

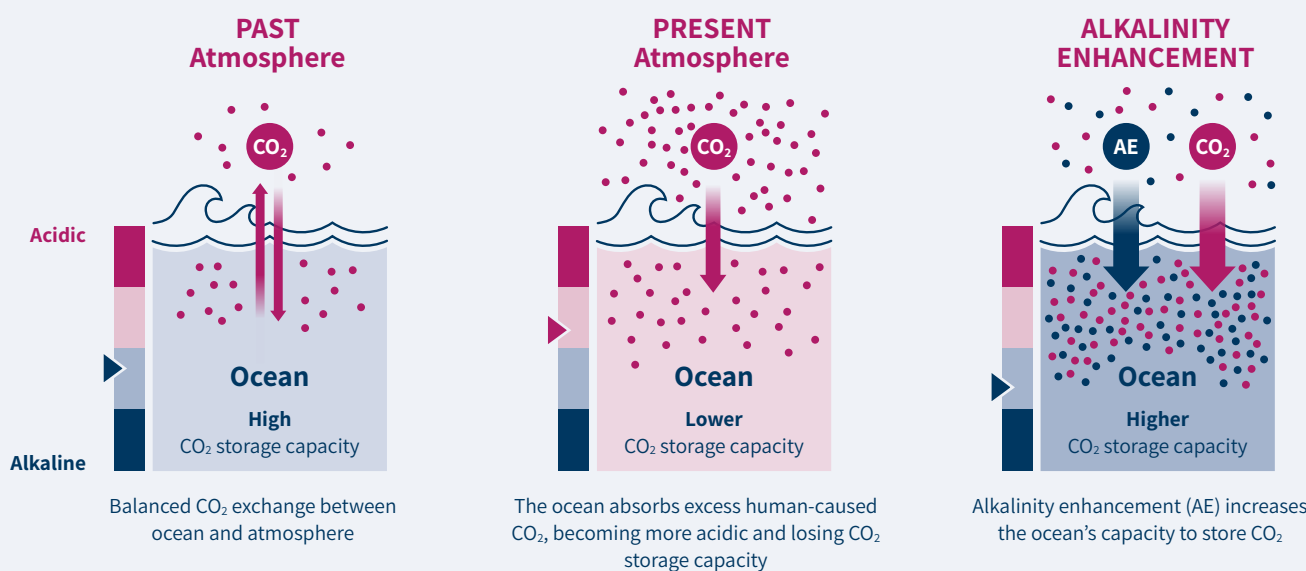
Ocean alkalinity enhancement

WHAT IS IT ABOUT?

Ocean alkalinity enhancement (OAE) refers to a set of approaches that aim to alter seawater chemistry by increasing its alkalinity, or by removing acidity, to enhance the ocean's capacity to absorb carbon dioxide.

OAE can be pursued through different pathways, including adding alkaline minerals, releasing alkaline solutions or applying electrochemical processes.

In doing so, OAE builds on a natural part of the Earth's carbon cycle, where 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 accelerate or replicate it on a timeframe relevant for climate mitigation.¹



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 CO₂, 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 CO₂ 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 CO₂ 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.

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 CO₂ emissions are outpacing naturally occurring CO₂ 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 legitimacy is key:

Past cases suggest that local trust, acceptance and stakeholder engagement can substantially shape the trajectory of OAE projects, either helping them move forward responsibly, or contributing to setbacks.⁹ Consequently, philanthropies supporting concrete OAE projects are well advised to ensure the involvement of local communities from the outset and foster proactive and open discussions about the projects' impact on coastal ecosystems.

OAE is a systems challenge:

To remove gigatonnes of CO₂ from the atmosphere, OAE would require new infrastructure, resource flows and governance. Funders should therefore understand OAE not only as a CDR pathway, but as an emerging field with implications for marine ecosystems, energy demand and coastal communities. By supporting the research and governance structures needed to assess whether OAE can be developed and scaled responsibly, funders can help shape a solution with the potential to meaningfully contribute to climate mitigation.

 [Link to bibliography](#)