D5.4 Contribution of restoration activities to NDCs (Nationally Determined Contributions)

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REST-COAST

Large Scale RESToration of COASTal Ecosystems through Rivers to Sea Connectivity

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Preface

The Rest-Coast Project (Large scale RESToration of COASTal ecosystems through rivers to sea connectivity) is an EU Horizon 2020 research project (Grant agreement No. 101037097) whose overall goal is to address with effective and innovative tools the key challenges faced by coastal ecosystem restoration across Europe. The approach chosen for this project will deliver a highly interdisciplinary contribution, with the demonstration of improved practices and techniques for hands-on ecosystem restoration across several Pilot Sites, supported by the co-design of innovative governance and financial arrangements, as well as an effective strategy for the dissemination of results.

Summary

This document aligns with the REST-COAST goal of demonstrating that large-scale restoration of coastal ecosystems through Nature-based Solutions (NbS) can serve as a low-carbon solution for climate adaptation, disaster risk reduction, and biodiversity enhancement. It underscores the significant potential of coastal ecosystem restoration, particularly in coastal wetlands as Blue Carbon Ecosystems that could play a crucial role in enhancing the effectiveness of compulsory Nationally Determined Contributions under the Paris Agreement. The analysis primarily focuses on the efforts of REST-COAST countries (also considering the European Union) to meet climate targets set by United Nations.

Throughout the document, the critical role that coastal and marine ecosystems, especially Blue Carbon Ecosystems is highlighted for their capacity to capture and store large amounts of carbon - often more efficiently than terrestrial forests - while also providing essential ecosystem services such as flood protection, water quality improvement, and habitat provision for marine life among others. The report also explores the potential of carbon credits as a financial mechanism to support these coastal restoration efforts. It delves into the challenges and opportunities within carbon markets, emphasizing the need for innovative financing and business models to advance with NbS for restoration. Furthermore, the document reviews existing policy frameworks at both national and international levels and other key global agreements such as the Kunming-Montreal Global Biodiversity Framework and the Ramsar Convention on Wetlands.

The document sets several objectives, with a primary focus on assessing current Nationally Determined Contributions (NDCs) to identify gaps and opportunities for integrating coastal restoration. Highlighting the role of coastal ecosystems in climate mitigation and adaptation, it aims to start developing policy recommendations to guide countries in enhancing their NDCs. Lastly, it stresses the need for countries to improve their NDCs in the coming years and over time, in line with the iterative process established by the Paris Agreement but considering the potential of REST-COAST restoration activities in achieving these goals.

In conclusion, the report advocates for the inclusion and strengthening the recognition of coastal ecosystem restoration in NDCs - and broader climate policies - as a crucial strategy for meeting global climate targets. It calls for the establishment of quantifiable restoration targets, promotion of NbS, the enhancement of monitoring and reporting mechanisms, and the fostering international cooperation across Europe and beyond. The document also emphasizes the need for a holistic approach that aligns coastal restoration with broader sustainable development goals and existing policy frameworks. Finally, it aims is to demonstrate that large-scale coastal restoration can be a viable and impactful nature-based solution to the climate crisis, contributing to both mitigation and adaptation efforts.

Key findings

- Coastal and marine ecosystems, particularly blue carbon ecosystems like wetlands and seagrasses, have significant potential to contribute to climate change mitigation and adaptation through carbon sequestration and coastal protection. However, this potential is often underrecognized in current NDCs.
- There are varying degrees of integration of coastal ecosystem restoration in NDCs and related policies across countries participating in REST-COAST project.[1] While some nations have taken steps to acknowledge the importance of these ecosystems, others have yet to fully capitalize on their potential.
- Challenges in mainstreaming coastal restoration into NDCs include limited awareness, competing priorities, governance issues, and the need for robust monitoring frameworks.
- Opportunities exist to enhance NDCs by setting specific targets for coastal ecosystem restoration, integrating ecosystem-based approaches, and leveraging co-benefits.

[1] Bulgaria, Denmark, France, Germany, Italy, Israel, the Netherlands, Poland, and Spain

- The REST-COAST project, through its nine Pilot Sites,[2] is demonstrating the effectiveness of coastal restoration for climate adaptation and disaster risk reduction. These efforts will provide valuable data and methodologies that can inform future NDC updates.

Disclaimer

At the time of writing this report, not all REST-COAST restoration actions have been finalized and the collection and analysis of their outcomes is still ongoing. References to the available results are included where applicable.

Terminology

Nature-based Solutions

The concept of Nature-based Solutions (NbS) has evolved leading to a range of interpretations. Due to the increasing use of the term across multiple sectors (e.g. climate change mitigation, urban planning, conservation), its meaning became broad and somewhat ambiguous. To prevent its practical value from being diluted, IUCN made a concerted effort to pioneer the formalization of the NbS concept nearly 20 years ago, culminating in the definition's adoption by Resolution at the IUCN World Conservation Congress in 2016. This provided a formal and science-based agreed framework to ensure clarity and consistency in the application of the concept of NbS, aiming to guide policymakers, practitioners, and researchers in developing and implementing NbS effectively. Since then, other international organizations, such as the United Nations and the European Commission, have defined NbS and promoted their use, each placing emphasis on different aspects of the term (see below). This reflects the concept's evolution, complexity and versatility, which allows it to adapt to the varying realities and goals of those who apply it. Despite some differences, the core approach and key elements of NbS are shared across different institutions:

> **IUCN, 2016.** Actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits (WCC-2016-Res-069).
>
> **European Commission, 2021.** Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions (EC, 2021. Evaluating the impact of nature-based solutions. A handbook for practitioners).
>
> **UNEP, 2022c.** Nature-based solutions are actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits (UNEP/EA.5/Res.5).

Given the European context of the REST-COAST project, both the IUCN and EC definitions were examined.[3] Both concepts and understandings of NbS are closely aligned, emphasizing the importance of achieving biodiversity net benefits as essential tools for tackling environmental and social challenges. However, a closer examination of the EU NbS Handbook for Practitioners, particularly the list of indicators and societal challenges addressed, reveals that the EC approach is more focused on participatory planning at the local

[2] Archachon Bay, Ebro Delta, Foros Bay, Nahal Dalia, Rhone Delta, Sicily Lagoon, Venice Lagoon, Vistula Lagoon, Wadden Sea
[3] See Milestone 5.3. "*Standardised metrics applicable to the IUCN NbS Standard and complying with EU NbS*" for further details.

level with emphasis on urban settings and infrastructure. Given that REST-COAST Pilot Sites are located in protected areas, rather than urban environments, this document will be generally adopting the IUCN's definition of NbS.

IUCN also counts on a Global Standard for Nature-based Solutions (NbS Standard) that intends to be a simple yet robust hands-on tool that enables the translation of the NbS concept into targeted actions for implementation. It serves to reinforce best practices, address shortcomings, and ensure interventions to align with internationally recognized NbS principles established at the IUCN World Conservation Congress.

List of abbreviations

BBNJ	Biodiversity Beyond National Jurisdiction (High Seas Treaty)
BCE	Blue Carbon Ecosystems
COP	Conference of Contracting Parties
ETS	Emissions Trading System
ESS	Ecosystem Services
EU	European Union
GBF	Global Biodiversity Framework
GHG	Greenhouse gas
INDC	Intended Nationally Determined Contribution
LULUCF	Land Use, Land Use Change, and Forestry
NAPs	National Adaptation Plans
NbS	Nature-based Solution
NDC	Nationally Determined Contribution
NECP	National Energy and Climate Plans
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
MSP	Marine Spatial Planning
OECMs	Other Effective Conservation Measures
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WFD	Water Framework Directive
WP	Work Package

1 Introduction

This report addresses REST-COAST commitments under Task 5.3 "*Scaling up: Transformative evolution of local/national policies in the Pilots*" as part of Work Package 5 (WP5). This WP focuses on achieving a transformative governance for restoration upscaling in coastal areas, using the nine selected Pilot Sites and considering the policy framework. The core mission of REST-COAST is to demonstrate that upscaled coastal restoration through Nature Based Solutions (NbS) can serve as a low-carbon footprint solution for climate adaptation and disaster risk reduction for threatened coastal systems, while also enhancing biodiversity (see IUCN NbS definition in Box 1).

> **Nature-based Solutions** (NbS) are "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.

Box 1. NbS definition according to IUCN (2016)

In this context, it is crucial to assess current initiatives aimed at fostering climate-resilient coastal regions, at both national and international (European) levels. Nationally Determined Contributions (NDCs) are climate action plans developed at the national or regional levels to cut emissions and adapt to climate impacts, in line with international climate objectives. Therefore, NDCs are integral to the global response to climate change and play a crucial role in this analysis. By examining these efforts, WP5 aims to provide insights into effective strategies and policies that support the REST-COAST mission, emphasizing the importance of scalable restoration practices for sustainable coastal management. Additionally, countries can enhance their NDCs to include effective coastal management strategies, ensuring that coastal areas contribute meaningfully to global climate mitigation and adaptation efforts.

Through this comprehensive assessment, the report seeks to identify challenges and offer preliminary recommendations for improving the integration of coastal restoration measures into NDCs, also considering previously assessed barriers to upscale restoration (see Deliverable 1.2)[4] and the potential use of REST-COAST hands-on restoration actions (e.g. projects in Pilots) for upscaling when available.

1.1 Main objectives

The primary objective of this report is to evaluate the contribution of restoration activities to NDCs within the framework of the REST-COAST project. This evaluation aims to provide insights and recommendations on how coastal restoration can enhance national efforts to meet climate targets set by the Paris Agreement. Specifically, the report focuses on the following main objectives:

Objective 1. **Highlighting the Role of Coastal Ecosystems to Mitigate the Climate Change Impact:** To emphasize the significance of coastal and marine ecosystems, particularly blue carbon ecosystems addressed in REST-COAST Pilot Sites, such as wetlands and seagrass meadows, in achieving NDC targets. The report will address the carbon sequestration potential of these ecosystems, their role in climate adaptation, disaster risk reduction and ecosystem services they provide.

[4] Ibáñez C, Alemany A, Bertomeu F, Frías S, Molero J, Merciai R and Puértolas L. 2023. Technical report on barriers and enablers for coastal restoration upscaling: A multi-level perspective. Deliverable D1.2. EU Horizon 2020 REST-COAST Project, Grant agreement No 101037097.

Objective 2. **Assessing Current NDCs to identify Gaps and Opportunities**: To review and analyse countries' climate commitments to pinpoint gaps in the integration of coastal restoration within NDCs as well as for enhancing these contributions. This includes examining the extent to which restoration projects, particularly REST-COAST initiatives, support the mitigation and adaptation goals outlined in national climate strategies.

Objective 3. **Laying the foundation for developing Policy Recommendations for upscaling restoration efforts:** To outline preliminary and actionable policy recommendations to guide countries in integrating coastal restoration into their NDCs, fostering a policy transformation across different levels. These recommendations will be derived from the analysis of REST-COAST planned efforts, identified gaps, and potential opportunities to more effectively incorporate coastal ecosystem restoration into national climate policies and strategies. It will also consider to overcoming existing barriers identified in previous deliverables and milestones of this project (e.g. Milestone 5.4. "*Briefing addressing approaches taken at municipal, regional, national policy levels*").

1.2 The NDCs in the context of the Paris Agreement

In December 2015, during the 21st Contracting Parties meeting (COP21) to the UN Climate Change Conference (UNFCCC), world leaders reached a groundbreaking agreement to tackle climate change and its adverse impacts: the Paris Agreement. This unprecedent accord sets long-term goals to guide all nations in 1) substantially reducing global greenhouse gas (GHG) emissions; 2) periodically assessing the collective progress towards limiting the global temperature increase; and 3) providing financing to developing countries to mitigate climate change, strengthen resilience and enhance abilities to adapt to climate impacts. As a legally binding international treaty, the Agreement entered into force on November 4, 2016. Today, 195 Parties (194 States plus the European Union) have joined. Concerning REST-COAST scope, the European Union and Israel ratified the Agreement by October 5 and November 22, 2016, respectively.

The Agreement operates on a five-year cycle, requiring each country to submit an updated national climate action plan known as **Nationally Determined Contribution** (NDC) (article 4.2 Paris Agreement). These NDCs are central to the global climate action framework established by the Agreement, outlining each country's specific commitments and strategies for climate **mitigation** and **adaptation** (Box 2). The ultimate goal is to limit global temperature rise to well below 2°C, and preferably to 1.5°C, above pre-industrial levels (article 2.1 Paris Agreement). However, in recent years, world leaders have stressed the need to limit global warming to 1.5°C by the end of this century.[5] This temperature goal is further operationalized in article 4.1 of the Agreement by aiming for GHG neutrality in the second half of the century (Obergassel *et al*., 2019). Within NDCs, countries define their specific climate targets and provide information on the policies. strategies and measures that will be deployed to achieve them. In addition, countries can outline means of implementation needed to support their planned climate measures including financial resources, capacity building, technology development and transfer, and monitoring. While the Paris Agreement does not strictly prescribe the contents of NDCs to give countries the flexibility needed to adapt them to their national context, countries are encouraged to set economy-wide absolute emissions reduction targets as well as sector specific targets including energy, transportation, industry, agriculture and forestry.

[5] UN's Intergovernmental Panel on Climate Change indicates that crossing the 1.5°C threshold risks unleashing far more severe climate change impacts, including more frequent and severe droughts, heatwaves and rainfall. To limit global warming to 1.5°C, greenhouse gas emissions must peak before 2025 at the latest and decline 43% by 2030.

> **Adaptation** means anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause, or taking advantage of opportunities that may arise. Examples of adaptation measures include large-scale infrastructure changes, such as building defences to protect against sea-level rise, as well behavioural shifts, such as individuals reducing their food waste. In essence, adaptation can be understood as the process of adjusting to the current and future effects of climate change.
>
> **Mitigation** means preventing or reducing the emission of GHG into the atmosphere to make the impacts of climate change less severe. Mitigation is achieved either by reducing the sources of these gases — e.g. by increasing the share of renewable energies or establishing a cleaner mobility system — or by enhancing the storage of these gases — e.g. by increasing the size of forests. In short, mitigation is a human intervention that reduces the sources of GHG emissions and/or enhances the carbon sinks.

Box 2. Climate Adaptation and Mitigation according to the European Environment Agency. Source: EEA, 2023.

The requirement for countries to prepare, communicate, and maintain successive NDCs creates a dynamic and progressive framework, in which countries are expected to improve their NDCs over time and to increase their ambition by developing more effective strategies and policies. This iterative process is designed to foster continuous improvement and greater alignment with the global climate goals. With the Paris Agreement, countries also established an Enhanced Transparency Framework, starting in 2024, under which countries will report transparently on actions taken and progress achieved in climate change mitigation, adaptation measures and support provided or received. The ETF also provides for international procedures to review the submitted reports. The information gathered through the Enhanced Transparency Framework will feed into the Global stocktake[6] which will assess the collective progress towards the long-term climate goals. This will lead to recommendations for countries to set more ambitious plans in the next round. In this sense, recommendations emanating from REST-COAST project could be considered to feed the process.

In the context of the Paris Agreement, Parties to the UNFCCC are also required to enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change alongside reducing emissions. Climate adaptation plans and strategies are integral components of comprehensive climate action plans, complementing mitigation efforts and playing a crucial role in enhancing resilience to the unavoidable impacts of climate change. In 2010, the UNFCCC established a process of formulating and implementing National Adaptation Plans (NAPs), laying out countries' adaptation needs and how to address them. While this process only applies to Developing and Least Developed countries (as defined by the UNFCCC), other countries have adopted similar strategies to guide their adaptation action.

Coastal and marine ecosystems, play a significant role in carbon sequestration (see following chapter 1.3) and provide natural defences against climate impacts like sea-level rise and extreme weather events. In the following sections, this document will analyze how, in a coastal context, NDCs not only often highlight the needs to put in place conservation and restoration efforts of natural ecosystems (see chapter 2.1), but also offer significant potential as key strategies for both mitigation and adaptation. Thus, the integration of coastal ecosystem restoration in NDCs makes a valuable contribution for enhancing their overall effectiveness and sustainability. Therefore, hands-on measures under REST-COAST could feed actions to palliate the climate crisis (Figure 1).

[6] The global stocktake is a process that allows countries and stakeholders to assess their collective progress towards achieving the goals of the Paris Agreement, as well as identifying areas where they are falling short. The first global stocktake (2023) affirmed that we are not on track to limit global warming to 1.5ºC and the window for meaningful change quickly closing. For detailed contents, see Decision 1/CMA.5 "*Outcome of the first global stocktake*", in the UNFCCC CoP report.

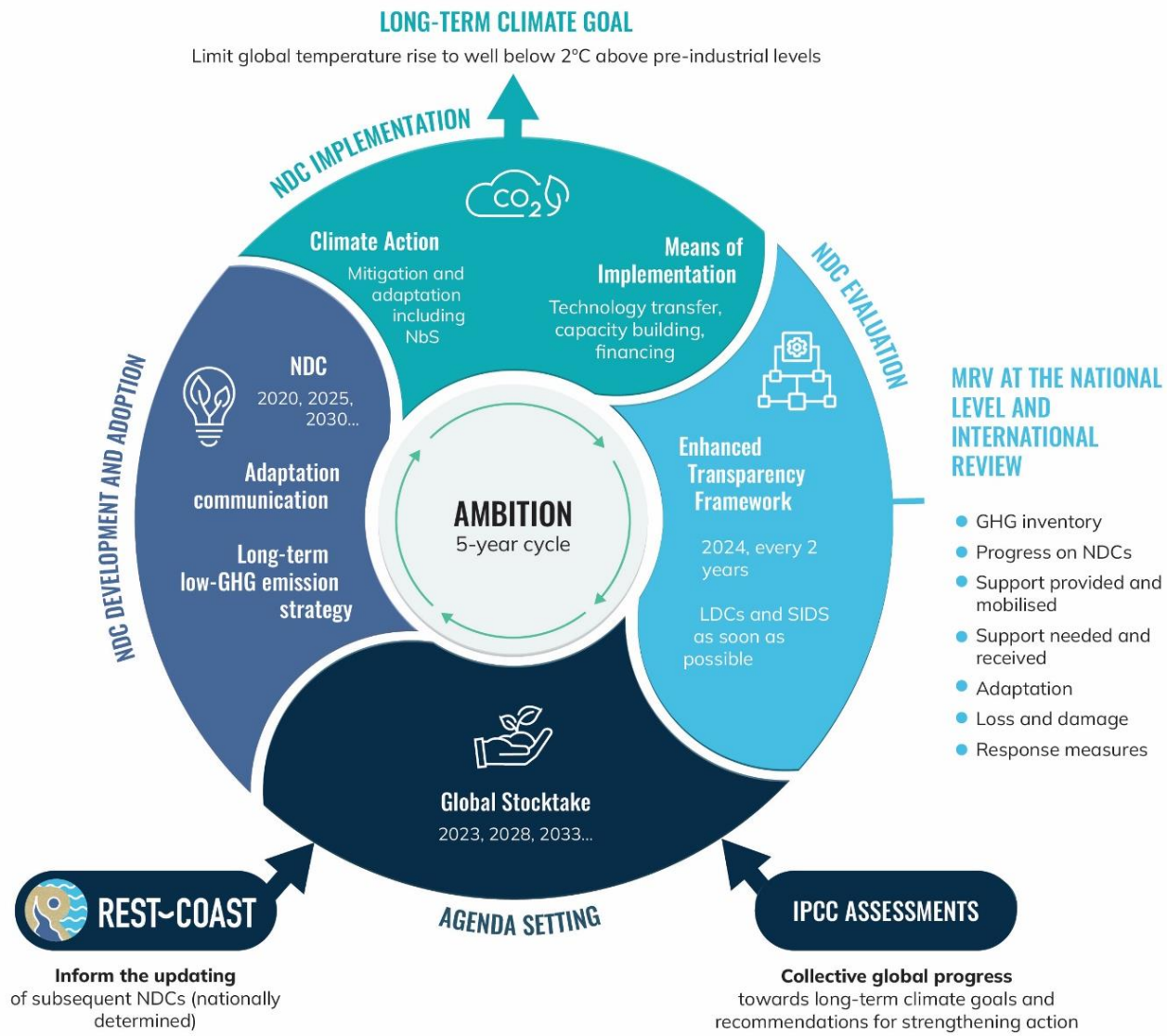

Figure 1. The NDC cycle under the Paris Agreement and entry points for the RESTCOAST Project. Source: based on Thomas et al., 2023.

2 The role of Blue Carbon Ecosystems in climate action

Ecosystems´ natural ability to sequester and store carbon is central to tackling climate change. While conserving, restoring and managing ecosystems to bolster their natural carbon sink capacity cannot replace the imperative for rapid reductions in fossil fuel emissions across all sectors, they can provide a vital contribution to decarbonisation efforts. When coupled with effective emissions reductions efforts, NbS can help mitigate climate change by accelerating emissions reductions and compensating for some emissions that are currently practically or economically unfeasible to avoid (UNEP & IUCN, 2021). According to IUCN (2020), research highlights that NbS could provide around 30% of the cost-effective mitigation needed by 2030 to stabilise warming to below 2°C.

Blue carbon ecosystems (BCEs) can play a pivotal role in both mitigating climate change and adapting to its impacts, thus contributing to NDCs for achieving the targets set out by the Paris Agreement. BCEs are marine and coastal ecosystems that have high carbon stocks, contribute to the sequestration and long-term storage of carbon, and can be managed to reduce GHG emissions (Lovelock and Duarte, 2019). Tidal ecosystems

including mangroves,[7] seagrasses, salt marshes and other coastal wetlands are well-known BCEs as they are among the most carbon-rich ecosystems on Earth and have an important role as GHG sinks (Adame *et al.*, 2024; McLeod *et al.* 2011; Zhong *et al*. 2023). BCEs are exceptionally efficient at capturing and storing carbon in their sediments and biomass (Taillardat *et al*., 2020). These ecosystems are estimated to capture up to six times more carbon than tropical rainforests, which have traditionally been the focus of nature conservation (and restoration) efforts (Dencer-Brown *et al*., 2022; Liu *et al.*, 2024). While carbon sequestration rates are highly variable as they depend on context specific conditions, they have high carbon sequestration capacities with estimates ranging between **43 ±64 MgC/ha for Zostera marina seagrass habitats** to **282 ±99 MgC/ha for salt marsh habitats** (Malak *et al.*, 2021). Globally, coastal vegetated habitats are estimated to sequester around **0.84 Gt CO_2eq/year**, which is comparable to the amount sequestered by terrestrial forests despite covering less than 3% of their area (Duarte *et al.,* 2013; Taillardat *et al.*, 2018). In terms of carbon storage, tidal marshes, seagrass beds and mangroves are all wetland habitats where the slow decomposition of organic matter leads to long-term carbon accumulation (Abdul Malak *et al.*, 2021). Consequently, **healthy coastal wetland habitats** have amongst the largest carbon stocks, with estimates ranging between **50 - 150 Mg/ha of carbon** (Malak *et al.*, 2021).

Despite their importance, coastal ecosystems are under threat from a range of human activities, including coastal development, pollution, overfishing, and climate change (Wylie *et al.*, 2016). It is estimated that around 50% of the world's coastal wetlands have been lost in the last century, with rates of loss accelerating in recent decades (Pendleton *et al.*, 2012). In the EU, it is estimated that around 85% of the historical extent of salt marshes has been lost, while seagrass meadows have declined by around 30% in the last 50 years (European Environment Agency, 2019). When coastal ecosystems are degraded or lost, the ecological processes supporting carbon sequestration services are disrupted, leading to the potential release of their large carbon stores. In this way, coastal ecosystems can go from being important net carbon sinks to a significant source of GHG emissions. Globally, it is estimated that degraded coastal wetlands emit approximately 0.45 Gt annually (Howard *et al*., 2023).

Restoring lost and degraded wetlands is crucial to conserving these important ecosystems to maintain and enhance their carbon mitigation benefits, with the Ramsar Convention providing a robust framework that underscores its benefits.[8] While knowledge on the complex processes that underline the production and absorption of GHGs in coastal wetlands is incomplete, it is widely accepted that restoring degraded coastal wetlands has an overall positive climate mitigation impact (Malerba *et al*., 2022).[9] The **restoration of salt marshes and seagrass meadows** can significantly enhance carbon sequestration rates, with estimates ranging from **0.4 to 8.0 tCO_2eq/ha/year for saltmarshes** and **0.4 to 1.8 tCO_2eq/ha/year for seagrass meadows** (Howard *et al.*, 2017).

Beyond carbon capture, tidal ecosystems provide a range of other ecosystem services (ESS), including biodiversity support and water quality improvement while providing important nursery habitats for commercially important fish and shellfish species (Barbier *et al.*, 2011). Additionally, seagrass meadows and salt marshes can provide a range of services to help adapt to the unavoidable impacts of climate change including stabilising sediments, reducing coastal erosion and attenuating wave energy, delivering valuable coastal protection services, including reduction of saltwater intrusion (Ondiviela *et al.*, 2014; White and

[7] Europe does not have natural mangrove forests like those found in tropical regions. However, they are mentioned here due to their occurrence in several EU overseas regions and territories located in tropical and subtropical areas, such as those associated with France and the Netherlands.

[8] "The Ramsar Convention Manual: A Guide to the Convention on Wetlands"; Resolution IX.1 (2005): "Framework for Wetland Inventory"; Resolution X.7 (2008): "The Ramsar Vision for the Future"; Resolution XI.9 (2012): "An Integrated Framework and guidelines for avoiding, mitigating and compensating for wetland losses"

[9] In the context of wetlands, some environmental concerns are also raised regarding gas emissions with significant global warming potential, such as methane (CH_4) and nitrous oxide (N_2O) which can diminish the wetlands' ability to mitigate climate change (Malerba *et al.*, 2022). Despite these concerns, scientific evidence supports not only that wetlands restoration leads to net carbon benefits, but also that these issues can be addressed through targeted management and conservation practices and strategies, such as water and vegetation management or soil amendments (Huang *et al.*, 2013; Yin *et al.*, 2023; Malerba *et al.*, 2022). This would ensure that wetland restoration remains a valuable tool for climate mitigation.

Kaplan, 2017). The restoration of BCEs can maintain and enhance the delivery of these ecosystem services. For instance, a meta-analysis by Narayan *et al.* (2016) found that coastal wetlands can reduce wave heights by an average of 35%, demonstrating that they can help protect against the more frequent and severe storms predicted under a warming climate.[10] In addition, restoring tidal ecosystems can also enhance their resilience and adaptive capacity, enabling them to better withstand and recover from climate-related impacts. This is particularly important given climate projections that estimate a 2-6°C rise in sea surface temperatures in European basins by 2100 under high-emissions scenario (EEA, 2023).[11] These benefits make the restoration of tidal BCEs a promising nature-based solution by protecting society and nature against some of the unavoidable impacts of climate change including more intense and frequent extreme weather events and sea level rise (Duarte *et al.*, 2013). Moreover, restoring ecosystems that are not traditionally classified as BCE can also deliver significant ESS, including supporting climate adaptation and enhancing resilience. For instance, while the climate mitigation potential of macroalgal forests is poorly understood and is likely to be limited in some contexts, macroalgal forest restoration can enhance nursery services, boost ecosystem resilience, and possibly attenuate wave energy (Pessarrodona *et al*., 2023; Duarte *et al*., 2013). Similarly, oyster reef restoration can provide numerous benefits such as improved water quality, habitat provisioning for marine life, and seashore stabilization among others (Grabowski *et al.,* 2012; Zu Ermgassen *et al.*, 2020).

3 Strengthening the contributions of Blue Carbon Ecosystems in the policy framework through NDCs

After decades of slow convergence of ocean and climate policies (Dobush *et al.*, 2022), the protection and restoration of BCEs are increasingly recognized by policy makers as essential components of climate action plans at both the global and EU levels (Thomas *et al.*, 2023). Additionally, from the economic perspective, protection and restoration of BCEs offer potentially high returns on investment delivering a high benefit–cost ratio. For example, the conservation and restoration of mangroves could deliver benefits three times larger than their cost, including water regulation, storm surge protection, carbon sequestration, fisheries productivity and tourism attractiveness, resulting in a net benefit of $0.2 trillion over a 30-year period (Dencer-Brown *et al.*, 2022). Despite this importance in mitigating and adapting to climate change, their integration into policies has remained underdeveloped (Dencer-Brown *et al.*, 2022). This prolonged under-recognition, coupled with a lack of commitment, has hindered the widespread integration of BCEs and policy development and implementation, such as the case for NDCs. However, incorporating BCE restoration into NDCs could significantly enhance a country's climate mitigation and adaptation strategies. As demonstrated by a recent example in China, targeting BCEs such as mangroves can be more cost-effective than focusing on terrestrial forests when aiming to enhance forest stocks in line with the targets set out under the Chinese NDC (Liu *et al.*, 2024).

Restoring coastal ecosystems can also have significant economic benefits. A study by Costanza *et al.* (2014) estimated that the global value of ecosystem services provided by coastal wetlands, including climate regulation, coastal protection, and fisheries support, is around $194,000 per hectare per year. Similarly, Himes-Cornell *et al.* (2018) found that the restoration of seagrass meadows in the Mediterranean Sea could

[10] Narayan *et al.*, (2016) conducted a comprehensive meta-analysis of 69 studies on natural and nature-based coastal defenses. Their findings demonstrate the significant role of coastal wetlands in flood protection. The study revealed that salt marshes can reduce wave heights by 72% on average, while mangroves can reduce them by 31%. Coral reefs were found to be even more effective, reducing wave heights by an average of 70%. The overall 35% reduction in wave height across all types of coastal wetlands underscores their importance as natural buffers against coastal flooding and erosion. This natural flood protection service not only enhances coastal resilience but also provides a cost-effective alternative or complement to traditional engineered flood defenses. The study highlights the potential of nature-based solutions in climate change adaptation strategies, particularly for coastal communities vulnerable to sea-level rise and increased storm intensity.

[11] European Environment Agency. 2023. European sea surface temperature. https://www.eea.europa.eu/en/analysis/indicators/european-sea-surface-temperature?activeAccordion=546a7c35-9188-4d23-94ee-005d97c26f2b

generate economic benefits of €190 million to €1.1 billion per year by 2050, through increased fish production, improved water quality, and enhanced carbon sequestration. Moreover, the benefits of restoring coastal ecosystems extends beyond ecological and economic gains to encompass significant cultural, social, recreational and spiritual advantages. Restoration efforts revive traditional practices that foster social cohesion and preserve cultural heritage. Such non-material benefits highlight the holistic value of coastal ecosystem restoration, enhancing overall well-being and bolstering community resilience.

The recognition of coastal ecosystems as critical components in climate change mitigation and adaptation coupled with an ongoing degradation that has spurred a growing movement for their restoration. The United Nations Decade on Ecosystem Restoration (2021-2030) is the global initiative designed to scale up the restoration of degraded and destroyed ecosystems as a means of addressing climate change, enhancing biodiversity, and supporting human well-being (UNEP, 2021). It's action plan specifically targets the conservation and restoration of marine and coastal ecosystems (UN, 2023). Also at UN level, the Convention on Biological Diversity through the Global Biodiversity Framework framed the restoration of 30% of all degraded ecosystems by 2030 in Target 2 (Box 3). Similarly, the EU Biodiversity Strategy for 2030 calls for the restoration of degraded ecosystems, including coastal and marine habitats, as part of the efforts to tackle the twin crises of biodiversity loss and climate change (European Commission, 2020a).

> ***TARGET 2: RESTORE 30% OF ALL DEGRADED ECOSYSTEMS***
>
> *"Ensure that by 2030 at least 30 per cent of areas of degraded terrestrial, inland water, and coastal and marine ecosystems are **under effective restoration**, in order to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity."*

Box 3. Target 2 Kunming-Montreal Global Biodiversity Framework. Source: Convention on Biological Diversity.

Effective restoration of these ecosystems will act as solutions to climate change inspired and supported by nature, providing both environmental, socio-economic and cultural benefits. For instance, healthy coastal ecosystems support fisheries, protect coastlines from erosion, and attract more sustainable tourism practices and visitors, thereby contributing to sustainable development goals (Bueb *et al.*, 2021). As such, integrating blue carbon initiatives into NDCs not only helps in reducing GHG concentrations but also promotes overall ecosystem health and resilience, aligning with broader global sustainability objectives and maximizing the impact of both mitigation and adaptation measures. By setting specific targets for the conservation and restoration of BCEs, countries can harness the power of NbS to enhance the ambition and effectiveness of their climate actions. Moreover, by integrating coastal ecosystem restoration into national climate policies and strategies, countries can leverage the multiple co-benefits of these actions, including biodiversity conservation, coastal protection, and sustainable livelihoods.

The REST-COAST Pilot Sites encompass a range of intertidal ecological features as well as a mix of marine, coastal and fluvial ecosystems, some of which BCEs. Intertidal habitats are present in all Pilots and are the primary focus of restoration actions (Figure 2). The restoration of saltmarshes and the recovery of natural flow dynamics are the predominant actions, closely followed by the improvement of the hydraulic connectivity (Figure 3). All this underlines the importance of the REST-COAST project in the context of climate policies and the contribution to NDCs, since coastal ecosystems restoration, particularly wetlands, can significantly increase natural carbon sinks, while simultaneously delivering benefits from ESS improvements, including climate adaptation and resilience.

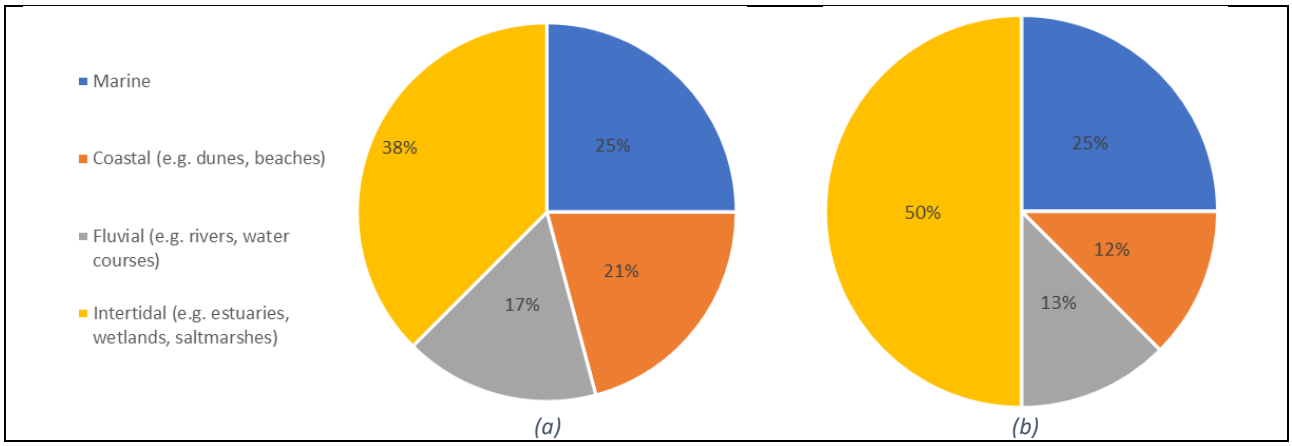

Figure 2. Type of ecosystems in Pilot Sites (a) vs Ecosystems under restoration actions within REST-COAST (b). Source: REST-COAST Milestone 5.4.

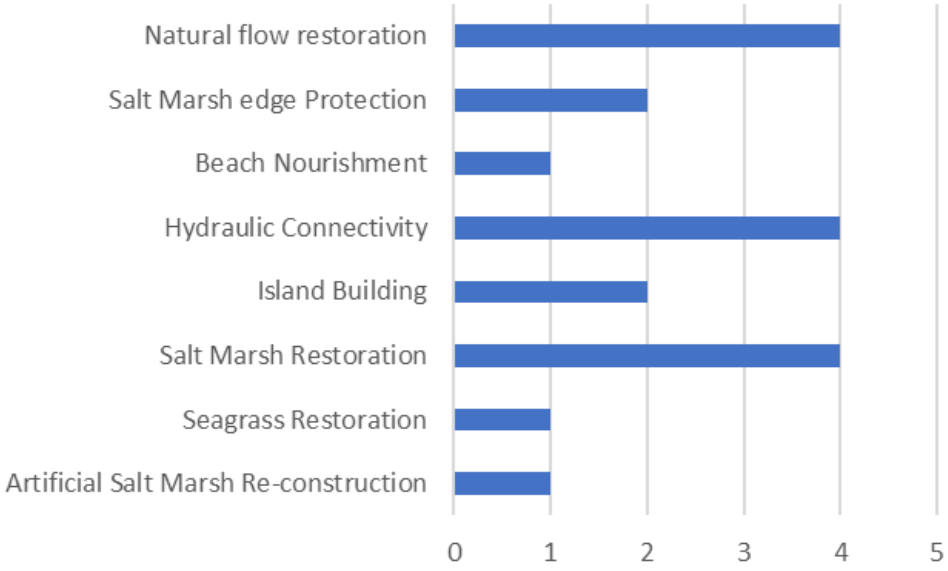

Figure 3. Number of restoration actions across REST-COAST Pilot Sites. Source: REST-COAST Milestone 5.4.

4 The potential of carbon credits for coastal restoration finance

Negative emissions are critical to achieving the Paris Agreement's net-zero pledges by offsetting the remaining GHG emissions that cannot be eliminated. The restoration of coastal ecosystems offers a highly cost-effective NbS for sequestering and storing atmospheric carbon. Despite its clear benefits and potential, a major barrier to their large-scale implementation is the lack of sufficient funding and financial support (Frantzeskaki *et al*., 2019; Sarabi *et al*., 2019; Seddon *et al*., 2020). To address this financial gap and unlock the full potential of NbS in meeting the Agreement targets, it is an urgent task to promote the design and implementation of green financial instruments for the development of innovative NbS business models.[12]

[12] See further information on NbS business models here "*Nature-based solutions Business information package*" (Blessing and Barrientos, 2023) https://networknature.eu/sites/default/files/uploads/d52-business-information-packagenew.pdf

4.1 The role of innovative finance and business models for NbS restoration

Currently, projects aligned with the NbS definition (see Terminology, this document) are predominantly funded by governments and other public bodies, and to a lesser extent by private philanthropists (UNEP, 2022a). These entities generally operate as grantors, providing funds to obtain non-monetary rewards like enhanced natural capital and social welfare.

The capacity of public authorities to attract funding for NbS restoration through conventional granting approaches is diminishing due to tight budgets and the competition with other public policy priorities (Toxopeus and Polzin, 2021). In addition to the limits in size, grants are also limited in time, as they are often awarded on a project-by-project basis. These characteristics make grant-based public funding models inadequate for delivering large-scale implementation of NbS projects. Grey solutions (e.g. seawalls, groynes, and breakwaters) for coastal management tend to be preferred by certain decision-makers and stakeholders over NbS because their functions and benefits are apparent and visible in the short term, whereas the services provided by NbS develop beyond the timeframes of short-term decision-making cycles (Kabisch *et al*., 2016). Project-based grants furthermore result in NbS being often implemented as isolated pilots, failing to achieve full integration at landscape scale within wider socio-ecological systems (Altamirano *et al*., 2021). Therefore, significant restructuring of financial models must be pursued in order to achieve NbS upscaling needed for the implementation of NDCs under the Paris Agreement.

A major opportunity in this sense consists in establishing value-capture arrangements and innovative NbS business models able to mobilise and leverage private investments in ecosystem restoration (EIB, 2023; OECD, 2020; TNC, 2019; UNEP, 2022a).

Implementing value capture mechanisms involves setting up direct or indirect payment systems from those who benefit from the ecosystem services provided by a NbS. This can include selling products derived from the NbS, like timber or oysters, or imposing fees on residents who gain from reduced flooding risks. By integrating value capture strategies into the NbS business model, it becomes possible to create financing strategies that aim to attract initial capital from investors. Unlike funders, these investors seek financial returns, such as interest or dividends, in addition to non-monetary benefits.

Involving private sector actors through value-capture and financing arrangements offers opportunities to enhance the capital available for NbS projects, increasing scale and the overall impacts. In addition, this approach would also diversify funding sources, align possibly contrasting interests in local governance through incentives and rewards, and boost financial capacity by leveraging the private sector's financial expertise.

4.2 The opportunities brought by carbon credits

Carbon credits are financial assets representing real, quantified and priced units of removal of GHG emissions from the atmosphere. These credits are produced by dedicated organisations known as carbon standards and verified by independent third parties. Companies and individuals can buy carbon credits and retire them to offset emissions or hold them as financial assets. By establishing a system of clear property rights over ecosystem services, this mechanism enables the creation and development of markets for ESS, i.e. carbon sequestration (Figure 4).

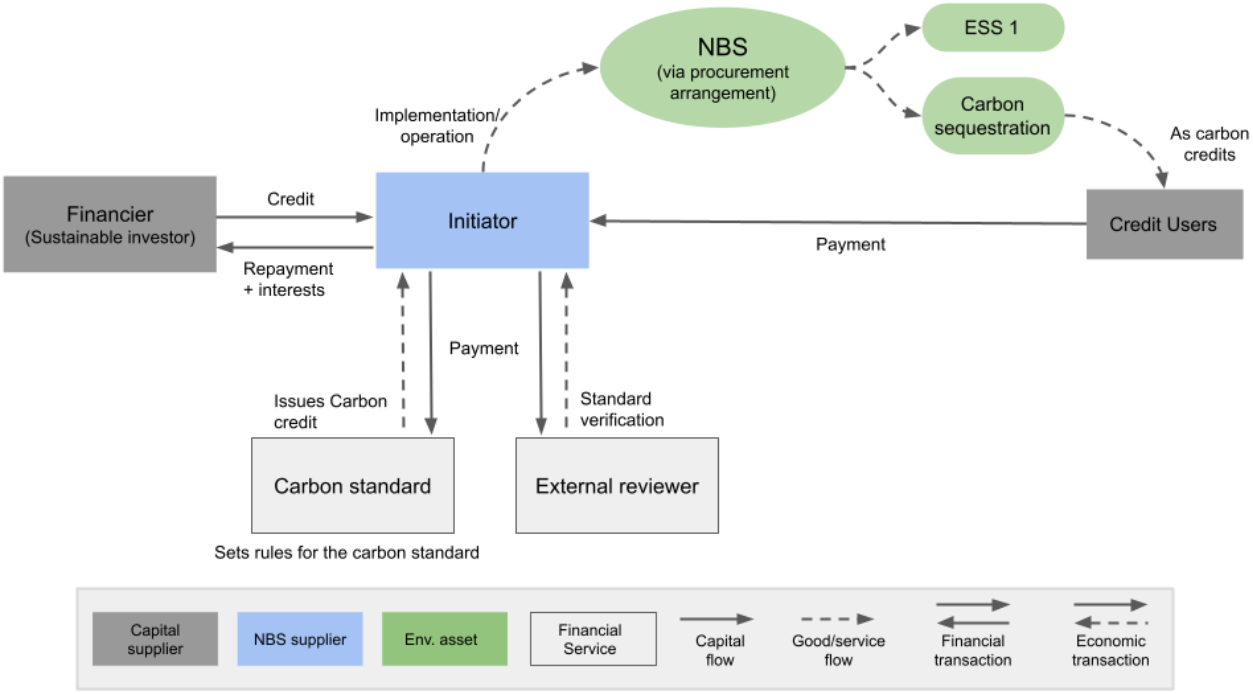

Figure 4. NbS business model including carbon credits. Source: REST-COAST Deliverable D3.2.

The prospect of carbon credit revenue can attract private sector investment, including commercial and impact-oriented investors. This can be facilitated through financial instruments like green bonds and environmental impact bonds, which are designed specifically to suit the needs of green and impact-oriented investors.

All these benefits brought by carbon credits increase the scalability and long-term sustainability of coastal restoration projects, which is as already mentioned vital for the implementation of NDCs. This is especially true when considering the growing interests for high-quality credits (i.e. credits associated with ecosystem restoration rather than conservation, or those linked to additional benefits including other ecosystem services) within broader voluntary carbon markets (Ecosystem Marketplace, 2024).

The following list present several case studies of innovative carbon credit schemes focused on coastal ecosystem restoration, each highlighting unique approaches to leveraging blue carbon for climate action:

- The **Prométhée-Med Project** is a pioneering initiative under France's Label Bas-Carbone, the national standard established in 2018 to certify voluntary carbon projects. This project, developed by EcoAct, Digital Realty France, Schneider Electric France, and the Calanques National Park, is the first Label Bas-Carbone approved methodology focused on blue carbon ecosystems, specifically targeting the protection of *Posidonia oceanica* meadows. By safeguarding these crucial seagrass beds in the Mediterranean, the project aims to reduce carbon emissions by 24,000 tCO_2eq annually. The Label Bas-Carbone is a key national policy to leverage private funding to advance France's climate goals and ecological restoration efforts. The label was specifically designed to allow small projects to register for carbon credit issuance, ensuring that even fragmented and locally managed habitats can benefit from carbon funding, and making it easier for companies to engage in strategic environmental stewardship (De la Fuente 2023, Comte *et al.*, 2024).
- The **Papariko Project** in Kenya is a transformative mangrove reforestation initiative lead by Vlinder, in partnership with local communities and Solid World. This project aims to restore 1,500 hectares of degraded mangrove forests, sequester carbon, support biodiversity, and provide livelihoods for coastal populations. The project adopts a long-term perspective expecting to sequester 640,000 tCO_2eq by 2042. A standout feature of the Papariko Project is its focus on empowering local

communities, particularly women, who play a central role in project implementation. The project not only provides jobs but also shares 50% of carbon revenues with local stakeholders, ensuring long-term benefits for the community over the next 30 years. This model is crucial in overcoming barriers that often limit small-scale projects, offering a transparent and equitable approach to carbon financing (Solid World, 2024).

- The **Yokohama Blue Carbon Project**, initiated in 2014, is an innovative initiative aimed at reducing greenhouse gas emissions through the natural carbon absorption of marine ecosystems. As part of Yokohama's goal to cut emissions by 30% by 2030, the project certifies and trades carbon credits derived from seagrass restoration. Initially focused on offsetting emissions from short-term events, the project has since expanded to ongoing corporate activities and individual use. The success of this local initiative has inspired other municipalities to collaborate with Yokohama, broadening the impact of blue carbon offsets across Japan. Effective mediation among stakeholders and strong public support have been key to the project's growth, making it a model for community-driven climate action (Kuwae *et al.*, 2022).

4.3 Challenges for the development of carbon markets

Despite the value of addressing the financial gap through carbon credits, the current context presents several key challenges that must be faced to successfully implement these projects:

- **Verification and Certification**: Rigorous monitoring, reporting, and verification processes are essential to ensure the credibility of carbon credits. This involves independent third-party verification and adherence to methodologies like Verra's VM0033 and Clean Development Mechanism's AR-AM0003.[13] The process for verification and certification thus involves significant transaction costs and administrative hurdles, which might result in significant barriers for their implementation in smaller-size NbS projects. The distribution of these costs throughout the lifetime of the project might also be challenging for project manager with limited financial capacity, as much of these are concentrated upfront (e.g. costs of conducting baseline studies to establish the pre-restoration carbon stock, and those associated with the certification process), while long-term commitments are still needed to meet monitoring and reporting requirements.
- **Volatility**: Another challenge is brought by the fact that the market for carbon credits can be volatile. Despite the overall expectation that carbon credits' prices will increase as company and other entities take action to comply with their climate neutrality pledges, voluntary carbon markets are still rather underdeveloped and characterised by a significant margin of uncertainty. Supportive policies and regulatory frameworks to increase the stability of the market environment will be essential for the success of carbon credit schemes and their integration in coastal restoration financing.
- **Economic Valuation**: the benefits that NbS restoration can produce in the form of carbon sequestration can be measured using different economic valuation methods (e.g. the abatement cost method) which requires skills in ex-ante and post-ante valuation as well as data not always available within the organizations/stakeholders engaged in the process of NbS restoration.
- **ESS Quantification/scientific uncertainty:** Coastal ecosystems are dynamic and complex, with many interacting factors. As a result, carbon sequestration rates can vary significantly over time and across different areas of a wetland: seasonal changes, hydrological conditions, and human impacts can all influence these rates. Depending on the project's circumstances, predicting and accounting for how

[13] CDM's AR-AM0003 and VERRA's VM0033 are well-established methodologies for the quantification of greenhouse gas emission reductions/removals specifically tailored to nature restoration and Tidal Wetland and Seagrass Restoration, respectively. Methodologies for carbon reduction and sequestration are being progressively developed and updated to address the peculiarities of (coastal) restoration projects in order to facilitate the issuance of carbon credits in these contexts.

these systems respond to restoration efforts involves significant uncertainty, and might involve scientific and technical challenges.

- **Integrity**: Transaction volumes for the Forestry and Land Use category in the voluntary carbon market declined after REDD+ project[14] methodologies came under significant scrutiny. These integrity issues have undermined confidence in the carbon market, as investors perceive an increased exposure to greenwashing risks.
- **Market access**: As voluntary carbon markets are still not fully developed, establishing connections with potential buyers can be challenging, and smaller projects might have to rely on intermediaries to find buyers.

The stratification of these challenges results in a complex policy issue,[15] which must be met with appropriate governance reforms and coordination efforts. It is crucial to increase efforts in developing standardized methodologies and protocols for ecosystem service quantification and carbon credit verification. Additionally, supportive public policies and regulatory frameworks are often missing, and their introduction would contribute to the stabilization of the carbon market. While these reforms are under development, the provision of financial and technical support from public entities to restoration projects, especially those with a smaller size, can ensure broader participation and the demonstration of successful implementation.

5 Nationally Determined Contributions and REST-COAST

The REST-COAST project, through its nine Pilot Sites located in various countries, including Bulgaria, Denmark, France, Germany, Italy, Israel, the Netherlands, Poland, and Spain, aims to demonstrate the potential of upscaled coastal restoration as a low-carbon solution for climate adaptation and disaster risk reduction. Therefore, the restoration actions implemented through REST-COAST can directly – or indirectly - support countries in achieving their NDC targets in several ways:

- **Enhancing carbon sequestration and avoiding emissions**: As highlighted above, coastal ecosystems are efficient carbon sinks, and their restoration can contribute to increasing the uptake and long-term storage of atmospheric carbon dioxide, thereby mitigating climate change. Protection and restoration of high-carbon ecosystems is also key to safeguarding existing carbon sinks as climate benefits are not only from enhanced sequestration, but also due to the avoided emissions from continued degradation of those ecosystem (Christianson *et al.*, 2022; Mengis *et al.*, 2023). For example, the large carbon stores of coastal wetlands are vulnerable to oxidation when disturbed resulting in considerable emissions of carbon from degraded coastal wetlands, while protected ones are sequestering carbon or at a net balance (Lovelock *et al.*, 2017). This aligns with NDC targets related to reducing GHG emissions.
- **Improving coastal protection**: As concluded in WP2 (D2.2 "*Good practice criteria for multi-variable risk reduction from restoration/ESS at the Pilots, as a function of projection horizon and domain scale, as enablers to introduce risk products in coastal governance*)", restored coastal ecosystems, such as salt marshes, dunes (e.g. through effective sediment management) or seagrass meadows, can provide natural barriers against sea level rise, storm surges, and coastal erosion, enhancing the resilience of coastal communities and infrastructure to climate change impacts. This directly supports the adaptation component of NDCs.

[14] REDD+ projects use carbon finance to fund community activities that reduce emissions from deforestation and forest degradation and enhance sustainable forest management.

[15] It is crucial to acknowledge the significant regulatory heterogeneity across EU member states regarding carbon market mechanisms, which presents a substantial impediment to the establishment of a standardized pan-European carbon market. This regulatory fragmentation manifests in diverse national approaches to carbon crediting and offsetting, creating a complex mosaic of policies and practices. The absence of harmonized EU-wide legislation engenders market inefficiencies and hinders the development of a unified and robust European carbon market.

- **Biodiversity conservation and restoration**: Coastal restoration projects aim to restore and conserve habitats and species, contributing to the preservation of biodiversity, which is essential for maintaining ecosystem functioning and services. Thus, healthy coastal ecosystems can enhance their resilience to climate change. Important to note that the entire surface of most of the REST-COAST Pilot Sites is under a protection figure (mostly N2000 sites). The REST-COAST WP4, which focuses on adaptation management for restoration and upscaling, has developed a scorecard methodology for Pilots using EUNIS (sub)habitat maps and the European Red List of Habitats to assess coastal system behaviour and restoration effects on ESS and BDV gains under climate change. It will help to visualize the effect of restoration measures in Pilots with different spatial scales to inform decision-making processes (see Deliverable 4.1 "*Scorecard methodology (tool) for coastal system restoration effects on ESS and BDV*").
- **Strengthening the policy framework:** REST-COAST project will not only provide data, methods, tools and practical examples of successful restoration, but also can enhance policy-making and regulatory frameworks. The project's evidence-based approach supports the development of robust national and international strategies for coastal management in line with NDC goals. Additionally, deliverables under WP5 (e.g. D5.2 "*Roadmap for governance transformation strategy and criteria for effective restoration programmes at the Pilots*" and D5.3 "*Recommendations from Core and Fellow Pilots as a key management element for present/future restoration actions*") emphasize the importance of establishing a transformative governance and the proper policy framework to support these coastal restoration practices. WP5 also highlights the need to identify opportunities to grasp the policy context that may feed into the existing policy framework in Pilot Sites and beyond.
- **Providing financial pathways** to fully leverage the potential of coastal ecosystems restoration in mitigation, adaptation and resilience. This approach enables countries to make significant progress in enhancing the ambition of their NDCs achieving their climate goals while also promoting sustainable development and enhancing the well-being of coastal communities. See REST-COAST D3.2 "*Review of innovative public funding, finance and provisioning arrangements*" which identifies and analysis of promising innovative financial arrangements from around the world, and the assessment of the potential to transfer these to the REST-COAST Pilots, as well as other NbS projects.

The project will also provide **co-benefits.** Restored coastal ecosystems not only enhance physical or biological conditions - such as improved water quality and nursery grounds for commercial species- but also act as a catalyst for additional economic activities. These improvements can boost the attractiveness of the area, help to promote eco-tourism, support recreational activities, etc., all of which can contribute to sustainable development and economic growth, aligning with the broader objectives of NDCs.

By demonstrating how the REST-COAST project's restoration efforts can contribute to countries' NDCs, the project can strengthen the case for better integrating coastal ecosystem restoration into national climate plans. In addition, the outcomes, lessons learnt, and recommendations from the project can inform the revision of NDCs by helping to identify suitable targets, measures, and policies to capitalise on the climate mitigation and adaptation potential of coastal ecosystems. Furthermore, they can also provide insights into how to strengthen the governance, financial arrangements, and policy frameworks needed to support and upscale these efforts.

The project's focus on addressing key challenges faced by coastal ecosystem restoration across Europe, such as demonstrating improved practices and techniques for hands-on ecosystem restoration, co-designing innovative governance and financial arrangements, and developing an effective strategy for disseminating results, directly aligns with the goals of NDCs in promoting sustainable and resilient coastal management.

By leveraging the knowledge, experience, and best practices generated through the REST-COAST project, countries can enhance their NDC implementation strategies and contribute to global efforts in combating climate change while preserving and restoring valuable coastal ecosystems.

5.1 Exploring NDCs at national Level

As stated above, NDCs serve as the cornerstone of the Paris Agreement, embodying each country's commitments to reduce GHG emissions and adapt to the impacts of climate change. As nations submit their updated NDCs, it is crucial to identify the extent to which they recognize and address the mitigation and adaptation potential of coastal and marine ecosystems.

This section provides an in-depth review of the NDCs submitted by the European Union (EU) and its Member States, as well as Israel. It is focused on both individual NDCs submitted at the country level and the collective NDC submitted by the EU. Although NDCs are commonly submitted by individual nations, the EU, as a Party to the Paris Agreement, submits a single NDC on behalf of all its Member States, coordinated by the corresponding Presidency of the Council of the EU. Since the Agreement entered into force, three joint submissions have been made by Presidencies of Latvia, Germany and Spain in 2015, 2020 and 2023, respectively. Notably, France also submitted individual NDCs in 2016 and 2020 to complement the collective EU NDCs. This analysis excludes any sub-national or non-state actor contributions submitted to the UNFCCC. This review aims at identifying potential gaps related to coastal and marine ecosystems and underscoring the essential role of ecosystem restoration in maximizing climate benefits.

European Union's NDC

The EU has demonstrated a strong commitment to enhancing its climate ambition over time. In its initial NDC, submitted as an Intended Nationally Determined Contribution (INDC) in 2015 by Latvian Presidency and converted to an NDC upon ratification of the Paris Agreement in 2016, the EU pledged to **reduce domestic GHG emissions by at least 40% by 2030** compared to 1990 levels (European Union, 2015). However, in December 2020, the European Council endorsed a more ambitious target of a net domestic reduction of **at least 55% in GHG emissions by 2030** compared to 1990, which was communicated to the UNFCCC as an updated NDC (European Union, 2020). This enhanced target was made legally binding through the European Climate Law (Regulation 2021/1119)[16] adopted in June 2021, which also set the objective of achieving **climate neutrality by 2050** (European Union, 2023).

To implement the updated NDC, in 2021 the EU also adopted a comprehensive legislative package known as ***"Fit for 55"***[17] which aims to align EU policies with the new 2030 climate target (European Union, 2023). The package includes several key elements that were formally adopted in 2023, such as:

- A strengthened EU Emissions Trading System (ETS) with a 62% emission reduction target for covered sectors by 2030 compared to 2005 levels (Directive 2023/959).[18]
- Expanded sectoral coverage of the EU ETS to include maritime transport, buildings, road transport, and additional sectors.
- Increased national GHG reduction targets for non-ETS sectors under an amended Effort Sharing Regulation, totalling an EU-wide reduction of 40% by 2030 compared to 2005 levels (Regulation 2023/857).[19]

[16] Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law')

[17] European Commission. 2021. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality.

[18] DIRECTIVE (EU) 2023/959 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 10 May 2023 amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading system

[19] Regulation (EU) 2023/857 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement, and Regulation (EU) 2018/1999

- A new EU-wide target for net GHG removals in the Land Use, Land Use Change, and Forestry (LULUCF) sector of 310 $MtCO_2eq$ by 2030, with legally binding national targets (Regulation 2023/839).[20]
- More ambitious CO_2 emission standards for new passenger cars and vans, requiring a 100% reduction from 2035 onwards.

While the EU's updated NDC and the accompanying "*Fit for 55*" package demonstrate a significant increase in climate ambition, coastal and marine ecosystems – along with their potential for climate change mitigation and adaptation - remain undervalued.

The **EU NDC includes a target for net GHG removals in the LULUCF sector, which encompasses wetlands.** The EU's revised LULUCF Regulation 2023/839 integrates GHG emissions and carbon removals from land use and land use change into the EU climate framework. The regulation sets ambitious targets for net carbon removal, **including a binding national target for each Member State**, and promotes synergies between climate and biodiversity, while also aiming to simplify reporting and advance on monitoring technologies. The regulation provides for six land use reporting categories, of which wetlands are one, meaning that Member States are required to report on GHG emissions and carbon removals resulting from the management of wetlands. This target could technically extend to coastal ecosystems in line with the 2013 Intergovernmental Panel on Climate Change (IPCC) guidelines for the inclusion of wetlands in national GHG inventories, which cover coastal wetlands including mangrove forests, salt marshes and seagrass beds. However, the EU countries are not obliged to adopt the IPCC guidelines, and the EU NDC does not explicitly mention coastal wetlands. In addition, other coastal ecosystems that are potentially important from a climate mitigation and adaptation perspective, such as macroalgae (e.g. kelp forests), benthic sediments, and mud flats, are not yet included in the IPCC guidelines as scientific data is currently lacking (Blue Carbon Initiative, 2023).

The EEA Handbook on the revised LULUCF Regulation mentions wetland protection and peatland restoration and rewetting as management options to protect or enhance carbon sequestration capacity. The regulation's focus on enhanced monitoring, particularly the promotion of interoperability, is said to help assess potential co-benefits or conflicts between mitigation, adaptation, and biodiversity measures. Although this handbook identifies blue carbon as potential ecosystems, it admits that there is still limited information available on the amount of carbon stored in these ecosystems, how to quantify the impact of human activities, and how to restore degraded ecosystems (European Environment Agency, 2024).

Although coastal and marine ecosystems have significant potential to contribute to the EU's climate objectives, they will need to be better recognised and integrated in the EU's NDC and related policies. This would also improve coherence with other EU objectives including those on biodiversity. The EU Biodiversity Strategy for 2030 (European Commission, 2020a) recognizes that achieving good environmental status of marine ecosystems should involve protecting and restoring carbon-rich marine ecosystems. By setting specific targets for the conservation and restoration of coastal and marine ecosystems and integrating them into EU and national climate policies, leveraging on the power of NbS, and improving the monitoring systems for coastal and marine ecosystems, the EU can enhance the ambition and effectiveness of its climate actions, while improving biodiversity and generating co-benefits for coastal regions.

In addition to NDC, the **National Energy and Climate Plans** (NECPs) are also relevant as comprehensive planning and monitoring documents that EU Member States are required to develop under the Energy Union and Climate Action Governance Regulation (EU) 2018/1999. These plans outline how each country intends to address energy efficiency, renewables, GHG emissions reductions, interconnections, and research and innovation over a ten-year period. While NECPs are distinct from NDCs, they are closely linked to the EU's

[20] Regulation (EU) 2023/839 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2018/841 as regards the scope, simplifying the reporting and compliance rules, and setting out the targets of the Member States for 2030, and Regulation (EU) 2018/1999 as regards improvement in monitoring, reporting, tracking of progress and review

collective NDC. NECPs must demonstrate how national efforts contribute to meeting the EU's overall climate and energy targets, which form the basis of the EU's NDC. They serve as a mechanism to ensure coherence between national policies and the EU's collective climate commitments under the Paris Agreement. The information in NECPs is used to track progress towards both national targets and the EU's collective NDC commitments. NECPs are updated periodically, allowing for adjustments that reflect evolving national circumstances and contribute to potential increases in ambition of the EU's NDC over time. Thus, while the EU submits a single NDC, NECPs provide a detailed view of how individual Member States contribute to and align with this collective commitment, reflecting the multi-level governance approach to climate action within the EU.

EU Member States' NDCs and NECPs

As mentioned above, while the EU submits a collective NDC on behalf of its Member States, each EU countries also outline its own climate targets and actions through NECPs for the 2021-2030 period. In the case of France, the country has also submitted an individual NDCs, specifically to address climate actions in its overseas territories that are beyond EU jurisdiction. A review of these national-level documents for the eight EU countries where REST-COAST Pilot Sites are located reveals varying degrees of recognition and integration of coastal and marine ecosystems (see summary in Table 1). Overall, the reviewed NECPs all acknowledge the contribution of nature to achieve climate mitigation and adaptation goals. All NECPs set specific targets and measures regarding enhancing natural carbon sinks and stores for climate mitigation. Specific nature-based targets and measures for climate adaptation were also included in six of the eight reviewed NECPs. However, it is important to underline that NECPs are primarily focused on climate mitigation meaning that relevant targets and measures might exist in other documents such as national climate adaptation plans.[21]

NECPs recognise the need to enhance the role of nature in climate action, but the targets and measures put forward almost entirely focus on forest, agricultural and inland wetland ecosystems. In line with the current EU LULUCF Regulation which sets an EU-wide net removal target for the land use sector, all NECPs establish a target to increase national LULUCF sector sinks by 2030. While the inclusion of wetlands in NECP mitigation targets is not currently mandatory, the revised LULUCF Regulation will require **Member States to account for and include managed wetlands in their emission reduction commitments by 2026**.[22] Some Member States (e.g. Spain and Italy) already voluntarily include managed wetlands in their NECP LULUCF commitments, and all Member States are required to report on emissions and removals for wetland land use and land use change categories for the period 2021-2025.[23] Although the IPCC guidelines for GHG inventory accounting includes mangroves, saltmarshes and seagrasses in the wetlands land category, only four of the nine reviewed documents explicitly include coastal ecosystems in their commitments. Most Member States currently focus on inland wetlands in their NECP, as well as wetlands managed for agricultural or peat extraction purposes. As shown in the EU's most recent 2023 GHG emission inventory report, the definition of wetlands varies across Member States with only two (Bulgaria and Poland) of the REST-COAST countries explicitly mentioning coastal wetlands. Similarly, there is no harmonised definition for coastal ecosystems (e.g. France classifies mangroves as forests), making their inclusion in the EU level NECP challenging. Moreover, GHG commitments under LULUCF currently only focus on three types managed wetland ecosystems, meaning that some unmanaged ecosystems and other ecosystems with a potential role in climate action, such as macroalgal forests, are not included. Beyond commitments to enhance emission

[21] EU Member States are mandated to report on their national climate adaptation efforts under the under the Regulation on the Governance of the Energy Union and Climate Action. National reports are available online at https://reportnet.europa.eu/public/dataflow/895.
[22] The Commission reserves the right to postpone the mandatory accounting of wetlands for another five years if necessary.
[23] Even if Member States choose not to include managed wetlands in the scope of their LULUCF commitments, they are still required to account for emissions and removals for land use reported as "wetland remaining wetland", "settlement or other land converted to wetland" and "wetland converted to settlement of other land" in their national GHG inventories.

reductions and removals, only three of the reviewed documents put forward specific measures for enhancing the potential of coastal ecosystems for climate mitigation and only one for climate adaptation.

The review of corresponding NECPs is as follows:

The **Spanish NECP** strongly incorporates sustainable ecosystem management and conservation measures in climate mitigation and adaptation. While the focus remains on forests, agroecosystems and inland wetlands, it is the only reviewed NECP with a target that explicitly covers coastal ecosystems: "the restoration of at least 50,000 hectares of wetlands, including coastal wetlands, by 2030". Example of measures focusing on marine ecosystems specifically can also be found in the **French NDC for its overseas territories** that includes one link with improved marine ecosystem management in the case of French Polynesia. Some NECPs include specific targets for wetlands and measures for wetlands, which could include coastal wetlands. The **Netherlands NECP**, for example, includes a dedicated targets for wetlands aiming to achieve reductions of 1 megaton CO_2eq GHG emissions by 2030 through measures in 90,000 ha of peatland (including converting 10,000 ha of agricultural land to nature or wet crops and increasing groundwater levels in 80,000 ha). However, the plan acknowledges that measures for wetlands beyond forest and agricultural land are currently limited. To address this, a working group under the National Programme for Rural Areas (NPLG) has been created to establish climate measures for wetlands including transitional areas, sea/coast/salt marshes, open water and river marshes. The **Polish NECP** also includes specific measures for wetlands and floodplains, such as the restoration of wetlands and marshes in Natura 2000 and green infrastructure sites. However, the focus is on wetlands within agricultural and forestry land with no mention of coastal or marine ecosystems. Similarly, the **Bulgarian NECP** includes measures to restore and sustainably use wetlands and peatlands, but only in agricultural and forest land. The **Danish NECP** only considers coastal and marine ecosystems in terms of ensuring that climate measures such as offshore wind do not impact nature.

Several NECPs refer to other instruments that include measures relevant to coastal ecosystems. The **Spanish NECP** refers to other strategies and instruments that include coastal ecosystems such as the Master Plan for the Network of Marine Protected Areas,[24] the 4th Wetlands Action Plan 2022-2026 and the National Strategy for Green Infrastructure, Connectivity and Ecological Restoration.[25] However, the focus is primarily on ensuring that the measures of the NECP do not negatively impact on the conservation and sustainable management of coastal ecosystems. The consideration of how coastal ecosystems can strengthen the measures of the NECP could therefore be strengthened. The **German NECP** itself makes few references to coastal ecosystems, but it refers to the Federal action plan for NbS for climate, which has a chapter dedicated to marine and coastal ecosystems. The plan acknowledges the important role of these ecosystems including seagrass beds, salt marshes and kelp forests as carbon sinks and stocks and outlining actions to safeguard and enhance their climate benefits. For example, the German government plans to develop an integrated approach for the protection and restoration of saltmarshes, to launch a recovery program for seagrass beds, to promote research in pilot macroalgal restoration sites, to evaluate the carbon storage and sequestration potential of marine sediments to define carbon-rich marine areas, and to investigate the potential of biogenic reefs to sequester carbon. The plan includes other relevant initiatives including for preserving coastal wilderness areas and developing a national restoration plan in line with the EU Nature Restoration Regulation. Similarly, the **Italian NECP** refers to the National Ecological Transitional Plan[26] linking climate action to biodiversity restoration and protection, including marine and coastal conservation. Another example is the reference to the French Ecological Plan in the **French NECP**, which creates a framework for coordinated climate

[24] Red de Áreas Marinas Protegidas de España (RAMPE) https://www.miteco.gob.es/es/biodiversidad/temas/biodiversidad-marina/espacios-marinos-protegidos/red-areas-marinas-protegidas-espana/red-rampe-index.html

[25] Estrategia Nacional de Infraestructura Verde y de la Conectividad y Restauración Ecológicas https://www.miteco.gob.es/es/biodiversidad/temas/ecosistemas-y-conectividad/infraestructura-verde/infr_verde.html

[26] Piano nazionale di transizione ecologica https://www.mase.gov.it/pagina/piano-la-transizione-ecologica

and conservation, but it does not include specific acknowledgment targets or measures for coastal ecosystems.

Israel's NDC

Israel submitted its updated NDC in July 2021, committing **to reduce its net GHG emissions by 27% by 2030 compared to 2015 levels** (Government of Israel, 2021). The NDC does not strongly consider the role of natural carbon sinks and stores in meeting its mitigation targets stating that LULUCF pools are negligible in Israel. In addition, the NDC does not mention the potential role of nature protection and restoration in climate change adaptation. Therefore, Israel's NDC does not quantify the climate mitigation potential of coastal ecosystems or set specific targets and measures for their management and restoration.

When outlining Israel's action for climate adaptation, the NDC points towards the work being undertaken by the National Adaptation to Climate Change Committee, which is coordinating cross sector adaptation activities and projects including the development of Adaptation Reports. These adaptation reports, outlining steps that need to be taken at the national and local level, may recognise the role of NbS. However, reviewing these documents was outside the scope of this report. Israel does acknowledge the role of natural systems in climate adaptation within its National Action Plan on Climate Change (2022-2026). The plan includes actions to address the effects of climate change on land and marine biodiversity, such as restoring rivers, integrating NbS in basin management, creating buffer zones around forests, establishing a national plan for the protection of biodiversity and ecosystem restoration and planning ecological corridors. Moreover, the plan includes NbS to address climate risks in urban systems. However, the plan does not include measures for natural systems in its mitigation action plan and does not explicitly refer to coastal ecosystems.

Despite no mention coastal ecosystems in its NDC and National Action Plan on Climate Change, Israel has undertaken initiatives to restore coastal ecosystems. For instance, the Israel Marine Plan (2015), a comprehensive marine spatial planning initiative, includes measures to protect and restore sensitive coastal habitats such as seagrass meadows and *kurkar* (calcareous sandstone) reefs (Ministry of Environmental Protection, 2019). The plan aims to promote the sustainable use of marine resources while enhancing the resilience of coastal ecosystems to climate change impacts. This example demonstrates Israel's growing recognition of the importance of coastal and marine ecosystems for climate change mitigation and adaptation, as well as its efforts to protect and restore these valuable habitats. However, there is still a need to more fully integrate these ecosystems into national climate policies and to set specific targets and measures for their conservation and restoration.

The table below (Table 1) summarises whether the role of nature in general and coastal ecosystems is fully (green), partially (orange), or not (red) acknowledged and whether specific mitigation and adaptation targets and measures are put forward in each of the documents. The table also lists relevant tools referenced in the documents that support the implementation of these measures.

DOCUMENT (YEAR)	ECOSYSTEMS IN GENERAL			COASTAL ECOSYSTEMS			RELEVANT TOOLS (plans, strategies, projects)
	MENTION	MITIGATION (targets/ measures)	ADAPTATION (targets/ measures)	MENTION	MITIGATION (targets/ measures)	ADAPTATION (targets/ measures)	
BULGARIA*							
NECP (2024)							National Strategy on Adaptation to Climate Change and the 2030 Action Plan
DENMARK							
NECP (2023)							Marine Nature Fund, which will contribute to restoration of marine ecosystems, Agreement on Nature (the Nature Package)
EU							
NDC (2023, 2020)							European Climate Law (Regulation 2021/1119), Fit for 55 legislative package, LULUCF Regulation 2023/839, EU Biodiversity Strategy 2030, EU Nature Restoration Regulation
FRANCE							
NECP (2024)							Ecological Plan, 4th Wetlands Action Plan 2022-2026, Multiannual energy programming (EPP), National Low-Carbon Strategy (SNBC), National Plan for Adaptation to Climate Change (PNACC), State plan for civil protection against the risk of floods
NDC Overseas Territories (2021, 2016)							
GERMANY							
NECP (2023)							Federal Action Plan on Nature-based Solutions for Climate and Biodiversity (2023)
ISRAEL							
NDC (2015, 2021)							Decision in 2018 for Adaptation to Climate Change, Israel Marine Plan, National Action Plan on Climate Change (2022-2026)
ITALY							
NECP (2024)							National Climate Change Adaptation Plan (PNACC), National Ecological Transition Plan (ETP), 'Parks for Climate' programme
NETHERLANDS							
NECP (2024)							2016 National Adaptation Strategy (NAS), Delta Programme, Peatland Strategies
POLAND							
NECP (2024)							
SPAIN							
NECP (2023)							National Strategy for Green Infrastructure, Connectivity and Ecological Restoration, State Strategic Plan for Natural Heritage and Biodiversity (2021-2030), Wetlands Strategic Plan (2020-2030), Marine Strategies, National Plan for Adaptation to Climate Change (2021-2030), Master Plan for the network of MPAs

Table 1. The inclusion of coastal ecosystems in NECPs and NDCs in REST-COAST countries. (*) Countries in alphabetical order.

5.2 REST-COAST contribution to NDCs

The REST-COAST project, through its Pilot Sites, is expected to provide valuable insights into the potential contributions of different types of ecosystems to climate mitigation and adaptation. The survey launched by WP5 (Milestone 5.4 "*Briefing addressing approaches taken at municipal, regional, national policy levels*") revealed that REST-COAST Pilot Sites encompass a diverse range of ecological features, with a focus on intertidal habitats such as estuaries, wetlands, and saltmarshes, as well as a mix of marine, coastal, and fluvial ecosystems. The planned restoration actions across the nine REST-COAST Pilot Sites are anticipated to deliver multiple ESS, significantly advancing towards the Green Deal's climate neutrality objectives in line with the Paris Agreement target. These actions focus on the five key ESS identified within the project, which vary from site to site: Reduction of coastal erosion, Reduction of flood risk, Water purification, Carbon sequestration, and Food provisioning. The Table 2 below provides a summary of the restoration actions by Pilot Site and their associated ESS. The diverse range of ESS targeted underscores the multifaceted benefits of coastal restoration.

Pilot Site	RESTORATION ACTION	TYPE OF ECOSYSTEM*	ECOSYSTEM SERVICES				
			Reduction coastal erosion	Reduction flood risk	Water purification	Carbon sequestration	Food provisioning
ARCACHON BAY	*Seagrass Restoration*	MAR	X	X		X	
EBRO DELTA	*Salt Marsh Restoration*	IT	X	X		X	
	Hydraulic Connectivity	IT			X		X
	Beach Nourishment	CO	X	X			
	Natural flow restoration	FL	X	X			
FOROS BAY	*Seagrass Restoration*	MAR	X	X		X	
NAHAL DALIA	*Hydraulic Connectivity*	IT		X	X		
	Salt Marsh Restoration	IT			X		
	Salt marsh edge protection	IT			X		
	Natural flow restoration	FL			X		
	Natural flow restoration	IT			X		
RHONE DELTA	*Salt Marsh Restoration*	IT	X	X		X	
	Island Building	IT					X
	Hydraulic Connectivity	IT	X	X			X
	Natural flow restoration	IT	X	X			X
SICILY MED ISLAND	*Salt Marsh Restoration*	IT	X	X	X		
	Island building within saline lagoons for bird nesting/feeding	IT			X		
	Hydraulic Connectivity	IT		X			
	Biodiversity wetland niches building	IT			X		
VENICE LAGOON	*Artificial Salt Marsh Re-construction*	IT	X	X	X	X	X
	Salt marsh edge protection	IT	X	X	X	X	X
VISTULA LAGOON	*Island Building*	IT		X			X
WADDEN SEA	*Salt Marsh Restoration*	IT	X	X		X	X

Table 2. Summary of restoration actions conducted at REST-COAST Pilot Sites and ESS related. Source: REST-COAST Milestone 5.4.
(*) **MAR**: Marine (e.g. seagrasses); **IT**: Intertidal (e.g. estuaries, wetlands, saltmarshes); **CO**: Coastal (e.g. dunes, beaches); **FL**: Fluvial (e.g. rivers, water courses)

Most of these initiatives - except for two related to fluvial ecosystems in the Ebro Delta and Nahal Dalia - are developed in BCE (saltmarshes, wetlands, and seagrasses) highlighting the importance of the project and its critical role in combating climate change. These efforts not only directly contribute to NDC targets but also generate valuable data and methodologies that can inform and enhance future climate strategies. Given the significance of BCE for NDCs, each action is crucial for both mitigating and/or adapting to climate change impacts in their respective areas. These REST-COAST expected contributions to climate are summarized in Table 3.

PILOT SITE	RESTORATION INTERVENTIONS	EXPECTED CONTRIBUTION TO CLIMATE
ARCACHON BAY *(France)*	*This Pilot is pioneering a new approach to **seagrass meadow restoration** which has lost approximately 50% of their cover over the past 30 years, **focusing on hydrodynamics**.*	***Mitigation**: healthy meadows could play a crucial role in trapping sediment, enhancing their capacity as natural carbon sinks.* ***Adaptation**: The restoration of seagrass meadows also strengthens coastal protection by attenuating wave energy, reducing storm impacts and controlling coastal erosion. Additionally, restored seagrass meadows are expected to improve water quality.*
EBRO DELTA *(Spain)*	*This Pilot is implementing innovative restoration actions including **restoring connectivity** between the Alfacada coastal lagoon and the sea by removing an artificial dyke, as well as restoring coastal embryonic dunes and a sand barrier through nourishment techniques.*	***Mitigation:** Restoring connectivity at the site will improve hydrodynamics and ecological function, enhancing sediment transport and retention, which is expected to deliver co-benefits including carbon sequestration.* ***Adaptation**: The restoration of dunes and a sand barrier is expected to support coastal resilience by reinforcing natural defences against erosion and storm surges, contributing to flood risk reduction. In addition, restoration will enhance ecological function and habitat condition thereby reinforcing the delta's natural resilience.*
NAHAL DALIA *(Israel)*	*This Pilot is implementing a **comprehensive ecological restoration approach** for a variety of habitats found in estuarine and coastal wetland areas, including groundwater-fed marshlands, dense hydrophilic vegetation, a flowing and connected river, and a functioning estuary connected to the sea.*	***Mitigation**: Fishpond rewilding, wetland restoration and flow enhancement are expected to support the natural carbon sequestration and storage abilities of healthy coastal wetland and estuarine ecosystems. Additionally, the conversion of chosen fishponds into wetlands will further enhance their role in carbon sequestration.* ***Adaptation:** The restoration of coastal ecosystems in the area is expected to enhance water retention and resilience to extreme weather events. In addition, restoration actions aiming to improve water quality are expected to reduce climate change impacts on water resources and natural systems.*
FOROS BAY *(Bulgaria)*	*This Pilot is applying an in-situ method for **seagrass restoration**. The experimental set-up consists of three test plots where sods of seagrass were transplanted to test their ability to recolonize area. The soft bottom in the bay is likely to be recolonized down to about 6 m depth.*	***Mitigation**: Seagrass restoration is expected to enhance climate change mitigation potential by enhancing carbon accumulation rate.* ***Adaptation**: Restoration activities are expected to reduce flooding and erosion risk through bed stabilization. Additionally, water quality is expected to improve resulting in benefits for biodiversity and ecosystem resilience.*
SICILY LAGOON *(Italy)*	*This Pilot is implementing several actions to **restore the area´s coastal lagoon system** including the construction of islands to favour nesting and breeding of target species of birds, the dredging of channels to foster hydraulic and ecological connectivity between lagoons, the restoration of saltmarshes restoration and the construction of barriers between Longarini lagoon and the sea to control water levels. In addition, the pilot is assessing the potential for restoring degraded seagrass meadows through the small-scale restoration of a seagrass meadow patch. The potential of dune revegetation and beach nourishment is also being assessed.*	***Mitigation**: By restoring salt marshes, it is expected to enhance ability to sequester carbon. Additionally, improving hydraulic connectivity will help sustain wetland habitats, ensuring continued carbon accumulation and storage. Moreover, seagrass meadows will also contribute significantly to blue carbon storage. Opportunities for low-carbon restoration practices, such as minimizing fossil fuel use in sediment management and leveraging nature-based stabilization techniques, are being explored to further reduce the carbon footprint of restoration activities.* ***Adaptation**: Improved habitat quality and hydrodynamic processes at the site are expected to mitigate the impacts of climate change and improve ecosystem resilience to climate stressors, such as sea level rise and increased storm intensity. Restoration of seagrass is also expected to contribute to coastal protection.*
VENICE LAGOON *(Italy)*	*This Pilot is **restoring artificial saltmarshes** located in the central/southern lagoon by reversing the degradation processes occurring in the area and improving some of the features that hindered naturalization processes. By mitigating saltmarsh border erosion and fostering conditions suitable to the colonization of vegetation and wildlife, the project expects to expand priority habitat surfaces and bolster biodiversity.*	***Mitigation**: The restoration of saltmarshes is expected to enhance the natural carbon storage and sequestration capacities of these ecosystems.*
VISTULA LAGOON *(Poland)*	*This Pilot is erecting an **artificial island** to establish connectivity to the Baltic Sea. The island is accommodating sediment from dredged channels and providing habitat for birds hatching on meadows. Second, long-term improvement of water quality could be effectuated by installation of many floating islands, whose vegetation will be harvested and physically removed from the lagoon.*	***Mitigation**: The pilot is not expected to result in additional carbon sequestration potential as the vegetation in the artificial island will be maintained by periodic mowing to prevent natural emergence of trees.* ***Adaptation**: The pilot is not expected to deliver additional climate adaptation benefits.*
RHONE DELTA *(France)*	*The ecological restoration in this Pilot focused on re-establishing hydrosaline equilibrium through the **restoration of hydraulic continuity**, as part of a realignment strategy. The main objectives are to restore the former saltworks by reducing salinity, improving water quality, and enhancing connectivity.*	***Mitigation**: Hydro-connectivity restoration is expected to deliver carbon sequestration benefits due to improved water renewal, which helps reduce hypoxia limiting carbon emission. In addition, the progressive restoration of saltmarsh and seagrass habitats is expected to enhance the carbon sequestration capacity of these ecosystems.* ***Adaptation**: The site is expected to mitigate the effects of sea level rise by creating new natural barriers through the abandonment of former dikes.*
WADDEN SEA *(Netherlands, Germany)*	*This Pilot is developing a **sustainable sediment management strategy** to protect the estuary's ecological health, as well as the region's financial prosperity. The estuary is highly turbid due to land reclamation and dredging, preventing sediment from settling. This excess sediment is being managed to promote land accretion and mudflat formation. Measures to facilitate sediment deposition include brushwood groynes (low-carbon intensive) and reopening dikes to create new intertidal areas.*	***Mitigation**: The promotion of land accretion and mudflat formation is expected to result in long-term carbon sequestration. These areas naturally accumulate excess sediment, burying organic matter and carbon for long-term storage in the soil. Moreover, as vegetation establishes, carbon uptake is expected to increase, further enhancing sequestration.* ***Adaptation**: Improved ecological conditions thanks to restoration interventions in the estuary is expected to deliver a range of co-benefits including flood mitigation.*

Table 3. Restoration interventions being implemented at each of the RESTCOAST nine pilot sites and their expected contributions to climate mitigation and adaptation.

Additionally, several Pilot Sites are applying metrics in terms of carbon sequestration. Though some results have yet to be reported, REST-COAST Pilot Sites are already showing promising results that demonstrate the potential of coastal restoration action as cost-effective measures for climate action, and the long-term resilience of coastal areas (Table 4).

PILOT SITE	DEMONSTRATED CLIMATE MITIGATION BENEFITS
ARCACHON BAY	*Restored seagrass areas are being compared with bare seabeds to better understand the relationship between sediment trapping and the carbon sequestration potential of these ecosystems over time. Initial analysis shows promising results, with* ***potential carbon gains of around 0.42 tonnes of carbon per hectare per year.***
EBRO DELTA	*While data are not yet available,* ***monthly monitoring of GHG emissions and changes in vegetation cover and composition will provide essential data to quantify the climate benefits of restoration. Numerical modelling of sediment transport, coastal erosion and inundation is also being developed to assess how restoration interventions influence sediment dynamics, shoreline stability, and dune sustainability, helping to optimize future management strategies for enhanced coastal resilience and carbon sequestration.***
FOROS BAY	*The site is currently assessing climate change mitigation potential by comparing the carbon accumulation rate of existing/restored seagrass areas with seabed not occupied by meadows. While* ***data are not yet available****, this will help better understand the contribution of restoration.*
SICILY LAGOON	***Data on carbon sequestration are not available****, as carbon sequestration is not a targeted ecosystem service for the Sicily pilot site. Efforts to reduce the climate impact of the transport of sediment needed for island reconstruction have been estimated to result in* ***10x less emissions****.*
VENICE LAGOON	***While data is not yet available****, the site is monitoring the carbon sequestration and GHG emissions at the saltmarshes.*
RHONE DELTA	*The effectiveness of the measures in terms of their climate mitigation potential is under analysis meaning* ***data are not yet available****.*
WADDEN SEA	*The use of restoration approaches that minimise emissions, namely the application of re-used sediment, is estimated to mitigate* ***57,752 tons of CO_2*** *over the project's lifetime.*

Table 4. REST-COAST Pilot Site efforts to demonstrate and quantify climate mitigation benefits.

As countries prepare to update their NDCs in the coming years, the insights and outcomes from REST-COAST's Pilot Sites could serve as compelling evidence for the inclusion of more ambitious coastal and marine ecosystem restoration targets in national climate plans. For instance, it is expected a unique contribution from the REST-COAST WP1 by showcasing hands-on coastal restoration at the Pilots. This demonstration will highlight the feasibility of codeveloping a tailored technical upscaling based on ESS for risk reduction and climate adaptation. Such initiatives will be crucial to convince national - and EU - authorities to incorporate targeted restoration measures into their national planning tools and policies.

The upcoming NDC submission deadlines - 2028 for the EU and 2026 for Israel - present key opportunities to strengthen climate commitments by incorporating new measures based on BCE and drawing on the results of the REST-COAST project. These revisions/updates could significantly enhance climate ambitions by:

- Setting quantifiable targets for coastal ecosystem restoration and protection.
- Including specific measures for enhancing carbon sequestration through BCE.
- Integrating the carbon/climate benefits of coastal restoration into other policies, (e.g. climate adaptation strategies).
- Developing mechanisms for monitoring and reporting on climate benefits from restored coastal ecosystems.
- Allocating dedicated funding for BCE restoration and research.

By leveraging REST-COAST findings, these updated NDCs could mark a substantial advance in recognizing coastal ecosystems' role in climate change mitigation and adaptation. This approach would enhance climate commitments while promoting biodiversity conservation and coastal resilience, showcasing the multifaceted benefits of coastal restoration actions in climate policy.

For the EU, this allows time to fully integrate findings from multiple Member States' Pilot Sites. Israel, with its earlier deadline, could pioneer in setting specific targets for BCE restoration, potentially becoming a model for other Mediterranean nations.

5.3 Exploring the international and EU policy landscape for NDCs

For many years, international bodies and organizations have been dedicated to the conservation and sustainable use of coastal and marine ecosystems worldwide, increasingly incorporating climate change concerns and commitments in their agendas as the climate crises intensifies. This has also been highlighted at the previous UN Ocean Conferences and through the UN Ocean Decade 2021-2030 (Challenge 5). In particular, the Because the Ocean' initiatives, instigated at COP21, promotes the importance of oceans as part of climate negotiations (Because the Ocean, 2019). It recently published a report on ocean-related measures in climate strategies with suggested actions for climate mitigation (blue carbon & renewable energy) and climate adaptation (sustainable fisheries and aquaculture, and the greening of shipping). Since 2020, annual Ocean and Climate Change Dialogues are also taking place to strengthen ocean-based climate action (UNFCCC, n.d.). In the EU, two missions are relevant for climate change action and coastal restoration, namely the EU missions 'Adaptation to Climate Change' and 'Restore our Ocean and Waters by 2030', aiming to bring concrete solutions through research and innovation, and delivering new forms of governance and collaboration, and citizen engagement to contribute to these topics.

The recent High Seas Treaty, a new international legally binding framework for marine areas outside national jurisdiction (BBNJ), offers another opportunity to address ocean-related climate change issues on a larger scale, including to address the adverse effects of climate change and ocean acidification and to restore the carbon cycling services of the ocean (Council of the EU, 2023; Kachelriess, 2023). The EU has recently ratified this Treaty while Israel has yet to sign it, the Treaty will enter into force when 60 countries or organisations approve it (Council of the EU, 2024).

To strengthen ongoing efforts and improve their effectiveness, actions outlined in NDCs would benefit from synergies with other multilateral environmental agreements related to coastal and marine environments. This chapter therefore lists relevant policy tools to provide a general overview of the international and EU policy landscape, and to place the REST-COAST project in the context of ongoing processes for climate action and the conservation of our oceans and coasts.

Kunming-Montréal Global Biodiversity Framework

The Kunming-Montréal Global Biodiversity Framework (GBF) was adopted in December 2022 at the 15th meeting of the Conference of the Parties to the Convention on Biological Diversity. This framework aims to halt and reverse biodiversity loss by 2030 and embraces the vision of living in harmony with nature by 2050. The Global Biodiversity Framework features 23 action-oriented targets for 2030, and four global goals to preserve biodiversity by 2050. This framework approaches biodiversity loss and climate change as interlinked issues. It therefore looks at how they interact, considering both the impacts of climate change on biodiversity as well as the role that biodiversity can play in climate change mitigation and adaptation.

A number of these action-oriented targets to 2030 address issues that operate at this climate-biodiversity nexus, thereby contributing to climate change mitigation and adaptation. Target 8 of the Global Biodiversity Framework (Box 4) especially, as this target aims to minimize the impact of climate change and ocean acidification on biodiversity and increase resilience (mitigation, adaptation, disaster risk reduction) and to foster positive impacts of climate action on biodiversity. The Global Biodiversity Framework also sets the targets to restore 30% of all degraded ecosystems (Target 2), protect 30% of land, water and seas (Target 3), and to enhance ecosystem functions and services through NbS and ecosystem-based approaches (Target 11). All these targets include coastal and marine ecosystems, therefore providing a crucial foundation for climate change mitigation and adaptation through coastal ecosystem restoration action.

> ***TARGET 8: MINIMIZE THE IMPACTS OF CLIMATE CHANGE ON BIODIVERSITY AND BUILD RESILIENCE***
>
> *"Minimize the impact of climate change and ocean acidification on biodiversity and increase its resilience through mitigation, adaptation, and disaster risk reduction actions, including through nature-based solution and/or ecosystem-based approaches, while minimizing negative and fostering positive impacts of climate action on biodiversity."*

Box 4. Target 8 Kunming-Montreal Global Biodiversity Framework. Source: Convention on Biological Diversity.

In addition, the interlinkage between climate and biodiversity is also presented in the 2030 Agenda for Sustainable Development, which sets out an ambitious framework to address global societal challenges through 17 Sustainable Development Goals (SDGs). For example, the protection and restoration of ecosystems, including peatlands, wetlands, marine and coastal ecosystems, and their role as natural buffers against climate-related disasters, are considered essential to accomplish SDG 13 on climate action. In addition, Goal 14 on 'Life below water' and Goal 15 on 'Life on land' address the link between climate and biodiversity, providing opportunities for synergies between ecosystem restoration and NbS, and offering multiple benefits for both (CBD, 2022; IES, 2021).

International Convention on Wetlands of International Importance (RAMSAR)

The RAMSAR Convention is an international treaty that aims to protect and sustainably use wetlands worldwide. Adopted in 1971 in Ramsar, Iran, this treaty stands as one of the oldest global environmental agreements. The mission of the Convention is "*the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world*" (RAMSAR, 2024). Its work is based on three pillars: 1) work towards the wise use of all their wetlands; 2) designate suitable wetlands for the list of Wetlands of International Importance (the "Ramsar List") and ensure their effective management; and 3) cooperate internationally on transboundary wetlands, shared wetland systems and shared species. Today, the RAMSAR Convention boasts 172 Contracting Parties,[27] encompassing all REST-COAST countries.

Wetlands, as BCE (see section 1.3), form an important opportunity for the Convention's Contracting Parties to meet their targets under the Paris Agreement. As mentioned above, to enhance synergies between multilateral environmental agreements such as the Ramsar Convention and the UNFCCC, they could be included in NDCs as part of the planned solutions for climate change mitigation and adaptation. The IPCC provided guidelines on the inclusion of coastal wetlands in GHG accounting that could be helpful for countries to include wetlands in their NDC (Blue Carbon Initiative, 2023; IPCC, 2014). According to the Ramsar Convention, the extent and geographical scope of wetlands need to be identified, and the monitoring systems need to improve to effectively include them in countries' NDCs. In addition, specific GHG removal targets could be included in projects aimed at managing and restoring coastal and marine ecosystems. The Ramsar Convention also recognises the adaptation solutions that coastal ecosystems can provide, such as flood protection and water and food security, which could also be included in the NDCs (Ramsar Convention, 2020).

One of the current priorities of the Ramsar Convention is to "*explore the role of wetlands in climate change mitigation (including blue carbon, freshwater wetlands), and how this may support the ongoing*

[27] Contracting Parties to the Ramsar Convention. Update 24/08/2023.

management, wise use and restoration of wetlands". Several resolutions were adopted focussing on the role of wetlands in climate change mitigation and adaptation at the Convention's COP 14. These resolutions[28] can help the inclusion of wetlands in NDCs, for instance by providing methods to assess the vulnerability of different wetland types to climate change and their contribution to the global carbon cycle, as well as showing how wetland restoration can be used for climate responses (Ramsar Convention, 2022).

In addition to providing methods and a platform to exchange information, the Ramsar Convention also offers an important international level of protection for coastal wetlands and further opportunities to protect blue carbon ecosystems. In this context, this convention actively promotes the integration of the designation of new Ramsar sites or the extension of existing ones, enhancing management and reducing the drivers of wetland degradation and loss in NDCs, as part of the climate mitigation and adaptation sections. The Ramsar Convention also actively encourages Contracting Parties to reach out to the UNFCCC and subsidiary bodies to provide relevant information on the potential of wetlands for climate change solutions (Ramsar Convention, 2020).

Guided by the IPCC the Ramsar Convention, the number of countries recognizing wetlands' role in climate change mitigation and adaptation has been steadily increasing. At COP14, 55% of Ramsar's Contracting Parties reported having policies or guidelines in place to enhance the role of wetlands in mitigating or adapting to climate change, while 24% have partially done so.[29] This number has continued to increase significantly since the Paris Agreement (Ramsar Convention, 2022). The most recent UNFCCC synthesis report on the NDCs also showed that 21% of the Contracting Parties referred to wetlands in their specific priority areas and sub-areas for national mitigation actions in their NDCs. This analysis was based on the NDCs of both the EU and Israel (UNFCCC, 2021).

Looking at the national reports submitted to COP14, Bulgaria, France, Germany, Italy and the Netherlands reported having these policies and guidelines in place, while Denmark and Poland have partially implemented measures.[30] These efforts focus most on wetlands in forests and agricultural land (LULUCF regulation), while some countries mentioned specific wetlands or wetland ecosystems. For instance, France mentions coastal ecosystems and integrated coastline management, Germany mentions specific areas such as the Wadden sea area, and Poland mentioned the handbook they developed for surface water restoration. Israel´s 2015 national report to the Ramsar Convention includes a general reference to measures planned to enhance the role of wetlands in mitigating climate change, yet their most recent report in 2018 does not make reference to these measures. The contribution of coastal wetlands to climate change mitigation and adaptation could be further emphasised and specified for specific coastal ecosystems, although more Contracting Parties to the Ramsar Convention are focusing on wetlands in general.

Regional Sea Conventions - UNEP Regional Seas Programme

Since 1974, this Programme is the most important regional mechanism for the conservation of the marine and coastal environment. The focus of the UNEP Regional Seas Programme is on promoting regional cooperation among countries that share a common body of water, with each region developing strategies and regional plans for their respective areas. This programme has brought together multiple stakeholders to address marine pollution and degradation of oceans and coastal areas through a regional approach to

[28] including Resolution X.24 on "Climate change and wetlands", Resolution XI.14 on "Climate change and wetlands: implications for the Ramsar Convention on Wetlands" and Resolution XII.13 on "Wetlands and disaster risk reduction".

[29] The Ramsar Convention defines wetlands as "any land area that is saturated or flooded with water, either seasonally or permanently", this includes both inland wetlands and coastal wetlands. Coastal wetlands include all coastlines, mangroves, saltmarshes, estuaries, lagoons, seagrass meadows and coral reefs.

[30] This was based on the national reports submitted to COP14 of the Ramsar Convention, found per country on the Ramsar website.

environmental action. Most of these regions adopted a legal framework which are referred to as Regional Seas Conventions and Action Plans. The UNEP Regional Seas Programme consists of three types of Conventions and Action Plans[31] across 18 different regions worldwide.

Many of these Regional Seas Conventions have developed their own strategic documents to address the effects of climate change in their respective regions. However, the UN adopted a new resolution at their latest Environment Assembly on "*Strengthening ocean efforts to tackle climate change, marine biodiversity loss and pollution*", here recognising the work done under the UN Decade for Ecosystems Restoration (2021-2030).

Four different Regional Sea Conventions are relevant in the REST-COAST area of intervention:

- Mediterranean Action Plan (UNEP/MAP) - Barcelona Convention;
- Commission on the Protection of the Black Sea Against Pollution - Bucharest Convention;
- Convention for the Protection of the Marine Environment of the North-East Atlantic – Oslo-Paris Convention (OSPAR);
- Baltic Marine Environment Protection Commission - Helsinki Convention (HELCOM).

Regional seas also play a critical role in balancing sustainable use and conservation to move towards a sustainable blue economy, including the support of developing a regional network of marine protected areas (MPAs). In addition, they support action across diverse stakeholders and regions, and enhance science-based decision-making at regional and national levels (UNEP, 2022b).

The Regional Seas Programme periodically sets its strategy, with the latest version (Fifth edition) published in the document "Regional Seas Strategic Directions 2022-2025". The primary objective of this strategy is to achieve a "*diverse, resilient and pollution-free ocean that supports equitable sustainable livelihoods*". This will be accomplished by better integrating the conservation and sustainable use of oceans and coasts into policies and programmes, while promoting a holistic approach to address each region's ecological, climate, pollution, and health crisis. The document emphasizes the critical role of oceans and coasts in climate stabilization, specifically in preventing ocean acidification and sea level rise. Consequently, one of the medium-term outcomes by 2025 is to ensure that "*Climate change mitigation and adaptation goals incorporated in all ocean-related decision-making for Regional Seas Programme target audiences: decarbonisation, dematerialisation and resilience pathways towards sustainable oceans, including use of nature-based solutions, adopted by decision-makers at all levels*". This expected outcome is intricately linked to REST-COAST upscaling plans. Additionally, the restoration of marine and coastal carbon sinks and reservoirs, along with other critical ecosystems, is a specific target of this strategy, aiming to increase resilience through NbS.

[31] The three types of Regional Sea Conventions and Action Plans are: UNEP administered (e.g. Barcelona Convention), Non-UNEP administered (e.g. Bucharest Convention) and Independent (e.g. OSPAR)

A summary of the relevant international policy tools discussed above is provided in Table 5 below:

POLICY INITIATIVE	MAIN OBJECTIVE(S)	SPECIFIC TARGETS	CONTRIBUTION TO COASTAL RESTORATION IN NDC
Kunming-Montréal Global Biodiversity Framework (*2022*)	• 4 long-term goals for living in harmony by 2050 • 23 action-oriented restoration targets to halt biodiversity loss by 2030	• Target 2: restore 30% of degraded ecosystems • Target 3: protect 30% of land, water and seas • Target 8: minimize the impacts on climate change on biodiversity and build resilience • Target 11: restore, maintain and enhance Nature's Contributions to People	• Addresses biodiversity loss and climate change as intertwined issues • Includes specific targets for restoration, protection, climate action and sustainable use • GBF Targets specifically include coastal and marine ecosystems and their importance
2030 Sustainable Development Goals *(2015)*	• 17 Global Goals to address global societal challenges	• Goal 13: Climate Action • Goal 14: Life below water • Goal 15: Life on land	• Mentions protection and restoration, including peatlands, wetlands, marine and coastal ecosystems (context of adaptation to climate-related disasters) • Goal 14 and Goal 15 address link between climate and biodiversity (opportunities for synergies)
RAMSAR Convention *(COP 14 in 2022)*	• Main goal: work towards the wise use of all Ramsar wetlands (designate and effectively use), and international cooperation on transboundary wetlands • Priority: to explore the role of wetlands in climate change (mitigation and adaptation)	• Resolution X.24 on "Climate change and wetlands", • Resolution XI.14 on "Climate change and wetlands: implications for the Ramsar Convention on Wetlands" • Resolution XII.13 on "Wetlands and disaster risk reduction" • Uses IPCC guidelines to account for blue carbon ecosystems in national GHG inventories	• Enhance methods to assess the vulnerability of different wetland types to climate change • Improve understanding of their role in the global carbon cycle • Provide measures where wetland restoration can be used to respond to climate change • Promotion of uptake wetlands in NDCs (designation, extension, management, reduction of negative drivers affecting wetlands)
Regional Seas Conventions *(Strategic Directions 2022-2025)*	• Primary objective: to achieve a diverse, resilient, and pollution-free ocean that supports equitable sustainable livelihoods • Medium-term outcome (2025) to achieve that Climate change mitigation and adaptation goals are incorporated in all ocean-related decision-making (including NbS)	• UN Resolution: "Strengthening Ocean efforts to tackle climate change, marine biodiversity loss and pollution" • Relevant Regional Sea Conventions for RESTCOAST: Barcelona Convention, Bucharest Convention, OSPAR, HELCOM	• Strategic Directions document emphasizes the critical role of oceans and coasts in climate stabilization, specifically in preventing ocean acidification and sea level rise. • Restoration of coastal and marine carbon sink and reservoirs specifically mentioned, to increase resilience through NbS • Regional Sea Conventions aim to contribute to: a sustainable blue economy, coherent regional network of MPAs, stimulate action across diverse stakeholders and regions, and enhance science-based decision-making

Table 5. Relevant international policy landscape.

Relevant policies and legislation in the EU context

Besides the two pillars of environmental law within the European Union's context (the Birds and Habitats Directives), the European Green Deal forms the umbrella of policy initiatives for climate and environmental action in the EU with an overarching goal to put the EU on the path to a green transition and reach climate neutrality by 2050. The REST-COAST project is part of the European Green Deal Call, funded by the EU Horizon 2020 programme, which aims to support research and innovation driving the transformative changes needed to achieve the objectives of the Green Deal (European Commission, 2024). Key components of the Green Deal are particularly relevant for climate and biodiversity are the 'Fit for 55' Package and the EU Biodiversity strategy for 2030. The EU Biodiversity Strategy, among other EU policies and legislation, and their relevance

for climate change mitigation and adaption in the context of coastal and marine ecosystem restoration are explored and discussed as follows:

- The EU Biodiversity Strategy for 2030 is the EU's current comprehensive plan to halt biodiversity loss and put nature on the path of recover by 2030. The two key objectives of this strategy are the protection of 30% of EU's land and seas, 10% of which to be strictly protected (30x30 target) and to develop an ambitious EU Nature Restoration Plan, including legally binding targets for nature restoration. The strategy recognizes the importance of protecting and restoring coastal and marine ecosystem for climate mitigation and adaptation.
  Since 2021, Member States are encouraged to submit voluntary national pledges for both the protection of 30% of land and seas and 30% status improvement targets by 2030. This is done through the biogeographical process and supported by the European Commission. The European Commission's working document 'Criteria and guidance for protected areas designations' (2022) mentions the **importance to focus on protecting carbon-rich ecosystems** (such as shelf sediments, coastal wetlands and seagrass meadows) because of their contribution to climate change mitigation. Although the deadline to submit the pledges was originally set for the end of 2022, currently only a handful of Member States have submitted their pledges. The protection of marine area, with currently only 12% marine area is protected in comparison to 26% of the terrestrial areas particularly leaves room for improvement (European Commission, 2023b). Although this process shows potential for the recovery of coastal and marine ecosystems and thus their contribution to NDCs, more needs to be done to motivate Member States to commit to this process. The EU Biodiversity Strategy sets out several commitments and actions to create an EU nature restoration plan, in particular to strengthen the EU legal framework for nature restoration. This includes a proposal for legally binding restoration targets that cover coastal, freshwater and marine ecosystems, as well as other actions relevant to coastal and marine ecosystems including the reduction of negative impacts on sensitive marine species and habitats and the reduction of bycatch.

- The EU Nature Restoration Regulation was adopted to help achieve the second objective mentioned by the EU Biodiversity Strategy, namely, to **set legally binding targets for the restoration of nature**. This regulation is EU's first comprehensive legal framework for the restoration of degraded ecosystem, setting the target of restoring **20% of EU's land and sea by 2030 and all ecosystems in need of restoration by 2050**. The law actively **promotes synergies with EU climate policies, including NECPs,** as well as other relevant legislative files, such as the Birds and Habitats Directive, the Marine Strategy Framework Directive, Water Framework Directive, Blue Economy Strategy, and habitats and species listed under the Convention on the Conservation of Migratory Species of Wild Animals and the relevant Regional Seas Conventions. Member States are required under the law to submit National Restoration Plans outlining their **coherent restoration plan by September 2027**, outlining how they will deliver on the restoration targets provided by this regulation. Key targets to restore, re-establish and improve the condition of coastal and marine areas are provided, as well as specific targets for improving surface water connectivity and the restoration and rewetting of peatlands in agricultural land. Special focus is placed on restoring ecosystems with the most potential to capture and store carbon, and those that can help prevent and reduce the impact of natural disasters. The annexes of the Nature Restoration Regulation list the relevant habitat types and (groups of) species to be restored, specified per region for marine ecosystems, and examples of restoration measures to be taken. In addition, targets and provisions of the law can be amended in the future based on scientific and technical advances. This comprehensive approach for restoration recognised the importance of coastal restoration for climate change mitigation and adaptation and promotes synergies with other EU legislation, it thus provides a strong framework to integrate coastal and marine ecosystem restoration in climate action plans.

- The Farm to Fork Strategy aims to accelerate the EU's transition to a sustainable food system by 2030. This strategy recognises the **need to reduce the impact of food systems on the environment and climate**,

as well as the need to **increase the resilience of food system**. The agriculture sector is crucial for climate change mitigation, currently responsible for 10% of the EU's GHG emissions, as well as climate change adaptation, as this sector is vulnerable to the effects of climate change and biodiversity loss. The strategy aims to promote a shift towards sustainable fish and seafood production, including cooperation between coastal states, and to re-assess how the Common Fisheries Policy copes with climate change. In addition, the Farm to Fork Strategy seeks **to reduce the excess of nutrients that negatively impact biodiversity in surrounding areas, including rivers, lakes, wetlands, and seas** (EEAC, 2022). Although coastal ecosystem restoration is not included in the strategy, its objectives are designed to reduce the pressures of agriculture on these ecosystems and enhance overall sustainability. In addition, the current regulation for an EU certification framework for permanent carbon removals, carbon farming and carbon storage in products could incentivize farmers to rewet peatlands by offering them credits for such actions.

- Since 2008, the EU Marine Strategy Framework Directive (MSFD) aims to reverse threats to Europe's marine environment from human activity and to ensure our seas remain clean, healthy, and productive. This Directive requires Member States **to formulate national marine strategies and** is currently under review by the European Commission (European Commission, 2020b). The MSFD offers a **comprehensive framework to monitor climate change impacts on EU's seas based on descriptors**, such as biological diversity, population of commercial fish/shellfish, sea floor integrity and alteration of hydrographical conditions. These descriptors contribute to the understanding of the impacts of climate change on the marine environment that could be used to inform EU's NDC and those of its Member States.

- Coastal waters are also subject to the Water Framework Directive (WFD), the EU's legal framework for water policy, which aims **to achieve good environmental status for Europe's waters by 2027**. This directive sets out a planning framework for the management of each river basin district in the EU. **Climate adaptation is one of the four priorities** (along with zero pollution, biodiversity, and circular economy) outlined in the current work programme of the Common Implementation Strategy, the body supporting the successful implementation of the Water Framework Directive. Although this legislation has the potential to support the integration of coastal ecosystem restoration for climate change adaptation in NDCs, **better implementation of the Water Framework Directive would be needed**, as so far there has been little progress in improving the conservation status of EU waters since the Directive was adopted (European Commission, 2020; Johansson, 2023). In addition, the Floods Directive aims to assess and manage flood risks throughout the EU, which offers valuable information for climate adaptation and climate resilience in coastal regions.

- EU Member States with coastal areas are required under the Maritime Spatial Planning (MSP) Directive **to develop national maritime spatial plans**, to be implemented from March 2021 onwards. Maritime Spatial Planning is a future-oriented process **to ensure a sustainable long-term balance between people and marine life, considering economic activities, ecological factors, and people's livelihoods**. These plans aim to outline how these Member States intend to meet the environmental requirements of various EU Directives (incl. Birds and Habitats Directives, Marine Strategy Framework Directive, Water Framework Directive) and relevant policies. Recently, 16 national maritime spatial plans of coastal Member States were analysed, concluding that **these national plans are not sufficient to meet EU climate and nature targets.** To harness the potential of coastal and marine ecosystems for EU climate targets, this analysis advises Member States, inter alia, to secure sufficient area for protection (in line with the EU Biodiversity Strategy), consider the impact of offshore renewable energy on biodiversity, and enhance cooperation between Member States (WWF, 2024).

- The Integrated Maritime Policy (IMP) provides a holistic approach to all sea-related EU policies. This policy aims **to enhance sustainable growth while reducing the impact of maritime affairs on the**

environment, focussing on improved coordination of interlinked activities related to oceans, seas, and coasts. Its objectives include, inter alia, maximising the sustainable use of oceans and seas, increasing maritime knowledge and data, improving quality of life in coastal regions, and minimizing the effects of climate change on coastal regions. This policy thus further promotes synergies among EU legislation and policies, providing knowledge for and supporting climate change adaptation, while simultaneously promoting co-benefits for coastal communities.
There is an important outcome from the Integrated Maritime Policy, namely the Blue Economy Strategy, encouraging businesses to focus on renewable energy, marine ecosystem conservation, pollution reduction and increased resilience to climate change. This approach considers the conservation and restoration of coastal vegetation systems key to reach the EU's decarbonisation targets (especially tidal marshes, mangroves and seagrasses) and to establish resilient coastal and marine ecosystem by rebuilding biodiversity, for instance by designing artificial reefs, restoring important sea-bed habitats (coral reefs, macroalgal forests and others), and developing solutions to depollute areas or fight eutrophication. To further enhance this, the European Commission proposed a new Action Plan to conserve fisheries resources and protect marine ecosystems, including necessary actions for fisheries to protect sensitive species and habitats in relation. This approach encourages climate change mitigation and adaptation through the restoration of coastal ecosystems, mentioning specific ecosystem types and offering specific restoration measures, that are well aligned with economic goals in coastal regions.

- The EU Climate law, part of the Fit for 55 Package, **sets the legally binding target for Member States to cutting net GHG emissions by at least 55% by 2030 and reaching climate neutrality by 2050**. To reach this target, Member States are required to develop national energy and climate plans (NECPs) under the Regulation on the Governance of the Energy Union. The European Commission's EU-wide assessment revealed that while 2030 GHG emissions will be significantly lower, **Member States must make additional efforts to achieve the 55% reduction target set by the Climate Law**. In this context, policies and measures to reflect the increased ambition for climate change adaptation and mitigation and to enhance carbon sinks are promoted, including the preservation, protection, and restoration of ecosystems. This regulation promotes the upscaling of offshore renewables but makes no reference to limit these projects impacts on coastal and marine ecosystems (European Commission, 2023a).

- In 2021, the EU adopted its EU Adaptation Strategy, outlining the **long-term vision for the EU to become fully resilient and adapted to the impact of climate change by 2050**. The strategy requires Member States to submit national adaption plans. As of 2020, all EU Member States had developed an adaptation strategy. These strategies complement NDCs - and other climate mitigation plans such as NECPs – by identifying priorities and measures that are specifically focused on climate adaptation. Through the EU Adaptation Strategy, at least 20% of the EU's budget is to be allocated to climate change adaptation. **Nature-Based Solutions are promoted** in this policy, **including for the protection and restoration of wetlands, peatlands, coastal and marine ecosystems**.

Since the Paris Agreement, oceans have been receiving increasing attention in climate change strategies around the world. Coastal and marine ecosystem restoration can make a significant contribution to climate change action, as they have significant carbon sequestration and storage capacity and offer numerous co-benefits for climate change adaptation in coastal regions. While their potential for climate change mitigation and adaptation is increasingly recognised, their integration into climate change strategies remains limited and can be further strengthened to maximise their potential. In particular, the actions outlined in the NDCs would benefit from the work done under other multilateral environmental agreements and policies, which provide the necessary basis for including the restoration of coastal and marine ecosystems in these climate strategies.

An overview of the relevant EU policy landscape described above is provided as follows (Table 6):

EU POLICY INITIATIVE	TARGETS AND PROVISIONS RELEVANT FOR COASTAL RESTORATION AND CLIMATE ACTION	CONTRIBUTION TO COASTAL RESTORATION IN NDC
Green Deal	EU Nature Restoration Regulation (2024): • Restore 20% of EU's land and sea by 2030 and all by 2050. • Provides key targets to restore, re-establish, and improve condition of coastal and marine ecosystems. • Additional targets to improve river connectivity. 30x30 Target (2022): • Protect 30% of EU's land and seas (10% strict), refers to the importance of carbon-rich coastal ecosystems. EU Farm to Fork strategy (2020): • Aims to reduce the impact of food systems on the environment and climate and to increase the resilience of food systems.	• Biogeographical process show potential for coastal restoration and their contribution to NDCs, but Member States need to be motivated to engage. • Recognizes the importance of coastal restoration for climate change mitigation and adaptation. • Promotes synergies with EU climate policies. • Member States are required to submit National Restoration Plans to plan restoration. • Promotes shift to sustainable fish and seafood production. • Reduce impact of excess nutrients on biodiversity (incl. rivers, lakes, wetlands, seas). • Proposal for Carbon Farming, to incentivize farms for rewetting of peatlands.
MSFD	• Requires Member States to create national marine strategies.	• The MSFD offers a comprehensive framework to monitor climate change impacts on EU's seas.
WFD	• Member States are required to develop River Basin Management Plans. • Climate adaption is one of four priorities. In addition, the floods directive addresses flood risk management in the EU.	• Good potential to support the integration of coastal restoration in NDCs from an additional objective (water). • Better implementation of WFD by MS is needed. • Floods Directive offers knowledge for coastal adaptation.
MSP Directive	• Member States are required to develop national maritime spatial plans from 2021.	• Requires Member States to synergise actions between various Directives (BHD, MSFD, WFD). • Current national plans are not enough to reach EU's climate and nature objectives (need to emphasize protection, impact of offshore renewables on biodiversity, cooperation between Member States).
IMP	• Maximise sustainable use of oceans and seas. • Increase maritime knowledge and data. • Improve quality of life in coastal regions. • Minimize effects of climate change in coastal regions. Approach for Sustainable Blue Economy: • Particularly addresses businesses in the blue economy. • Promotes decarbonisation through coastal restoration. • Promotes coastal resilience measures by rebuilding biodiversity. • Stimulates natural solutions to depollute areas and fight eutrophication.	• This strategy particularly seeks to balance blue economy with ecosystem restoration • Promotes synergies among EU legislation and policies for seas. • Support knowledge and action to reduce impact of climate change. • Promotes co-benefits for coastal communities. *EC proposal for new action plan on fisheries shows potential (aligning restoration measures with blue economy in coastal regions).*
Climate Law	• Requires Member States to develop national energy and climate plans.	• Protection and restoration of ecosystems are mentioned as option for Member States to make additional efforts to achieve the EU climate targets. • The regulation does not describe actions to limit the impact of offshore renewables on coastal and marine ecosystems.
Adaptation Strategy	• Requires Member States to submit national adaptation plans.	• The protection and restoration of wetlands, peatlands, coastal and marine ecosystems is promoted as NbS for climate adaptation.

Table 6. Summary of relevant EU policies and NDC contribution.

Globally, the Global Biodiversity Framework and the SDGs are driving action to protect and restore coastal and marine ecosystems, recognising their potential for carbon sequestration and their importance as natural buffers to reduce the risks of climate change in coastal regions. Both the Ramsar Convention and the Regional Seas Conventions have included climate change mitigation and adaptation objectives in their programmes, which are expected to provide essential steps forward for the uptake of coastal and marine ecosystem restoration in NDCs. These are expected to improve; assessments of the impact of climate change on these different ecosystems, accurate monitoring tools including their carbon sequestration capacity, management

and sustainable use, and the development of effective restoration measures, including the application of NbS in the context of climate change adaptation. These multilateral environmental agreements can also enhance regional cooperation and provide a platform to share knowledge, data and best practices among Contracting Parties for coastal and marine ecosystem restoration.

The EU has many policies, legislation, strategies and action plans in place that provide the necessary basis for including coastal and marine ecosystem restoration in its NDC and those of individual Member States. These ecosystems are addressed in many processes, which frequently promote their protection and restoration, the potential benefits for climate mitigation and adaptation, and their sustainable use. This means that **Member States are encouraged – and frequently required - to understand the impacts of climate change on these ecosystems, integrate them in various national planning tools, improve monitoring methods, consider measures to enhance their contribution to climate change mitigation and adaptation, including NbS, and improve their cooperation with other Member States**.

Despite these EU processes highlighting and encouraging the contribution of coastal and marine ecosystems restoration for climate change action, which provides for their inclusion in these NDC's, certain aspects could be improved for this to be done successfully. For instance, a better understanding of the impacts and contribution of coastal and marine ecosystems to climate change mitigation and adaptation is needed, as well as effective monitoring systems to assess this. **The EU and its Member States will need to strengthen the implementation of various policies and strategies and maintain high ambitions for climate change action, emphasizing the role of coastal ecosystems for carbon sequestration and adaptation to climate change**. In addition, **enhancing synergies between relevant policies and strategies, both at EU or global level, would amplify the contribution of marine and coastal ecosystem restoration for climate change mitigation and adaptation, and improve a better understanding of competing priorities,** and thus strengthen their contribution for the climate actions outlined in NDCs.

6 Final Discussion

The analysis conducted in this report revealed that coastal and marine ecosystems have a significant potential to contribute to climate action in REST-COAST countries and the European Union. However, their integration into the relevant NDCs – and NECPs – remains inadequate. The review has identified several **gaps and limitations** in the inclusion of coastal and marine ecosystem restoration in NDCs, namely:

- Lack of explicit mentioning of coastal and marine ecosystems;
- Limited emphasis on ecosystem-based approaches;
- Absence of specific targets for coastal restoration;
- Failure to recognize the co-benefits of coastal restoration efforts.

Within the NDC context, these gaps and limitations represent **missed opportunities** to maximize the impact of coastal restoration and leverage the climate mitigation potential of coastal ecosystems, thereby undermining the important contributions coastal ecosystems could make towards achieving Paris Agreement goals. By addressing the identified gaps, countries and the EU could strengthen their climate commitments through enhancing and protecting natural carbon sinks while improving coastal protection, conserving biodiversity, and supporting sustainable development.

Taking into account expected project outcomes, REST-COAST is demonstrating that restored coastal ecosystems - such as wetlands, seagrass meadows, and salt marshes- provide multiple **benefits**, including carbon sequestration, coastal protection, biodiversity conservation, as well as **co-benefits** like improving water quality, supporting fisheries or fostering sustainable economic activities (e.g. ecotourism). Furthermore, it is relevant to consider the use of **revenue-generating financial mechanisms**, such as carbon credits, which can contribute to the scalability and long-term sustainability of restoration projects.

In the **policy** context, the role and contribution of coastal ecosystem restoration to climate change mitigation and adaptation has received increased attention since the adoption of the Paris Agreement. This shift is reflected in global initiatives, such as at the UN Ocean Conferences and relevant UN conventions related to Climate Change, as well as within EU processes, notably the EU Nature Restoration Regulation. This evolving policy landscape not only offers decision-makers and management bodies tools to incorporate coastal restoration into climate strategies (e.g. promoting research and innovation, and enhancing cooperation), but also contributes by improving monitoring methods to assess the impacts of climate change and the effectiveness of restoration measures.

Despite the acknowledged importance of coastal restoration in climate action, mainstreaming these efforts into NDCs and other national climate policies and planning tools, like NECPs, faces **challenges** at different levels. This challenging situation may include, among others, a limited awareness and understanding of coastal ecosystems' relevance, conceptual deficiencies on addressing a right policy framework and proper alignment with existing policies, competing priorities and resource constraints, governance and coordination issues, or even the absence of robust monitoring and evaluation frameworks. Overcoming these obstacles requires concerted efforts, including raising awareness, strengthening institutional capacities, promoting cross-sectoral collaboration, enhancing synergies with relevant policies, exploring public and private financial pathways, and fostering international cooperation and knowledge-sharing.

Considering all above, along with findings from previous WP5 deliverables (e.g. M5.4. "*Briefing addressing approaches taken at municipal, regional, national policy levels*"), integrating coastal restoration into NDCs and national climate change strategies represents a potential NbS that aligns with broader policy goals for sustainable development and economic growth in coastal regions. The preliminary recommendations below propose key steps – among others - for effectively integrating coastal ecosystem restoration into broader climate action strategies.

6.1. Preliminary Recommendations

Based on the analysis and findings presented in this report, the following recommendations – grouped by topic - are proposed as a first approach to strengthening current NDCs and climate change policies:

AWARENESS RAISING:

- Explicitly **recognize the importance of coastal and marine ecosystems** in NDCs and national climate change strategies, highlighting their roles in carbon sequestration, coastal protection, biodiversity conservation, and providing co-benefits.
- **Promote ecosystem-based approaches and NbS**, emphasizing the role of coastal restoration as a key component of these efforts.
- Identify and **leverage the co-benefits of coastal restoration**, such as improving water quality, supporting fisheries, promoting ecotourism, and enhancing food security, to align with broader sustainable development goals.

INTEGRATION, COOPERATION AND KNOWLEDGE SHARING:

- Establish specific, **quantifiable targets for the restoration** and conservation of coastal ecosystems, such as wetlands, seagrass meadows, mangrove forests, and salt marshes, within NDCs and national policies.

- Strengthen the inclusion of coastal wetlands in EU Member State commitments for emissions reductions and removals on managed wetlands, which will become part of the required scope of commitments under the LULUCF Regulation in 2026.
- Consider **integrating future climate scenarios and changing socio-economic conditions** into the planning of coastal restoration activities at case study level.
- **Develop robust monitoring and evaluation frameworks** to track the progress and impact of coastal restoration efforts, ensuring accountability and informing adaptive management strategies.
- **Strengthen reporting mechanisms** in line with the Enhanced Transparency Framework under the Paris Agreement, ensuring transparent, accurate, and comprehensive reporting of coastal ecosystem restoration efforts and their contributions to climate mitigation and adaptation.
- **Foster international cooperation and knowledge-sharing** on best practices, innovative approaches, and lessons learned in coastal restoration and its integration into NDCs and national policies.

INSTITUTIONAL CAPACITY BUILDING:

- **Promote awareness and capacity-building programs** to increase understanding among policymakers, stakeholders, and the general public about the importance of coastal ecosystems and the benefits of their restoration.
- **Strengthen institutional capacities and governance frameworks** to support the effective implementation of coastal restoration measures, including cross-sectoral coordination, stakeholder engagement, and integrated coastal zone management.

POLICY COHERENCE:

- **Align coastal ecosystem restoration** with the implementation of existing EU, national and local level policies.
- **Integrate coastal restoration measures into broader climate change adaptation and disaster risk reduction strategies**, recognizing the role of restored ecosystems in enhancing resilience to sea-level rise, storm surges, and coastal flooding.
- **Recognize and integrate the role of coastal ecosystems** in achieving multilateral environmental agreements related to climate, biodiversity, and sustainable development goals
- **Enhance synergies between relevant policies**, strategies and action plans for climate action, ensuring that coastal ecosystem restoration is consistent with other competing priorities.
- The EU and its Member States are recommended **to fulfil their obligation under the new EU Nature Restoration Regulation to prioritise** and link the targets for coastal, marine, and freshwater ecosystem restoration for climate change mitigation and adaptation, including their connectivity to provide co-benefits to coastal communities.

FINANCE:

- **Explore and expand innovative financing mechanisms involving value-capture arrangements** to support the upscaling of coastal restoration initiatives, involving public and private sector stakeholders.
- **Promote long-term funding models** beyond project-based grants to align with extended timelines required for the benefits of coastal restoration to materialise.
- **Enhance the stability and accessibility of carbon markets** by implementing supportive policies, regulatory framework, and standardised methodologies (also at national and/or local level) for carbon credit verification and valuation.
- **Implement mechanisms to distribute the financial returns with local communities**, particularly where marginalised groups are identified, to promote local acceptance and avoid maladaptation.

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