

Synthesis

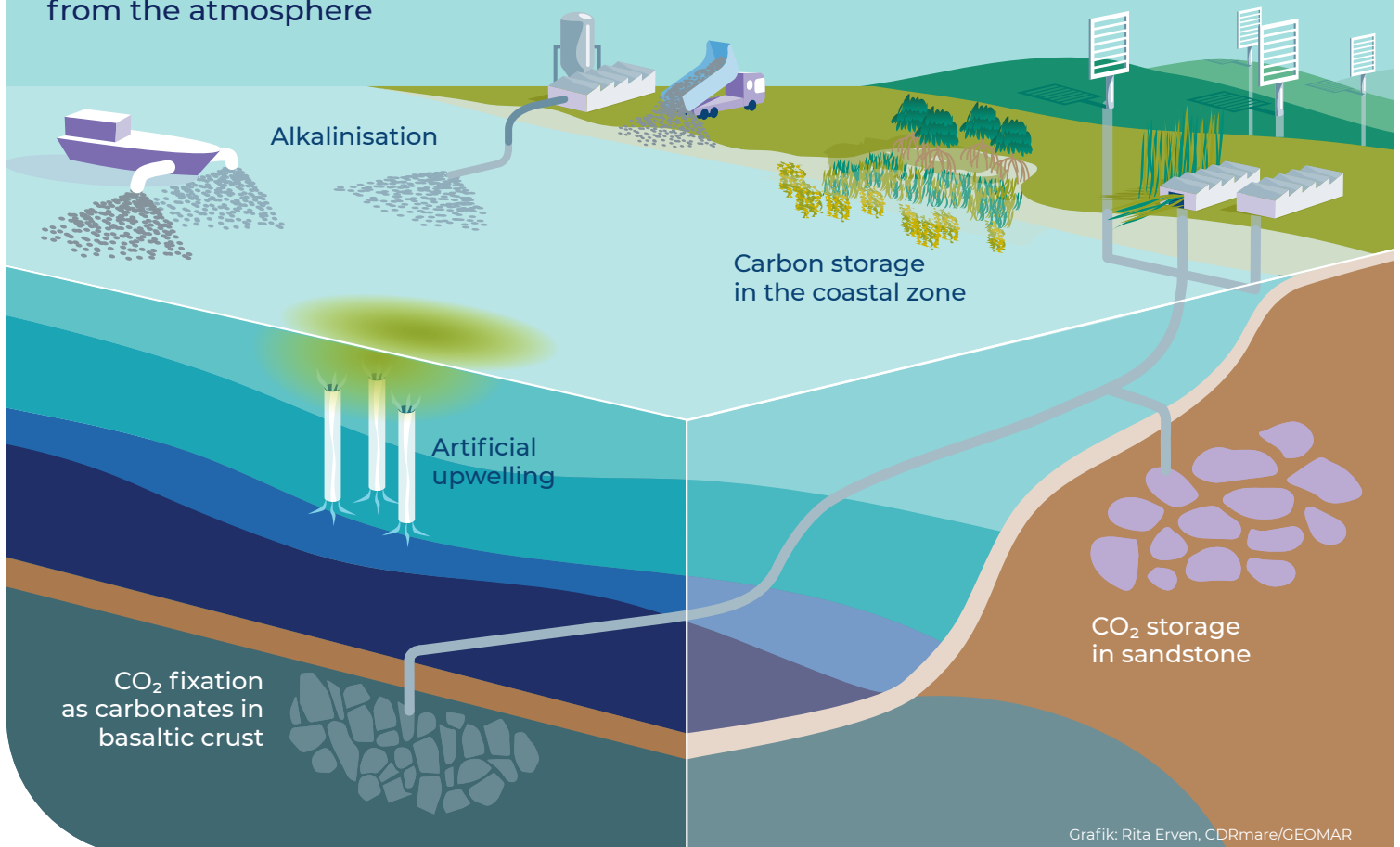
## An assessment framework for marine carbon dioxide removal methods

More research is currently being conducted on marine carbon dioxide removal methods than ever before. Expertise on each approach continues to grow. At the same time, policymakers are relying on carbon dioxide removal methods to meet national climate goals. What is missing is a tool to bring together research results and evaluate methods - in a transparent way that everyone can understand. In the research mission CDRmare mission, an interdisciplinary team of scientists develops an evaluation framework, a guide to make this possible. It not only asks whether a method is technically, legally, or politically feasible, but also whether its use can be described as »desirable« in terms of the ethical and moral principles of our society – a fundamentally important contribution to future debates.

**The big climate goal: net zero**

- > There is a consensus in climate research: even with ambitious climate policies, humanity is still expected to **release residual amounts of carbon dioxide and other greenhouse gases** by the middle of the 21<sup>st</sup> century, which will contribute to further global warming.
- > To offset these residual emissions, and thus their climate impact, humanity would need to **remove carbon dioxide from the atmosphere at the same rate**.
- > Many known **carbon dioxide removal (CDR)** methods are land-based. However, because land is a scarce resource, **ocean-based methods** are now being increasingly explored.

### Ocean-based methods of carbon dioxide removal from the atmosphere



## Difficult decisions for society and politics

- > Human interventions in the ocean system to **increase carbon dioxide uptake** are, among other things, changing ocean chemistry or ecosystems and thus the living conditions for many marine organisms.
- > **The ocean** is also a **space intensively and diversely used** by mankind – and our demands on the services of the oceans continue to increase. In the long term, they should provide a growing world population with food, energy and raw materials (also for the energy transition) that can no longer be produced on land to a sufficient extent.
- > **Any use** of and intervention in the sensitive ocean system **must therefore be carefully considered** and it must be ensured that the oceans and their ecosystems are not harmed.
- > If the **carbon dioxide removal required to offset residual emissions** were to be done increasingly by ocean-based methods, this would require **large-scale interventions over long periods of time**. This would necessitate the emergence of international industries and associated governance and regulatory structures whose purpose would be to increase ocean carbon dioxide uptake and storage.
- > This complex baseline situation poses an enormous **challenge** to society and its decision-makers. The task is to effectively limit climate change while at the same time ensuring sustainable development and thus a future worth living for all people on earth.

## Answers are needed

- > To meet this challenge, political actors need **understandable and transparent information** about whether marine carbon dioxide removal methods actually work to the extent hoped for, whether they would be politically, legally, socially, and financially feasible, what benefits and risks they pose to humans and the environment, and whether their use and all associated impacts are actually desirable in the long term.
- > Answers to these questions can support decision-making processes before marine CDR methods are potentially implemented on a large scale.

## An assessment framework for marine carbon dioxide removal methods

- > In the research mission CDRmare, scientists from the natural sciences, social sciences, humanities, law, and economics develop **an urgently needed assessment framework** for marine CDR methods.
- > It not only asks **which methods work** and can actually be technically implemented, but also examines **whether the effects achieved are desirable** and whether we can use marine CDR methods to help achieve the net-zero goal **without compromising internationally recognized goals and standards in other areas** – such as the UN Sustainable Development Goals.
- > The new assessment framework will cover the many dimensions of the issue of carbon dioxide uptake and storage in the ocean and will enable decision-makers, politics, business, and civil society to make a **fact-based and comprehensible judgment** on individual methods or future projects.
- > It is also intended to **synchronise the framework with approaches to assessing land-based carbon dioxide removal methods** so that it can compare ocean-based carbon dioxide removal methods with land-based methods.

The development of the assessment framework described here is being conducted within the CDRmare research consortium »ASMASYS – Unified assessment framework for proposed methods of marine CDR and interim knowledge synthesis«.



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