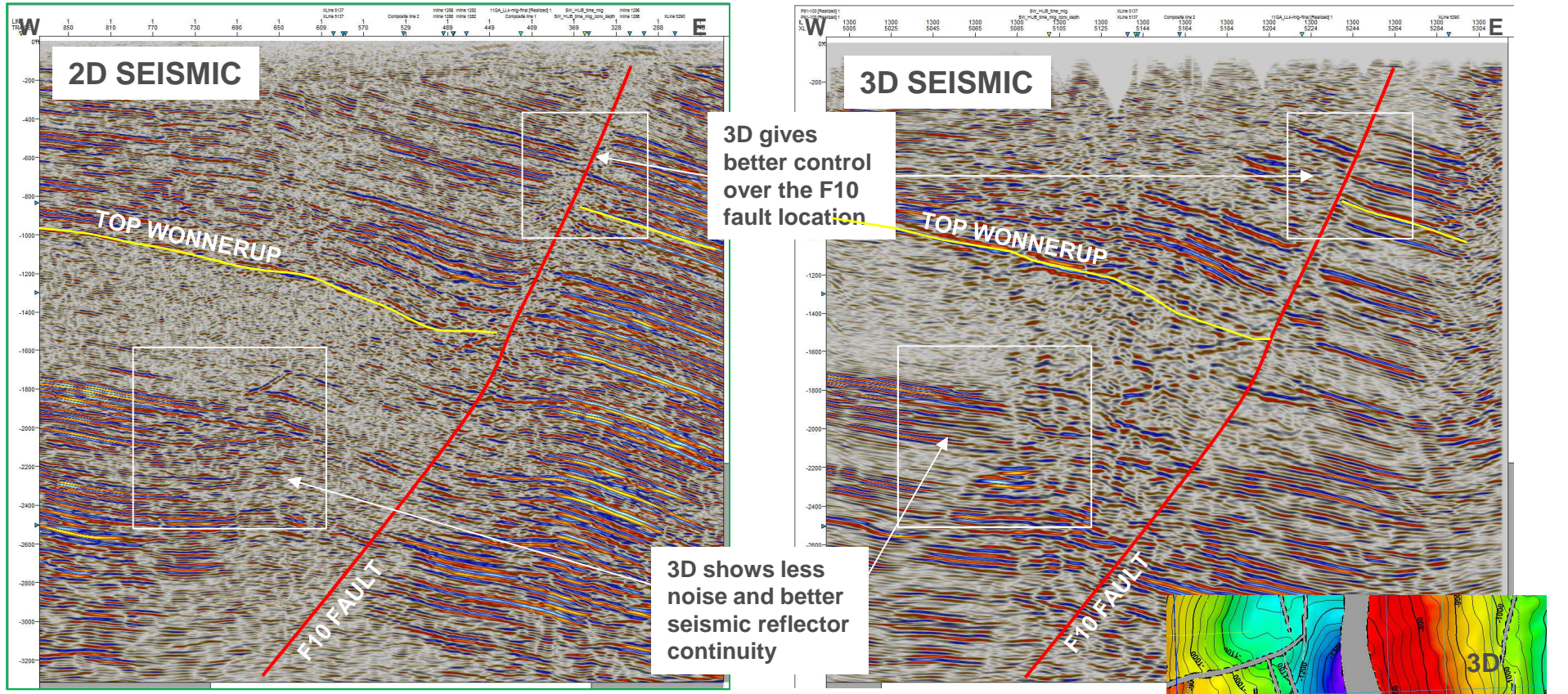
Third well some core, more for instrumentation and water/pressure testing using a water rig

- 1,850 metres

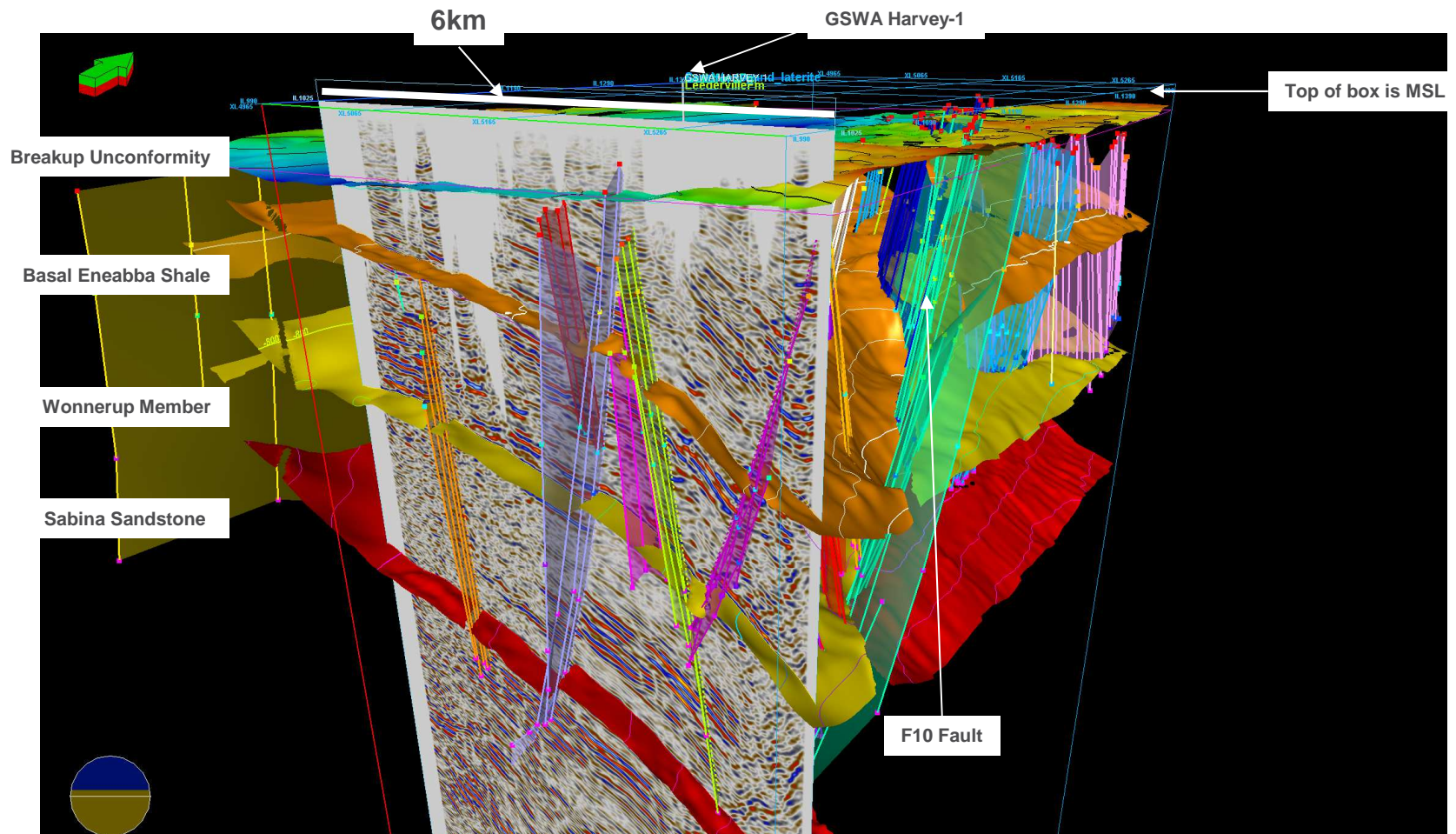


Water rig at St Hilda's

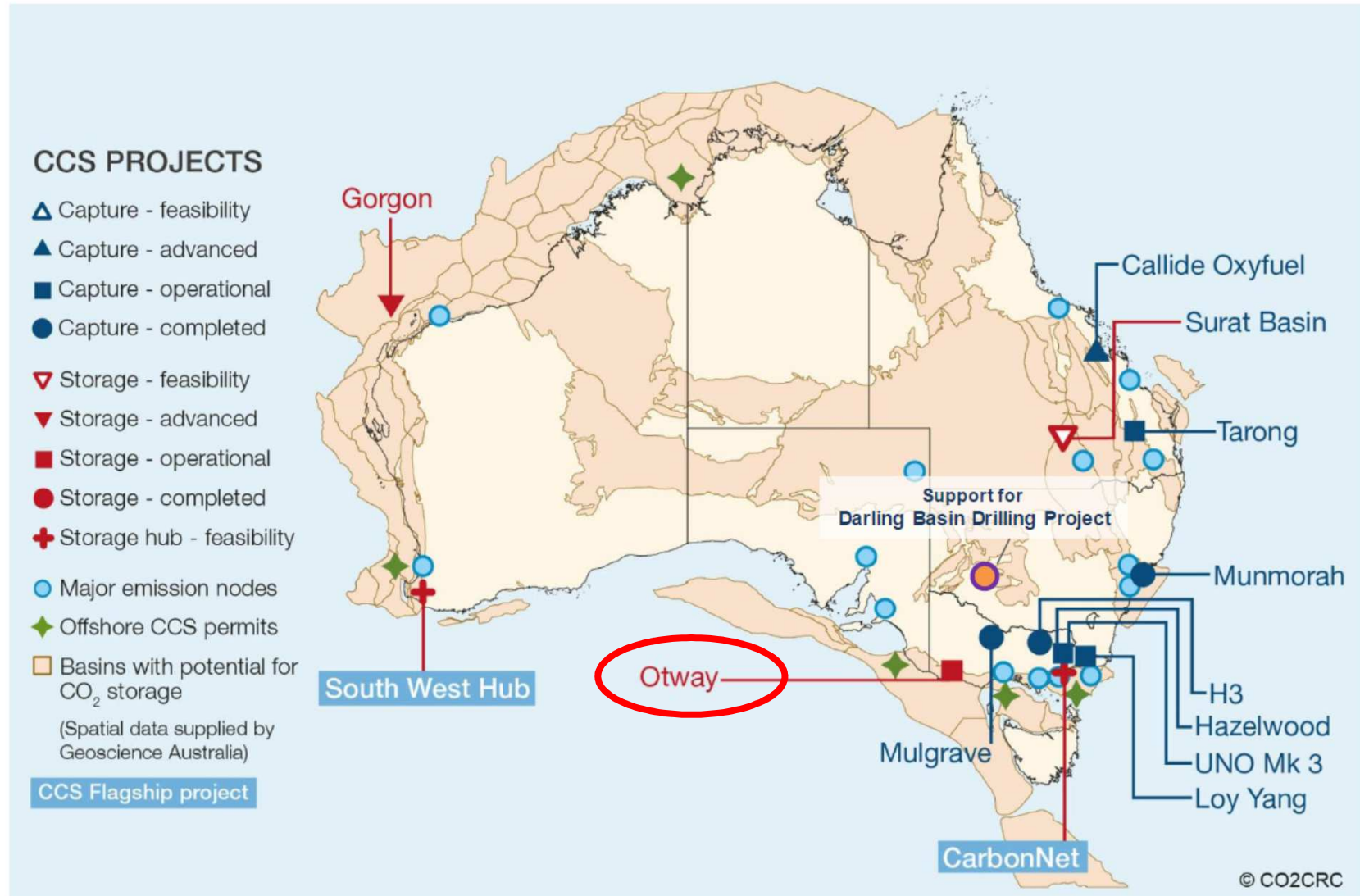
2D VS 3D DATA QUALITY COMPARISON



3D element description



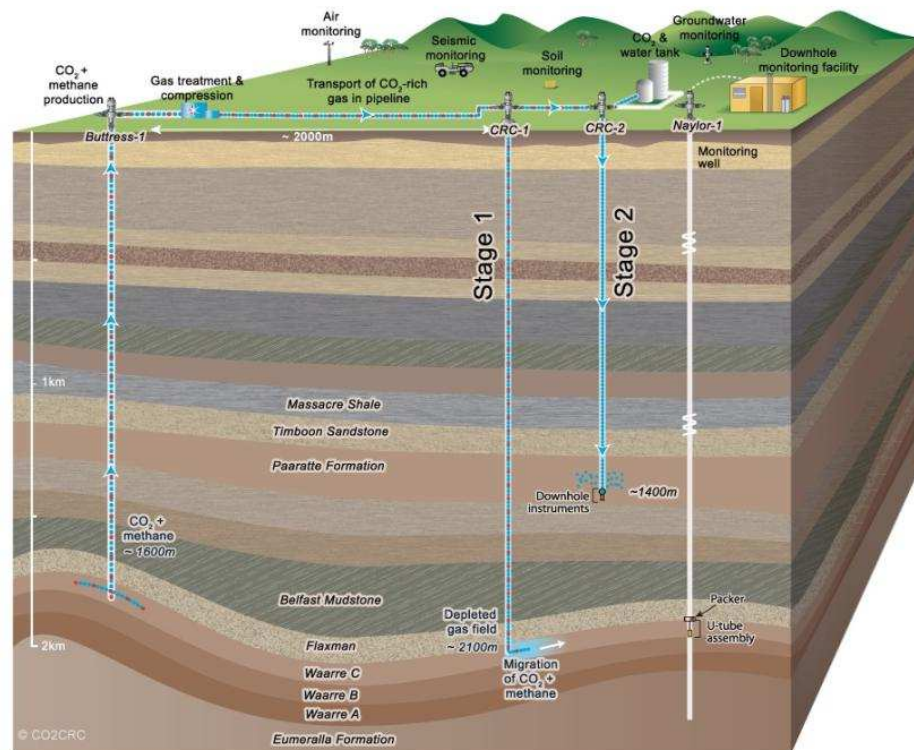
CCS projects in Australia



CO2CRC Otway Project

One of the top storage R&D facilities in the world

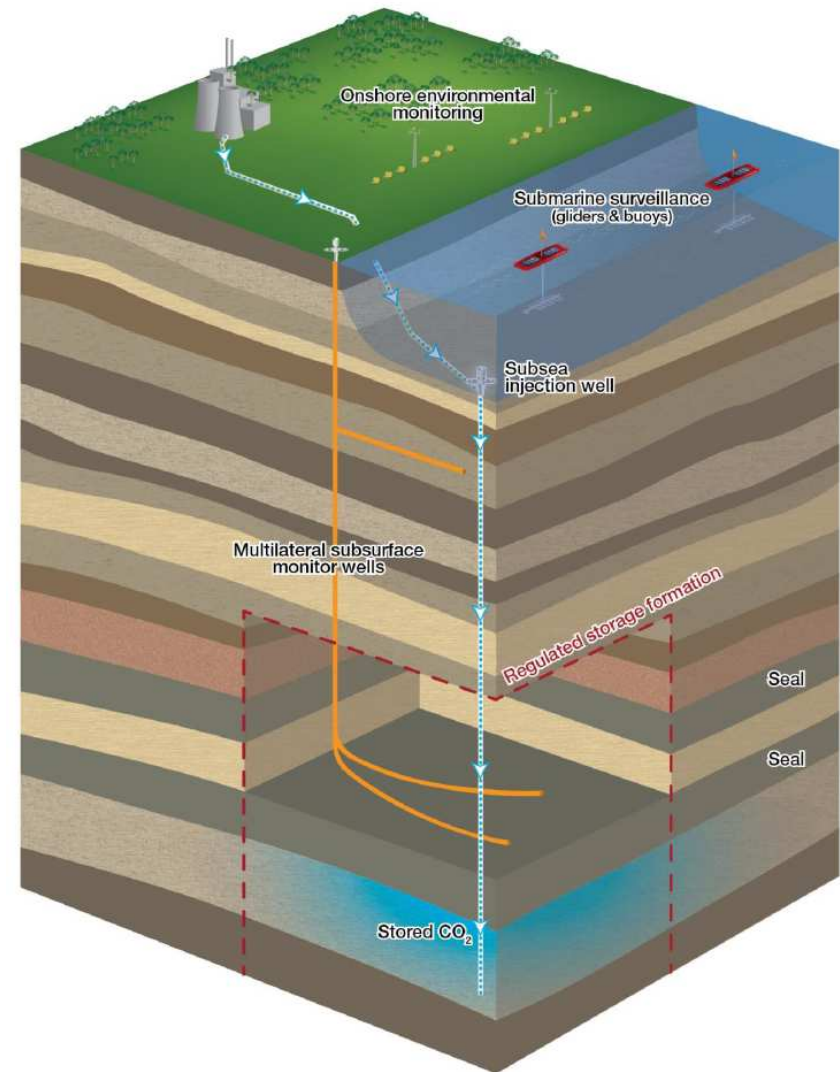
- 400kt reserve of CO₂, highly characterised site
- Good relationship with community and regulators



- World's first demonstration of safe storage in depleted gas field (65,000t)
- Attracting researchers, equipment and funding from around the world
- International links with EU, USA, China, UK, Canada and Korea

CO2CRC 2015 - 2010

- Secured \$51.4m funding for research assets:
 - Otway sub-surface laboratory
 - Monitoring equipment for Gippsland
 - Research laboratories (capture and storage)
- New operational funding secured
- New work program in preparation



The decade ahead

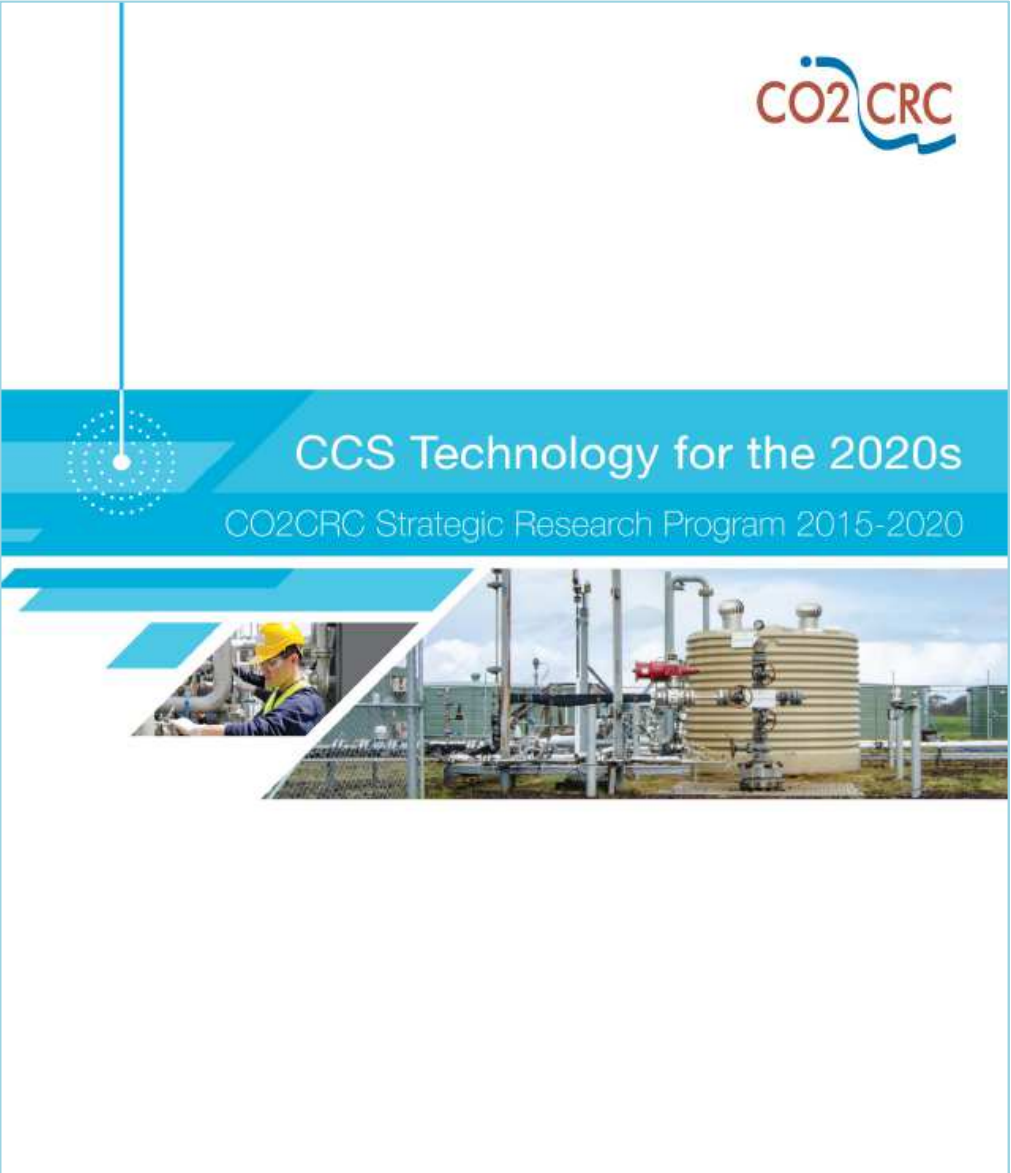

Objectives:

Use of Otway Facilities for field based research:

- Stage 2C
- Stage 3

Four research themes:

1. Geological Integrity
2. Engineering Storage
3. Fit for Purpose MMV
4. Geochemical Engineering



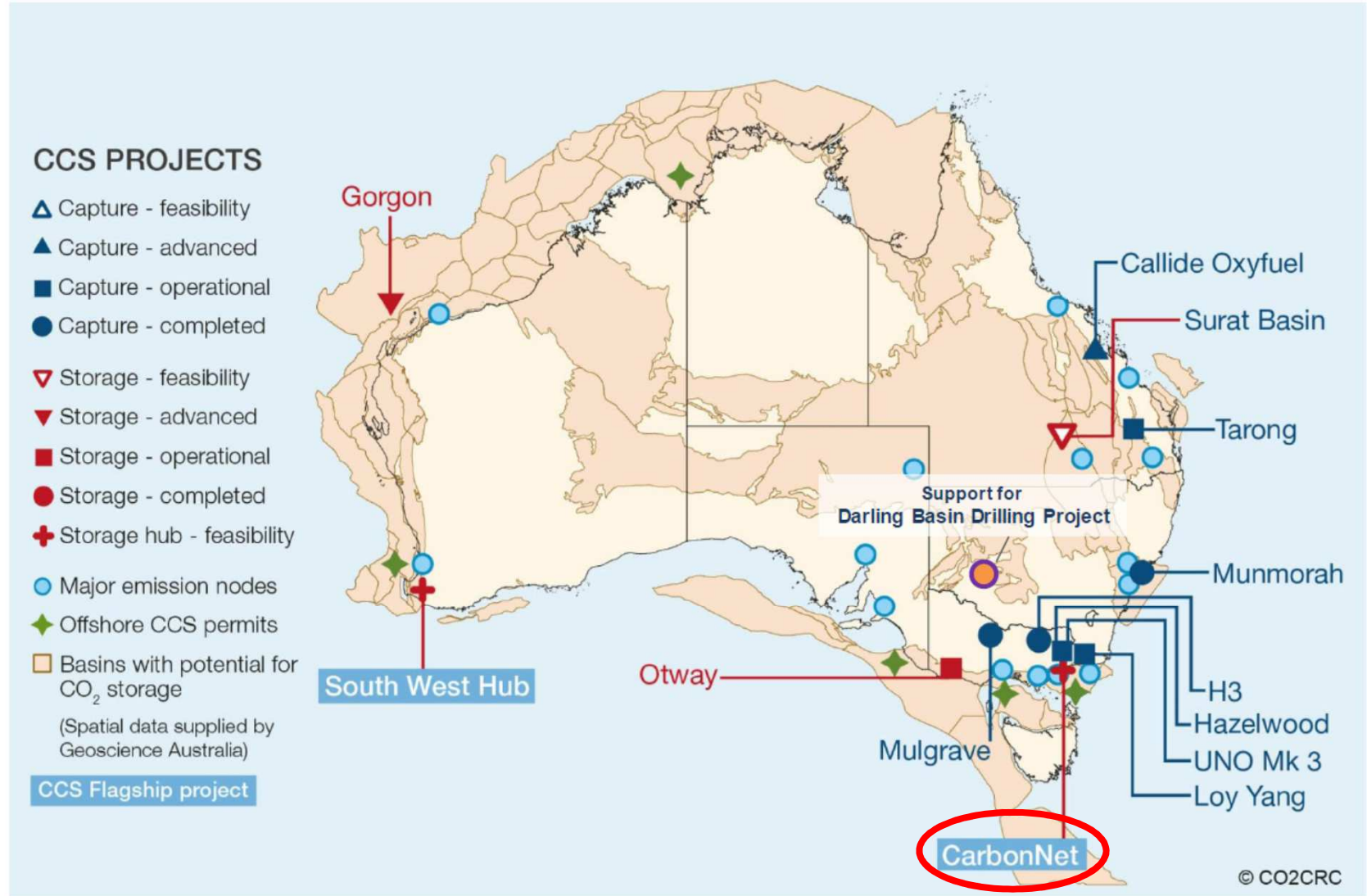
CCS Technology for the 2020s
CO2CRC Strategic Research Program 2015-2020

CO2CRC Otway Project Stage 2C

- CO2CRC Otway Stage 2C - using new seismic techniques to monitor CO₂ in the subsurface.
- Understanding how CO₂ plumes move and stabilise in saline aquifers;
- Buried sensors to improve resolution;
- Time-lapse seismic monitoring of small quantities of CO₂, to monitor plume behaviour and stabilisation.

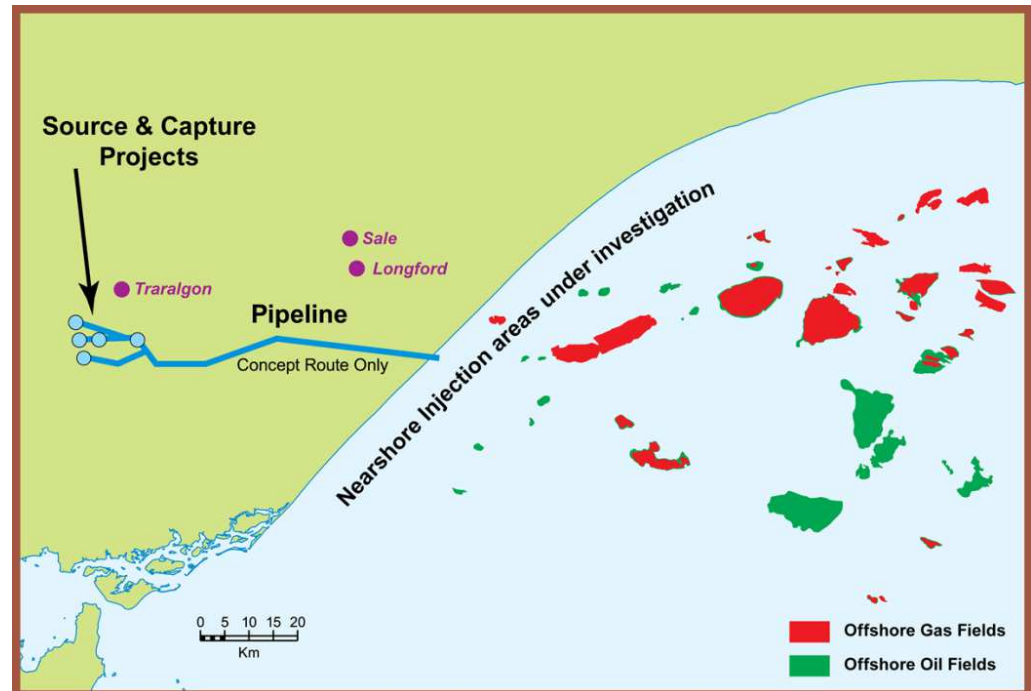


CCS projects in Australia

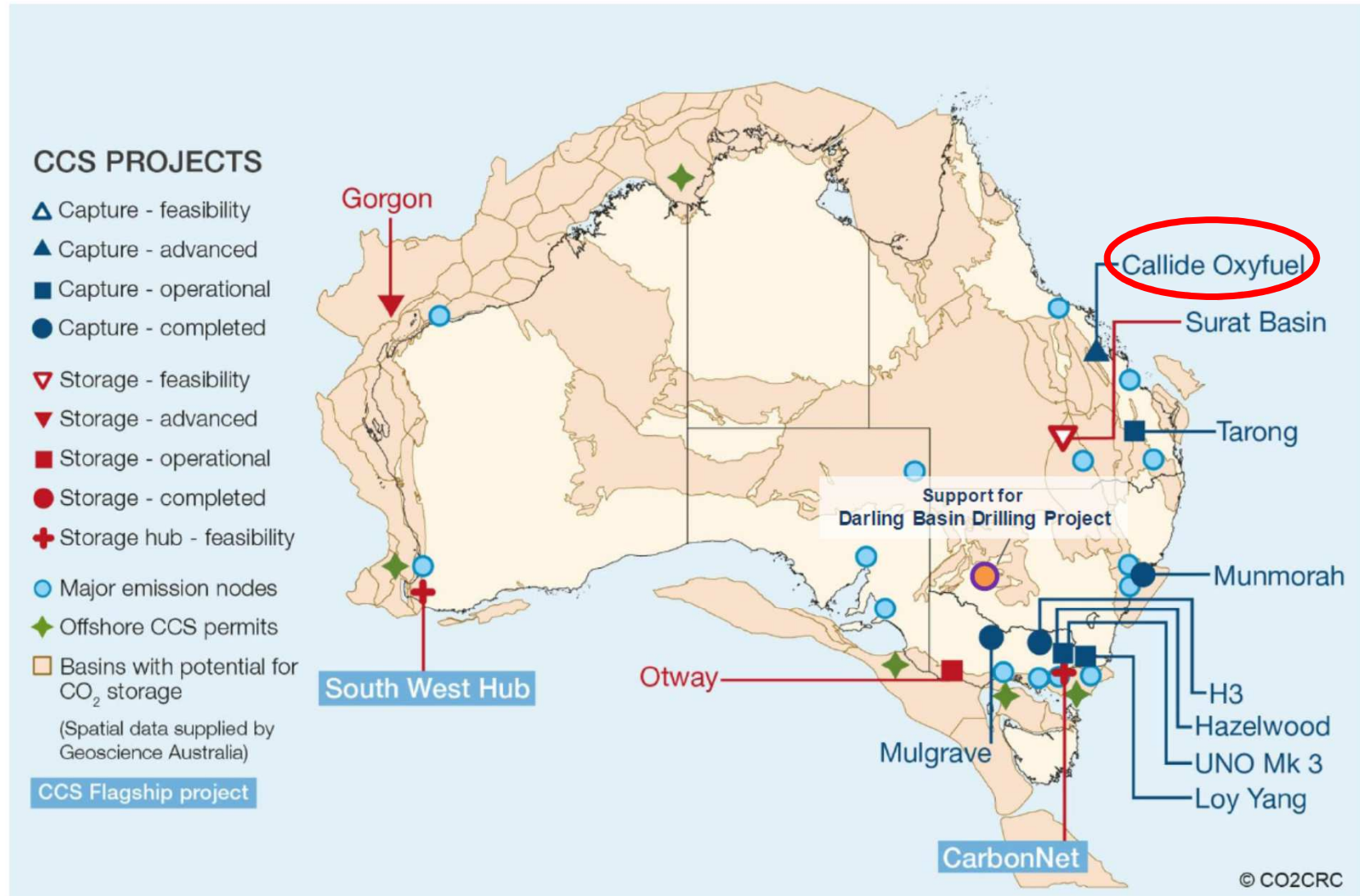


The CarbonNet Project

- Investigating feasibility of commercial scale multi user network
- Aiming to capture and store 1-5m tonnes of CO₂ pa with the potential to increase capacity over time
- Gippsland Basin is highest quality CO₂ storage site in Australia
(2009 Carbon Taskforce)
- Funded by the Australian Government & the State of Victoria
- Awarded A\$100m for feasibility

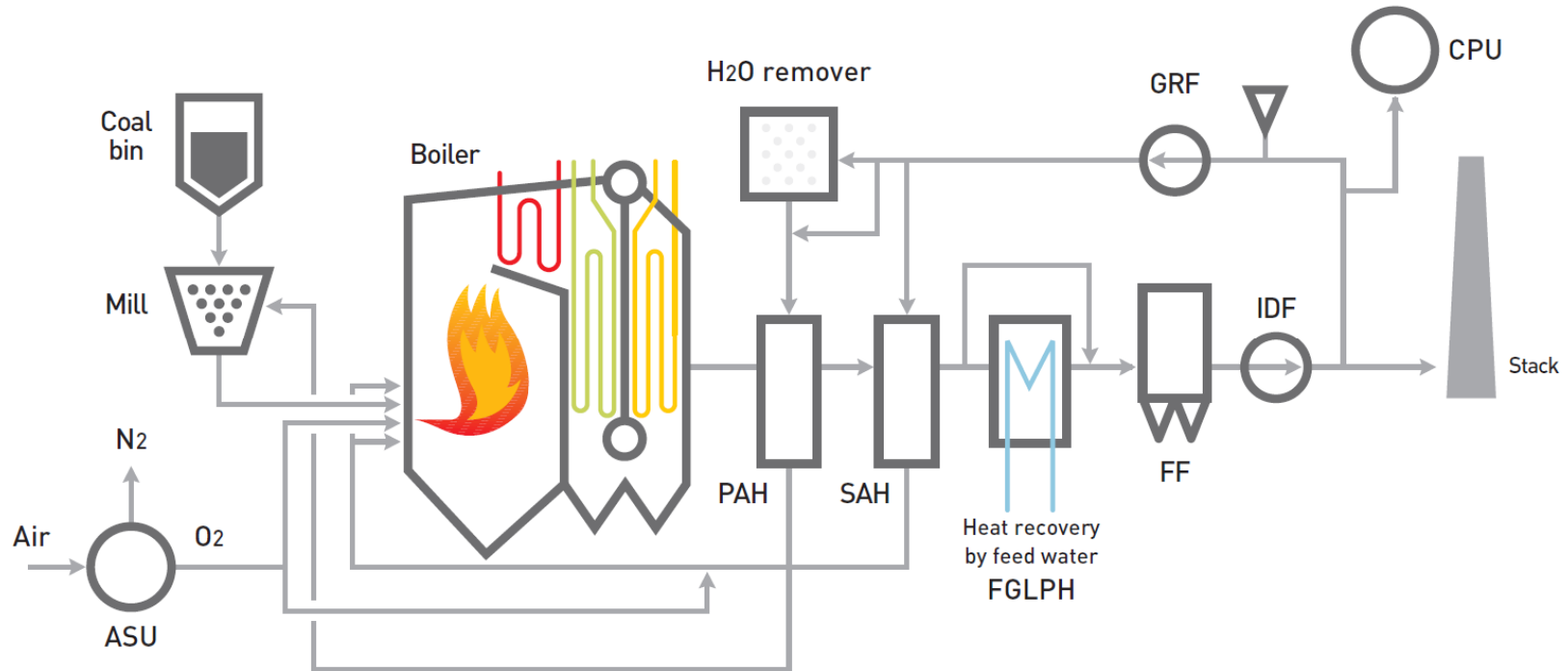


CCS projects in Australia



Callide Oxyfuel Project

- Retrofit to existing power station
- \$200m project
- 30MW, 75 t/d CO₂ capture capacity



Callide A Power Station prior to oxyfuel retrofit



Callide A Power Station post oxyfuel retrofit



Capture plant

- 75 t/d CO₂ capture



Callide oxyfuel summary and findings

- Started full capture in December 2012 → early 2015
- Aiming for 10,000 hrs of operation
- Successfully capturing >75 t/d; not currently storing
- Considerable time spent optimising system and CPU logic
- Flue gas is highly corrosive (1000-1500ppm SO_x, 18-25% water), some corrosion issues on materials
- High reliance on sensors – require frequent calibration, hard work
- SO₂ reacting with steel, leading to deposits and blockages

Summary

- Gorgon soon to be the world's largest full scale geological storage of CO₂ project, storing between 3.4 – 4 Mtpa (2015)
- Australia's two mainland demonstration scale projects (South West Hub and CarbonNet) still at an early stage
- Significant investment in capture research
- GA is providing pre-competitive studies for basin characterisation (incl. seismic)

Thank you!

Thanks to Chevron, CarbonNet, SouthWest Hub, Department of Industry, the CO2CRC and Callide Oxyfuels for providing information and updates