Australia's National
Science Agency

The CSIRO In-Situ Laboratory for carbon capture and storage research

CSIRO is investigating crucial monitoring technology and systems to provide science-based evidence to inform the development of cost-effective, reliable, accepted and safe CCS projects.

Our research

Decarbonisation goals

As Australia's national science agency, CSIRO strives to inspire and shape technology development that drives low-cost electrification and decarbonisation of our major industries and exports in a competitive, low-carbon global economy. Achieving this requires affordable and secure technologies at scale to manage historic emissions as well as those generated in hard to abate sectors. This has guided our research into decarbonisation and emissions reduction technologies, including carbon capture and storage (CCS), for more than 25 years.

CCS is a technology designed to reduce carbon dioxide (CO_2) emissions from industrial processes and power generation. This is done by capturing CO_2 at its source – such as a factory or power plant – compressing it, and transporting it to a suitable geological site where it is injected deep underground for long-term storage. This prevents the CO_2 from entering the atmosphere and contributing to climate change.

Storing CO_2 at a commercial scale in deep geological formation is one of a range of options being considered to reduce atmospheric emissions while enabling a reliable and smooth transition to lower emissions industries and economy. CCS offers the scale and potential for hard-to-abate industries such as cement, glass, and steel manufacturing, where electrification is unable to mitigate process emissions.

In-Situ Laboratory initiative

The In-Situ Laboratory (ISL) research facility plays a crucial role in understanding and addressing CCS risks, communicating research, and increasing science-based awareness. The ISL supports the development of government policy by providing advice towards CCS development and deployment in Australia.

The research facility provides a long-term field site for domestic and international education and training, capacity development, and real-world CCS technology testing and assessment.

The ISL is a collaboration between CSIRO, Commonwealth Department of Industry, Science and Resources (DISR, CCS RDD fund CCS49360), the Research Institute of Innovative Technology for the Earth (RITE, Japan), and the Western Australia Department of Energy, Mines, Industry Regulation and Safety (WA DEMIRS).

The ISL is situated near the town of Harvey, 130 km south of Perth and deliberately located above a major geological fault structure called the F10 which is key to the research that has taken place there since 2018.

The F10 fault is a prominent near-vertical fault structure within the Lesueur Sandstone formation, part of the onshore southern Perth Basin. Geologically, it is significant because it provides a natural example of fault architecture and behaviour in a region considered suitable for carbon storage.

The fault cuts through multiple sedimentary layers, including porous sandstones and low-permeability siltstones, offering insights into how faults may act as either barriers or conduits for fluid migration.

Its complex internal structure – comprising fault gouge, fracture zones, and varying lithological juxtapositions – makes it an ideal site for studying fault seal integrity and the potential for CO_2 up-fault migration. Understanding the F10 fault's behaviour in the presence of CO_2 will help geoscientists assess the risks and performance of CCS projects in similar geological settings.

Carbon storage near fault systems

At the outset, geological carbon storage projects typically avoid fault systems to minimise potential migration risks.

With the scale required of the CCS industry to help mitigate global emissions, the likelihood of injected CO_2 encountering fault systems increases. This shift requires detailed understanding of how CO_2 interacts with these geological features. To address this challenge effectively, it is crucial to thoroughly characterise, forecast, measure and monitor the potential impacts of these interactions on the integrity of storage sites.

Affordable and reliable monitoring systems to detect and manage residual risks will be essential for ensuring the long-term safety and success of geological carbon storage initiatives.



Data collection and analysis

Real-time monitoring and remote access capabilities at the ISL significantly enhance the efficiency and responsiveness of subsurface research. These technologies enable continuous observation, allowing researchers to detect changes as they occur and respond promptly to emerging phenomena.

Remote access further amplifies the value of real-time data by allowing scientists and stakeholders to interact with the monitoring systems from anywhere. Remote capability is especially important in distant, dispersed or hazardous environments – such as unmanned offshore platforms – where physical access is costly or impractical, making remote monitoring a critical proxy for reducing operational expenses and improving safety.

Harvey 5 and Harvey 6 wells

The Harvey 5 and Harvey 6 wells are integral components of the ISL. Harvey 5, completed in 2025, serves as a possible CO_2 injection well, while Harvey 6, drilled in early 2024, functions as a dedicated geophysical monitoring well.

Harvey 5 and Harvey 6 reach a total depth 1014 and 700 metres depth respectively, and their completion included the successful installation of fibre optic cables for Distributed Strain Sensing (DSS), enabling high-resolution monitoring of strain and temperature variations along the wellbore.

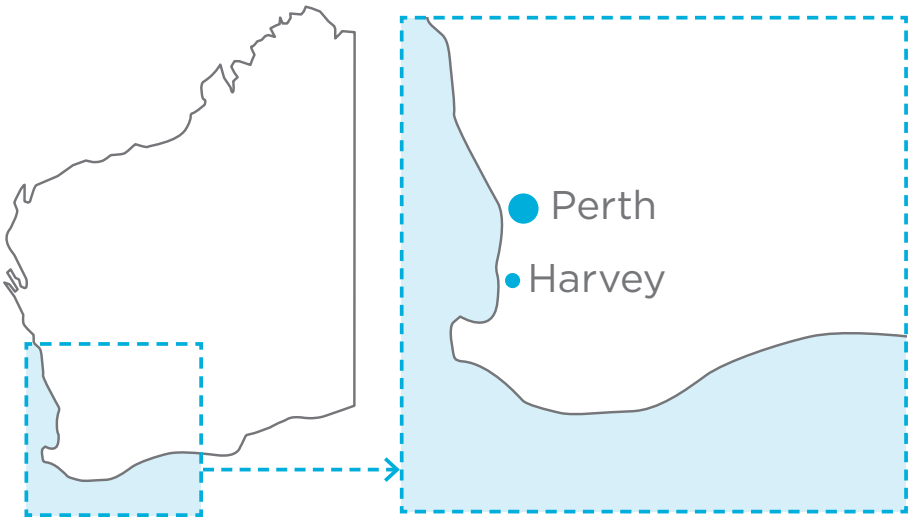
The strategic placement of these wells across the fault zone allows researchers to capture real-time data on well performances, fault behaviour, stress transfer, and fluid migration. This configuration supports cross-correlation between tiltmeters and DSS datasets, providing a detailed picture of subsurface behaviour in response to injection activities. The insights are critical for improving the safety and reliability of CCS technologies.

International collaboration case study

Through the Japan-Australia Partnership on Decarbonisation through Technology, both nations are collaborating to develop and deploy advanced decarbonisation technologies to reduce greenhouse gas emissions.

Through this partnership CSIRO works with RITE, a Japanese research organisation focused on developing and promoting advanced technologies for environmental conservation and sustainable development, including CCS.

The ISL is pivotal to this collaboration with the insights gained from this research contributing to global efforts in reducing greenhouse gas emissions and achieving climate goals.



Cover image: The InSitu Laboratory site.

Above, left to right: Analysis of rock cuttings; Harvey 5 casing inspection prior to installation; international Harvey 5 project team.

Back page: Dr Ziqiu Xue from RITE presenting the benefits of fibre optic Distributed Strain Sensing monitoring to visitors.

The importance of science-based information

By providing science-based evidence on the behaviour of CO_2 in faulted geological formations, the ISL helps policymakers, investors and the community better understand the risks and technical requirements associated with long-term carbon storage. The facility's advanced research is critical for shaping regulatory frameworks that ensure safety, reliability, and environmental integrity.

The ISL serves as a tangible field site for supporting capacity building across government, industry, and academia. Its collaborative structure strengthens Australia's position in climate mitigation efforts and supports the responsible deployment of CCS technologies across the country.

Engaging with the community

At the ISL, local stakeholders are informed and involved in the research being conducted. The ISL project team actively fosters science-based awareness among landowners and regional communities through discussion, transparent communication, site visits and outreach activities to help build understanding of and confidence in the technologies involved.

By maintaining open dialogue, listening to concerns, and demonstrating rigorous environmental monitoring, the ISL's work helps build public trust in the science supporting CCS projects.

For further information on CSIRO's energy research visit csiro.au/energy

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