INFOSHEET

Blue Carbon

FOUNDATION Development and Climate Alliance

Status: April 2026

Inhalt

1. What are Blue Carbon Ecosystems?

Blue Carbon Ecosystems (BCEs) traditionally describe coastal ecosystems such as mangrove forests, seagrass meadows and saltmarshes. More inclusive definitions include other marine and freshwater ecosystems, sometimes coined emerging BCEs, as they also store significant amounts of CO_2 and therefore make a valuable contribution to climate protection and to achieving the goals of the Paris Agreement.

2. Blue Carbon Ecosystems and their role in climate regulation

Traditional BCEs store large amounts of carbon in their biomass and by capturing sediments (including sand, clay, shell debris) and detritus (including plant debris) in their root systems. This makes their annual carbon storage potential ten times higher than that of tropical forests.[1] The soil of BCEs does not get saturated with carbon because sediments accumulate vertically, which means that the root and sediment mats slowly grow upward as the water level rises. How long carbon remains sequestered depends on where it is stored. Carbon in the biomass of stems, trunks and leaves has relatively short storage times (<50 years), while carbon stored in the sediment root mats remains sequestered for centuries to millennia.[2] There are mats that have accumulated more than ten metres of sediment over thousands of years, making the longevity of BCEs much higher than that of terrestrial forests. Freshwater ecosystems such as bogs share significant similarities with traditional BCEs, particularly regarding how carbon is sequestered. An inclusive definition of BCEs to include freshwater ecosystems is particularly important considering the growing demand for BCE projects in the Voluntary Carbon Market (VCM).[3]

Although macroalgae store carbon in their biomass, CO_2 usually remains sequestered for only decades and is released back into the water when the algae die.[4] However, there are innovative approaches to utilize the biomass of cultivated macroalgae for applications such as bioplastics, agricultural products, cosmetics and biochar, which increase the timeframe carbon is sequestered for.

Additionally, there are also technical methods which increase the oceans natural CO_2 absorption. These involve adding alkaline substances such as limestone or silica to the water, which improve the oceans CO_2 storage capacity and therefore help counteract the temperature increase caused by anthropogenic climate change.

[1] National Oceanic and Atmospheric Administration (NOAA), (2026)

[2] McLeod et al. (2011)

[3] Adame et al. (2024)

[4] Rose and Hemery (2023)

3. Decline of Blue Carbon Ecosystems and impacts on climate change

Currently, BCEs decline at rates of around 1 to 2% per year, mainly due to environmental and anthropogenic stressors. Historical coverage of these ecosystems has declined by approximately 30 to 50%.[5] BCEs are at risk of flooding when the vertical growth of sediment mats cannot keep pace with sea level rise. This is exacerbated by increased wind and wave activity, which leads to erosion of sediment mats and damages biomass. In addition, human activities in coastal regions, such as construction, nutrient runoff from agriculture and industry, aquaculture, and unsustainable tourism, can negatively impact these ecosystems.[6]

When BCEs degrade, the carbon stored over centuries and millennia is re-released into the water column and can eventually end up back in the atmosphere. An estimated 1.02 billion tonnes of CO_2 is released annually by degraded BCEs, exacerbating the climate crisis.[5]

4. Additional effects of Blue Carbon Projects on sustainable development

Especially traditional BCEs provide invaluable ecosystem services to coastal communities that go beyond climate mitigation.[7] Blue Carbon (BC) Projects focusing on the restoration and protection of these ecosystems support associated positive impacts.

- BCEs provide protected habitats for the early development of fish, shellfish, bird, and amphibian species. They support high biodiversity and often serve as fishing grounds for local communities.
- In addition, these ecosystems improve water quality and provide natural coastal protection by absorbing wave energy, reducing erosion, and stabilising sediments. As climate change increases the intensity of storms, BCEs play an important role in mitigating indirect effects of climate change.
- BCEs support local livelihoods such as subsistence fishing or generation of income through sustainable tourism activities and often have cultural and spiritual value for local and indigenous groups.[8]

For BC Projects to be successful and accepted by local communities, it is important that project developers respect local and indigenous land rights, involve stakeholders, and take traditional knowledge into account during both planning and implementation of the project.[9]

[5] Blue Carbon Initiative (2026)

[6] Lovelock and Reef (2020)

[7] Murray and Milligan (2023)

[8] Vierros (2017)

[9] Pricilla et al. (2021)

5. Different types of Blue Carbon Projects

Similarly to terrestrial forests, nature-based Blue Carbon Projects can have conservational approaches, where existing ecosystems are protected from further destruction and potential emissions are avoided. Other projects focus on the restoration of BCEs, where new plants (mangroves, seagrass, marsh vegetation) are planted, to enable future carbon sequestration. These projects remove carbon emissions from the atmosphere. Some projects also apply a combination approach of both methodologies.

Beyond nature-based carbon removals, an emerging category are engineered carbon removals, where CO_2 is actively removed from the atmosphere through engineered systems or nature-based and engineered hybrid approaches. Some of these methodologies may fall under the definition of Blue Carbon when they involve marine or intertidal environments. However, this project type is still minor compared to nature-based projects.

6. Blue carbon projects in the Voluntary Carbon Market

Currently, 99 Blue Carbon Projects (BC Projects) are listed in registries of relevant standards (this includes projects dealing with freshwater ecosystems).[10] Most projects are registered through VERRAs Verified Carbon Standard (VCS).

At present, there are no BC Project methodologies which carry the Core Carbon Principles (CCP) label from the Integrity Council for the Voluntary Carbon Market (ICVCM), a quality label that indicates high integrity of carbon credits. However, three methods for nature-based project types (mangrove afforestation/reforestation and macroalgae collection for emission avoidance) and four methods for technical project types are currently under review to receive the label.[11] There are currently 26 active BC Projects, while 73 are in the development phase. Of all listed BC Projects, only 16 projects employ carbon avoidance methodologies, while the remaining 83 BC Projects are either nature-based removal or engineered removal projects.

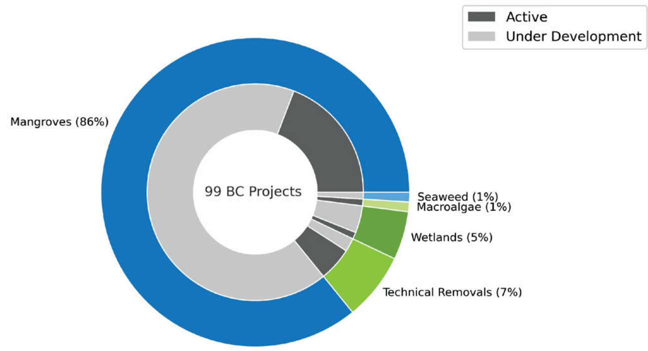
Carbon dioxide removal (CDR) certificates have become increasingly popular because they are the only type of certificate accepted under the Science Based Targets initiative (SBTi) Corporate Net-Zero Standard for making climate-related claims and neutralising residual emissions.[12] The standard also emphasises on the importance of long-lived carbon removals, which store sequestered carbon from centuries to millennia – a characteristic that BCEs naturally have.

[10] Standard Registries investigated for this report: ACR, CAR, GS4GG, Plan Vivo, Global Tree C-Sink , VCS, Puro.Earth, SCS, CCBS, SD VISta, The Fairtrade Climate Standard, CSI Global Artisan C-Sink, International Carbon Registry iCR, TREES, Isometric; as of 19.01.2026; Freshwater Wetland Restoration and Conservation Projects (WCR) were included in the analysis.

[11] ICVCM CCP Assessment Status (2026)

[12] Science Based Targets initiative (2025)

78% of BC Projects are located in the Global South of which 25% are so called Least Developed Countries (LDCs), while the remaining projects are based in North America, Europe and the Middle East. Most BC Projects by number are currently found in Indonesia, followed by India and Mexico.



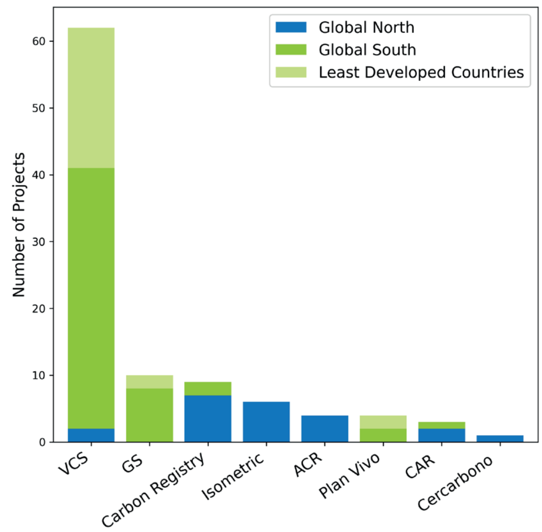


Figure 1
Overview of BC Projects in the Voluntary Carbon Market
Upper figure shows the proportion of BC Projects by ecosystem and status (active and under development).
Lower figure shows the distribution of BC Projects by standard and region.

Credits generated through nature-based BC Projects retailed at roughly $30 USD per tonne of CO_2 in 2024.[13] The comparatively high value of BC credits is a result of the positive co-benefits and the relatively small number of issuances compared to other VCM projects. Credits generated through engineered-removal BC Projects had average prices of $457 USD per tonne of CO_2 in 2024.[14]

Although the number of BC Projects in the VCM continues to rise, BC certificate issuances accounted for less than one per cent of all certificates issued between 2014 and 2025.[15] However, the share of BC certificates issued is likely to increase in the future as listed projects move from the development phase to the active phase.

7. Quality criteria

Permanence – The project must implement mechanisms to ensure that carbon is sequestered for long timeframes. BCEs are vulnerable to natural phenomena like storms and once disturbed carbon is easily re-released into the water. Long-term commitment of projects, buffer pools (a non-tradable reserve portion of certificates) and insurance are important to prevent or compensate re-release of carbon.

Additionality – The impact of the BC Project must be additional, meaning the conservation or reforestation of the BCE would not happen without the project. It is important to use correct baselines – the scenario that predicts what would happen without the project. If baselines imitate high losses of BCEs, a project can sell more virtual credits than are generated. The baseline scenario is specifically relevant for CO_2 avoidance projects.

Carbon leakage – relocation of activities and emissions to other locations due to the protection of a project site: in BC Projects, this can affect aquaculture, rice cultivation, fishing or deforestation.[16] Projects must take this into account and implement mechanisms to prevent it.

Robust validation methods – Since most of the carbon in BCEs is stored in sediments and roots and the longevity varies between biomass and sediments, validation methods should use both on-site and remote sensing methods.[17] Currently, methods for quantifying soil carbon are still uncertain, which is why cautious, conservative accounting or the temporary omission of soil carbon accounting is advisable. [16]

Stakeholder engagement – Local communities must be involved in the planning, management and implementation of BC Projects. Considering local livelihoods, land tenure and local knowledge is essential for successful BC Projects.[8] Projects which consider gender-equitable participation and reinvest revenues into communities also strengthen social sustainability and lower the risk of project results being reversed.

[13] Ecosystem Marketplace (2025)

[14] CDR.fyi (2025)

[15] Farahmand et al. (2025)

[16] Jennerjahn et al. (2026)

[17] Macreadie et al. (2022)

8. Recommendations

We advise buyers to purchase high integrity BC credits that account for aspects such as permanence and additionality, avoid double counting and have a low risk of the captured greenhouse gases being re-emitted (reversal risk).
Strict independent third-party validation of BC Projects to ensure both climate integrity and social and environmental impacts is recommended.

As BC Projects include both carbon removal and avoidance projects, it is important to select appropriate projects for the intended claims (these are environmental statements such as 'climate neutrality' or 'net zero'), as well as for the company's own sustainability strategy.
It should be ensured that the project supports additional Sustainable Development Goals (SDGs), such as gender equality, sustainable economic growth, and educational opportunities.

BC Projects, especially conservation projects which avoid emissions, are well suited for Contribution Claims.[18] This allows companies to contribute to climate protection by calculating a price for residual emissions, which they then invest in climate protection projects. BC Projects are very suited for this purpose, due to their good reputation and additional benefits, such as biodiversity conservation, coastal protection, improved water quality, and securing livelihoods.

[18] Kreibich et al. (2024)

Foundation Development and Climate Alliance

Chausseestraße 22, 10115 Berlin
Telephone: +49 30 3465573-00
E-mail: info@allianz-entwicklung-klima.de

www.allianz-entwicklung-klima.de/en