

TECH OFFER

Modular, Scalable and Cost-Effective Hybrid CO₂ Capture Technology



KEY INFORMATION

TECHNOLOGY CATEGORY:

Sustainability - Low Carbon Economy

Sustainability - Sustainable Living

TECHNOLOGY READINESS LEVEL (TRL): **TRL6**

COUNTRY: **AUSTRALIA**

ID NUMBER: **TO175390**

OVERVIEW

The widespread adoption of CO₂ capture has been constrained by three major barriers: bulky and costly equipment footprints, the high energy demand of solvent regeneration, and overall cost inefficiencies that render conventional systems commercially unattractive. These challenges are especially acute in space- and utility-constrained environments such as offshore platforms, marine vessels, and brownfield industrial facilities, where compact, efficient solutions are essential. As a next-generation carbon dioxide capture technology, this innovation directly addresses these operational constraints.

The proposed technology is a compact, high-efficiency CO₂ capture process that integrates first-generation solvent absorption with second-generation membrane separation in a single intensified system. In this design, CO₂ transfers from flue gas through a membrane and is absorbed into a solvent within the same modular unit. By eliminating the need for gas compression required in stand-alone membrane systems, the process operates effectively at normal flue gas pressures of around one bar. The membrane barrier further prevents direct gas-liquid contact, reducing solvent degradation from impurities and extending solvent life. Positioned as a modular CO₂ capture system, it strengthens the commercial viability of advanced carbon dioxide capture

technology while enhancing durability and process efficiency.

This hybrid approach delivers **25–40% lower capture** costs compared to conventional systems, **offering both CAPEX and OPEX** savings. Its compact footprint enables deployment in space-limited sites, including offshore and marine applications. Moreover, the system produces high-purity CO₂ suitable for industrial and food-grade markets, opening new revenue streams and enhancing economic viability.

The technology owner seeks collaboration with companies aiming to reduce CO₂ emissions, research organisations, and EPC firms through R&D partnerships, licensing, and test-bedding opportunities.

TECHNOLOGY FEATURES & SPECIFICATIONS

The technology is a modular CO₂ capture system that integrates solvent absorption and membrane separation into a single intensified unit. It consists of:

- **Membrane modules:** Enabling selective CO₂ transfer from flue gas into the solvent without direct gas–liquid contact.
- **Chemical solvent system:** Chosen for high CO₂ selectivity and stability at regeneration temperatures.
- **Low-temperature, low-pressure regeneration unit:** Designed to operate on waste steam or low-grade heat to minimise energy consumption.
- **Compact and integrated auxiliary systems:** Lower number of auxiliary equipment like pumps, heat exchangers reduces overall footprint and simplify operation.

This integrated design reduces CAPEX and OPEX including solvent degradation, reduces steam consumption, and delivers high-purity CO₂ in a footprint significantly smaller than conventional systems.

POTENTIAL APPLICATIONS

Our breakthrough technology captures CO₂ efficiently and cost-effectively from flue gases with CO₂ concentrations above 3%. Designed for real-world impact, it reduces emissions for:

- **Power Generation:** Gas turbine and coal-fired plants
- **Hard-to-Abate Industries:** Steel, cement, refineries, ammonia production
- **Offshore & Marine:** Oil and gas platforms, FPSOs, and ships
- **Renewable Combustion:** Biomass and biogas facilities
- **Industrial Sites Without Steam Access:** Biogas upgrading, diesel generators, and more

With a modular, compact design and low capital cost, it's ideal for both retrofit (brownfield) and new-build (greenfield) projects. Beyond cutting emissions, the system produces high-purity CO₂ suitable for industrial or food-grade markets with minimal further processing – providing a potential revenue opportunity. This technology is the first step in achieving the emission reduction targets.

MARKET TRENDS & OPPORTUNITIES

According to the Intergovernmental Panel on Climate Change (IPCC), meeting the 1.5°C climate goal will require the removal of approximately 6 billion tonnes of CO₂ annually by 2050. McKinsey & Company estimates that achieving net zero will require global CO₂ capture capacity to grow over 100 times. This represents a market opportunity of US\$175 billion per year in CCUS

investment by 2035, with a cumulative US\$3.5 trillion required by 2050. Around 60% of this investment will be on CO₂ capture, directly aligning with our technology's capabilities.

UNIQUE VALUE PROPOSITION

- **Membrane/solvent hybrid capture:** Unlike conventional solvent systems, where gas and liquid are in direct contact (leading to solvent degradation from flue gas impurities), our process keeps the phases separated by a membrane wall. This minimises solvent degradation and extends solvent life.
- **Low-temperature, low-pressure regeneration:** The process operates at low temperature and pressure and can utilise waste steam. This reduces steam consumption, energy use, and OPEX. Low-temperature operation also keeps the solvent below its thermal degradation point, further lowering solvent loss.
- **Compact, modular design:** Major equipment is compact, with fewer auxiliary systems required. This reduces CAPEX and plant footprint, making it ideal for space-constrained or offshore applications.
- **Operational reliability:** The design avoids common problems in conventional solvent systems such as channelling and flooding, improving process stability and uptime.

Compactness, modularity, low temperature/low-pressure operation, and lower OPEX and CAPEX collectively deliver a significant reduction in the cost of CO₂ abatement while improving operational reliability and deployment flexibility.