

Australia's ocean-climate opportunity

Science enabling ocean-based climate solutions

Australia's ocean plays a vital role in regulating the global climate, absorbing carbon dioxide and heat while supporting biodiversity, industries and communities. As Australia seeks pathways to net zero emissions and greater climate resilience, the ocean presents significant opportunities for climate mitigation, adaptation and sustainable economic development.

CSIRO delivers an integrated portfolio of research across the ocean-climate nexus, supporting governments, industry and communities to identify which ocean-based opportunities can deliver genuine climate benefits while protecting marine ecosystems and cultural values.

Ocean observation systems

Improving climate prediction, carbon accounting and climate risk management

All ocean-climate solutions depend on robust observations and a clear understanding of how marine systems are changing.

CSIRO operates and contributes to Australia's national ocean observing capability through research vessels, autonomous platforms, long-term monitoring programs, ocean modelling and international observing networks. These systems provide critical information on ocean temperature, carbon uptake, ocean acidification, ecosystem health and climate variability.

This research underpins:

- climate and seasonal forecasting
- understanding of drivers of marine heatwaves and other extreme events
- tracking ocean carbon stocks and fluxes and the progression of ocean acidification
- assessing climate risks to marine industries and communities
- providing the evidence base needed to evaluate ocean-climate interventions.

Ocean observations form the foundation upon which all credible ocean-based climate solutions are built.

csiro.au/about/facilities-collections/mnf/about/mnf-impact/oceanographic-research

Coastal ecosystem restoration

Enhancing carbon storage, biodiversity and climate resilience

Healthy coastal ecosystems provide some of Australia's most valuable natural climate solutions.

CSIRO's coastal and marine restoration research investigates restoration pathways for seagrass meadows, mangroves, saltmarshes, shellfish reefs, kelp forests, coral reefs, and other coastal habitats that support ecosystem recovery and strengthen resilience to climate change.

Research focuses on:

- measuring blue carbon storage and sequestration
- designing effective restoration approaches
- understanding ecosystem responses to climate stressors
- quantifying biodiversity and community benefits
- evaluating coastal protection and adaptation outcomes
- identifying barriers to and pathways towards large scale implementation

By restoring degraded coastal ecosystems, Australia can simultaneously improve carbon storage, biodiversity outcomes and resilience to future climate impacts.

research.csiro.au/marine-restoration-nbs/

Sustainable aquaculture and low-emissions marine food systems

Building climate-smart ocean food production

Demand for sustainable protein is expected to grow significantly in coming decades.

CSIRO's aquaculture and marine food system research supports the development of productive, environmentally sustainable and climate-resilient seafood industries.

Research spans:

- sustainable aquaculture production systems
- climate risks to marine food production
- feed innovation and resource efficiency
- environmental monitoring, ecosystem interactions, social-ecological dependencies and climate-smart management options
- opportunities for sustainable low-emissions marine protein production.

Marine food systems have the potential to contribute to food security while maintaining lower emissions footprints than many conventional protein sources, provided development occurs within ecological limits.

research.csiro.au/cor/

Clean shipping and marine decarbonisation

Supporting the transition to low-emissions maritime industries

Maritime transport remains one of the most challenging sectors to decarbonise, yet it is essential for Australia's economy and international trade.

Through initiatives such as the Australian Sustainable Low Emissions Transport (ASLET) program, CSIRO works with industry, ports, governments and technology developers to identify practical pathways for reducing maritime emissions.

Research includes:

- alternative marine fuels including hydrogen-derived fuels and other low-emission fuel pathways
- energy efficiency and vessel optimisation
- port and supply-chain decarbonisation
- technology assessment and systems analysis
- economic and environmental evaluation of transition pathways.

This work helps inform investment decisions while supporting the development of a future low-emissions maritime sector.

csiro.au/research/technology-space/energy/decarbonising-industry-transport/aslet

Offshore renewable energy

Enabling Australia's emerging offshore energy sector

Australia possesses exceptional offshore renewable energy resources, creating opportunities to support national decarbonisation objectives.

CSIRO research helps governments and industry understand how offshore renewable energy can be developed responsibly within complex marine environments.

Research includes:

- marine spatial planning
- integrated environmental assessment
- oceanographic and ecological modelling and monitoring
- cumulative impact and risk analysis.

This science predicts and documents the interactions between offshore renewable energy infrastructure, ecosystems and other ocean industries, and helps support evidence-based decisions that balance renewable energy development with biodiversity, fisheries, cultural values and other ocean uses.

nespmarinecoastal.edu.au/project/4-7/

Marine carbon dioxide removal

Evaluating emerging climate intervention approaches

In addition to reducing emissions, achieving global climate goals may require the removal of carbon dioxide already present in the atmosphere.

CSIRO is investigating the potential role of marine carbon dioxide removal approaches, including ocean alkalinity enhancement and other emerging pathways that seek to increase long-term carbon storage in ocean systems.

Research focuses on:

- understanding carbon removal effectiveness
- environmental risks and ecosystem impacts
- monitoring, reporting and verification methods
- governance and regulatory considerations
- social licence and responsible innovation frameworks.

The aim is not to promote individual technologies, but to provide the evidence needed to determine whether these approaches can be safe, effective and environmentally responsible.

csiro.au/research/environmental-impacts/emissions/carbon-dioxide-removal/ocean-alkalinity-enhancement

An integrated ocean-climate research portfolio

Individually, each of these opportunities represents a potential contribution to Australia's climate response. Together, they form a portfolio of ocean-based solutions spanning mitigation, adaptation, resilience and carbon removal.

CSIRO's unique strength lies in bringing these areas together through integrated ocean, climate, environmental, technological and socio-economic research. By combining long-term observations with solution-focused science, CSIRO is helping Australia understand not only what opportunities exist, but which can deliver lasting climate benefits while protecting the health of our marine environment.



Understanding the ocean's role in climate change is essential. Realising its potential as part of the solution will depend on science.

CSIRO is Australia's national science agency, delivering solutions for a productive, sustainable and secure future.

CSIRO. Improving the life of every Australian.

Contact us
1300 363 400
csiro.au/contact
csiro.au

For further information
Environment
Mark Hemer
+61 3 6232 5017
mark.hemer@csiro.au

B&D | 26-00254