



# Addressing the energy transition challenge: Blue carbon

CSIRO actively researches the challenges associated with the transition of energy, industrial, manufacturing, agricultural and transport sectors to meet Australia's net zero emissions ambitions.

As Australia's national science agency, CSIRO is well positioned to support governments, industries and communities through the energy transition.

Science and innovation will be critical in supporting Australia's transition, which is being driven by new technologies, changing consumer preferences, and efforts to reduce greenhouse gas emissions.

As we move towards a net-zero emissions future the four key components of the energy sector – electricity, industry, transport and exports – are evolving rapidly. In this dynamic landscape, CSIRO provides reliable, actionable, evidence-based research.

Here we look at the role of blue carbon.

## Blue carbon: the role of aquatic ecosystems in sequestering carbon

### What is blue carbon and why is it important?

Blue carbon is the organic carbon that is captured and sequestered by marine and coastal plants in ecosystems such as mangrove forests, seagrass meadows and tidal marshes. Through photosynthesis, the plants fix carbon which is then stored in the plant's aboveground biomass, such as trunks and leaves, and below-ground in their extensive root structures.

These blue carbon ecosystems can sequester atmospheric carbon at a faster rate than larger land-based forests and although they occupy only 2% of the world's seabed area, are responsible for 50% of the carbon captured and stored in ocean sediments. However, when they are degraded or disturbed, the carbon stored in the sediment can be released and become a significant source of greenhouse gases.

Along with their high carbon sequestration rates, coastal blue carbon ecosystems also provide services that benefit people such as protection from storms and coastal flooding, underpin fisheries and support livelihoods, especially through fisheries and tourism in some developing areas of the world.

Coastal blue carbon ecosystems are ranked as one of the most effective ocean-based solutions for climate change. Under the Paris Agreement, countries may include blue carbon in their Nationally Determined Contributions (NDCs) and consequently many countries, including Australia are seeking to incorporate them in their National emissions inventories. This can also include efforts to accredit methods for management activities that either avoid losses of carbon, or other greenhouse gases (GHG), or seek to enhance sequestration of carbon – such as the Emission Reduction Fund (ERF).

In 2017, Australia included mangroves in its national emissions reporting for 2015 and currently has just released for public comment its first ERF blue carbon method that relies upon the reinstatement of tidal flows to coastal areas.

## What are the challenges around blue carbon?

Researchers are working to understand the role that blue carbon can play as Australia works towards a target of net zero emissions. To fully realise the potential of blue carbon such that we can include it in our national GHG accounting it is important that we are not just able to quantify the ability of marine and coastal ecosystems to lock up carbon; we also need to know where and to what extent they occur, and how we can best protect and restore them.

Firstly, better methods are required for measuring the extent of and changes in blue carbon habitats, and the stocks of soil organic carbon present, and the rates at which carbon is either being sequestered or released. CSIRO and our collaborators have been working on improved remote sensing and the use of aerial drones and underwater vehicles, that harness machine learning methods to systematically map these ecosystems. The use of mid infrared spectroscopy, which CSIRO originally developed for measuring terrestrial soil carbon, is now being applied in coastal sediments and greatly reduces the cost and improves the speed of carbon analyses.

While blue carbon potentially allows multiple development goals to be addressed through a single policy framework that incorporates economic growth, environmental sustainability and social equity there are a number of complexities involved. This requires a better understanding of the land tenure, property rights and other legislative requirements pertaining to the land on which these coastal blue carbon ecosystems occur.

The development and approval of other approved blue carbon abatement methods is also another key priority for enabling the adoption of blue carbon.

As the narrative continues to evolve towards nature-based solutions and the range of benefits blue carbon ecosystem provide, methods for quantifying these ecosystems services and incorporating these into various reporting and accounting frameworks will be required.

## What is CSIRO doing to help?

Collaboration is key when it comes to an area of research as far-reaching and complex as blue carbon.

CSIRO has a strong track record of working both nationally and internationally with relevant stakeholders, including governments, non-governmental agencies, industry and research institutions. Our research has provided the evidence-base for robust policy and finance mechanisms and appropriate practical action.

**As Australia's national science agency and innovation catalyst, CSIRO is solving the greatest challenges through innovative science and technology.**

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Over the past decade, this work in Australia has included partnering with universities to collect and analyse information to produce the first national assessment of Australia's blue carbon stocks; working with Government to develop accredited blue carbon methods such as the recently released tidal reintroduction method; and working with industries and NGOs to assess the opportunities and constraints to implementing blue carbon initiatives.

In 2021 we commenced a collaboration with BHP on a research program to examine nationally the carbon abatement potential of various blue carbon methods that could be implemented through Australia's Emissions Reduction Fund. The program is also developing ways of quantifying the additional benefits coastal blue carbon ecosystems provide and that accrue to fisheries, biodiversity and coastal risk reduction. The information and tools developed by the program will be publicly available to support investors, project developers and communities.

Internationally, we are working closely with the Australian Government to provide science, technical assistance, building capacity and knowledge of Indo-Pacific nations to enable them to harness the climate change mitigation and adaptation opportunities these ecosystems provide. For example, we provide assistance to Fiji and Papua New Guinea and Indonesia through capacity building, mapping of blue carbon ecosystems, collection of carbon samples is enabling blue carbon integration into national inventories and climate policy.

In 2019, we established the Blue Carbon Hub in partnership with the Indian Ocean Rim Association (IORA) to build knowledge and capacity in protecting and restoring blue carbon ecosystems throughout the Indian Ocean by providing advice and capacity building expertise to IORA member states; engaging in and facilitating relevant research; and establishing and disseminating best-practice on blue carbon ecosystems.

### Further reading

<https://research.csiro.au/iora-blue-carbon-hub/>

<https://www.csiro.au/en/research/natural-environment/oceans/coastal-carbon-cluster>

[https://blog.csiro.au/blue-carbon-indian-ocean/?utm\\_medium=newsletter&utm\\_campaign=Sphere-Sphere-Issue-127&utm\\_source=Sphere-Sphere-Issue-127-email-20210608](https://blog.csiro.au/blue-carbon-indian-ocean/?utm_medium=newsletter&utm_campaign=Sphere-Sphere-Issue-127&utm_source=Sphere-Sphere-Issue-127-email-20210608)

Australian vegetated coastal ecosystems as global hotspots for climate change mitigation  
<https://www.nature.com/articles/s41467-019-12176-8>

Coastal development: resilience, restoration and infrastructure requirements  
<https://www.oceanpanel.org/blue-papers/coastal-development-resilience-restoration-and-infrastructure-requirements>

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