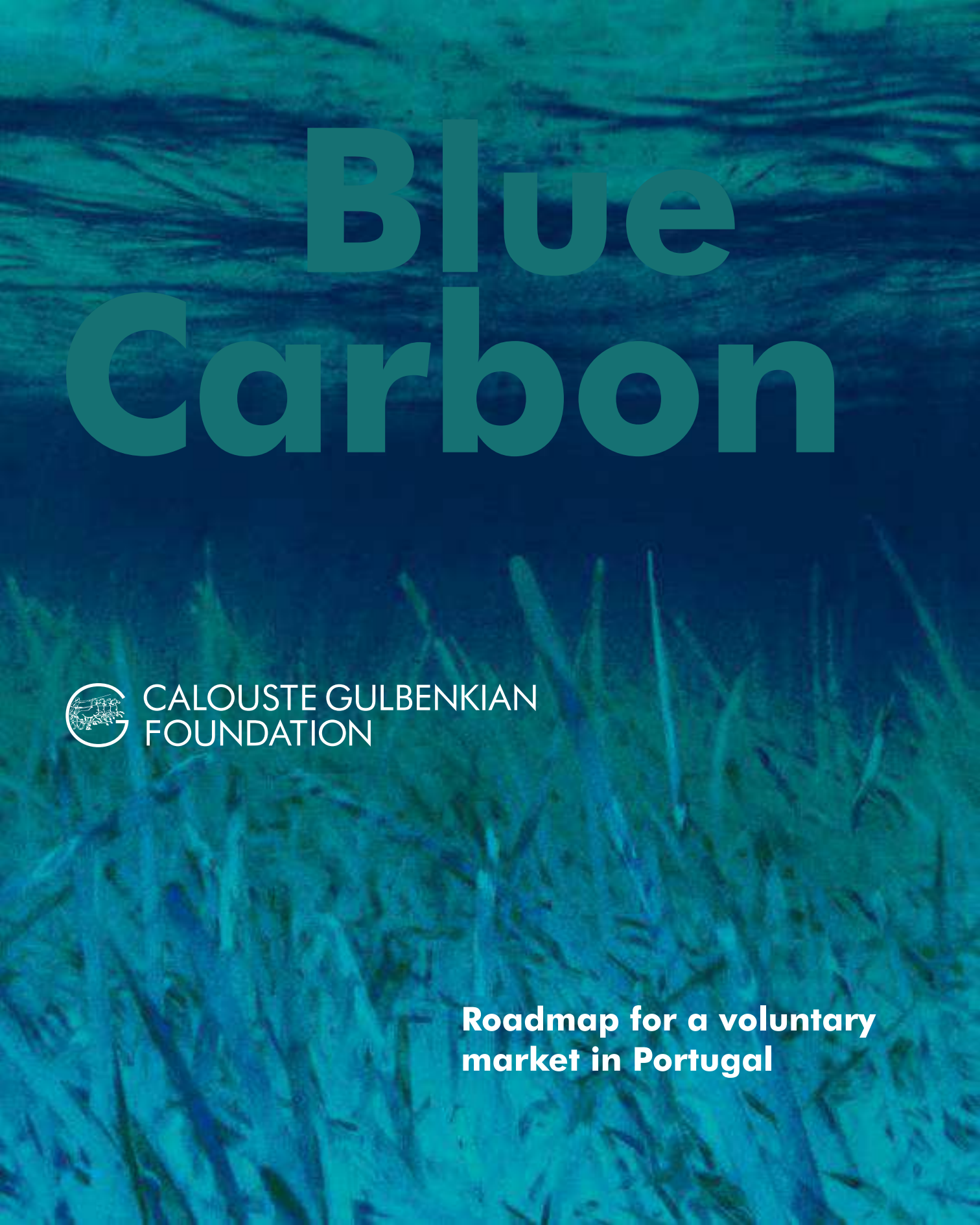

Blue Carbon

CALOUSTE GULBENKIAN FOUNDATION

Roadmap for a voluntary market in Portugal

Roadmap for a voluntary market in Portugal

Raul Xavier de Oliveira

FUNDAÇÃO CALOUSTE GULBENKIAN

ANP ASSOCIAÇÃO NATUREZA PORTUGAL | WWF
ANP em associação com WWF

CCMAR Centro de Ciências do Mar Algarve

Gulbenkian Oceano

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Opening Remarks

Portugal's relationship with the ocean has profoundly influenced its history, geography, identity, and economy. This privileged relationship also means increased responsibilities not only in terms of governance, knowledge, and defence but, above all, in promoting its conservation and protection for the good of all.

Over the last decade, the appreciation of the ocean and the increasing knowledge of blue natural capital have become priority areas in the Calouste Gulbenkian Foundation's action plan. The Gulbenkian Oceans Initiative was created in 2013 with a view to understanding the value of the ocean. For five years, it aimed to identify the economic value of the services and benefits provided by marine ecosystems and account for their natural capital in order to inform and improve public and private marine environmental management policies.

Concurrently, the Valuing the Ocean initiative was launched to improve cross-sectoral collaboration and communication of the ocean's value to engage the general public and influence long-term change. This initiative was led by the Foundation's London Office.

We have also invested in the development of the blue bioeconomy in partnership with the Oceano Azul Foundation to boost national and international startup businesses that use marine biotechnology to create innovative and sustainable sea-based renewable resource products and services and to leverage synergies between the business sector, R&D, and the investor community.

The Gulbenkian Blue Carbon Project arose as part of this commitment to promoting the role of the ocean, highlighting the contribution of marine ecosystems – saltmarshes and seagrass meadows – to carbon sequestration processes and the critical role they may play in meeting Portugal's climate action targets.

With this in mind, over the last year and in collaboration with our partners ANP|WWF and the Centre of Marine Sciences of the University of Algarve, rigorous work has been conducted on mapping and characterising these blue carbon ecosystems to make future conservation and restoration actions feasible.

Science shows that the carbon sequestration capacity of these ecosystems is between 10 and 40 times higher than that of tropical forests. By contributing to the protection and restoration of blue carbon ecosystems, we are meeting the interests of several parties: the public entities that are in charge of managing these territories and do not always have enough resources to keep them healthy, private entities that want to invest in environmental projects and offset their carbon footprint, and – more importantly – citizens and biodiversity. For a country so dependent on the ocean and with such a high population density on the coast, preserving marine and coastal ecosystems is decisive for both the environment and the protection and resilience of coastal communities in the face of climate change.

The work conducted under this project has created a knowledge base not available in Portugal until recently and which is now recorded in this Roadmap and its accompanying scientific reports. This publication aims to be the starting point for a broader discussion on how best to enable blue carbon ecosystem conservation and restoration projects, emphasising the correlation between climate and the ocean.

As the Calouste Gulbenkian Foundation enters its new programmatic cycle 2023-2027 guided by the principles of sustainability and equity, it has renewed its commitment to climate action and protection of the ocean, building on an integrated strategy with its teams in Portugal and the United Kingdom. The positioning of the Gulbenkian Blue Carbon Project in this new strategy will provide continuity to the work developed to date and represent the possibility of giving greater international relevance to this initiative.

Martin Essayan

Trustee of the Calouste Gulbenkian Foundation

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Foreword

The release of the document “Blue Carbon: Roadmap for a Voluntary Market in Portugal” is a milestone in the development of the Gulbenkian Blue Carbon project, enabling Portugal, a maritime nation by geography, history and vocation, to join the group of nations adopting Blue Carbon strategies as components of their climate action.

Blue carbon strategies refer to climate change mitigation and adaptation through the conservation and restoration of vegetated coastal habitats, present in Portugal as seagrass meadows and saltmarshes. Unfortunately, these habitats have experienced significant losses in Portugal due to building of infrastructure (industrial, harbor, airport), conversion to other uses, such as aquaculture or rice paddies, and degradation from pollution due to excess organic and nutrient inputs and mechanical damage.

Investing in avoiding further losses and restoring degraded habitats helps mitigate climate change by avoiding emissions and restoring sinks, respectively, while also generating a wealth of benefits, such as coastal protection, food supply and biodiversity enhancement supported by healthy coastal habitats. These actions also advance the recently adopted Kunming-Montreal Global Biodiversity Framework, which aim at stopping biodiversity losses and restore 30% of degraded habitats, among other goals, by 2030.

The roadmap provided here identifies potential projects and clarifies the actions required to activate them, initiating a path of climate action through nature based solutions to the benefit of nature and people.

Carlos M. Duarte

Distinguished Professor of Marine Science, King Abdullah University of Science and Technology, and Global Ambassador of the Gulbenkian Blue Carbon project

Introduction

This roadmap was designed by Associação Natureza Portugal in association with WWF (ANP|WWF) as part of the Gulbenkian Blue Carbon Project, a Calouste Gulbenkian Foundation (CGF) initiative in collaboration with the Centre of Marine Sciences (CCMAR) of the University of Algarve.

This roadmap presents specific guidelines for creating blue carbon projects and recommendations to leverage the development of a blue carbon market in Portugal. It aims to ensure the environmental integrity of the projects and project-related investments. The document is supplemented with a brief analysis of the state of the art of the voluntary blue carbon market and its framework in key international and national policies.

This roadmap was developed based on an extensive literature review and technical documents from the main institutions involved in blue carbon worldwide, as well as by listening to key stakeholders, including national and international public decision-makers, businesses, and non-governmental organisations. It also entailed participating in seminars, workshops, and webinars organised by the main institutions involved in blue carbon projects with international scope. In addition, CCMAR collected and analysed information on blue carbon ecosystems (saltmarshes and seagrasses) in Portugal as a result of a literature review on ten systems along the Portuguese coast, including a survey on their carbon sequestration and storage potential, restoration and conservation measures, among other relevant information. Lastly, it also sought to assess the existing conditions for project development and identify the main gaps and recommendations with a view to promoting a voluntary blue carbon market in Portugal.

The Gulbenkian Blue Carbon Project was motivated by the CGF's intention to offset unmitigable CO_2 emissions related to its 2021 activities. It also aims to bring visibility to the importance and potential of blue carbon at the ocean-climate nexus in Portugal.

Therefore, the mapping of the systems, preparation of the roadmap, and design of a pilot project for the restoration of a blue carbon ecosystem funded by the CGF are intended to pave the way for a voluntary blue carbon market in Portugal that promotes the conservation and restoration of saltmarshes and seagrass meadows on national territory.

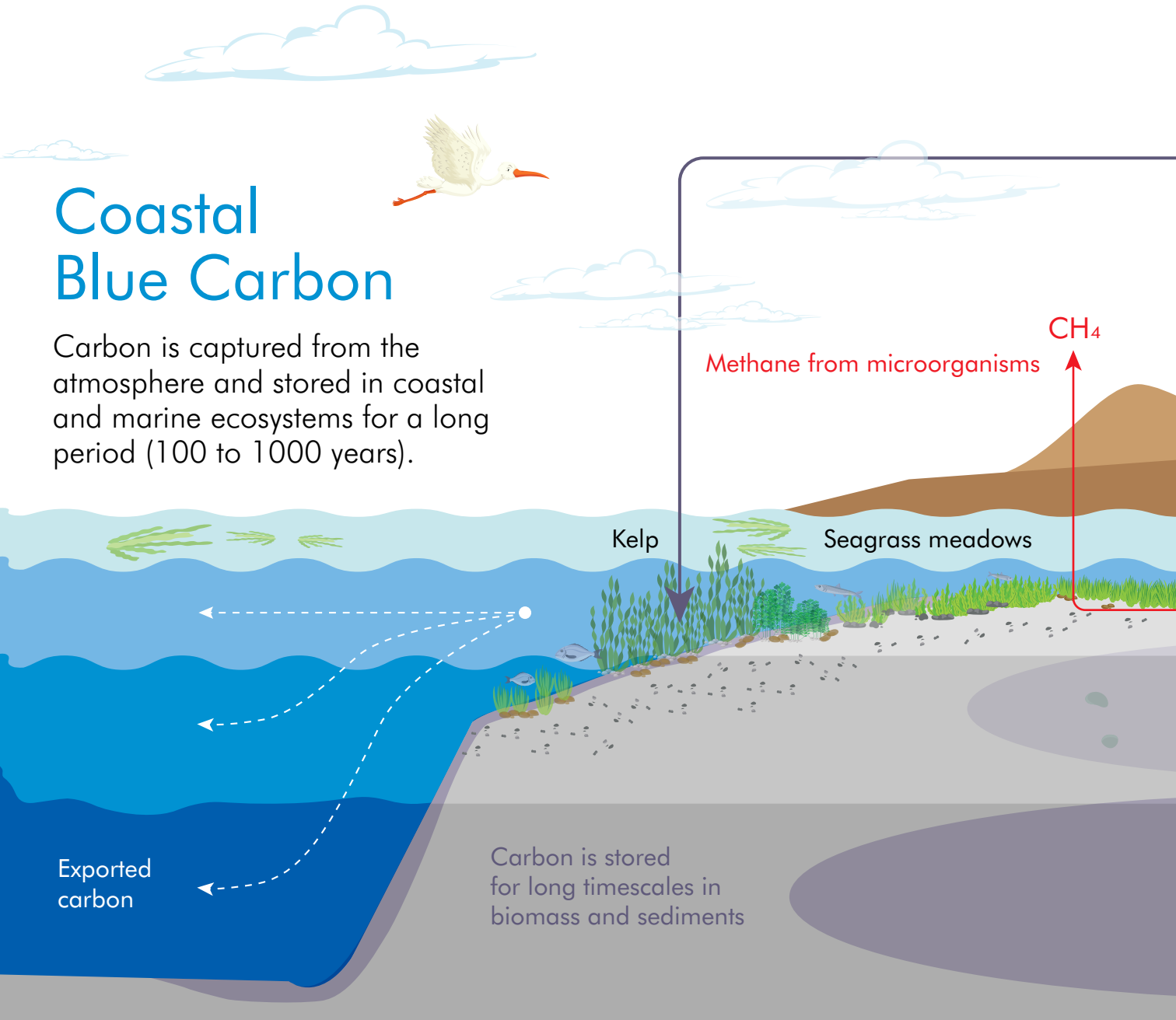
01

What is Blue Carbon?

© Carmen Santos

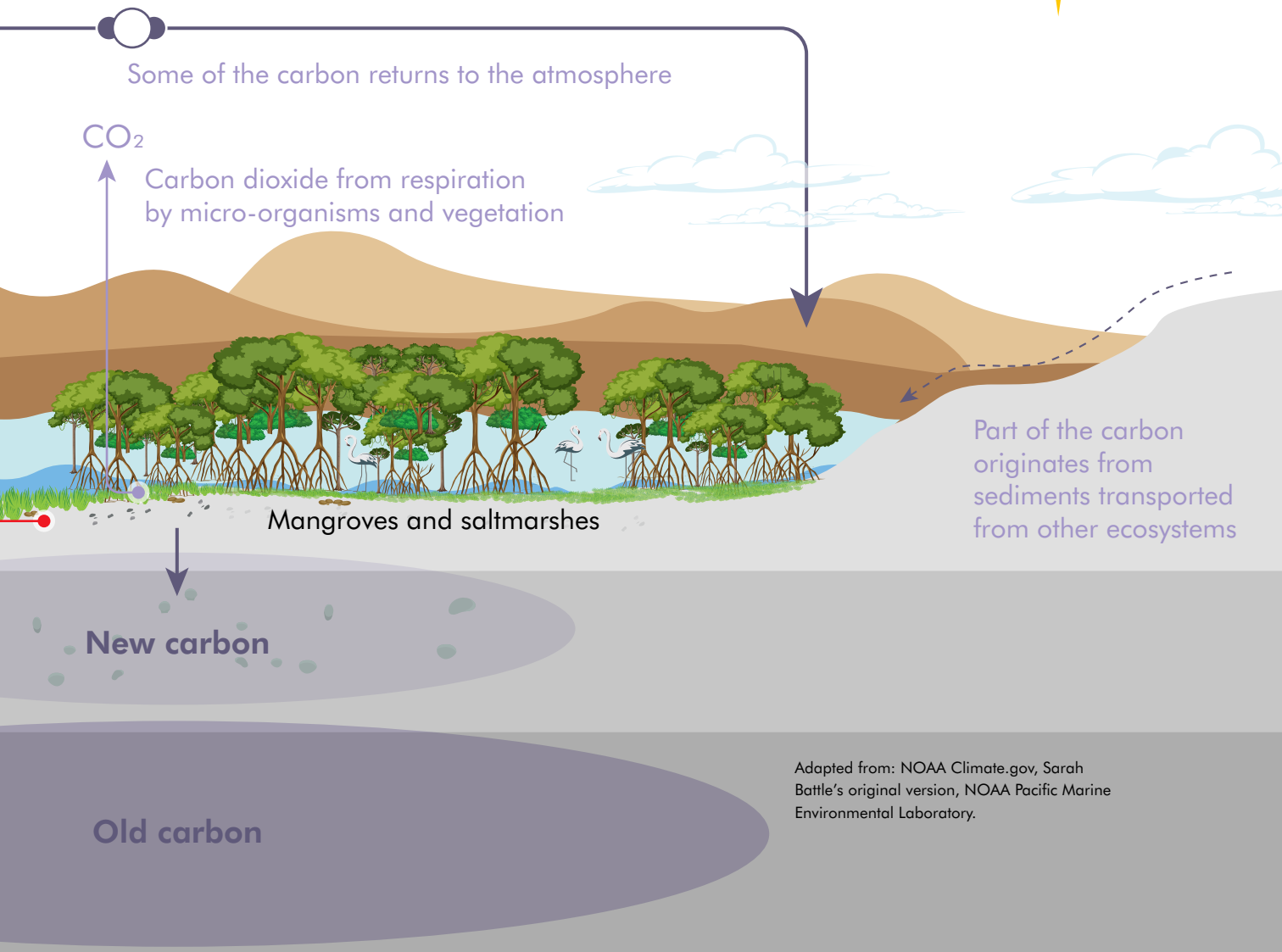
"Blue carbon" refers to the organic carbon captured and stored in coastal and marine ecosystems. These ecosystems have a high capacity to remove carbon dioxide (CO_2) from the atmosphere through photosynthesis and store large amounts of carbon for a long period (100 to 1000 years). This is due to the fact that most blue carbon is stored in the sediments of the ecosystems – unlike forests, which have more carbon concentrated in plant biomass.[I, II]
The term "blue carbon" was first mentioned in a 2009 United Nations Environment

Figure 1. Carbon flux in blue carbon ecosystems



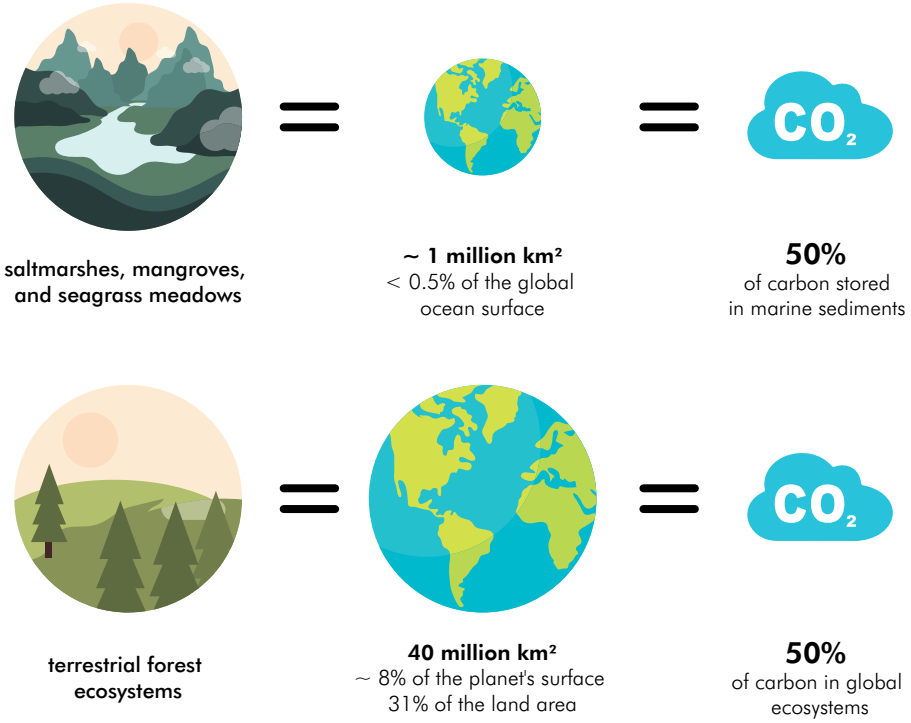
Programme report[1], to highlight the role of the ocean and coastal ecosystems in mitigating climate change and to contribute to the discussion of policies and international agreements on the subject. The term "blue carbon ecosystems" has been used to refer to the coastal wetland habitats with the highest capacity for CO_2 removal and carbon (C) storage, particularly mangroves, saltmarshes, and seagrass meadows.[III; I]. Approximately 150 countries have at least one of these three main blue carbon ecosystems[IV]. There are only saltmarshes and seagrass meadows in Portugal, as mangroves only grow in tropical climates.

[1] "Blue Carbon: The Role of Healthy Oceans in Binding Carbon" United Nations Environment Programme, GRID-Arendal.



Adapted from: NOAA Climate.gov, Sarah Battle's original version, NOAA Pacific Marine Environmental Laboratory.

Figures 2 e 3. Carbon stock and accumulation rates in the main ecosystems of blue carbon



Carbon accumulation rates, per gram (g) of carbon (C) stored per square metre per year (gC/m²/year)

226
Mangroves

218
Saltmarshes

138
Seagrass meadows

The importance of Blue Carbon Ecosystems

Saltmarshes, mangroves, and seagrass meadows occupy approximately 1 million km² [I], representing less than 0.5% of the global ocean surface. Nevertheless, they account for approximately 50% of the carbon stored in marine sediments[II]. As they are extremely productive, blue carbon ecosystems annually store similar amounts of carbon to terrestrial forest ecosystems, which occupy 40 million km² [V]. Studies show that mangroves, saltmarshes, and seagrasses sequester carbon at 10 to 40 times the rate of tropical forests. They also store three to five times more carbon per hectare than tropical forests.[VI, VII] These data illustrate that blue carbon ecosystems are among the most effective carbon sinks on the planet, i.e., they have high carbon accumulation rates per unit area. Values vary widely between system types and regions, but commonly quoted averages are: 226 gC/m²/year for mangroves, 218 gC/m²/year for saltmarshes, and 138 gC/m²/year for seagrass meadows.[VIII]

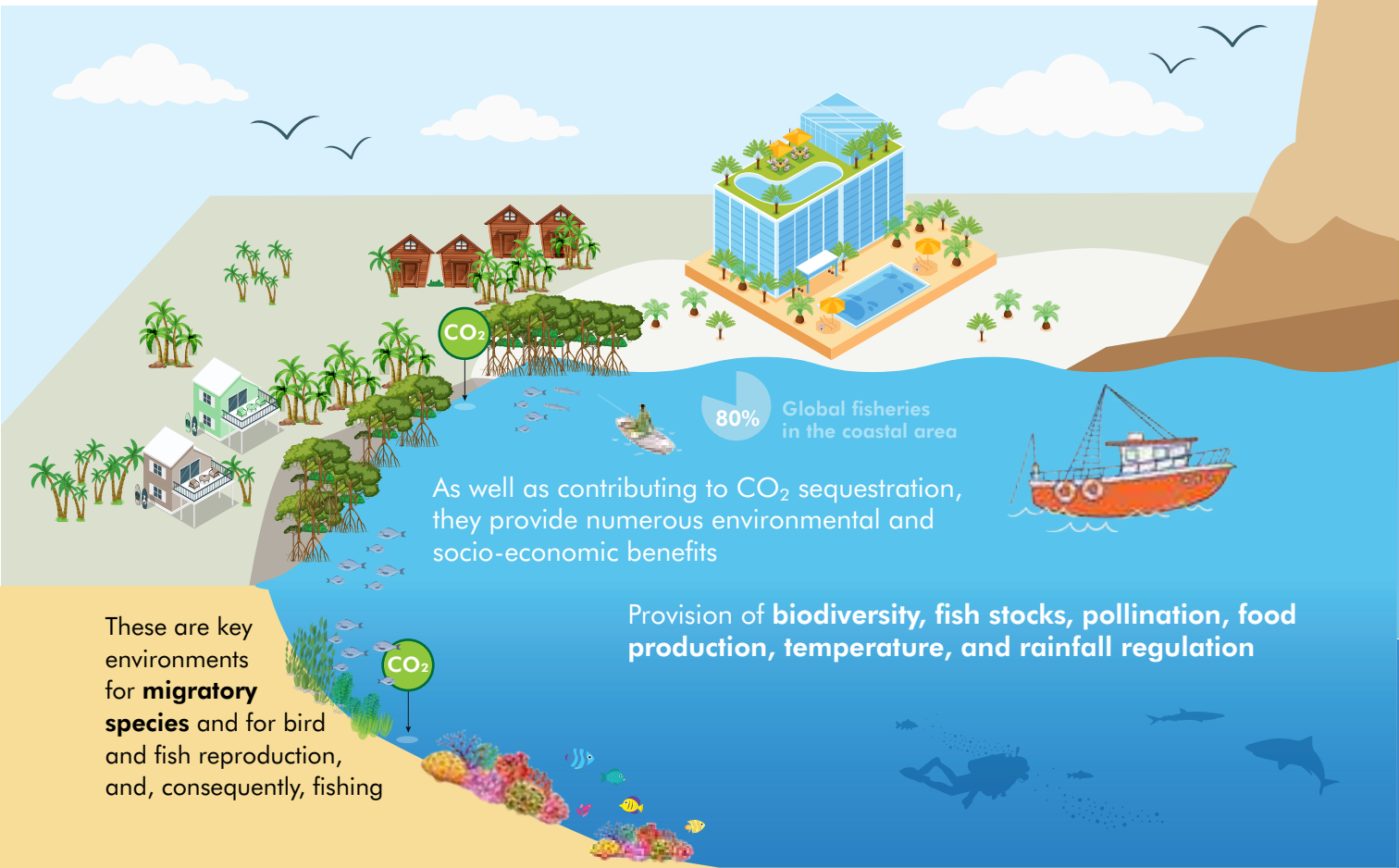
In addition to contributing to CO_2 sequestration, blue carbon ecosystems provide numerous environmental and socio-economic benefits associated with providing other ecosystem services, such as maintenance of biodiversity, fish stocks, water purification, and coastal protection[I, IX]. They are essential environments for marine food chains, including for species exploited by coastal fisheries, which account for approximately 80% of global fisheries [VIII] They are also key areas for various migratory bird and fish species. In addition, coastal ecosystems also help mitigate the impacts of coastal storms, reduce flooding, and protect against rising sea levels – events aggravated by climate change [X, XI].

Despite their benefits, it is estimated that approximately 25% to 50% of coastal ecosystems have already been degraded or eliminated due to human action and that 0.2% to 3% of their area is lost annually. Thus, the fact that they are major carbon sinks means that the degradation of blue carbon ecosystems is also a climate problem, as some of the carbon they contain is released back into the atmosphere and remineralised in the form of CO_2. The carbon emissions associated with the annual loss of blue carbon ecosystems are estimated to range from 0.04 to 1.46GtC/year[2], equivalent to the emissions of 100 million to 2 billion barrels of oil.[3] This difference in values reflects the variation in global data on the annual rate of habitat loss and the proportion of carbon remineralised into CO_2 [VIII].

[2] 1Gt = 1,000,000,000 tons
1Gt of C is equivalent to the emission of CO_2 from the consumption of 2 billion barrels of oil

[3] Calculations performed on the United States Environmental Protection Agency GHG equivalence calculator available at: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Figure 4. Other services associated with blue carbon ecosystems



Sporobolus Maritimus

Blue Carbon, a Nature-Based Solution

Measures to protect and restore blue carbon ecosystems are nature-based solutions (NBS) that contribute to the mitigation and adaptation to climate change.
Nature-based solutions are "actions to protect, sustainably manage and restore natural and modified ecosystems in order to meet society's challenges effectively and dynamically, to provide human well-being and biodiversity benefits" [XII].
Besides increasing the resilience of ecosystems and communities, NBS are essential for limiting global temperature increases. The Intergovernmental Panel on Climate Change (IPCC) estimates that such measures have the potential for mitigating greenhouse gas emissions (GHG) between 8 and 14 $GtCO_2eq$ per year, of which around 1 $GtCO_2eq$ is attributed to the protection and restoration of blue carbon ecosystems [XIII].

What remains to be known

The advancement of science on blue carbon has been significant in recent years, although important knowledge gaps remain, including:

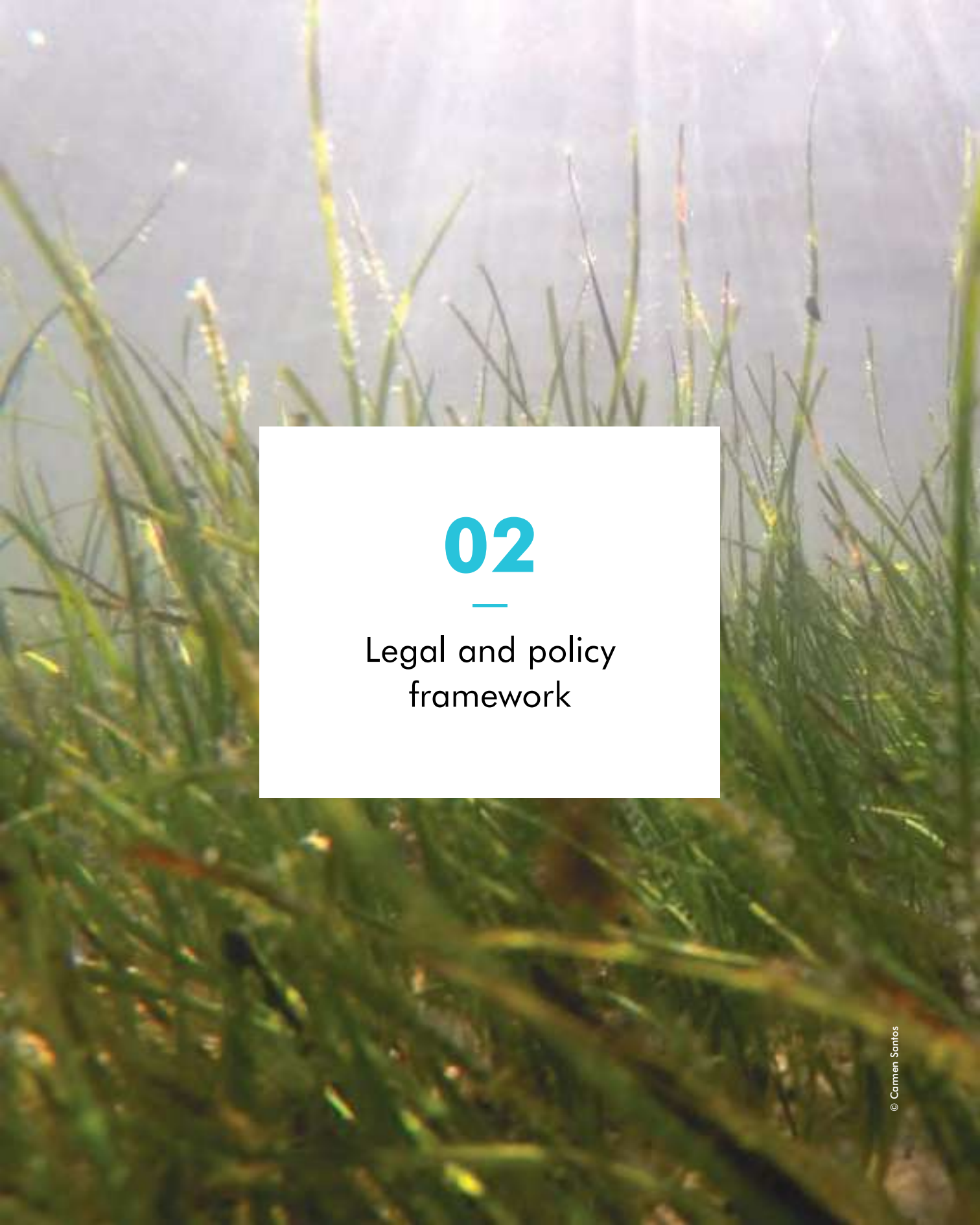
- a more precise mapping of the extent of the various ecosystems and the periodic quantification of their variation (loss of or gain in area);
- the balance between GHG sequestration and emission in blue carbon ecosystems;
- increasing confidence about the permanence of sequestered carbon according to the different types of systems and species present in each region;
- CO_2 emissions from the degradation of ecosystems and their sediments.

Increasing knowledge will bring scientific accuracy concerning these issues, which will be crucial to determine, ever more precisely, the contribution blue carbon ecosystems make to the global carbon "budget" from both the perspective of the emissions – due to the loss of natural habitats – and the sequestration and storage through conservation, management, and restoration.

Another aspect to be further studied is the impact of climate change on blue carbon ecosystems, particularly the increase in sea level, average temperatures, storms, and the concentration of CO_2 in the atmosphere. These impacts can positively or negatively affect carbon sequestration and storage in different ecosystems. For example, sea level rise may stimulate the expansion of the saltmarsh area inland or, conversely, eliminate a specific saltmarsh area if there is no space for it to move naturally. Increases in temperature and CO_2 concentration can either stimulate the productivity of some species or cause the loss of biodiversity [XIV]. The IPCC estimates a moderate risk of impact on blue carbon ecosystems in the case of a temperature increase of 1.5ºC by the end of the century. In the case of a temperature increase above 2ºC, the impact risk is high [VIII].

On the other hand, there is growing scientific consensus on the fact that the conservation and restoration of coastal and ocean ecosystems, in conjunction with the reduction in non-climatic stressors, reduce the vulnerability of biodiversity to climate change and increase the resilience of communities and biological processes in ecosystems[xv]. This reinforces the understanding that nature-based solutions can be considered "no-regret measures"– i.e., measures that will always create a positive impact if implemented adequately.

Additionally, efforts have been made in the scientific field to deepen the understanding of the carbon cycle in the different coastal and ocean ecosystems, as well as the contribution of kelp forests, coral reefs, and marine macrofauna to this flux[x]. Among these, kelp forests (macroalgae) have greater accumulated scientific knowledge about their carbon sequestration potential, but there is great difficulty in monitoring and measuring the amount of carbon effectively transported and stored in the seabed[xv, xvi]. Although there is growing interest in the role of macroalgae, this uncertainty about the fate of the absorbed carbon means that – unlike saltmarshes, mangroves, and seagrasses – they are not immediately recognised as one of the established blue carbon solutions for the mitigation of GHG increase.



02

Legal and policy framework

Due to their geographical location and socio-economic and environmental relevance, blue carbon ecosystems are included in several programmes, agreements, and policies. The protection and restoration of saltmarshes, mangroves, and seagrass meadows can provide direct and indirect contributions to the objectives and targets of the main international conventions, notably on wetlands (Ramsar Convention), biodiversity (Convention on Biological Diversity), and climate change (United Nations Framework Convention on Climate Change).

Blue carbon ecosystems are included in the definition of wetlands, and many of them are listed as Ramsar sites[4], for example, the Ria Formosa and Sado Estuary in Portugal. Under the Ramsar Convention, signatory countries commit to "*addressing the causes of wetland loss and degradation*" by managing these sites properly.
Under the Convention on Biological Diversity, aspects associated with blue carbon ecosystems can also be found. The new agreement – the *Kunming-Montreal Global Biodiversity Framework* – was adopted in December 2022, and includes four goals and 23 targets to be achieved by 2030. Many of these have a direct or indirect bearing on blue carbon ecosystems, notably those that ensure the "effective conservation and management of at least 30% of the world's land areas, inland waters, coastal zones, and oceans" and that "maintain, enhance or restore the integrity, connectivity and resilience of all ecosystems by substantially increasing the area of natural ecosystems by 2050"[5].

Additionally, coastal zones feature in the Sendai Framework on Natural Disaster Risk Prevention prominently as they not only play a key role in mitigating extreme weather events but also are the environments in which hundreds of millions of people live or depend on for subsistence. Similarly, actions taken in blue carbon ecosystems can relate to several of the 17 Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda, such as Climate Action (SDG 13), Life Below Water (SDG 14), and Life on Land (SDG 15)[6].

Global

The Paris Agreement, signed in 2015 at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), aims to ensure the viability of human life by limiting the global temperature increase by the end of the century to below

[4] The Convention on Wetlands, available at https://www.ramsar.org/

[5] The Convention on Biological Diversity, COP15 press release. https://www.cbd.int/article/cop15-cbd-press-release-final-19dec2022

[6] Sustainable Development Goals: https://www.undp.org/es/sustainable-development-goals

Climate Demonstration

2ºC, - preferably to 1.5ºC - compared to pre-industrial levels.[7] For this to happen, countries must "conserve and enhance, as appropriate, greenhouse gas sinks and reservoirs" and "calculate, report, and verify greenhouse gas inventories", among other measures.

The main instruments for reporting and monitoring the binding commitments of the Paris Agreement are the Nationally Determined Contributions (NDC) and national GHG inventories. NDCs are each country's set of national measures and commitments to contributing to the Paris Agreement's global target, i.e., they present the possible extent of their reduction in GHG emissions and promote carbon sequestration by sinks. NDCs have to be reviewed every five years to ensure continuous improvement and increased ambition over time.

The role of national GHG inventories is to contribute to the global accounting of the variation in GHG emissions, including removals related to land use, land-use change, and forestry (LULUCF). Ideally, NDC commitments should be backed by national inventories; otherwise, progress cannot be properly verified, undermining their credibility. Therefore, including blue carbon in national inventories is an important step to ensuring that these ecosystems' conservation, management, and restoration measures can be properly reported and monitored in the NDCs. In other words, including blue carbon

[7] The UNFCCC Paris Agreement: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

ecosystems in each country's NDCs, including Portugal's contribution to the NDC-EU, is a strong incentive to promote the protection and restoration of these ecosystems.

The UNFCCC determines the requirements for the preparation of national inventories[8], including the use of the 2006 *IPCC Guidelines for National Greenhouse Gas Inventories*[9] to guarantee the integrity of the methodologies used in calculating GHG. This guide contains a supplement on methodologies, the Wetlands Supplement, which includes mangroves, saltmarshes, and seagrass meadows[xvii]. This is the main reference on GHG emission factors related to land-use change in coastal wetlands and, consequently, for integrating carbon into national GHG inventories and NDCs. It should be noted that mangroves are also considered forests,[v] thus are included in the methodologies for reducing emissions from deforestation and forest degradation, plus conservation and sustainable forest management, known as REDD+.

In the first round of NDC submissions at the end of 2015, 74 countries included mitigation (28 countries) or adaptation (59 countries) actions relating to blue carbon ecosystems.[10] Among these, only two were European: Iceland, which stated its intention to include wetland restoration as part of its mitigation effort from 2020 onwards, and Georgia, which cited prioritising coastal planning and management as an adaptation measure to rising Black Sea levels to minimise economic losses. Many countries, such as the United States and Australia, have reinforced their intention of including coastal wetlands, which harbour blue carbon ecosystems, in accounting for anthropogenic carbon emissions and removals following the IPCC guidelines[xviii]. Given the potential for more countries to include blue carbon in their NDCs or further detail their NDCs in this regard, the *The Blue Carbon Initiative*[11] has developed a comprehensive guide[12] to support countries in this process. The guide does not provide a standardised roadmap, as there are several possible paths and ways to achieve that goal, but rather guidance on assessing options for inclusion in the NDCs. In short, it recommends a detailed analysis of the following aspects:

- Data comprehensiveness and clear identification of habitat degradation factors and related mitigation values in GHG inventories.
- Intra-governmental and political coordination.
- Implications for the implementation in terms of funding and capacity.

8 The Convention on Wetlands: https://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf#page=2

9 IPCC Guide to National GHG Inventories: https://www.ipcc-nggip.iges.or.jp/public/2006gl/

10 The sum of the countries is greater than 74 because each country can present both types of measures.

11 Expert input from the following organisations: Conservation International, International Partnership for Blue Carbon, International Union for Conservation of Nature (IUCN), NDC Partnership, Silvestrum Climate Associates, The Nature Conservancy, and The Pew Charitable Trusts.

12 National Blue Carbon Policy Assessment Framework: https://www.thebluecarboninitiative.org/new-guidance-to-identify-blue-carbon-policy-priorities

European Union

In its NDC (NDC-EU), the European Union has set the goal of reducing net GHG emissions to at least 55% by 2030 compared to 2005 levels. This goal is expected to be attained only through domestic measures, i.e., without the contribution of international credits, and should be achieved through a 43% reduction in emissions in the sectors covered by the European Emissions Trading Scheme (EU ETS)[13] – the so-called regulated market – and a 30% reduction in the non-ETS sectors, including the LULUCF sector. The latter goal was translated into mandatory emission reduction targets for each member state, with Portugal being responsible for reducing 17% of its GHG emissions compared to 2005.
Blue carbon ecosystems are not referred to in the NDC-EU emission mitigation targets, but it is anticipated that carbon emissions and removals relating to wetlands will be accounted for and could form part of the NDCs from 2026 onwards. Regulation (EU) 2018/841[14] establishes the rules for accounting for GHG emissions and removals from the LULUCF sector and verifying the Member States' compliance with their commitments. It also establishes that wetlands are to be reported in a specific category containing the following information:

- wetland that remains as a wetland,
- another area converted into a wetland, or
- wetland area converted into a settlement or other type of area.

The regulation also highlights the importance of wetland ecosystems for carbon storage and that their protection and restoration can reduce GHG emissions in the LULUCF sector. It also reaffirms that the IPCC guidelines for National Greenhouse Gas Inventories should be considered in this context.

[13] Sectors covered by the ETS: electricity and heat generation, mineral oil refining, metallurgy, clinker, lime, and glass production, ceramics, pulp and paper, chemicals in scale, and aviation. https://climate.ec.europa.eu/eu- action/eu-emissions-trading-system-eu-ets_en

[14] Regulation (UE) 2018/841: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R0841&rid=1

The European mechanism on greenhouse gas removals (capture and storage)

To achieve carbon neutrality by 2050, the EU plans to increase carbon removal from the atmosphere to neutralise GHG emissions that cannot be eliminated. Therefore, in November 2022, the European Commission presented a proposal to create a European voluntary mechanism to reliably certify carbon removals.[15]

Methods that could be used to remove carbon dioxide from the atmosphere (referred to as CDR) include natural processes that remove carbon from the atmosphere, including the restoration of blue carbon ecosystems. Other methods mentioned use chemical processes to capture and store carbon dioxide, such as technologies that capture the CO_2 emitted during industrial production processes to inject it into the deep soil. The uncertainties regarding the risks and benefits associated with each CDR method vary greatly according to their development level. In this scenario, the IPCC considers nature-based solutions, such as those related to blue carbon ecosystems to be the most reliable as they offer several socio-economic and environmental benefits[XIX].

National

Portugal's contribution to the NDC-EU implies a GHG reduction target of at least 17% by 2030 in relation to 2005 figures. Although blue carbon is not explicitly included in these targets, there are references in the national mitigation and adaptation plans that can be quoted in relation to blue carbon ecosystems:

Mitigation
The mitigation targets and actions are included in the *Roadmap for Carbon Neutrality 2050* (RNC 2050[16] in the acronym in Portuguese) and the *2030 National Energy and Climate Plan* (PNEC 2030[17] in the acronym in Portuguese).
To achieve carbon neutrality by 2050[18], the RNC 2050 foresees the need to reduce GHG emissions between 85% and 90% compared to 2005 and achieve CO_2 sequestration levels between 9,000,000 and 13,000,000 tonnes per year by 2050. That roadmap provides general guidance for achieving this goal, establishing the importance of increasing the carbon sequestration capacity of forests and other land uses, but it does not emphasise

[15] https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7156

[16] https://descarbonizar2050.apambiente.pt/roteiro/

[17] https://apambiente.pt/clima/plano-nacional-de-energia-e-clima-pnec

[18] The Government has announced its intention to bring this target forward to 2045 in January 2023, but this intention has not yet translated into a revision of the RNC or PNEC accordingly

the role played by saltmarshes and seagrass meadows. However, this does not exclude the possibility of the potential carbon removal by these ecosystems to contribute to that target in the future.

The PNEC 2030 sets out the policies and measures for applying the guidelines contained in the RNC 2050 and establishes the goal of reducing GHG emissions between 45% and 55% in relation to 2005 by 2030. This overall goal is broken down into specific goals for the following sectors: services (70%); residential (35%); transport (40%); agriculture (11%); and waste and wastewater (30%). However, no reference is made to saltmarshes and seagrass meadows in the PNEC measures, limiting the promotion of natural sinks to agriculture and forests only (action line 6.5).
The Climate Framework Law states that the State should implement actions for the ecological restoration and sustainable development of coastal and marine ecosystems, including saltmarshes and seagrass meadows.[19] This is the most explicit mention of blue carbon ecosystems in this law, although it should be noted that no specific targets or indicators are provided, for example, regarding the areas to be maintained/expanded.

Adaptation
The Climate Change Adaptation Action Plan (P-3AC)[20] defines nine priority action lines in response to the main vulnerabilities to climate change identified for Portugal. Two of these action lines can be directly linked to blue carbon ecosystems: "*Increasing the resilience of ecosystems, species, and habitats to the effects of climate change*"; and "*Increasing resilience and coastal protection in areas of high risk of erosion and inundation and landslides*".

Further analysis of ongoing and planned P-3AC measures will be useful for identifying synergies with possible saltmarsh and seagrass meadow restoration and conservation projects in Portugal. Likewise, this analysis may be relevant to identifying measures that can ensure that these projects have a greater chance of success, such as those aimed at preventing siltation and contamination of coastal environments.

[19] According to article 58, paragraph "d" of Law no. 98/2021, of December 31st

[20] https://apambiente.pt/clima/programa-de-acao-para-adaptacao-alteracoes-climaticas-p-3ac

03

Blue carbon ecosystems in Portugal

Saltmarshes and seagrass meadows are the main blue carbon ecosystems in Portugal. Based on research conducted by the Centre of Marine Sciences of the University of Algarve (CCMAR) under the Gulbenkian Blue Carbon Project, it is estimated that there are around 11,700 hectares of blue carbon ecosystems in mainland Portugal: approximately 10,000 hectares of saltmarshes and 1,700 hectares of seagrass meadows (Scientific Report I. *Assessment of blue carbon ecosystems in mainland Portugal*, Scientific Report II: *TThe 10 main blue carbon ecosystems in mainland Portugal*).
The survey conducted on these two ecosystems by CCMAR included collecting and analysing information on the ten largest estuarine-lagoon systems on the Portuguese continental coast: the Ria de Aveiro, Mondego Estuary, Óbidos Lagoon, Tejo Estuary, Sado Estuary, Mira Estuary, Ria de Alvor, Arade Estuary, Ria Formosa, and Guadiana Estuary. Except for the Óbidos Lagoon, all the other systems are under some type of protection regime either at the national level within the National Network of Protected Areas (RNAP in the acronym in Portuguese) or at the European level within the Natura 2000 network as a Site of Community Importance (SCI), a Special Protection Area (SPA), or wetlands of international importance under the Ramsar Convention (Ramsar Sites).

The technical sheets in CCMAR's scientific reports contain specific details for each system studied.

The extensive natural areas of blue carbon ecosystems that historically occupied the coastal zone have been converted to other uses such as agriculture, urban and port development, aquaculture, and salt production. Current threats to blue carbon ecosystems in Portugal are port infrastructures (wharves, ports), pollution (industrial, urban, and tourism-related), the alteration of river and lagoon beds, coastal interventions (breakwaters, dykes, jetties, etc.), the introduction of exotic species, and the removal of inert waste materials (by dredging and desilting).[xx] Specific and detailed information for each system studied can be found in the scientific reports published together with this roadmap.
To estimate the potential recovery of blue carbon ecosystems lost over the years, it is crucial to map the areas converted to other uses that are inactive, as well as those in the process of degradation. This analysis was conducted by the Portuguese Environment Agency (APA) for the Algarve region, which identified, for example, 645 hectares of inactive artificialized areas in the Ria Formosa that could be the target of active or passive saltmarsh and seagrass meadow restoration projects[xxi].

Figure 5. Location of estuarine systems containing blue carbon ecosystems in Portugal

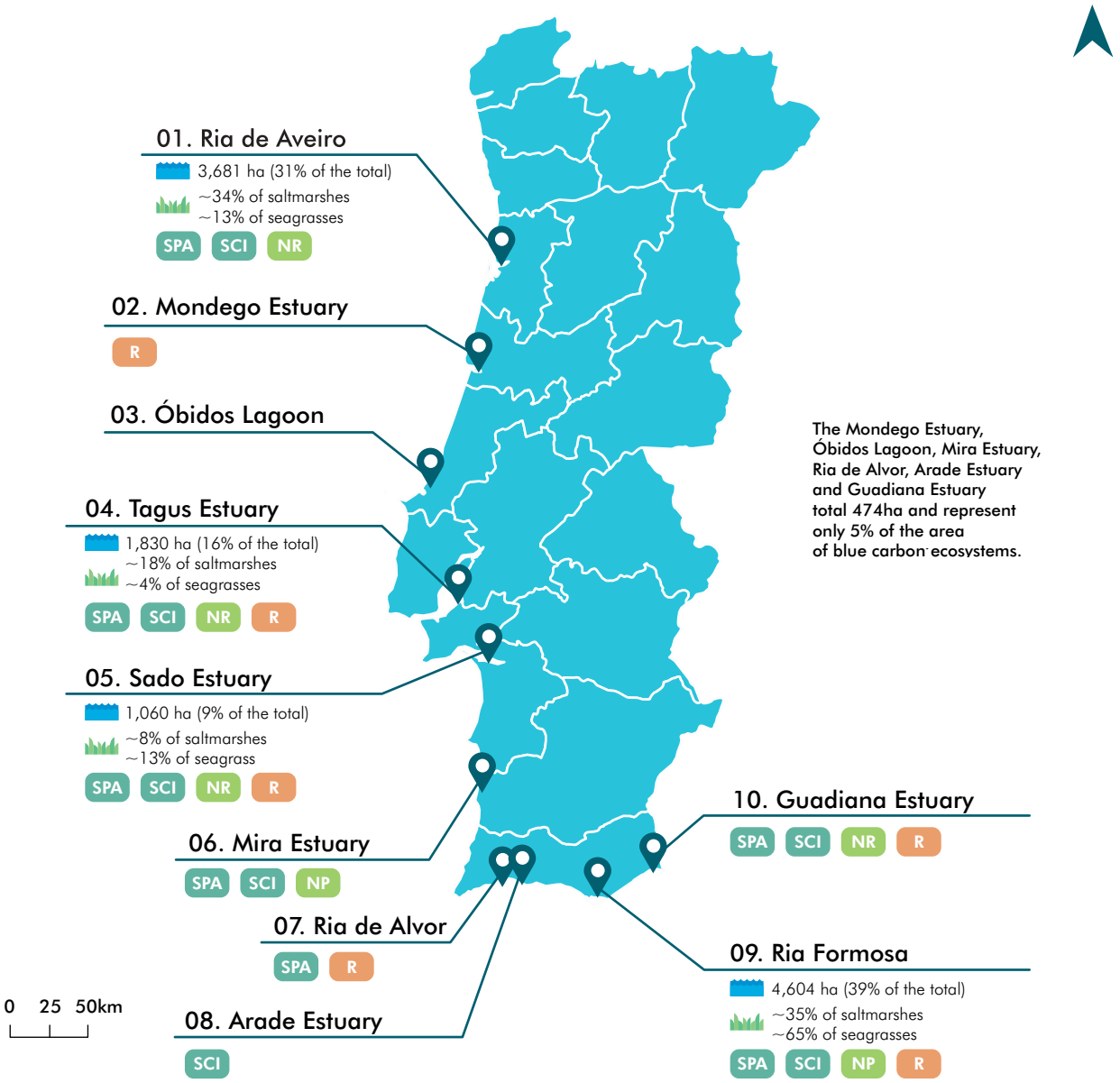
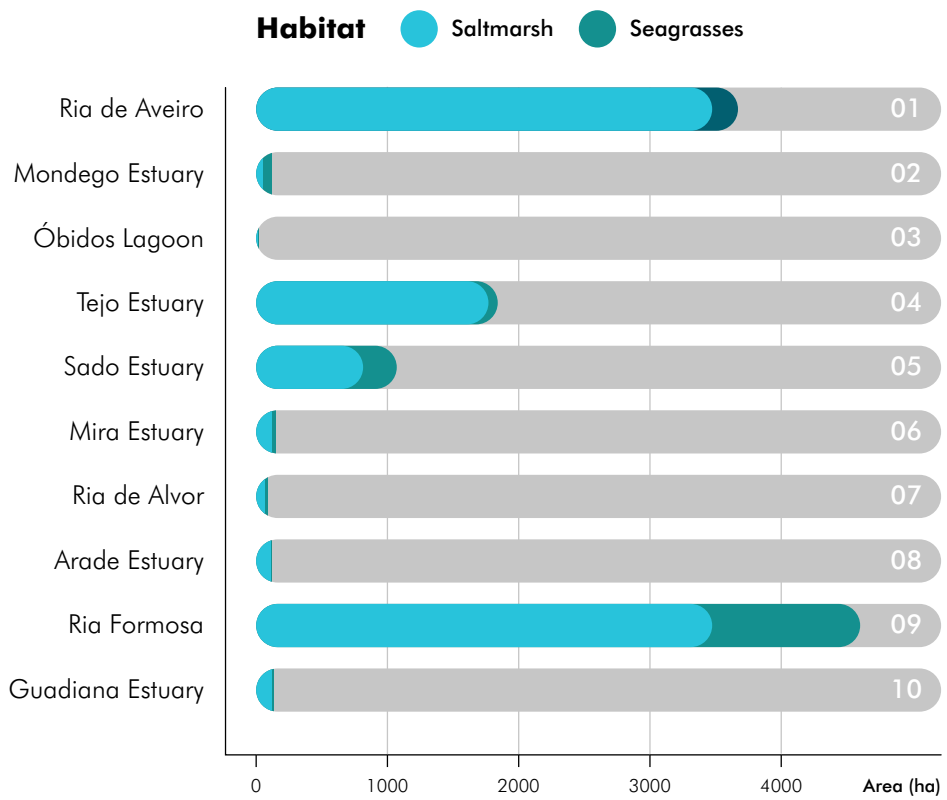


Figure 6. Area occupied by the two blue carbon ecosystems – seagrasses and saltmarsh – in each of the systems studied in mainland Portugal



Source: CCMAR's Scientific Reports, Gulbenkian Blue Carbon Project

Carbon storage and sequestration

There is no official data published by the Portuguese government on the extent of blue carbon ecosystems in Portugal, and information on carbon stocks and sequestration rates is scarce and lacks greater precision. The estimates presented were based on the scientific literature, which has several limitations for most of the systems studied. The data on the Ria Formosa are the most credible and were used as a reference to calculate carbon storage and sequestration in other systems whenever data from a given system or other nearby systems were not available. Therefore, the information presented here should be used with extreme caution and is not a substitute for obtaining specific *in situ* data.

CCMAR estimated that the total carbon stored in the main blue carbon ecosystems in mainland Portugal is 845,000 tonnes, with 87% sequestered in saltmarsh areas (733,000 tonnes) and 13% sequestered in seagrass meadows (113,000 tonnes).
The carbon (C) sequestration rate was estimated at 3717 t/year, with 79% in saltmarshes (2930 t/year) and 21% in seagrass meadows (787 t/year).
Considering the estimates regarding their areas and carbon sequestration rates and applying the IPCC conversion factor[21] to calculate the amount of carbon dioxide, it is estimated that blue carbon ecosystems contribute to the removal of approximately 13,500 tonnes of CO_2 from the atmosphere each year.

This means that, on average, each hectare of saltmarsh and seagrasses removes between 1 and 2 t CO_2 /year[22], respectively. Nevertheless, the actual capacity of each environment can vary significantly as per vegetation density, species, climate, conservation status, and depth. For example, for comparison purposes, a recent study on seagrasses in the Mediterranean Sea, particularly *Posidonia oceanica*, points to a removal rate of approximately 4 t CO_2/ha per year. That work resulted from synthesising approximately one hundred measurements made along the Mediterranean coast at depths ranging from 0.5m to 32 m.[XXII]

[21] Conversion factor: 44 units of (CO_2) per 12 units of (C) (IPCC, 2006)

[22] Calculation Memory:

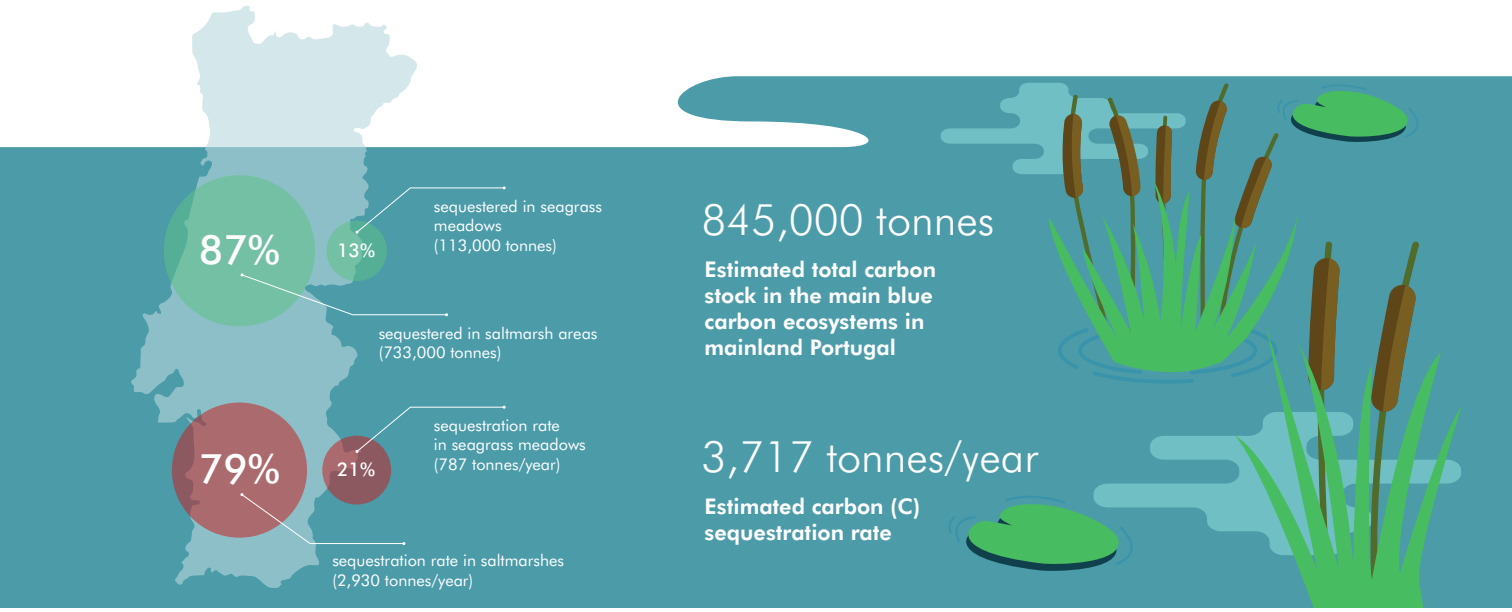
Saltmarsh = 2,930 t C/year / 10,040 ha = 0.291 t C/ha/year

CO_2 conversion = 0.291 x 3.67 (44/12) = 1.06 t CO_2eq/ha/year

Seagrasses = 787 t C/year / 1,684 ha = 0.467 t C/ha/year

CO_2 conversion = 0.467 x 3.67 (44/12) = 1.71 t CO_2eq/ha/year

Figure 7. Sequestration and storage of blue carbon in major ecosystems – mainland Portugal



Much more precise measurements are needed to determine the carbon credits generated by the conservation and management of these ecosystems. Specifically, it is necessary to know more about the area occupied by each blue carbon ecosystem and the sequestration rate of different systems with blue carbon ecosystems in Portugal in order to make more precise calculations.

Moreover, the accounting of net CO_2 removal at the national level depends on other variables which occur naturally, such as the emission of CO_2 and other gases (for example, methane (CH_4) and nitrous oxide (N_2O)) and those from anthropogenic interventions in these systems. The main methodologies available to develop this type of accounting are found in the IPCC Guidelines on wetlands and can be complemented with specific methodologies and data where available. For example, a country should have specific data on its ecosystems' real carbon sequestration rates and not just model-based figures[23].

CCMAR studies also analysed the availability and quality of existing information, summarised in the tables below.

[23] The IPCC Wetlands Supplement has guidelines indicating the use of minimum evidence required for GHG inventory inclusion (Tier 1), country-specific emission factors (Tier 2), or the use of modelling approaches (Tier 3).

Figure 8. Data availability for the calculations of carbon stock and sequestration rates in the sediment in each of the systems studied

System	Saltmarsh stocks	Saltmarsh rates	Seagrass stocks	Seagrass rates
Ria de Aveiro	Yes (5 species)	No	Yes (1 species)	No
Mondego Estuary	No	No	No	No
Óbidos Lagoon	No	No	No	No
Tagus Estuary	No	No	No	No
Sado Estuary	No	No	No	No
Mira Estuary	No	No	No	No
Ria de Alvor	No	No	No	No
Arade Estuary	No	No	No	No
Ria Formosa	Yes (3 subtypes)	Yes (1 subtype)	Yes (2 subtypes)	Yes (2 subtypes)
Guadiana Estuary	No	No	No	No

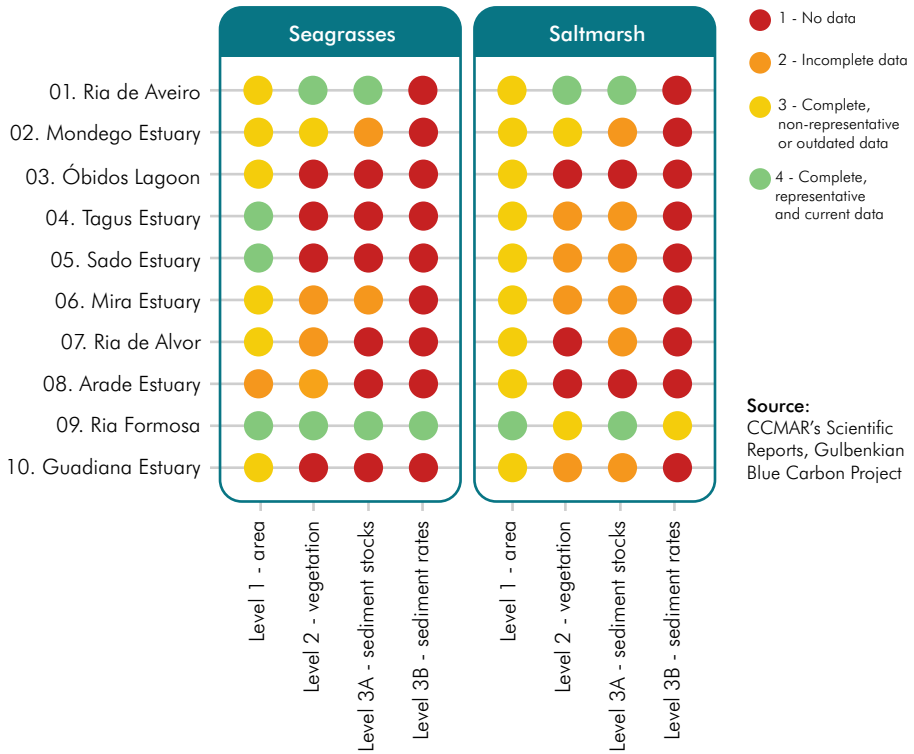
Source: CCMAR's Scientific Reports, Gulbenkian Blue Carbon Project

It can be concluded that, out of all the systems analysed, data are available on the Ria Formosa only – both for seagrasses and saltmarshes – with sufficient quality to serve as a basis for designing blue carbon interventions/projects. For the other systems, the development of projects will always have to be preceded by fieldwork to determine carbon sequestration rates and carbon stocks both in sediment and vegetation.

Initiatives in blue carbon ecosystems in Portugal

In Portugal, a number of initiatives have been implemented with the aim of giving relevance to blue carbon ecosystems, related to awareness-raising, research, protection and reconstruction of seagrass meadows and salt marshes, namely:

Figure 9. Data quality (on a scale of 0 to 3) at the three levels (area, vegetation, and sediment) for each type of blue carbon ecosystem – seagrasses and saltmarsh – in the systems studied



SEAGHORSE 2021-2023 project[24]**:** coordinated by CCMAR and funded by Belmiro de Azevedo Foundation, it aims to contribute to the reconstruction of a seagrass meadow and its repopulation by seahorses in a sanctuary in the Ria Formosa. Species transplants have been performed, which were collected from a semi-natural donor site located at the Olhão Pilot Fish Farming Station of the Portuguese Institute for the Ocean and Atmosphere (EPPO/IPMA).

Guardians of the Sea: with the support of women from the Sado Estuary fishing community, the Ocean Alive cooperative mapped 20 seagrass meadows in this system using GPS. In 2022, after removing a mooring cable that was damaging the plants, an active seagrass restoration intervention was made in the Tróia peninsula area, which comprised stabilising the sediment and transplanting plants from the same meadow.

[24] https://www.seaghorse.pt/

The restoration activity was funded by Viridia - Conservation in Action and supported by several companies. [25]

BioPradaRia Project[26]: this research project, coordinated by CESAM (University of Aveiro) and developed between 2018 and 2022, sought to promote the restoration, management, and conservation of marine meadows in the Ria de Aveiro. It published several studies, including one that assesses the challenges and opportunities for the creation of a standardised method for restoring marine coastal ecosystems [XXIII] and another one that presents a three-step approach to improving the resilience of *Zostera noltei* in order to facilitate the success of restoration plans for this species [XXIV].

Biomares Project: this project was coordinated by CCMAR and funded by LIFE programme, and it aimed at re-establishing the marine meadows that once existed in the Arrábida Marine Park. Transplanting was performed between 2007 and 2010: 60 plots were replanted in the Portinho da Arrábida and Galapos areas. The plants were collected from the Ria Formosa and the Sado Estuary and then transported to Arrábida, where they were planted.[27]

It should be noted that there are no blue carbon projects in Portugal, i.e., none of these initiatives aimed to reduce CO_2 from the atmosphere or certify these reductions to generate carbon credits given the incipient development of scientific knowledge about blue carbon ecosystems and the weak maturity of the voluntary blue carbon market. Further examples of projects can be found in CCMAR's scientific reports.

25 https://viridia.pt/why-we-exist/our-projects/reforesting-the-sea/

26 https://biopradaria.weebly.com/

27 http://biomares.ccmar.ualg.pt/projecto-biomares.html

04

Blue carbon in the voluntary market

Carbon credit markets (or simply carbon markets) were conceived under the UNFCCC as a complementary financing mechanism for contributing to the overall reduction or mitigation of GHG emissions and promoting the development of a low-carbon economy. Carbon credit markets do not replace the urgent need for massive reductions in GHG emissions, but they can generate additional reductions that would otherwise be too expensive or even technically unfeasible. Thus, the carbon market enables countries, companies, organisations, and individuals to offset part of their GHG emissions by purchasing credits generated by projects that are proven to reduce GHG emissions or capture carbon dioxide.

Carbon credit

Each carbon credit unit refers to one tonne of carbon dioxide equivalent (CO_2eq). This measure is used to convert other GHGs to the equivalent amount of carbon dioxide with the same Global Warming Potential (GWP). For example, according to the IPCC, the GWP of methane (CH_4) is 28, meaning that each methane tonne is equivalent to 28 tonnes of CO_2 eq[XIX].

There are two types of carbon markets: regulated and voluntary.

Regulated carbon market: these are mechanisms established under the UNFCCC to contribute to national GHG reduction commitments. Countries have the autonomy to regulate the market at the national or sub-national level, adopting strict and standardised rules, ensuring that all those involved have access to the same information and that transactions are fair and transparent. For example, they must ensure a robust emissions accounting to avoid double counting (when the same tonne of CO_2eq is counted as a reduction by two companies or countries). Regulated markets can be found in Canada, China, Japan, the United States of America, and EU countries[28].

The European Emissions Trading System (ETS) was the world's first and largest regulated carbon market (EUR 683 billion worth of allowances were traded in the ETS in 2021, 90% of the world's value). The ETS is the main European instrument for reducing GHG emissions. According to the European Commission, the sectors covered by the EU ETS (not including LULUCF) reduced emissions by approximately 35% between 2005 and 2019.

The ETS operates under a cap-and-trade scheme to control the overall volume of GHGs emitted by the sectors covered. The emission limit ("cap") is reduced annually to ensure

[28] https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en

that mitigation efforts remain prioritised. Companies regulated by the ETS must purchase carbon allowances ("trade") through the market or the system's auctions (between EUR 80 and EUR 90 per tonne in recent years), thus contributing to meeting their reduction targets in addition to the efforts to change production processes to ones that generate fewer GHGs. Annually, the companies covered by the regulated market must present enough licenses to fully meet their non-mitigable emissions[29], otherwise, they may have to pay heavy fines.[30] There are other instruments regulated by the UNFCCC but without direct relevance to Portugal.[31]

At COP27 in 2022, the rulebook for Article 6 of the Paris Agreement was agreed upon, establishing new instruments for cooperation among countries to achieve their NDC targets and contributing to limiting global warming to 1.5°C. Initial guidelines on the international trading of emission mitigation outcomes among countries (ITMOs) were adopted, as well as on the authorisation process, flows, and procedures for generating carbon credits from projects of the new mechanism as mentioned in article 6.4, which will replace the Clean Development Mechanism. GHG reduction and removal projects under the UNFCCC must comply with the guidelines and will be validated by a supervising body yet to be established under the Paris Agreement. Since there are still procedures to be agreed upon and infrastructure requiring implementation, this new internationally regulated market is expected to be active from 2025 onwards.

Voluntary carbon market (VCM): these carbon credit trading initiatives are not associated with the countries' legal commitments or obligations under the UNFCCC. This means the voluntary market does not trade GHG emission allowances, but GHG reductions or removals generated and purchased voluntarily. The voluntary market allows organisations to offset emissions that are difficult to reduce in order to neutralise their carbon footprint voluntarily or to integrate corporate, social and environmental responsibility actions. Offsetting occurs through the purchase of credits generated by projects that:

- Avoid or reduce GHG emissions such as renewable energy or avoided deforestation;
- Remove or sequester GHGs such as reforestation or technology-based removal[xxv].

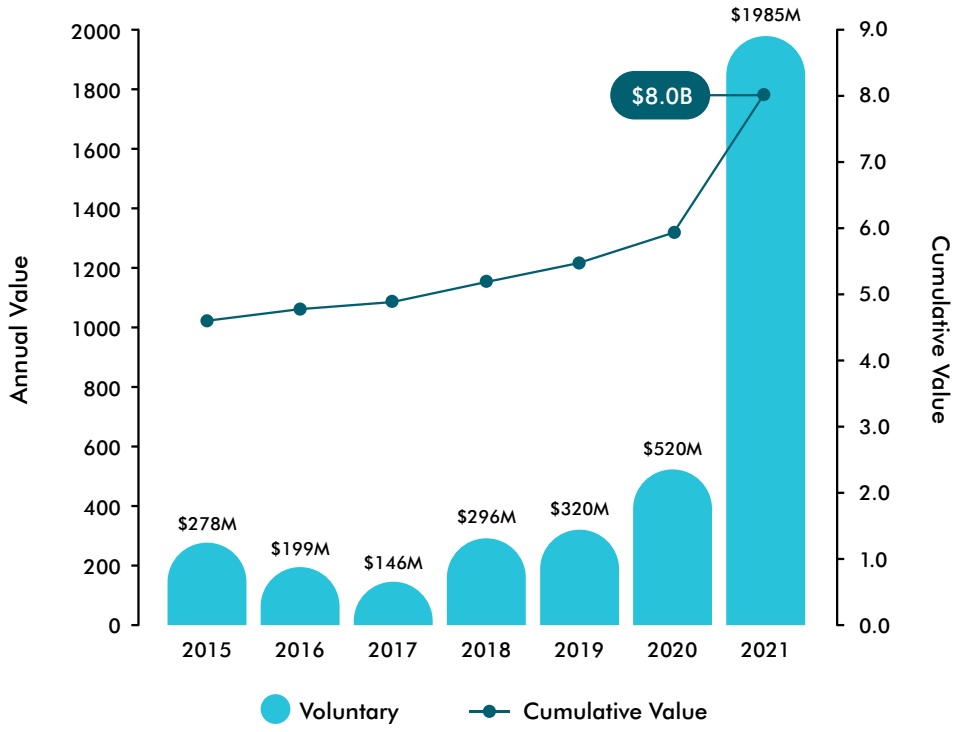
[29] The GHG emissions related to an industrial process or commercial operation, whose reduction or elimination is technically unfeasible or financially prohibitive to the sustainability of the activity, are considered non-mitigable.

[30] https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en#a-cap-and-trade-system

[31] Another instrument regulated by the UNFCCC is the Clean Development Mechanism (CDM), which allows developed countries with GHG reduction targets to purchase carbon credits generated in developing countries (which had no GHG reduction targets before the Paris Agreement). Projects must follow methodological standards set by the IPCC, and transactions must be validated and registered by bodies created under the UNFCCC. The CDM will be replaced by a new international mechanism, as mentioned in the Paris Agreement.

The purchase and sale of carbon credits in the voluntary market do not depend on the fact that the country where the project is being developed has specific legislation on voluntary carbon markets unless there are regulations that restrict it. Obviously, local legislation must be respected as there may be other restrictions regarding the proposed initiatives, property rights, etc. Therefore, it is useful that countries regulate the voluntary market to bring legal security to investments and guarantee better projects. In Portugal, for example, the government has presented a legislative proposal for the regulation of the voluntary carbon market, which should bring greater clarity about the responsibilities involved, necessary procedures, accepted activities, and methodologies for projects, among other relevant issues which will be addressed in the following chapters. The law's version under public consultation does not cover blue carbon ecosystems. Although it is recommended that blue carbon should be included in the legislation, its absence does not prevent restoration and conservation projects in these ecosystems from generating carbon credits as long as they are credible and verified by an independent body (issues to be detailed in the following sections).

Figure 10. Voluntary Carbon Market Size by Value of Traded Carbon Credits, 2015 to 2021 (USD)



Source: Ecosystem Marketplace, 2022

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Blue Carbon Research

Between 2020 and 2021, transactions in the voluntary carbon market almost quadrupled from USD 500 million to about USD 2 billion in carbon credits. The majority of this amount – about 67% (USD 1.3 billion) – comes from the forestry and land use sector, which includes blue carbon projects. The second largest sector was renewable energy, with 36%. The average price per carbon credit was USD 4/tonne, below the regulated market. However, projects that generate additional benefits related to increased biodiversity, job creation, and support to the local communities are more highly valued – as is the case with blue carbon projects. For example, projects with community involvement in reforestation and restoration had an average price close to USD 10/tonne[xxvi].

There are more than 170 types of carbon projects in the world (Fig. 12), divided into eight categories: Forestry and Land Use (which includes Blue Carbon); Renewable Energy; Housing and Community; Chemicals/Industry; Energy Efficiency; Waste Management; Agriculture; and Transport. [xxvi]

Figure 11.
Transactions in the voluntary carbon market

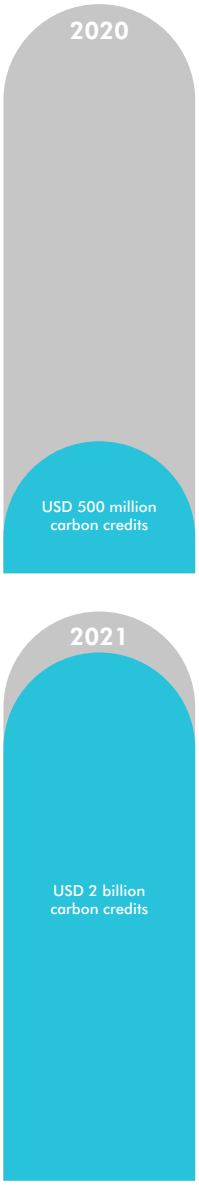
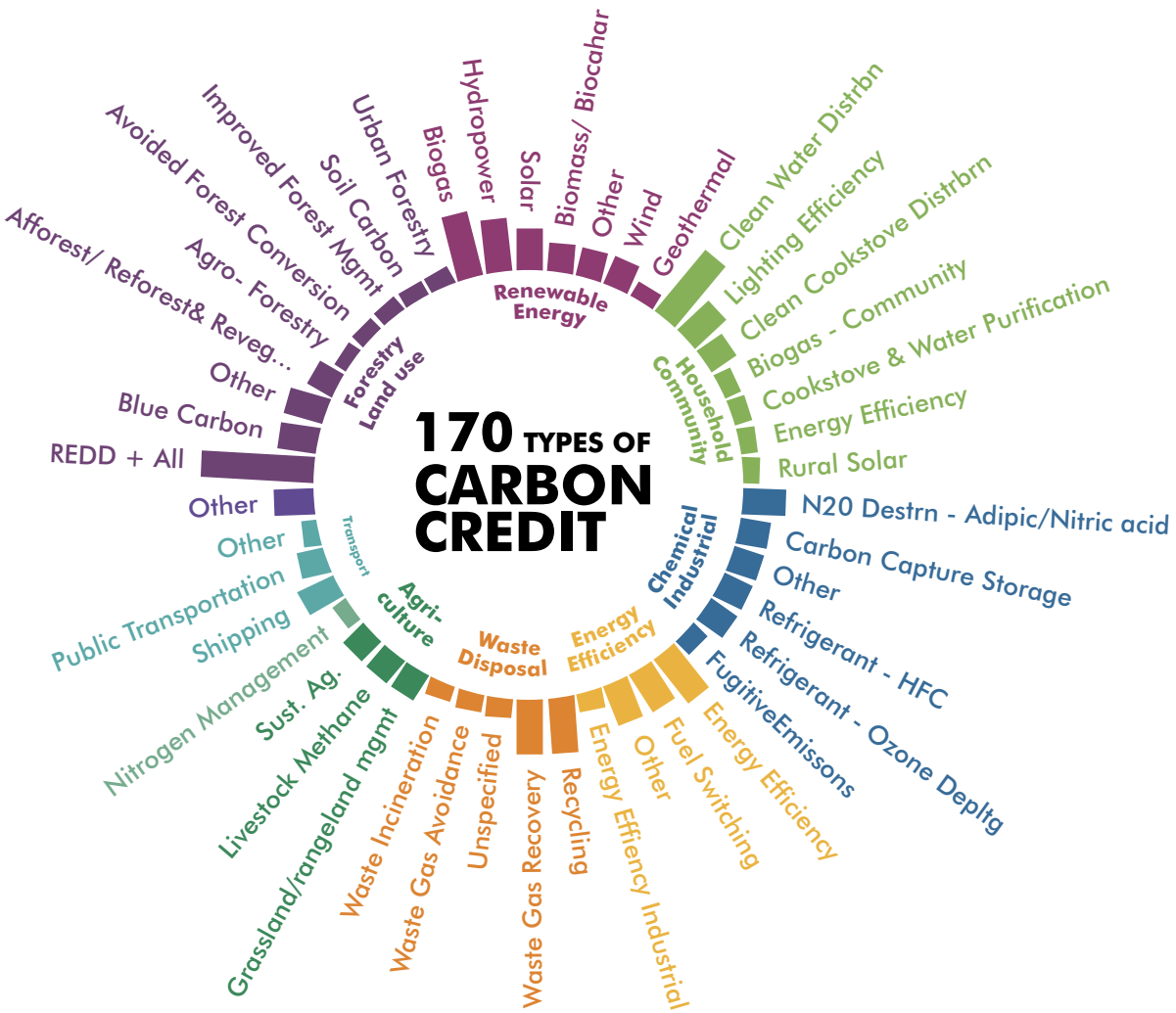


Figure 12. Types of Carbon Projects



Reproduced from: Forest Trends' Ecosystem Marketplace, 2022. The Art of Integrity: State of the Voluntary Carbon Markets

Purchase of carbon credits: the sale of credits in the voluntary market may be carried out directly between the interested party and the person responsible for the project or through an intermediary (broker).

a) Direct purchase from the project manager

In this option, the company or interested party negotiates credits directly with the organisation responsible for the project it intends to support. In this case, investments in the development of the project with a commitment of return in future credits can be made, or credits can be purchased from reductions in GHG

already validated, contributing to the economic sustainability of the project. Purchasing carbon credits directly from the project manager has the advantage of being closer to the reality of the project being supported. On the other hand, this option requires those interested in the credits to search for and identify suitable projects and those responsible for them. Furthermore, in the case of projects under development, carbon credits are not available immediately after investment.

Example: Apple purchased 17,000 tonnes of CO_2 in credits directly from a mangrove conservation project in Colombia[32], managed by Conservation International. According to the records of the certifier VERRA, the emission reductions ocurred between 2015 and 2016, and the credits were validated and sold in 2021. The project used the VCS/ VERRA VM0007 methodology framework. Although there is no information on the amounts paid, reports from Conservation International indicate that only part of the carbon credits generated will be claimed on behalf of Apple, as most of its funding consisted of philanthropic donations.

The interest of Portuguese companies in blue carbon

Some Portuguese companies that sought out the Gulbenkian Blue Carbon Project partners showed an interest in offsetting part of their GHG emissions through blue carbon projects. These companies have already purchased carbon credits on the voluntary market to reduce their carbon footprint and achieve other corporate responsibility indicators. They have shown great interest in the possibility of geographical proximity between the carbon projects they intend to invest in and the markets where they are present. Therefore, they intend to support projects in Portugal as soon as they are available, oor with a clarified path forward. The companies mentioned that their GHG emission reduction policies are based on programmes such as the Science Based Targets initiative[33], and that the carbon credits acquired are usually accredited by a recognised body in order to ensure integrity and quality criteria.
It was identified that there is a need for clarification among companies about the different stages of a blue carbon project and that, in many cases, it will be necessary to make a pre-investment, i.e., the financing of preparatory phases so that these projects can generate verifiable, quality carbon credits.

[32] The "Blue Carbon Project Gulf of Morrosquillo" in Colombia aims to sequester 1,000,000 tonnes of CO_2 over the 30 years of the project through the conservation and management of 7,561 hectares of mangroves.

[33] https://sciencebasedtargets.org/

b) Buying from an intermediary
Many projects rely on intermediary companies to negotiate the sale of their carbon credits. These are usually platforms designed to identify and purchase large quantities of carbon credits, allowing the creation of a portfolio of projects from which credits can be purchased. The advantage of this option is the ease of access – as the company or interested party only needs to search in the different portfolios for a project that suits its needs – while the other adjustments are left to the platform. The disadvantages may be several: lack of transparency about the price of the carbon credit *versus the* intermediary commission, i.e., it is not always clear how much of your investment will actually contribute to the project; lack of clarity about the integrity of the credits generated, including whether there was independent verification; and inadequate use of funding where it is not mostly allocated to project actions.

Example: Gucci invested in protecting mangroves in the Mosquitia region in Honduras[34], through the company South Pole[35]. The investment took place in a project still in development; therefore, it did not generate certified credits. A Spanish[36] NGO coordinates the project with the support of governmental entities and is under validation process by the VCS Standard VM0007 methodology. According to Conservation International and the 2021 Gucci Impact Report, much of the project funding does not aim at a return on carbon credits. Even though a portion of the credits are used for GHG offsetting, much of the investment goes beyond the carbon neutrality strategy of this company and is reported as part of its strategy on governance, social, and environmental responsibility.

Environmental integrity criteria for carbon reduction projects

Purchasing carbon credits to offset emissions, known as *offsetting*, still raises questions about its real contribution to mitigating climate change. The main concerns relate to the robustness of the carbon credits (whether emissions have actually been reduced), the additionality of certain types of projects (whether GHG reductions/removals would not occur anyway in the absence of the project) and the possibility that offsetting creates a disincentive for companies to reduce their emissions internally [xxv].

These and other issues are addressed by a wide variety of initiatives that establish general principles and specific recommendations related to the various types of carbon projects.

[34] https://registry.verra.org/app/projectDetail/VCS/3294

[35] https://www.southpole.com/projects/muskitia-blue-carbon

[36] https://ayudaenaccion.org/proyectos/articulos/carbono-azul/

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Ria Formosa, Portugal

Based on some of the main initiatives, we have grouped together five criteria that define the environmental integrity of the credits generated by carbon projects and should be observed by blue carbon projects:

Figure 13. Integrity criteria for GHG reduction/removal projects in the carbon market

Additionality	Avoid double counting and fictitious credits	Permanence or Durability	Emission leakage	Do no harm
Demonstrate that the GHG reduction/removal would not have occurred in the absence of the project, comparing to the baseline scenario of emissions in the project area or "business as usual".	GHG reduction/removal must be demonstrated, traceable and each credit unit must be used only once.	Ensure that the GHG reductions/ removals generated by the project will not be reversed over a long period of time (>100 years).	Prevent GHG emissions from growing outside the project area due to direct or indirect impacts of activities.	Not to result in social and environmental harm, such as human rights violations or ecological disturbances.

Source: Based on the criteria and principles of the ICROA, ICVCM, and HQBC initiatives

Initiatives on the environmental integrity of carbon credits

ICROA/IETA (International Carbon Reduction and Offsetting Alliance): sets a benchmark for responsible corporate action, focusing on the integrity of carbon credit use, quality of supply, and increasing impact and ambition.

ICVCM (Integrity Council for the Voluntary Carbon Market Core Principles): aims to inform how to deliver real, verifiable, high-integrity carbon credits.

HQBC Guidance (High-Quality Blue Carbon Guidance): specifies the principles and recommendations for blue carbon projects in the voluntary market, reviewing current and emerging knowledge, guidance, and best practices.

The role of carbon certification standards

Integrity criteria are embedded in the rules of the main carbon certification standards, which also have various methodologies to be applied during project design and implementation to prove compliance. One of their central elements is the methods for defining the baseline (GHG emissions and removals that occur in the absence of the project) and estimating and calculating the CO_2 reductions that actually occur due to the solutions implemented according to the type of project (*baseline-and-credit system*).

Independent or public bodies can set carbon certification standards. The first carbon certification standard was the CDM, established under the UNFCCC's Kyoto Protocol.[xxxiv] This standard has dozens of methodologies and remains the most widely used, for example, for certifying renewable energy projects[xxvi]. There are certification standards established by national governments such as the UK[37], Australia[38] and Taiwan, and sub-national governments such as Andalusia/Spain[39] and California/USA[40]. Currently, independent accreditation agencies – usually international non-profit organisations – have the largest share of the carbon market. There are dozens of certification standards applied by those agencies. The Verified Carbon Standard (VCS/VERRA), Gold Standard, Climate Action

37 https://woodlandcarboncode.org.uk/about/context

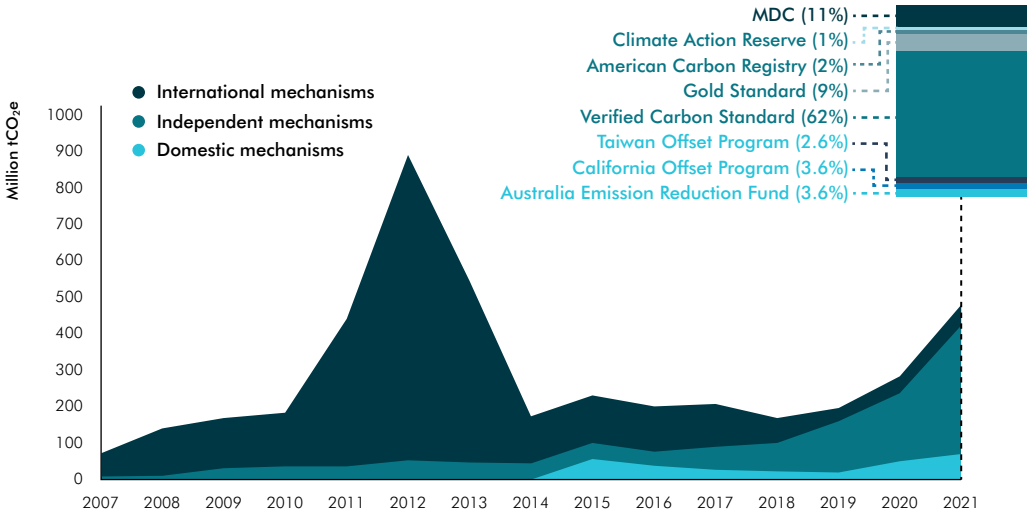
38 https://www.cleanenergyregulator.gov.au/ERF

39 https://www.juntadeandalucia.es/medioambiente/portal/web/cambio-climatico/indice/-/asset_publisher/hdxWUGtQGkX8/content/sistema-andaluz-de-compensaci-c3-b3n-de-emisiones-sace--1/20151

40 https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program

Reserve, American Carbon Registry, and Plan Vivo are the most widely recognised. Some of these have methodologies relating to wetlands, and others specific to blue carbon ecosystem restoration and conservation activities (see further detail in the section "Blue Carbon Projects").

Figure 14. Global Volume of Certified Emissions per Crediting Mechanism Category



Source: State and Trends of Carbon Pricing 2022 (World Bank, 2022)

Due to the voluntary nature of this market, the certifiers have the role of safeguarding the quality of the carbon credits, transparency, and credibility of the baseline-and-credit system on which the voluntary carbon market is based. Credits certified by these bodies are considered more credible. However, the process (Accreditation --> Verification --> Registration) is usually too expensive and time-consuming and can make smaller-scale projects unviable. Therefore, projects that do not go through the accreditation provided by these entities but are based on credible, demonstrable, and independently verified methodologies are a possible alternative. Credits that do not undergo accreditation or transparent independent verification are considered "bad credits" since their integrity cannot be proven.

Figure 15. Categories of carbon credits in voluntary markets

Type	Accreditation	Verification	Registration	Use
A) Accredited	It uses a published, verified methodology approved by a certification agency. They go through the accreditation process	Verified by an independent body	The credits issued are included in transparent records of accreditation agencies	Used only once to offset one tonne of CO_2eq, and retired or cancelled after use
B) Not Accredited, but Verified	They can use either approved standard Methodology or customised methods based on science. They do not go through an accreditation process	Verified by an independent body	There is no obligation to submit information for registration. They can do so via private credit negotiation sites	There is a higher risk of being used more than once in case there is insufficient control, transparency and/or audits
C) Neither Accredited nor Verified	They may not go through an accreditation process. They may or may not use reliable measurement methodologies	Not verified by an independent body	No obligation to submit information for registration	Risk of fictitious credit purchase and non-existent compensation. High risk of double counting

Source: Own elaboration based on "Introduction to Carbon Standards" (Fair Carbon, 2022)[41].

[41] Available at https://faircarbon.org/content/fc/introtostandards

What characterises a good carbon credit

A good carbon credit should be associated with projects that meet environmental integrity criteria (additionality; avoidance of double counting; permanence; avoidance of leakage; do no harm), use recognised methodologies or credible methods verified by an independent organisation, and are transparent about its use, preferably in accessible records.

A high-quality credit is one that, in addition to meeting the criteria of a good credit, also generates additional socio-environmental benefits, for example, by involving and improving the quality of life of communities and generating gains in biodiversity and the various ecosystem services.

High quality in blue carbon projects, according to the *HQBC Guidance*, is associated with a project that observes the following principles: 1) safeguards nature (preserves and improves ecosystem resilience); 2) empowers people (ensures participation, respects knowledge, distributes benefits equitably); 3) applies the best information (uses the most appropriate interventions, the best available scientific information, and ensures accurate and transparent GHG accounting); 4) operates locally and according to the context (takes into account the role of ecosystems in power dynamics, resource use, ownership regimes, and governance structures); 5) mobilises high integrity capital (financial flows associated with strategies of integrity and fair and transparent contracts and agreements).

Blue carbon projects – examples, funding, and implementation

The global availability of blue carbon credits in the voluntary market is still very low due to the complexity, cost and time required for their certification. On the other hand, a growth in the number of projects approved or under development is evident. The first blue carbon project was certified in 2013 (see case study below), and only five projects had been approved worldwide by 2020. By the end of 2022, certifiers VERRA and Plan Vivo had already approved 13 projects, all related to the conservation or restoration of mangroves in developing countries. One of the projects in Kenya included seagrass conservation. However, credits for this project have yet to be generated as approval by Plan Vivo is pending.
In fact, only five projects are generating and selling blue carbon credits, i.e., they have already passed the verification of results and obtained the emission reduction certificates. All these projects aim at avoiding the deforestation of mangroves. Some of these projects are analysed in more detail in the following section. Other projects related to saltmarshes and seagrasses are being developed or waiting for approval from major certifiers. In late 2022, the first seagrass restoration project was approved in Virginia, USA (see case study below).

Seagrass meadows also provide essential habitats for threatened species of seahorses

National and regional initiatives are developing methodologies to promote blue carbon ecosystem conservation and restoration projects aimed at reducing emissions. These include the Andalusian Blue Carbon Standard[42] with two pilot projects under development (see case study 3 below), and the Australian Government's Emission Reduction Fund[43], which is still undergoing a methodological review.

It is possible to find seagrass restoration initiatives that sell uncertified credits on the voluntary market, such as the *Seagrass Grow* project in the United States. However, the lack of transparency regarding the methodologies used, verification process, independent audit, and registration make it difficult to ensure these types of credits' credibility and environmental integrity.

[42] https://www.juntadeandalucia.es/medioambiente/portal/web/cambio-climatico/indice/-/asset_publisher/hdxWUGtQGkX8/content/sistema-andaluz-de-compensaci-c3-b3n-de-emisiones-sace--1/20151

[43] https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program

Listed below are the main existing standards and methodologies that can serve as reference for blue carbon projects in Portugal, considering activities in saltmarshes and seagrass meadows.

Figure 16. Main current standards and methodologies for blue carbon projects considering activities in saltmarshes and seagrass meadows

Certifier	Standard	Methodology
VERRA	Verified Carbon Standard (VCS)	VM0033 v.2: Methodology for Wetland and Seagrass Restoration
Plan Vivo	Plan Vivo Standard	Accepts diverse methodologies provided they meet the requirements of the Plan Vivo manual: *Methodology Requirements*
American Carbon Registry	ACR	*The Restoration of California Deltaic and Coastal Wetlands Methodology; The Mississippi Deltaic Wetland Restoration Methodology*
Junta de Andalucía	V1	*Methodology for estimating carbon stocks and emission factors in tidal flats and marine phanerogamous meadows V1*
Australian Government	Emission Reduction Fund	*Carbon Credits (Carbon Farming Initiative - Tidal Restoration of Blue Carbon Ecosystems) Methodology.*

Case studies:

Below, we selected four case studies to demonstrate the work involved in developing blue carbon projects, the need to invest in scientific knowledge and stakeholder engagement, and the time and complexity involved between investing in and generating carbon credits. We selected two projects that generated carbon credit sales on mangroves – which were part of the stakeholder consultation for this roadmap – and two projects on seagrasses (one of the potential ecosystems in Portugal) – one is in the validation phase with the VCS, and the other is an initiative with two projects in the Andalusian Blue Carbon System.

Mikoko Pamoja Project / Kenya

It was the first blue carbon project in the world, certified in 2013 by Plan Vivo.

Activities/Area: Consists of the conservation and restoration of 117 hectares of mangroves through community awareness and management.

Reduction in emissions: An estimated 2,500 tonnes of CO_2/year are generated in credits.

Threats/Additionality: Mangroves were degraded and threatened due to increased exploitation for firewood and construction. This was the main reason for justifying the project's additionality, along with the fact that the communities whose livelihoods depend on these areas were sensitised and involved directly through the project activities.

Coordination: The *Association for Coastal Ecosystems Services* (ACES) is the project coordinator responsible for commercial transactions involving the buyers and communities. In addition to the ACES, the project is managed by the Mikoko Pamoja Community Organisation (MPCO), composed of Gazi Bay representatives and the Mikoko Pamoja Advisory Committee (MPSG), which provides technical support and is composed of the founding organisations of the project, including government agencies (Kenya Marine and Fisheries Research Institute (KMFRI) and Kenya Forest Service (KFS)), universities (Edinburgh Napier and Bangor), an international NGO (WWF Kenya), and a private foundation (Earthwatch Institute).

Project development: the ACES was responsible for creating the Project Design Document (PDD) and submitting it for validation and certification by Plan Vivo. Project activities began after three years of negotiations, with intense community involvement, meetings with partners, and scientific assessment. The Government

and the two local communities involved had to reach an agreement to allow them to access and manage the mangroves.

Reference level: The project benefited from previous research on threats and the conservation status of the ecosystems, which was essential for establishing scenarios/benchmarks. In addition, carbon stocks were assessed considering both natural and restored forests.

Funding: The project has been partially funded by the financial or *in-kind* resources of the various partners that compose the Advisory Committee. Some of these are also buyers of the credits generated by the project. Costs included the research, liaison, preparation of the project design document, validation process, and implementation activities. It is unclear exactly how much money was required to make the project successful, but according to information from the project partners, it is estimated that the development of the PDD alone cost USD 250,000.

Implementation and Sale of Credits: The project involves activities such as increased surveillance, improved community education and awareness, ecological and community restoration of mangroves, monitoring of regeneration, etc. About 67% of the revenues from carbon credits are used to support local water and sanitation, education, health, and environmental conservation projects.
It started generating credits for the area already forested (protection) only after one year, whereas it took about five years for the reforested area. Initial prices were low (from USD 9 to 15/tonne of CO_2). In 2022, this project achieved sales of approximately USD 20/tonne as they were considered quality credits, i.e., with added value due to the direct benefits for the community and the environment. As a result, they began by receiving USD 8,000 annually in 2013, rising to approximately USD 20,000 in 2022.

Sources: The Project Design Document, available on the Plan Vivo website[44], and an intervew with WWF-Kenya, partner of the Mikoko Pamoja Project.

[44] Mikoko Pamoja Project: https://www.planvivo.org/mikoko-pamoja

Virginia Coast Reserve Seagrass Restoration Project

It is the first project on seagrass restoration approved under VERRA Standard VM033. Although the project was approved in 2022, its activities started in 2015. Therefore, as soon as the first verification of results occurs, the project can generate the first certified credits from a blue carbon project on seagrass meadows.

Activities/Area: The project comprises seagrass restoration through direct seeding techniques. The intervention area covers 66,000 hectares within a private Nature Reserve that has been managed by the Nature Conservancy (TNC) for over 50 years in Virginia, United States (*Virginia Coast Reserve - VCR*). The first phase of the project aims to restore around 3,000 hectares.

Reductions in emissions: Over the 30-year crediting period, the project is estimated to generate 40,486 tonnes of CO_2 in credits. At the end of the first five years (from 2015 onwards), it is expected to have generated between 300 and 400 tonnes of CO_2, and it will generate between 3,000 and 4,000 tonnes of CO_2 after ten years.

Threats/additionality: Before 1930, the species *Zostera marina* was widely distributed in Virginia's coastal bays, but the combined impact of a pathogen outbreak and a powerful hurricane in 1933 led to the total collapse of seagrass populations in that area. Seagrass meadows remained absent until the late 1990s when the re-emergence of small natural patches of *Zostera marina* indicated that favourable conditions for seagrass growth had re-emerged.

Coordination/partners: The Virginia Department of Environmental Quality (VA DEQ) is the project proponent as ownership of the carbon credits generated is vested in the state of Virginia as legally defined in the Code of Virginia.
TNC is responsible for managing the project and implementing the seagrass restoration actions.
The Virginia Institute of Marine Science (VIMS) is also responsible for implementing seagrass restoration and collecting data for the project's carbon monitoring.
The University of Virginia is responsible for collecting data for monitoring the carbon project.

Project development: TNC was responsible for creating the PDD in partnership with the company TerraCarbon LLC. Eligible field activities for crediting began in 2015, drawing on the experiences and scientific conclusions of a long history of partnership between TNC and the VIMS, which have been developing and implementing seagrass restoration methods in this Virginia coastal reserve since

Seagrass meadows in the United States of America

1999. For example, it has been estimated that the restoration of 700 hectares between 2001 and 2015 generated a net removal of approximately 8,000 tonnes of CO_2. In addition, as described by TNC, there was intense community involvement in the years preceding the start of the project, capacity building and awareness raising activities, public consultations, and meetings with partners.

Baseline scenario and monitoring: The project does not account for the reductions in GHG emissions but rather the net CO_2 removals due to seagrass restoration. Therefore, the baseline scenario is considered null, and the removals will come from the positive variation of area covered by seagrass as a result of project activities. The project benefits from the existence of an annual mapping conducted by the VIMS. Vegetation cover is determined using GIS data on the distribution of submerged aquatic vegetation and density from multispectral aerial imagery and techniques commonly used in field biology.

Funding: The PDD does not cite the implementation and development costs of the project. However, research and interviews to key stakeholders conducted for this roadmap helped to determine that at least USD 1,000,000 have been invested since 2001, with the participation of government agencies and TNC through fundraising and philanthropic donations. The direct cost of restoring seagrasses in the Virginia coastal reserve is estimated at USD 1,200 per hectare. This figure is associated with the current conditions and accumulated experience in the project's intervention area, but it should be noted that there is a significant variation depending on the area, climatic conditions, threats, intervention needs, etc.

Implementation: Seeds are collected from an area of approximately 10 hectares in the restored South Bay meadows in the Virginia Coast Reserve. TNC and the VIMS work with volunteers to collect flowering shoots by hand. The shoots are stored

in open-air seawater tanks during the summer months. Seeds are distributed in areas identified through research and monitoring as potentially suitable habitats for seagrasses. Seeds are transmitted from boats to meadow restoration plots of approximately 4,000 m² by hand.

Sale of credits: The project has yet to generate any carbon credits, i.e., it has yet to undergo the independent verification phase of its results. Under the Code of Virginia, revenue from the sale of blue carbon credits must go towards the monitoring and research of submerged aquatic vegetation, namely seagrasses, or cover any administrative costs of participating in the credit market.

Sources: The PDD, available on the VERRA website, and documents and information from TNC and VIMS.

Mangrove management in Mozambique

The Blue Forests Project Mozambique + REDD Project + Mozambique to FCPF

This case illustrates how investments in information and baseline conditions are critical for the future development of blue carbon projects. A project whose objective was not to generate carbon credits created the basis for the government of Mozambique to develop a mangrove management strategy and a project that raised millions of dollars through the sale of carbon credits.

The overall objective of the Blue Forests project in Mozambique was to improve the understanding of the benefits of coastal ecosystems, their relationship with carbon and other ecosystem services, and promote better community management of mangroves. WWF-Mozambique implemented the project between 2015 and 2020 with funding from the Global Environment Facility (GEF), amounting to USD 425,000. The project had an institutional partnership with government agencies and community associations. According to information obtained in an interview, part of the resources was earmarked for mangrove-focused studies, which cost between USD 20,000 and USD 50,000 each, not including logistics costs. The studies helped to identify the potential blue carbon market and recommend project development in two areas to be managed by the communities. Through GEF investments, it has been possible to support the development of the National Mangrove Management Strategy (the first ever in the country), which established not only the target of restoring 5,000 hectares by the end of 2022 but also the management priorities for preventing habitat loss and ensuring the development of communities. The strategy considers blue carbon projects as a sustainable funding mechanism for mangrove conservation. The FNDS (National Fund for Sustainable Development) is responsible for managing this topic and follows REDD+ procedures.

As a result of all this investment, the government of Mozambique developed a REDD+ project including mangroves and submitted it to the Forest Carbon Partnership Facility (FCPF),[45] a World Bank trust fund. In 2021, Mozambique received USD 6.4 million for the reduction of 1.28 million tonnes of carbon emissions accounted for since 2019. The payment occurs between the government of Mozambique and the FCPF under the Emissions Reductions Payment Agreement (ERPA). This agreement includes the transfer of ownership of the carbon credits generated until the end of 2024.

Sources: Interview with project partner WWF-Mozambique, information from the GEF Blue Forests[46] website and the FCPF initiative website.[47]

[45] FCPF: https://www.forestcarbonpartnership.org/carbon-fund

[46] GEF Blue Forests: https://gefblueforests.org/project/mozambique-site/

[47] FCPF Moçambique: https://www.forestcarbonpartnership.org/country/mozambique

Pilot projects following the Andalusian Blue Carbon Credit Standard:

Following the development of the specific methodology for certifying blue carbon projects, the Regional Government of Andalusia, Spain, has created a catalogue of projects so that potential funders can support their implementation and benefit from the carbon credits generated. Currently, there are two projects available. The following table summarises the information available on the Andalusian Regional Government website[48].

Figure 17. Pilot projects following the Andalusian Blue Carbon Credit Standard

Project	Restoration of the Bay of Cadiz	Restoration in the Cabo de Gata-Níjar Natural Park
Object/Ecosystem	Restoration of the saltmarsh vegetation.	Conservation and restoration of seagrass meadows (*Posidonia oceanica*).
Activities	To replenish the saltmarsh with *Spartina maritima* and natural recolonisation through specific actions to improve the water regime and restore the profile of the land in the intervention areas.	Replacement of the current anchoring structures by systems that minimise the impact on meadows. This could be complemented by planting in currently degraded areas.
Intervention area (ha)	365	11
Tonnes of CO_2 removed (in 50 years)	106,367	684
Estimated cost (EUR)	345,044	273,060
Average Tonne CO_2/ha/year	5.83	1.24
Ratio €/tonne CO_2	3.24	399.21
Ratio €/ha	945.33	24,823.64

[48] https://www.juntadeandalucia.es/medioambiente/portal/documents/328613/31543413/catalogo_andaluz_proyectos_absorcion_carbono_azul_221114.pdf/c9ee73e7-e340-2e6c-1ce9-401b95d8d72c?t=1668417969331

Project funding:

Considering the examples of blue carbon projects available and the reports of the main institutions involved, it can be concluded that the amounts received from the sale of blue carbon credits do not cover the actual costs of the projects. The costs of the project feasibility assessment, preparation and registration of the PDD, and validation and certification of carbon credits can range between EUR 50,000 and EUR 150,000, excluding the implementation costs of the activities. Therefore, certification processes will hardly be a viable option for small-scale projects[xxvii]. In this case, options may include grouping several small-scale projects into one – which is accepted by the main certifiers – or opting not to submit the project to an accreditation agency but to submit it at least to an independent output verification (type B credit as described in the table above: *Categories of carbon credits in the voluntary markets*).
In most of the projects currently registered, financing has involved fundraising through international funds such as the GEF and the Blue Natural Capital Financing Facility (BNCFF), support and investment from local governments, and the participation of international NGOs. In some cases, namely the project in Kenya, some companies helped to fund the project's preliminary stages – some to guarantee the future purchase of carbon credits and others as a donation towards social and environmental responsibility. In other words, companies can buy credits from existing projects or fund their development stages, such as:

- The project's feasibility analysis (technical, social, financial, legal).
- The development of the PDD (detailed project description, application of the methodology, stakeholder involvement).
- The implementation (field activities, management, training, communication).
- The certification process (if applicable).
- Monitoring.

In general, the resources from the sale of blue carbon credits have been useful for ensuring the economic sustainability of the projects, i.e., the maintenance of existing activities necessary to achieve the expected long-term results, achievable in 30 years on average. Resources can also be useful for expanding project results, for example, more species planting, although this may also imply new maintenance and verification costs.

05

Guidelines for project development

No single model for planning and implementing carbon projects applies to every type of blue carbon project. Its design may vary according to the type of system, existing conditions to make it feasible, and activities required, among others. Based on the existing literature,[49] a set of basic steps is proposed.

[49] *Coastal Blue Carbon in Practice; Manual for The Creation Of Blue Carbon Projects In Europe And The Mediterranean; Guiding Principles for Delivering Coastal Wetland Carbon Projects; and High-Quality Blue Carbon Principles and Guidance*

Figure 18. Step by step for project development and certification

Feasibility analysis

a. Availability of ecosystem data: carbon stock and flow, and conservation status, preferably with specific data on the intervention area

b. Existence of approved methodologies to estimate GHG reductions/removals according to the activities foreseen in the target ecosystems

- i. To estimate the potential GHG reduction/removal of the project
- ii. To assess the additionality of the project
- iii. To identify the risks of non-permanence of carbon and GHG leakage, notably concerning sea level rise

c. Technical feasibility to conduct the monitoring of project results

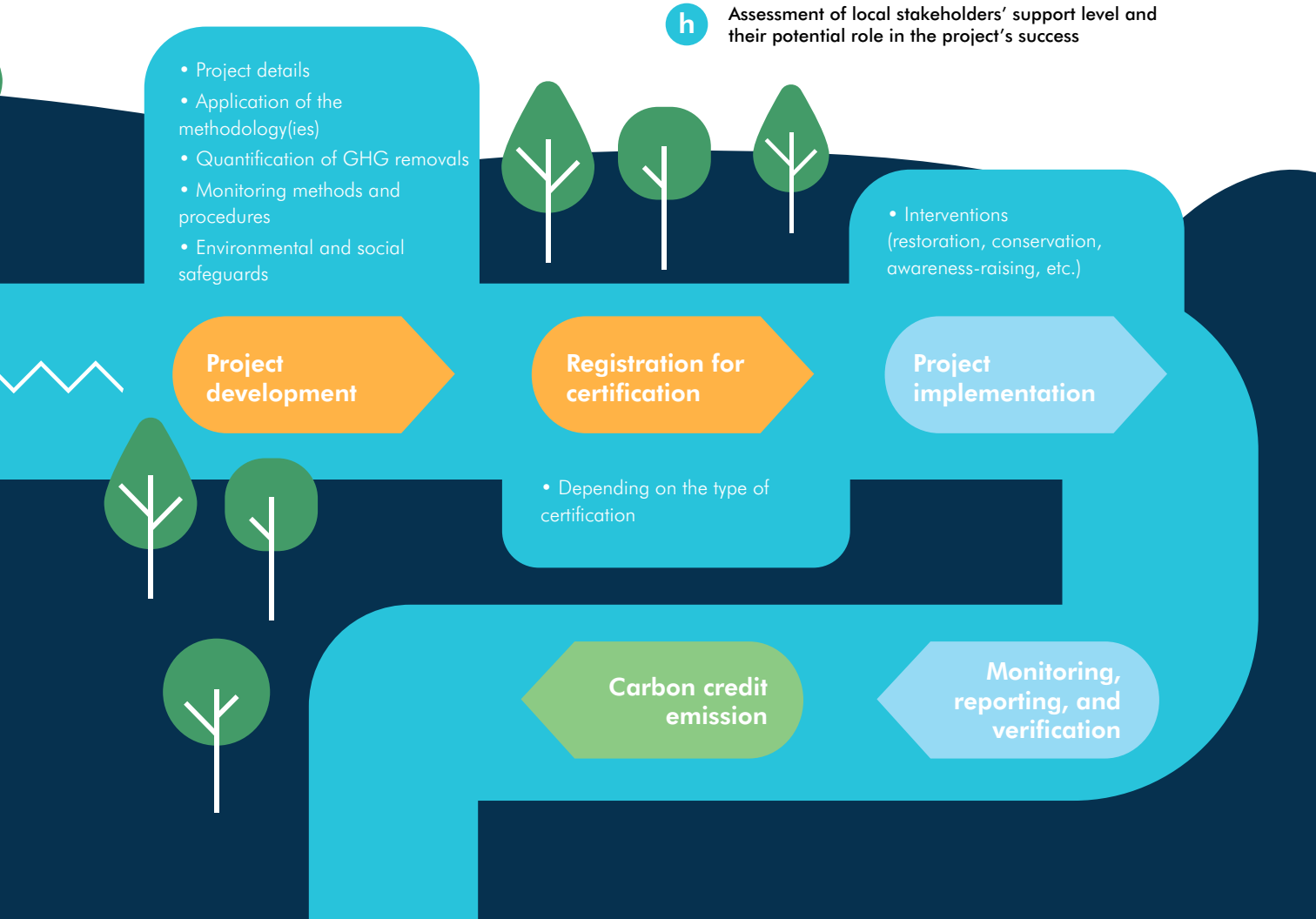
d. Legal feasibility: clarity on restrictions, necessary permits, ownership of the intervention area and ownership of the credits generated

e. Clarity about the causes of degradation or threats to the ecosystems

f. Consolidated knowledge about the activities that will restore or conserve the target ecosystem

g. Financial analysis: to estimate the development, implementation, and management costs, as well as possible income from credit sales and other partnerships

h. Assessment of local stakeholders' support level and their potential role in the project's success



Project development

Before the project design document is developed, preparing another document in advance – known as a Project Idea Note (PIN) – is good practice. It is quite brief (10-15 pages) and includes a brief description of the project, the expected benefits, and estimated costs. For example, the PIN helps to obtain institutional support and attract possible investors.
The PDD will be the basis for the carbon credit certification process and for communicating the details of the interventions, calculation and monitoring methods, stakeholder involvement, and social and environmental benefits, among others. It is a process that requires financial and human resources, technical knowledge, and involvement of different stakeholders.

The main elements of a PDD are a) Project details, b) Application of the methodology, c) Quantification of GHG reductions and removals, d) Monitoring, e) Environmental and social safeguards.

The handbooks referred to in this chapter contain exhaustive details on each of the elements; therefore, only a few items are summarised below:

a) Project details

- **Brief description:** objective, location, and context of the project.
- **Scope and type of project:** in the case of blue carbon projects, it is defined whether it is a conservation or restoration/planting project.
- **Project proponent:** it defines the managing institution and lists other actors involved in the project.
- **Project start:** it defines the date when a major action was initiated, not including the feasibility study. It can be considered the beginning of land preparation or other measures directly related to the project's expected outcome.
- **Scale of the project and estimated emission reductions:** if the project is considered small scale, the certification process may be simplified, and its cost reduced.
- **Description of activities:** this is one of the most extensive parts as it should contain details of the existing conditions before the project, such as land use practices, a description of causes and threats, a description of climate, biodiversity, etc. It should also explain how the project fulfils the conditions of the certification standard.
- **Site demarcation:** this section normally includes maps showing intervention areas and the project's boundaries, preferably with georeferenced polygons.
- **Legal compliance:** it signals that the project activities comply with the relevant legislation and that the proponent has the right to act in the delimited area. This section also highlights the project's additionality as it should demonstrate that the actions are additional to the legal requirements.

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Sediment layers deposited in marine meadow and saltmarsh areas

b) Methodology application

- Title and reference of the methodology used.
- **Applicability:** to define to which project activities the selected methodology applies or does not. For example, VCS standard VM0033 applies to restoration activities, such as the removal of barriers for improving hydrological connectivity or restoring tidal flow, river sediment diversion, reduction of nutrient loading to improve water quality, introduction of native plants, and removal of invasive species, among others.
- **Project boundaries/scope:** to define geographical and temporal boundaries based, for example, on the residence time of organic carbon in the soil, the extent of carbon sinks or carbon pools (above and belowground biomass, sediments), and GHG emissions to be accounted for.
- **Reference Scenario:** to highlight and detail the land use and land use change scenarios most likely to occur in the absence of the project.
- **Additionality:** to demonstrate that the alternative scenario proposed by the project would hardly occur not only because it is not common practice but also due to financial, institutional, and technological barriers, among others. In other words, to demonstrate that carbon credit financing is a key factor in making the project viable.
    - There are tools available for supporting the identification of baseline scenarios and demonstrating additionality. The CDM Combined Tool and the VCS Tool for the Demonstration and Assessment of Additionality in VCS AFOLU Projects are widely accepted and used.

c) Quantification of GHG reductions and removals

Calculation methodologies usually consider the three predominant gases affected by natural processes (CO_2, CH_4 and N_2O). Emissions can be negative (removing gas from the atmosphere) or positive (releasing gas into the atmosphere). A project must have net negative and additional emissions to claim carbon credits (i.e., a positive reduction in emissions or increase in removals compared to the baseline GHG emissions and removals). This section of the PDD is usually divided into the following sub-items:

- **Baseline emissions:** to demonstrate the calculations regarding the probable GHG emissions and removals from the baseline scenario detailed previously, based on the methodologies and tools indicated.
- **Project emissions:** to demonstrate the calculations regarding the probable GHG emissions and removals of the scenario proposed by the project. Generally, the options to perform the calculations are as follows:
    - **Use of default values and emission factors:** Usually provided by the chosen methodology and/or based on IPCC guidelines.
    - **Published figures:** Data from the same or a similar system to that of the project area (must come from published, peer-reviewed scientific literature).
    - **Modelling:** Modelling must follow strict criteria to be accepted. For example, the VCS standard details publicity, quality, and suitability requirements, requesting that the model be validated with direct measurements of a system with the same characteristics of depth, salinity, and tidal hydrology, among others.
    - **Proxies:** It is the use of a variable highly correlated with a GHG emission rate, useful when that variable is easier or less costly to measure than the emission rate itself. An example is estimating methane emissions from the composition of the vegetal community.
    - **Field data collection:** This measures GHG emission rates or changes in carbon stock through field sampling. It is often the most expensive and complex option but necessary in some blue carbon projects. For CO_2, sampling generally measures the change in the carbon stock in the soil and/or plants in the system. For CH_4 e o N_2O, sampling means directly measuring gas fluxes.
- **Leakage:** to demonstrate the conditions and efforts to prevent the project from leading to increased emissions or decreased removals of GHGs outside the project's area. Leakage can be related to changes caused by the project in the market environment, the displacement of activities or ecological functioning. An example of leakage occurs when the conservation or restoration of a certain area leads to the displacement of fishing activities to another area.
- **Non-Permanence Risk:** to apply risk calculations considering probability, possible causes, and the volume of sequestered carbon that may not be stored

for at least 30 years. There are tools to assist this calculation, such as the *VCS AFOLU Non-Permanence Risk Tool*.

- **Net GHG emissions:** the total calculation of the results of GHG reduction or removal expected by the project considering all previous elements.
- **Buffer:** a percentage of the total to buffer the possibility of non-permanence and leakage should be considered. The percentage will vary according to the risk analysis of each project.

d) Monitoring

It includes a description of the methods and procedures that will be used to quantify carbon storage and GHG emissions during the project's crediting period. It should detail the necessary technical requirements, parameters to be verified, frequency of monitoring, data to be collected, and data collection techniques. In addition, the quality assurance and quality control (QA/QC) procedures must be informed, and the responsibilities of the monitoring and managing team must be defined. For blue carbon projects, detailed guidance on stratification and sampling methods can be found in the VCS standard methodologies VM0033 and VM0007 and the CDM tool *"Calculation of the number of sample plots for measurements within A/R CDM project activities"*.

e) Environmental and social safeguards

Safeguards: Environmental and social safeguards are a set of policies, standards, and operational procedures designed to identify the adverse environmental and social impacts that a project may have to avoid, mitigate, and minimise. The seven Cancun safeguards were designed to guide REDD+ projects, but they are the main reference on the subject, even for projects that do not fall under this category.[50] Some of these safeguards are already integrated into the integrity criteria for carbon projects, such as avoidance of emissions leakage (avoidance of displacement) and permanence (avoidance of reversal).
In addition, for a blue carbon project to be considered high quality, it is also important to make explicit the expected additional benefits (beyond carbon), the measures to secure rights and consider community knowledge and leadership, and to promote equitable access to the carbon market.
Therefore, the measures and best practices that will be implemented to avoid ecological and social damage and promote positive impacts should be described. At the very least, the following aspects should be assessed:

[50] Cancún Safeguards: https://redd.unfccc.int/fact-sheets/safeguards.html

Participatory workshop: the involvement of local communities can be fundamental in these processes

- Possible environmental impacts: a description of the method and results of the impact assessment (even when there is no legal requirement, a brief assessment should be presented).
- Compliance with science-based ecological protocols (e.g., for restoration activities).
- Local stakeholder consultation: description of the methods and results of the consultation, where available. The PDD is subject to public consultation in projects applying for certification to standards such as the VCS and Plan Vivo.

Cancún Safeguards

1. Policy alignment: Actions complementary to or consistent with the objectives of national forest programmes and other international conventions and agreements.
2. Governance structures: Transparent and effective national forest governance structures in view of national sovereignty and national legislation.
3. Rights: Respect the knowledge and rights of indigenous peoples and members of local communities, considering relevant international obligations, national circumstances, and laws, and noting that the UN General Assembly has adopted the UN Declaration on the Rights of Indigenous Peoples.
4. Participation: Full and effective participation of stakeholders, particularly indigenous peoples and local communities.
5. Biodiversity: Actions consistent with the conservation of natural forests and biological diversity, ensuring that REDD+ actions are not used to convert natural forests but rather to encourage their protection and conservation and contribute to other social and environmental benefits.
6. Reversal: Actions to address the risks of reversal of REDD+ results.
7. Displacement: Actions for reducing the displacement of carbon emissions to other areas.

06

Analysis of the eligibility conditions for blue carbon projects in Portugal

Considering the criteria and steps necessary for implementing blue carbon projects, the availability of relevant information to enable robust projects capable of generating blue carbon credits in the medium/long term in Portugal will be assessed below.

a) Approved methodologies for potential ecosystems

Considering the blue carbon ecosystems in Portugal, methodologies that can be used or adapted for projects in saltmarshes and seagrass meadows are available and will be presented further below.
It is recommended that potential regulation on the voluntary carbon market in Portugal specifies the methodologies accepted for blue carbon projects and the possibility and criteria for the approval of specific methodologies for Portuguese ecosystems. The relevance of creating an official norm/standard for blue carbon projects in Portugal should be assessed.

b) Availability of data on ecosystems: carbon storage and flux and conservation status

There is neither an official, periodic, systematic mapping of carbon stocks in coastal and marine ecosystems in Portugal nor official data on the annual rate of degradation or recovery of these ecosystems. Therefore, the National Inventory of Greenhouse Gases[xx] does not include emissions and removals from blue carbon ecosystems, covering only forests and agricultural land in the land use and land-use change sector.
According to the survey conducted by CCMAR, the data available in the literature for calculating blue carbon sequestration and storage in mainland Portugal are scarce or, where available, are outdated and incomplete. The Ria Formosa is the only one of the ten systems studied for which carbon sequestration rates have been estimated. Consequently, the carbon sequestration rates of the other systems are still very unreliable.

Although this situation does not prevent the development of a blue carbon project in Portugal, it requires each project to develop a reference scenario for carbon sequestration and storage in the specific area, based on a credible methodology and demonstrate the capacity to conduct the monitoring following scientific quality criteria and in line with existing standards.

It is essential that the national government invests in standardising the generation of this data, so that the GHG mitigation potential of blue carbon ecosystems can be more accurately estimated.

Blue Carbon Research

c) Clarity on restrictions and authorisations required

It is a key component in developing projects, bringing predictability to all stages. At the government level, there is at least the Portuguese Environment Agency (APA), the Institute for Nature Conservation and Forests (ICNF) or the Directorate-General for Natural Resources, Safety and Maritime Services (DGRM), which can play the role of licensing or authorisation-issuing entity, depending on the project's location and type of intervention. For now, there is no clear definition of the administrative procedures and necessary authorisations to be followed, as Portugal's voluntary carbon market is still in development. Within the scope of this project, some meetings were held with the aforementioned governing bodies, and it was possible to identify, on a preliminary basis, when each body should be contacted: if the project falls

within a National Ecological Reserve area or maritime public domain, the APA should be consulted, which may eventually charge the water resources tax although this may not apply to experimental projects; if it is in an area belonging to the domain of commercial ports, the port management entity should be involved; in the case of conservation areas (protected areas, Natura 2000 network, etc.), the ICNF should be consulted; if the project activities involve aquaculture, in addition to the authorisation from the ICNF, the DGRM should be involved to assess the need for issuing an Aquaculture Activity Title (TAA). In the latter case, scientific activities may eventually be exempted from this type of authorisation.

It should be noted that this information illustrates generic examples that need further refinement as there are no credit-generating blue carbon projects under development in Portugal yet. However, as project ideas are presented, it will be possible to detail specific needs according to the type and location of the interventions and, consequently, establish a structured roadmap for the necessary administrative procedures.

Some rules, such as those regarding the attributions relating to projects and credit registration, monitoring, inspection, and compensation, among others, may still emerge with the ongoing regulation of the voluntary carbon market in Portugal.

d) Ownership of land and credits generated

The ownership of the land where the project will be implemented (private, public, or public under concession) should be identified from the outset. This will help to define the paths to be taken regarding the necessary authorisations, as well as the generation and sale of potential carbon credits. Considering that most of the blue carbon ecosystem areas in Portugal are under some protection regime and most likely in the public domain (maritime), the APA is the first institution to be contacted to identify ownership. In other cases, the Directorate-General for Territorial Development provides a platform for consulting whether private individuals are registered in a given area.[51]

Some areas may be private property or be in a port area. In the case of private property, the owner must always authorise (legal obligation) and be involved in all stages of the project (good practice). In port areas, the port management authority will have to be involved so that the authorisation for intervention in specific, delimited areas can be formalised, and the extent to which the intervention may limit maritime traffic and vice versa must be considered.

[51] DGTerritório: https://snic.dgterritorio.gov.pt/visualizadorCadastro

Marine meadows in Ria Formosa

Additionally, the existence of neighbouring communities that may be directly or indirectly affected by the interventions must be taken into consideration. These communities should be consulted and involved in the project in case they are the users – even if they are not the owners – of the space to be intervened in order to safeguard the restrictions it may impose on their activities. Depending on the project, local communities can also play a leading role in conservation and restoration activities, as seen in the case studies from Kenya, Mozambique, and Virginia and the Sea Guardians project previously mentioned.
A participatory and transparent involvement of local communities ensures that the project's restrictions in the intervention area do not affect them negatively and that they understand and comply with the restrictions. Involving the communities from the beginning can also benefit the project due to their empirical knowledge. In addition, communities can learn more about the systems in which they normally operate – communities can be empowered to protect them.
The original ownership of the credits generated from carbon capture or avoided emissions is usually linked to land ownership or defined through specific agreements, for example, between the funder and the landowner. Specific legislation on the carbon market should address this issue and may define other exceptions and possibilities. The legislation may also clarify if public bodies can receive, abdicate, or transfer credits generated by projects in public areas.

e) Consolidated knowledge about restoration/conservation activities

Considering that initiatives for the restoration and conservation of saltmarshes and seagrass meadows in Portugal are still few and small scale, there is not an established database on the different types of potential or necessary interventions. Therefore, it will be up to the project proponent to search for examples and consider the best practices recommended in the national and international scientific field.
Such knowledge can be drawn from various sources: actions implemented by the national government and/or municipalities; actions implemented by NGOs, such as those carried out by Ocean Alive (marine meadows), or by universities and research centres such as CCMAR; practices from other countries, such as Spain or the United States.
As pilot projects start to be implemented in Portugal, a portfolio containing the necessary actions according to the conservation status, location and threats to the project's target system may be created. Such a portfolio – or project database – can be created and managed by the government (following the example of Andalusia in Spain); it can be an independent initiative of NGOs or Universities; or a broad initiative of all these actors in the blue carbon market. The information and knowledge gained through pilot projects will help to reduce risk and drive future investment in blue carbon projects.

f) Understanding and focusing on the causes of degradation

There is no updated official information on the main causes of degradation and threats to blue carbon ecosystems in Portugal. The literature review conducted by CCMAR cited in this roadmap is a reference for project preparation. However, the project proponent must specifically assess the target intervention area.

Even at the feasibility analysis stage, it is essential to be clear about the causes of degradation and possible threats to the systems in question. For example, there are several reports of failure in forest and coastal wetland restoration projects whose focus was primarily on planting species when there was, in fact, a need for reducing the causes of degradation still active.

Ideally, the national government should identify the main threats to blue carbon ecosystems and study potential management actions, such as establishing conservation areas, improving the water quality in seagrass meadows, creating space for ecosystems to migrate in case of sea level rise, etc.

07

Recommendations on the voluntary blue carbon market in Portugal

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Given the current state of knowledge about blue carbon ecosystems and the low maturity of the blue carbon market globally – and even more in Portugal – we present below a set of recommendations for the different stakeholders that may contribute to the future structuring of the voluntary blue carbon market in Portugal.

a) Public decision-makers should:

1. **Create the Blue Carbon Forum Portugal:** Ideally, it is an initiative that should be created within the State and should involve the different sectors (Government, academia, companies/investors, NGOs) to create a network for disseminating and expanding knowledge on this topic, including a collaborative data system. Such a network can contribute to the development and/or implementation of national regulation on the voluntary carbon market, enhancing it and including the specificities relating to blue carbon ecosystems. The following examples may inspire the design of a Blue Carbon Forum in Portugal: *The UK Blue Carbon Forum*[52]*; Norwegian Blue Forests Network (NBFN)*[53]*; Blue Carbon Network for the Gulf Coast*[54]. The following recommendations could be the subject of discussion within this Forum.

2. **Promote the development of an official blue carbon stock map** combining field collection with spatial and literature data. This initiative should have the State and academia's participation and rely on private funding, following the example of the experience underway in the UK[xxviii].

3. **Develop blue carbon monitoring methodologies** (stocks, rates, distribution area, etc.) and define the national baseline scenario for saltmarshes and seagrasses in close coordination between the APA, other bodies, and the national scientific community. The State must make public funding available and allow companies to co-finance projects of this nature. The standardisation of data generation will be useful for estimating more precisely the GHG mitigation potential of blue carbon ecosystems, the real need for intervention, and the extent to which the voluntary market could meet the demand for carbon credits.

[52] The UK Blue Carbon Forum: https://www.ukbluecarbonforum.com/

[53] Norwegian Blue Forests Network: https://nbfn.no/

[54] Blue Carbon Network for the Gulf Coast: https://nerrssciencecollaborative.org/project/Simpson15

4. **Conduct a detailed assessment of national public policies** with a direct influence on blue carbon ecosystems, which combined analysis depends on direct government support and will be relevant to the following steps:

    a. To conduct an analysis of sufficiency between the actions needed and what is actually planned.
    b. To assess the need for resources on budget availability.
    c. To determine the relevance of the blue carbon market as a catalyst for conservation and restoration actions, attracting private capital to meet the identified need for resources.
    d. To identify possible misalignments or inconsistencies between existing policies and plans that may compromise the viability of the investments in blue carbon projects, for example, certain public subsidies or the absence of adequate protection rules that will ultimately negatively impact saltmarshes and seagrass meadows.
    e. To identify regulations that may restrict the voluntary carbon market in Portugal.

5. **Create specific legislation or regulation** subject to public consultation which recognises and promotes the voluntary blue carbon market in Portugal, including:
    - Definitions and types of ecosystems.
    - MRV (Monitoring, Reporting, and Verification) criteria.
    - Registration criteria or creation of a National Registry for carbon projects.
    - How the projects relate to the NDCs.
    - Accepted standards and methodologies or criteria for new methodologies.
    - Institutional responsibilities and permissions required.
    - Types of intervention: Conservation, Restoration, Management.
    - Environmental and social safeguards for blue carbon projects.
    - Eligibility and ownership of the carbon credits generated.

We understand that developing a voluntary blue carbon market in Portugal means stimulating good projects in blue carbon ecosystems in the country through the voluntary purchase of credits by Portuguese companies (in various forms).
Therefore, we advocate the inclusion of blue carbon ecosystems in the laws and regulations that will be approved on the VCM in Portugal to clarify the way and bring security to investments.

6. **Assess the need for creating an official norm/standard** for accrediting blue carbon projects in Portugal.

7. **Clarify the administrative process** for authorising blue carbon projects, and provide faster analysis of requests for experimental projects, particularly with regard to authorisations for the use of abandoned aquaculture areas.

8. **Identify the main threats to blue carbon ecosystems** and assess potential management actions, such as: establishing conservation areas, improving the water quality of seagrass meadows, creating space for ecosystems to migrate in case of sea level rise, etc.

b) Companies and project proponents should:

9. **Provide support for project development** – including financial support – allowing them to successfully generate carbon credits in the future. Companies will have to be willing to invest, considering that the return in terms of carbon credit generation will not be immediate and that supporting the maturation process of the voluntary blue carbon market is within the scope of their social responsibility.

10. **Foster the early involvement of local stakeholders** in project development, especially communities directly linked to the intervention areas. They should also consider NGOs that can facilitate the participation of stakeholders in the communication of these projects or the participation of companies, authorities, etc.

11. **Be aware of the causes of degradation** and possible threats to the systems in question from the feasibility analysis stage onwards. In addition, considering the interconnectedness of the systems, a landscape-level approach is recommended, i.e., the scope of a project should go beyond the target area to be conserved or restored. Threats and potential solutions that may occur in adjacent areas must also be considered.

c) Environmental NGOs and other civil society organisations should:

12. **Promote the feasibility analysis of projects** in articulation with researchers, local communities, and public decision-makers. The criteria to be evaluated are detailed in the “Feasibility Analysis” section.

13. **Use their technical expertise and capacity to engage** local communities in order to lead or co-lead the development and implementation of blue carbon projects.

14. **Encourage the creation of blue carbon project portfolios** so that different companies can fund the project development and implementation stages.

15. **Collaborate with public decision-makers** on the various recommendations addressed to them, particularly in creating a Blue Carbon Forum, conducting a detailed assessment on policies, and identifying threats to ecosystems.

d) Research centres and Universities should:

16. **Promote the creation of a unified repository** of information on blue carbon ecosystems in Portugal, with open and accessible data.

17. **Contribute to developing an official blue carbon stock map** by combining field collection data, spatial data, and data available in the literature.

18. **Liaise with companies** to ensure (co)financing of blue carbon research projects.

19. **Encourage the creation of blue carbon project portfolios** so that different companies can fund the project development and implementation stages.

20. **Contribute to the feasibility analysis**, particularly in assessing existing data, technical feasibility for monitoring, and available and recommended methods and interventions.

Acronyms

ANP|WWF	Associação Natureza Portugal in partnership with WWF
APA	Portuguese Environment Agency
BNCFF	Blue Natural Capital Financing Facility
C	Carbon
CCMAR	Centre of Marine Sciences
CDM	Clean Development Mechanism
CDR	Carbon Dioxide Removal
CGF	Calouste Gulbenkian Foundation
CO_2	Carbon Dioxide
DGRM	Portuguese Directorate-General for Natural Resources, Safety and Maritime Services
ETS	European Union Emissions Trading Scheme
EU	European Union
GEF	Global Environment Facility
GHG	Greenhouse Gases
GWP	Global Warming Potential
HQBC	High Quality Blue Carbon Guide
ICNF	Nature Conservation Institute and Forestry
ICVCM	Integrity Council for the Voluntary Carbon Market
IETA	International Emissions Trading Association
IPCC	Intergovernmental Panel on Climate Change
LIFE	The LIFE programme is the EU's funding instrument for the environment and climate action
LULUCF	Land Use, Land-Use Change and Forestry
MRV	Monitoring, Reporting, and Verification
NBS	Nature Based Solutions
NDC	Nationally Determined Contributions
NECP	National Energy and Climate Plan
NGO	Non-Governmental Organization
P-3AC	Action Programme for Climate Change Adaptation
PDD	Project Design Document
PIN	Project Idea Note
REDD+	Reducing Emissions from Deforestation and Forest Degradation, conservation and enhancement of forest carbon stocks and the sustainable management of forests
RNC	Carbon Neutrality Roadmap
SDGs	Sustainable Development Goals
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
VCM	Voluntary Carbon Markets

List of units and conversions

g	Gram
m²	Square meter
ha	Hectare (1 ha = 10,000 m^2)
kg	Kilogram
ton	Metric ton (1 ton = 1,000 kg)
Gg	Gigagram (1 Gg = 1,000 metric tons)
Gt	Gigatonne (1 Gt = 1,000,000,000 metric tons)

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About the Calouste Gulbenkian Foundation

The Calouste Gulbenkian Foundation is an international foundation based in Portugal that promotes the development of people and organisations through art, science, education, and charity for a more equitable and sustainable society. It was created in 1956 by the will of Calouste Sarkis Gulbenkian, a philanthropist of Armenian origin who lived in Lisbon, Portugal, between 1942 and 1955, the year he died. The Foundation promotes greater access to culture and the transformational power of art in developing people and societies. It contributes to reducing inequalities in access to education and care for the most vulnerable. It also promotes knowledge, scientific research, and greater participation and involvement of citizens and civil society in building sustainable communities. The Foundation includes a museum, an arts centre, an orchestra and choir, an art library and archives, and a scientific research institute. Through grants and scholarships, it also develops innovative programmes and projects and supports social institutions and organisations in Portugal, the United Kingdom, France, Portuguese-speaking African countries, and the Armenian communities.

About ANP|WWF

WWF is one of the world's largest and most respected independent conservation organisations, with over 5 million supporters and a global network active in over 100 countries. WWF's mission is to halt the degradation of nature and to build a future in which humans live in harmony with nature by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable and promoting the reduction of pollution and waste. ANP|WWF is a Portuguese NGO working in Portugal in partnership with WWF to conserve biological diversity and national resources, seeking a planet where people can live in harmony with nature.
www.natureza-portugal.org

About CCMAR

The Centre of Marine Sciences (CCMAR) is one of the leading research centres for marine sciences in Portugal. Located in southern Portugal, CCMAR is an independent, non-profit research organisation of the University of Algarve. Dedicated to research and development in marine sciences, CCMAR aims to promote multidisciplinary research and training related to the marine environment, emphasising processes of environmental change that affect marine ecosystems. With a multidisciplinary team of about 250 scientific researchers, well-equipped facilities and laboratories, and easy access to important marine and coastal ecosystems, CCMAR develops activities in five main areas: Research, Training, Industry, Society, and Cooperation.

CALOUSTE GULBENKIAN FOUNDATION

Blue Carbon: A Roadmap for a Voluntary Market in Portugal

Elaborated by ANP|WWF as part of the Gulbenkian Blue Carbon project

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ACKNOWLEDGMENTS

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COVER

Photo © Ferdinand Stohr, Unsplash

ISBN

978-989-8380-44-9

LEGAL DEPOSIT

521318/23

SEPTEMBER 2023

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The Gulbenkian Blue Carbon project aims at mapping and characterising the blue carbon ecosystems of mainland Portugal and at promoting investment in the conservation and restoration of these ecosystems. Promoted by Calouste Gulbenkian Foundation, it is developed in partnership with ANP|WWF and with CCMAR – Center for Marine Sciences, University of Algarve.

This roadmap is accompanied by the scientific reports produced by CCMAR:

Scientific Report I: *Assessment of blue carbon ecosystems in mainland Portugal*

Scientific Report II: *The 10 main blue carbon ecosystems in mainland Portugal*