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German Environment Agency

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Why carbon credits derived from large-scale marine CO_2 removal (mCDR) projects should not be marketed at this time

Public and political debates surrounding the use of marine carbon dioxide removal (mCDR) projects, a subgroup of marine geoengineering (mGE), have gained significant momentum as global greenhouse gas emissions continue to rise [1,2]. Carbon credits from large-scale marine carbon dioxide removal (mCDR) projects are increasingly being offered and marketed. The following section explains the legal situation, the scientific evidence, and the risks associated with the marketing of carbon credits from mCDR projects.

1 Need for legitimate scientific research on climate effectiveness and potential environmental impacts

With regard to mCDR, a fundamental distinction must be made between nature-based solutions and technological approaches. Nature-based solutions, such as the reforestation of mangrove forests or the restoration of seagrass beds utilize and enhance natural biological processes in the ocean to sequester CO_2 from the atmosphere. In addition to their CO_2 sequestration function, they offer a range of co-benefits (e.g., coastal protection, biodiversity) and pose only minor risks to the marine environment [3]. Nature-based solutions are therefore not covered by the following discussion.

Technological mCDR projects can be classified into biotechnological (ocean fertilization and biomass sinking), physical (artificial upwelling), and chemical (ocean alkalinity enhancement and electrochemical processes, eDOC) methods. These represent relatively new approaches, and there is a significant need for further scientific research, particularly regarding their climate effectiveness - that is, if and to what extent CDR projects actually contribute to an effective and lasting impact in climate change mitigation. Relevant questions here include a holistic assessment (e.g. lifecycle assessment), issues of scalability, and the durability of storage in the ocean. There is insufficient scientific evidence available for any of these questions. Therefore, the climate effectiveness of mCDR projects has not yet been proven.

Furthermore, mCDR projects may pose significant risks to humans and the environment, as they interfere with complex natural processes. Oceans are open systems without boundaries. Once introduced, substances cannot be removed - or can only be removed with great difficulty - and once set in motion, reactions can only be reversed to a limited extent, if at all. Therefore, there is a risk of irreversible damage and transboundary impacts. Consequently, there is still a significant need for research before mCDR projects can be implemented on a commercial scale.

2 Marine carbon removal technologies in the IPCC reports

It is often claimed that the Intergovernmental Panel on Climate Change (IPCC) considers CDR to be indispensable for achieving the goals of the Paris Agreement. In fact, the IPCC assumes this necessity only for certain scenarios it has discussed. For example, none of the scenarios sufficiently accounts for a more sustainable lifestyle (reduced use of cars, decreasing meat

consumption, innovations in building construction), a sharp decline in the costs of expanding renewable energy, or the potential of an improved circular economy [4,5,6]. Furthermore, mCDR projects have so far been represented only minimally, if at all, in the IPCC scenarios.Overall, the assumed use of CDR in climate protection scenarios significantly overestimates what is actually achievable, given the current state of deployment and feasibility [7]. In 2024, only about 2 Gt of CO_2 were sequestered globally, primarily through land-based removals - in particular, (re)afforestation - but less than 0.1% (0.0013 Gt of CO_2) was sequestered through novel, primarily technical CDR methods such as BECCS (Bioenergy with Carbon Capture and Storage) [8].

3 Legal Situation in Germany

To date, the national law in Germany, the High Seas Dumping Act ("Hohe-See-Einbringungsgesetz"; HSEG) has only permitted research projects involving mCDR methods. Commercial use of mGE methods is generally prohibited. These regulations apply to projects in all marine waters, with the exception of the coastal waters of other states, provided that they are either conducted by a German vessel or the material that will be used was loaded at a German port. The international basis for the HSEG is the London Protocol (LP).

4 Purchasing Carbon Credits

More and more companies are striving to reduce their emissions and become as climate-neutral as possible. The motivation is, on the one hand, to meet the expectations of policymakers and consumers alike, and on the other hand, to create a positive public image with regard to climate protection [9,10,11]. Thus, carbon credits and the voluntary carbon market are playing an increasingly important role in corporate climate strategies and in global efforts to achieve climate-neutral performance [12]. Since the Paris Agreement, numerous companies have voluntarily set their own climate targets or even carbon neutrality goals. To achieve this, they plan to use or are already using the voluntary carbon market to offset a portion of their emissions [9,13].

Carbon credits are also increasingly being offered for marine carbon removal (mCDR) projects, particularly by small start-ups, although their climate effectiveness have not yet been proven and their potential adverse environmental effects have not yet been sufficiently investigated [14]. This development is taking place without uniform global standards for countries and companies, because the sale of carbon credits on the voluntary carbon market is not subjected to any governmental oversight [15,16]. Studies show that economic considerations are the primary driving force behind the purchase of carbon credits. As a result, low-quality carbon offset projects are often supported [17,18,19]. This can lead to a situation where, in practice, no compensation takes place - that is, no emissions reduction occurs. Additionally, environmental hazards repeatedly arise from these projects [20,21]. In recent years, there has also been an increase of greenwashing incidents [22,23,24,25,26]. It is estimated that more than 80% of the credited carbon credits have not led to any actual emissions reductions [27,28].

5 Cooperation between start-ups or companies, certification agencies, carbon credit registries, third-party auditors and buyers

The integrity of carbon credits from the voluntary carbon market is in theory thought to be strengthened through a clear division of roles. Certification agencies establish guidelines through their provided standards, according to which project developers can have their projects certified. Third-party auditors then verify, based on these guidelines, the extent to which emissions have actually been reduced or removed from the atmosphere as a result of the project. If this verification is successful, the achieved reductions or removals are officially certified. For start-ups and companies, certification agencies serve not only as a visible seal of quality but also as objective proof that the reported emission reductions or removals were actually achieved in full [27,29].

Companies wishing to purchase carbon credits can commission carbon credit registries to invest their funds in various mCDR projects. These carbon credit registries serve as an additional layer of oversight, verifying the integrity of the generated carbon credits before adding providers of mCDR techniques to their advertised portfolio. In theory, this interaction among all stakeholders is intended to ensure the quality of mCDR projects, since mCDR providers, certification agencies, carbon credit registries and third-party auditors act as independent entities.

In reality, however, this structure has proven problematic due to conflicts of interest: the third-party auditors who review projects from mCDR providers are also paid by those same providers [27,29,30,31]. A case study based on Verra, the world's largest certification agency, showed that approximately 64% of the auditors accredited there (21 out of 33) had previously conducted audits for projects whose CO_2 reductions were later found to have been significantly overestimated [27].

The German Environment Agency emphasizes that companies must prioritize avoiding and reducing emissions within their own value chains and should only offset remaining emissions with high-quality credits as a last resort. Nevertheless, purchasing carbon credits remains attractive to companies. Companies may rely on the quality assurance provided by external agencies and registries. Furthermore, they do not have to face the difficult challenge of restructuring and improving their internal processes and supply chains in the short term so that they are no longer dependent on fossil fuels [11,19,32,33].

6 The Need for Effective and Reliable Monitoring, Reporting, and Evaluation

An analysis by the German Environment Agency shows that there is a great need for reliable monitoring, transparent reporting, and independent verification. In addition, effective national and international regulation as well as better integration into scientific processes are required [14].

7 Conclusions from the Perspective of the German Environment Agency

- **Prohibition of trading carbon credits from marine carbon dioxide removal (mCDR) projects**
  Under the German national law, the High Seas Dumping Act ("Hohe-See-Einbringungsgesetz"; (HSEG)) and the London Protocol, commercial marine geoengineering (mGE) projects, which include mCDR projects, are prohibited if they are carried out in Germany's exclusive economic zone, by German vessels, or if the material used is loaded at German ports. Only legitimate scientific research into mGE methods is permitted; however, generating profits from research projects is not allowed.

- **No scientific evidence for the marketing of carbon credits from mCDR projects**
  According to the German Environment Agency, there is currently no sufficient scientific evidence for the long-term climate effectiveness, ecological safety, and reliable quantification of marine carbon dioxide removal. Therefore, there is currently no scientific basis for the recognition or marketing of carbon credits from mCDR projects.

- **Careful revision of carbon credits offered from mCDR projects on the voluntary market**
  The German Environment Agency recommends paying close attention to the quality of the provider and the offer when investing in climate protection projects or purchasing "climate-neutral" or "climate-neutrally manufactured" products. "Climate-neutral" products are not automatically environmentally friendly, as the term "climate-neutral" is not legally protected1. In the past, courts have repeatedly prohibited companies from using this term on products or in advertising. Particularly when emissions offsetting is planned to be achieved through mCDR projects, there is no guarantee that it provides any added value for climate protection. Furthermore, negative effects on people and the environment cannot be ruled out.

- **Purchase of carbon credits by companies**
  The German Environment Agency also advises companies that the climate effectiveness of mCDR projects has not yet been proven. Offsetting emissions using carbon credits derived from mCDR projects is therefore associated with significant uncertainties.

- **Application of the Act against Unfair Competition Act**
  In principle, misleading environmental advertising claims are prohibited under the Act of Unfair Competition (UWG) in Germany. This also applies to start-ups and companies in Germany that offer or trade carbon credits from mCDR projects.

[1] Note: Effective September 27, 2026, the EmpCo Directive and its national implementation must be applied. This directive will significantly restrict environmental and climate-related statements, in particular, "climate-neutral" or neutrality claims, that are based solely on offsetting. Neutrality pledges that are unsubstantiated or based primarily on the purchase of carbon credits will only be possible to a limited extent or under stricter conditions in the future.

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Umweltbundesamt
Wörlitzer Platz 1
06844 Dessau-Roßlau
Tel: +49 340-2103-0
buergerservice@uba.de
Internet: www.umweltbundesamt.de

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Authors, Institutions

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