European Commission

European Climate, Infrastructure and Climate Executive Agency - CINEA

Studies in support of the implementation of the Mission – Wetlands and Blue Carbon

Workshop Report

EUROPEAN COMMISSION

European Climate, Infrastructure and Environment Executive Agency
Unit C1 — Horizon Europe Climate

Contact: *CINEA HORIZON EUROPE*

E-mail: *CINEA-HE-CLIMATE@ec.europa.eu*

European Commission
B-1049 Brussels
BELGIUM

Studies in support to the implementation of the Mission – Wetlands and Blue Carbon

Workshop Report

CINEA/2023/OP/0005

European Climate, Infrastructure and Environment Executive Agency

This report should be cited as:

Whiteoak, K., Cziesielski, M.J., Macreadie, P., Costa, M., Wartman, M., Serrano, O., Watterson, J., Wiltshire, J., Crotty, F., *Studies in support to the implementation of the Mission – Wetlands and Blue Carbon: Workshop Report*, Publications Office of the European Union, 2025. doi:10.2926/0554

Manuscript completed in March 2025.

Luxembourg: Publications Office of the European Union, 2025

PDF ISBN 978-92-9405-190-5 doi:10.2926/0554358 HZ-01-25-031-EN-N

Contents

1. Introduction

1.1. Purpose of the workshop

This workshop was organized by Trinomics, Ricardo and Blue Carbon Lab in context of "Studies in Support to the Implementation of the Mission: 'Wetlands and Blue Carbon'" for CINEA (CINEA/2023/OP/0005). The aim was to test, validate and complement the current findings.

The workshop was organized as an online event and held on 4th February 2025.

This document provides a summary of the workshop, and the valuable feedback received.

For this purpose, the report includes the following Chapters:

- **Chapter 1:** Introduction
- **Chapter 2:** Stakeholder feedback per breakout session
- **Annex A:** Background information provided to participants prior to the workshop
- **Annex B:** Workshop slides

2. Stakeholder feedback per breakout session

This section summarises the stakeholder contributions received in each breakout session.

2.1. Feedback on Breakout Session 1: What are the barriers to including all wetland categories within the GHG inventory?

One of the main functions of the session was to discuss and gather information on the gaps in the reporting of wetlands in GHG inventories, and in addition, to identify transparency problems in reporting and reporting "good practice". The session also considered blue carbon inventories, which are related to but distinct from wetland inventories. The discussion focused on three main topics:

1. **Barriers**. What are the barriers to Member States (MS) producing complete and accurate inventories of GHG inventories from wetlands? Are activity data (AD) limiting? Are emission factors (EFs) limiting? Are the necessary methods available in IPCC guidance which MS can use to estimate removals of CO_2 and emissions of GHGs, or are there limitations in the guidance available?
2. **Resources**. Are there enough skilled people to do the work? How much time will it take to generate and update complete wetlands' inventories? What are the likely costs of this work?
3. **Improvements**. What improvements could be made to the current reporting of wetlands? What are the views of the participants about cooperation across MS to estimate emissions? How can estimates be made for early years where AD availability and quality are poorer?

Barriers

Reporting for wetlands

- Stakeholders indicated that, in Germany, the national inventory report (NIR) mentions that one of the biggest gaps is coastal wetlands, and especially tidal marshes. In Germany marshes are reported under the IPCC category "Grassland".

Activity data (AD)

- Some stakeholders (Germany) mentioned the difficulty of gathering information on the area of wetlands. In Germany for example, fishponds represent a large area of flooded land, but precise geographical data gathered does not always match national statistics, creating discrepancies – in this case- by a factor of two in area.
- Some stakeholders (Spain) highlighted problems with mapping, specifically with mudflats – where there are large fluctuations. There is a question about what is classified as managed land, and not managed land. RAMSAR categorisation = managed land.
- Stakeholders highlighted the issue with measurement and extrapolation at a country scale (France). Measurements are often site-specific. There are two main difficulties: 1) spatial variability; 2) methodological issues. Using eddy co-variance and other techniques to extrapolate.

- Some stakeholders stated that it would be helpful to have guidelines about how to differentiate the carbon sources and deal with that in the inventory, with a common approach.

Emission factors (EFs)

- Stakeholders (Germany) mentioned that EFs in the IPCC Guidelines were “rather limiting”, and often only based on a few sets of experimental data, e.g. for seagrasses, there are four measurements used to generate IPCC default EFs in the 2013 Wetlands Supplement. A collection of EFs at EU level would be useful.
- A stakeholder noted the differentiation of carbon source was very complicated – good to have guidance about how to handle this issue at EU level. There is a need for more EFs. MS need to use Tier 3 methods (to estimate carbon fluxes). But for non-CO2 gases, perhaps not useful for countries to have country-specific methods. GHG emissions for accounting need to have timeseries back to 1990, and this is a major barrier (as data earlier in the timeseries may not be readily available, and uncertainties may be relatively larger with respect to more recent data).
- A stakeholder noted that for Tier 1 data for carbon stocks, there is more data now – shows that Tier 1 is not changing much. However, there is large country variability, and a lack of Tier 2 data. The UK is doing a study on carbon accumulation rates and this is being published in March 2025.
- Because of the large variabilities in carbon stocks and stock change between countries, some participants highlighted that IPCC Tier 1 EFs were not always suitable, and Tier 2 not always available.
- A stakeholder commented on carbon farming requirement for Tier 3 methodology and gave an example in Japan where the Ministry of Land, Transport and Infrastructure supports restoration of seagrass meadows. It quantifies areas and uses formulas to calculate carbon sequestration. An economic value is attributed and companies buy credit and the money generated is in turn reinvested in expanding blue carbon. Tier 1 methods are used as Japan considers that Tier 3 [methodology costs] would discourage this restoration initiative.

Resources

Cost

- Stakeholders from Germany noted the “costs are the problem” and we are a “long way behind”.

- They also noted that they had been working a long time on a complete wetland inventory. They noted that they started 15 years ago with a huge interdisciplinary joint research programme on organic soils in Germany, the cost has been more than 10 million Euros. And they are now in the follow-on project. The costs for that are five million Euros.
- The cost of generating country-specific emission factors and using higher tier methods can be very large. In Germany, for example, experts have been working for 15 years, with projects costing up to 15M Euros, working on a country specific methodology (Tier 3 approach). To fill in the gaps in EFs for fishponds, another project has just started but it is expensive, with 100000 Euros per eddy covariance (EC) tower and many of these are needed. Tier 3 is not really defined (in the IPCC guidance).
- Stakeholders from France noted that flux towers are a “powerful method” and that there are examples at regional scale in France (La Rochelle). Difficult associating CO_2 flux with vegetative typologies have been experienced and they are now working on more regional scale measurements. There are other towers in the Loire area, and other restored areas. A regional project to associate carbon flux with one ecosystem costs approximately one million Euros.
- Stakeholders mentioned the cost of equipment, e.g. EC towers or chambers (applicable to different scales of emissions) as a barrier.

Expertise and knowledge

- A stakeholder noted that the EU has the carbon farming regulation and there is the requirement of a Tier 3 methodology.
- Stakeholders from Spain noted that they were investigating a case study at EU level, where satellite data from 2018 was used – these data need to be updated. The maps need to be updated.
- A stakeholder noted that access to equipment is a limiting factor: 1) flux towers (to assess carbon fluxes over larger areas of land); 2) flux chambers (to assess carbon fluxes over smaller areas of land). For salt marshes, emissions are highly variable and dependent on restoration status.
- A stakeholder suggested that EU MS with non-key category (KC) categories could use Tier 1 methodologies to ensure completeness of their wetland inventories.
- All stakeholders stated that these projects require not only GHG inventory experts but a lot of other specialists. Knowledge is a resource limitation: understanding and analysing the data collected requires specific expertise

and is a limiting factor. Participants highlighted training needs and the requirement for people to have the appropriate skill sets.

Questions were raised about the "starting position" of the IPCC methodological Tier used by EU MS: Do MS want to start at a higher Tier (i.e. Tier 2 or Tier 3)? Is using a higher tier the default position for MS?

- There was general agreement that this was the default position – to use a higher tier. One stakeholder (involved in a project to encourage countries to include blue carbon in their GHG inventories ([1]) expressed the opinion that if MS do not have higher Tier estimates, then they would not include estimates in their wetland inventories. They noted that we cannot wait for perfection.

Time

- Some stakeholders mentioned the high variability of emission/removals between and within habitats. A restored salt marsh can take 20 to 100 years to become a carbon sink. It is necessary to consider the variability across seasons (higher flux in the summer for seagrasses). Ideally projects to collect data should last several years.
- Some stakeholders suggested prioritising the resources required to generate wetland inventories and use IPCC Tier 1 values for countries with relatively small areas of wetlands and where net emissions are likely to be small.

Improvements

National boundaries defined for inventory

- Some stakeholders raised important points about the geographical boundaries of emissions and whether coastal wetlands fall (or fully fall) within the national boundaries defined for GHG inventories – e.g. mean high water (of tides) ([2]). It is important to consider the implications of using different measures of boundaries – whilst complying with IPCC methodologies adopted under the UNFCCC. Boundary definitions could include sovereign area, or sea territorial boundary (12 nautical miles).

---

[1] https://bluecarbonpartnership.org/wp-content/uploads/2023/03/IPBC-Dialogue-2023-22-Feb-Bonotto.pdf

[2] As an example, the areas used for the UK CRF submissions were based on the Standard Area Measurement to mean high water, providing a total area of the UK of 24,438.5 k ha.

- A stakeholder noted that it is important not to conflate mitigation action with inclusion in a GHG inventory. It was noted that carbon fluxes for soils are not well quantified. There needs to be a prioritisation of sources to include in a GHG inventory, and coastal wetlands might not be prioritised. The stakeholder could imagine instruments, i.e. EU legislation, that address wetland issues without wetlands being in the GHG inventory. An example was given of MS taking pride in forest expansion, but it was not necessary to create a GHG inventory to achieve this expansion; this is “a good lesson” for the approach that could be taken to wetlands.

EU support

A question was raised of whether the EU should take the lead and provide support and perhaps even pre-calculate GHG emissions in the wetland sector.

- A stakeholder noted that the provision of support by the EU would be vital mainly for connecting researchers to calculate emissions. Guidance on methodology would also be useful.
- There was no strong or clear view about whether the Commission should provide precalculated values of emissions and removals from wetlands for MS to use.
- There is a need to understand the current quality of wetlands, not just the loss of wetland habitats.
- There was broad agreement about the Commission providing methodological support for EU MS inventory compilers to help them estimate wetland GHG inventories, including how to use proxy data to go back to 1990. It was suggested to look at lessons learnt from supporting MS to create high quality inventories for other sectors such as the forest sector in the LULCUF sector.
- A stakeholder thought that providing emission factors is a good idea, but probably not the most useful advice that the Commission could provide. Activity data and how you can use proxies to go back to 1990 and the link between scientists and what scientists can give and what the inventory compilers need is far more important.

2.2. Feedback on Breakout Session 2: Blueprint for Blue Carbon: Building an EU-wide Monitoring Roadmap

This Breakout Session focused on addressing monitoring gaps, standardization, policy integration, and carbon reporting frameworks for blue carbon ecosystems in the EU. The discussion is summarized into five thematic areas:

Addressing Data Gaps in Blue Carbon Ecosystem (BCE) Extent & Distribution

1. Seagrass & Tidal Marsh Monitoring Gaps:

    (a) Stakeholders have observed inconsistencies in seagrass and tidal marsh coverage across datasets. Corine Land Cover data excludes seagrass, while Sentinel and Landsat tend to over- or underestimate coverage depending on location.

    (b) Baltic Sea gaps are expected; much of the seagrass distribution data is based on point data rather than mapped extents, limiting its utility.

    (c) Stakeholders think that European datasets do to not adequately track changes in BCE extent, particularly when considering temporal shifts due to restoration, degradation, or natural migration.

2. Mapping Accuracy & Standardization Issues:

    (a) Stakeholders noted that minimum mapping units vary across datasets, leading to loss of small tidal marshes and wetland patches from the classification.

    (d) Dredging Impacts were discussed: The UK was mentioned as a case study in monitoring inconsistencies—over 300 different dredging reporting methods exist, complicating seagrass impact assessments.

3. The Need for a Conceptual Framework to Visualize Data Use:

    (a) Stakeholders proposed a conceptual figure for the roadmap report that would illustrate how different data sources contribute to blue carbon monitoring, helping clarify which datasets are best suited for different monitoring objectives.

Enhancing Mapping Accuracy & Monitoring Systems

1. Advances in Remote Sensing & Earth Observation:

    (a) Stakeholders agreed that scaling up remote sensing technologies is critical. Recommendations included:

        - Sentinel, Landsat, and Planet Labs for high-resolution imagery.
        - Drones for in situ validation in shallow waters.
        - AI & Machine Learning models to extract meaningful trends from satellite data.

- Multi-scale approaches: Satellite data should be paired with on-ground surveys to validate carbon stocks.

2. Data Harmonization Across EU Member States:

   (a) Stakeholders pointed out that EMODnet aims to provide a centralized dataset, but there is no single habitat classification system for blue carbon ecosystems.

   (e) Stakeholders highlighted an issue with land cover vs. land use classification—many countries only classify wetlands based on land use, not their ecological function, limiting their inclusion in climate policies.

Integration into Policy Frameworks & IPCC Reporting

1. Aligning Blue Carbon Monitoring with IPCC Guidelines:

   (a) Stakeholders emphasized that IPCC reporting currently lacks indicators for wetland condition—it tracks extent but not health.

   (f) Stakeholders argued that emission factors and conversion metrics for blue carbon ecosystems are outdated, needing revision based on recent scientific findings.

2. Addressing the Gap in Reporting Ecosystem Losses:

   (a) In response to a question about Australia's approach to reporting BC losses, the authors of this study said that to their knowledge Australia does not yet systematically report spontaneous seagrass loss under its greenhouse gas inventory, despite research showing significant carbon losses from diebacks. The authors noted that BC stock losses don't necessarily translate to GHG emissions because the BC may be relocated ('leakage') but remain in a form that escapes conversion to GHGs.

   (g) Stakeholders added that Mexico has similar reporting challenges, where mangrove loss was not historically tracked under land use change metrics, making it easier for degraded areas to be converted into coastal development sites.

Establishing Objectives & Actions for Improved Monitoring

1. Standardizing Carbon & Ecosystem Service Accounting:

   (a) There was consensus that carbon monitoring should be expanded to include other ecosystem services like:

- Biodiversity benefits.
- Coastal protection services (insurance industry already factors this into risk modelling).
- Tourism & fisheries value of healthy blue carbon ecosystems.

2. Financing Restoration Beyond Carbon Markets

Stakeholders cautioned against the over-commercialization of biodiversity; warning that trying to monetize ecosystem health could undermine its intrinsic value.

(h) Stakeholders noted that carbon credits alone will not be sufficient to fund restoration—other financial incentives are needed.

Next Steps & Priorities for the EU Blue Carbon Roadmap

1. Data & Monitoring:

Develop a standardized classification system for BCEs across Member States.

(i) Expand remote sensing approaches using multi-scale validation techniques.

(j) Ensure that ecosystem condition is integrated into monitoring frameworks, not just BCE extent.

2. Policy & Market Integration:

Advocate for updated IPCC methodologies that include better emission factors and sequestration dynamics for seagrass, salt marshes, and mangroves.

(k) Work towards an EU-wide blue carbon data repository to streamline monitoring and reporting.

(l) Explore alternative financing mechanisms beyond carbon credits for blue carbon restoration.

Conclusion & Key Takeaways

Major takeaways included:

- Data gaps remain a significant barrier—improving monitoring will require better integration of remote sensing, on-ground validation, and existing datasets.

- Blue carbon market mechanisms are still evolving—seagrass remains difficult to incorporate into voluntary carbon markets.
- The EU must align monitoring with emerging policy frameworks like the Green Deal, EU Restoration Law, and Marine Strategy Framework Directive.
- Collaboration across Member States is crucial to ensure that monitoring efforts are standardized, accessible, and policy-relevant.

2.3. Feedback on Breakout Session 3: Blue carbon changes in Europe – Drivers, pressures, measurement and restoration

This Breakout Session focused on categorisation of drivers of change and blue carbon sequestration enhancement. The discussion is summarized into two thematic areas:

Categorisation of drivers of change

- Stakeholders suggested to subdivide ‘invasive species’ in native and non-native species
- ‘Sediment dynamics’ may be also influenced by erosional actions (depending on currents)
- Regarding ‘Climate change’ stakeholder said that there are changes in season and long-term changes in growing ocean lightening especially in the North, which gets worse with melting glaciers. It was acknowledged though that it is difficult to link to one specific driver.
- Stakeholders suggested that ‘Heavy metal pollution’ could also be put under pollution.
- Stakeholders discussed that Agriculture and aquaculture could be added to ‘land use change’, while ‘Fertilizers etc used in agriculture’ could be pollution. Also, stakeholders see ‘eutrophication’ as a driver in itself, but not a pollution driver.
- Another driver to be considered could be ‘Fresh water pollution’, which was however agreed to part of salinity and salinity gradients.
- Stakeholders suggested to rename ‘human exploitations’ to ‘human activities’.
- Further suggested drivers included chemicals and micro plastics, and further climate change impacts, among others. However, it was recognized that these pressures did not have a significant presence in the literature in the EU at this stage.

Further points mentioned

- Difference between research efforts (in geography and questions discussed):
    - Stakeholders agreed that there are differences due to differing past long-term efforts. For example, the UK, as well as NL, DK, ES, GR they have been looking into seagrass for a long time already. Other countries are just catching up now and data, especially long-term, remains sparse and challenging to obtain.
    - It was agreed that there is a lack of contribution of the Eastern Europe countries.
    - Stakeholders noted that the lack of funding for research into blue carbon has also contributed to less presence of data and investigation locally. This has consequently affected policy and the protection status of blue carbon habitats in the EU.

Blue carbon sequestration enhancement

- It was discussed if blue carbon sequestration enhancement is synonymous with restoration activities. Stakeholders raised that the removal of the sources of harm should not be neglected.
- Practical guidance on seagrass and saltmarsh restoration activities: Stakeholders had some different views on the importance of more detailed guidance on restoration of these ecosystems. It was suggested that priority might be put on enabling clear understanding at EU and Member State level of the regulatory and policy frameworks to allow greater restoration to take place.
- Shortage of blue carbon sequestration measurement in restoration sites for seagrass and saltmarsh in the EU: Stakeholder feedback suggests that there is a lack of, if any, measurement of these sites in the EU. Stakeholders emphasised that there are simply too few restoration projects to derive sufficient information. Stakeholders also mentioned that there is also a need to conduct Blue Carbon baseline studies before restoration / recovery. This is so far not being done as standard. Additionally, stakeholders mentioned that the interest of funders could focus more on the area to be restored instead of the blue carbon sequestered.
- Cost data for EU restoration projects: Some stakeholders have helpfully suggested some further sources. It was emphasised that passive restoration (such as removing tidal barriers and other sources of harm) should be further investigated.

- Funding: Stakeholder emphasised that Sothern European countries highly depend on EU fundings. National funding seems to be difficult to increase there.

Annex A: Background information provided to workshop attendees

04 February 2025

CINEA Study

in support to the implementation of the EU Ocean Mission:

Wetlands and blue carbon

THE WORKSHOP

This workshop is organized by Trinomics, Ricardo and Blue Carbon Lab in context of "Studies in Support to the Implementation of the Mission: 'Wetlands and Blue Carbon'" for CINEA (CINEA/2023/OP/0005).

The aim is to test, validate and complement our current findings.

You can register to the workshop here. Please be aware that you need the latest version of Zoom to be able to attend this meeting. Otherwise, participation via the browser will be necessary.

For questions, please contact: bluecarbonEUworkshop@trinomics.eu

THIS DOCUMENT

This document contains background information on each of the breakout sessions (BS):

BS 1: What are the barriers to including all wetland categories within the GHG inventory

This task aims to try and improve the accuracy and completeness of the EU Member States (MS) greenhouse gas (GHG) inventories. Specifically, we are trying to understand the current status of all reporting categories of wetlands, across all EU MS. The EU is also trying to understand if and how EU MS could create "blue carbon" GHG inventories. Management of blue carbon ecosystems, including their restoration, enhancement, maintenance and protection, representing a viable and cost-effective opportunity for contribution to global efforts to reduce GHG emissions for some individual countries or regions.

As part of the research, we would like to gather views from researchers and technical experts who have expertise in wetlands, blue carbon and GHG emissions – this will form the basis of our breakout session.

Task 1: Understanding of the current reporting processes across the EU Member States on GHG emissions and removals in wetlands

The overall objective of Task 1 is to develop our understanding of the current reporting processes across the EU Member States on GHG emissions and removals in wetlands. There are several important questions which need to be asked to understand the current situation, including: How do EU MS estimate land use and land-use change for wetlands? Do they include both freshwater and coastal wetlands in their GHG inventories? Across the EU's land area, it has been calculated that there are approximately 617 000 km2 of (non-mangrove) wetlands. This includes various types of wetlands. Seagrass is well studied, although there are still large uncertainties in its distribution, especially for deep-water seagrasses. Information is available about the distribution of salt marshes, but there is limited reporting in GHG emission inventories.

To enable us to understand the current reporting, we have created a relational database amalgamating all the EU MS wetland submissions from the Common Reporting Format (CRF) tables and National Inventory Reports (NIRs) to the United Nations Framework Convention on Climate Change (UNFCCC), for the years 1990 and 2021. This database is searchable and enables us to identify gaps in reporting. Coastal wetlands – commonly referred to as blue carbon ecosystems and include mangroves, tidal marshes and seagrass – differ from terrestrial and inland wetland ecosystems in terms of carbon storage and GHG reporting requirements. Despite their recognized potential for carbon sequestration, the NIRs submitted by EU MS often do not include coastal blue carbon stock change, or they combine it with data from other freshwater wetlands. In the EU, accounting of managed wetlands is voluntary in the period 2021-2025. Mandatory accounting of wetlands in the first accounting period would strengthen the LULUCF regulation but would be difficult to implement. Not all Member States have fully established monitoring and reporting systems for wetlands, and it takes time to develop and implement them.

The IPCC categories which are currently used for reporting emissions and removals in wetlands are:

1. **Wetlands remaining wetlands**
   - 1.1. Peat extraction remaining peat extraction;
   - 1.2. Flooded land remaining flooded land;
   - 1.3. Other wetlands remaining other wetlands (Coastal wetlands, including vegetated (mangroves, saltmarsh and seagrass) and unvegetated)
2. **Land converted to wetlands**
   - 2.1. Land converted to peat extraction;
   - 2.2. Land converted to flooded land;
   - 2.3. Land converted to other wetlands (Coastal wetlands, including vegetated (mangroves, saltmarsh and seagrass) and unvegetated).

The IPCC has written a large amount of technical guidance, but not all of this is mandatory to use. The Enhanced Transparency Framework (ETF) of the Katowice Climate Package requires the use of the 2006 IPCC Guidelines, with flexibility for least developed countries and small island developing states, and the use of the 2013 Wetlands Supplement is encouraged for all Parties. EU MS and the EU do not have to use the 2013 Wetlands Supplement, but they are encouraged to. There is further elaboration about the estimation of emissions and removals in wetlands in the IPCC 2019 Refinement, but this has not yet been adopted under the UNFCCC. Parties can choose to use the 2019 refinement where they find it more appropriate to their national circumstances, they will, however, need to transparently justify its use in their national GHG inventory report.

The reporting requirements indicate that a Member State may report aggregated estimates for all land conversions to wetlands, when data is not available to report them separately, and should specify which types of land conversions are included. The 2019 Refinement updates the information in the 2013 Wetlands Supplement further by providing new guidance for CO2 and non-CO2 emissions from ‘Land Converted to Flooded Lands’ and ‘Flooded Lands Remaining Flooded Lands’, specifically to assess changes in the soil carbon pools. Both the 2013 Wetlands Supplement and the 2019 Refinement follow the IPCC’s standard “tiered” guidance to GHG estimation. Both sets of guidelines also suggest activity data (AD) which inventory compilers could use.

Main findings

Globally, mangroves are the most widely studied blue carbon ecosystem, however, within the geographic region of the EU, mangroves are virtually absent (<1% of the global mangrove area). There are still large uncertainties in the distribution of other coastal wetland types (seagrasses and saltmarshes) which are the more prevalent coastal wetlands within the EU region. Utilising the relational database and assessment of activity data, emissions, removals, and uncertainties, we have been reviewing the EU MS reporting of wetland emissions as outlined within the Wetlands Supplement, the methodologies used, and likely time frame and costs for full reporting.

From evaluating the data provided with the CRF’s and NIR for each of the EU 27-MS overall 81% of the total area for wetlands can be found in seven countries; however 59% of the total wetland areas are found within two countries – Sweden (32%) and Finland (27%). The remaining 22% is split between five countries – Poland (5.8%), Ireland (5.2%), Romania (4.4%), Netherlands (3.5%) and Germany (3.5%). Yet net CO2 emissions from wetlands are not proportional to the total areas of wetlands. For example, Sweden the country with the largest area of wetlands, only reports 1.71% of net CO2 emissions from wetlands. The main reason for this is that Sweden assumes large areas of wetlands are unmanaged, and hence do not need to be included in a GHG inventory. Of the percentage of total net CO2 emissions from wetlands in the EU, Germany accounts for 34% of net emissions and Ireland 12%. Only six countries report net CO2 removals from wetlands (negative net emissions), the majority of these removals are from Romania (69% of total net CO2 removals) and Spain (19%). Eight out of 27 MS report methane (CH4) emissions from wetlands; the highest are from Germany accounting for 92% of the total CH4 wetland emissions in the EU. The N2O emissions are 100 times lower than net CO2 emissions (in CO2 equivalent units). When considering the combination of net CO2, CH4 and N2O emissions, Germany has the highest emissions representing 47% of the overall EU emissions from wetlands.

We have analysed the IPCC methodological tiers used by the EU MS to estimate their emissions of GHGs and removals of CO2. Five countries (representing 82% of CO2 equivalent emissions from wetlands in EU) use a mixture of tier 1, 2 and 3 methodologies as part of their calculations, with further details related to IPCC categories not always clear from the NIRs. Also, the level of disaggregation reported is very different for each country. For countries who list them, the sub-categories included in the CRF tables are diverse.

We have analysed uncertainties reported in wetland categories in EU MS NIRs, reported at 95% Confidence Intervals. Uncertainties in the LULUCF sector are often high both relative to the uncertainties in the energy sector, and in absolute terms. Finland and Ireland report uncertainties greater than 100%; Germany reports uncertainties of approximately 30%, but Latvia reports uncertainties that are very small: less than 5%.

Focusing on coastal wetlands, only one EU country (Malta) clearly includes net CO2 emissions from coastal wetlands, included under the category “4.D.1.3 Other wetlands remaining other wetlands” (-0.0135 kt CO2). The term “coastal wetlands” is not included in any other CRF table or National Inventory Report, even though 22 Member States have a sea border. There are “important” areas of wetlands, including mangroves, in overseas territories. Some MS (for example France) do consider mangroves in their reporting, but report these in the forestland category. Seagrass is not mentioned in the MS NIRs, although we know from the other work packages that there are areas of seagrass within the EU.

Questions for the breakout sessions are presented on the following page.

QUESTIONS FOR DISCUSSION

We will present an analysis of the gaps we have found within GHG reporting of wetlands within the opening presentation and breakout group session. During the breakout session we will discuss:

- What barriers are there to including all wetland categories within the GHG inventory?
- How can we improve the transparency, completeness and accuracy of reporting?

We have had discussions with the USA, UK and information provided from some European countries (e.g. Finland) and the European Environment Agency, but further understanding is needed. Inclusion of coastal wetlands in GHG inventories and reporting on blue carbon involves several reporting requirements, such as defining the habitat to be included, creating a baseline map, estimating GHG emissions and removals of CO2, monitoring changes within the environment, etc.

- Where would these sets of activity data be sourced from?
- We are interested in knowing the potential costs that you believe each of the Blue Carbon reporting activities would require. In particular, we would like to discuss the different activities that Blue Carbon reporting would entail (e.g. data collection, report writing, quality assurance and control, etc.) and the frequency with which these activities would need to be carried out, together with the costs associated with them. Will a Tier 1 methodology or higher Tier methodologies be used?

BS 2: Blueprint for Blue Carbon: Building an EU-wide Monitoring Roadmap

The goal of this task is to use existing spatial data (e.g., habitat mapping, protected areas, land cover, land cover change) to understand the distribution of coastal and freshwater wetlands within EU countries. More specifically:

- **For coastal and freshwater wetlands**:
    - Map the distribution of wetlands in the EU countries, including a comparative analysis among the datasets used in the analysis.
    - Estimate how much area of these ecosystems are protected based on the presence of protected areas, including those under the EU Habitats Directive and Ramsar Convention.
- **For coastal wetlands:**
    - Map distribution changes of these ecosystems since 1990 based on existing digital maps.
    - Provide recommendations on how to improve map accuracy, including costs for different levels of accuracy and further steps needed to monitor changes in blue carbon ecosystems.

The key findings are presented in the following.

Map the distribution of wetlands

Mangroves

The draft map for mangroves indicates that the outermost regions may encompass approximately 93 000 ha of mangroves, with more than 94% of the mangroves occurring within French Guiana.

Tidal marshes

The draft map for tidal marshes indicates that the outermost regions may include approximately 508 ha of tidal marshes within their coastlines in 2020. In addition, we estimate that the Member States include more than 408 000 ha of tidal marshes within their coastlines in 2020.

Figure 1 Spatial distribution (ha) of mangroves (green) for EU member states and outermost regions.

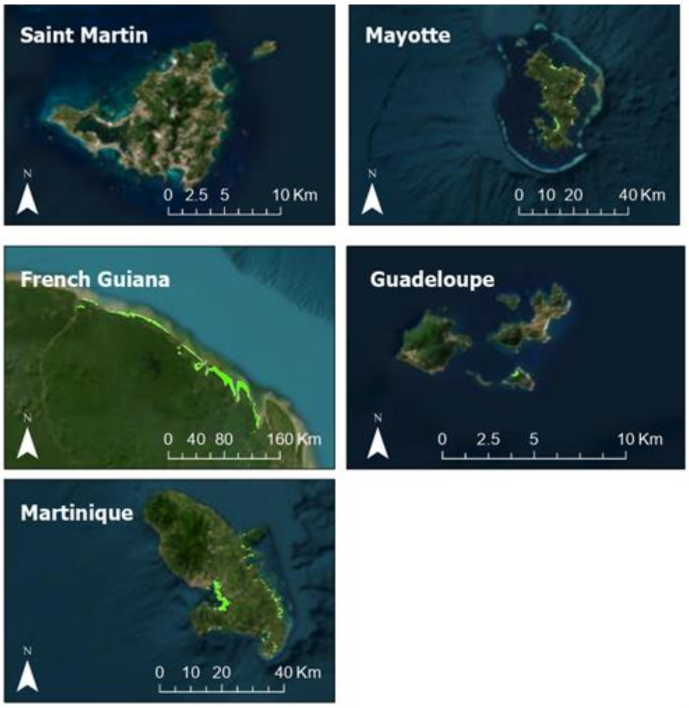
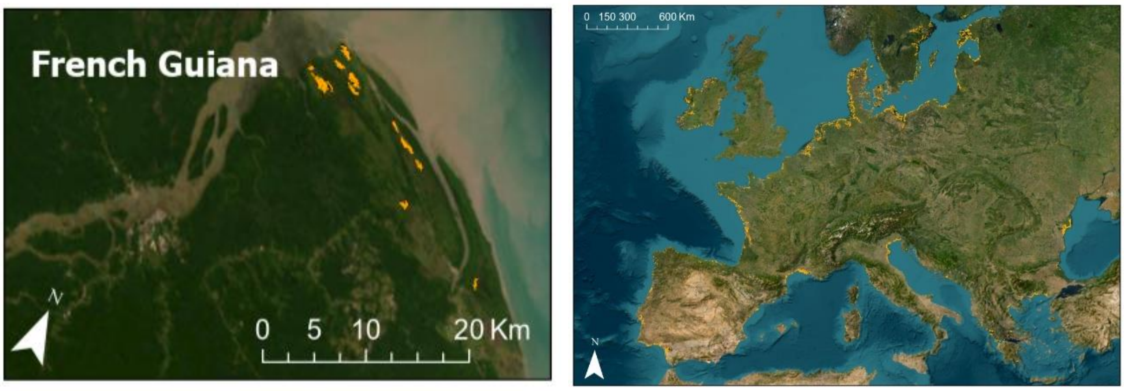


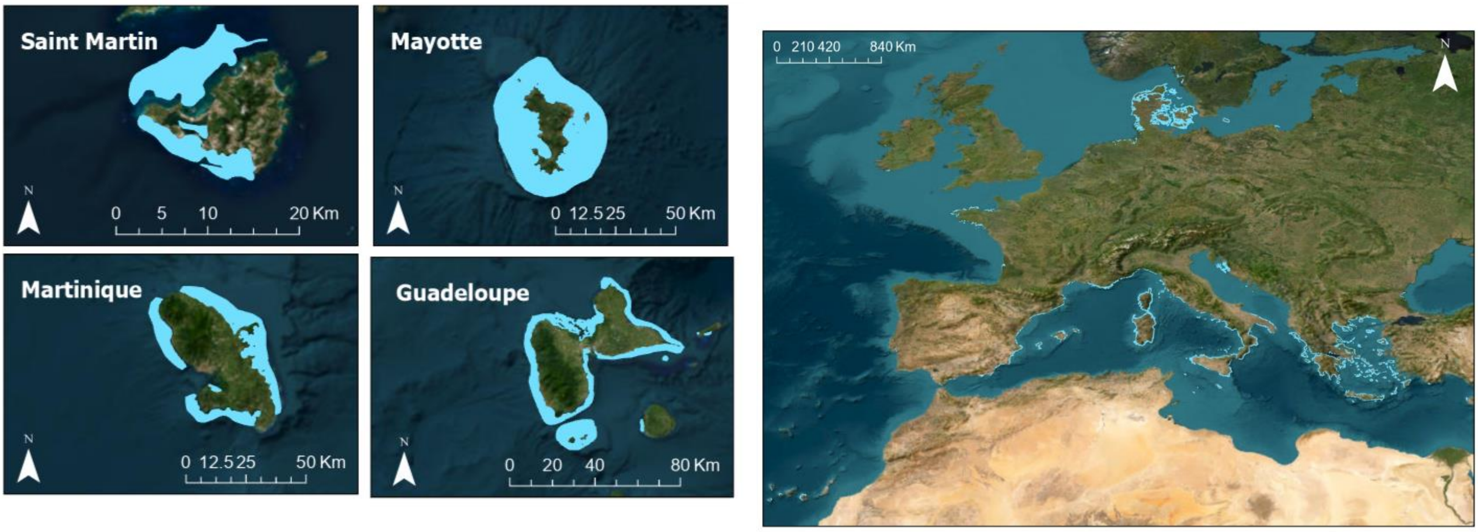
Figure 2 Spatial distribution (ha) of tidal marshes (orange) for EU member states and outermost regions.



Seagrasses

The draft map for seagrasses indicates that the outermost regions may encompass more than 290 000 ha of seagrasses. In addition, we estimate that Member States would include approximately 1.4 million ha of seagrasses within their coastlines and Exclusive Economic Zones.

Figure 3 Spatial distribution (ha) of seagrasses (blue) for EU member states and outermost regions.



Coastal wetlands across EU Member States

We estimated that blue carbon ecosystems are distributed within more than 2 million hectares across the EU and their outermost regions. Table 1 breaks down the distribution of mangroves, tidal marshes and seagrasses across the EU and Outermost regions.

Table 1 Distribution (ha) of different blue carbon ecosystems within each EU Member State and outermost regions. Portugal and Spain include their outermost regions of Azores and Madeira, and Canary Islands, respectively. Values were rounded to the nearest integer.

EU Member State	Area (ha)		
	Mangroves	Tidal Marshes	Seagrasses
Austria			
Belgium		784	
Bulgaria		1 954	934
Croatia		5 162	29 794
Cyprus		220	6 986
Czechia			
Denmark		26 331	413 831
Estonia		26 954	9
Finland		731	
France		66 971	123 272
Germany		34 534	98 440
Greece		21 350	294 922
Hungary			
Ireland		13 067	358
Italy		22 860	386 872
Latvia		16 344	1 140
Lithuania		3 944	726
Luxembourg			
Malta			
Netherlands		18 115	
Poland		16 116	3 134
Portugal		15 763	4
Romania		71 466	8
Slovakia			
Slovenia		142	
Spain		34 137	115 869
Sweden		11 695	4 285
Outermost regions			
Guadeloupe	3 152		76 033
French Guiana	87 968	478	
Martinique	1 698		55 842
Mayotte	579		148 437
Réunion	*	19	*
Saint Martin	1		10 696

* Territories that are known to have mangroves according to the literature, but existing maps included in this study do not cover them.

Inland wetlands

The maps for the different freshwater wetlands show that the outermost regions are likely to have more than 250 000 ha of these ecosystems. From this area, swamps would occur in approximately 153 776 ha, while marsh would be the wetland type with the smallest area (i.e., 20 430 ha). Flooded flats and permanent water would occur within 28 776 ha and 48 304 ha, respectively.

For the Member States, we estimate that they are likely to include approximately 17 million ha within their territories. From this total area, permanent waters would occur in approximately 8 million ha, while saline would be the wetland type with the smallest area (i.e., 4 720 ha; and limited to Austria, Hungary and Netherlands). Flooded flats, marshes and swamps would occur within 1.4 million ha, 5.1 million ha and 2.4 million ha, respectively.

Figure 5 Spatial distribution (ha) of inland wetlands including swamps, flooded flat, permanent water, saline and marsh in the EU's outermost regions.

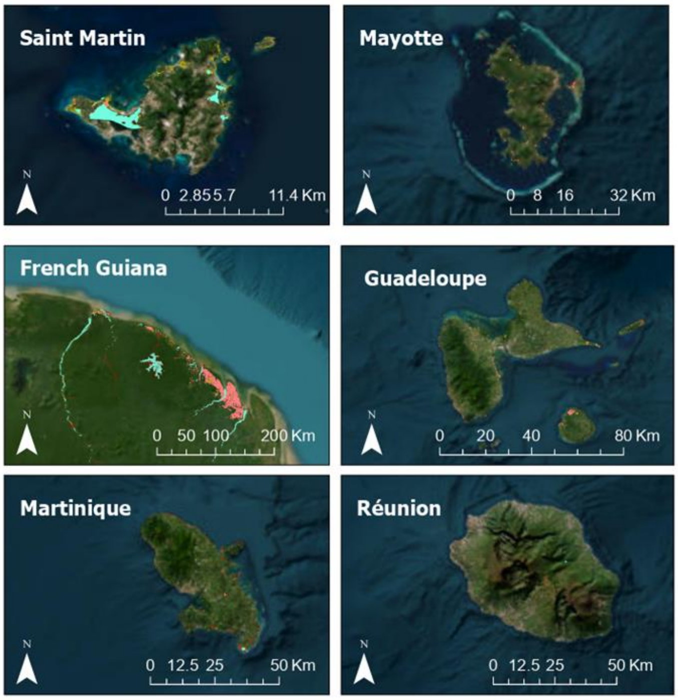
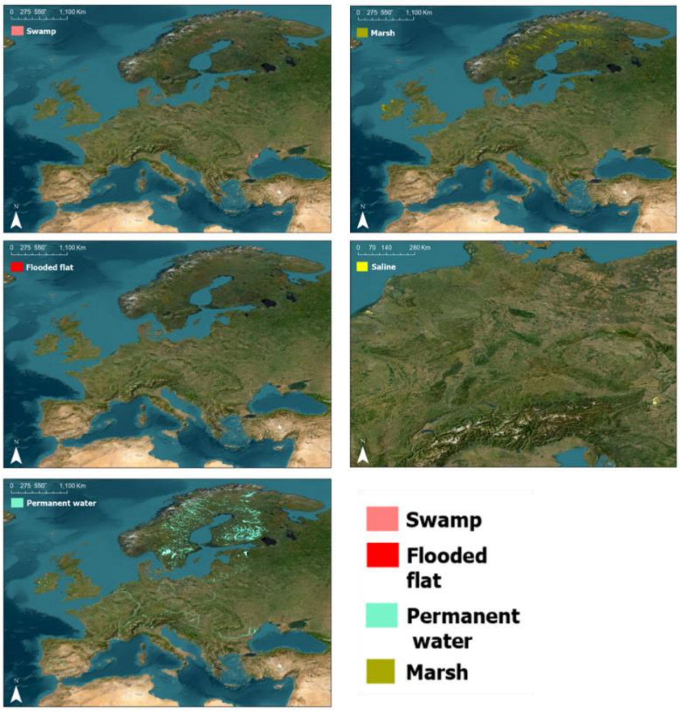


Figure 4 Spatial distribution (ha) of inland wetlands including swamps, flooded flat, permanent water, saline and marsh across EU member states.

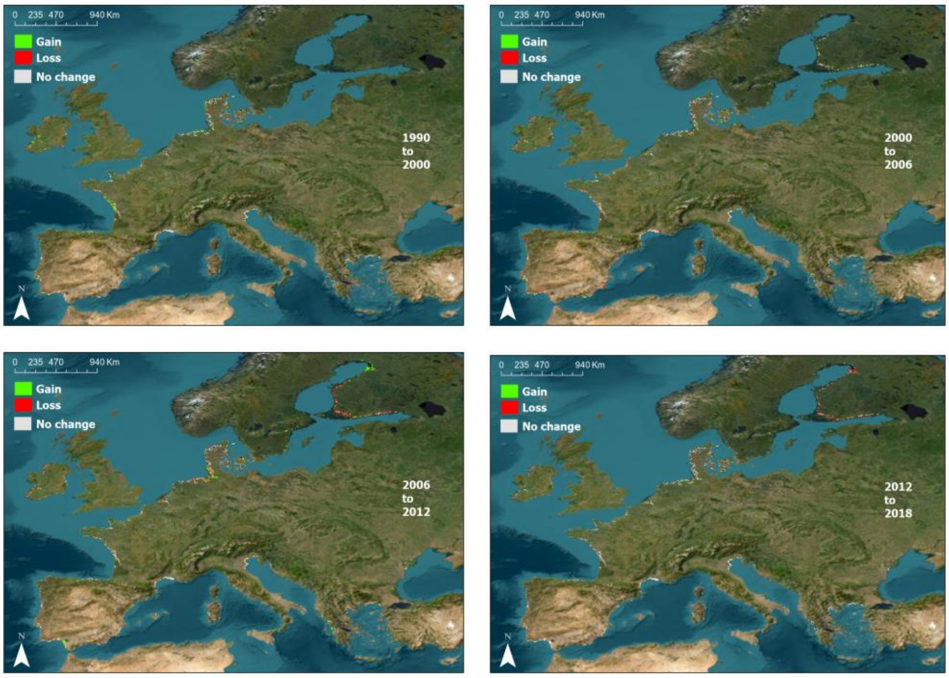


Map the distribution change of coastal wetlands

Tidal marshes

The objective of this sub-task was to map the land cover change since 1990 based on existing land cover change data. For that, we conducted an extent change analysis focused on the long-term CORINE Land Cover (CLC) inventory dataset1 which includes data from 1990, 2000, 2006, 2012, and 2018. For the purposes of this analysis, we focused on tidal marshes with the aim to quantitatively map gains and losses of the distribution of these ecosystems through land use changes over time: 1990-2000, 2000-2006, 2006-2012, and 2012-2018. Preliminary results show large spatial variation on tidal marshes gains and losses over time. Major tidal marsh losses occurred between 2000-2012, while major gains occurred between 2006-2012.

Figure 6 Spatial patterns in tidal marsh extent change between 1990 and 2018 across the EU.



Blue Carbon Monitoring Roadmap for EU Member States

The roadmap is designed to enhance the monitoring of blue carbon ecosystems (BCEs) and their carbon storage capacities within EU Member States, supporting climate mitigation, biodiversity conservation, and sustainable development goals.

Building on insights from coastal wetland distribution mapping and the analysis of changes in wetland extent, the **Blue Carbon Roadmap** offers targeted recommendations to strengthen BCE monitoring across the EU.

Key components of the Roadmap include:

- **Identifying knowledge gaps** in the extent of BCEs within the EU, as revealed by findings from the Task at hand.
- **Improving mapping accuracy** and proposing a systematic protocol for mapping and monitoring changes in BCE extent.
- **Integrating monitoring systems** across Member States to ensure consistency and collaboration.
- **Establishing objectives and actions** to address these gaps, structured around short-, medium-, and long-term goals.

The Roadmap aims to guide policymakers and stakeholders in enhancing and coordinating blue carbon monitoring efforts across the EU. It seeks to harmonize monitoring systems, address critical knowledge gaps, and align with the EU's climate and biodiversity objectives.

Roadmap Outline

Objective 1: Map the distribution of coastal wetland ecosystems and monitor changes in extent and condition	
Action 1.1	Develop baseline spatially explicit distribution maps of coastal wetland ecosystems (mangroves, tidal marshes and seagrass) across EU MS and Outermost regions.
Action 1.2	Track changes in coastal wetland extent.
Action 1.3	Improve spatial mapping and data accuracy.

Action 1.4	Monitor changes in coastal wetland ecological condition.
Action 1.5	Utilize advanced technologies and cost-effective approaches to enhance monitoring and reporting capabilities.

QUESTIONS FOR DISCUSSION

- How can Member States collaborate to track changes in wetland extent systematically?
- What technologies (e.g., satellite imagery, drones) can be cost-effectively deployed for mapping and monitoring?
- Are there successful examples of integrating ecological condition monitoring into broader reporting frameworks?
- How can we ensure that mapping efforts align with IPCC and UNFCCC reporting requirements?

Objective 2: Enhance the monitoring of blue carbon and other ecosystem services within coastal wetland ecosystems	
Action 2.1	Develop baseline spatially explicit maps of blue carbon storage including above and below-ground biomass, soil carbon stocks, and accumulation rates.
Action 2.2	Implement standardised methods for measuring or estimating change in carbon stocks, carbon sequestration, and GHG fluxes (e.g., CO2, CH4, N2O) in mangroves, tidal marshes, and seagrasses.
Action 2.3	Establish a comprehensive GHG inventory system to monitor and report changes for coastal wetlands.
Action 2.4	Develop protocols to quantify and monitor other ecosystem services (e.g., biodiversity, water purification, coastal protection, and fisheries enhancement) provided by coastal wetlands.

QUESTIONS FOR DISCUSSION

- What are the challenges in harmonizing blue carbon monitoring methods across Member States?
- How can standardized protocols enhance data quality and international reporting consistency?
- What role can a comprehensive GHG inventory play in improving NDC submissions?
- Which ecosystem services (beyond carbon) should be prioritized for monitoring, and why?
- How can stakeholders (e.g., researchers, policymakers, local communities) collaborate to improve blue carbon monitoring?

Objective 3: Map the distribution of coastal wetland ecosystems and monitor changes in extent and condition	
Action 3.1	Foster collaboration among EU MS to share best practices, tools, and data for coastal wetland mapping and monitoring.
Action 3.2	Build a centralised EU-level database for the storage and sharing of coastal wetland mapping, carbon, and monitoring data across EU MS.
Action 3.3	Develop tools and guidance for policymakers to incorporate monitoring results into decision-making processes.
Action 3.4	Integrate coastal wetland ecosystem monitoring with national climate, biodiversity, and conservation strategies to inform long-term management goals. .
Action 3.5	Develop public-facing platforms to communicate monitoring results and raise awareness of coastal wetland's role in climate mitigation and adaptation.

QUESTIONS FOR DISCUSSION

- How can EU Member States overcome barriers to collaboration and data sharing?
- What are the benefits of a centralized EU-level database, and how should it be structured?
- What tools or approaches are most effective in translating monitoring data into policy decisions?
- How can monitoring efforts be better integrated with conservation and climate strategies?
- What strategies can be used to engage the public and raise awareness about coastal wetlands?

BS 3: Blue carbon changes in Europe: Drivers, pressures, measurement, and restoration

Enhancing the protection, conservation, and restoration of 'blue carbon' wetlands in the European region has two-fold benefits:

- Firstly, enabling allied coastal ecosystems to maintain their crucial ecological functions and associated biodiversity benefits, and
- Secondly, climate adaptation benefits can be derived via carbon sequestration.

While the term 'blue carbon' traditionally includes mangroves, seagrasses, and saltmarsh habitats, the European continent mostly has only seagrasses and saltmarshes.

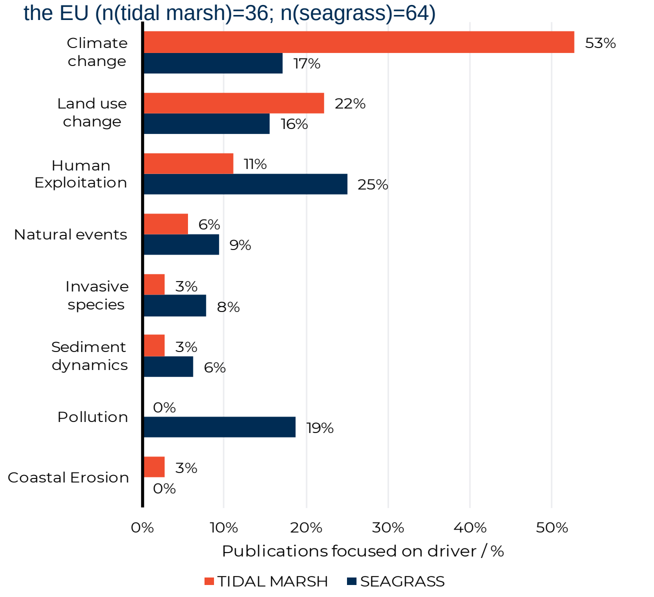
This session will focus upon these two ecosystems and aims to discuss the current knowledge on drivers influencing the habitats, the state-of-play on 'blue carbon'-related projects and initiatives at the European level, and their cost structures and funding mechanisms.

Drivers of change in blue carbon ecosystems in the EU

Blue carbon ecosystems are increasingly threatened by a complex interplay of natural and human-induced pressures. The key drivers of degradation of blue carbon ecosystems (BCEs) range from direct anthropogenic impacts, such as coastal development and pollution, to broader climatic changes, including rising sea levels and temperature fluctuations. As BCEs are key for carbon sequestration and resilience-building against climate change, addressing the drivers of their decline is crucial for achieving long-term environmental and policy goals.

Current research is focused on certain biological features of BCEs, the degree of disturbance and regional research attention. Our analysis has shown that *Posidonia oceanica (P. oceanica)* and *Zostera marina (Z. marina),* two of Europe's largest seagrass meadows and carbon sinks, are prominent research topics. This is particularly the case for *P. oceanica* due to its endemic presence in the Mediterranean, the significant threats it faces, and its consequently strong protection under EU legislation[3]. The differences in the number of studies across countries can be explained by different coastal sizes, disturbance levels and uneven research efforts/attention across regions.[4] Western Europe, especially Spain and Italy, has a higher concentration of studies, whereas regions like Croatia, Greece, and Romania, despite their extensive coastlines and

Figure 7 Share of drivers mentioned in literature per habitat across the EU (n(tidal marsh)=36; n(seagrass)=64)



[3] Gumusay, M. U., Bakirman, T., Kizilkaya, I. T., et al. (2018). A review of seagrass detection, mapping and monitoring applications using acoustic systems. European Journal of Remote Sensing, 52(1), 1–29.

[4] Bertram, C., Quaas, M., Reusch, T. B. H., et al. (2021). The blue carbon wealth of nations. Nature Climate Change, 11(8), 704–709.

significant tidal marshes, remain underrepresented in research efforts.[5][6]

The common drivers of change emerging in EU-focused literature are: climate change, human exploitation, land use change, and pollution. The drivers of change in BCEs are often threats or pressures influencing changes in the BCE's distribution and extent, and can thereby negatively impact carbon stocks and/or flows. BCE ecosystems are complex systems affected by multiple, often compounding and interlinked pressures. Our literature review showed that climate change is the most frequently cited driver of BCE impacts and loss, followed by human exploitation and land use change. For seagrass ecosystems, pollution is also a significant driver. Seagrass ecosystems face generally a more diverse range of pressures compared to tidal marshes. Less predominant drivers include natural events, invasive species, and sediment dynamics.

The most frequently cited drivers regarding BCE loss (i.e., climate change, human exploitation, and land use change) are aligned with EU policy priorities and associated research funding. Our findings are based on published research and, therefore, represent the greatest concerns highlighted in the scientific literature rather than the absolute greatest impacts on BCEs. However, one can assume that the focus of research reflects an urgency to understand the impacts of specific drivers in more detail, suggesting that these drivers warrant further attention in policy and conservation strategies. The impacts of various drivers on BCE, including their effects on seagrass and saltmarsh ecosystems, are summarized in the table in the Annex.

QUESTIONS FOR DISCUSSION

1. In your experience, are our findings aligned with the key drivers of change you observe in your region? Which drivers of change would be underrepresented in the research, but are critical in practice?
2. Do you think the current uneven research distribution affects policymaking and conservation efforts in your area? How could these gaps be addressed to better represent local realities and challenges?
3. Do you think the focus of current research is effectively capturing the most urgent issues for blue carbon ecosystems in the EU?

Restoration projects on Blue Carbon Ecosystems in the EU

While no formal blue carbon strategy exists at EU level, several instruments aim to contribute to blue carbon sequestration enhancement. The EU recognised the relevance of healthy oceans and water, also in light of climate ambitions. Different legislative instruments contribute to the enhancement of BCEs, such as the following: the marine protected areas7, the 2008 Marine Strategy Framework Directive (2008/56/EC), the EU Recommendations on Integrated Coastal Zone Management (ICZM), the 2014 Directive on Establishing a Framework for Maritime Spatial Planning (2014/89/EU), the 2002 EU Recommendation on Integrated Coastal Zone Management (2002/413/EC), and the Nature Restoration Law (2024/1991). The EU Climate Law recognises a blue carbon economy as a business model for healthier ecosystems (COM(2021)800). Additionally, the Commission proposed a maritime policy in support of the European Green Deal which interlinks blue carbon preservation with the protection of coastal biodiversity (COM(2021)240). European funding also increasingly supports BCE restoration projects, especially via Horizon Europe.

[5] European Marine Observation and Data Network (EMODnet). (2020). Seagrass distribution; Fourqurean, J. W., Duarte, C. M., Kennedy, H., et al. (2012). Seagrass ecosystems as a globally significant carbon stock.

[6] Worthington, T. A., Spalding, M., Landis, E., et al. (2023). The distribution of global tidal marshes from earth observation data. bioRxiv (Cold Spring Harbor Laboratory).

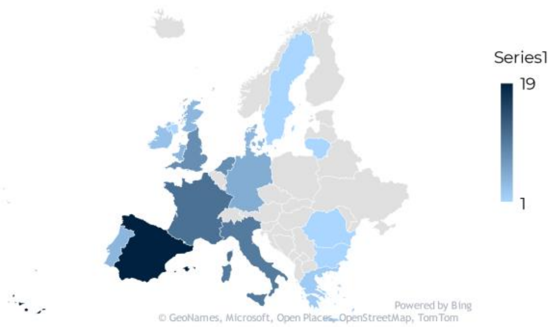
[7] The effectiveness of MPAs at regulating human activities has been questioned in recent literature: Arminian-Bisquet, J. et al (2024). Over 80% of the European Union's marine protected area only marginally regulates human activities.

At national level, we were unable to identify strategies specifically targeting blue carbon ecosystem sequestration. At the time of writing, France was the only Member State we identified with a National Maritime and Coastline Strategy (Stratégie nationale pour la mer et le littoral - SNML) that explicitly commits to strengthening and extending the protection of fragile ecosystems in the Mediterranean, like seagrass beds. Elsewhere in Europe, the NGO Ulster Wildlife developed a Blue Carbon Action Plan for Northern Ireland.[8] There is a general agreement in literature that the protection of BCE would be simplified if they would be classified as an endangered ecosystem. An example of this approach is the tripartite conservation framework Wadden Sea Plan between Denmark, Germany and the Netherlands.[9]

Characteristics of BCE restoration projects in the EU

Restoration efforts in the EU are regionally focused. As the literature review on drivers revealed, restoration projects of BCEs focus on certain research topics. Most projects are located in the Mediterranean (especially for seagrass) and the UK (especially for tidal marshes). Moreover, restoration projects are mainly run by public stakeholders, mainly national governments, and research institutions. NGOs and multistakeholder collaborations are also common; projects run by businesses or other private stakeholders have so far been rare. Project owners often run multiple projects, also across different BCEs.

Figure 8 Countries for which we identified restoration projects



Note: The figures are based on an initial literature review and thus only indicative. Considering this, Spain accounts for 20% of the projects (n=87)

The declaration of projects as successful depends on the defined project goals. Project goals can differ significantly and include aspects such as securing livelihoods, community engagement, or the prevention of coastal erosion. Restoration success is often reported in terms of item-based ecological indicators, such as the survival of planted transplants, seedlings, recruits, or propagules. These indicators can hint the overall project success, but mostly do not represent the success in terms of the recovery of ecosystem function and services. Blue carbon sequestration rates are so far rarely considered as an indicator for success, especially in seagrass restoration projects for which no before/after restoration measurement examples could be found in Europe.

Implementing appropriate monitoring constitutes the greatest challenge to assessing a project's success. Our analysis finds that BCE restoration projects would need monitoring systems for at least 10 years to be able to generate meaningful results. However, the current set-up and funding structures of restoration projects typically do not allow for the implementation of such monitoring. Projects are mostly funded for shorter periods and the often limited budget is rather spent on the restoration activities themselves than holistic monitoring systems.

The measurement of blue carbon sequestration

The measurement of carbon sequestration in BCE restoration projects gains momentum but remains challenging. The measurement of blue carbon is currently not common practice in BCE restoration projects. In seagrass habitats, hardly any project in the EU currently conducts systematic long-term monitoring of carbon sequestration. Regarding tidal marshes, the measurement of blue carbon is more common, but often not labelled as such. Studies on tidal marshes that do provide insights into their methodologies typically combine (small-scale) sampling with already published values for carbon stocks or sequestration rates. These sequestration rates are often based on generalisations and estimations that are highly sensitive to site-specific circumstances.

The lack of funding, the short-term oriented design of restoration projects, and a lack of standardised methodologies lead to a lack of comprehensive data on blue carbon sequestration in restoration projects.

[8] Strong, J.A., et al. (2021). Blue carbon restoration in Northern Ireland - Feasibility study

[9] IUCN (2020). Wadden Sea.

Restoration projects often have to be implemented within a limited budget and an often short-term time frame. Furthermore, there is a lack of standardised methodologies to assess blue carbon sequestration rates, e.g., in terms of setting a baseline year or basis scenario for comparison, as well as the laboratory measures to calculate carbon contents. This restricts the accurate carbon stock assessments and the ability to track progress. Our analysis suggests that more often the project ambition is focused on on ensuring good survival rates of restoration actions or maximising the restoration area. Improved technical solutions, associated capacity building as well as standardized methods are needed to assess the effectiveness of a restoration project in terms of carbon sequestration. All this requires a greater availability of budget.

Costs of BCE restoration projects

There is a lack of good quality cost data on blue carbon ecosystem restoration projects within the EU and worldwide. Very little cost data on saltmarsh and seagrass restoration projects is available in public literature, with available data generally being of poor quality and lacking detail. Further, restoration costs appear to be highly site-specific and variable, with historic costs potentially as an inaccurate guide for current and future costs. An overview of seagrass restoration costs is presented in Annex B.

Costs vary per project and depend on factors such as necessary upfront investments, required labour, measurement, and monitoring. The costs of restoration projects depend on the type of implementation action, and site-specific aspects (e.g., perimeter, area, levee to be removed), as well as project management and stakeholder engagement costs. Establishing a restoration project comes with high costs, including high up-front project costs and relatively expensive measurement and verification methods.[10] Ongoing maintenance costs are difficult to predict in advance. Another major cost aspect for BCE blue carbon projects is caused by difficulties to conduct quantification through remote sensing. However, researchers expect that even for expensive management actions, like dyke removal, the provision of ecosystem services is likely to overweigh the investment costs in the long term.[11] Unfortunately, these ecosystem services are not well represented in financial revenue streams for project implementers.

Funding instruments

BCE restoration projects are so far almost exclusively funded by public actors. Most restoration projects rely on public funding, with limited private sector involvement. High costs and the current low opportunities for revenue (including from carbon credits) are significant barriers to private investment.

Carbon revenues are currently treated as a means to attract private finance. Our analysis finds that stakeholders perceive the trade of carbon credits as a potential means to involve private actors in the financing of BCE restoration. Carbon revenue could help facilitate ongoing project implementation, such as monitoring and maintenance. However, it is mostly considered as a potential additional revenue stream rather than a primary one. It is also recognised that so far, few restoration projects in saltmarsh and seagrass ecosystems have measured changes in blue carbon sequestration and that a focus on carbon could overlook the importance of biodiversity and ecosystem services in the projects.

Our analysis suggests that blue carbon projects are not financially viable if financed by carbon crediting alone. Especially in the EU which has higher wages and property values, blue carbon revenues would not cover all restoration project costs. It is also considered costly to apply the VCS methodologies in the European context, where coastal projects are mostly rather small and labour costs are high. Furthermore, little data is available on blue carbon for many parts of Europe which makes it difficult to establish project baselines to calculate the additional carbon benefits of interventions.[12] As per end 2024, no European blue carbon restoration projects could be identified that have produced carbon credits.

[10] Macreadie, P., et al. (2022). Operationalizing marketable blue carbon.

[11] Costa, M., et al (2024). Spatially explicit ecosystem accounts for coastal wetland restoration.

[12] Endangered Landscapes, et al. (2023). Blue Carbon Markets.

Carbon-credit revenue could be paired with other sources of revenue to make blue carbon projects self-sustaining in the long term. Potential other environmental credits to pair the carbon credits with could be through products, such as seaweed products, through properly valuing the co-benefits provided by blue carbon projects, through the layering of government and philanthropic funds, or through direct payments from those who benefit from blue carbon projects, like insurers, tourism and aquaculture operators.[13] It should be recognised that carbon is but one of many ecosystem services produced from blue carbon ecosystem restoration projects.

QUESTIONS FOR DISCUSSION

1. How can the recording and reporting of implementation costs be improved?
2. Which general funding structure do you expect as the most suitable for BCE restoration projects?
3. Are you aware of innovative funding schemes, that might be applied in BCE restoration projects?
4. Are you aware of project cost information for saltmarsh or seagrass restoration projects, that you could share with the project team? (Especially additional to the costs presented in the annex)
5. Are you aware of any saltmarsh or seagrass restoration projects that have measured changes in blue carbon sequestration on the project site?

[13] Macreadie, P., et al. (2022). Operationalizing marketable blue carbon.

Annex A: Drivers' impacts on BCEs

Table 2: Summary of drivers' impact on seagrass and saltmarsh

Seagrass	Tidal marsh
Climate change	
Rising temperatures threaten *P. oceanica* seedlings, reducing biomass and formation rates (5-30% per degree above 25°C) and mortality above 29°C; with species-specific responses to warming observed. [14,15]	*S. maritima*: Growth rate reduced by 39% and 64% under elevated CO2 (400 ppm and 700 ppm) combined with high temperatures (32°C). [16]
Rising sea levels reduce light availability for *P. oceanica*, leading to habitat retreat; 2 cm of depth increase causes a 1 m retreat on a 2° slope[17,18]	Sea-level rise threatens marsh stability; increased submersion and wave energy may release up to 130,000 tonnes of CO_2 by 2100 from eroded carbon pools. Additionally, higher wave heights associated with sea-level rise could reduce marsh coverage and increase recolonization time.[19,20]
Human exploitation	
Human activities, such as trawling, anchoring, and coastal development, have caused a 13-34% loss of *P. oceanica* in the Mediterranean[21]**, with decline rates (-1.74%/year) double the global average.** [22,23,24] **These activities lead to canopy loss, reducing carbon sequestration (11-52%) and causing soil C_{org} losses up to twice as high (59 ± 29%) as indirect climate impacts.** [25]	Dredging reduces carbon accumulation rates for *S. maritima* to 120 g C m^{-2} y^{-1} compared to 218-750 g C m^{-2} y^{-1} in other less impacted marshes.[26]
Land-use change	
Coastal infrastructure (bridges, ports) disturbs sediments, causing C_{org} losses (~8.90 Mg ha^{-1}) and slowing seagrass recolonization; with loss rates (-	Marshes impacted by infrastructure have C_{org} stocks (~54.9 Mg ha^{-1}) similar to unvegetated areas compared to ~86.5 Mg ha^{-1} in unaffected

[14] Olsen, Y. S., Sánchez-Camacho, M., Marbà, N., & Duarte, C. M. (2012). Mediterranean seagrass growth and demography Responses to experimental warming. Estuaries and Coasts, 35(5), 1205–1213.

[15] Guerrero-Meseguer, L., Marín, A., & Sanz-Lázaro, C. (2017). Future heat waves due to climate change threaten the survival of Posidonia oceanica seedlings. Environmental Pollution, 230, 40–45.

[16] Mateos-Naranjo, E., López-Jurado, J., Mesa-Marín, et al. (2021). Understanding the impact of a complex environmental matrix associated with climate change on the European marshes engineer species Spartina martima. Environmental and Experimental Botany, 182, 104304.

[17] Boudouresque, C. F., Bernard, G., Pergent, et al. (2009). Regression of Mediterranean seagrasses caused by natural processes and anthropogenic disturbances and stress: a critical review. Botanica Marina, 52(5), 395–418.

[18] WWF. (2021).The Climate Change Effect in the Mediterranean; Six stories from an overheating sea

[19] Cunha, J., Cabecinha, E., Villasante, S., et al. (2024). Quantifying the role of saltmarsh as a vulnerable carbon sink: A case study from Northern Portugal. The Science of the Total Environment, 923, 171443.

[20] Zhu, Z., Van Belzen, J., Zhu, Q., et al. (2019). Vegetation recovery on neighboring tidal flats forms an Achilles' heel of saltmarsh resilience to sea level rise. Limnology and Oceanography, 65(1), 51–62.

[21] Boudouresque, C. F., Bernard, G., Pergent, et al. (2009). Regression of Mediterranean seagrasses caused by natural processes and anthropogenic disturbances and stress: a critical review. Botanica Marina, 52(5), 395–418.

[22] Tryfon, E. (2016). A5.535 Posidonia beds in the Mediterranean infralittoral zone

[23] Waycott, M., Duarte, C. M., Carruthers, T. J. B., et al. (2009). Accelerating loss of seagrasses across the globe threatens coastal ecosystems. Proceedings of the National Academy of Sciences, 106(30), 12377–12381.

[24] Marbà, N., Díaz-Almela, E., & Duarte, C. M. (2014). Mediterranean seagrass (Posidonia oceanica) loss between 1842 and 2009. Biological Conservation, 176, 183–190.

[25] Dahl, M., McMahon, K., Lavery, P. S., et al. (2023). Ranking the risk of CO2 emissions from seagrass soil carbon stocks under global change threats. Global Environmental Change, 78, 102632.

[26] Sousa, A. I., Santos, D. B., Da Silva, E. F., et al. (2017). 'Blue Carbon' and Nutrient Stocks of Salt Marshes at a Temperate Coastal Lagoon (Ria de Aveiro, Portugal). Scientific Reports, 7(1).

4.5%/year) exceeding recovery rates (+2.5%/year). [27,28]	marshes, which is about 1.5 times less. [29,30] Land-use changes have also contributed to losses in marsh coverage. [31,32,33]
Natural events	
Baltic eelgrass meadows store ~635 g C_{org} m⁻² compared to the ~2,721 g C_{org} m⁻² average of temperate regions due to high-energy environments and lower carbon retention. [34]	Sheltered marshes accumulate carbon faster (3.08 mm/year) than exposed ones (1.51 mm/year) due to reduced sediment resuspension. Hence, sheltered meadows store more carbon annually (3,965 g C_{org} m^{-2}) than exposed meadows (2,712 g C_{org} m^{-2}).[35,36]
Deeper meadows (>10 m) experience a sharp decline in carbon stocks; *P.oceanica* stocks drop from 200 kg C m^{-2} at 2 m to 19 kg C m^{-2} at 32 m due to reduced light availability. [37,38]	High marshes store more C_{org} (65 Mg ha^{-1}) than low marshes (38 Mg ha^{-1}) or tidal flats (46 Mg ha^{-1}) due to reduced submersion and enhanced sediment stability. [39]

[27] Casal-Porras, I., De Los Santos, C. B., Martins, M., et al. (2022). Sedimentary organic carbon and nitrogen stocks of intertidal seagrass meadows in a dynamic and impacted wetland: Effects of coastal infrastructure constructions and meadow establishment time. Journal of Environmental Management, 322, 115841.

[28] Danovaro, R., Nepote, E., Lo Martire, M., et al. (2020). Multiple declines and recoveries of Adriatic seagrass meadows over forty years of investigation. Marine Pollution Bulletin, 161, 111804.

[29] Casal-Porras, I., De Los Santos, C. B., Martins, M., et al. (2022). Sedimentary organic carbon and nitrogen stocks of intertidal seagrass meadows in a dynamic and impacted wetland: Effects of coastal infrastructure constructions and meadow establishment time. Journal of Environmental Management, 322, 115841.

[30] Van De Broek, M., Baert, L., Temmerman, S., et al. (2018). Soil organic carbon stocks in a tidal marsh landscape are dominated by human marsh embankment and subsequent marsh progradation. European Journal of Soil Science, 70(2), 338–349.

[31] Holon, F., Boissery, P., Guilbert, A., et al. (2015). The impact of 85 years of coastal development on shallow seagrass beds (Posidonia oceanica L. (Delile)) in South Eastern France: A slow but steady loss without recovery. Estuarine Coastal and Shelf Science, 165, 204–212.

[32] Wetland-Based Solutions. (2022). Mediterranean wetland restoration: an urgent priority.

[33] De Los Santos C, Sigurðardóttir R, Cunha A, et al. (2014). A survey-based assessment of seagrass status, management and legislation in Europe. Front. Mar. Sci. Conference Abstract: IMMR | International Meeting on Marine Research 2014. doi: 10.3389/conf.fmars.2014.02.00027

[34] Billman, M., Santos, I. R., & Jahnke, M. (2023). Small carbon stocks in sediments of Baltic Sea eelgrass meadows. Frontiers in Marine Science, 10.

[35] Martins, M., De Los Santos, C. B., Masqué, P., et al. (2021). Carbon and nitrogen stocks and burial rates in intertidal vegetated habitats of a mesotidal coastal lagoon. Ecosystems, 25(2), 372–386.

[36] Dahl, M., Asplund, M. E., Deyanova, D., et al. (2020). High seasonal variability in sediment carbon stocks of Cold-Temperate seagrass meadows. Journal of Geophysical Research Biogeosciences, 125(1).

[37] Serrano, O., Lavery, P. S., Rozaimi, M., et al. (2014). Influence of water depth on the carbon sequestration capacity of seagrasses. Global Biogeochemical Cycles, 28(9), 950–961.

[38] Hastings, R., Cummins, V., & Holloway, P. (2020). Assessing the impact of physical and anthropogenic environmental factors in determining the habitat suitability of seagrass ecosystems. Sustainability, 12(20), 8302.

[39] Mazarrasa, I., Neto, J. M., Bouma, T. J., et al. (2023b). Drivers of variability in Blue Carbon stocks and burial rates across European estuarine habitats. The Science of the Total Environment, 886, 163957.

Annex B: Summary of seagrass restoration costs from literature and interview, in EUR 2024

Year	Location	Method	Unit cost low	Unit cost high	Cost per m2 low	Cost per m2 high	Costs include	Source / reference
2018	Mediterranean	Collection and replanting of Posidonia oceanic a fragments by divers	€ 14.97	€ 32.20	€ 9.58	€ 20.61	Materials, human and technical resources and associated logistics. Low cost is for 2,500m2, high cost for 10 000m2	Red Electrica (2018).[1]
2018	Mediterranean	Collection of seeds, planting of seedlings by divers	€ 9.86	€ 26.75	€ 6.31	€ 17.12	Materials, human and technical resources and associated logistics. Low cost is for 2,500m2, high cost for 10 000m2	Red Electrica (2018)
2014-2018	Mediterranean	Manual transplant of aquatic angiosperm sods 30cm in diameter	€ 21.10		€ 0.003		EUR 42k to transplant and colonise a lagoon of 15km2. Costs include boat hire. Much activity done by volunteers and natural growth appears very high	Sfriso, A., et al. (2021).[1]
2010	Global average	Various			€ 10.96		Various	Bayraktarov, E. et al (2016)[1]
2024	Western Australia	Manual transplant of seagrass using divers			€ 15.00		Seed collection, materials, boat deployment	Personal communication, John Statton of University c Western Australia
2024	South Australia	Sandbag deployment by boat	€ 10.50		€ 10.50		Seed collection, materials, boat deployment	Personal communication, updating this reference: Tanner, J.E. 2023.[1]
2017-2022	Mediterranean	Transplanting seagrass directly by hand using divers			€ 250		Transplantation only	Personal communication abou the LIFE project: https://lifeseposso.eu/
2001	USA	Manual transplant of seagrass using divers			€ 0.56		Unspecified	Thorhaug, Anitra (200
2005	South Australia	Mechanical transplant of Posidonia and Amphibolis griffithii			€ 70.38		Underwater mechanical seagrass harvesting and planting machines	Lord and Associates (2005)[1]
2003	Victoria, Australia	Manual transplant of plugs			€ 110.94		Collection, planting and monitoring	Walker, J (2003)[1]

Annex B: Workshop slides


NEED TO CONSIDER LAND AND SEA TOGETHER

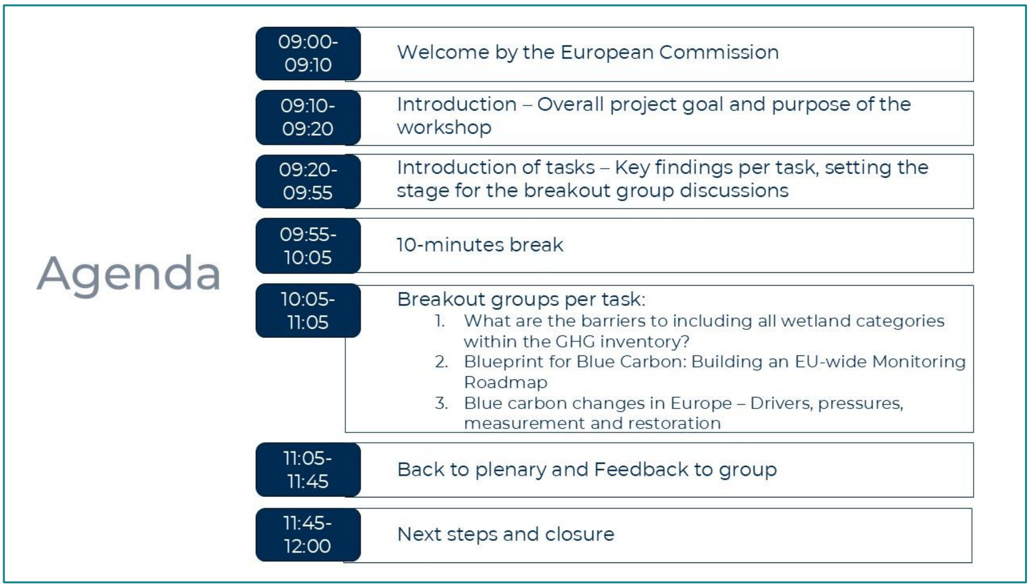

CHALLENGES IN MONITORING

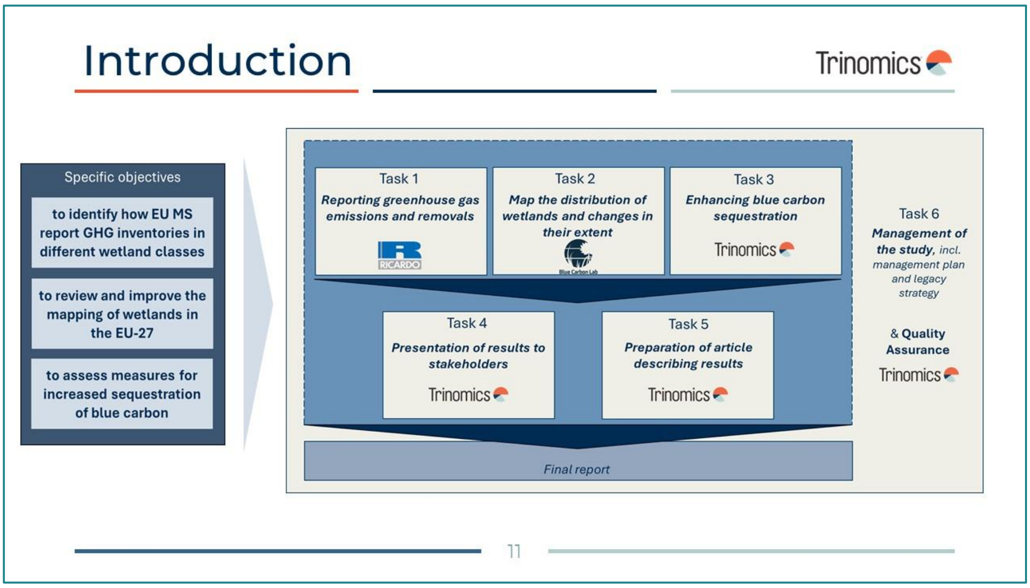

NEED FOR HARMONISATION
EMODNET CENTRAL PORTAL
EMODnet
1000 km


LEGISLATION
LULUCF
From 2026, Member States must include wetlands, including blue carbon, in their emissions inventories and in their targets
Carbon Certification Framework
to facilitate and encourage the deployment of permanent carbon removals, carbon farming and carbon storage in products by operators or groups of operators


PRESSURE TO DO SOMETHING
AN OCEAN OF CHANGE 2024
Commission should propose new legislation on ocean resilience and coastal adaptation emphasising nature-based solutions for better preparedness for climate-related challenges and including an EU-wide and evidence-based monitoring system on carbon sequestration in marine ecosystems ("blue carbon").
Ocean Manifesto
I would like you to explore the feasibility of European blue carbon reserves and other ways to help build a new business model for coastal communities.
mission letter of Commissioner Costas Kadis

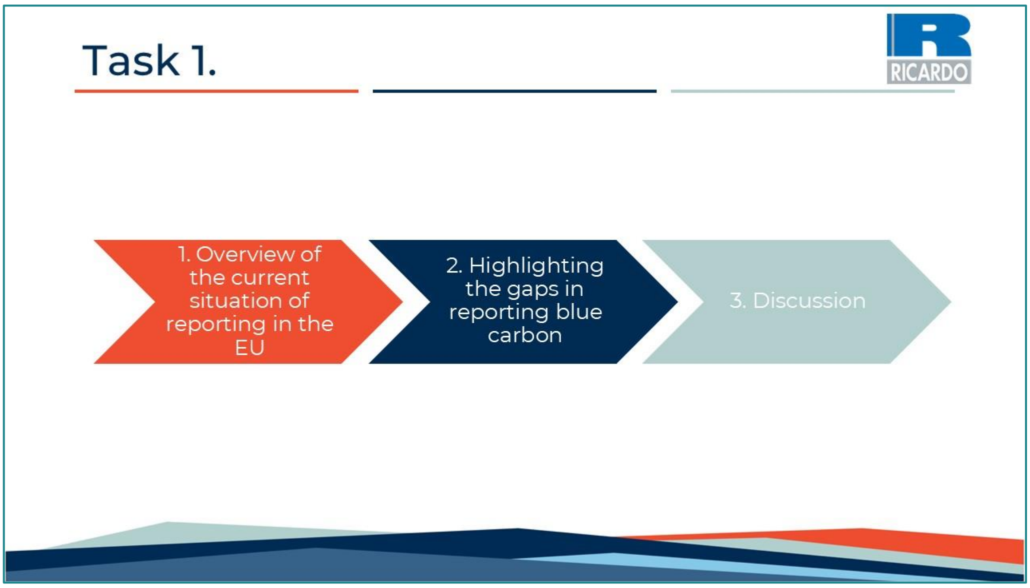

Shaping the European Oceans Pact: Commission launches a call for evidence
closes 17 February 2025
• maintain a healthy, resilient, and productive ocean.
• promote a sustainable and competitive blue economy, including fisheries and aquaculture.
• work towards a comprehensive agenda for marine knowledge, research, innovation and investment.

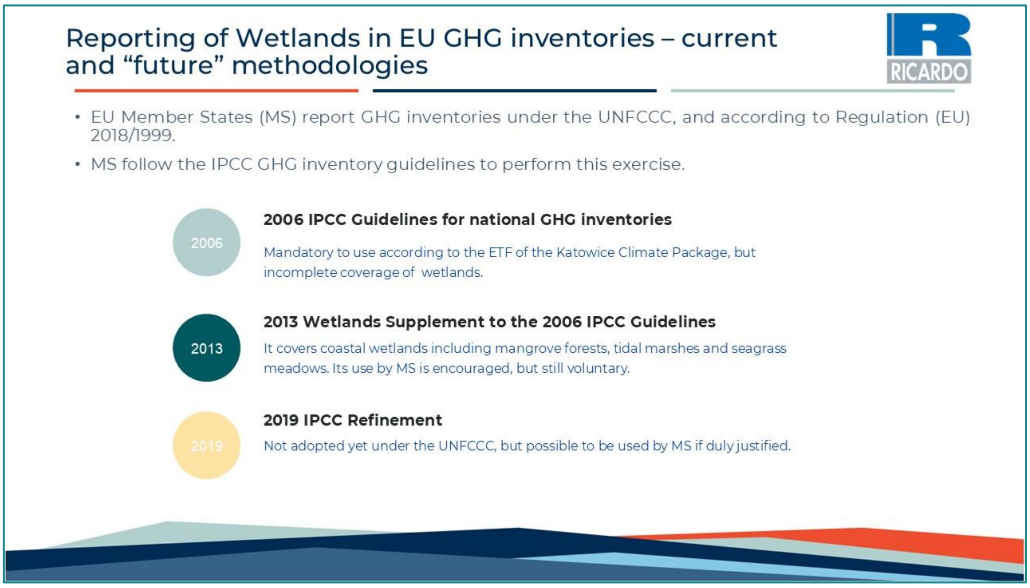

Agenda
09:00-09:10
Welcome by the European Commission
09:10-09:20
Introduction – Overall project goal and purpose of the workshop
09:20-09:55
Introduction of tasks – Key findings per task, setting the stage for the breakout group discussions
09:55-10:05
10-minutes break
10:05-11:05
Breakout groups per task:
1. What are the barriers to including all wetland categories within the GHG inventory?
2. Blueprint for Blue Carbon: Building an EU-wide Monitoring Roadmap
3. Blue carbon changes in Europe – Drivers, pressures, measurement and restoration
11:05-11:45
Back to plenary and Feedback to group
11:45-12:00
Next steps and closure


Introduction
Trinomics
Specific objectives
to identify how EU MS report GHG inventories in different wetland classes
to review and improve the mapping of wetlands in the EU-27
to assess measures for increased sequestration of blue carbon
Task 1
Reporting greenhouse gas emissions and removals
RICARDO
Task 2
Map the distribution of wetlands and changes in their extent
Task 3
Enhancing blue carbon sequestration
Trinomics
Task 4
Presentation of results to stakeholders
Trinomics
Task 5
Preparation of article describing results
Trinomics
Task 6
Management of the study, incl. management plan and legacy strategy
& Quality Assurance
Trinomics
Final report
11


Workshop purpose
Present key findings of our work to date
Provide additional detail in the break-out sessions on each of the three tasks
Seek feedback on this work and any key gaps from stakeholders and experts
12


RICARDO
Trinomics
Blue Carbon Lab
Key findings per Task
www.trinomics.eu
13


Task 1.
RICARDO
1. Overview of the current situation of reporting in the EU
2. Highlighting the gaps in reporting blue carbon
3. Discussion


Reporting of Wetlands in EU GHG inventories – current and "future" methodologies
RICARDO
• EU Member States (MS) report GHG inventories under the UNFCCC, and according to Regulation (EU) 2018/1999.
• MS follow the IPCC GHG inventory guidelines to perform this exercise.
2006
2006 IPCC Guidelines for national GHG inventories
Mandatory to use according to the ETF of the Katowice Climate Package, but incomplete coverage of wetlands.
2013
2013 Wetlands Supplement to the 2006 IPCC Guidelines
It covers coastal wetlands including mangrove forests, tidal marshes and seagrass meadows. Its use by MS is encouraged, but still voluntary.
2019
2019 IPCC Refinement
Not adopted yet under the UNFCCC, but possible to be used by MS if duly justified.

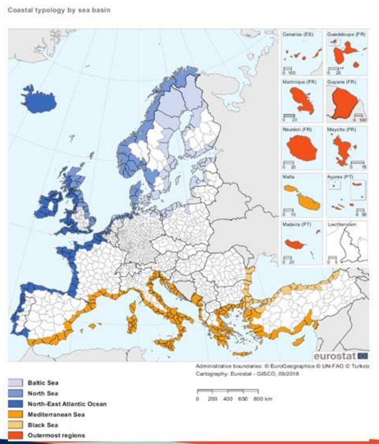
Reporting of Wetlands - IPCC 2013 Wetlands Supplement

- The 2013 Wetlands Supplement extends the coverage of the 2006 IPCC Guidelines by filling gaps in the coverage and providing updated information reflecting scientific advances.
- It covers **drained inland organic soils, rewetted organic soils**, **coastal wetlands**, **inland wetland mineral soils,** and **constructed wetlands for wastewater treatment**.

Source of emissions/ sink for removals	2006 IPCC Guidelines (coastal wetlands)		Wetlands Supplement (coastal wetlands)	
	Category	Guidance by	Category	Guidance by
CO_2	-	-	New sources/sinks under 3B1 to 3B6 Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land from the following activities: • forest management in mangroves • extraction in mangroves, tidal marshes and seagrass meadows (including excavation, aquaculture and salt production) • rewetting, revegetation and creation in mangroves, tidal marshes and sea grass meadows • soil drainage in mangroves and tidal marches New subcategories under Wetlands need to be created to cover all potential reporting options: 3B4aiii (Other Wetlands Remaining Other Wetlands), and 3B4biii (Land Converted to Other Wetlands)	climate zone/region vegetation type salinity (where applicable/ available) management activity
CH_4	-	-	New category: 3C11 CH_4 Emissions from Rewetting of Mangroves and Tidal Marshes	wetland type salinity
N_2O	-	-	New category: 3C12 N_2O Emissions from Aquaculture	Fish produced

Example of coastal wetlands – Classification of land area

- Only 1 EU country (Malta) clearly includes net CO_2 emissions from coastal wetlands, included under the category "*4.D.1.3 Other wetlands remaining other wetlands*" (-0.0135 kt CO_2).
- "coastal wetlands*" is not included in any other CRF table/NIR.
- In EU, 22 MS have a sea border – so potentially a large area of wetlands in the EU
- There are "important" areas of wetlands, including mangroves, in overseas territories.
- Some MS e.g. France include mangroves, but report these in the Forestland category.
- Seagrass is not mentioned in the MS NIRs

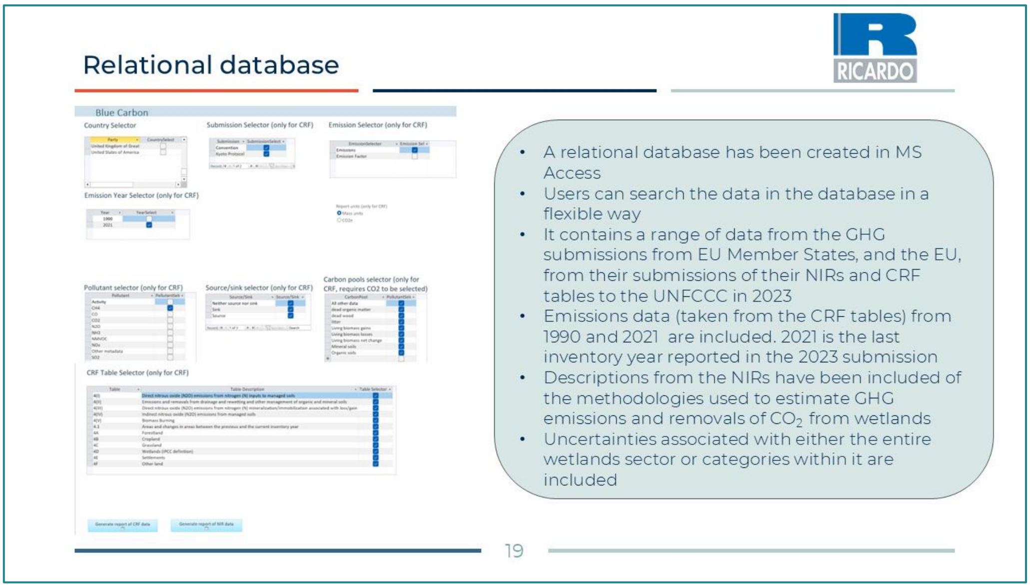


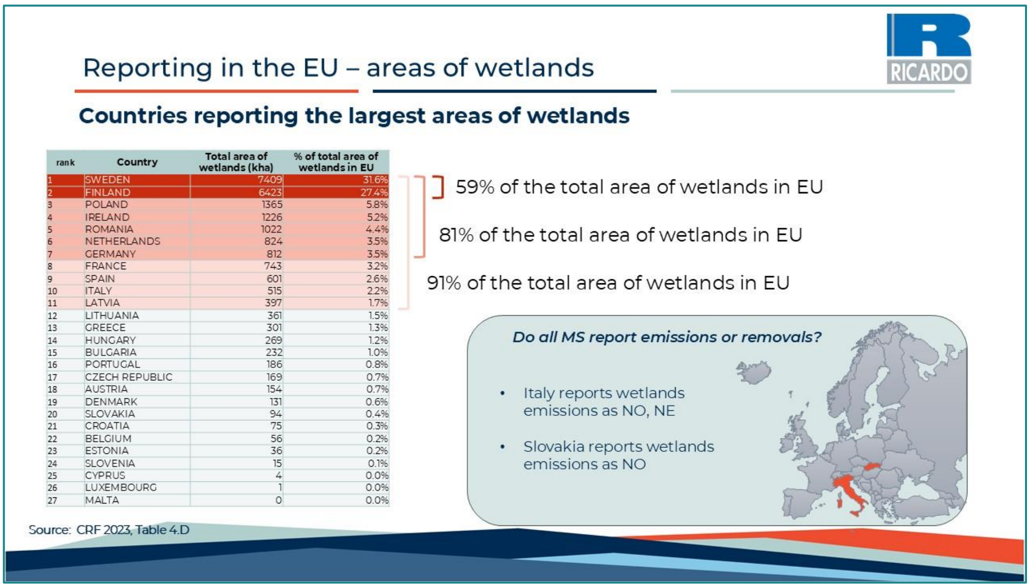
An expandable relational database has been created

Aim
- Determine how the EU MS estimate emissions and removals from wetlands, whether they include or disregard freshwater and coastal wetlands in their aggregated totals.
- Included detailed emissions data and associated metadata

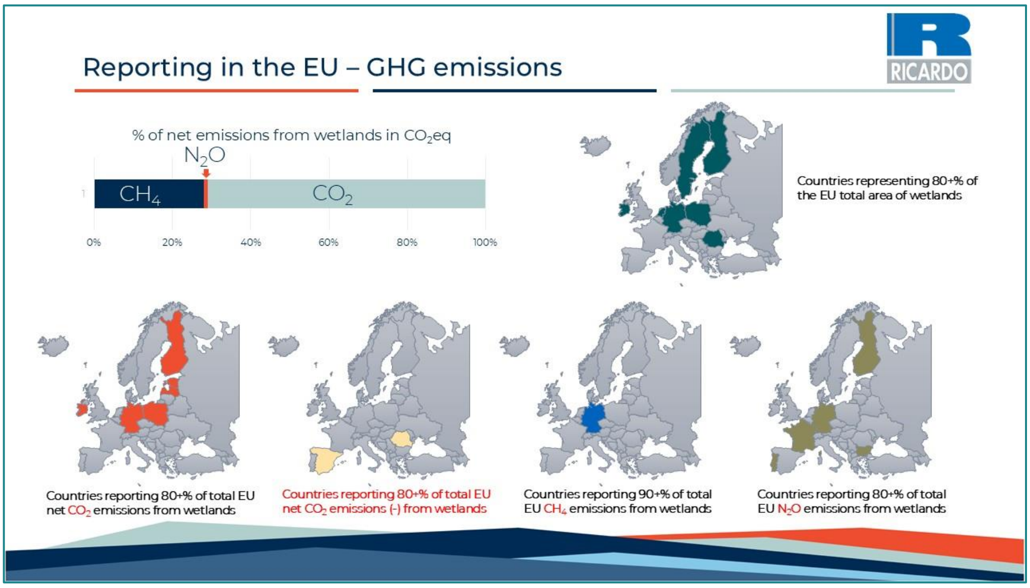
Information available
- Information related to wetlands extracted from UNFCCC CRF tables for EU MS + UK + USA (for the year 2021 and data for 1990, from the submission year 2023)
- Information related to wetlands extracted from the 2023 NIRs (methodology used to estimate emissions of GHGs and removals of CO_2, wetlands definition, uncertainties, improvements planned)
- 2022 UNFCCC ERT reviewers' comments

Functionalities
- Queries (search per country, pollutant, source/sink category, carbon pool, report units, emission factor, emission year, CRF table)
- Key word search and "export to MS Excel" functionality
- Additional data can easily be added in the future





rank	Country	Total area of wetlands (kha)	% of total area of wetlands in EU
1	SWEDEN	7409	31.6%
2	FINLAND	6423	27.4%
3	POLAND	1365	5.8%
4	IRELAND	1226	5.2%
5	ROMANIA	1022	4.4%
6	NETHERLANDS	824	3.5%
7	GERMANY	812	3.5%
8	FRANCE	743	3.2%
9	SPAIN	601	2.6%
10	ITALY	515	2.2%
11	LATVIA	397	1.7%
12	LITHUANIA	361	1.5%
13	GREECE	301	1.3%
14	HUNGARY	269	1.2%
15	BULGARIA	232	1.0%
16	PORTUGAL	186	0.8%
17	CZECH REPUBLIC	169	0.7%
18	AUSTRIA	154	0.7%
19	DENMARK	131	0.6%
20	SLOVAKIA	94	0.4%
21	CROATIA	75	0.3%
22	BELGIUM	56	0.2%
23	ESTONIA	36	0.2%
24	SLOVENIA	15	0.1%
25	CYPRUS	4	0.0%
26	LUXEMBOURG	1	0.0%
27	MALTA	0	0.0%



Reporting in the EU – definitions of wetlands

Definitions of wetlands – examples

Country	Wetlands definition
Sweden	**Wetlands is assumed unmanaged** and is defined as mires and areas saturated by freshwater. However, an area of approx. 10,000 ha that is used for peat extraction is included under Wetlands and therefore assumed managed.
Finland	Wetlands include **peat extraction areas** and **peatlands** that do not fulfil the definition of Forest Land, Cropland, Grassland or Settlements. **Inland waters**, which comprise reservoirs and natural lakes and rivers, are included in Wetlands. Peat extraction areas, lands converted from other land use to Wetlands as well as Wetlands that have undergone a change in land management are considered managed lands.
Ireland	"Wetlands" refer to **unmanaged wetlands** (including peatlands not commercially exploited, inland marshes, salt marshes, moors and heathland and intertidal flats) and **managed peatlands**, which are those wetland areas drained for the purpose of commercial exploitation and harvesting of peat for energy and horticultural products.
Romania	The 4.D category includes **wet areas with vegetation, waters / ponds.**
Germany	Pursuant to the 2006 IPCC Guidelines, the "Wetlands" land-use category must subsume all those **land areas where soils are intermittently or constantly waterlogged, or covered with water, and that do not fall within the land-use categories 4.A, 4.B, 4.C and 4.E**. In the German inventory, these areas are combined in the sub-categories Terrestrial Wetlands (IPCC: Other Wetlands) and Waters (IPCC: Flooded Land). In addition**, all areas that are related to Peat extraction** are combined within an additional sub-category under the land-use category Wetlands (IPCC: Peat Extraction; cf. the 2006 IPCC Guidelines, IPCC (2006b)). These peat-extraction areas, and their changes over time, are recorded and listed in a spatially explicit manner.

- Definitions provided by MS are not always fully transparent, or consistent between MS
- Allocation of activities in wetlands to specific wetland categories can be variable – classification issues

22

Methodological Tiers used

5 countries representing 82% of CO_2 eq emissions from wetlands in EU

Overview of the tier of method used for 4.D wetlands

Country	% of total net CO_2 emission in EU	CO_2	CH_4	N_2O
GERMANY	47.3%	T2, T3	T2	T2
FINLAND	10.4%	T1, T2, T3	T1, T2	T2
IRELAND	9.6%	D, T1, T2, T3	D, T2	D, T2
POLAND	7.3%	T1		
LATVIA	7.0%	T1, T2	T1, T2	T2

Overview of the emission factors used for 4.D wetlands

Country	% of total net CO_2 emission in EU	CO_2	CH_4	N_2O
GERMANY	47.3%	CS, D	CS, D	CS, D
FINLAND	10.4%	CS, D	CS, D	CS
IRELAND	9.6%	CS, D	CS, D	CS, D
POLAND	7.3%	D		
LATVIA	7.0%	CS, D	CS, D	CS

CS: country specific
D: default

Tier
- A mix of Tiers T1 to T3
- Information on Tiers reported in CRF not detailed enough for this study – there is a need to refer to the NIRs
- Some issues of transparency with reporting e.g. Ireland reporting D in Tiers

EFs
- Mix of country specific (CS) emission factors (EFs) and default (D) EFs

Summary main findings

Definitions
- Definition of wetlands varies between MS, with some like Sweden assuming large area of wetlands unmanaged
- This impacts the reporting, as only emissions from managed wetlands are considered

Methodology
- We observe a mix of Tiers T1 to T3 for methodology, and a mix of CS and D for emission factors
- Some MS provide detailed methodological descriptions (e.g. FI), whilst others are simpler (e.g. PO).
- Some transparency problems, e.g. incorrect use of Notation Keys

Emissions reported
- Italy and Slovakia don't report emissions from wetlands (NO, NE)
- The level of disaggregation of reporting categories is very different from one country to another

Uncertainties
- Uncertainties are reported according to gas.
- Uncertainties associated with wetlands GHG emissions span a wide range.
- Finland and Ireland report uncertainties greater than 100%, but Latvia reports uncertainties that are very small: less than 5%.

Task 2 – Overview

Blue Carbon Lab

2.1 Map the distribution of wetlands

- Coastal and freshwater
- Estimate the area of protection

2.2 Map the changes in distribution of coastal wetlands

2.3 Develop a Blue Carbon Monitoring Roadmap

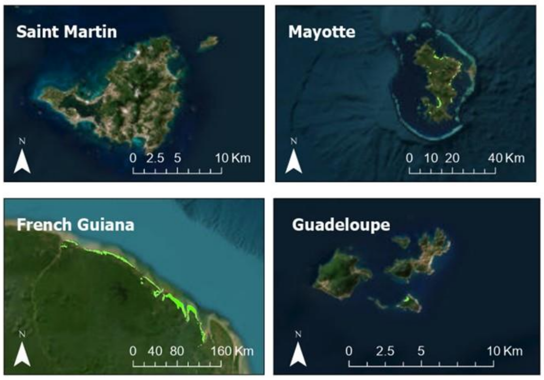
- Recommendations to enhance mapping accuracy and systematic BCE monitoring

25

Key Findings Task 2: Distribution

Blue Carbon Lab

Mangroves



~93,000 ha in outermost regions

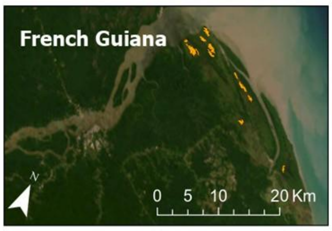
~94% in French Guiana

26

Key Findings Task 2: Distribution

Blue Carbon Lab

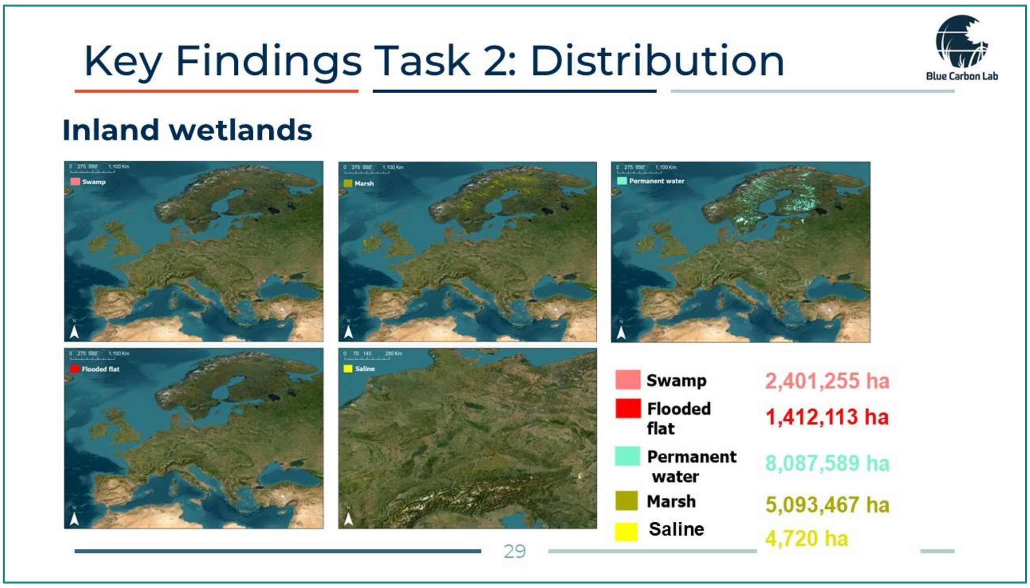
Tidal marshes

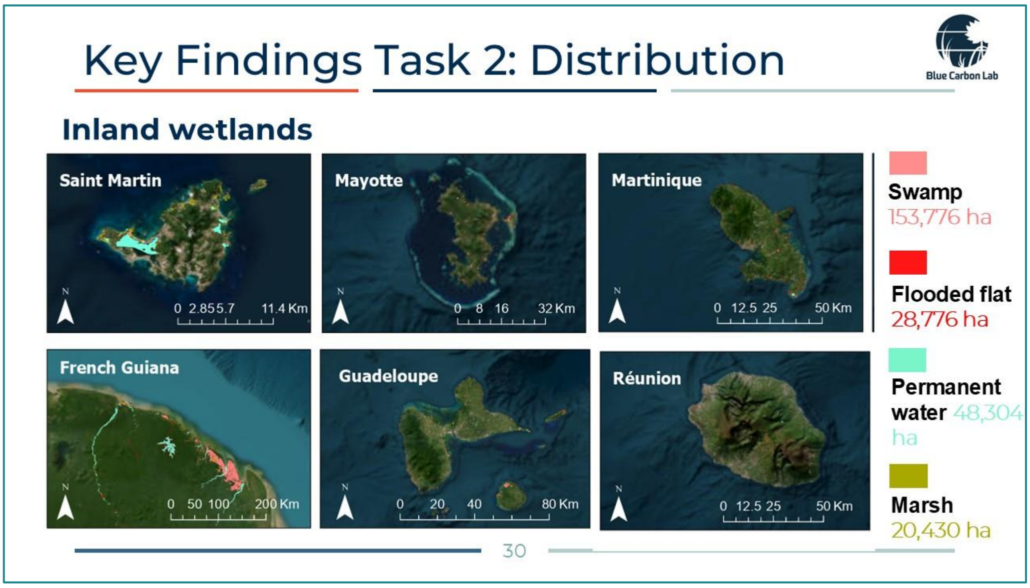


~409,000 ha distributed throughout EU's coastline.

27

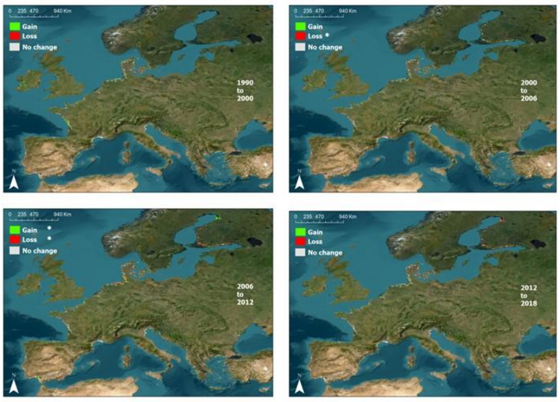

Key Findings Task 2: Distribution
Blue Carbon Lab
Seagrasses
0 210 420 840 Km
Saint Martin
0 5 10 20 Km
Mayotte
0 12.5 25 50 Km
Martinique
0 12.5 25 50 Km
Guadeloupe
0 20 40 80 Km
~1.4 million ha
distributed throughout
the EEZ of EU MS
28


Key Findings Task 2: Distribution
Blue Carbon Lab
Inland wetlands
Swamp 2,401,255 ha
Flooded flat 1,412,113 ha
Permanent water 8,087,589 ha
Marsh 5,093,467 ha
Saline 4,720 ha
29


Key Findings Task 2: Distribution
Blue Carbon Lab
Inland wetlands
Saint Martin
0 2.85 5.7 11.4 Km
Mayotte
0 8 16 32 Km
Martinique
0 12.5 25 50 Km
French Guiana
0 50 100 200 Km
Guadeloupe
0 20 40 80 Km
Réunion
0 12.5 25 50 Km
Swamp
153,776 ha
Flooded flat
28,776 ha
Permanent water 48,304 ha
Marsh
20,430 ha
30

Key Findings Task 2: Distribution Change

Tidal marshes



- Preliminary results show **large spatial variation on tidal marshes** gains and losses over time:
- Major **losses** occurred between 2000-2012
- Major **gains** between 2006-2012

Task 3 - Overview

Trinomics

3.1 Detect the main investigated drivers of blue carbon habitat's loss

3.2 Assess carbon stocks in blue carbon habitats in the EU

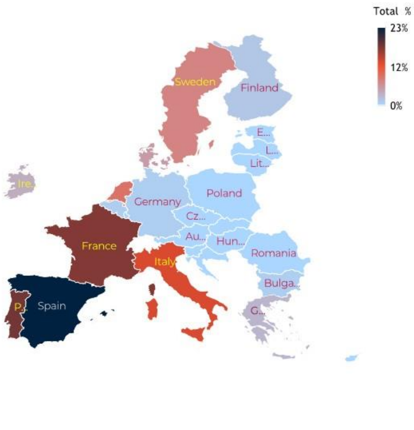
3.3 Identify blue carbon projects and strategies, and their cost and funding structure

32

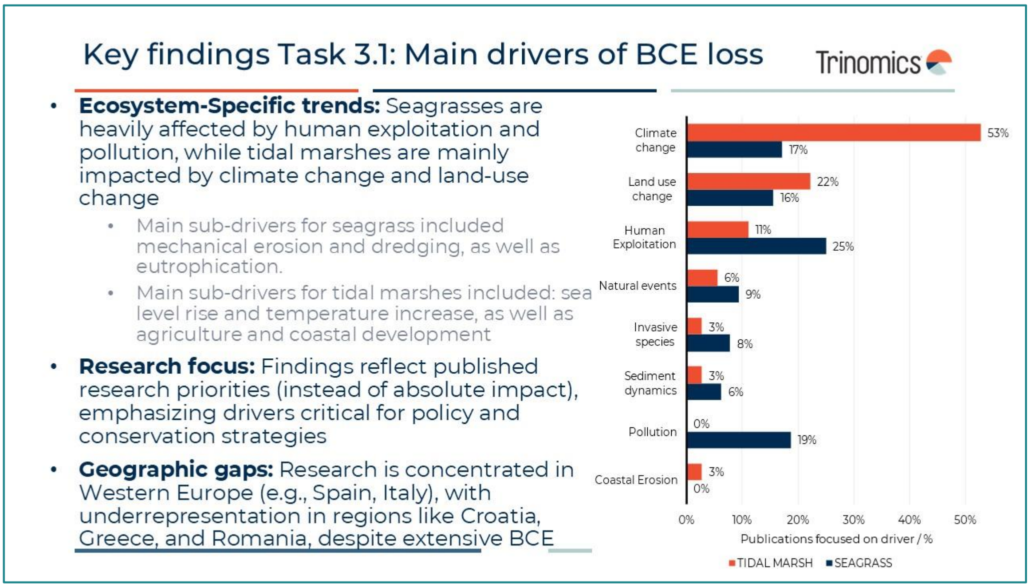
Task 3.1: Drivers of BCE loss

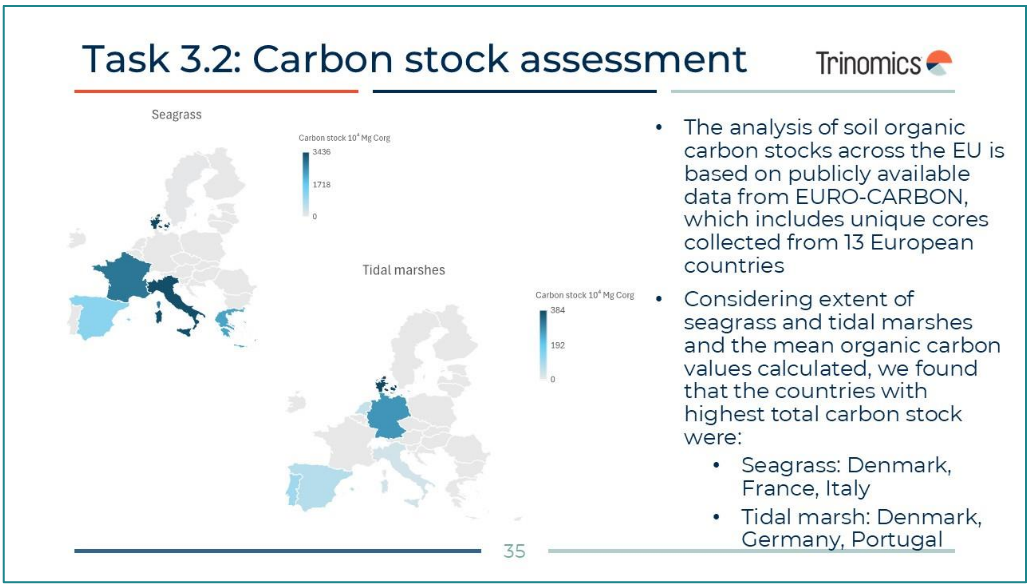
Trinomics

- Objective: Identify the main drivers causing the loss of blue carbon ecosystems in the EU
- More than 100 articles were reviewed, focusing on seagrass, tidal marshes and mangroves
- Most studies are concentrated in Spain (23%), France (17%), Portugal (17%), and Italy (13%)
- Research on pressures on mangroves in the outermost regions of the EU remained scarce (>5%)



33


Key findings Task 3.1: Main drivers of BCE loss
Trinomics
Ecosystem-Specific trends: Seagrasses are heavily affected by human exploitation and pollution, while tidal marshes are mainly impacted by climate change and land-use change
Main sub-drivers for seagrass included mechanical erosion and dredging, as well as eutrophication.
Main sub-drivers for tidal marshes included: sea level rise and temperature increase, as well as agriculture and coastal development
Research focus: Findings reflect published research priorities (instead of absolute impact), emphasizing drivers critical for policy and conservation strategies
Geographic gaps: Research is concentrated in Western Europe (e.g., Spain, Italy), with underrepresentation in regions like Croatia, Greece, and Romania, despite extensive BCE
Climate change
53%
17%
Land use change
22%
16%
Human Exploitation
11%
25%
Natural events
6%
9%
Invasive species
3%
8%
Sediment dynamics
3%
6%
Pollution
0%
19%
Coastal Erosion
3%
0%
0% 10% 20% 30% 40% 50%
Publications focused on driver / %
TIDAL MARSH
SEAGRASS


Task 3.2: Carbon stock assessment
Trinomics
Seagrass
3436
1718
0
Tidal marshes
384
192
0
The analysis of soil organic carbon stocks across the EU is based on publicly available data from EURO-CARBON, which includes unique cores collected from 13 European countries
Considering extent of seagrass and tidal marshes and the mean organic carbon values calculated, we found that the countries with highest total carbon stock were:
Seagrass: Denmark, France, Italy
Tidal marsh: Denmark, Germany, Portugal
35


Task 3.3: BC restoration actions, strategies, projects
Trinomics
Large range of restoration practices for saltmarsh and seagrass:
Wide variety of well-documented practices for saltmarsh and seagrass restoration, and innovation continues, although implementation guidelines are rare
Monitoring and reporting tends to focus on ecological indicators, less so on carbon sequestration (particularly historically)
Common: Replanting and Reintroduction of natural processes
Strategies for enhancement of sequestration in blue carbon ecosystems
No formal strategy at EU level directly focusing on blue carbon sequestration enhancement, but several pieces of EU legislation support these ecosystems
No formal strategies at MS level identified that specifically target BC sequestration enhancement, but some strategies and actions to support these ecosystems (France, Italy, Netherlands).
36

Measurement in restoration sites

Trinomics

Key finding: Measurement of blue carbon sequestration changes in restoration projects is lacking

- Seagrass: No examples of long-term measurement of BC sequestration in restoration sites in the EU
- Saltmarsh: some EU examples, but very few with long term sequestration monitoring

Measurement challenges in restoration projects:

- Lack of standardised methodologies
- Need for improved data collection / monitoring
- Lack of funding dedicated to long term monitoring:
  - Monitoring needs are longer term (10+ years) than project duration (<5 years)
  - Funders prefer to maximise restoration actions and area

37

Cost of restoration activities

Trinomics

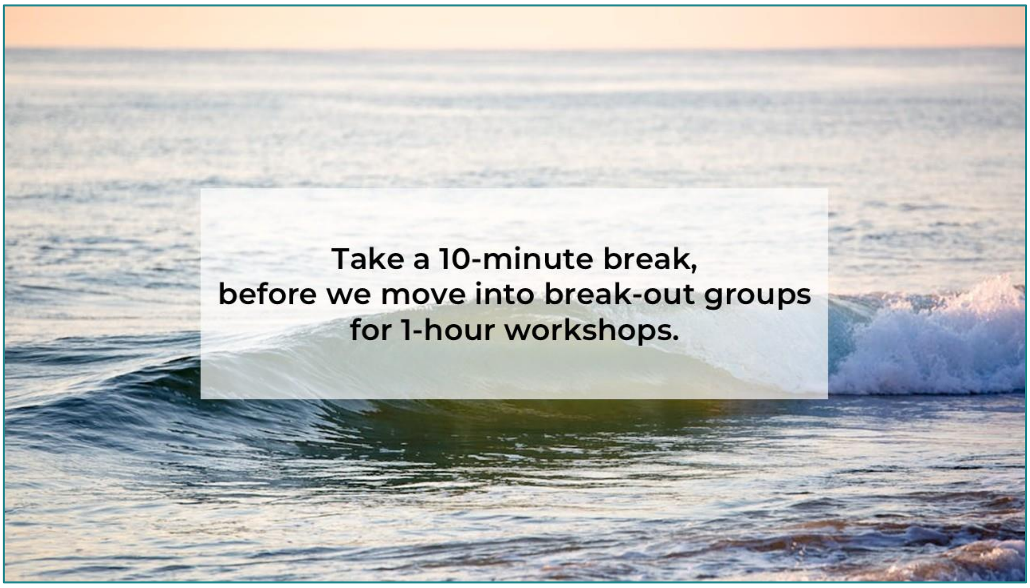
Key finding: Cost data for BC restoration projects in EU is a gap

- Very little available data at project level for both seagrass and saltmarsh
- Some data on restoration activity, but far less on other aspects (e.g. monitoring, planning, approvals)
- Much of available data is quite dated, may not represent current costs
- Shortage of cost data is considered a key impediment to upscaling

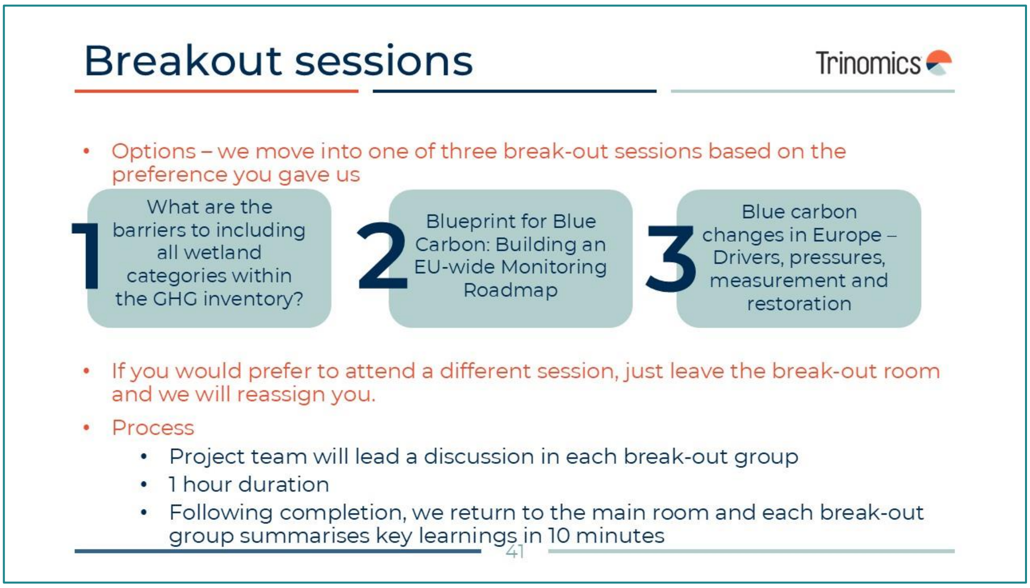
Financing of blue carbon restoration projects in the EU

- Almost exclusively public funding, mostly Horizon and LIFE
- Attempts to introduce blue carbon credit markets:
  - Few national carbon credit methods involving BC ecosystems (France, UK) but no registered projects as yet
  - Private voluntary methods in place (e.g. Verra)
  - No existing BC projects selling carbon credits in the EU
  - Acceptance that carbon revenues insufficient to cover project costs

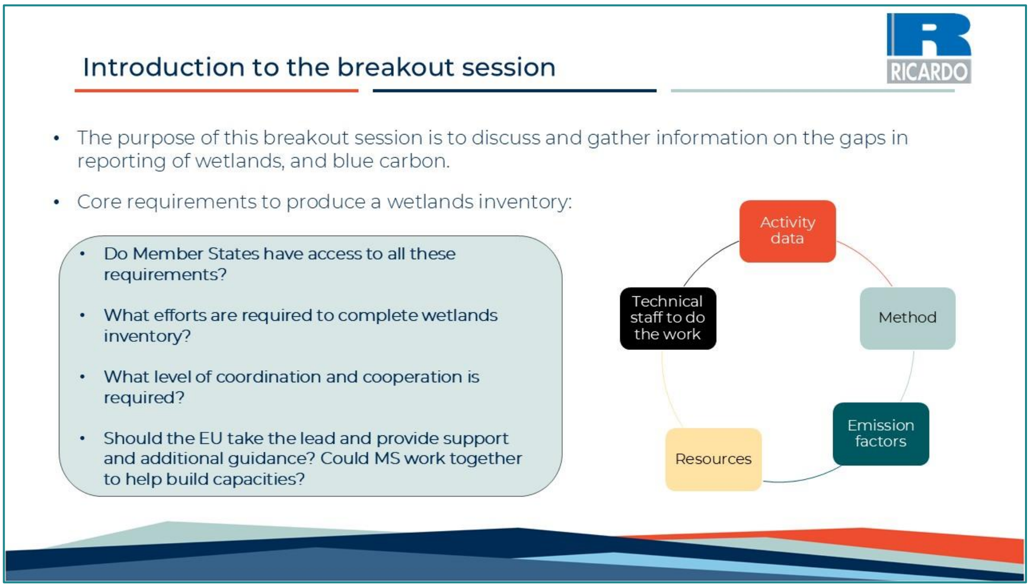
38

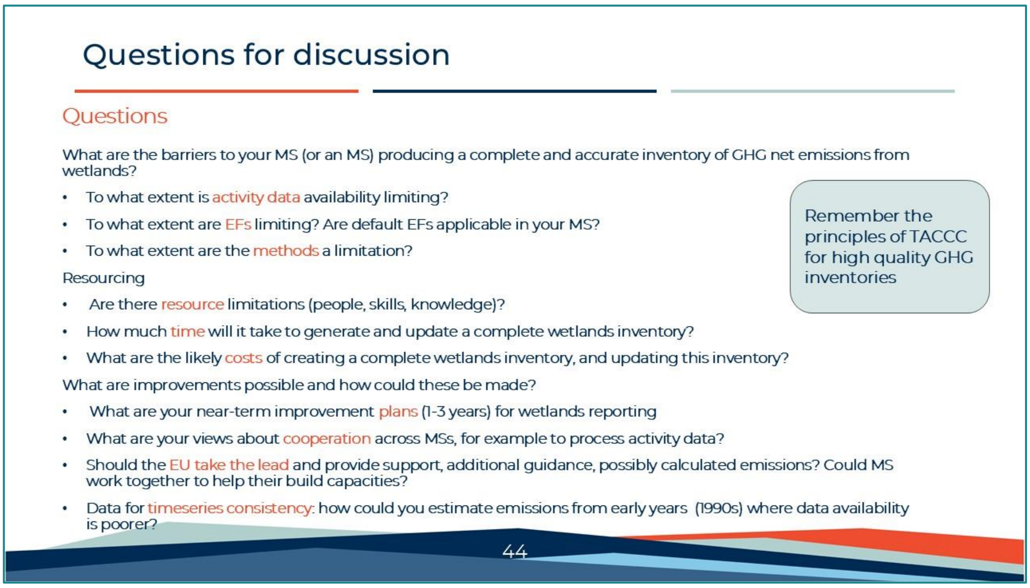


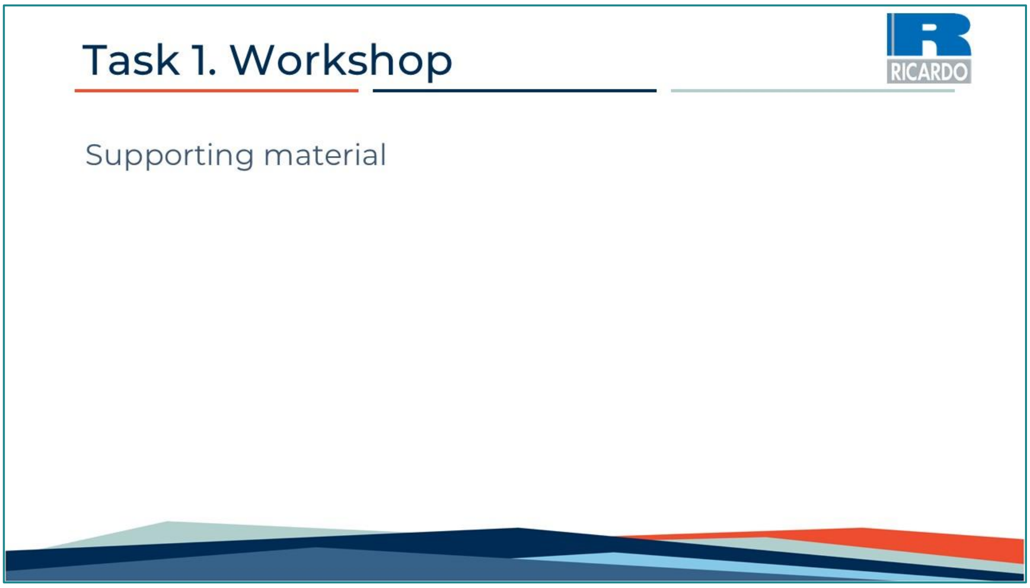

RICARDO
Trinomics
Blue Carbon Lab
Breakout Session
www.trinomics.eu
40

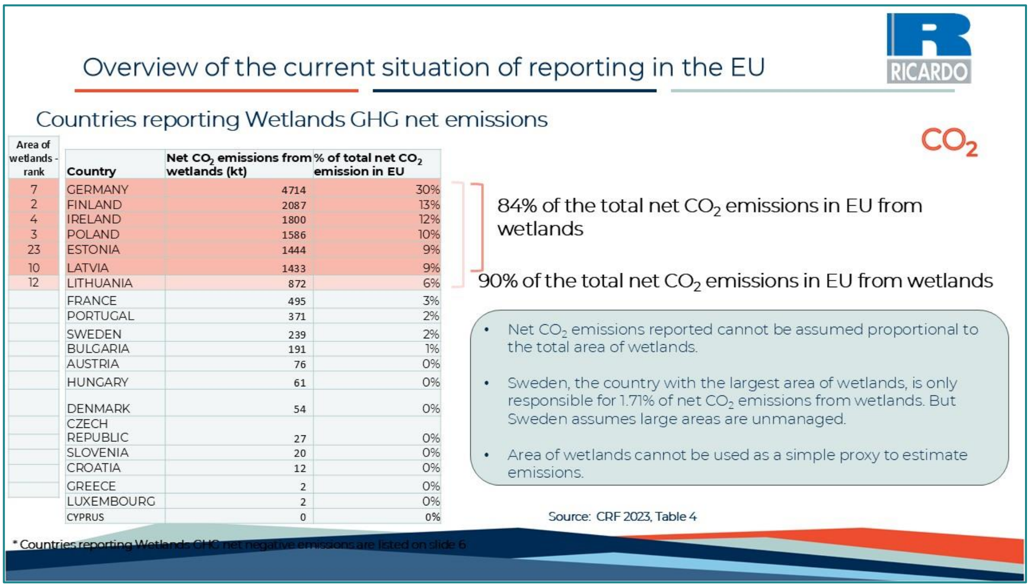

Breakout sessions
Trinomics
Options – we move into one of three break-out sessions based on the preference you gave us
1 What are the barriers to including all wetland categories within the GHG inventory?
2 Blueprint for Blue Carbon: Building an EU-wide Monitoring Roadmap
3 Blue carbon changes in Europe – Drivers, pressures, measurement and restoration
If you would prefer to attend a different session, just leave the break-out room and we will reassign you.
Process
Project team will lead a discussion in each break-out group
1 hour duration
Following completion, we return to the main room and each break-out group summarises key learnings in 10 minutes
41


RICARDO
Trinomics
Blue Carbon Lab
Breakout Session 1:
What are the barriers to including all wetland categories within the GHG inventory?
www.trinomics.eu
42


Introduction to the breakout session
RICARDO
The purpose of this breakout session is to discuss and gather information on the gaps in reporting of wetlands, and blue carbon.
Core requirements to produce a wetlands inventory:
Do Member States have access to all these requirements?
What efforts are required to complete wetlands inventory?
What level of coordination and cooperation is required?
Should the EU take the lead and provide support and additional guidance? Could MS work together to help build capacities?
Activity data
Method
Emission factors
Resources
Technical staff to do the work

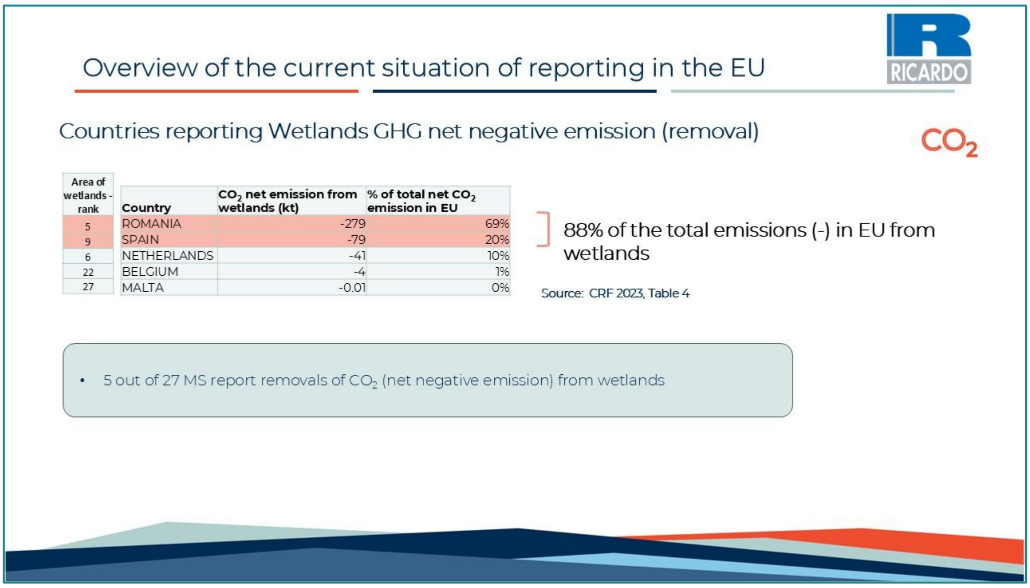

Questions for discussion
Questions
What are the barriers to your MS (or an MS) producing a complete and accurate inventory of GHG net emissions from wetlands?
To what extent is activity data availability limiting?
To what extent are EFs limiting? Are default EFs applicable in your MS?
To what extent are the methods a limitation?
Resourcing
Are there resource limitations (people, skills, knowledge)?
How much time will it take to generate and update a complete wetlands inventory?
What are the likely costs of creating a complete wetlands inventory, and updating this inventory?
What are improvements possible and how could these be made?
What are your near-term improvement plans (1-3 years) for wetlands reporting
What are your views about cooperation across MSs, for example to process activity data?
Should the EU take the lead and provide support, additional guidance, possibly calculated emissions? Could MS work together to help their build capacities?
Data for timeseries consistency: how could you estimate emissions from early years (1990s) where data availability is poorer?
Remember the principles of TACCC for high quality GHG inventories
44


Task 1. Workshop
RICARDO
Supporting material


Overview of the current situation of reporting in the EU
RICARDO
Countries reporting Wetlands GHG net emissions
CO_2

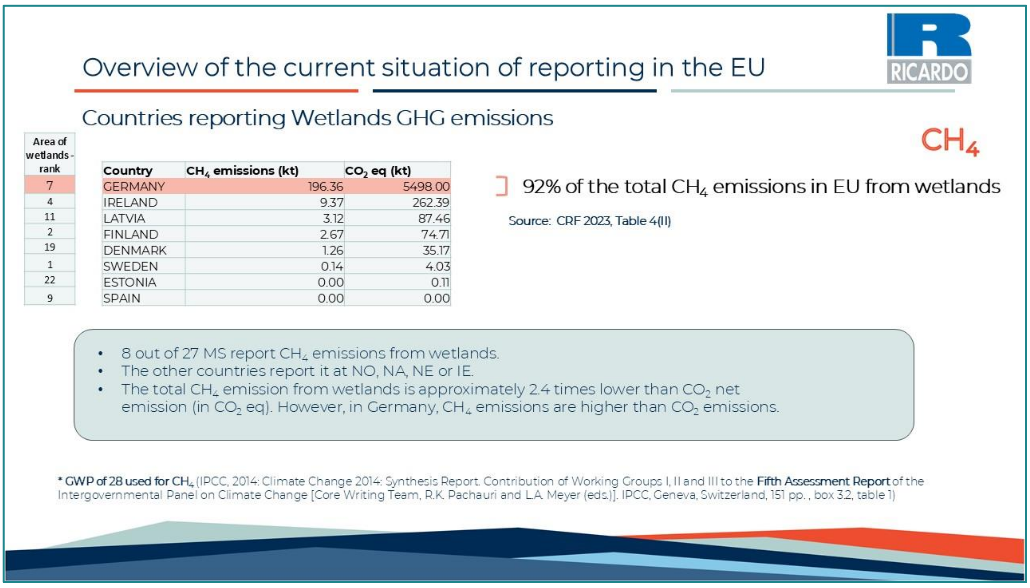
Area of wetlands - rank	Country	Net CO_2 emissions from wetlands (kt)	% of total net CO_2 emission in EU
7	GERMANY	4714	30%
2	FINLAND	2087	13%
4	IRELAND	1800	12%
3	POLAND	1586	10%
23	ESTONIA	1444	9%
10	LATVIA	1433	9%
12	LITHUANIA	872	6%
	FRANCE	495	3%
	PORTUGAL	371	2%
	SWEDEN	239	2%
	BULGARIA	191	1%
	AUSTRIA	76	0%
	HUNGARY	61	0%
	DENMARK	54	0%
	CZECH REPUBLIC	27	0%
	SLOVENIA	20	0%
	CROATIA	12	0%
	GREECE	2	0%
	LUXEMBOURG	2	0%
	CYPRUS	0	0%

84% of the total net CO_2 emissions in EU from wetlands
90% of the total net CO_2 emissions in EU from wetlands
• Net CO_2 emissions reported cannot be assumed proportional to the total area of wetlands.
• Sweden, the country with the largest area of wetlands, is only responsible for 1.71% of net CO_2 emissions from wetlands. But Sweden assumes large areas are unmanaged.
• Area of wetlands cannot be used as a simple proxy to estimate emissions.
Source: CRF 2023, Table 4
* Countries reporting Wetlands GHG net negative emissions are listed on slide 6


Overview of the current situation of reporting in the EU
RICARDO
Countries reporting Wetlands GHG net negative emission (removal)
CO_2

Area of wetlands - rank	Country	CO_2 net emission from wetlands (kt)	% of total net CO_2 emission in EU
5	ROMANIA	-279	69%
9	SPAIN	-79	20%
6	NETHERLANDS	-41	10%
22	BELGIUM	-4	1%
27	MALTA	-0.01	0%

88% of the total emissions (-) in EU from wetlands
Source: CRF 2023, Table 4
• 5 out of 27 MS report removals of CO_2 (net negative emission) from wetlands


Overview of the current situation of reporting in the EU
RICARDO
Countries reporting Wetlands GHG emissions
CH_4

Area of wetlands - rank	Country	CH_4 emissions (kt)	CO_2 eq (kt)
7	GERMANY	196.36	5498.00
4	IRELAND	9.37	262.39
11	LATVIA	3.12	87.46
2	FINLAND	2.67	74.71
19	DENMARK	1.26	35.17
1	SWEDEN	0.14	4.03
22	ESTONIA	0.00	0.11
9	SPAIN	0.00	0.00

92% of the total CH_4 emissions in EU from wetlands
Source: CRF 2023, Table 4(II)
• 8 out of 27 MS report CH_4 emissions from wetlands.
• The other countries report it at NO, NA, NE or IE.
• The total CH_4 emission from wetlands is approximately 2.4 times lower than CO_2 net emission (in CO_2 eq). However, in Germany, CH_4 emissions are higher than CO_2 emissions.
* GWP of 28 used for CH_4 (IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp., box 3.2, table 1)

Overview of the current situation of reporting in the EU

Countries reporting Wetlands GHG net emissions

N_2O

Country	emission (kt)	emission (CO_2 eq)
FINLAND	0.31	80.91
GERMANY	0.15	38.97
PORTUGAL	0.09	24.06
BULGARIA	0.07	19.44
FRANCE	0.06	16.47
IRELAND	0.04	11.46
LATVIA	0.02	5.79
LITHUANIA	0.02	4.02
NETHERLANDS	0.01	2.11
ESTONIA	0.01	2.02
CROATIA	0.01	1.47
SWEDEN	0.00	0.56
ROMANIA	0.00	0.55
HUNGARY	0.00	0.43
LUXEMBOURG	0.00	0.17
DENMARK	0.00	0.10
GREECE	0.00	0.06
SPAIN	0.00	0.03
BELGIUM	0.00	0.02
POLAND	0.00	0.00

86% of the total N_2O emissions in EU from wetlands

91% of the total N_2O emissions in EU from wetlands

- N_2O emissions are approximately 100 times lower than net CO_2 emissions (in CO_2 equivalent)
- 20 MS of 27 report emissions; the others report NO, or NA.

Source: CRF 2023, Table 4

* **GWP of 265 used for N_2O** (IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the **Fifth Assessment Report** of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp., box 3.2, table 1)

Overview of the current situation of reporting in the EU

Countries reporting Wetlands GHG net emissions

$CO_2 + CH_4 + N_2O$

Area of wetlands - rank	Country	Net CO2 emissions from wetlands (kt)	% of total net CO2 emission in EU
7	GERMANY	10250.78	47.3%
2	FINLAND	2243.03	10.4%
4	IRELAND	2082.531	9.6%
3	POLAND	1585.907	7.3%
11	LATVIA	1525.765	7.0%
23	ESTONIA	1446.24	6.7%
12	LITHUANIA	875.7285	4.0%
	FRANCE	518.2936	2.4%
	PORTUGAL	394.746	1.8%
	SWEDEN	244.0713	1.1%
	BULGARIA	210.778	1.0%
	DENMARK	89.68386	0.4%
	AUSTRIA	75.8769	0.4%
	HUNGARY	61.19022	0.3%
	CZECH REPUBLIC	26.69414	0.1%
	SLOVENIA	19.85448	0.1%
	CROATIA	13.40165	0.1%
	GREECE	2.271102	0.0%
	LUXEMBOURG	2.233342	0.0%
	CYPRUS	0.496122	0.0%

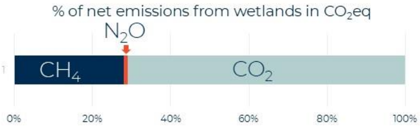
82% of the total net CO_2 eq emissions in EU from wetlands

92% of the total net CO_2 eq emissions in EU from wetlands

- Considering combined emissions of $CO_2 + CH_4 + N_2O$, Germany becomes the largest emitter EU in CO_2 eq terms

Source: CRF 2023, Table 4

Overview of the current situation of reporting in the EU



Countries representing 80+% of the EU total area of wetlands

Countries reporting 80+% of total EU CO_2 emissions from wetlands

Countries reporting 80+% of total EU CO_2 emissions (-) from wetlands

Countries reporting 90+% of total EU CH_4 emissions from wetlands

Countries reporting 80+% of total EU N_2O emissions from wetlands

Categories used to report emissions

5 MS representing 82% of CO_2 eq emissions from wetlands in EU

Summary of the net CO_2 emission from wetlands per category

Country	Finland	Germany	Ireland	Latvia	Poland
4.D.1. Wetlands remaining wetlands	1990.7	3740.2	1624.0	161.4	11.8
4.D.1.1 Peat extraction remaining peat extraction	1823.5	2343.8	1624.0	140.7	11.8
4.D.1.2 Flooded land remaining flooded land	3.9	NO	NO	IE,NA	NO,NA
4.D.1.3 Other wetlands remaining other wetlands	163.3	1396.5	NO	20.7	NO
4.D.2. Land converted to wetlands	96.7	973.6	10.3	22.7	1574.1
4.D.2.1 Land converted to peat extraction	20.8	24.3	4.6	NO	1574.1
4.D.2.2 Land converted to flooded land	0.8	NO	NO	NO,IE	NO,NA
4.D.2.3 Land converted to Other Wetlands	75.0	949.3	5.7	22.7	NO

Number of sub-categories included in the CRF 2023 for the net CO_2 emissions from wetlands

Country	Finland	Germany	Ireland	Latvia	Poland
4.D.1. Wetlands remaining wetlands					
4.D.1.1 Peat extraction remaining peat extraction	2	3	0	0	0
4.D.1.2 Flooded land remaining flooded land	2	5	0	0	0
4.D.1.3 Other wetlands remaining other wetlands	4	3	0	0	0
4.D.2. Land converted to wetlands					
4.D.2.1 Land converted to peat extraction	3	14	1	0	0
4.D.2.2 Land converted to flooded land	5	15	1		0
4.D.2.3 Land converted to Other Wetlands	3	11	1	0	0

- The level of disaggregation is very different from one country to another
- For countries who list them, the sub-categories included in the CRF table are diverse

Source: CRF 2023, Table 4.D

Methodological Tiers used

5 countries representing 82% of CO_2 eq emissions from wetlands in EU

Overview of the tier of method used for 4.D wetlands

Country	% of total net CO_2 emission in EU	CO_2	CH_4	N_2O
GERMANY	47.3%	T2, T3	T2	T2
FINLAND	10.4%	T1, T2, T3	T1, T2	T2
IRELAND	9.6%	D, T1, T2, T3	D, T2	D, T2
POLAND	7.3%	T1		
LATVIA	7.0%	T1, T2	T1, T2	T2

Overview of the emission factors used for 4.D wetlands

Country	% of total net CO_2 emission in EU	CO_2	CH_4	N_2O
GERMANY	47.3%	CS, D	CS, D	CS, D
FINLAND	10.4%	CS, D	CS, D	CS
IRELAND	9.6%	CS, D	CS, D	CS, D
POLAND	7.3%	D		
LATVIA	7.0%	CS, D	CS, D	CS

CS: country specific
D: default

Tier
- A mix of Tiers T1 to T3
- Information on Tiers reported in CRF not detailed enough for this study – there is a need to refer to the NIRs
- Some issues of transparency with reporting e.g. Ireland reporting D in Tiers

EFs
- Mix of country specific (CS) emission factors (EFs) and default (D) EFs

Methodological Tiers used

5 countries representing 82% of CO_2 eq emissions from wetlands in EU

Tier used per wetlands categories

Country	CO_2	CH_4	N_2O
GERMANY	Details not tabulated in the NIR		
FINLAND	4.D Wetlands (remaining, converted) - Peat extraction areas: living biomass – **T3**	4.(II) Non-CO2 emissions from drainage and rewetting and other management of organic and mineral soils - Wetlands: Peat extraction areas – **T2**	4.(II) Non-CO2 emissions from drainage and rewetting and other management of organic and mineral soils - Wetlands: Peat extraction areas – **T2**
	4.D Wetlands (remaining, converted) - Peat extraction areas: DOM, SOM – **T2**	4.(II) Non-CO2 emissions from drainage and rewetting and other management of organic and mineral soils - Wetlands: Flooded land – **T1**	4.(II) Non-CO2 emissions from drainage and rewetting and other management of organic and mineral soils - Other Wetlands – **T2**
	4.D Wetlands (remaining, converted) - Flooded land: living biomass – **T3**	4.(II) Non-CO2 emissions from drainage and rewetting and other management of organic and mineral soils - Other Wetlands – **T2**	
	4.D Wetlands (remaining, converted) - Flooded land: DOM, SOM – **T1**		
	4.D Wetlands (remaining, converted) - Other wetlands: SOM – **T2**		
IRELAND	Details not tabulated in the NIR		
POLAND	T1		
LATVIA	Details not tabulated in the NIR		

Uncertainties (Approach 1) – CO_2

5 countries representing 82% of CO_2 eq emissions from wetlands in EU

Country	IPCC category/Group	Combined uncertainty (%)	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (%)	Uncertainty in trend in national emissions introduced by activity data uncertainty (%)	Uncertainty introduced into the trend in total national emissions (%)
Finland	4D1. Wetlands remaining Wetlands	156			9.644
Finland	4D2. Land converted to Wetlands	150			0.452
Germany	4.D Wetlands	29.26	0	0.17	0.03
Ireland	4.D Wetlands	103.7	0.89	0.25	0.85
Latvia	4.D.1 Wetlands remaining Wetlands – Carbon stock change, living biomass	1.098	0.005	0	0
Latvia	4.D.1 Wetlands remaining Wetlands – Carbon stock change, dead organic matter	0.071	0	0	0
Latvia	4.D.1 Wetlands remaining Wetlands – Carbon stock change, organic soils	0.557	0.003	0.001	0
Latvia	4.D.2 Land Converted to Wetland - Carbon stock change, organic soils	2.467	0.004	0	0
Latvia	4.D. Wetlands 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils, Peat extraction from lands, drained organic soils	0.05	0	0.006	0
Latvia	4.D. Wetlands 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils, Peat extraction from lands, rewetted organic soils	2.464	0.004	0	0
Poland	4.D Wetlands				

CO_2

- Uncertainties associated with estimating emissions and removals in wetlands are expected to be relatively large as complex biological processes control emissions
- Uncertainties reported by Finland and Ireland are large: > 100%
- Latvia reports uncertainties of only a few %, and these are small in absolute terms
- Poland does not report uncertainties

Uncertainties (Approach 1) – CH_4 and N_2O

5 countries representing 82% of CO_2 eq emissions from wetlands in EU

CH_4

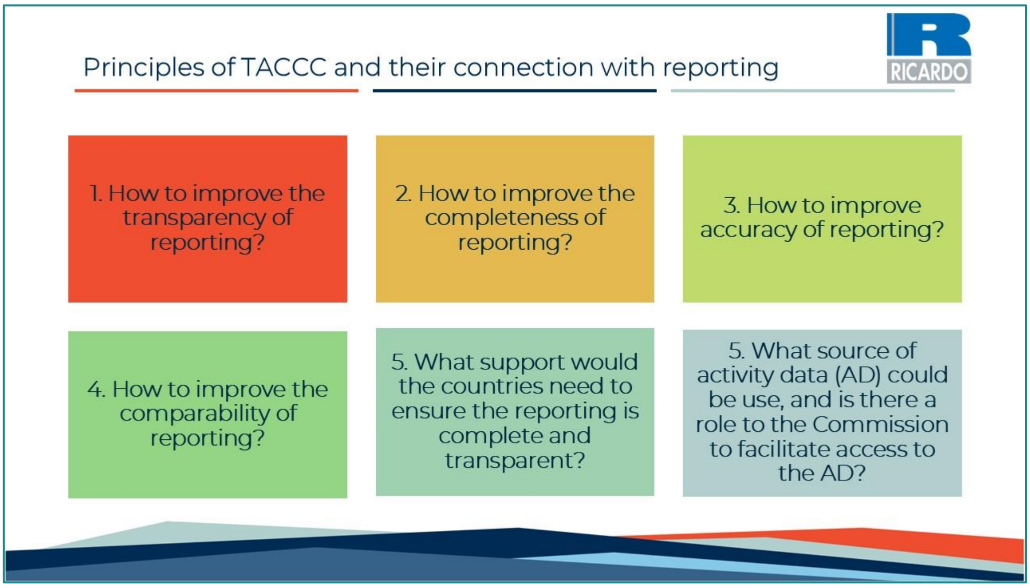
Party	GHG	IPCC category/Group	Combined uncertainty (%)	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (%)	Uncertainty in trend in national emissions introduced by activity data uncertainty (%)	Uncertainty introduced into the trend in total national emissions (%)
Germany	CH_4	4.D Wetlands	67.39	0	0.41	0.17
Ireland	CH_4	4.D LULUCF - Wetlands	108.71	0.54	0.11	0.3
Latvia	CH_4	4.D. Wetlands 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils, Peat extraction from lands, drained organic soils	0.654	0	0	0
Latvia	CH_4	4.D. Wetlands 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils, Peat extraction from lands, rewetted organic soils	1.981	0.01	0	0

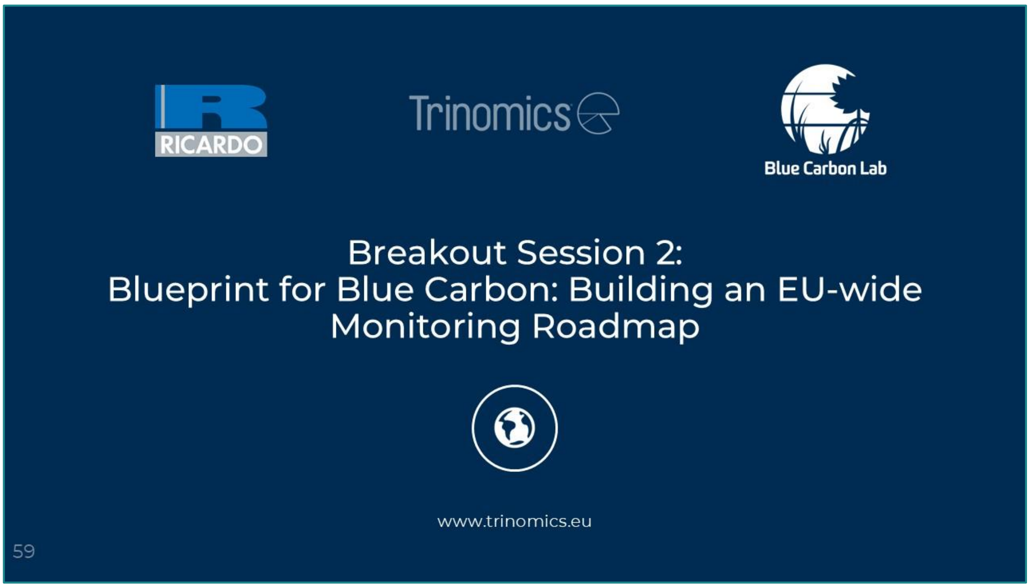
N_2O

Party	GHG	IPCC category/Group	Combined uncertainty (%)	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty (%)	Uncertainty in trend in national emissions introduced by activity data uncertainty (%)	Uncertainty introduced into the trend in total national emissions (%)
Germany	N_2O	4.D Wetlands	167.86	0	0.01	0
Ireland	N_2O	4.D LULUCF - Wetlands	131.89	0.02	0.03	0
Latvia	N_2O	4.D. Wetlands 4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils, Peat extraction from lands, drained organic soils	1.073	0	0	0

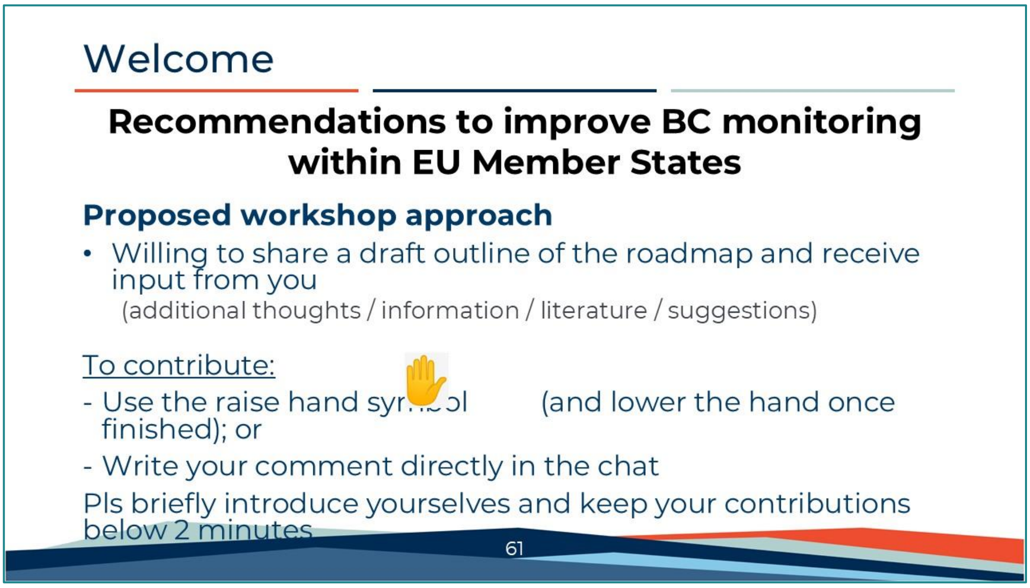
Completeness – managed or unmanaged

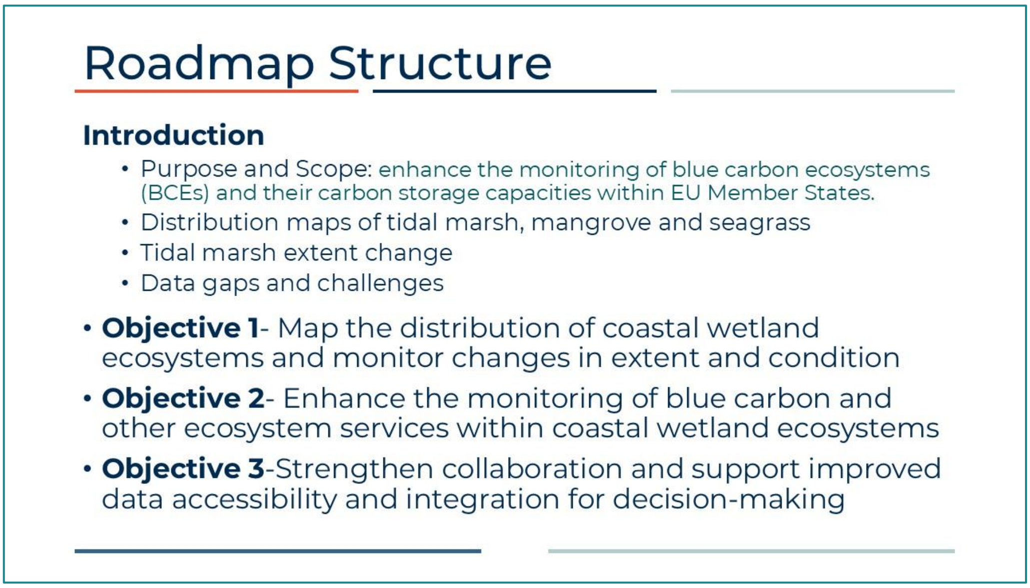
Country	Wetlands definition
NL	The Wetland land use category mainly comprises **open water**. Land use on peat areas is mainly Grassland, Cropland, or Settlements. Emissions from drainage in peat areas are included in carbon stock changes in organic soils for these land use categories.
SE	Wetlands is assumed **unmanaged** and is defined as mires and areas saturated by freshwater. However, an area of approx. 10 000 ha that is used for **peat extraction** is included under Wetlands and therefore assumed managed.
DE	Land areas where soils are **intermittently or constantly waterlogged, or covered with water**, and that do not fall within the land-use categories 4.A, 4.B, 4.C and 4.E. In the German inventory, these areas are combined in the sub-categories Terrestrial Wetlands (IPCC: Other Wetlands) and Waters (IPCC: Flooded Land). In addition, all areas that are related to **Peat extraction** are combined within an additional sub-category under the land-use category Wetlands.
USA	All **wetlands are considered managed** (personal communication from USA inventory stakeholders)

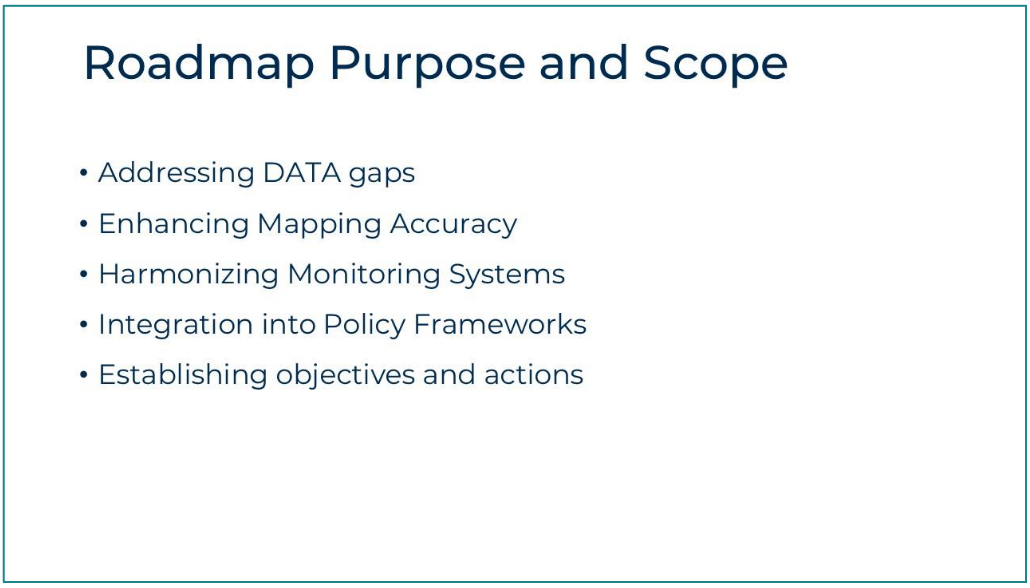

Principles of TACCC and their connection with reporting
RICARDO
1. How to improve the transparency of reporting?
2. How to improve the completeness of reporting?
3. How to improve accuracy of reporting?
4. How to improve the comparability of reporting?
5. What support would the countries need to ensure the reporting is complete and transparent?
5. What source of activity data (AD) could be use, and is there a role to the Commission to facilitate access to the AD?


RICARDO
Trinomics
Blue Carbon Lab
Breakout Session 2:
Blueprint for Blue Carbon: Building an EU-wide Monitoring Roadmap
www.trinomics.eu
59


Introductions
Blue Carbon Lab
innovative research solutions to help mitigate climate change and enhance our blue economy, while supporting aquatic biodiversity, economic growth, capacity building, and community wellbeing.
Workshop Conveners
Prof Peter Macreadie
(Director Blue Carbon Lab, Australia)
Dr Oscar Serrano
(PI at CEAB-CSIC, Spain)
60


Welcome
Recommendations to improve BC monitoring within EU Member States
Proposed workshop approach
• Willing to share a draft outline of the roadmap and receive input from you
(additional thoughts / information / literature / suggestions)
To contribute:
- Use the raise hand sy…ol (and lower the hand once finished); or
- Write your comment directly in the chat
Pls briefly introduce yourselves and keep your contributions below 2 minutes
61

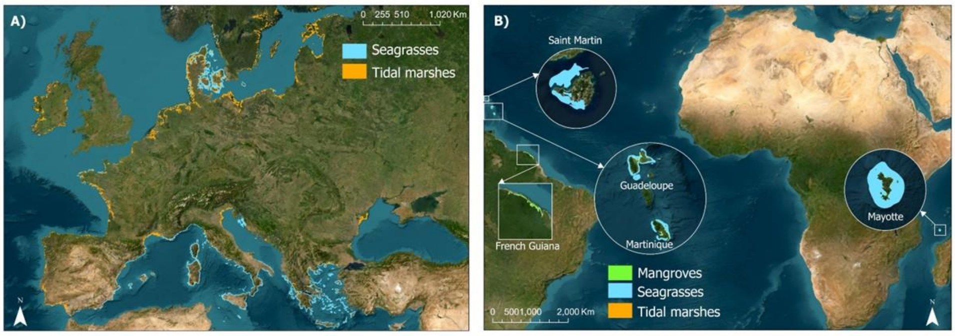

Roadmap Structure
Introduction
• Purpose and Scope: enhance the monitoring of blue carbon ecosystems (BCEs) and their carbon storage capacities within EU Member States.
• Distribution maps of tidal marsh, mangrove and seagrass
• Tidal marsh extent change
• Data gaps and challenges
• Objective 1- Map the distribution of coastal wetland ecosystems and monitor changes in extent and condition
• Objective 2- Enhance the monitoring of blue carbon and other ecosystem services within coastal wetland ecosystems
• Objective 3-Strengthen collaboration and support improved data accessibility and integration for decision-making

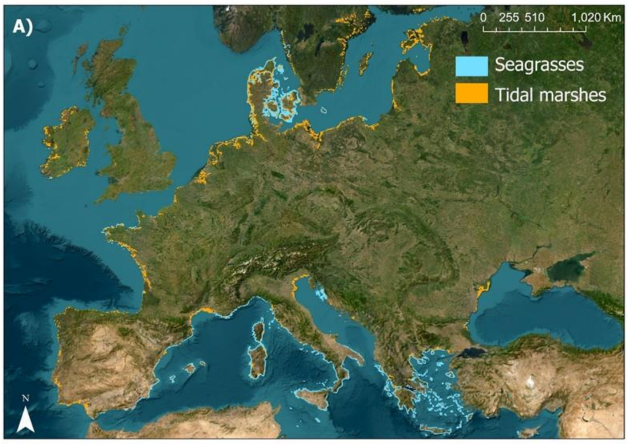

Roadmap Purpose and Scope
• Addressing DATA gaps
• Enhancing Mapping Accuracy
• Harmonizing Monitoring Systems
• Integration into Policy Frameworks
• Establishing objectives and actions

Distribution maps of tidal marsh, mangrove and seagrass

>2 million ha of BCE distributed across EU and outermost regions.....

Is it TRUE / ACCURATE?

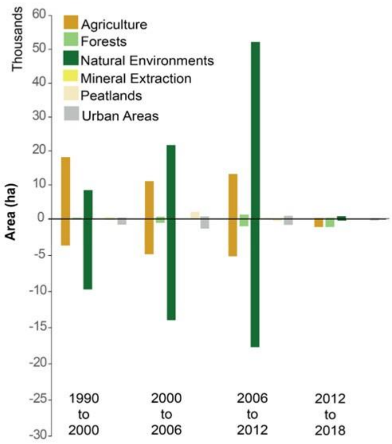




- Are we missing seagrasses at depths >25 m in the Med?
- So little seagrass extent in the Adriatic Sea?
- Are *Zostera*, *Cymo* (and *Halophila*) well represented in the Med?
- What about North Europe, any evident gaps in the distribution?

Tidal marsh land-use change

- tidal marsh loss has decreased substantially in the 2012-2018 time period, with most of the habitat loss occurring between 2000 and 2012 (Figure A). In contrast, when analyzing the potential land conversion from other land uses to tidal marshes, we could estimate that the period between 2006 and 2012 was also the one with the highest expansion of tidal marshes across the EU Member States (Figure A). We also found that the period between 2012 and 2018 was the one with higher stability, with approximately 337,000 ha showing no changes in their distribution (Figure A, Tables A and S3).
- Overall, changes in tidal marsh occurred between 2000 and 2012, associated with transition to other vegetation types and natural environments. In addition, land use transitions between tidal marshes and agriculture were also responsible for large areas of distribution change across the study region.
- Despite the larger changes in the distribution of tidal marshes, it is important to highlight that most of the mapped tidal marsh distribution have not shown changes in their distribution.



Data gaps and challenges

Ecosystem extent gaps

- Existing maps are mostly at global scale, with limited data at regional or country scales
- Lack of updated maps or maps are incomplete, limited and mismatched spatial and temporal resolutions
- Missing historic extent for IPCC reporting

Monitoring system limitations

- Lack of a comprehensive monitoring system across all Member States that produces compatible distribution maps at the same time span and resolution
- Temporal data gaps due to inconsistent monitoring, which difficult tracking long-term changes

Carbon data gaps:

- Lack of uniform data collection protocols across EU
- Insufficient comprehensive baseline carbon inventories, with carbon sequestration data missing, and GHG fluxes following conservation/restoration/loss
- GHG fluxes following conservation/restoration actions

Land-use and drivers of change gaps:

- Land tenure data missing
- Reliance on CORINE data, limitations in resolution (30 m) and coverage (excludes seagrasses), and could misclassify ecosystems (e.g., tidal marshes)
- Lack of large-scale, high-accuracy and coordinated BCE mapping monitoring to analyse land-use changes over time.

ROADMAP Objective 1 : Map the distribution of coastal wetland ecosystems and monitor changes in extent and condition

Action 1.1 — **Develop spatially explicit distribution maps of coastal wetland ecosystems (mangroves, tidal marshes and seagrasses) across EU Member States and Outermost regions.**

- Improve the mapping of seagrass ecosystems including:
  - Mapping of small seagrasses (Zostera marina, Zostera noltii and Cymodocea nodosa, and the exotic spreading Halophila) in the Mediterranean,
  - Mapping of deep Posidonia oceanica and deep C. nodosa.
- Improve distribution mapping of EU Member States and Outermost regions including:
  - Reunion
- Ensure that spatial distributions maps are consistent across BCEs and have the same resolution

Action 1.2 — **Track changes in coastal wetland extent and condition**

- Member States should adopt the IPCC guidelines (Wetlands Supplement) for measuring and reporting changes in coastal wetlands extent and condition

ROADMAP Objective 1 : Map the distribution of coastal wetland ecosystems and monitor changes in extent and condition

Action 1.3 — Improve spatial mapping and data accuracy

Action 1.4 — Monitor changes in coastal wetland ecological condition

Action 1.5 — Utilize advanced technologies and cost-effective approaches to enhance monitoring and reporting capabilities.

Discussion Objective 1

- How can Member States collaborate to track changes in wetland extent systematically?
- What technologies (e.g., satellite imagery, drones) can be cost-effectively deployed for mapping and monitoring?
- Are there successful examples of integrating ecological condition monitoring into broader reporting frameworks?
- How can we ensure that mapping efforts align with IPCC and UNFCCC reporting requirements?

70

ROADMAP Objective 2: Enhance the monitoring of blue carbon and other ecosystem services within coastal wetland ecosystems

Action 2.1	Implement standardized methods for measuring or estimating change in carbon stocks, carbon sequestration, and greenhouse gas fluxes (e.g., CO2, CH4, N2O) in mangroves, tidal marshes, and seagrasses.
Action 2.2	Develop baseline spatially explicit maps of blue carbon storage including above and below-ground biomass, soil carbon stocks, and accumulation rates.
Action 2.3	Establish a comprehensive GHG inventory system to monitor and report changes for coastal wetlands.
Action 2.4	Strengthen blue carbon monitoring to support integration into carbon markets
Action 2.5	Develop protocols to quantify and monitor other ecosystem services (e.g., biodiversity, water purification, coastal protection, and fisheries enhancement) provided by coastal wetlands.

Discussion Objective 2

- What are the challenges in harmonizing blue carbon monitoring methods across Member States?
- How can standardized protocols enhance data quality and international reporting consistency?
- What role can a comprehensive GHG inventory play in improving NDC submissions?
- Which ecosystem services (beyond carbon) should be prioritized for monitoring, and why?
- How can stakeholders (e.g., researchers, policymakers, local communities) collaborate to improve blue carbon monitoring?

72

ROADMAP Objective 3: Strengthen collaboration and support improved data accessibility and integration for decision-making

Action 3.1	Foster collaboration among EU Member States to share best practices, tools, and data for coastal wetland mapping and monitoring.
Action 3.2	Build a centralized EU-level database for the storage and sharing of coastal wetland mapping, carbon, and monitoring data across EU Member States.
Action 3.3	Develop tools and guidance for policymakers to incorporate monitoring results into decision-making processes.
Action 3.4	Integrate coastal wetland ecosystem monitoring with national climate, biodiversity, and conservation strategies to inform long-term management goals.
Action 3.5	Raise awareness of coastal wetlands' role in climate action and encourage community involvement in their monitoring and conservation.

Discussion Objective 3

- How can EU Member States overcome barriers to collaboration and data sharing?
- What are the benefits of a centralized EU-level database, and how should it be structured?
- What tools or approaches are most effective in translating monitoring data into policy decisions?
- How can monitoring efforts be better integrated with conservation and climate strategies?
- What strategies can be used to engage the public and raise awareness about coastal wetlands?

74

RICARDO Trinomics Blue Carbon Lab

Breakout Session 3:
Blue carbon changes in Europe – Drivers, pressures, measurement and restoration

www.trinomics.eu

75

Proposed approach

This break-out session is an opportunity for us to share some key findings of our work, and test them with a knowledgeable audience

It is intended to be interactive:

- Please share your thoughts however you prefer (ask any questions in the Zoom chat, give your opinions in Slido, raise your hand to intervene)
- Provide additional information / literature / suggestions if you have them
- Ask questions and disagree with any part of the presentations

76

Slido

Trinomics

- Throughout this session, we have questions that we seek your feedback on
- With your phone, please scan the barcode which will take you straight to Slido
- As we go through the presentation, we will ask you to answer questions
- If you have your own question to the team or the audience,
  please put it in the Zoom chat or raise your hand to intervene directly

77

This is a test question - Correct?

ⓘ Start presenting to display the poll results on this slide.

Drivers of change in BCE

Trinomics

Drivers	Sub-drivers
Climate change	Sea level rise
	Temperature rise
	Extreme weather events
	Changes in salinity
	CO2 concentration rise (e.g. ocean acidification)
	Hydrological changes (e.g. precipitation pattern)
Land use change	Agriculture
	Construction or coastal development
	Reclamation
Pollution	Eutrophication
	Aquaculture
Human exploitation	Mechanical erosion (e.g. by trawling and anchoring)
	Industrial or human activity
	Dredging
	Filling
	Heavy metal contamination
	Drainage
Invasive species	No associated sub-driver
Natural events	Physical (e.g. bathymetry, slope, exposure)
	Hydrodynamic factor (e.g. energy, flow speed)
	Coastal erosion
Sediment dynamics	Sediment properties (e.g. grain size and soil type)

Categorization of drivers and sub-drivers

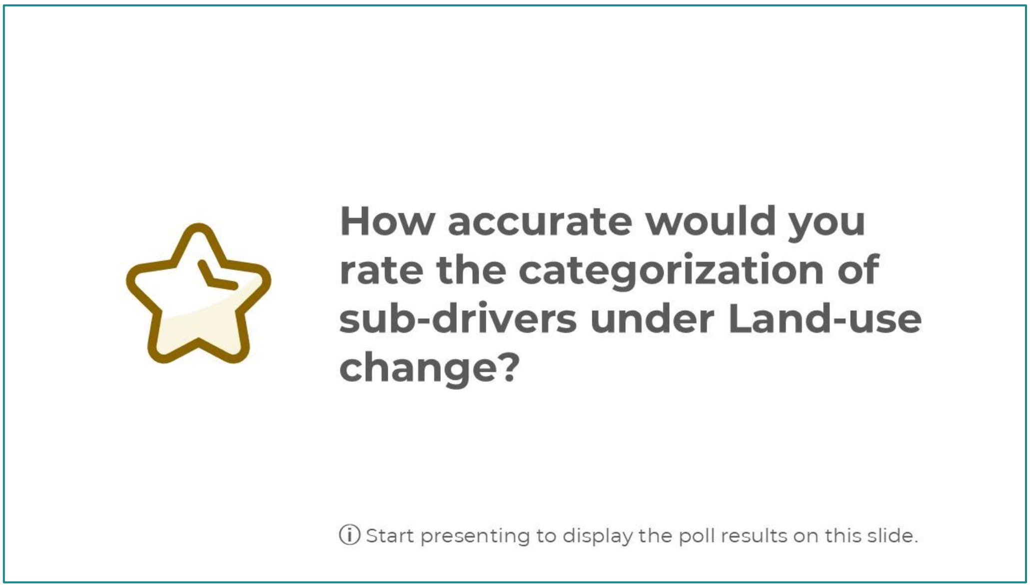
79

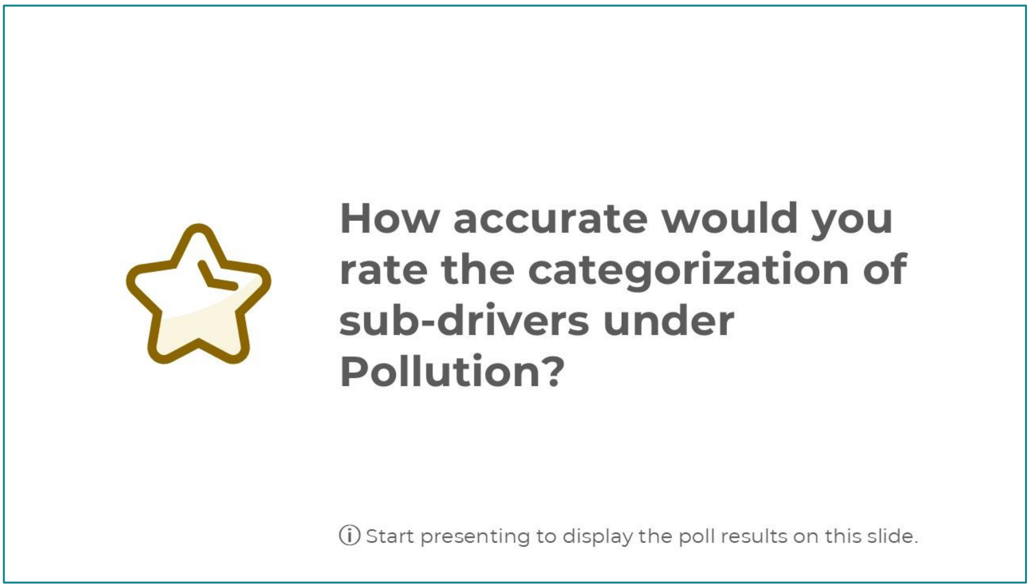
Do you agree with the categorization of drivers and their respective sub-drivers

ⓘ Start presenting to display the poll results on this slide.

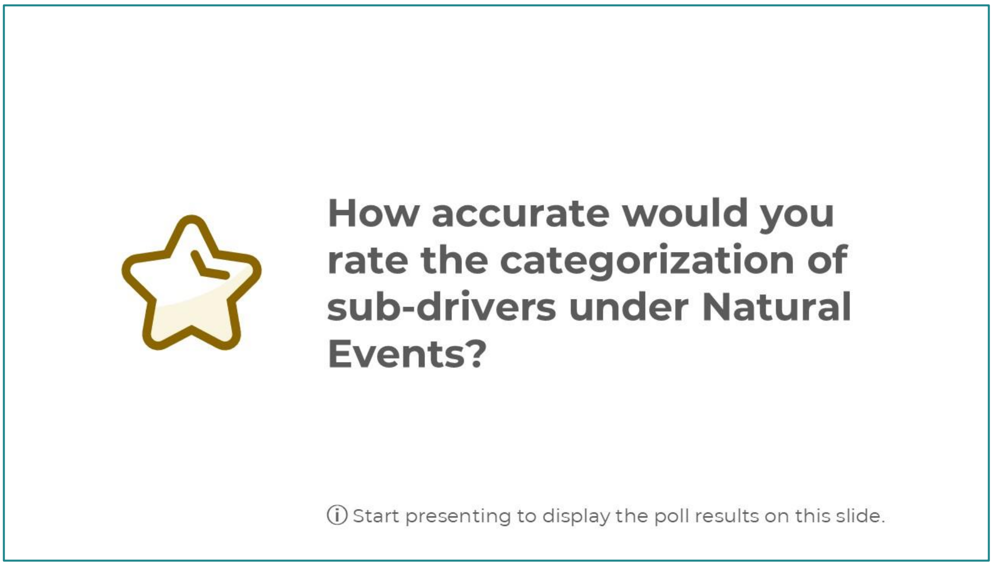
How accurate would you rate the categorization of sub-drivers under Climate Change?

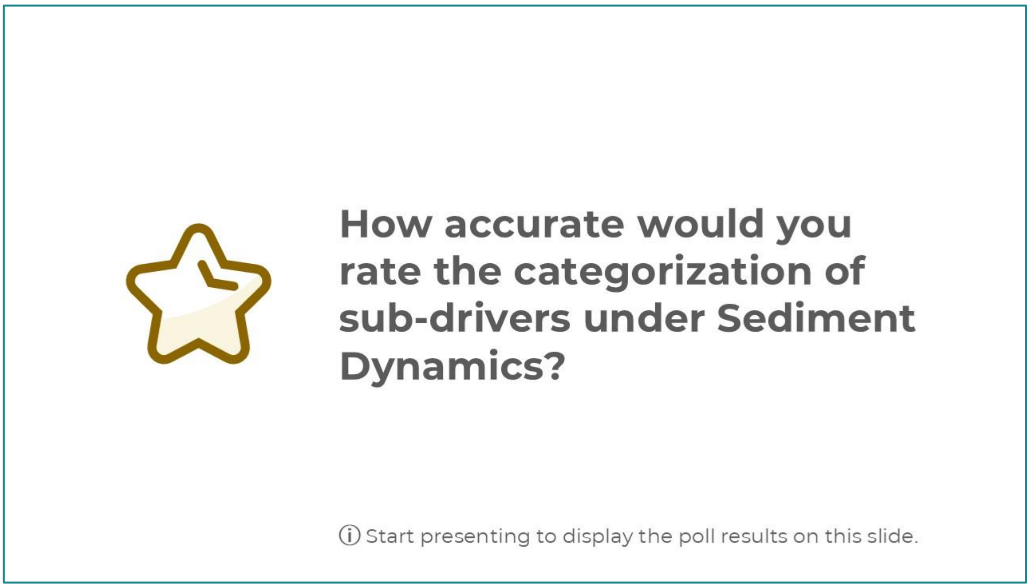
ⓘ Start presenting to display the poll results on this slide.

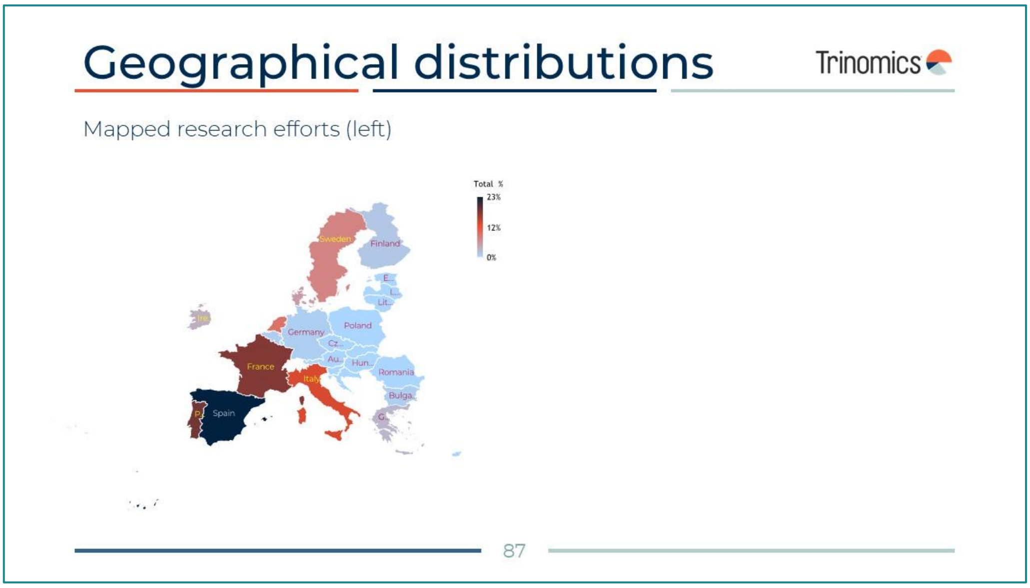

How accurate would you rate the categorization of sub-drivers under Land-use change?
ⓘ Start presenting to display the poll results on this slide.

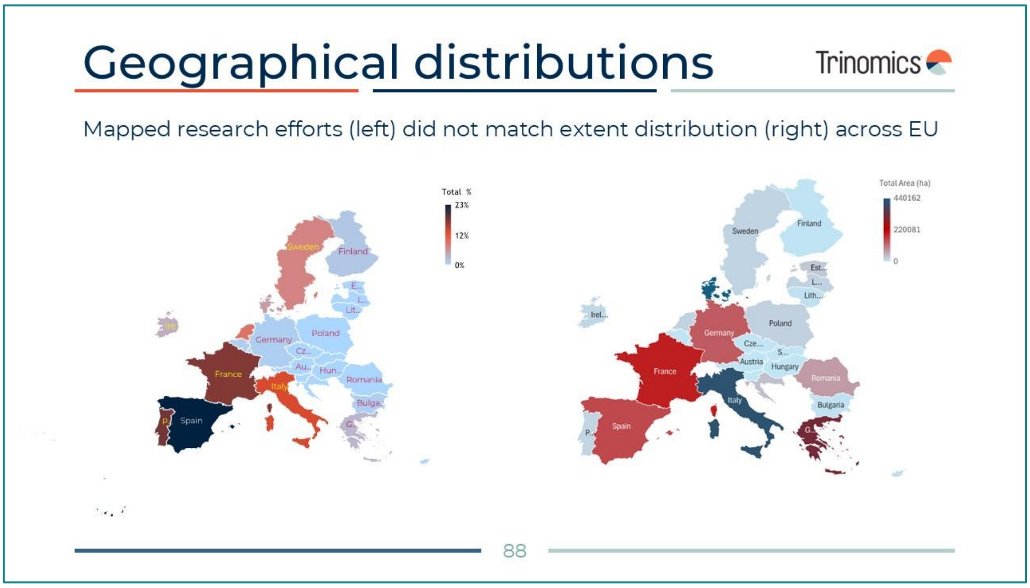

How accurate would you rate the categorization of sub-drivers under Pollution?
ⓘ Start presenting to display the poll results on this slide.

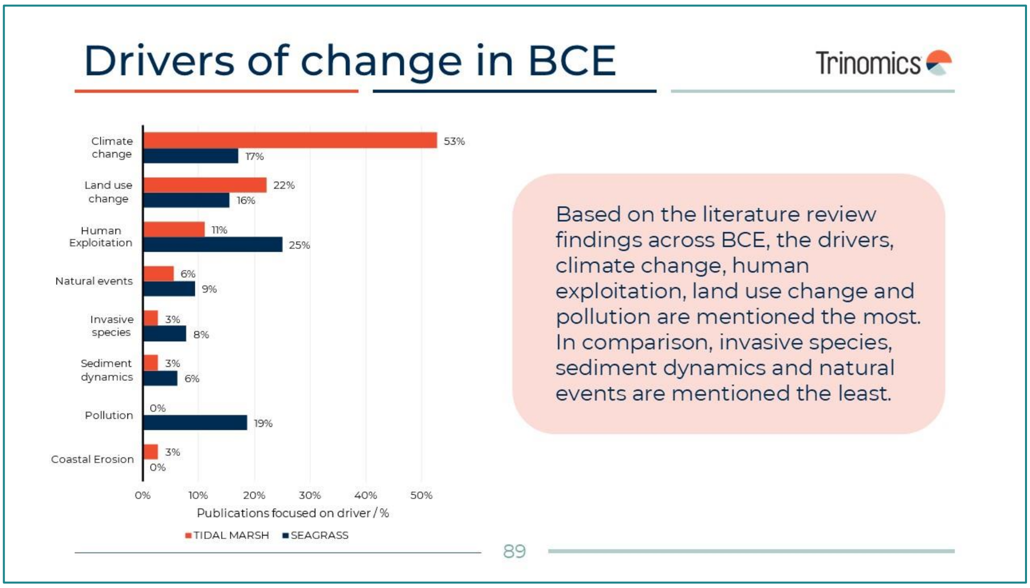

How accurate would you rate the categorization of sub-drivers under Human Exploitation?
ⓘ Start presenting to display the poll results on this slide.

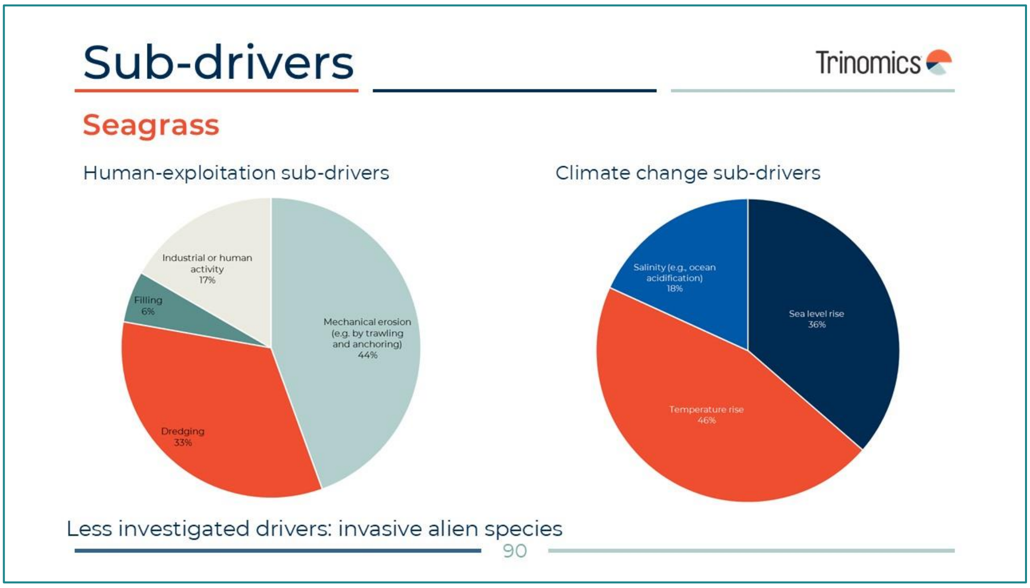

How accurate would you rate the categorization of sub-drivers under Natural Events?
ⓘ Start presenting to display the poll results on this slide.

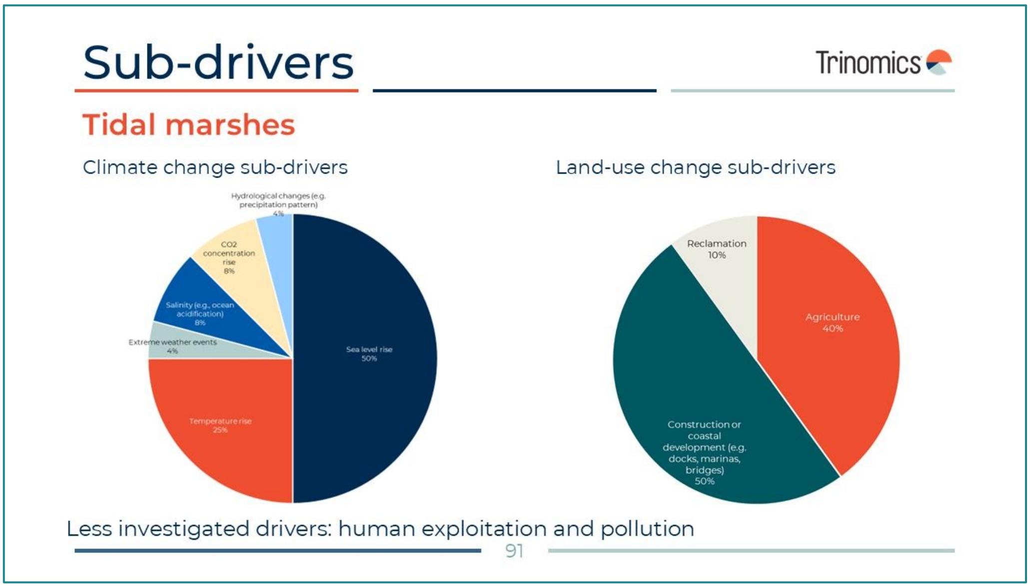

How accurate would you rate the categorization of sub-drivers under Sediment Dynamics?
ⓘ Start presenting to display the poll results on this slide.

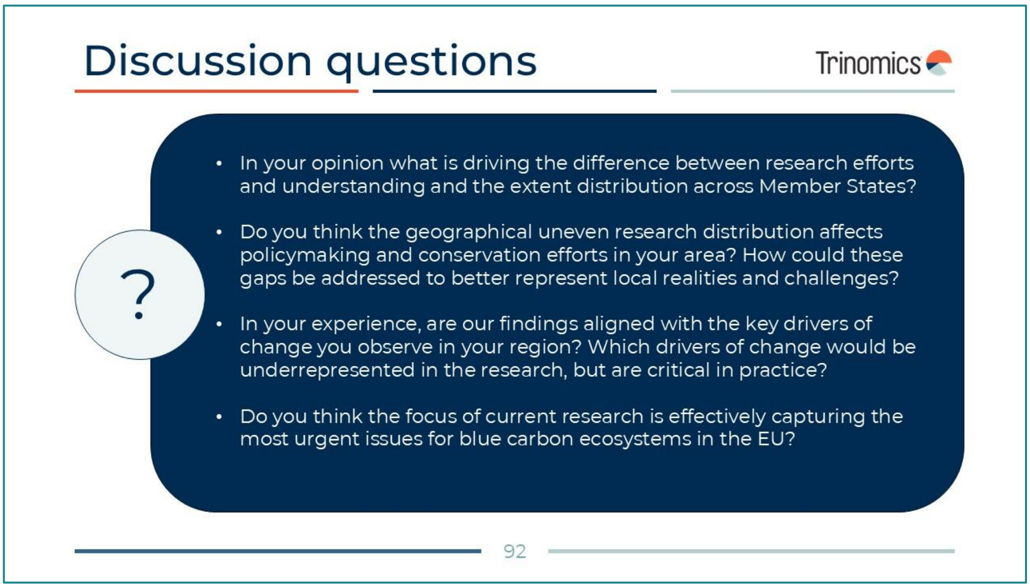

Geographical distributions
Trinomics
Mapped research efforts (left)
Total %
23%
12%
0%
Sweden
Finland
Poland
Germany
France
Italy
Spain
Romania
87

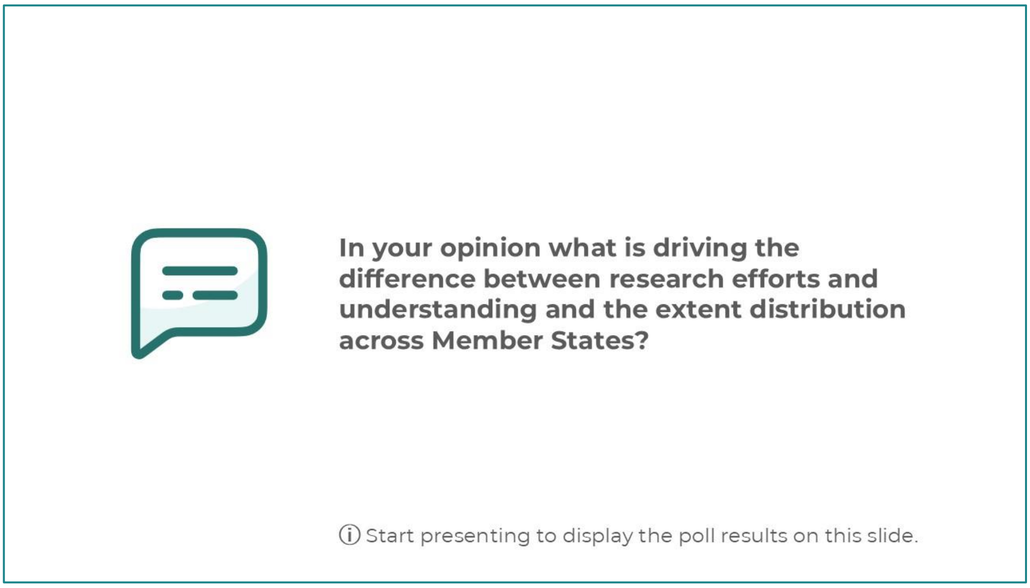

Geographical distributions
Trinomics
Mapped research efforts (left) did not match extent distribution (right) across EU
Total %
23%
12%
0%
Sweden
Finland
Germany
Poland
France
Italy
Spain
Romania
Total Area (ha)
440162
220081
0
Sweden
Finland
Poland
Germany
France
Spain
Italy
Austria
Hungary
Romania
Bulgaria
88

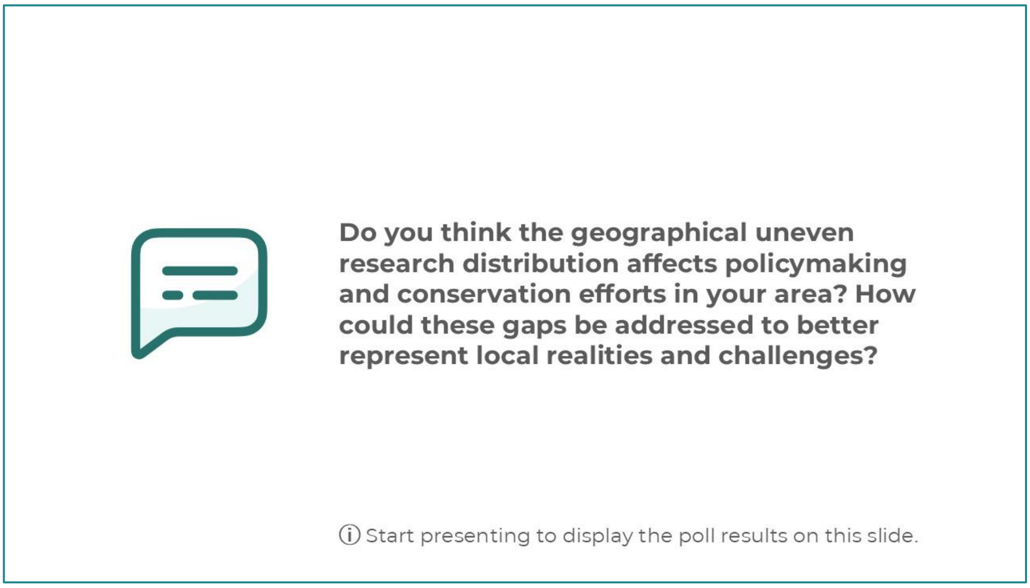

Drivers of change in BCE
Trinomics
Climate change
53%
17%
Land use change
22%
16%
Human Exploitation
11%
25%
Natural events
6%
9%
Invasive species
3%
8%
Sediment dynamics
3%
6%
Pollution
0%
19%
Coastal Erosion
3%
0%
0%
10%
20%
30%
40%
50%
Publications focused on driver / %
TIDAL MARSH
SEAGRASS
Based on the literature review findings across BCE, the drivers, climate change, human exploitation, land use change and pollution are mentioned the most. In comparison, invasive species, sediment dynamics and natural events are mentioned the least.
89

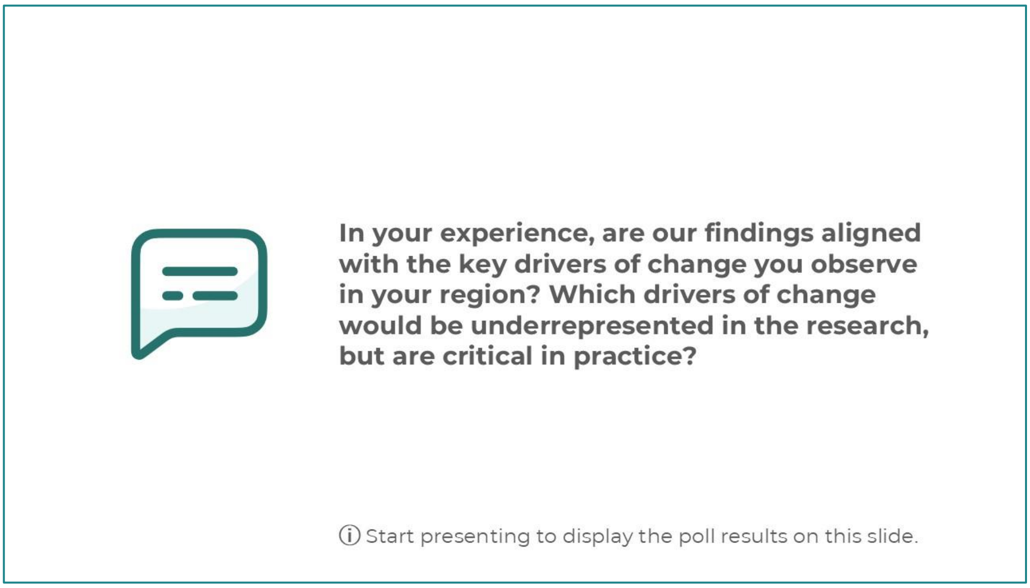

Sub-drivers
Trinomics
Seagrass
Human-exploitation sub-drivers
Industrial or human activity 17%
Filling 6%
Mechanical erosion (e.g. by trawling and anchoring) 44%
Dredging 33%
Climate change sub-drivers
Salinity (e.g. ocean acidification) 18%
Sea level rise 36%
Temperature rise 46%
Less investigated drivers: invasive alien species
90

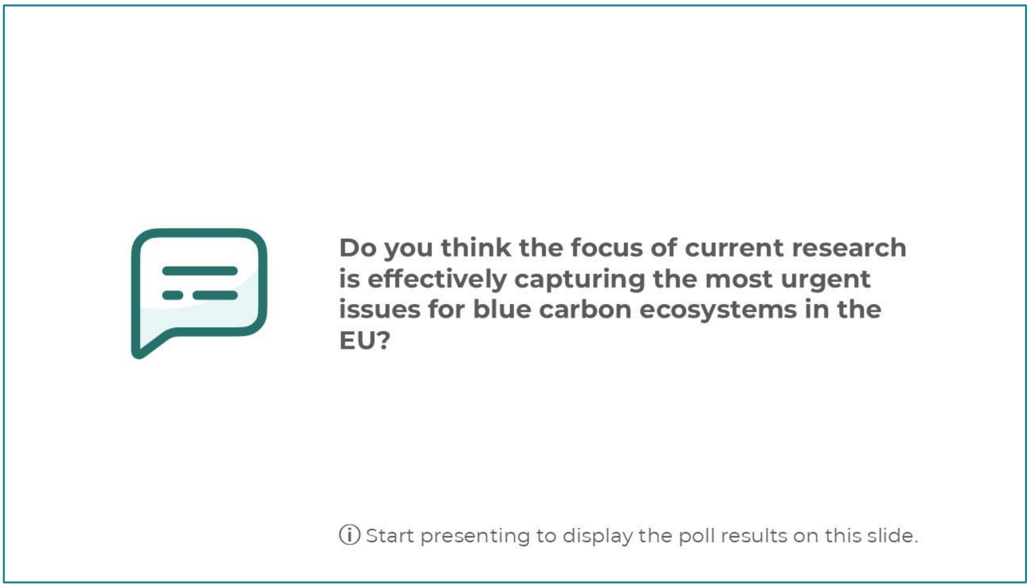

Sub-drivers
Trinomics
Tidal marshes
Climate change sub-drivers
Land-use change sub-drivers
Hydrological changes (e.g. precipitation pattern) 4%
CO2 concentration rise 8%
Salinity (e.g., ocean acidification) 8%
Extreme weather events 4%
Temperature rise 25%
Sea level rise 50%
Reclamation 10%
Agriculture 40%
Construction or coastal development (e.g. docks, marinas, bridges) 50%
Less investigated drivers: human exploitation and pollution
91


Discussion questions
Trinomics
?
• In your opinion what is driving the difference between research efforts and understanding and the extent distribution across Member States?
• Do you think the geographical uneven research distribution affects policymaking and conservation efforts in your area? How could these gaps be addressed to better represent local realities and challenges?
• In your experience, are our findings aligned with the key drivers of change you observe in your region? Which drivers of change would be underrepresented in the research, but are critical in practice?
• Do you think the focus of current research is effectively capturing the most urgent issues for blue carbon ecosystems in the EU?
92


In your opinion what is driving the difference between research efforts and understanding and the extent distribution across Member States?
ⓘ Start presenting to display the poll results on this slide.


Do you think the geographical uneven research distribution affects policymaking and conservation efforts in your area? How could these gaps be addressed to better represent local realities and challenges?
Start presenting to display the poll results on this slide.


In your experience, are our findings aligned with the key drivers of change you observe in your region? Which drivers of change would be underrepresented in the research, but are critical in practice?
Start presenting to display the poll results on this slide.

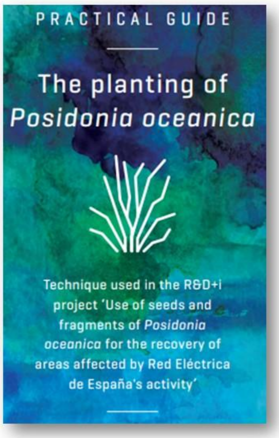

Do you think the focus of current research is effectively capturing the most urgent issues for blue carbon ecosystems in the EU?
Start presenting to display the poll results on this slide.

Sequestration enhancement

Trinomics

Context – 'enhancing' blue carbon sequestration in EU

- Focus on seagrass and saltmarsh – mangroves only in outermost territories
- Our interpretation of enhancing blue carbon sequestration: **restoration** to more natural state – would you agree? (see Slido question)
- *Actions* for implementing seagrass and saltmarsh restoration are well documented, but success rate is highly context-dependent and innovation continues
- Implementation of restoration activities is highly specialized, and usually led by highly trained researchers – few guidelines exist explaining 'how to' restoration activities (see image for exception)
- Do you agree with this, and is lack of guidelines a problem we need to fix? (See Slido question)



97

Do you agree with our interpretation of 'blue carbon sequestration enhancement' as being restoration of these ecosystems to more natural states?

ⓘ Start presenting to display the poll results on this slide.

Is there a shortage of practical guidance on how to implement seagrass and saltmarsh restoration activities, and is it a priority to fill this gap?

ⓘ Start presenting to display the poll results on this slide.

5

BC restoration projects in EU

Trinomics

Source of funding	Project	Habitat
EIB	Study on investing in NBS	All
ERDF	PACCo (Promoting Adaptation to Changing Coasts)	Seagrass
	MITIGACC	Seagrass
EU Copernicus programme	Copernicus Marine Service	All
Horizon	REST-COAST	Seagrass
	WaterLANDS	Seagrass
	MERCES	Seagrass
	RESTORE4Cs	All
LIFE	LIFE Blue Natura	Seagrass
	LIFE SEPOSSO	Seagrass
	ReMEDIES	Seagrass
	Seagrass restoration handbook UK & Ireland	Seagrass
	SERESTO	Seagrass
	LIFE VIMINE	Seagrass & tidal marsh

slido

Please download and install the Slido app on all computers you use

Are there other EU blue carbon restoration projects that we should include in our scope?

ⓘ Start presenting to display the poll results on this slide.

Monitoring of restoration sites

Trinomics

Long term sequestration monitoring an important gap

- Many BC sequestration measurement samples exist across the EU (Subtask 3.2 has 7,817 samples from 922 cores; 708 seagrass, 214 saltmarsh)...
- But... very little BC sequestration measurement from *EU restoration sites*:
  - Above sample: very few from the same location over time
  - Seagrass: **no examples** of long-term BC measurement of seagrass restoration sites in the EU
  - Saltmarsh: some examples in Europe, rarely with long term monitoring
    - Elschot, K., et al. (2015). Ecosystem engineering by large grazers enhances carbon stocks in a tidal salt marsh.
    - Natural England (2021). Carbon storage and sequestration by habitat 2021.
    - Mossmann, H., et al. (2022). Rapid carbon accumulation at a saltmarsh restored by managed realignment exceeded carbon emitted in direct site construction.
    - Ouyang, X. and Lee, S.Y. (2014). Updated estimates of carbon accumulation rates in coastal marsh sediments.
- Slido question: Have we overlooked literature that reports on the *measurement* of BC sequestration in EU restoration sites?

102

Have we overlooked literature that reports on the measurement of BC sequestration in EU restoration sites? Please mention any important literature below

ⓘ Start presenting to display the poll results on this slide.

Monitoring of restoration sites

Trinomics

Why is there so little BC sequestration monitoring of EU restoration sites?

Interviewees gave us the following reasons (Slido: how would you rank these?):

- Existing monitoring focuses more on ***ecological indicators of restoration success*** – blue carbon sequestration is less of a focus on restoration sites
- Funding **duration**: restoration can take 10+ years to take place, while project funding typically lasts less than 5 years.
- Funders prefer to **maximise expenditure on other things** than sequestration monitoring (such as project area)
- **Revenue** from carbon not a realistic driver for monitoring. Few methods, low revenues
- Lack of **standardized methodologies** for measurement of BC sequestration

104

How would you rank the importance of the following explanations for why there is very little BC sequestration measurement in restoration sites

ⓘ Start presenting to display the poll results on this slide.

Strategies, policies, regulation

Trinomics

No clear strategies aimed at BC sequestration enhancement in the EU

- No formal strategy at EU level directly focusing on blue carbon sequestration enhancement
- But, several pieces of EU legislation support these ecosystems:
  - Marine Protected Areas
  - 2002 EU Recommendation on Integrated Coastal Zone Management 2002/413/EC.
  - 2008 Marine Strategy Framework Directive 2008/56/EC
  - 2014 Directive on Establishing a Framework for Maritime Spatial Planning 2014/89/EU,

106

Strategies, policies, regulation

Trinomics

Few initiatives at national level either:

- No national strategies specifically targeting BC ecosystem enhancement
- Some national initiatives that will help:
  - France: National Maritime and Coastline Strategy (Stratégie nationale pour la mer et le littoral)
  - Ulster Wildlife (NGO) developed a BC Action Plan for Northern Ireland
  - Netherlands sets quantitative targets for seagrass restoration, (10,000 ha of seagrass in the Wadden Sea by 2028)
- Have we missed important EU or national initiatives supporting BC sequestration enhancement?

107

Have we missed an important EU or national initiative supporting BC sequestration enhancement?

ⓘ Start presenting to display the poll results on this slide.

Cost of BC ecosystem restoration

Trinomics

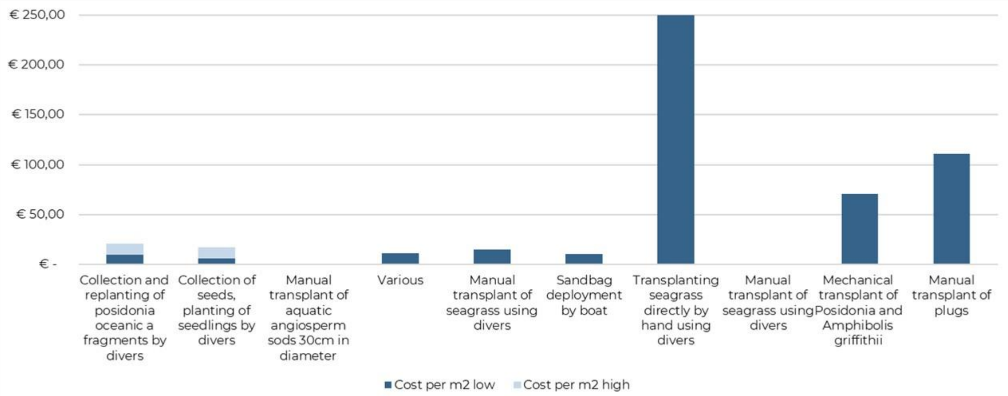
- Key finding: cost data for BC restoration projects in EU is a gap
  - Very little available data at project level for both seagrass and saltmarsh
  - Some data on restoration activity, but far less on other aspects (e.g. monitoring, planning, approvals)
  - Much of available data is quite dated, may not represent current costs
  - Shortage of cost data is considered a key impediment to upscaling

109

Cost seagrass restoration

Trinomics

Seagrass restoration costs per method (EUR 2024)



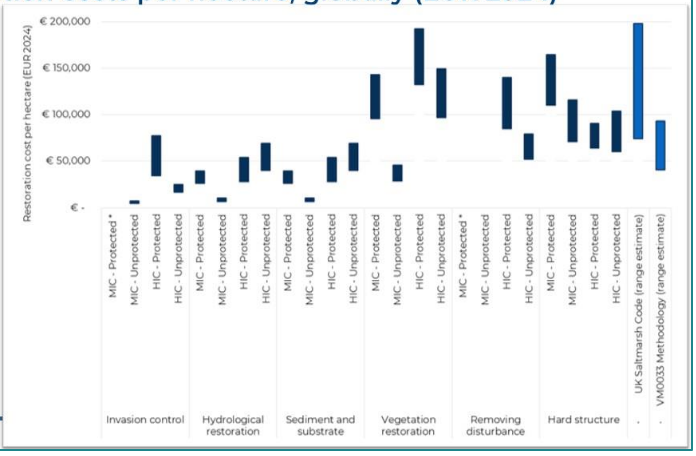
Year	Location	Method	Unit cost low	Unit cost high	Cost per m2 low	Cost per m2 high	Costs include	Source / reference
2018	Mediterranean	Collection and replanting of Posidonia oceanic a fragments by divers	€ 14.97	€ 32.20	€ 9.58	€ 20.61	Materials, human and technical resources and associated logistics. Low cost is for 2,500m2, high cost for 10 000m2	Red Electrica (2018).
2018	Mediterranean	Collection of seeds, planting of seedlings by divers	€ 9.86	€ 26.75	€ 6.31	€ 17.12	Materials, human and technical resources and associated logistics. Low cost is for 2,500m2, high cost for 10 000m2	Red Electrica (2018)
2014-2018	Mediterranean	Manual transplant of aquatic angiosperm sods 30cm in diameter	€ 21.10		€ 0.003		EUR 42k to transplant and colonise a lagoon of 15km2. Costs include boat hire. Much activity done by volunteers and natural growth appears very high	Sfriso, A., et al. (2021).
2010	Global average	Various			€ 10.96		Various	Bayraktarov, E. et al (2016)
2024	Western Australia	Manual transplant of seagrass using divers			€ 15.00		Seed collection, materials, boat deployment	Personal communication, John Statton of University of Western Australia
2024	South Australia	Sandbag deployment by boat	€ 10.50		€ 10.50		Seed collection, materials, boat deployment	Personal communication, updating this reference: Tanner, J.E. 2023.
2017-2022	Mediterranean	Transplanting seagrass directly by hand using divers			€ 250		Transplantation only	Personal communication about the LIFE project: https://lifeseposso.eu/
2001	USA	Manual transplant of seagrass using divers			€ 0.56		Unspecified	Thorhaug, Anitra (2001)
2005	South Australia	Mechanical transplant of Posidonia and Amphibolis griffithii			€ 70.38		Underwater mechanical seagrass harvesting and planting machines	Lord and Associates (2005)
2003	Victoria, Australia	Manual transplant of plugs			€ 110.94		Collection, planting and monitoring	Walker, J (2003)

Costs tidal marsh restoration

Trinomics

Tidal marsh restoration costs per hectare, globally (EUR 2024)

Dark blue: Wang, J., et al. (2022). Economic Evaluation and Systematic Review of Salt Marsh Restoration Projects at a Global Scale.



Costs tidal marsh restoration

Trinomics

Cost structure Saltmarsh Code (UK)

- Estimated data range (not reporting on specific projects)
- Costs for applying VM0033 Methodology are expected to be 9x as high

Cost aspect	
Restoration cost (incl. construction)	41 000-52 000 €/ha
Maintenance cost (2-20 years)	124 €/year/ha
Maintenance cost (21-100 years)	62 €/year/ha
Project Design document (Based on UK Peatland Code)	6 157 € (One-off)
Initial Validation Fee	4 926 € (One-off)
Verification cost (by VVB) (Annual verification frequency)	2 462 € per verification

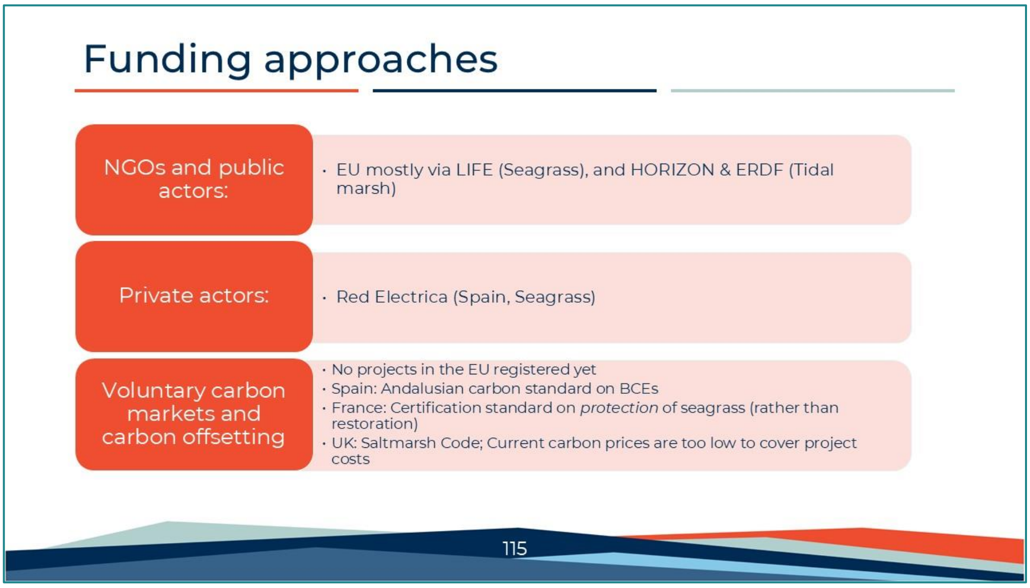
113

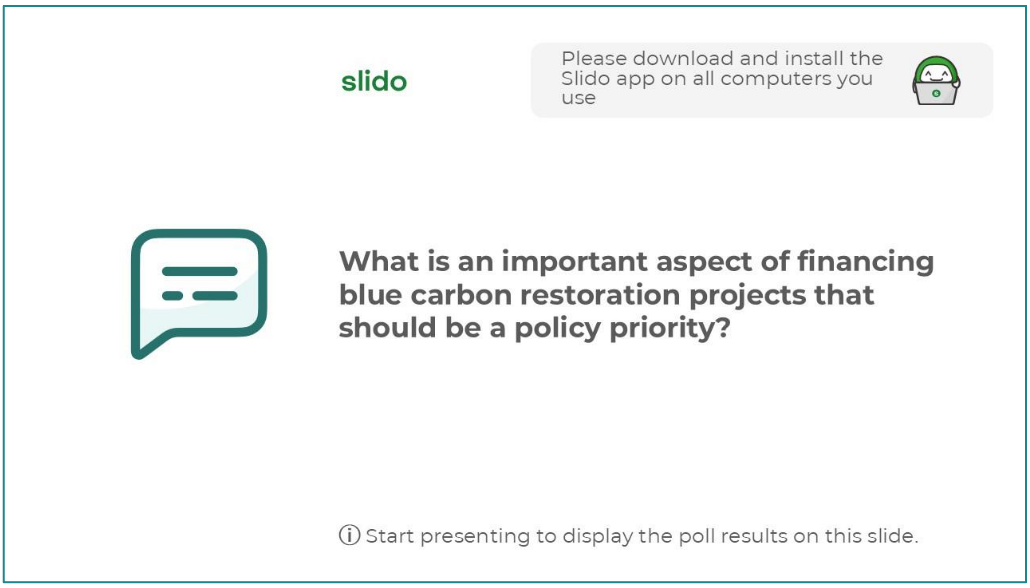
slido

Please download and install the Slido app on all computers you use

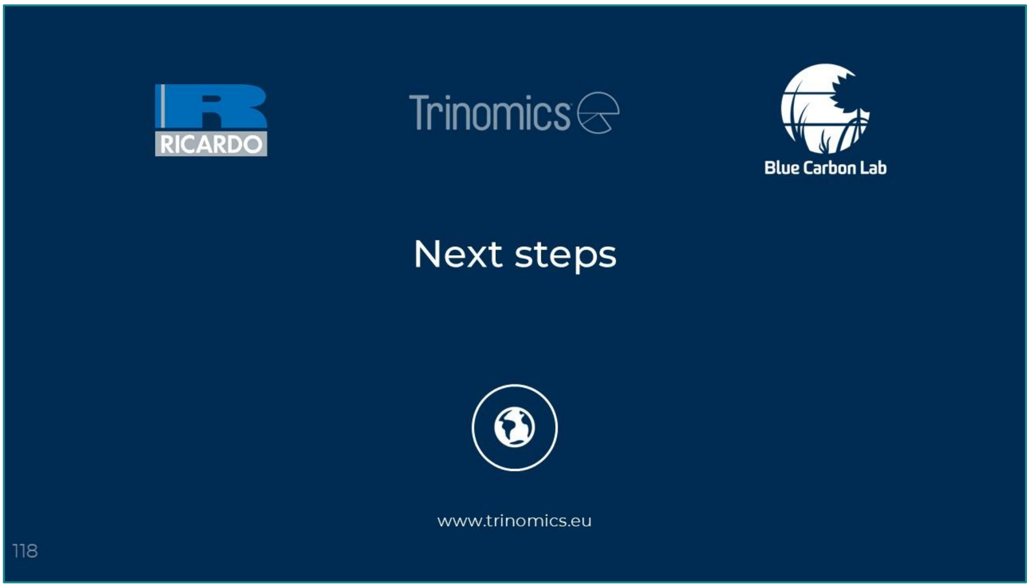
Have we missed any useful sources of cost data for EU restoration projects (saltmarsh or seagrass)?

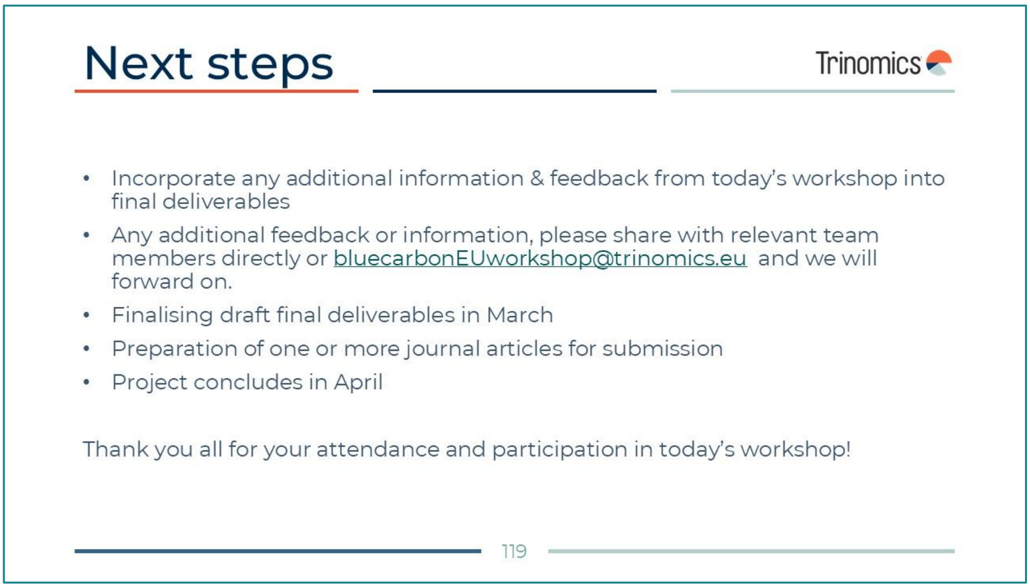
ⓘ Start presenting to display the poll results on this slide.


Funding approaches
NGOs and public actors:
EU mostly via LIFE (Seagrass), and HORIZON & ERDF (Tidal marsh)
Private actors:
Red Electrica (Spain, Seagrass)
Voluntary carbon markets and carbon offsetting
No projects in the EU registered yet
Spain: Andalusian carbon standard on BCEs
France: Certification standard on protection of seagrass (rather than restoration)
UK: Saltmarsh Code; Current carbon prices are too low to cover project costs
115


slido
Please download and install the Slido app on all computers you use
What is an important aspect of financing blue carbon restoration projects that should be a policy priority?
Start presenting to display the poll results on this slide.


RICARDO
Trinomics
Blue Carbon Lab
Feedback from break-out groups
10 minutes per group
www.trinomics.eu
117


RICARDO
Trinomics
Blue Carbon Lab
Next steps
www.trinomics.eu
118


Next steps
Trinomics
• Incorporate any additional information & feedback from today's workshop into final deliverables
• Any additional feedback or information, please share with relevant team members directly or bluecarbonEUworkshop@trinomics.eu and we will forward on.
• Finalising draft final deliverables in March
• Preparation of one or more journal articles for submission
• Project concludes in April
Thank you all for your attendance and participation in today's workshop!
119


RICARDO
Trinomics
Blue Carbon Lab
Thank you!
bluecarbonEUworkshop@trinomics.eu
European Commission
www.trinomics.eu
120

Getting in touch with the EU

In person

All over the European Union there are hundreds of Europe Direct centres. You can find the address of the centre nearest you online (european-union.europa.eu/contact-eu/meet-us_en).

On the phone or in writing

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

– by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),
– at the following standard number: +32 22999696,
– via the following form: european-union.europa.eu/contact-eu/write-us_en.

Finding information about the EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website (european-union.europa.eu).

EU publications

You can view or order EU publications at op.europa.eu/en/publications. Multiple copies of free publications can be obtained by contacting Europe Direct or your local documentation centre (european-union.europa.eu/contact-eu/meet-us_en).

EU law and related documents

For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex (eur-lex.europa.eu).

EU open data

The portal data.europa.eu provides access to open datasets from the EU institutions, bodies and agencies. These can be downloaded and reused for free, for both commercial and non-commercial purposes. The portal also provides access to a wealth of datasets from European countries.

Publications Office
of the European Union