



POLICY BRIEF:

Unlocking Europe's blue carbon economy

KEY POLICY ASKS

1. Fund a clear mCDR R&I agenda under FP10
2. Drive for OIR regulation and coordinated governance
3. Establish mCDR market framework

OCEANRY

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SUMMARY:

Marine carbon dioxide removal (mCDR) offers a significant opportunity to strengthen Europe's climate resilience, ocean health and technological competitiveness. By supporting rigorous ocean iron replenishment (OIR) research and developing clear governance frameworks, Europe can lead the next generation of high-integrity carbon removal solutions and accelerate progress towards the EU's 2040 and 2050 climate targets.

OIR builds on natural processes. Iron limits phytoplankton growth across large parts of the ocean. Restoring trace amounts of iron to iron-depleted waters mimics natural events such as volcanic ash and desert dust deposition, which are known to trigger plankton blooms. Phytoplankton drive the ocean's biological carbon pump. By revitalising them, OIR has the potential to support marine food webs, increase the production of cloud-forming aerosols and store carbon in the deep ocean for centuries or longer. Models suggest that at global scale, OIR could remove gigatons of CO₂ from the atmosphere every year. Larger field studies with robust MRV are now needed to confirm this potential and its safety.

How Oceanry works: three core scientific pillars:

1

Biomimicry & trace nutrition

Adding bio-available iron to marine areas depleted of it mimics natural volcanic and atmospheric dust deposition.

2

Restoring plankton

Enhancing plankton growth rebuilds the foundation of marine food webs and revives oceanic ecosystem health.

3

Dual climate impact

Driving long-term carbon removal into deep seas, while simultaneously releasing cloud-forming aerosols that cool the atmosphere naturally.

Key policy asks for the European climate leaders:

Oceanry welcomes the opportunity to contribute to upcoming European Union workshops and policy discussions to help shape these frameworks and support the launch of initial research trials in 2027-2028.

1. Fund a clear mCDR R&I agenda under FP10

that identifies the most pressing knowledge gaps in OIR research, directs sufficient funding towards answering them and aligns priorities across the wider research from laboratory to controlled ocean trials. CarbonGap estimates that €2.6 billion in public R&I support is required for early-stage carbon dioxide removal in the next seven years. The EU must dedicate funding for marine-based innovation and ocean testing within FP10 and the European Competitiveness Fund to help determine under what conditions mCDR's potential can be realised.

2. Drive for OIR regulation and coordinated governance through the Ocean Act.

Integrate mCDR policy across climate, marine, and biodiversity legislation to create a clear, predictable regulatory environment. Designing the upcoming Ocean Research and Innovation Strategy alongside the Ocean Act will establish the necessary legal frameworks, transparent permitting pathways, and environmental safeguards. Linking these policies with European ocean observation infrastructure, such as OceanEye, ensures the empirical data and monitoring capacity needed to evaluate mCDR methods are in place.

3. Establish mCDR market framework under the CRCF.

Accelerate the development of transparent, robust monitoring, reporting, and verification (MRV) tailored to mCDR under the Carbon Removal Certification Framework (CRCF). Standardised baseline modelling, methodologies and independent scientific guardrails are essential to guarantee ecological safety, build public trust, and ensure long-term sequestration integrity.

THE CHALLENGE:

Restoring balance to a disrupted ocean system

Climate change is disrupting the ocean processes that regulate Earth's temperature. Anthropogenic greenhouse gas emissions have pushed the planet into a severe energy imbalance, with Earth absorbing heat at a rate equivalent to **13 Hiroshima bombs every second**. As glaciers melt and cloud cover decreases, the planet is further losing its reflective surfaces. Because **70% of Earth is ocean**, the planet now behaves like a large, dark heat-absorbing surface.

The result is a cascading ocean crisis. More than 90% of the excess heat from global warming is absorbed by the ocean, driving rapid acidification as CO₂ dissolves into surface waters.

Phytoplankton, the foundation of marine life, is among the most severely affected. These microscopic organisms are responsible for nearly 50% of Earth's oxygen production (*Field et al. 1998*). When photosynthesizing, they draw down atmospheric CO₂ and convert it into oxygen and biomass, feeding the marine food web and launching the biological carbon pump that transports carbon into the deep ocean. They also enable cloud formation through aerosol production. Without plankton, fewer clouds form, less sunlight is reflected, and warming accelerates. Over the past century, chlorophyll, the standard measure of phytoplankton, has declined significantly across 62% of the ocean surface between 1890-2010. (*Boyce et al. 2014, Gruber 2011*)

One of the drivers of this decline is **iron depletion**. Iron moves up the food web: plankton take it from seawater and fish eat the plankton, storing the iron in their blood and muscle. In a natural ocean that iron comes back to the surface as animals excrete, or die and decompose, and plankton use it again. However, human activity is taking iron currently out of the system. When fish are caught and landed, the iron in their bodies does not circulate back to the natural cycle. Commercial fishing removes up to 30,000 tonnes of iron this way every year (*Moreno and Haffa 2014*), roughly the weight of four Eiffel Towers.

If these animals remained in the ocean, the iron stored in their bodies would naturally circulate: when predators feed, when whales release nutrient-rich feces, and when animals die and sink (called marine snow). This recycling is an essential part of the ocean's nutrient engine.

THE OPPORTUNITY:

Ocean Iron Replenishment

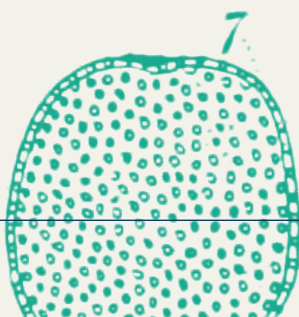
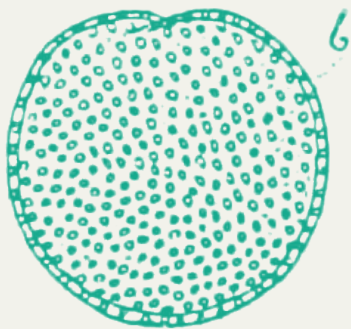
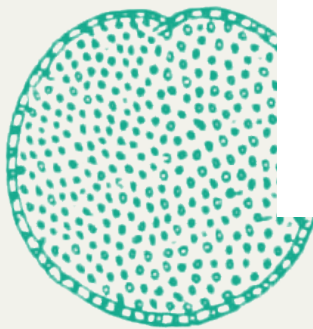
Ocean iron fertilization, better described today as ocean iron replenishment (OIR), has shown strong potential to revive plankton activity and significantly increase carbon removal.

The process of OIR involves introducing trace amounts of natural iron dust into iron-deficient ocean areas to stimulate the growth of phytoplankton. A single bloom can draw down millions of tonnes of CO₂ within weeks (*Hamme et al. 2010*). Roughly 1% of the particulate organic carbon produced in surface waters is exported to the deep ocean, where residence times can exceed 1,000 years (*Siegel et al. 2021*). OIR could help address the 2.6 teratonnes of legacy CO₂ already accumulated in the atmosphere. In addition to the long-term storage of CO₂, an even greater amount of CO₂ is incorporated into the living marine organisms with lifespans ranging from years to centuries. Furthermore, long-term carbon cycling within the ocean's various layers provides additional CO₂ sequestration for similar periods.

BENEFITS

In addition to carbon removal, iron replenishment has other benefits:

- maintain and restore the **marine foodweb** through the support of plankton growth
- increase surface-water alkalinity and **reduce local acidification**
- enhance generation of **cloud-forming aerosols** and help cool overheated regions
- offer conditions for abundant and **diverse marine life** to return



Research status and remaining gaps

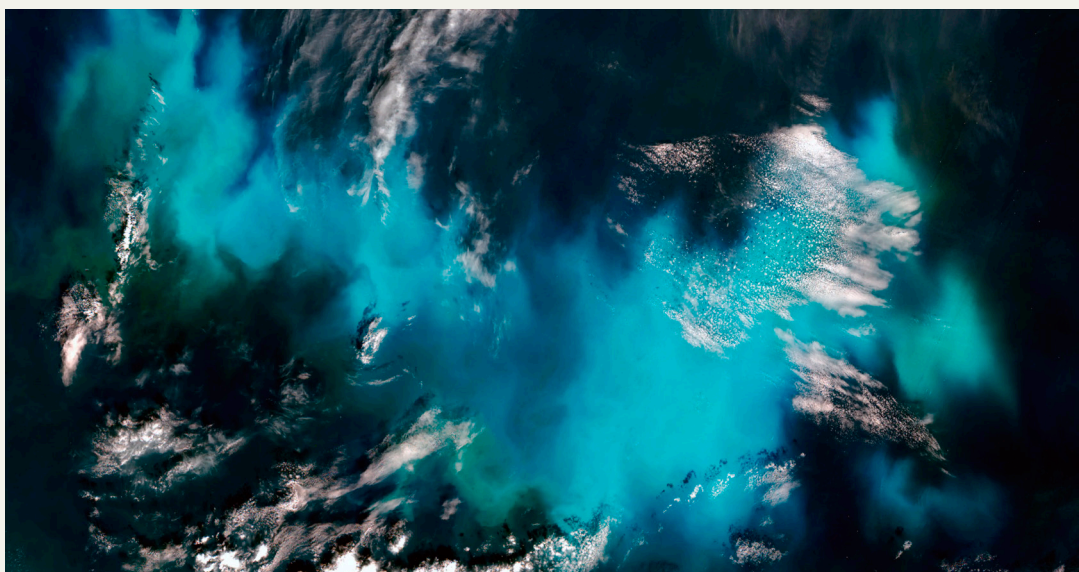
Thirteen open-ocean experiments between 1993 and 2009 showed that small additions of iron trigger phytoplankton blooms in iron-limited waters. In the best resolved of them, at least half the bloom sank below 1,000 metres (*Smetacek et al. 2012*). What those experiments were not designed to show is how much carbon stays down, for how long, and what the bloom does to the wider ecosystem. They ran for weeks, over small areas. The international research community now agrees on the next step: larger and longer trials, monitored for their ecological effects as closely as for carbon, with stopping rules agreed in advance (*NASEM 2022; Buesseler et al. 2026*).

WHY THIS MATTERS FOR EUROPE

Europe's climate neutrality target cannot be met without removing carbon already in the atmosphere, and the ocean has by far the largest capacity to store it. OIR could also help restore the plankton that European fisheries and marine ecosystems depend on. The next generation of trials is being planned now, in the Pacific, led from the United States, and the safeguards written for them will become the global default. Europe can help write them, or inherit them.

Atlantic Ocean Algae Bloom
15 May 2024

Source: European Union,
Copernicus Sentinel-2 imagery



What Oceanry brings?



Oceanry is a Finnish non-profit advancing research into ocean iron replenishment as a way to restore marine ecosystems. We bring together biological oceanography, atmospheric chemistry and policy, and work with the University of Las Palmas de Gran Canaria and an advisory board of scientists with direct field experience of iron addition experiments. Oceanry's goals are to increase awareness on OIR; promote research and conduct a Proof-of-Concept in 2028 on the Northern Atlantic; and develop global regulation and standardization.

Oceanry welcomes the opportunity to explore these steps with the European Commission, the European Parliament and our research partners.

For more information:
oceanry.org

Oceanry's research programme runs in three stages, with each stage gated on the one before:

1. Modelling: plankton growth, carbon export, satellite measurement, aerosol production.
2. Mesocosm experiments in fully enclosed systems, where effects can be measured against controls
3. Open ocean experimentation at high-seas at the North Atlantic. Conducted under the assessment framework of the London Convention and Protocol.

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