C2G
Carnegie Climate Governance Initiative

An initiative of
CARNEGIE COUNCIL for Ethics in International Affairs

POLICY BRIEF

Governing Marine Carbon Dioxide Removal

According to the Intergovernmental Panel on Climate Change (IPCC), large-scale Carbon Dioxide Removal (CDR) is now required in all pathways to keep global warming under 1.5°C. With more than two thirds of Earth covered by water, many potential CDR techniques might be considered for deployment in the marine environment in the future.

Marine CDR techniques are for the most part theoretical, but if ever deployed, some could create large and potentially long-term risks and governance challenges. We do not yet know enough about the risks, costs and potential benefits, or governance requirements, to understand if marine CDR techniques could be viable, or – if so – whether, when or how to deploy them at scale.

How to Govern Marine CDR

Marine CDR could occur within recognised exclusive economic zones, territorial seas or the global commons. Each raises different sets of governance issues. Some techniques could have potential transboundary impacts, requiring a level of international governance. Relevant fora, processes and communities which do or could contribute to this include

- Government at all levels
- Convention on Biological Diversity (CBD)
- London Protocol to the London Convention on the Prevention of Marine Pollution (LC/LP)
- UN Convention on the Law of the Sea (UNCLOS)
- UN Framework Convention on Climate Change (UNFCCC)
- UN General Assembly (UNGA)
- Civil Society Organizations (CSO) and the commercial sector
- Research communities
- Regional bodies like the Arctic Council
- Other interested and affected publics

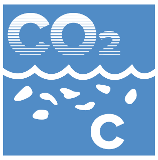
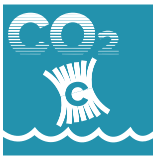
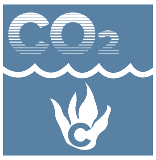
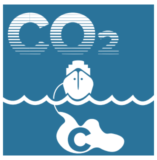
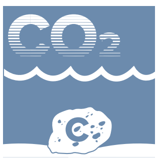
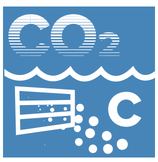
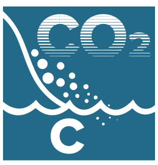
Effective governance would likely include broad participation in decision-making; transparency and access to information; as well as regulation at the international, national, and subnational levels, and would apply to research, testing, deployment and monitoring. Some key challenges for consideration include

- Ensuring appropriate codes for conduct, safeguards and policy direction for research
- How to include interested and effected parties in meaningful discussion about the techniques
- Understanding the balance between the potential for harm, loss and benefits of deployment
- Resolving who decides when/if/under what conditions to move from research to deployment
- Issues around intellectual property and commercialisation
- Monitoring and attribution of impacts
- Assessing wider impacts, including on the Sustainable Development Goals
- Aligning governance frameworks

Marine CDR Techniques, Readiness and Governance Challenges

Different marine CDR techniques are at different states of readiness and while some present governance challenges specific to the methods they involve (see table), all face common governance challenges including

- Responsibility for implementation, financing and compensation
- Public interests including concern and informed consent
- Commercialisation and patenting issues
- Monitoring and addressing climate impacts

Proposed Technique		Technological Readiness	Specific Governance Challenges
	**Ocean fertilisation** Introducing nutrients (e.g., iron, nitrogen, phosphorus) to surface waters to promote CO_2 uptake through photosynthesis.	• Technically feasible; for example, the industrial infrastructure for iron and nitrogen are well understood. • Some experiments have been carried out, with significant variations in capacity to take up carbon.	• Regulatory and legal measures include customary international law, LP, UNCLOS and CBD, but may not be comprehensive. • High uncertainty about environmental impacts and ocean mechanics. • Global constraints to phosphorus supply.
	**Crop residue oceanic carbon sequestration** Storing carbon by dumping crop residue and other organic material in the deep ocean.	• No technological constraints.	• Regulatory and legal measures include customary international law, LP, UNCLOS and CBD. • Uncertain environmental impacts of depositing crop wastes in the deep ocean.
	**Macroalgal cultivation for sequestration** Large-scale farming of macroalgae (e.g., seaweed) in near and/ or offshore waters, to capture carbon through photosynthesis.	• Nearshore macroalgal aquaculture is a well-established industry so no technological constraints to its deployment. • Offshore would require additional testing before deployment. • The challenge of entrapping macroalgae in the seabed is still being explored.	• Nearshore waters are governed by nation states. Customary international law, LP and UNCLOS would be relevant to deployment outside exclusive economic zones. • Environmental protection and food safety regulations would apply. • Exploring the effect of ocean acidification on microalgae growth.
	**Placing liquid CO_2 in the mid/deep oceans, on the seabed and in sediments** Injecting liquid CO_2 at depth, placing it on the seabed, or sequestrating it in sediments.	• Limited theoretical research only. • No technology is currently available. • Adapting technologies from offshore oil industry may make early adoption possible. • The longevity of materials in situ is not yet understood.	• Regulatory and legal measures include customary international law, LP, UNCLOS and CBD, but may not be comprehensive. • The environmental impacts are uncertain.
	**Mineralisation of injected CO_2 within geologic structures** Injecting CO_2 into appropriate host rocks beneath the seabed to react with the minerals there to form stable minerals/rock.	• A viable complete mineralisation process has been demonstrated on land. • Offshore experimentation is planned. • Delivery mechanisms at sea are unresolved.	• Regulatory and legal measures include customary international law, LP and UNCLOS, but may not be comprehensive. • The environmental impacts are uncertain.
	**Ocean carbon capture and storage (OCCS)** Removing dissolved inorganic carbon from the water to be taken to long term storage sites.	• Underlying principles well understood, used in small scale in laboratories. • Scaling up from laboratories to oceans is a challenge. • Unresolved issues around sequestration of carbon (e.g., costs unknown).	• If conducted in nearshore waters, the technique would be subject to nation state governance. • In international waters, the governance frameworks are uncertain.
	**Enhanced weathering and ocean alkalinity** Adding alkalinity to increase CO_2 uptake, and reduce acidification.	• A well-understood chemical process. • Uncertainty about the best minerals or materials to use. • Distribution (shipping) readily available. • Uncertainty about environmental impacts.	• Regulatory and legal measures include customary international law, LP, UNCLOS and CBD, but may not be comprehensive.