OCEAN NETs

POLICY BRIEF

Good governance of marine carbon dioxide removal

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Imprint

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Good governance of marine carbon dioxide removal

Enhancing the ocean's ability to sequester and store carbon dioxide has been proposed to contribute to the global climate strategy towards carbon neutrality. Approaches for marine carbon dioxide removal (CDR) vary in their interaction with the ocean and potential intended and unintended effects. Regulating and managing the deployment of marine CDR in the ocean is complex given these and other specificities and uncertainties, mandating a comprehensive and coherent approach in policy and decision-making. Employing a 'good governance' approach can help navigate related challenges. This policy brief aims to provide inspiration and input for informed decision-making with regards to the rapidly advancing field of marine CDR.

5 key recommendations for action

1

A comprehensive and coherent governance approach should underpin any future deployment of marine CDR. It should embrace an **extended governance framework** that includes all relevant multilateral environmental agreements and processes (e.g., the newly signed BBNJ Agreement). Such a wider framework can build upon and strengthen the current regulatory mechanism under the London Protocol, which can be described as unfit for purpose.

2

International climate, ocean and biodiversity regimes within the wider governance framework must be **aligned on the topic of marine CDR**. There must be consensus in terms of scope, goals and aims, as well as clearly articulated boundaries of action and scope (e.g., limits on scale and spatial coverage) of deployment. Mechanisms and instruments should be established **for coordination between regimes** - to ensure integrity, maximise benefits and limit trade-offs.

3

It is imperative that an **anticipatory approach to potential deployment** is adopted in policy and decision-making. Potential **interactions between marine CDR, the environment and society** should be considered in a holistic and systemic assessment of interactions and impacts across many dimensions, including land-based resources.

4

Marine CDR activities potentially impact the marine environment in a range of ways, which emphasises the importance of comprehensive environmental impact assessments. The establishment of an **assessment framework for deployment that accounts for potential intended and unintended impacts** on the marine environment and related ecosystem services, the temporal and spatial range of these effects, as well as cumulative impacts of proposed and operating marine CDR and of other ocean activities, is key for potential future large-scale roll-out of marine CDR.

5

Navigating the challenges and complexities related to potential future deployment of marine CDR requires an **effective, equitable, responsive and robust governance framework in place. A "good governance" approach** can help establish such a framework, building on principles such as accountability, or fairness and justice, and guide the way towards a meaningful and widely accepted framework.

The ocean for achieving the 1.5°C climate target

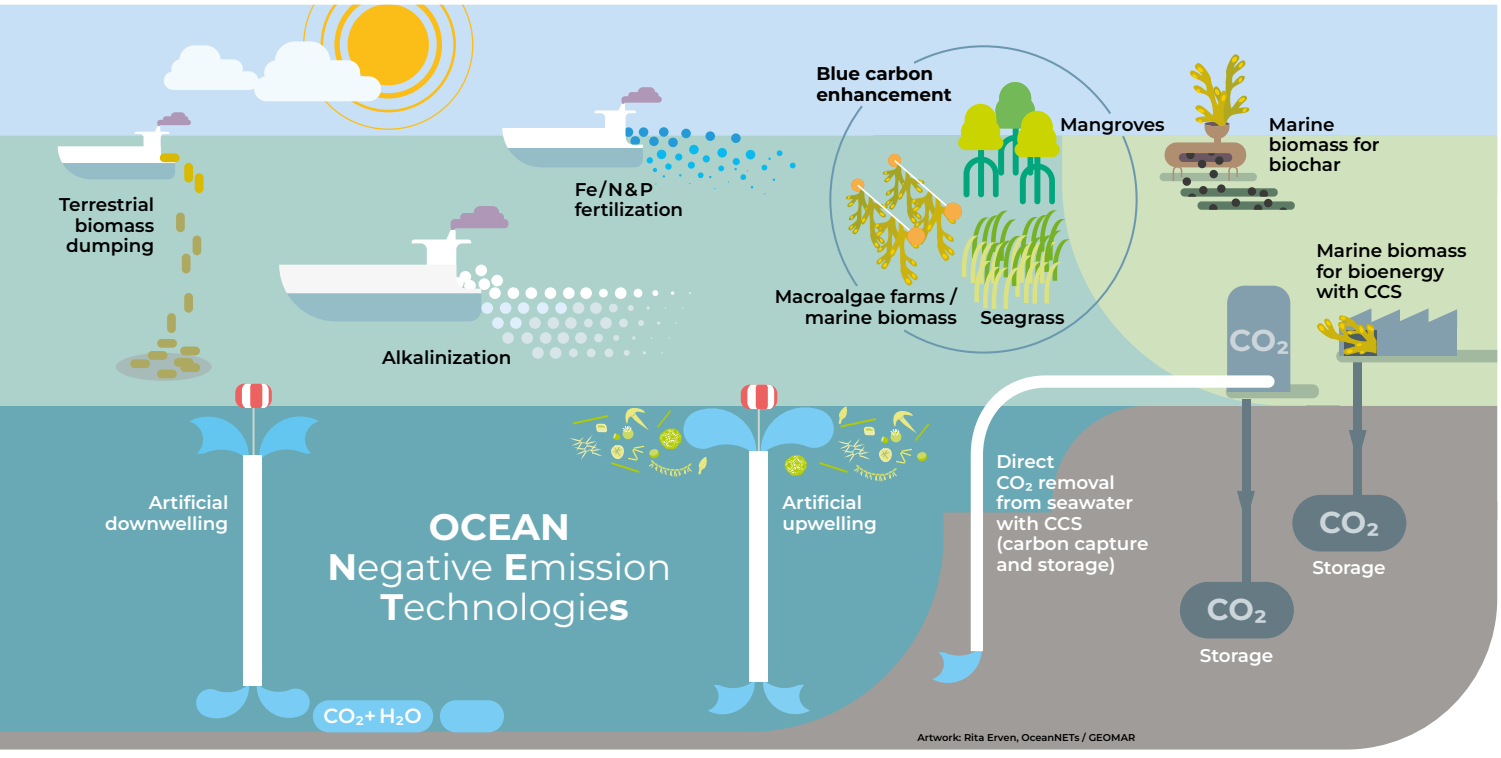
The ocean is an integral part of the global climate system. The ocean influences climate by storing carbon, absorbing and distributing heat and moisture. Its function as natural buffer of climate change has, over time, led to unfavourable consequences for the marine environment. Acidification, deoxygenation, ocean warming and sea-level rise, amongst many other stressors related to climate change, deteriorate coastal and marine ecosystems at an alarming rate (IPCC 2019) – often times exacerbating other problems the ocean is facing, such as biodiversity loss.

In order to limit the impacts of climate change, Parties to the Paris Agreement have committed to limiting global warming well below 2°C and '*pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels*' (Art. 2,1 (a)). It has been determined that in order to keep within the 1.5°C target, carbon dioxide emissions must reach net zero by 2050 (IPCC 2018). While immediate and significant global emissions reductions are at the core of reaching this climate goal, experts believe that residual emissions from hard-to-abate sectors and activities (e.g., from the cement industry) will need to be addressed through approaches which go beyond reductions.

Researchers have found the ocean's ability to sequester and store carbon dioxide (CO_2) to hold potential for additional 'carbon dioxide removal' (CDR) (GESAMP, 2019). Marine CDR approaches engineer the removal and subsequent storage of CO_2 in ocean water or ecosystems. A range of ocean-based approaches for CDR have been proposed for reducing atmospheric CO_2 levels. These approaches intentionally change the ocean's biogeochemical, physical or ecological condition for the purpose of higher CO_2 uptake and storage.

Figure 1: Overview of different approaches to marine CDR examined in the OceanNETs project

Design by Rita Erven, OceanNETs/GEOMAR



Unintended impacts of marine CDR on the ocean's condition and ecosystem services

Marine CDR may impact the marine environment beyond the intended impact of carbon sequestration and storage. The wide-ranging types of interactions between marine CDR and the ocean can cause **unintended impacts** on the ocean and related ecosystems (Röschel & Neumann 2023). For example, ocean alkalization involves adding alkaline materials or solutions. Enhancing the ocean's alkalinity could have the added benefit of countering acidity (Feng et al., 2016). Simultaneously, the addition of silicate materials could further fertilize the ocean, potentially impairing the ocean's regulatory properties (Bach et al., 2019). These impacts may not have been the primary intention of the activity, yet they must be included in governance considerations.

How is marine CDR currently regulated?

The **London Convention** and the **London Protocol**[1] (LC/LP) are the primary means for protecting the ocean from pollution caused by dumping or by disposal of waste or other matter. Since 2007, ocean fertilization has been included in the scope of work of the LC/LP, in response to an iron-enrichment experiment near the Galapagos Islands (Fuentes-George 2017). In 2010, an Assessment Framework was adopted (LC-LP.2) which guides Parties on how to assess proposals for ocean fertilization research and provides detailed steps for completion of an environmental assessment, including risk management and monitoring.

In 2013, the Contracting Parties to the London Protocol adopted resolution LP.4(8), thereby amending the Protocol to include marine geoengineering activities. This amendment adds a new article which states that "Contracting Parties shall not allow the placement of matter into the sea from vessels, aircraft, platforms or other man-made structures at sea for marine geoengineering activities listed in Annex 4, unless the listing provides that the activity or the sub-category of an activity may be authorized under a permit" (Art. 6bis). Although the definition of marine geoengineering (see below) could include a range of marine CDR approaches, Annex 4 lists only "ocean fertilization". At present, a process is underway adding further marine CDR activities to the regulatory scope of the LP[2]. It should be noted that the amendment is not yet in force. A two-thirds majority must ratify the amendment for it to enter into force and at present, only six of 53 Parties to the LP have done so.

The LC/LP defines marine geoengineering as "**a deliberate intervention in the marine environment to manipulate natural processes**, including to counteract anthropogenic climate change and/or its impacts, and that has the potential to result in deleterious effects, especially where those effects may be widespread, long-lasting or severe."

The LC/LP may be utilized to regulate deployment of certain marine CDR approaches in the future, limited to its scope of regulating activities that comprise dumping or placement of matter in the ocean. However, the current regulation can be described as reactive, fragmented and even unfit for purpose. It is limited in scope in terms of marine CDR approaches addressed and does not appropriately take cumulative impacts of marine CDR activities into account.

Figure 2: LC 45th Consultative Meeting and LP 18th Meeting of Contracting Parties, IMO, London, 2023.
Photo: IMO

1 *The 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) and the 1996 Protocol on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Protocol) are generally referred to as a treaty complex (LC/LP).*

2 *The four techniques that are reviewed include: 1) alkalinization, 2) microbubbles and glass beads for albedo enhancement, 3) macroalgae cultivation, and 4) marine cloud brightening.*

An extended framework for governance of marine CDR

Adopting a broader global ocean governance perspective may be useful for understanding the wider implications of marine CDR deployment for the environmental governance regime. Below, some of these relevant environmental governance frameworks and their relation to marine CDR are presented (see also Figure 3). This wider framework approach can be taken up for developing and implementing a strategy for comprehensive governance that extends beyond the explicit regulation through the LC/LP.

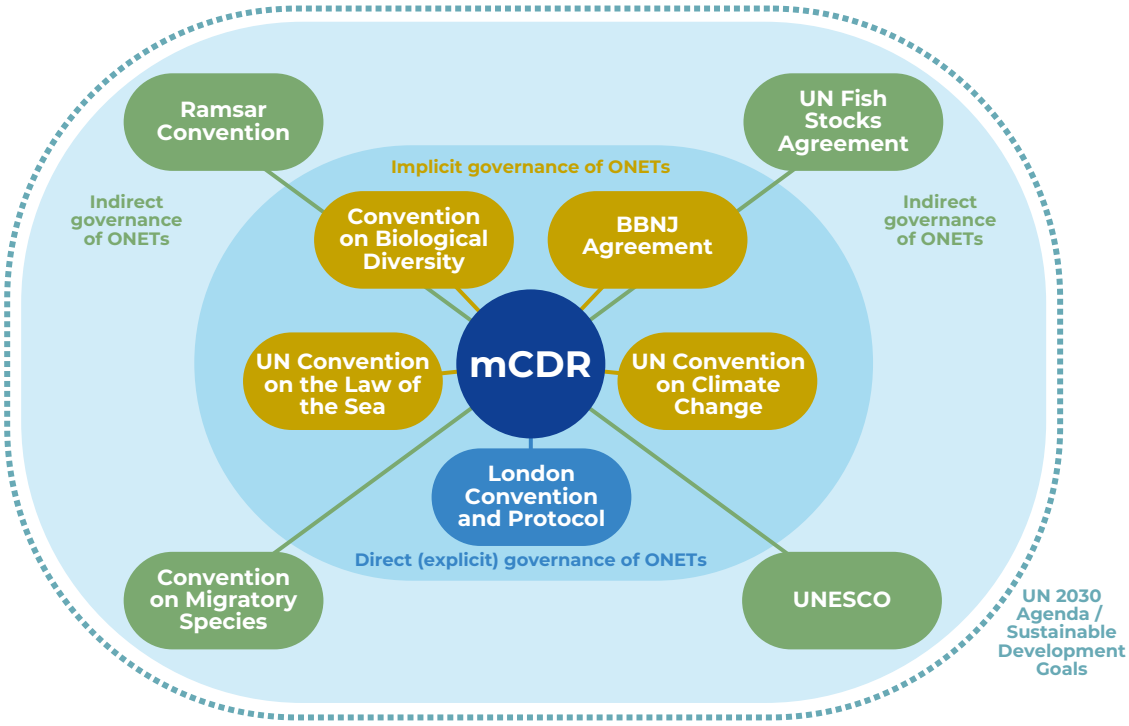


Figure 3: Extended governance framework relevant to marine CDR

Röschel & Neumann, 2023, design by Rita Erven

Environmental agreements that implicitly address marine CDR

The **Convention on Biological Diversity** (CBD), which has the objective to conserve biological diversity and promote its sustainable use and the fair and equitable sharing of related benefits to society, is a relevant framework for governing new and potentially harmful maritime activities. In 2010, the CBD passed a decision to prohibit climate-related geoengineering "that may affect biodiversity, until there is an adequate scientific basis on which to justify such activities and appropriate consideration of the associated risks for the environment and biodiversity and associated social, economic and cultural impacts" (X/33 8(w)), with the exception of small-scale scientific research studies. This decision is not legally binding and precedes emerging marine CDR approaches.

The **United Nations Convention on the Law of the Sea** (UNCLOS) mandates the general protection and preservation of the marine environment across the entirety of the ocean from its 168 Member States and thereby implicitly governs marine CDR. The provisions of the new newly signed **BBNJ Agreement**[3] on area-based management tools, as well as stipulations for environmental impact assessments are of clear relevance to marine CDR activities that potentially impact the marine environment in areas beyond national jurisdiction.

3 *Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction*

The **United Nations Framework Convention on Climate Change** (UNFCCC) regulates the "common concern of humankind" of climate change and includes the ocean within its definition of the climate system. The UNFCCC implicitly addresses marine CDR through its potential future role in the global climate strategy, though official negotiations have to this date not explicitly included marine CDR via geoengineering or negative emissions technologies.

Further environmental agreements that are linked to marine CDR

A range of international agreements make up an 'indirect governance framework' to further consider in the context of marine CDR (Figure 3). These are environmental frameworks with policy objectives that may be positively or negatively impacted by marine CDR deployment, including through **potential unintended impacts on marine and coastal ecosystem services**. For a comprehensive regulation and management of marine CDR deployment, these should be taken into consideration to ensure policy coherence, minimise possible negative effects - and maximise co-benefits.

A recent advisory opinion of the **International Tribunal of the Law of the Sea** (ITLOS) on the obligation of State Parties in relation to climate change suggests that marine geoengineering can be viewed as contrary to UNCLOS' objective to prevent pollution (UNCLOS, Art. 195), as such activities would turn one type of pollution into another (ITLOS, Art. 231). Yet, marine CDR can also be viewed as a means of preserving and protecting the marine environment, which States have an obligation to do under UNCLOS (Webb, 2024). This potentially divided direction in terms of marine CDR might complicate coherence and alignment on the topic of marine CDR – and shows how important it is to establish a comprehensive and widely accepted framework.

Further governance dimensions and challenges

Marine CDR poses diverse challenges for governance across all levels. Future decisions in terms of deployment of marine CDR – if to move forward, to what extent, or under what conditions – all entail complexities and hold risks and trade-offs. These challenges, some of which are introduced below, need to find consideration within comprehensive governance of marine CDR.

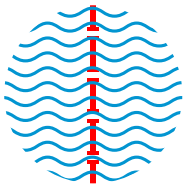
URGENCY

Decision-making with regards to deployment of marine CDR may in the future be pressured by an **urgency to act**, as the impacts of climate change are felt across the globe and society demands leadership to force decisions on climate mitigation measures. Under perceived urgency, decision-making with regards to marine CDR may forgo elements of comprehensive governance, such as transparency and early stakeholder engagement.

UNCERTAINTY

Many **uncertainties and unknowns** prevail with regards to the deployment of marine CDR and potential side effects. It remains uncertain how the marine ecosystem will ultimately respond, especially given that climate change is acting as a multiplier to other challenges. Additional uncertainties remain with regards to the real-world CO_2 sequestration and storage rates secured by different technological approaches. However, uncertainty and application of the precautionary principle could potentially lead to inaction ("policy paralysis"). Decision-making will need to move forward on the topic, whether it is about defining a position on these technologies or establishing comprehensive approaches to regulate and manage marine CDR at scale. Avoidance of the topic would potentially leave gaps within the governance framework – and lead to trade-offs with other policy goals.

TRANSBOUNDARY IMPACTS



Marine CDR approaches, especially those introducing materials into the seawater, are subject to perpetual **transboundary movements** of ocean water, reflecting the connectivity of the marine environment. Intended as well as unintended (positive and negative) effects of the technologies may alter the ocean's biogeochemical state beyond the deployment area and reach another area of jurisdiction in the ocean. Considerations of equity must also be undertaken e. g., in terms of who may claim the stored carbon. Marine CDR may thus lead to 'ocean-use' conflicts and disputes over effects and benefits between stakeholders and regions, and between countries deploying marine CDR and countries or stakeholders affected by such activities.

The way forward: Good governance of marine CDR

Looking ahead, marine CDR will likely grow as policy topic within the scope of climate mitigation in the future. Governing marine CDR under consideration of the marine environment is complex given the intended and potential unintended impacts, the gaps and dichotomies in the present governance regime, and overarching challenges in reference to these – including potential trade-offs with other policy or societal goals. It is therefore crucial that the identified complexities are addressed by decision-making in a comprehensive and timely manner.

A "good governance" approach can help navigate the challenges and complexities of marine CDR and establish a comprehensive approach. It can serve as a way to address and overcome policy lock-ins or paralysis. Principles such as coordination, accountability, or fairness and justice can guide the way towards a meaningful and widely accepted framework for navigating the future deployment of marine CDR.

This policy brief aims to support policy makers in anticipating future challenges related to decision-making with regards to the potential deployment of marine CDR by presenting a wider governance framework and good governance approach. The principles for good governance of marine CDR presented below aim to provide inspiration and input for policy makers across governance levels for strengthening the current governance framework, without pre-empting if marine CDR will in reality be part of the future global climate strategy.

PRINCIPLES OF GOOD GOVERNANCE OF MARINE CDR

For the **good governance of marine CDR**, **a set of principles** is proposed to guide decision making. The principles are designed to support the achievement of effective, equitable, responsive and robust governance of deploying marine CDR as part of a global strategy to combat climate change. They build upon deliberations[4] and reiterate previous findings and recommendations made in terms of the governance needs for marine CDR, especially for the research phase (see e. g., Böttcher et al., 2023). These principles can guide the way towards a meaningful and widely accepted framework for governing marine CDR comprehensively and coherently.

Effective governance

1 **Direction:** Marine CDR could play an important role in combatting climate change, yet also add another activity to the ocean space along with potential unintended positive and negative effects. **A clear, agreed-upon vision for marine CDR that articulates definite and measurable directions and boundaries** should serve as the baseline for good governance thereof.

2 **Coordination:** Strengthening **coordination between relevant regimes** across all levels of governance enhances synergies, avoids doubling of efforts and addresses conflicting agendas. Clear rules for use support coordination across regimes, as well as mechanisms for explicit exclusion of defined activities, coordinated management actions and defined spatial coverage.

4 *The '10 principles for good governance of marine CDR' presented here were co-developed with experts from different fields in a scenario workshop held in 2023. They build upon a practical framework for the design, evaluation and analysis of environmental governance developed by Bennet & Satterfield (2018).*

Effective governance

3 **Information:** Deliberations and decision-making should be guided by **relevant and recent evidence** and knowledge from natural and social science as well as of indigenous, traditional and local knowledge. **International cooperation and data sharing** should support understanding of ocean dynamics and potential interactions between marine CDR and the ocean, and society.

4 **Accountability:** Direct and indirect benefits from marine CDR must be accounted for as well as liability in case of negative impacts. Further, instruments for ensuring accountability (e.g., environmental impacts assessments (EIA)) should apply to all activities defined as marine CDR, including to nature-based approaches.

Equitable governance

5 **Recognition and participation:** All relevant **stakeholder groups and their interests and views must be considered.** Decision-making processes should incorporate stakeholders that are not primary investors in marine CDR, as well as those that may experience impacts from deployment activities in neighbouring territories and beyond.

6 **Fairness: Power imbalances between regions** where marine CDR may be deployed and those deploying the technologies must be addressed by governance. Mechanism for including the aspect of benefit sharing (i.e., carbon counting negative emissions; financial benefits) and burden sharing (i.e., economic or environmental losses) should be considered.

7 **Ethics and justice:** The **human right to a clean, healthy and sustainable environment** needs to find consideration in the discourse around marine CDR deployment. Consent to marine CDR activities must be given and in case of negative impacts, stakeholders should be able to defend themselves against incursions or facilitate reparations or compensations.

Responsive governance

8 **Anticipation:** Elimination of all uncertainties and possible risks related to marine CDR on the marine environment and society will not be possible. Still, society may decide to move forward with marine CDR. At this stage, **governance should anticipate the potential deployment of various technological approaches.**

9 **Adaptability, flexibility and learning:** Research and development in the field of marine CDR is quickly advancing. Governance should aim to adapt to new findings quickly. Within the governance regime, there must be an integrated process to **revisit, evolve and adapt to identified changes** and be flexible to new findings, or to consider that future global priorities may shift.

10 **Innovation: Research on marine CDR should not be restricted in such a way that future discussions come to a standstill based on persistent knowledge gaps.** In addition, science should avoid pre-empting the discourse around whether or not, and to what extent, marine CDR should be deployed to combat climate change.

Robust governance

11 **Rule of law:** All principles of good governance should operate under the rule of law. **Institutional legitimacy** in terms of governing marine CDR must be conferred and perceived by all Parties to realize a collective vision for governance of marine CDR.

Summary and Outlook

Marine CDR has the potential to contribute to the Paris Agreement goal of limiting global warming to well below 2°C and keeping the 1.5°C target within reach. Uncertainties with regards to marine CDR are deep and the potential for damaging the marine environment in favour of reaching climate targets requires careful consideration and assessment. Nevertheless, it is imperative to move forward in developing a comprehensive, coherent and foresight-oriented governance approach for marine CDR. Gaps in governance can be harmful to society in the long-run, and put global climate, environment and sustainability goals at risk. This policy brief aims to offer inspiration and guidance in this regard without prescribing if, or to what extent, marine CDR could or should be part of the future global strategy to combat climate change.

In order to account for the many complexities related to marine CDR and the potential impacts on the marine environment, as well as the ecosystem services humanity benefit from, decision-makers should adopt a wider perspective on governance. Such a wider governance framework extends beyond the regulation of marine CDR through the London Convention and London Protocol (LC/LP) and aims to align with broader societal goals. Reflecting on the quickly advancing field of marine CDR in science and the private sector, decision-makers ought to endorse a proactive approach to governance to avoid missing the window for establishing good and robust governance on this quickly moving target.

The "principles for good governance of marine CDR" presented above aim to help navigate the highlighted challenges and complexities of marine CDR for establishing such a comprehensive and coherent governance framework for marine CDR. Integration of principles such as accountability, fairness and justice comprehensively into decision-making in coordination with the identified wider governance framework can support the navigation of potential future deployment of marine CDR while maximising benefits and minimising trade-offs for society.

Further reading

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List of Acronyms

BBNJ Agreement // Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction

CBD // Convention on Biological Diversity

CMS // Convention on the Conservation of Migratory Species of Wild Animals

ITLOS // International Tribunal for the Law of the Sea

LC/LP // Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) and the 1996 Protocol on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Protocol)

Ramsar Convention // Convention on Wetlands of International Importance Especially as Waterfowl Habitat

UNCLOS // United Nations Convention on the Law of the Sea

UNESCO // Convention Concerning the Protection of the World Cultural and Natural Heritage

UNFCCC // United Nations Framework Convention on Climate Change

UNFSA // United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN Fish Stocks Agreement)

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OCEAN NETs

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OceanNETs responds to the societal need to rapidly provide a scientifically rigorous and comprehensive assessment of negative emission technologies (NETs). The project focuses on analyzing and quantifying the environmental, social, and political feasibility and impacts of ocean-based NETs. OceanNETs will close fundamental knowledge gaps on specific ocean-based NETs and provide more in-depth investigations of NETs that have already been suggested to have a high CDR potential, levels of sustainability, or potential co-benefits. It will identify to what extent, and how, ocean-based NETs can play a role in keeping climate change within the limits set by the Paris Agreement.

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Research Institute for Sustainability
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The Research Institute for Sustainability (RIFS) conducts research with the aim of investigating, identifying, and advancing development pathways for transformation processes towards sustainability in Germany and abroad. The institute was founded in 2009 as the Institute for Advanced Sustainability Studies (IASS) and has been affiliated with the Helmholtz Centre Potsdam – GFZ German Research Centre for Geosciences under its new name since 1 January 2023 and is thus part of the Helmholtz Association. Its research approach is transdisciplinary, transformative, and co-creative. The Institute cooperates with partners in science, political and administrative institutions, the business community, and civil society to develop solutions for sustainability challenges that enjoy broad public support. Its central research topics include the energy transition, climate change and socio-technical transformations, as well as sustainable governance and participation. A strong network of national and international partners and a Fellow Programme support the work of the Institute.

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