Philanthropy Briefs

CARBON MANAGEMENT

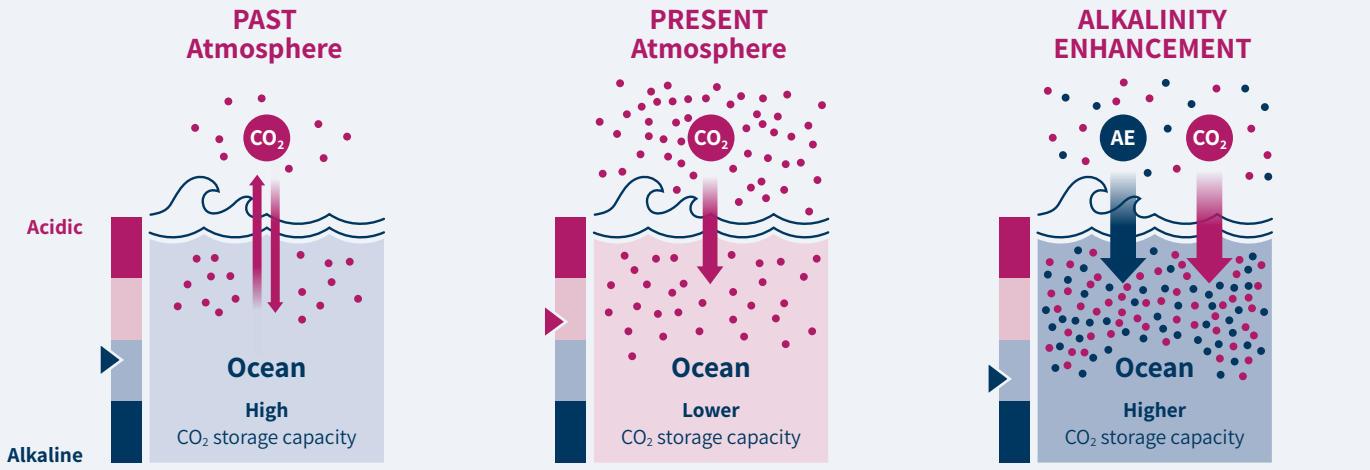
Ocean alkalinity enhancement

a series by Active Philanthropy

WHAT IS IT ABOUT?

Ocean alkalinity enhancement (OAE) aims to alter seawater chemistry by increasing its alkalinity and, in turn, the ocean's capacity to absorb carbon dioxide. Most approaches involve adding finely ground alkaline materials to the ocean, typically derived from rocks such as basalt or olivine.

In doing so, OAE aims to accelerate a naturally occurring process called rock weathering, by which rain and rivers erode rocks and transport alkaline materials into the ocean. Once dissolved in seawater, these materials help store carbon in stable forms and buffer against acidification. While this process naturally unfolds over thousands of years, OAE seeks to speed it up to a timeframe relevant for climate mitigation.[1]



Balanced CO_2 exchange between ocean and atmosphere

The ocean absorbs excess human-caused CO_2, becoming more acidic and losing CO_2 storage capacity

Alkalinity enhancement (AE) increases the ocean's capacity to store CO_2

Adapted from The LOC-NESS Project, Woods Hole Oceanographic Institution 2026

WHY IS OAE IMPORTANT FOR OUR CLIMATE?

The ocean plays a central role in buffering climate change. It has absorbed around 30% of all human-caused CO_2, storing far more carbon than the atmosphere.[2]

OAE builds on this natural function by seeking to increase the ocean's capacity to absorb and store additional CO_2 by mid-century. As land-based CDR approaches like reforestation, biochar and DAC will not be sufficient alone to meet climate goals, OAE is widely considered a promising ocean-based addition in the CDR toolkit. **Given the vastness of the ocean, OAE has immense scaling potential and could be effective at removing and permanently storing gigatonnes of CO_2 emissions annually.**[3] What is more, OAE could, in principle, also help to counteract ocean acidification, one of the largest threats to marine life.

In practice, however, OAE is not yet ready for large-scale deployment. Unresolved challenges include uncertain real-world effectiveness, high energy and material requirements, complex monitoring and verification needs, and limited evidence on potential impacts on marine life and ecosystems.[4] **Due to the sensitivity and importance of marine ecosystems for life on the planet, large-scale interventions must be carefully considered.** A key task for philanthropy will be to determine if and under what conditions OAE could be responsibly scaled.

[1] MIT Climate Portal 2024, [2] Lebling et al. 2022, [3] National Academies of Sciences, Engineering, and Medicine 2022, [4] Project Drawdown® 2025

WHAT FUNDERS CAN DO

Testing the water: OAE's potential unintended outcomes for marine ecosystems warrant a precautionary approach. At the same time, a robust CDR portfolio is urgently needed. Funders can alleviate this tension by enhancing data and knowledge on both carbon removal effectiveness and environmental impacts. The Carbon to Sea Initiative, a philanthropic initiative advancing responsible assessment of OAE, showcases how funders can help accelerating progress on critical open questions, including evidence gaps such as the potential effects of OAE on marine species. Narrowing these gaps through research and field trials will be crucial to building public confidence in the field and attracting public funding for OAE and other carbon removal approaches.

Establish safeguards: As OAE research starts to move from the lab to the field, governance structures need to keep pace to ensure that projects and trials are conducted responsibly.[5] Funders can support advocacy organisations, policy experts and civil society groups across local, national or international levels to develop governance tools such as standards for community involvement and environmental assessments. The goal is not to create additional red tape to OAE research, but to ensure that experiments are transparent and accountable, ultimately contributing to OAE's legitimacy and public acceptance.

There are many different strategies to engage in climate philanthropy. See our Spotlight on Climate Funding Strategies to learn more.

3 FAST FACTS

7 Gt

the amount of alkaline minerals that would need to be mined annually for 1 Gt CO2 per year, comparable with the annual output of the global cement industry.[6]

100x

the rate at which human CO_2 emissions are outpacing naturally occurring CO_2 removal from rock weathering.[7]

> 10,000 years

the durability of carbon stored through OAE, making it more durable than many land-based CDR approaches.[8]

THINGS TO CONSIDER WHEN FOCUSING ON OAE

Public acceptance is key:
Public acceptance, particularly among local coastal communities, is essential for the success of OAE projects. This is illustrated by a case in which public opposition resulted in the failure of an OAE pilot project in the UK.[9] Consequently, philanthropies supporting concrete OAE projects are well advised to ensure the involvement of local communities from the outset and foster open discussions about the projects' impact on coastal ecosystems.

OAE is a material challenge:
To remove gigatonnes of CO_2 from the atmosphere, OAE would come with a massive need for materials and energy: it would mean mining and grinding billions of tonnes of alkaline rock, transporting it to suitable deployment sites, and dispersing it into seawater. Funders should therefore understand OAE not only as a CDR pathway, but as a new industry with implications for ecosystems, energy demand and people. While OAE's logistical requirements may not be decisive for early-stage pilots, they become critical at climate-relevant scales.

Link to bibliography

[5] Lebling and Savoldelli 2025, [6] Environment Agency 2025; RMI 2023, [7] GEOMAR 2024, [8] Savoie et al. 2025, [9] Ranevska 2025