Rivers, bays, oceans: Marine and freshwater environments at risk from carbon removal companies that are altering water chemistry

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This technology update on Ocean Alkalinity Enhancement (OAE) and Direct Ocean Capture (DOC) summarises the latest developments on the Geoengineering Monitor Map, highlighting new trends for civil society and climate justice movements to follow in their efforts to oppose geoengineering globally. This update is Part Two of a four-part series on marine geoengineering, where we cover other technologies like Ocean Fertilisation and Biomass Sinking (coming soon!). It was researched and written by ***Anja Chalmin****, and published with the support of the Geoengineering Monitor team.*

Critical developments covered in this update

- An increasing number of companies particularly in the US, Canada, and Europe, are trialing, piloting, and commercialising Ocean Alkalinity Enhancement (OAE) and Direct Ocean Capture (DOC) technologies though various methods including ocean dumping, discharging into rivers, and deploying offshore reactors.
- Several OAE and DOC companies, such as Heimdal, have also recently gone bust despite raising millions of dollars from investors, highlighting the instability of what is an otherwise rapidly-growing sector.
- Whereas OAE and DOC projects have been carried out in marine environments for a number of years, some companies are now also discharging carbonated water or crushed rock into rivers from wastewater treatment plants and other industrial sites and infrastructure, where it travels up to 1,000 km before reaching the ocean.
- Last year, Canadian for-profit company Planetary Technologies was forced to abandon open-ocean OAE trials in St Ives Bay, Cornwall, following sustained protests from local residents.
- Despite the serious concerns about the speed and scale of projects, energy use, supply chain impacts, and risks to marine and freshwater ecosystems, carbon offset sales are a driving force behind a number of OAE and DOC projects, although the extremely low delivery rates show how speculative these technologies remain.
- Many companies do not publicly disclose key information about their research and commercial operations, such as the quantity and source of the minerals and other materials that they require, making an assessment of likely impacts significantly harder.

OAE and DOC are marine geoengineering methods that modify ocean chemistry so that the oceans absorb more CO_2 from the atmosphere than they would under natural conditions.

OAE, the most common of the two, involves increasing the alkalinity of seawater in the open ocean and in coastal and nearshore areas. This approach aims to force the oceans to absorb more CO_2 from the atmosphere, either by

binding it □□in the form of carbonate and bicarbonate minerals or by splitting seawater into acidic and alkaline streams, with the alkaline stream being returned to the ocean□. There are various approaches to OAE, including electrochemical processes, and adding ground-up alkaline minerals to seawater or to beaches, such as olivine rock extracted from mining sites.

DOC involves extracting gaseous CO_2 from seawater, typically through electrochemical processes, for use in consumer products or for injection into geological formations. There are also an increasing number of sites where alkaline □□substances or rocks are channelled into rivers, which are then expected to make their way into the ocean.

Despite the fact that their environmental impacts are not yet clearly understood, some companies are already commercialising OAE and DOC by selling carbon offsets on the voluntary carbon markets. □Currently, OAE is the second largest marine geoengineering method in terms of carbon removal credits sold, although the 2% delivery rate shows the extent to which these projects are still unproven. The 0.01% delivery rate for DOC projects on the voluntary carbon markets reinforces this point.

Proponents of OAE and DOC often argue that enhancing alkalinity is harmless because it mimics natural weathering processes. However, natural processes occur over geological timescales, whereas OAE and DOC are far faster. By altering ocean chemistry, the large-scale deployment of OAE and DOC could pose a serious threat to marine and freshwater environments and result in significant consequences for ecosystems, such as changes in species abundance.

OAE with silicate and carbonate rocks

This approach involves dumping crushed silicate or carbonate rocks, or industrial by-products such as slag, into seawater with the aim of enhancing its alkalinity. These alkaline materials are often discharged into seawater in near-shore environments, or seawater is pumped into OAE reactors where the alkaline materials react with CO_2.

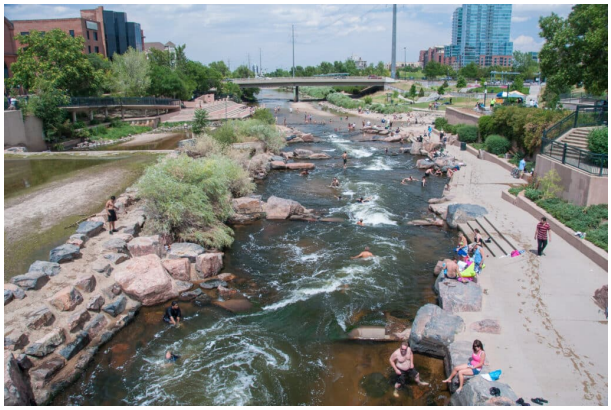
A relatively new development involves treating wastewater with carbonate materials in sewage treatment plants, and then discharging the resulting bicarbonates into rivers from effluent pipes.

One of the greatest risks associated with these approaches is the fact that mining, crushing and transporting the rocks required is energy-intensive, and has environmental and social impacts along the entire supply chain.

CREW Carbon, USA: Discharging carbonated water from wastewater treatment plants

CREW Carbon was founded in 2022 as a spin-off from Yale University's Carbon Containment Lab. The company is headquartered in New York and is commercialising a patented technology that enhances the alkalinity of industrial and municipal wastewater treatment plants. Minerals such as carbonate rocks are added to wastewater treatment reactors where they convert atmospheric CO_2 into dissolved bicarbonate ions. The treated water is then discharged into seawater, rivers, or aquifers.

CREW Carbon has several ongoing project test sites, including the East Shore Water Pollution Abatement Facility in Connecticut, the Hampton Roads Sanitation District in Virginia, several wastewater treatment sites in New England, as well as other undisclosed sites. The company is also currently developing a project at the South Platte Renew wastewater treatment facility in Denver, Colorado. The individual facilities treat up to 150 litres (40 gallons) of wastewater per day, which is discharged into rivers and seawater. The company does not disclose key information such as the quantity of mined rock that is consumed in the process, or where it is sourced from.



Confluence Park, downstream of the South Platte Renew water treatment plant, Denver. ***Kent Kanouse/Flickr***

Planeteers GmbH, Germany: Using rivers to transport bicarbonates to the ocean

Planeteers GmbH was founded in 2022 and is headquartered in Hamburg, Germany. The company aims to enhance the capacity of the oceans to absorb CO_2, and to sell carbon removal credits. Planeteers has developed two approaches, and the first involves converting captured CO_2 from point sources such as power stations into bicarbonate. This patent-pending process involves dissolving the captured CO_2 in water and bringing it into contact with alkaline minerals, such as limestone, to convert it into bicarbonate, which is then disposed of in rivers or directly into the ocean.

The second approach is Planeteers' patented Hydrated Carbonate Minerals technology, which produces the mineral compound ikaite. This compound is then released into marine environments, with the aim of increasing ocean alkalinity and enabling seawater to absorb more atmospheric CO_2. Ikaite, a calcium carbonate hydrate, is produced inside a reactor unit where CO_2, water, and the alkaline mineral calcium carbonate ($CaCO_3$) react at a specific (undisclosed) temperature. According to the company, the ikaite gradually dissolves when introduced into marine environments.

In 2024, Planeteers tested its technology at four wastewater sites in Germany. In 2026, it commissioned its Helix pilot site and plans to develop its Ostrea and Nautilus projects later in the year. The Helix site at the municipal wastewater treatment plant in Hetlingen, Germany, aims to capture and convert 10 tonnes of CO_2 per year, which it plans to scale up. It captures CO_2 from wastewater derived from a combined heat and power plant, and converts it into bicarbonate, which is then discharged into the Elbe River via the wastewater treatment plant's existing infrastructure. The treated water then flows over 100 km into the North Sea.

According to Planeteers, Ostrea and Nautilus will be commercial-scale sites, but their capacity has not yet been disclosed. The Ostrea site will be commissioned at a wastewater treatment plant on the Baltic Sea coast in northern Germany, with the bicarbonate being discharged into the Baltic Sea. The Nautilus site is being developed in cooperation with the Swiss energy company Energy 360° AG, and will be commissioned at the Buchs wastewater treatment plant on the Swiss riverside of the River Rhine, where the bicarbonate will be discharged. It will then travel over 1,000 km to the North Sea, passing through Lake Constance, Liechtenstein, Austria, Germany, and the Netherlands.

Planeteers is already selling carbon removal credits through Isometric and on its own website for €420 per tonne of CO_2 and the first buyers include companies such as Airminers, Frontier and Milkywire. In 2024, the company completed a US$ one million seed funding round, and its second funding round, led by Carmeuse Ventures, was completed in 2025.

CarbonRun, Canada: River alkalinity enhancement in Nova Scotia

and Norway

CarbonRun was founded in 2022 and is headquartered in Nova Scotia, Canada. The company dumps crushed limestone powder and other alkaline minerals into rivers in order to raise the alkalinity of river water. According to the company, the crushed limestone quickly dissolves, converting the CO_2 in the river water into bicarbonate as well as minerals such as calcium and magnesium. The limestone is piped from a silo-like doser into a nearby river, which then transports the bicarbonate into the ocean.

The company launched its first river alkalinity enhancement project in 2024 in the West River in Pictou County, Nova Scotia, which flows into Sheet Harbour on Nova Scotia's Eastern Shore. The following year, it launched projects in the Moser River, also in Nova Scotia, and the Kvina River, in Norway. Key information, such as the amount of limestone powder added to each river system and its source has not been disclosed by the company.

The Moser River project dumps limestone into the river at a site near the Wilson Falls, around eight km north of the Nauglers Settlement, which then flows into the Necom Teuch Harbour, an inlet off the Atlantic Ocean. The Kvina River project is based in Kvindesdal in Agder County, and limestone is added to the river in Nyland and Steindor, which are located about eight and 20 km north of Kvindesdal, respectively. The river flows into the North Sea via the Fedafjorden.

CarbonRun is a venture capital-backed company, and in 2024 signed a US$ 25 million offtake agreement with Frontier for the delivery of 55,450 tonnes of carbon removal by 2029. Buyers include Alphabet, Autodesk, H&M Group, JPMorgan Chase, McKinsey, Shopify, Stripe, Salesforce and Zendesk. In the same year, the company received a US$ one million research and development grant from Stripe.

Vycarb, USA: Scaling up after completion of a one-year open-water trial in New York Harbour

Vycarb was founded in 2022 and is based in New York. The company has developed two business models, the first aims to remove CO_2 from seawater by enhancing its alkalinity, while the second involves developing technology to measure carbon removal in marine environments.

Vycarb's OAE approach involves a modular pipe reactor that draws in CO_2 from various sources. In the reactor, the CO_2 reacts with water and with the calcium and magnesium found in crushed minerals such as dunite and silicates. The CO_2 then dissolves in the water to form carbonic acid. According to Vycarb, approximately 99% of the carbonic acid converts into bicarbonate and carbonate ions, with around 1% remaining as carbonic acid. The enriched water is then returned to the ocean. Information such as where the minerals are sourced from and how much is required has not been made publicly available.

In 2023, the company conducted two small-scale trials, one in collaboration with the East Hampton Shellfish Hatchery, in Montauk, New York, and a four-hour demonstration in New York Harbour. Then in 2024 and 2025, Vycarb conducted a one-year pilot trial in a container at the Brooklyn Navy Yard on New York City's East River. Vycarb is now seeking partnerships with industrial facilities where their system can be integrated, with the aim of scaling up to large-scale deployment. As part of this commercial development, this year Vycarb partnered with Tomco Systems, a producer of CO_2 equipment, including CO_2 storage tanks and CO_2 exhaust stream capture systems.

In 2025, Vycarb completed a US$ five million funding round led by the climate tech venture capital firm Twynam, with participation from MOL Switch, Hatch Blue, Clocktower Ventures, Idemitsu Kosan Co Ltd, and SGInnovate. As of May 2026, Stripe, Klarna and the WRLD Foundation have pre-purchased carbon credits, but none have been delivered yet.

Ecomerit Technologies, USA: An open-air test of airborne NaOH formation was conducted in New Zealand

Ecomerit Technologies LLC was founded in 2009 and is headquartered in California, USA. The company develops ocean-based power generators, such as ocean current and floating wind turbines. Ecomerit has also developed the Precipitor, a system that aims to capture atmospheric CO_2 and reduce ocean acidity. It consists of an offshore wind

turbine that electrolyses seawater and disperses an alkaline mist that reacts with atmospheric CO_2, forming bicarbonate, which drops into the ocean from the atmosphere and sinks. The company plans to use Precipitors in conjunction with seawater desalination plants, offshore wind turbines, and on ships.

The Precipitor functions by electrolysing residual brine or seawater to yield a liquid antacid solution, sodium hydroxide (NaOH), which is dispersed as an aerosol by wind turbines. According to the company, the chemical reaction in the air consists of two steps:

1. Airborne CO_2 reacts with NaOH to form sodium carbonate (Na_2CO_3) and water ($2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$).
2. Na_2CO_3, airborne CO_2 and H_2O react to form sodium bicarbonate ($NaHCO_3$) ($Na_2CO_3 + CO_2 + H_2O \rightarrow 2NaHCO_3$).

The $NaHCO_3$ then falls into in the ocean with the aim of reducing acidity and enhancing CO_2 absorption capacity. The carbon in the $NaHCO_3$ is expected to be absorbed by marine calcifying organisms and, at the end of their life cycles, to sink to the ocean floor and be stored in sediments. To date, no peer-reviewed publications or independent evaluations of this approach have been published.

In 2021, subsidiary company Ecomerit Technologies Pacific Ltd was registered in Matakana, New Zealand, and conducted a Precipitor test in 2024 in collaboration with Northport Ltd in Marsden Point, about 90 kilometres north of Matakana. The test took place on a Northport Ltd pier, where a Precipitor was set up and dispersed a mist of filtered water in order to study plume dispersion and, during the evening, laser lights were used to observe, measure and monitor the shape and nature of the plume of water mist.

Hourglass Climate Inc., USA: Contributing to open-ocean trials in the East Coast

Hourglass Climate Inc. was founded in 2024 and is based in New Jersey. The company aims to research, develop and scale mineral-based OAE through modelling, laboratory-scale trials and field trials, as well as contribute to the design, execution and data analysis of OAE field trials more generally. According to its website, Hourglass is currently collaborating in the analysis and monitoring of a number of outdoor trials, including Vesta's trials at North Sea Beach in New York and in nearshore waters off Duck in North Carolina, as well as an OAE trial in the Herring River Estuary in Massachusetts.

The company's own laboratory trials are being conducted at the MARINER laboratory at the Southern California Marine Institute, where mineral-based OAE is being tested in twelve seawater basins. The company is also developing 'RADIO', a tool that seeks to model the fluxes of alkalinity resulting from adding minerals to the seafloor. This tool is intended to enable carbon accounting for mineral-based OAE.

Although Hourglass claims to be conducting independent analysis on OAE, it already lauds the "*outsized potential for impact*" of mineral based OAE, and states that *"the resulting carbon removal is effectively permanent (>10,000 years)*". The company also claims that mineral-based OAE is an antidote to ocean acidification, making the bold claim that *"Widespread implementation of mineral-based OAE could therefore address not just the root cause of climate change, but the consequences of it too."*

The company has received funding from the Grantham Foundation, the Greenbridge Family Foundation, the Larsen Lam Climate Change Foundation, and the U.S. National Oceanic and Atmospheric Administration (NOAA).

Scaled Carbon PBC, USA: OAE monitoring and planned open-ocean trials

Scaled Carbon PBC was founded in 2023 and is based in Massachusetts. The company intends to accelerate marine enhanced weathering by grinding silicate rocks into sand and dispersing them in the ocean. It is researching methods of monitoring this process, with the aiming of being able to quantify and verify the resulting carbon removal. For this purpose, the company is developing a proprietary tracer-based monitoring, reporting and

verification (MRV) method. In early 2026, a working paper describing tests of the tracer in a microcosm experiment at the University of Tasmania was published, where forsterite olivine was used as the alkaline material. The study concluded that there is "*significant work to be done to develop this method and evaluate its potential usefulness in an operational CEW scenario*". Scaled Carbon is also seeking funding to conduct an open-ocean pilot trial.

Electrochemical Ocean Alkalinity Enhancement

The aim of electrochemical OAE is to increase seawater alkalinity and enhance CO_2 uptake. In electrochemical OAE processes, acids are extracted from seawater and alkaline solutions are discharged back into it. The resulting acid by-products, typically hydrochloric acid, are generally not returned to the ocean, although some companies, including Equatic and Planetary Technologies, neutralise acid by-products using a process that combines electrolysis with the addition of alkaline rocks.

Equatic, USA: Development of OAE projects in Canada, Malaysia and Singapore

Equatic is a University of California (UCLA) spin-off that was founded in 2021. The Los Angeles-based company is commercialising patented OAE technology developed at UCLA that uses rocks, electricity, seawater and air. The process begins with electrolysis, which is highly energy-intensive. Seawater is pumped into Equatic's plant, where an electrolyser converts it into hydrogen and oxygen gases, as well as a liquid acid stream, and a liquid alkaline stream containing calcium and magnesium ions (which are abundant in seawater). The alkaline stream is then exposed to ambient air to capture CO_2 by mineralising it in the form of calcium and magnesium carbonates. It is then discharged back into the sea. The acid stream is neutralised using crushed rocks, such as olivine, before also being discharged into the sea. According to Equatic, the captured CO_2 is released into the ocean in the form of dissolved bicarbonate and solid mineral carbonates, and hydrogen is captured as a by-product as well.

Since 2023, Equatic has been operating a pilot project from a 30-metre boat moored at the Port of Los Angeles with a nominal capacity of 36.5 tonnes of CO_2 per year (the actual capacity has not been made publicly available). The project is being conducted in collaboration with AltaSea, a public–private research institute, and both Equatic and AltaSea have received high-profile backing from the California Air Resources Board, which has publicised their technology research as the development of an essential climate solution.

Equatic previously operated a similar-sized pilot project at Singapore's Tuas Desalination Plant in collaboration with the country's national water agency, the Public Utilities Board. Equatic plans to deploy a demonstration project, Equatic-1, at the same site, with a planned nominal capacity of 3,650 tonnes of CO_2 and 110 tonnes of hydrogen per year. In 2024, Equatic announced a commercial project in Quebec, Canada. The location has not yet been disclosed, but the site is expected to capture 110,000 tonnes of CO_2 and to produce 3,600 tonnes of hydrogen per year. In 2026, Equatic signed a Memorandum of Understanding (MoU) with Boeing and the Sarawak Economic Development Corporation to develop a demonstration facility in the Malaysian state of Sarawak.

According to a BBC report, Equatic estimates that 2.3 MWh of energy is required to capture one tonne of CO_2, equivalent to the annual electricity consumption of over 175 New York residents. Therefore, if the process were to be scaled up, it would require a vast amount of electricity.

Planetary Technologies Inc., Canada: Two years of protests halt trials off the coast of Cornwall

Planetary Technologies Inc. was founded in 2019 and is headquartered in Nova Scotia, Canada. The for-profit company aims to enhance the alkalinity of seawater and sell carbon credits based on this process. It is seeking to develop and commercialise its SeaOH2 technology, which involves an energy-intensive electrolysis process combined with the addition of alkaline rock tailings to water. This produces magnesium hydroxide ($Mg(OH)_2$), an alkaline substance which Planetary intends to release into the ocean to react with dissolved carbon and form bicarbonate.

To date, Planetary has conducted trials off the coasts of Nova Scotia (Canada), Cornwall (UK) and in coastal waters off Norfolk (Virginia, USA). In the Halifax Harbour area of Nova Scotia, the company has been releasing $Mg(OH)_2$ since 2023. The project is being carried out at Nova Scotia Power's Tufts Cove Generating Station in Halifax, in

collaboration with Dalhousie University., The plant has been operational for around 190 days since Autumn 2024, and has consumed 2,600 tonnes of rock tailings in the process. The source of the alkaline rock tailings has not been made publicly available, although according to the company in 2023/24 the rock was shipped from Spain. Planetary issued its first carbon offsets at this site in 2025 and signed a $31 million offtake agreement with Frontier for 115,000 tonnes of CO_2, to be delivered between 2026 and 2030. In Virginia, together with the universities of Maryland and Delaware, Planetary conducted trials in coastal waters off Norfolk, at the mouth of the Elizabeth River, in 2024 and 2025.

Planetary also conducted an initial open-ocean trial in St Ives Bay, Cornwall, in 2022. Local residents only found out about the trial afterwards, and responded with sustained protests against any further and larger-scale open-ocean experiments, which were intended to generate revenue through the sale of carbon credits. In response to Planetary's plans, the community initiative 'Keep Our Sea Chemical Free' was formed to protect the bay, and local protests led to the company's intentions being critically questioned and ultimately thwarted. Planetary did not leave the bay until 2025, and a documentary has been produced about the protests.

In 2024, Planetary announced plans for a pilot trial in the Strait of Georgia, scheduled for spring 2025. The project involved releasing $Mg(OH)_2$ from the Lions Gate Wastewater Treatment Plant into the Burrard Inlet off Vancouver in the strait. The trial was to be conducted in collaboration with Ocean Networks Canada, the University of British Columbia and Metro Vancouver. Planetary's proposal was discussed at a 2024 meeting of the Canadian Standing Senate Committee on Fisheries and Oceans, and the British Columbia Centre for Innovation and Clean Energy announced funding of US$ 1.9 million, covering approximately half of the project's estimated costs. However, there has been no indication that these plans are being implemented, and the project website is no longer active.

A community protest at St Ives Bay, Cornwall. Photo by Joe and Rob Mc Cleo

Pacific Rim Design & Development Inc, USA: Mineralising flue gas carbon and dumping it into the ocean

Pacific Rim Design & Development Inc (PRDD) was founded in 1989 and is based in California, USA. The company has developed technology that can scrub nitrogen and sulphur compounds, as well as CO_2, from industrial flue gas. PRDD's CO_2 capture technology converts CO_2 into sodium bicarbonate ($NaHCO_3$) and sodium carbonate (Na_2CO_3) using lithium hydroxide. The reaction chamber consumes electricity and sodium chloride, which can be extracted from seawater. Lithium hydroxide and other chemicals are required to initiate the process and, according to PRDD, these are recycled. Following the capture and conversion process, the carbonate minerals are dumped into the ocean. The company states that "*Sodium carbonate and bicarbonate are loaded onto ships designed to appropriately dose the compounds into the sea*", and is collaborating with NOAA's Pacific Marine Environmental Laboratory and the University of Miami to optimise the "dosing" process. The research programme will comprise three stages: small-scale laboratory experiments, mesocosm experiments, and open-ocean and atoll field testing. Information on the schedule, location and scale of the tests has not been made publicly available.

Cestore AB, Sweden: An electrochemical approach aims to replace

CCS

Cestore AB, founded in 2023 and headquartered in Sweden, aims to commercialise a process whereby captured CO_2 is converted into dissolved inorganic carbon and released into oceans, lakes or rivers. The company plans to utilise the natural buffering systems of these water bodies for the "storage" of the captured CO_2. The process is based on an electrochemical method, where the captured CO_2 reacts with an alkaline feedstock in a water body to convert it into dissolved inorganic carbon, and the treated water is then returned to the water body. According to Cestore, this process also generates electrical energy.

The company intends to use this method to develop a more cost-effective alternative to CCS, eliminating the need for the compression, transport and geological storage of captured CO_2. In 2025, Cestore tested a prototype in a laboratory setting and, since then, the Maris project, funded by the Swedish Energy Agency, has been scheduled for 2026 involving a pilot test at Nynas AB's hydrogen production facility in Nynäshamn, 60 km south of Stockholm. The facility emits 60,000 tonnes of CO_2 annually, and the pilot project will entail testing a reactor with a capacity of two kilograms of CO_2 per hour. Maris will also examine the technical, economic and regulatory frameworks for a large-scale facility with a capacity of 50,000 tonnes of CO_2 per year at the Nynas production site.

Pronoe, France: Demonstration trial on Gran Canaria

Pronoe was founded in 2022 and is headquartered in France. The company is developing an electrochemical technology intended to increase the alkalinity of the ocean. It can be integrated into water treatment plants or sites with industrial effluents near the coast, such that an alkaline effluent can be discharged into coastal waters. In 2025, Pronoe signed an agreement with the Instituto Tecnológico de Canarias (ITC) on Gran Canaria to carry out the Teydea demonstration project, which will be implemented at the Pozo Izquierdo industrial desalination plant, located on the south-east coast of the island. Pronoe will also have access to the ITC's experimental area in Pozo Izquierdo, the ITC Brine Valorisation Test Bed. The start date and scope of the tests have not been made publicly available.

Heimdal Inc., UK: Despite substantial investor funding, the company has been liquidated

Heimdal Inc. was founded in 2020 and was headquartered in the UK. Its aim was to develop and commercialise an electrochemical OAE and Direct Air Capture (DAC) technology. In 2022, Heimdal commissioned an OAE pilot facility attached to an existing desalination plant on the coast of Kailua-Kona in Hawaii, which used electrolysis to remove hydrochloric acid from the brine produced during the desalination process. The resulting alkaline solution was then returned to the seawater. The pilot facility was container-sized, and had a CO_2 capture capacity of up to 36 tonnes per year at a cost of US$ 475 per tonne of CO_2. Heimdal planned to sell the hydrochloric acid to manufacturers in the textile, battery, metal and food industries, thereby reducing the cost of the process.

In 2024, Heimdal launched the DAC Project Bantam in Oklahoma, USA, involving a technology that uses crushed limestone to passively absorb CO_2, which was then released by heating the limestone in a 2,000-degree kiln.

The company was liquidated in 2026 despite having raised US$ 9.7 million in funding in 2024. There has been no official statement explaining why, although one explanation could be the high costs and energy requirements of the technologies it developed.

NuWa Solutions, USA:

NuWa Solutions was founded in 2025, is registered in Delaware and operates in Maine, USA. The company aims to develop 'pilot-ready' OAE projects in coastal environments and infrastructure, and sell carbon credits. It offers OAE project development services, including site screening in coastal environments, baseline monitoring and assistance with permitting issues. The company also seeks to implement MRV procedures for carbon credit sales. NuWa Solutions is currently seeking partners to establish its first pilot projects and is already compiling a list of prospective buyers for future carbon credit sales. There are currently no known collaborations.

Direct Ocean Capture

Rather than increasing the capacity of seawater to hold dissolved carbon, Direct Ocean Capture (DOC) involves extracting carbon directly from seawater in order to enhance its ability to absorb more CO_2 from the atmosphere. This is achieved by converting dissolved carbonate and bicarbonate ions back into CO_2, which is then extracted from the water as a gas. In order to initiate the process, seawater is acidified typically using electrochemical methods. The CO_2 extracted is intended for use in consumer products (CCUS), meaning it is released back into the atmosphere as soon as the products are consumed. Other proposals include injecting it into geological formations (CCS).

Brineworks B.V., the Netherlands: Construction of a pilot plant with EU funding

Brineworks B.V. was founded in 2023 and is headquartered in the Netherlands. The company has patented a CO_2 removal technology for seawater that is both modular and solvent-free. The electrolysis system produces an acid and a base from saltwater, which are then used to liberate the CO_2, producing hydrogen in the process. These gases are intended for use as feedstock in the production of synthetic fuels and plastics, for example.

In 2024, the company started piloting the technology in Gran Canaria under real-world conditions in collaboration with the Instituto Tecnológico de Canarias in Pozo Izquierdo, as well as the water technology company Elmasa, the water and sanitation utility Emalsa, and the local public administration (Cabildo de Gran Canaria). In 2025, Brineworks embarked on a two-year research project with the aim of optimising the electrolysis process, as well as planning and constructing the pilot plant in Gran Canaria. The € 1.8 million project is fully financed by the EU's Horizon Europe funding programme. In addition to the Horizon grant, Brineworks has raised more than seven million euros in funding rounds led by SeaX Ventures and Pale Blue Dot.

SeaO2, the Netherlands: Lack of funding may force the company to close down

SeaO2 was founded in 2021 and is headquartered in Amsterdam. The company seeks to develop and commercialise DOC technology which was developed at the Delft University of Technology and Wetsus Laboratories. This electrochemical process aims to remove CO_2 from seawater using electricity, membranes and seawater. A small quantity of seawater is filtered and passed through a bipolar membrane to split it into an acid (HCl) and a base (NaOH) via an electrochemical pH swing process. The resulting acid is then mixed back into the seawater, lowering its pH and reducing its carbon absorption capacity. This forces the CO_2 to bubble out of the seawater. The treated seawater is then mixed with untreated seawater and returned to the ocean.

In 2023, SeaO2 deployed Project Ripple, a small-scale prototype which captured up to one tonne of CO_2 per year. In 2025, the company commissioned Project Swell, a demonstration project located near The Hague, with a capture capacity of up to 25 tonnes of CO_2 per year. Another pilot, Project Breaker, is expected to capture up to 250 tonnes of CO_2 per year, but details such as the location of the project have not yet been made publicly available. In May 2026, despite having received more than seven million euros in funding since its foundation, the company announced that it would cease to exist unless it received further investment.

BlueShift Carbon Inc, USA: DOC concept aims to extract CO_2 and critical minerals

BlueShift Carbon Inc. was founded in 2024 and is headquartered in Massachusetts. The company aims to extract critical minerals from industrial waste, such as coal ash and olivine mining waste, while simultaneously capturing CO_2 directly from the ocean. BlueShift has developed a proprietary, membrane-free, redox-based electrochemical process to recover minerals such as nickel, as well as rare earth elements such as neodymium. This technology was developed with the support of the University of Michigan and Harvard University, and was funded by the US Department of Energy's Advanced Research Projects Agency. BlueShift plans to integrate its technology with existing infrastructure, such as desalination plants and power stations, to process alkaline industrial waste and seawater. The process involves isolating critical minerals from these streams and converting CO_2 into limestone. A pre-seed funding round of US$ 2.1 million in 2025 enabled BlueShift to begin construction of a pilot facility in

Boston Harbour, Massachusetts, and the company plans to generate revenue by selling carbon credits and critical and rare earth minerals, as well as by licensing its technology to desalination plants and other industries.

Filter tubes at a large desalination plant. ***Glitchfield/Flickr***

Gigaton CO2 Ltd, UK: DOC development paused for commercial reasons

Gigaton CO2 Ltd, founded in 2022, develops methods for capturing CO_2, including Direct Water Capture (DWC) and Direct Industrial Capture (DIC). The company's DWC approach uses an electrochemical method to extract CO_2 from fresh and saltwater, and is intended for deployment at coastal, offshore, and desalination sites. However, Gigaton has paused DWC development due to "*limited market appetite and no clear route to deployment at scale*". The company estimates that its technology can extract 100 tonnes of CO_2 per billion litres of water processed and anticipates an initial cost of US$ 200 to 500 per tonne of CO_2, with a long-term goal of reducing this to below US$ 100 per tonne.

Pure Carbon Blue, The Netherlands: Trialling DOC in canals

Pure Carbon Blue, founded in 2021, has developed an electrochemical DWC technology which aims to capture CO_2 from water and utilise it as a feedstock for producing aviation fuel or chemicals, or to inject it into geological formations. The company proposes deploying the technology near industrial or CO_2 injection sites, and is currently testing its technology in Dutch canals under varying seasonal conditions. It estimates that the cost of capturing CO_2 in this way will be between US$ 150 and US$ 200 per tonne.

Banyu Carbon Inc, USA: Plans to scale-up have been delayed

Banyu Carbon Inc, founded in 2022, aims to develop and commercialise a photochemical process for extracting CO_2 from seawater. The approach is based on technology developed and patented at the University of Washington, where the company is based. The photochemical process uses a reusable, light-activated synthetic molecule, called a 'photoacid', that becomes acidic when exposed to sunlight and reverts to its original neutral form in the dark. When dissolved in seawater, the photoacid causes the dissolved carbon to degas as CO_2. This CO_2 is then captured, and the decarbonised seawater is returned to the ocean.

In 2023, Banyu Carbon developed and tested a prototype on a small scale. Following a US$ 6.5 million funding round in 2023, the company announced a pilot project in Puget Sound Bay, Washington State, for 2024, and a demonstration project for 2026. These projects have not yet been implemented, and there is no indication that they are in the planning or construction stage. The pilot project aims to capture up to 10 kilograms of CO_2, and the demonstration plant is intended to fulfil a pre-purchase contract signed in 2023 with the Frontier carbon market, supplying 360 tonnes of CO_2 at a cost of US$ 1,400 per tonne.