Gap analysis and recommendations for improvement of Environmental Assessment Instruments for enhancing their transformative potential

D2.3 Gap analysis and suggestions of pathways to improving EA transformative potential

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1 Technical references

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- **Practice Note: Integrating Environmental Assessment and the Spatial Planning Process**
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- **Practice Note: Enhancement and Mitigation Catalogue**
  22 pages
- **Practice Note: Tiering in Environmental Assessment**
  21 pages

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3 Key gaps, recommendations and transformative potentials synthesis

This chapter provides a focused summary of the key gaps, opportunities and recommendations identified in WP2 for enhancing biodiversity in spatial planning processes through environmental assessment. It provides a critical analysis of weaknesses in current practices, uncovers untapped opportunities, and explores transformative potentials to strengthen the integration of biodiversity considerations more into planning and decision-making processes.

By addressing these gaps and leveraging these opportunities environmental assessment can play a stronger role in advancing sustainable and biodiversity-oriented spatial planning.

The synthesis is structured into four interconnected analyses and sections:

1. **EA instruments**
   This section provides an overview of the key EA instruments identified in WP2 that are essential for enhancing biodiversity in spatial planning processes.

2. **Key identified gaps**
   This section outlines the critical shortcomings in current practices and highlights opportunities to enhance biodiversity through EA in spatial planning processes.

3. **Specific recommendations for EA**
   Detailed, actionable recommendations are provided to address the identified gaps, with a clear linkage to each gap and its practical implications for improving EA practices.

4. **Transformative potential of recommendations**
   The analysis evaluates how the proposed recommendations align with the transformative change framework outlined in WP4 (D4.3), emphasizing their potential to drive systemic shifts towards sustainability.

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3.1 Environmental assessment instruments

Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) are instruments to ensure that environmental considerations are systematically integrated into planning and decision-making processes. These instruments, designed to for example address impacts, mitigate negative impacts, enhance biodiversity and monitor outcome and ecological development, consists of various components that can broadly be categorised into process-related components, tools/techniques, and approaches to EA.

Figure 1 illustrates the hierarchical structure within EA, delineating the relationship between instruments, their components, and the specific measures for mitigation and enhancement. Importantly, this figure also highlights nine components identified in BioValue as key for enhancing the role of EA as an agent for transformative change.

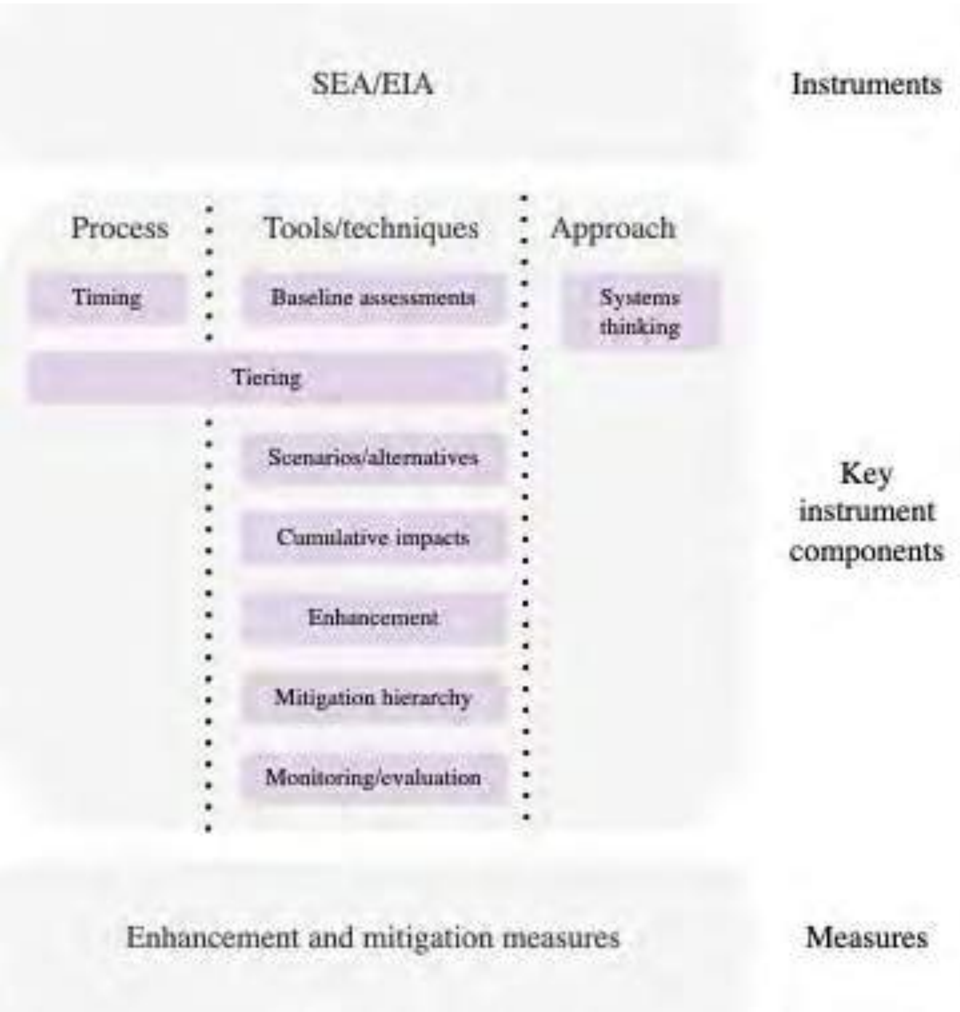

Figure 1 Hierarchical framework of Environmental Assessment Instruments and key components for transformative change.

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The effectiveness of EA instruments, and related components, in promoting transformative change in biodiversity within spatial planning is a complex issue. While the instruments provide a process and 'arena' for addressing biodiversity concerns through which transformation can be facilitated and realised, their mere presence does not automatically guarantee transformative change Their potential to drive transformative change significantly depends on how they are implemented, and the effective use of EA instruments goes beyond routine compliance and requires a proactive engagement.

Table 1 provides an overview of the identified key EA instrument components, including their purpose, application, and role in achieving effective environmental outcomes.

The descriptions are informed by key analyses conducted as part of WP2, including benchmarking, case studies of cumulative impact assessment and tiering, causality mapping based on EA reports analysis, and an evaluation of the integration of EA in spatial planning processes.

The following sections describe the identified gaps in EA practice related to strategic and project level of spatial planning, subsequent recommendations for EA and an assessment of their transformative potentials.

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Benchmarking	*Case studies*	*Causalities & causal-loops*	*Process of spatial planning*	*Critical EA instrument components*	
T2.1, T2.2	*T2.2*	*T2.3*	*T2.3*		
●		●	●	**Mitigation hierarchy**	The mitigation hierarchy is a core instrument in EA, guiding the implementation of measures to address the identified negative impacts on the environment through the avoidance, minimization, reparation or off-setting of impacts. The instrument provides a structured, sequential framework, prioritizing actions that avoid harm while minimizing reliance on repairing or offsetting.
●		●	●	**Enhancement**	Enhancement is a proactive instrument in EA, focusing on the implementation of measures that improve current baseline conditions rather than merely mitigating harm. Enhancement aims to achieve net-positive environmental outcomes and alignment with biodiversity goals.
	●		●	**Tiering**	Tiering facilitates communication and coordination between different levels of planning. The instrument ensures that insights, decisions, and priorities are passed between higher-tier and lower-tier levels assessments.
●	●		●	**Cumulative assessments**	Cumulative assessments are instruments designed to evaluate the aggregated impacts of multiple activities from different planning activities within the same area. The instrument aims to capture the broader, systemic interactions that contribute to biodiversity loss or gain, which is essential for understanding how individual impacts can accumulate in time and space.
●			●	**Baseline assessments**	Baseline assessment provides a comprehensive assessment of current environmental conditions within a planning area. The instrument establishes a reference point against which potential impacts of plans or project can be measured.
			●	**Scenario development/ alternatives**	Scenario and alternative development is an essential instrument for exploring different options for a given plan/project. It supports decision-makers in understanding trade-offs and benefits of certain e.g., design and location decisions.
●			●	**Monitoring/ evaluation**	Monitoring and evaluation is an instrument in EA designed to track the implementation and effectiveness of proposed mitigation and enhancement measures, ensuring compliance with biodiversity commitments, and providing feedback for adaptive planning and management.
		●	●	**Systems thinking**	Systems thinking is an instrument that recognizes the interconnected nature of activities, impacts and measures within complex socio-ecological systems. It provides a framework to identify leverage points – key areas where interventions can create significant positive changes – and assess how actions compromise or enhance these points.
●			●	**Process timing/ integration**	Timing and integration are critical instruments in and for EA, ensuring that the EA process aligns with the planning cycle. Proper timing ensures that EA insights influence key decisions early, avoiding reactive measures, while integration ensures that environmental and biodiversity priorities are incorporated into planning frameworks.

Table 1 Selected components in the EA instruments in WP2 analyses.

3.2 Key gaps identified in WP2 analysis of EA practice

Chapters 5 to 10 below introduce many more gaps than the ones proposed in Table 2 all of which contribute to understandings of the instrument components, their weaknesses and potentials for contributing to transformative change. The chapters thereby present more detailed insight into the comprehensive list of gaps, while this section is a synthesis of the *key* gaps identified. The selection is informed by the analyses (benchmarking, case studies, causalities and causal loops, and alignment with the planning process) conducted throughout the project and described in Chapters 5 to 10 in this report.

#	Description	Explanation
Gap 1	Limited integration of SEA in spatial planning processes	Current practices often delay the integration of SEA until after a plan has been drafted, significantly limiting its influence on planning outcomes. This delayed approach prevents SEA from effectively guiding critical decisions during the formative stages of the planning process.
Gap 2	Linear thinking in EA	A persistent challenge in both EIA and SEA is the reliance on linear frameworks that oversimplify the relationships between activities, impacts, mitigation measures, and their effects on biodiversity. This approach typically describes impacts as a straightforward sequence—where an activity leads to an impact, mitigated by specific measures—without recognizing the complex and dynamic nature of ecological systems. This oversimplification compromises the ability of EA to effectively safeguard biodiversity and support ecosystem resilience.
Gap 3	Disrupted tiering	The case studies reveal a gap in practice with disrupted tiering. While delegated tiering – where higher-level SEAs transfer assessment responsibilities to lower-level SEAs or EIAs – is sometimes implemented effectively, it is often unfulfilled, undermining its potential benefits.
Gap 4	Inadequate baseline studies	When baseline studies focus narrowly on immediate plan/project areas, the broader ecological context such as regional biodiversity networks, cumulative environmental pressures and connectivity are neglected. E.g. an EA for an infrastructure project may consider local species population but fail to account for its contribution to regional habitat fragmentation.
Gap 5	Limited development and use of scenarios and alternatives	EA practices underutilize scenarios and alternatives, limiting their potential to guide sustainable decision-making in spatial planning processes. Alternatives are frequently narrow in scope, focusing on minor variations rather than exploring diverse development pathways, including enhancement-focused options. Further, scenarios tend to overlook long-term impacts, cumulative effects, and trade-offs between biodiversity and other objectives in planning.

Gap 6	Insufficiently addressing cumulative impacts	Cumulative impacts can lead to significant biodiversity loss, habitat degradation, and ecosystem disruption, even when each activity's impact appears minimal in isolation. Current EA practices often fail to adequately address these dynamics, limiting their capacity to safeguard biodiversity.
Gap 7	Limited use of enhancement and vague implementation requirements	One significant gap in current EA practices is the minimal focus on proactive enhancement of biodiversity. Especially at the project level (EIA), measures predominantly aim to minimize or reduce negative impacts rather that to proactively avoid harm or enhance biodiversity. This reactive approach limits the transformative potential of EA to drive biodiversity gains. Moreover, even when enhancement measures are proposed, their implementation can be undermined by vague implementation requirements.
Gap 8	Reactive use of the mitigation hierarchy and limited enforcement of mitigation measures	The mitigation hierarchy is designed as a sequential framework for avoiding, minimizing, and compensating for environmental impacts. However, in practice, it is often applied reactively, focusing on mitigation and compensation after impacts have been identified, rather than proactively avoiding them at the outset. This reactive approach diminishes the hierarchy's potential to drive strategic, preventive actions. While EA serves as a decision-support tool, it can lack mechanisms to ensure implementation of proposed measures. Weak binding language, insufficient monitoring frameworks, and a disconnect between EA recommendations and permitting processes can result in measures being overlooked or poorly enforced.
Gap 9	Inadequate monitoring and evaluation	When monitoring and evaluation in EA lack comprehensive plans, clear targets, and strong links to baseline data, it limits their ability to be informed by dynamics in ecological systems and measure the effectiveness of mitigation and enhancement measures. Stakeholder engagement in monitoring is minimal, reducing transparency and collaboration.

Table 2 Key identified gaps of environmental assessment practice.

3.3 Recommendations for improving EA

This section presents recommendations aimed at enhancing the effectiveness of EA instrument components within the spatial planning process. These recommendations are designed to refine and enhance the integration of environmental considerations into planning decisions. By doing so, they ensure a more profound incorporation of biodiversity, ecosystem services and sustainability considerations into the planning process.

Table 3 presents specific pathways for advancing EA practices. Each recommendation addresses distinct identified gaps in current practice, providing clear and actionable guidance for both practitioners and policy makers.

	Description	Explanation	Addresses gap
#			#
Recommendation 1	Integrating SEA into the vision building	Early integration of SEA enables planners to embed biodiversity and ecosystem service (ESS) priorities into the policy agenda from the outset. By identifying key environmental challenges and opportunities, SEA ensures strategic planning aligns with biodiversity goals, such as habitat restoration and ecosystem connectivity. This approach establishes clear benchmarks, drives visionary planning policies, and enhances habitat size, quality, and connectivity, while proactively mitigating unintended biodiversity impacts and other sustainability impacts.	**1** (2, 7)
Recommendation 2	EA built upon systems thinking	Breaking conventional linear approaches within EA to adopt systems thinking allows for spatial planning that has a more comprehensive understanding of interrelations between activities, impacts, enhancement and mitigation. Doing so allows for the visualization of complex socio-ecological systems and brings attention to critical leverage points and systemic feedback loops that have a crucial role in supporting biodiversity objectives. It also aids in the identification of root causes so that impacts can be thoroughly and proactively addressed. Causal-loop diagrams can be one approach to gaining an overview of a complex system. Ideally, an overview of the complex systems informs early planning processes, especially regarding scenario development, design decisions and the application of enhancement measures.	**2** (1, 7, 8)

Recommendation 3	Successfully implemented tiering	To address the challenges posed through disrupted tiering and to ensure the coherency and coordination of planning levels, it is crucial that tiering is effectively and successfully implemented in both higher- and lower-tier EAs. This includes ensuring that lower-tier SEAs and EIAs adhere to and implement the tiering that is delegated to them from higher-tier SEAs and that higher-tier SEAs make use of insights collected for preexisting plans and projects in the area. This is also a matter of increased transparency of tiering by explicitly mentioning when insights are gained from other planning levels. Tiering can inform baseline studies, the development of alternatives, assessment of impacts, application of enhancement, mitigation measures, and monitoring measures. Addressing potentials for tiering early in the EA process allows for planning that is better aligned with strategic decisions.	**3** (1, 4, 5, 6, 7, 8, 9)
Recommendation 4	Broadening baseline studies in the diagnosis phase	In the diagnosis phase of spatial planning processes, baseline studies must adopt a broader, systems-oriented approach to provide a comprehensive understanding of existing conditions. This includes expanding the scope to include regional biodiversity networks, habitat connectivity, and cumulative pressures. Identifying vulnerabilities, such as areas prone to habitat fragmentation, should be a priority during this phase to guide enhancement and mitigation measures. Additionally, baseline studies should be integrated into monitoring frameworks to track biodiversity and ecosystem changes over time, enabling adaptive planning and management. Collaboration with e.g. local communities, conservation groups and regional network with other authorities is essential to share data and knowledge, and coordinate planning.	**4** (1, 2, 6, 7, 8, 9)
Recommendation 5	Enhancing the development and use of scenarios and alternatives in the strategy stage	To address the underutilization of scenarios and alternatives in EA, practices should broaden the scope of alternatives to include diverse, enhancement-focused options such as green infrastructure and habitat connectivity. Scenarios must incorporate long-term and cumulative impacts, exploring trade-offs and synergies between biodiversity and other planning objectives. By embedding scenario testing and alternative development directly into the strategy stage of spatial planning, EA can help shape sustainable pathways from the outset. This integration ensures that planning strategies consider long-term and	**5** (1, 2, 6, 7)

		cumulative impacts, align with biodiversity priorities, and balance trade-offs effectively. Enhanced stakeholder engagement further strengthens the EA and planning process.	
Recommendation 6	Addressing cumulative impacts	To achieve a comprehensive and complete overview of potential impacts and their significance for biodiversity, EA practice should place greater focus on uncovering and effectively assessing cumulative impacts. This involves accounting for past, present, proposed, and future plans and projects that coincide in either time or space and determining the potential aggregate impacts they may give rise to. Addressing cumulative impacts recognizes that planning activities do not occur in isolation of one another and neither do the corresponding impacts, and thereby also supports a systemic approach to impact assessment.	**6** (2, 8, 9)
Recommendation 7	Improving focus on and enforcement of enhancement measures	Increased application of enhancement measures can be a way of supporting the shift from the traditional no-net loss mindset, aimed at avoiding and remedying impacts, to a net-gain mindset, where biodiversity conditions are improved beyond current baseline conditions. If enhancement measures gain larger traction within EA and are more effectively enforced, then spatial planning has the potential to support and enhance biodiversity and evoke a transformative potential. Enhancement measures are best applied proactively within the planning process where opportunities for influencing plan and project design are greatest.	**7** (5, 9)
Recommendation 8	Strengthening proactive application and enforcement of the mitigation hierarchy	To address the reactive use of the mitigation hierarchy and weak enforcement of mitigation measures, EA processes must adopt a more proactive and enforceable approach. The mitigation hierarchy should be integrated at the earliest planning stages to prioritize the avoidance of impacts before decisions are made. Alternative analysis must explicitly evaluate options that prevent harm. Mitigation measures should be formulated with enforceable language, such as "must" rather than "should" and aligned with legal and regulatory frameworks to ensure binding commitments during approval and/or permitting. Robust monitoring must track implementation and effectiveness of these measures. Additionally, capacity building should be prioritized, securing practitioners with the skills and resources to apply the hierarchy consistently and proactively.	**8** (5, 9)

Recommendation 9	Enhancing application of monitoring and evaluation in EA	To address the gaps in monitoring and evaluation, comprehensive monitoring with clear targets aligned to baseline data should be established to track biodiversity and ecosystem changes over time. Incorporating system-level indicators can help monitor long-term outcomes, such as habitat connectivity or species recovery, and provide ongoing feedback for future planning cycles. Feedback loops must evaluate the effectiveness of mitigation and enhancement measures, enabling adjustments and informing future planning. Creating learning loops is critical for adaptive management Improving the practice of monitoring and evaluating within EA ensures the measurement of how effective implemented enhancement and mitigation measures are. It also has the potential to support baseline assessments. Monitoring can be supported by stakeholders/citizens science data collection which can also increase their engagement and capability building.	**9** (1, 2, 4)

Table 3 Recommendations for tackling the identified gaps and improving environmental assessment.

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3.4 Transformative potential of recommendations for EA

The following section analyses the recommendations outlined in Table 3 in relation to the ambitions for determining the transformative potential of applying the instrument components identified in Table 1.

All contributions are determined to be potentially positive and are therefore all green. However, the distinction between dark and light green comes down to how direct the contribution is expected to be. Dark green is therefore seen as a direct positive impact, while light green is circumstantial and/or indirect. The bullet points in the table elaborate upon the foreseen potentials regarding the three ambitions. The actual potential is, in all cases, circumstantial, and depends on how and to what extent the recommendations are followed.

The coding assigned in Table 4 are based on an assumed compliance with the entirety of the recommendation, referring here to the descriptions provided in Table 3.

	Ambition 1 **Spatial planning safeguards, restores, allows recovery, and enhances biodiversity**	**Ambition 2** **Spatial planning significantly contributes to balanced and responsible consumption and production without external social and environmental costs**	**Ambition 3** **Spatial planning significantly contributes to reducing socioeconomic inequalities, for example, in urban areas**
Recommendation 1: Integrating SEA into the vision building	• Embeds biodiversity in policy objectives and ensuring strategic planning that aligns with goals • Enhances habitat size, quality and connectivity	• Promotes planning oriented at responsible use of available land that is coordinated with strategic goals	• Provides potential for embedding social and economic objectives in the planning of urban areas • ESS that promotes biodiversity can also provide socioeconomic benefits
Recommendation 2: EA built upon systems thinking	• Helps identify targeted leverage points for enhancing biodiversity • Visualizes systemic relations between activities, impacts and measures	• Places focus on strategic consumption and use of areas with the greatest potential to safeguard and enhance biodiversity and identifies related leverage points	• Allows for understanding the entire system within which biological and social systems interact and identifies related leverage points
Recommendation 3: Successfully implemented tiering	• Ensures biodiversity goals from higher-tier SEAs are implemented in lower-tier planning • Supports proactive enhancement and mitigation measures	• Promotes resource-efficient planning through better tier coordination • Aligns strategic objectives with lower-tier plans to minimize environmental costs	• Prioritizes equitable urban planning through consistent integration of higher-tier insights • Prioritizes underserved areas for balanced resource distribution.
Recommendation 4: Broadening baseline studies in the diagnosis phase	• Expands baseline studies to include biodiversity networks and cumulative pressures • Identify vulnerabilities like habitat fragmentation to guide enhancement and mitigation	• Promote comprehensive data to support sustainable resource use • Aligns planning with ecological conditions to balance development and biodiversity	• Promotes stakeholder collaboration for inclusive data collection and planning • Improves environmental outcomes in underserved areas through shared knowledge
Recommendation 5: Enhancing the development and use of scenarios	• Broadens alternatives to prioritize biodiversity, including green	• Explores alternatives that aligns with responsible resource use	• Designs alternatives that improve access to ESS in underserved areas

and alternatives in the strategy stage	infrastructure and habitat connectivity • Incorporates long-term and cumulative impacts into planning strategies		• Enhances stakeholder engagement for inclusive planning
Recommendation 6: Addressing cumulative impacts	• Assesses aggregate impacts to ensure comprehensive protection and restoration • Adopts systemic planning to manage interconnected impacts and enhance resilience	• Evaluates cumulative effects to minimize environmental costs • Addresses overlapping impacts across sectors for responsible resource use, like land	• Ensures balanced distribution of environmental benefits across communities
Recommendation 7: Improving focus on and enforcement of enhancement measures	• Promotes a net gain mindset, improving to improve biodiversity beyond baseline conditions • Ensures proactive and enforceable enhancement	• Offset environmental costs of resource and land consumption through biodiversity gain • Integrated enhancement into planning	• Enhances environmental quality and access to ESS in underserved areas • Contributes to better health and well-being through e.g. improved green spaces
Recommendation 8: Strengthening proactive application and enforcement of the mitigation hierarchy	• Prioritize avoidance and proactive mitigation to minimize harm and support biodiversity recovery • Ensures enforceable measures	• Promotes harm-preventing alternatives to reduce environmental costs • Strengthen enforcement for sustainable and responsible resource use, e.g. land take	• Promotes equitable application of mitigation measures, benefitting underserved communities
Recommendation 9: Enhancing application of monitoring and evaluation in EA	• Tracks biodiversity changes and evaluates mitigation and enhancement measures' effectiveness • Strengthen baseline assessment to support biodiversity-sensitive planning	• Monitor impacts of land use to align with sustainable land use and changes. • Refines strategies through feed-back loops	• Enhances transparency and inclusivity through stakeholder engagement in monitoring

Table 4 Assessment of the transformative potential of recommendations for environmental assessment.

4 Introduction to gap and potential analysis for Environmental Assessment Instruments

This document is a formal deliverable D2.3 within Work Package 2 (WP2) of the BioValue project. Task 2.4 focuses on identifying gaps in current Environmental Assessment Instruments (EAI) practices and recommending improvements to enhance their transformative potential in promoting biodiversity value. This task aligns closely with the main goal of the BioValue project which is to: "safeguard and increase biodiversity through transformative change in spatial policymaking, planning practices and infrastructure development, upscaling opportunities for valuing biodiversity".

4.1 The basis for the gap analysis and recommendations

The basis for this task lies in the benchmark established in T2.1 and its systematic analysis against findings from T2.2 and T2.3. This benchmark analysis allows for a structured evaluation of how existing EA practices align – or fail to align – with best practices for integrating biodiversity considerations into EA. The work further incorporated insights from the Causal Loop Tool developed in T2.2, which was applied across the three project arenas (Trento, Mafra and Meck-Pom) to reveal the complex feedback loops and interactions between EA processes, biodiversity impacts, and spatial planning objectives.

The analysis is further informed by case studies that explore the integration of EA processes with tiering in spatial planning and the handling of cumulative impacts. The case studies provide real-world examples of how EA frameworks are implemented at different levels of planning and their effectiveness in addressing cross-scale and cumulative biodiversity impacts. The case study approach has been instrumental in identifying practical challenges and opportunities for improving tiering mechanisms and cumulative impact management within EA.

Task 2.4 also draws on data and insight from other work packages, including T1.2, T3.2 and T4.3, to ensure a comprehensive and interdisciplinary perspective. This integration enables the deliverable to go beyond isolated assessments, offering a broader view of how EAI can better support spatial planning and infrastructure development while enhancing biodiversity value.

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4.2 Key themes

The deliverable addresses several critical themes, each supported by targeted recommendations designed to improve practice and policy:

1. **Integration of EA with spatial planning**
Effective coordination of SEA and EIA with spatial planning processes is essential for embedding biodiversity objectives early in the planning cycle. This theme highlights the importance of ensuring EAs are not standalone exercises but integral instruments that guide strategic decision-making, helping to align spatial plans with long-term biodiversity and sustainability goals. examining how better coordination of SEA and EIA with spatial planning processes is crucial to embedding biodiversity objectives from the outset.

2. **Adopting systems thinking in spatial planning**
Systems thinking, exemplified by the Causal Loop Tool developed in T2.2, offers a robust framework for understanding the interconnected dynamics between spatial planning decisions and biodiversity outcomes. By identifying leverage points, feedback loops, and systemic interactions, this approach enhances the ability of planners and practitioners to anticipate cascading effects and address root causes of biodiversity degradation.

3. **Enhancement and mitigation measures in planning**
This theme focuses on the comprehensive catalogue of measures tailored to spatial planning to support biodiversity. The catalogue integrates findings from T2.2 and case study insights to offer actionable strategies and help transition EAs from reactive mitigation instruments to proactive frameworks for ecological resilience.

4. **Tiering in spatial planning**
Tiering is examined tiering as a mechanism for creating coherence across different spatial planning scales. By linking assessments and decisions across strategic levels (e.g. national or regional plans) to local planning and project-level implementation, tiering ensures alignment and consistency.

5. **Addressing cumulative impacts in spatial planning**
Cumulative impacts, such as habitat fragmentation and cross-sectoral pressures, require a more integrated approach in spatial planning. This theme emphasizes the necessity of methodologies that capture long-term, systemic biodiversity impacts and provide practical solutions to manage and mitigate these effects.

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4.3 Document structure

To ensure clarity and accessibility, the document is divided into six major chapters, each addressing key aspects of the findings, presenting both identified gaps and recommendations for enhancing EA practices within spatial planning frameworks:

Chapter 5 **Benchmark and benchmark analysis**
Discusses the benchmark established in T2.1, comparing it with findings from T2.2 and T2.3. This chapter identifies critical gaps in existing EA practices and highlights potentials for better integrating biodiversity considerations into spatial planning.

Chapter 6 **The Causal Loop Tool**
Details the development and application of the Causal Loop Tool, emphasizing its role in uncovering systemic interactions, identifying leverage points, and supporting transformative pathways in spatial planning processes.

Chapter 7 **Integration of Environmental Assessment with the spatial planning processes**
Explores both challenges and opportunities for aligning EA processes with spatial planning processes. It provides strategies for embedding biodiversity considerations into planning from the outset, enabling more proactive and effective outcomes.

Chapter 8 **Enhancement and mitigation**
Focuses on the development of a comprehensive catalogue of biodiversity mitigation and enhancement measures. This chapter integrates insights from causality analysis in T2.2, case studies, and practical applications to demonstrate how these measures can strengthen spatial planning practices.

Chapter 9 **Tiering across levels of assessment and planning**
Examines tiering as a tool for creating coherence between strategic and project level assessment and planning. This chapter identifies gaps in EA practices and explores potentials for strengthening the connection across spatial planning scales, drawing on case studies of both land-based and off-shore spatial planning.

Chapter 10 **Cumulative impacts**
Discusses approaches for managing cumulative biodiversity impacts. This chapter emphasizes gaps in addressing these impacts and highlights methods, including scenario-based approaches, for integrating cumulative impact considerations into EA for spatial planning.

To complement the chapters, three annexes provide additional detail and practical guidance. These practice notes are designed to translate analytical insights into actionable recommendations:

- **Integration practice note**: practical guidance for improving the integration of EA processes and content, along with the Causal-Loop Tool with the spatial planning process.
- **Enhancement and mitigation catalogue practice note**: A detailed compilation of enhancement and mitigation measures to support biodiversity in EA practices.
- **Tiering practice note**: Recommendations and examples for strengthening tiering mechanisms in EA, based on case studies and practical insights.

5 Benchmarking Environmental Assessment practice

As stated previously, the analysis presented here is based on the benchmark developed in Task 2.1 (Larsen et al., 2023). Here, best practice articulated in guidance documents by various organisations focussed on how to integrate biodiversity in EA is synthesised into a benchmark against which current practice can be measured. In Task 2.2 the best practice synthesised in the benchmark is compared to practice in EA reports from Denmark, Spain, Portugal and Germany (Larsen et al., 2024).

5.1 Gap analysis

In very broad terms, the comparison between current practice and the benchmark for best practice shows a significant gap where current practice does not live up to best practice. Looking more closely at the themes of the benchmark, the picture is more nuanced. There are two themes where the gaps are smaller, which are examined in this section and six themes where the gap is more significant. The larger gaps are where the potential for development is considered to be, and these gaps are thus also examined in the following section 5.2.

The gap between best practice and current practice is less apparent when it comes to two themes:

- Assessing significance
- Monitoring

Assessing significance concerns what methodology is used to evaluate the significance of biodiversity impacts as well as what parameters are used as the basis for the evaluation. Although there are differences between countries and types of reports, most EA reports use one or more established methods and rely on one or more parameters for evaluation. Thus, methods including comparing impacts to a reference situation, comparing impacts to thresholds, criteria or targets and comparing impacts to sensitivity of the impacted entity are all widely used. Evaluations are to a wide extent based both on parameters related to the characteristics of the activity or impact and the characteristics of the impacted biodiversity.

Looking to monitoring and follow-up, this is focused on several issues. One is whether and how the EA specifies plans for monitoring, another is what the aim of monitoring is and the last is how knowledge built from monitoring is to be used. Again, there are differences in results between the countries, and especially Denmark stands out as having larger gap between current practice and best practice than the other countries. Apart from Denmark, most reports establish plans for monitoring and a relatively large amount also include clear targets, indicators and responsibilities for monitoring and have clear links to sound baseline information. A gap in this regard is that much fewer reports specify plans to engage with stakeholders in relation to monitoring. Concerning how the results of monitoring are used, there is a gap between current practice and best practice, as most reports specify that monitoring should be used for implementing adaptive management, while much fewer point to building knowledge and checking compliance as end results.

As stated for six themes there are significant gaps between current practice and best practice. The themes are:

1. In adequate integration of multidisciplinary knowledge
The gap lies in a strong reliance on technical expert knowledge rather than also using multidisciplinary knowledge and local and indigenous knowledge that are crucial for holistic environmental assessments.

2. Poor management of synergies and trade-offs
Synergies and trade-offs are to some extent acknowledged in general, but the gap consists of the fact that specific synergies and trade-offs are not identified, managed and considered in decision-making.

3. Insufficient mapping and valuation of ecosystem services
These are similarly to synergies and trade-offs mentioned and acknowledged, but the gap emerges as they are not mapped, identified, assigned value, evaluated, mitigated and monitored, which limits the effectiveness of EA outcomes.

4. Lack of systematic goals and vision alignment
The gap consists of most reports not working specifically and systematically with goals and visions through including existing priorities and targets, deciding on a vision or applying an ecosystem-based approach.

5. Inadequate handling of uncertainty and transparency
The gap is found both in ensuring transparency about uncertainty and handling it more actively e.g. through a precautionary approach, identifying knowledge gaps and gathering information.

6. Deficient application of mitigation and enhancement strategies
There is still a gap in using the mitigation hierarchy explicitly and systematically and further in systematically mitigating based on residual impacts. Furthermore, there is a notable gap related to going beyond mitigation and proactively enhancing biodiversity values to achieve a net positive biodiversity impact.

The recommendations for closing the gaps between current practice and best practice are described in the following section.

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5.2 Recommendations

In general, the gap analysis identifies a large potential to improve the integration of biodiversity in EA by including more of the elements pointed out in the benchmark of best practice. Going back to the reasoning in guidance documents for why specific elements are important for best practice, the identified recommendations are elaborated in the following. Specifically, there has been identified recommendations to:

a. Supplement the use of expert knowledge with knowledge from other disciplines as well as local and indigenous knowledge

Based on the guidance documents, the potential is in a way a very practical one, where multiple perspectives including the local or indigenous perspective provides the best assessments and solutions. This broad-based approach acknowledge how closely biodiversity is linked to cultural, social, economic and other biophysical factors. Further, the potential lies in a recognition that norms and (local) value systems are important for determining and assessing impacts, enabling EA are both comprehensive and context-specific.

b. Going beyond acknowledging synergies and trade-offs to also identify, manage and take them into account

Trade-offs pose risks that decision makers need to be aware off, and the shift from merely acknowledging to actively identifying, managing and integrating synergies and tradeoffs is one of the established potentials of EA. Given the intricate connections biodiversity and cultural, social, economic and other biophysical factors, understanding these dynamics is essential for mitigating and enhancing biodiversity through EA.

c. **Including ecosystem services in the assessment from mapping them to monitoring them**

A potential of integrating ecosystem services in EA is, according to the guidance documents, that they are values for society and that mitigating impact on them can save costs of replacing or compensating. Integrating ecosystem services in EA can reveal how people, nature and activities rely on ecosystem services and impacts of the activity under assessment is compatible with other needs for ecosystem services. Such knowledge is a prerequisite for safeguarding ecosystem services and securing a balanced and fair exploitation.

d. Integrating biodiversity goals and visions as a framework for assessment

Based on the guidance documents, the potential of integrating biodiversity goals and visions is fundamentally the opportunity of steering the EA as a tool to achieve wider sustainability objectives. This can be through using the goals and visions as screening criteria, criteria for impact valuation and generally as measurable standards or indicators of acceptable/unacceptable change against which to measure impacts, which can be hard to measure numerically. The use of goals and visions also has potential to help guide decisions on trade-offs.

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e. **Ensuring transparency about uncertainty as well as taking action to handle uncertainty**

The point of departure in guidance documents is being transparent about uncertainty provides a potential for 'filling' knowledge gaps to support decision-making. The potentials of transparency and action on uncertainty includes using a precautionary approach and providing better and more flexible decisions. In the end the potential includes to securing that impacts are not underestimated, that unforeseen impacts can be addressed, and that action is taken on uncertain impacts rather than waiting till it is too late because there is uncertainty or missing information.

f. **Going beyond mitigating to prevent harm and move towards using a structured approach to mitigating as well as enhancing biodiversity**

Based on the guidance documents, the potential in moving beyond preventing harm is connected to the problems with especially compensation or off-setting. It is not always possible to compensate or off-set, rather damage can be irreversible, and lost biodiversity can be irreplaceable. Similarly, it is an issue that effects on biodiversity is cumulative over time, and an impact that may in isolation be mitigated to a point where it is insignificant the impact might over time be significant in cumulation with other impacts. Thus, the potential lies in not relying on off-setting or compensating but rather avoiding impacts or enhancing positive impacts to maintain and build up biodiversity values also over time.

g. Implementing monitoring frameworks, especially at the strategic level

Although the analysis of monitoring of biodiversity showed that it is mainly Danish EA monitoring practices that do not live up to best practice frameworks, it is relevant to propose a general recommendation to strengthen especially the strategic approach to monitoring, in which monitoring frameworks are proposed at higher-tier SEAs that facilitate monitoring measures in lower-tier SEAs and EIAs.

6 The Causal Loop Tool for systems thinking and biodiversity through EA

Systems thinking perspectives were integrated through the development of a causal-loop tool described in Deliverable 2.2 (Kørnøv et al.) and further application in the three arenas. The overall purpose of integrating systems thinking in environmental assessment is to shift from linear to circular thinking to better approach and integrate complex systems and interrelations within spatial planning. The deliverable begins by presenting causal-loop diagrams for biological principles that are critical for supporting and enhancing biodiversity, namely species-area relations and source-sink dynamics. Based on the causal-loop diagrams and the loops effectuate, three crucial leverage points of particular significance to enhancing biodiversity were identified: area for habitat, quality of habitat, and connectivity of habitat. These leverage points are mechanisms that can be impacted by decisions made within spatial planning and where spatial planners play a crucial role in ensuring their enhancement.

The report then delves into four cases related to spatial planning and/or linear infrastructure development: i. the conversion of agricultural land, ii. habitat conversion, iii. habitat fragmentation and iv. new habitat development. These cases have the potential to impact biodiversity and as such, are relevant for ensuring the enhancement of the biological leverage points. Causal-loop diagrams are presented for the four cases, which draw upon insight from existing EAs and depict the feedback loops between activities, impacts, mitigation and enhancement. A more detailed description of the methods and results can be accessed in the deliverable report (Kørnøv et al. 2024). An outline of how the causal loops leverage the spatial planning process is provided in practice note, *Integrating Environmental Assessment and the Spatial Planning Process* (Kørnøv 2024).

6.1 Gap analysis

The investigation of impacts and the application of causal-loops and systems thinking revealed several gaps in practice:

1. **Predominance of linear thinking in EA**

Impacts are often described linearly, such that an activity leads to an impact, which is mitigated through the implementation of measures, without recognizing how these activities, impacts and measures relate to and affect the embedded system. This compromises a complete understanding of the systemic relations between entities within the system and a recognition that, for instance, the application of mitigation measures may remedy one impact, but may cause another.

6.2 Recommendations

The gap analysis identifies the tendency to think linearly when identifying and assessing impacts, disregarding potentials for contextualising them within the larger systems that they are embedded within. The following recommendation calls for adopting a systems thinking approach to EA to reap the benefits that come when recognizing that impacts are not isolated occurrences.

a. Shift from linear to systems thinking

Systems thinking can challenge the otherwise linear thinking often practiced in EA. There are many different approaches to systems thinking, but the study conducted for BioValue has developed causal loop diagrams as a way of illustrating the identified spatial planning scenarios in relation to biodiversity impacts. My mapping the system, the study has illustrated that causal loop diagramming as a form of systems thinking can bring value to EA by:

- **Identifying systemic feedback loops:** Connecting activities, impacts, recipients and mitigation and enhancement measures into systems, makes it possible to identify where the different variables begin influencing each other and where potential feedback loops risk exacerbating impacts. Being aware of these feedback loops helps to qualify impact assessments by ensuring that the impacts are not assessed in isolation, but rather as factors in a larger system that can bring about detrimental and unintended consequences.

- **Identifying leverage points:** Identifying feedback loops allows for identifying those variables of the system that are most critical in supporting desirable feedback loops or have the potential to disrupt undesirable feedback loops. These variables are called leverage points and are areas where particular attention should be paid. In the study conducted for this project, leverage points were identified for biological systems, for spatial planners and for governance levels.

- **Visualizing complex systems:** The causal loop diagrams also allow for visualizing and connecting various systems and linking leverage points from these systems to one another. In this study, biological systems relate to spatial planning systems and to governance systems, as are their respective leverage points. Doing so also illustrates the influence that the decisions made through spatial planning, which are preferably informed and guided by EA processes, are crucial for maintaining and supporting biological and governance systems.

- **Connecting EA to objectives:** Connecting systems can also bring to light how spatial planning relates to societal or political objectives. In the causal loop diagrams created in this study, the objectives pertain to the enhancement of biodiversity, meaning that the objectives are those represented by the biological principles and their associated leverage points. Therefore, the diagrams become visual representations of how spatial planning relates objectives and through the polarity of the interrelations, whether certain spatial planning decisions contribute to or delay the fulfilment of these societal objectives.

- **Root-cause identification:** Systems thinking also has the potential of tracing problems to their roots, meaning that a prescribed cause based on a linear approach to impacts (e.g. the associated activity) may in fact prove to be entirely different when put into the perspective of the entire system. By connecting different systems, it is possible to identify variables that drive certain parts of the system, meaning that the root cause of an identified impact may be a matter of governance decisions that drive the given activity. Understanding root causes within EA can enhance its decision-support potential and allow for the proposal of enhancement and mitigation measures that appropriately and effectively address impacts.

7 Integration of EA and Causal-Loop Tool with the Spatial Planning Process

This section outlines the gaps and recommendations related to the use of Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) in spatial planning processes, as informed by the practice note "Integrating Environmental Assessment and the Spatial Planning Process" developed under the BioValue project. Drawing from the insights and methodologies proposed in the practice note, the text highlights key challenges and opportunities for integrating environmental considerations into planning frameworks to enhance biodiversity outcomes.

This analysis is included as Appendix A to the deliverable report to provide supplementary insights for practitioners and policymakers aiming to strengthen the role of EAs in spatial planning.

7.1 Gap analysis

1. Late integration of EA in planning cycles and fragmented processes

Environmental assessments are often integrated too late in the planning process, significantly limiting their influence on strategic decisions and planning outcomes. Furthermore, a lack of integration between EA processes and spatial planning stages can result in fragmented processes, hindering opportunities for synergy and comprehensive decision-making. The BioValue project provides critical examples of these challenge:

- *Experience from Mafra, Portugal*: At the municipal level, the last SEA undertaken for the spatial planning process was conducted too late to have a meaningful impact on the planning document. As a result, key environmental considerations were overlooked, and the assessment failed to influence the outcomes effectively.

- *Experience from Mecklenburg-Vorpommern, Germany*: In the case of rewetting areas to achieve climate mitigation, no SEA was conducted during the earlier policy-level stage (with developing the climate law) that set the framework for subsequent planning. This omission hindered the integration of environmental considerations into the foundational policies, potentially leading to missed opportunities for aligning climate and biodiversity goals from the outset.

These experiences illustrate the challenges of timing and integration in ensuring EAs are effective tools and embedded early in the spatial planning process to proactively shape strategic priorities and ensure that environmental and biodiversity considerations are central to decision-making.

2. Linear assessment approaches

Traditional environmental assessments often follow a linear framework, focusing on isolated impacts rather than considering the interconnected and dynamic nature of ecological systems. This limits the ability of SEA and EIA to anticipate cascading and systemic effects.

Chapter 5 of this report identifies the potentials for overcoming this limitation by adopting a systems-thinking approach. It introduces the Causal Loop Tool, developed within the BioValue project, as a resource to map complex cause-and-effect relationships between environmental factors, policy decisions, and biodiversity outcomes. This tool enables practitioners to identify strategic leverage points, uncover feedback loops, and design interventions that address the root causes of ecological issues rather than their symptoms. The integration of this tool into EAs can significantly enhance their capacity to guide sustainable spatial planning

3. Insufficient addressing of biodiversity dynamics

EAs inadequately integrate biodiversity aspects such as habitat connectivity and cumulative impacts, reducing their effectiveness in supporting resilient ecosystems.

4. **Weak feedback mechanisms**

The lack of iterative feedback and learning loops hinders the ability to adapt strategies based on real-world outcomes and monitoring.

The key issue underlying these gaps is not only when EAs are undertaken but also how they are conducted. Effective EAs require early and proactive integration into the planning process, robust systems-thinking approaches, comprehensive biodiversity considerations, and mechanisms for continuous feedback and adaptation. Without addressing these aspects, the full potential of EAs to guide sustainable and biodiversity-resilient spatial planning remains unrealized.

7.2 Recommendations

a. Early and proactive integration of SEA
Embedding SEA at the initial stages of spatial planning ensures that environmental considerations and biodiversity priorities are integral to shaping policy and strategic decisions. This early integration promotes sustainability from the outset, influencing plan outcomes.

b. Adopting systems thinking
Employing analytical tools like the Causal Loop Tool enhances a systems-thinking approach within both SEA and EIA processes, enabling the identification of critical leverage points and interdependencies, facilitating more holistic planning.

c. Enhanced scenario analysis
Implementing scenario-based analyses in both SEA and EIA enables a thorough evaluation of potential trade-offs and synergies, informing decisions that align with biodiversity and sustainability goals.

d. Fostering continuous learning and adaptation
Establishing robust feedback loops within environmental assessment processes ensures that monitoring results inform future planning cycles, supporting adaptive and responsive strategies to changing conditions and emerging insights.

e. Proactive biodiversity measures
Proactively integrating targeted biodiversity enhancement measures, such as habitat restoration and ecosystem connectivity, into EAs transforms them from passive evaluative tools into active agents.

8 Enhancement and mitigation

The exploration of enhancement and mitigation for biodiversity has been two-fold, consisting both of a catalogue that presents examples of different measures used in EA reports concerning spatial planning and infrastructure development, as well as an in-depth analysis of the integration of these measures and their role in supporting transformative change in spatial planning practices. The findings from this latter analysis are published as a scientific article and provide insight into the enhancement and mitigation strategies in Denmark, Portugal, Spain, and Germany, as well as a more in-depth study of the type of measure, wording, strength and implementation of measures in the Danish practice. The catalogue is meant to inspire practitioners as to potential measures that can support biodiversity by drawing upon the experience of historical reports. While outlining the status of integration, the two approaches also provide insight into the gaps and potentials for practice.

The catalogue and article draw upon the mitigation hierarchy and enhancement hierarchy, categorizing and prioritizing the applied approaches for addressing biodiversity impacts. The preferred approach is the application of enhancement measures that work to better conditions for biodiversity. Thereafter, the mitigation hierarchy consists of measures that either avoid, minimize, repair or off-set impacts, in which the former measures (e.g. avoidance) have greater potentials for improving biodiversity than the latter (e.g. off-setting). Nevertheless, the realized impact of the measures also depends on how they are applied, which can be distinguished between a proactive and reactive application.

A proactive approach to enhancing biodiversity is the early application of measures with the aim of enhancing beyond baseline conditions, referring here to the application of enhancement measures or mitigation measures that exceed the status quo and maximize positive impacts that ensure that conditions for biodiversity are better than before the plan/project implementation. These are often implemented into the design of the plan or project for the purpose of achieving 'net-gain' for biodiversity. On the contrary, a reactive approach refers to the application of mitigation measures in response to identified negative impacts, which most often refer to avoiding, minimizing, repairing or offsetting this impact. These are most often applied with a 'no net-loss' mindset.

This study on enhancement and mitigation measures is not representative of practice in the different countries but provides a window into the application of enhancement and mitigation within more recent reports.

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8.1 Gap analysis

The following gaps in the integration of enhancement and mitigation measures have been identified.

1. **Minimal focus on proactive enhancement of biodiversity**

The analysed reports demonstrate that both strategic levels (SEAs) and project levels (EIAs) assign mostly measures that minimize or reduce impacts, rather than avoid or enhance biodiversity. This means that practice is broadly speaking reactive and misses opportunities for proactively avoiding or enhancing biodiversity impacts and thereby, most effectively preventing harm from spatial planning and infrastructure development. As such, potentials for transformative change are not leveraged completely. Enhancement measures are more often referenced in SEAs than in EIAs but lack binding commitments that ensure their implementation.

2. **Challenge in tiering from SEA to EIA**

Through the analysis, it was identified where in the planning process the proposed measures were expected to be implemented. These results showed a tendency for the strategic higher-tier SEAs to refer to the later planning and project levels to ensure implementation of the proposed enhancement and mitigation measures. However, without a follow up or more binding language, there is a risk that implementation either does not take place or are diluted in later planning. This identified gap is like a gap also identified in Chapter 9 concerning a more comprehensive analysis of tiering across assessment and planning levels.

3. **EA does not ensure implementation**

EIA and SEA are notably a decision-support, rather than decision-making, tool. Many factors independent of EA can influence the final implementation of proposed enhancement and mitigation measures, and thus, while EA can adjust the enforceability of the measure through specific formulations ("must", "should", "can" be implemented), it cannot ensure the application.

4. **Enhancement does not ensure transformative change**

Enhancement, while aiming to improve current baseline conditions, does not inherently promote a transformative change unless the measure is successful in promoting 'net-gain' for biodiversity. The success of the measure can only be determined once the measure has been implemented and requires follow-up on the effectiveness of the measure.

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8.2 Recommendations

To address the abovementioned gaps, the following potentials are also identified to promote a more proactive and transformative practice with a focus on the enhancement of biodiversity.

a. **Strengthening the regulatory framework**

By strengthening the extent to which the EA Directives address and mandate the application of enhancement measures, the prominence of a 'net-gain' mindset within practice can be promoted. The Directives only mandate the mitigation of identified negative impacts, calling for a more reactive remedying of impacts that does not better the status quo, but merely reduces harm. So far, these have failed to bring about structural changes necessary for transforming biodiversity. But strengthening the focus of legislation towards enhancement as well as mitigation has the potential to shift towards a more proactive application that improves biodiversity beyond the current conditions.

b. **Ensuring strong, enforceable language**

Although there is a gap from SEA and EIA to realized implementation, EA can directly influence the expected implementation of proposed measures (both enhancement and mitigation) by using strong and enforceable language. This implies a shift from optional and advisory wordings, such as "can" and "should", towards obligatory phrasings, such as "must" and "shall". The analysis of current practice in Denmark showed a stronger tendency for obligatory phrasings when considering mitigation measures than enhancement measures, meaning that the implementation of enhancement measures is often vague and non-binding. Reframing the expected implementation of enhancement measures as obligatory has the potential to align the implementation enforcement with that of mitigation measures and ensure that a 'net-gain' for biodiversity is as important, if not more, as a 'no net-loss'.

c. **Improving tiering between EA planning levels**

Successfully tiering between planning levels, such as between the strategic SEA levels and project-based EIA levels can help ensure the continuity of planning decisions. The effective and seamless transfer of enhancement and mitigation measures between SEAs and EIAs can ensure that important strategic measures are accounted for and realized on project levels. This also has the potential to secure the proactive application of SEAs as a process for informing the EIA and recognizing that strategic decisions are not decoupled from subsequent projects.

d. **Early application of SEA and EIA**

Applying SEA and EIA early in the planning process has the potential to ensure their transformative potentials. Opportunities for enhancing biodiversity are greatest in the early phases of planning, seeing as critical decisions regarding plan and project design as well as the objectives they seek to fulfil remain flexible. Transformative change cannot be achieved if crucial decision-support tools, such as SEA and EIA, carry the sole function of assessing impacts of and applying mitigation measures to otherwise static plans and projects and are not proactively invited into the planning stages with greatest potential for transformation.

9 Tiering across levels of assessment and planning

The extent to which different levels of planning, especially embedded ones, "communicate" with one another is crucial for the effective transfer of insight from one level to another. An understanding of tiering examples from current EA practice was gained through two case studies (one for onshore EAs and another for offshore EAs) centred around biodiversity within Danish EAs for spatial planning, the results of which are published in a practice note and a scientific article (currently in progress). The first case concerns tiering within spatial planning-related SEAs and EIAs on land, while the second case concerns spatial planning EAs at sea. Both cases are situated within Denmark. The analysis identifies tiered contents within the EA reports and determines the direction, strength, and content of tiering. The practice note provides a more detailed depiction of the tendencies in terms of the content that is tiered while the article is a synthesis that focuses more on tendencies regarding direction.

Insights can be tiered in different directions: down-tiering where insights from higher-level SEAs are used in lower-level SEAs or EIAs; up-tiering in which insights from lower-level SEAs and EIAs are used in higher-level SEAs; and horizontal tiering in which insights are drawn from other non-spatial planning documents. Furthermore, the report and article recognize that tiering can also be delegated, in which either SEAs or EIAs delegate the consideration of certain insights to later planning levels. The strength of tiering can be divided into 'strong' in which tiering is successful and there is a clear and explicit communication between levels, 'weak' in which tiering can be identified but is not made explicit, and lastly, disrupted, in which tiering that is otherwise delegated between EA levels does not take place. The subject of tiering, namely the content that is tiered, range from data, alternatives, assessments of impacts, mitigation measures, enhancement measures, cumulative impacts, and monitoring.

Drawing upon the results from both the report and article, this section delves into the gaps and potentials related to tiering practice in EA. Detailed results can be found in Appendix C.

9.1 Gap analysis

Tiering of biodiversity insights takes place in both case studies, representing all tiering directions, strengths and contents. However, challenges also remain to reap the potentials that tiering can offer for practice:

1. **Disruption of delegated tiering**

In the case studies, delegated tiering is only used as a form of down-tiering in which higher-level SEAs delegate later assessments to subsequent lower-level SEAs or EIAs. While the analysis shows that delegated tiering is in some cases successfully implemented, there are several instances in which tiering is disrupted, indicating that potentials of tiering from level to another are not fully realized, even when the tiering potential is explicitly proposed. It also shows that the lower levels of planning do not always adhere and draw upon the critical decisions made at higher strategic levels.

2. **Inexplicit tiering**

In most cases, tiering is strong and explicitly mentioned. However, there are also cases of weak tiering in which the tiering is less explicit and the coherency between higher and lower levels of planning is unclear.

3. **Disrupted tiering of enhancement measures**

Enhancement measures, defined as those aiming to improve current conditions of biodiversity, are not as successfully tiered as mitigation measures, aiming to remedy identified negative impacts. The results indicate that mitigation measures are, in onshore EAs, the subject that is most often tiered, and that the insight persists in almost all cases from the higher-level SEA to a lower-level SEA and lastly to the project level. On the other hand, enhancement measures are not as successful and while remaining relatively consistent from higher-level to lower-level SEA, do not make it into corresponding EIAs and therefore risk not being implemented in project design. The fact that mitigation measures are more readily tiered than enhancement measures support an EA practice that is more reactive in remedying impacts rather than proactively preventing them or enhancing conditions.

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9.2 Recommendations

In order to address the identified gaps within tiering, the following recommendations are proposed.

a. **Strengthening tiering between SEA and EIA**

Although the results point towards tiering as a part of existing EA practice concerning spatial planning, then there is still potential for strengthening the tendency by improving the frequency with which information is tiered. This involves rethinking the role that both the strategic and project planning levels play:

- *SEA as a strategic guide for project levels* and although details regarding concrete projects may still be unknown during higher-level planning, the SEA can still be used to guide decisions at the project level and especially delegate future actions (assessments, mitigation, enhancement, etc.) in the subsequent planning and project development.

- *EIA as informant for strategic decisions* such that insights gained at project-levels can provide value for strategic levels of planning. This pertains to data collected or assessments made for similar project activities or within the same geographic area that can inform future planning.

b. **Ensuring that delegated tiering is successfully implemented**

Disruption occurs when the delegated tiering is not carried out as otherwise suggested by the higher-level SEAs. Ensuring that lower-tier SEAs and EIAs properly adhere to the tiering that is delegated to them at higher levels secures the strategic considerations throughout the planning hierarchy and that the identified potentials for improving communication between planning and project levels are respected. Lastly, it ensures coherency between planning levels such that the planning and projects levels do not contradict one another.

c. **Tiering of enhancement measures**

Tiering enhancement measures has the potential to ensure that plans and projects work towards improving conditions beyond the status quo. It is crucial that especially enhancement measures identified at the strategic levels, where strategic decisions are made regarding the overall objectives the plan and subsequent projects are aiming to support, also manifest themselves within the project level, and do not, as current practice suggests, get filtered out when progressing further down the planning hierarchy.

d. **Making tiering more explicit**

Further clarity and transparency in terms of when insights are tiered from one level to another can help communicate the coherency between different levels of planning. This would also support strong tiering practice and prevent weak or disrupted tiering.

10 Cumulative assessment of biodiversity impact

Cumulative assessments refer to the assessment of the collective impacts from activities that occupy the same area or overlap in terms of time. Cumulative assessments recognize that spatial planning does not occur in isolation but always builds upon an area with already existing activities and developments, that other planning activities can take place simultaneously and must also account for future planning in that area. Therefore, addressing cumulative impacts allows for environmental assessment that is more comprehensive and views planning as embedded in other activities in time and space.

Two case studies were conducted to shed light on current practice in Danish EA. The first case study pertained to EAs for spatial planning on land and was based on the same reports as for the tiering case study. The second case study pertained to EAs for spatial planning at sea and was, as with the tiering case study, also based on the SEA for Denmark's first Maritime Spatial Plan and associated projects.

Examples of cumulative impacts were identified throughout the reports and analysed in terms of the biodiversity receptor of the impact, the actions that accumulate to create the impact, a description of the impact, the determined significance of the impact, efforts for mitigating and monitoring the impact. The results give insight into the information provided in EA reports regarding the assessment of cumulative impacts and how prominent the practice is.

The analysis showed that cumulative assessment is practiced within the EA reports both for those on land and at sea. Of the 11 reports (consisting of both SEAs and EIAs), a total of 33 examples of cumulative impacts were identified. Most of them stem nevertheless from EAs associated with spatial planning at sea. The higher-tier SEAs for both land and sea illustrate the consideration of cumulative impacts, supporting their potential for providing strategic insight into consequences of planning and maintaining and overview of impacts posed by the embedded lower-tier plans and projects. Especially the SEA of the Maritime Spatial Plan addressed cumulative impacts pertaining mostly to future projects proposed within the plan area. Acknowledging and assessing that impacts from different activities can aggregate to larger and perhaps more significant impacts also supports a more systemic approach to EA.

The following sections delve into the gaps identified within cumulative assessment practice based on the analysis as well as recommendations for addressing these gaps.

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10.1 Gap analysis

The analysis of cumulative impacts has provided insight into the following gaps.

1. Lacking assessment of significance of cumulative impacts

Despite having identified 33 examples of cumulative impact assessment across 11 reports, potential significance of those impacts is in several cases not determined, by failing to explicitly mention significance. This is the case for all EAs on land and five of the EAs at sea. In those examples where significance is explicitly mentioned (all pertaining to EAs at sea), half are considered insignificant, and the other half is considered significant. The impact is most often identified to be potentially negative. The two examples exhibiting a positive impact pertain to the SEA of the Framework Local Plan on land. In this case, there is an identified gap in terms of how explicitly significance of cumulative impacts are assessed, especially for EAs on land. Additionally, there may be missed opportunities for shedding light on potential positive cumulative impacts especially at sea.

2. Weak mitigation and monitoring

Mitigation measures and monitoring measures are typically not proposed for cumulative impacts. In fact, only two mitigation measures and no monitoring measures were identified in the case studies, despite determining most of the identified impacts to be negative. This may correlate with the lacking specification of how significant the impacts are proposed to be, but regardless, it illustrates a missed opportunity in terms of remedying or avoiding impacts.

3. No recognition of cumulative impacts from past or present activities

Most of the identified cumulative impacts pertain to proposed projects that are set to be implemented within the same area. A few examples pertain to future planning that has not yet been proposed. While this recognizes the relation between the plan/project and other proposed and future activities within the area and while these are crucial for cumulative impacts, it is also a more limited scope in terms of what activities are considered. It does not, for instance, account for cumulative impacts in relation to past or already existing activities, which may mean that certain otherwise relevant cumulative impacts are not considered.

10.2 Recommendations

To address the identified gaps, the following recommendations for the assessment of cumulative impacts are proposed.

a. Explicit assessment of significance

Being explicit about the potential significance of the cumulative impact can help strengthen the assessment by increasing transparency. Failing to be explicit means that potentially significant impacts are disregarded and are neither mitigated nor monitored as a result.

b. Proposal of mitigation and monitoring measures

Proposing mitigation and monitoring measures to address cumulative impacts can help alleviate the pressures they may pose. The EA has the potential to be a tool for not only identifying impacts, but also supporting the avoidance, minimization, compensation, or even enhancement of identified impacts, and the cumulative impacts are no exception.

c. Expanding the scope of accumulating activities

Recognizing the potential impacts that past and ongoing/present activities may pose in terms of the plan/project being assessed is as fundamental for cumulative impacts as the proposed and future activities. By also including these activities within the scope of the EA, a more comprehensive and complete assessment of impacts is supported.

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12 Annexes

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Integrating Environmental Assessment and the Spatial Planning Process

PRACTICE NOTE

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Linking Environmental Assessment with Spatial Planning Processes to support biodiversity protection and enhancement

This report explores how integration of environmental assessment instruments—Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA)—within spatial planning processes can substantially enhance biodiversity outcomes. Effective integration allows these instruments to contribute proactively and meaningfully to planning, guiding decisions that support sustainable development and biodiversity protection goals. SEA sets the strategic framework by embedding environmental considerations at early planning stages, while EIA addresses project-level impacts, together forming a comprehensive approach to environmental safeguarding. **The report emphasizes the importance of integrating SEA from the outset of the planning process** to avoid the common practice of only assessing impacts after a plan has been drafted – a delayed approach that often limits the influence of assessment on planning outcomes. As shown in Figure 1, the earlier environmental assessment is integrated into the planning process, the greater its influence on critical decisions, ensuring that the most impactful choices are guided by a robust understanding of potential impacts and biodiversity opportunities.

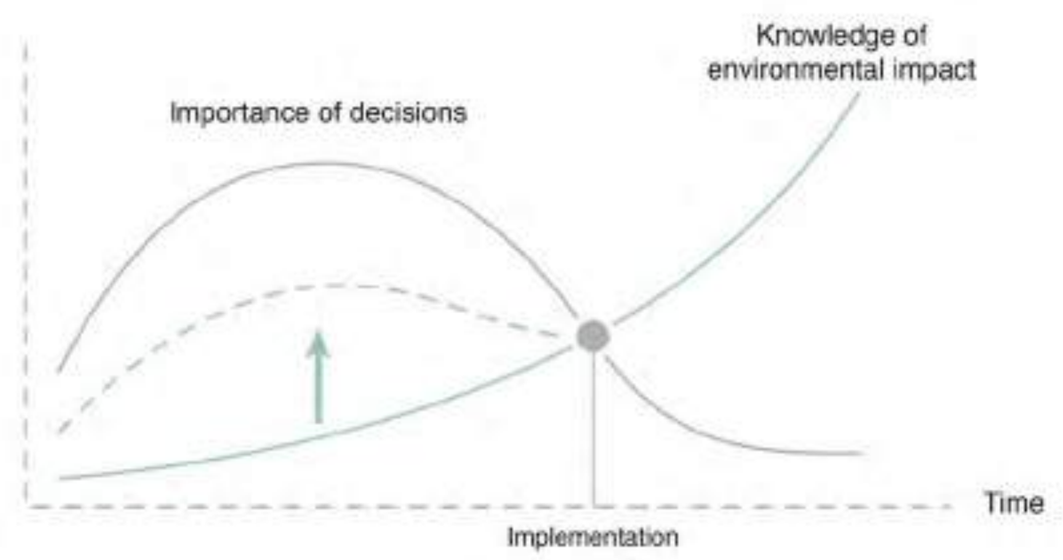

Figure 1.Timing of Environmental Assessment knowledge versus decision-making importance across the planning and implementation process. (Source: Kørnøv et al., 2022; translated).

A key element of this integration is the Causal Loop Tool, developed within the BioValue project, which introduces a systems-thinking approach to visualize interdependencies and feedback loops within environmental and planning systems (Kørnøv et al., 2024). The tool is instrumental in identifying three key leverage points for biodiversity that spatial planning can influence: **habitat**

quality, total habitat area, and habitat connectivity. By identifying where interventions may yield the most significant impacts, the tool allows SEA and EIA processes to transcends traditional linear assessment, adopting a system-thinking approach that captures the complexity of ecological interactions. This enables planners and EA practitioners to anticipate cascading effects, balance competing objectives, and adopt adaptive strategies that enhance biodiversity resilience.

The report includes a table that demonstrates how SEA, EIA, and the Causal Loop Tool align with the stages of spatial planning – from setting policy agendas through monitoring and evaluation. This structured approach emphasizes practical methods for embedding biodiversity considerations and addressing systemic feedback, helping planners, policymakers, and environmental assessors navigate interlinked ecological and planning objectives.

Outset in a generic spatial planning process

The spatial planning process, as outlined by Partidário (2024) in her recent policy note on spatial planning, is inherently cyclical, progressing through stages from vision-setting and policy alignment to proposal development, implementation, and continuous evaluation (see Figure 2). This cyclical nature is crucial for fostering adaptive planning practices that support sustainability and biodiversity resilience.

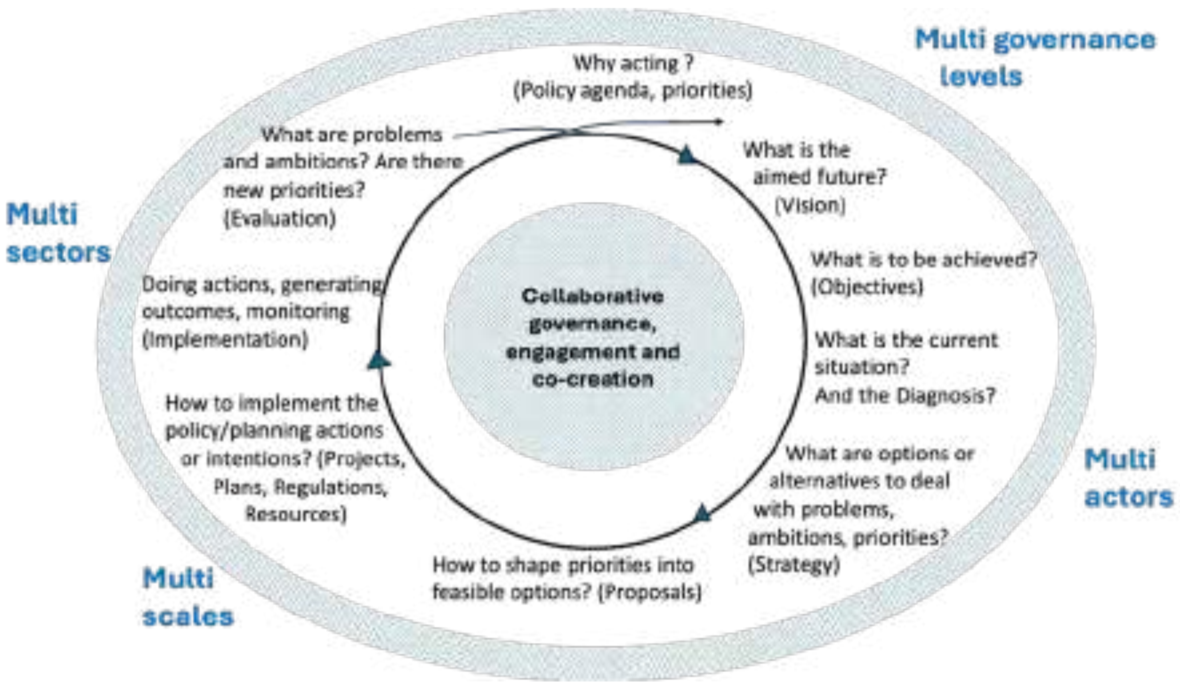

Figure 2 The generic cyclical spatial planning cycle. (Source: Partidário, 2024: 5)

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Integrating SEA and EIA across all stages of this cycle strengthens planning by embedding environmental considerations from the very outset. SEA promotes sustainability priorities early on, guiding the strategic context for project-level assessments undertaken by EIA. The combined application helps planners and stakeholders anticipate key environmental challenges, develop mitigation strategies, and identify biodiversity enhancement opportunities early in the planning process. By proactively addressing environmental trade-offs and managing unintended consequences, this approach supports informed decision-making that contributes to resilient, long-term environmental and biodiversity outcomes.

Linking the Causal Loop Tool to SEA and EIA

The Causal Loop Tool is a critical resource in reinforcing SEA's and EIA's integration within spatial planning. The tool employs a system-thinking framework to map complex cause-and-effect relationships between environmental factors, policy decisions, and biodiversity outcomes, thereby enriching both SEA and EIA processes.

Within SEA, the Causal Loop Tool enables planners to identify strategic leverage points early in the planning process. These points – such as habitat quality, total habitat area, and connectivity of habitats – represent critical opportunities for targeted interventions that align with broader sustainability and biodiversity goals. By mapping feedback loops, the tool reveals how specific policy choices may create long-term biodiversity impacts, enabling planners to adopt strategies that prevent negative outcomes before they arise.

In EIA, the Causal Loop Tool provides a more detailed, project-specific perspective. It highlights the interaction between individual development projects and their surrounding ecosystems, allowing practitioners to foresee cascading impacts, such as habitat fragmentation or pollution effects. By capturing the ripple effect of project-level actions, the tool helps practitioners devise targeted mitigation strategies that address root causes instead of symptoms.

Together, SEA and EIA, empowered by the Causal Loop Tool, shifts from a linear assessment approach to a dynamic, systems-based approach. This integration not only improves the responsiveness and adaptability of environmental assessments but also enables them to shape spatial planning outcomes proactively, guiding decision-making toward biodiversity conservation and sustainable development goals.

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Proposed Environmental Assessment Integration across the Planning Cycle

Table 1 presents a comprehensive framework that demonstrates the integration of SEA, EIA, and the Causal-Loop Tool at each key stage of the spatial planning process, including policy agenda-setting, vision and objectives formulations, diagnostics, strategy development, proposals, project formulation, implementation, and evaluation. This structured integration allows for a flow of environmental considerations from the earliest stages of policy formulation to the on-ground project execution and post-implementation assessment.

Each phase in the table specifies how SEA and EIA contribute essential strategic and project specific environmental insights. By incorporating the Causal Loop Tool, this framework is further strengthened, enabling complex cause-and-effect mapping that captures interdependencies across biodiversity and other sustainability dimensions. This helps stakeholders to anticipate unintended consequences, manage trade-offs, and identify synergies, supporting an integrated approach to spatial planning, offering practitioners a practical roadmap for making informed, ecological responsible decisions.

To further support this integration-focused practice, it is beneficial to reference an additional practice note, *Enhancement and mitigation measures for biodiversity in environmental assessment – a catalogue* (Ravn Boess and Kørnøv, 2024). This catalogue provides a suite of targeted measures specifically designed to address biodiversity considerations in spatial planning and infrastructure development. It offers practitioners concrete and actionable options for mitigating adverse impacts on biodiversity while actively promoting ecological benefits. This complements the integrated insights outlined in Table 1, ensuring that both mitigation and enhancement measures are systematically embedded within the planning and assessment framework, thereby aligning environmental assessments with biodiversity objectives and reinforcing the overall sustainability and resilience of spatial planning outcomes.

The table includes this symbol, which is used as a visual indicator to mark stages and actions that represent opportunities for transformative intervention within the spatial planning process. These symbols highlight elements that could be effectively integrated into the process to enhance outcomes but currently do not receive sufficient attention:

1. **Policy agenda**
   Highlights the opportunity for EA to proactively shape strategic priorities by identifying key environmental challenges and opportunities early on. This includes integrating biodiversity and ecosystem service (ESS) considerations into the political agenda, ensuring that these elements are foundational to all subsequent planning. This transformative intervention can guide policymakers to adopt biodiversity benchmarks that set a clear direction from the start.

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2. **Diagnosis**
   Highlights the potential to leverage EA instruments, to conduct baseline assessments and identify vulnerabilities, such as areas prone to habitat fragmentation or environmental degradation. By mapping out existing biodiversity, land use, and ecosystem conditions, practitioners can uncover root causes of environmental issues and highlight areas for intervention. This diagnostic approach allows for a deeper understanding of systemic issues, enabling more effective, informed decisions in subsequent planning stages.

3. **Evaluation**
   Underscores the importance of using feedback from implemented plans to inform future planning cycles. This transformative intervention supports the creation of a continuous learning loop, where insights gained from monitoring biodiversity outcomes and the effectiveness of mitigation and enhancement measures feed back into the planning process. Such an evaluation process ensures that the spatial planning system evolves and adapts to achieve long-term sustainability and biodiversity resilience.

In each of these stages, the signifies strategic intervention points where EA can actively influence planning outcomes, helping to embed biodiversity and sustainability at the core of the spatial planning framework.

SPATIAL PLANNING PROCESS	WP2 INPUTS	
	EAI-process, practice and content	**EAI' s leverage of the Causal-loop tool**
POLICY AGENDAS, PRIORITIES	**Proactively contributing** with EAI in influencing the political agenda by identifying key environmental challenges and opportunities, ensuring that biodiversity and ESS are integral to strategic priorities. SEA can guide early decisions on setting sustainability benchmarks, while EIA addresses project-specific priorities later. **Mitigating impacts** when SEA provides early insights into potential biodiversity risks, allowing mitigation measures (avoidance, minimization, off-setting) to be discussed before formal planning begins. EIA later ensures that these risks are addressed at the project level. **Enhancing biodiversity** when SEA promotes the proactive integration of biodiversity enhancement measures, ensuring that biodiversity priorities – such as habitat restoration and ecosystem connectivity – are prioritized from the outset.	**Identifying leverage points** by helping to identify systemic relationships between political priorities and biodiversity outcomes, showing critical points where interventions (policies) can shift the system toward sustainability. **Highlighting systemic feedback**, showing how political decisions can generate positive or negative feedback loops within biodiversity and ESS, helping to shape policies that anticipate unintended biodiversity consequences.
VISION/ OBJECTIVES	**Ensuring that objectives are aligned with ambitious but realistic goals**, such as reducing habitat fragmentation or increasing green infrastructure. **Identifying mitigation measures early**, ensuring that the plan avoids critical biodiversity loss through clear, enforceable targets. **Identifying enhancement measures during the goal-setting phase**, ensuring that biodiversity enhancement is embedded in the plan objectives, such as increasing green corridors or expanding natural areas within urban plans.	**Offering insights into the feasibility of biodiversity objectives** by mapping interactions, ensuring that goals are both achievable and impactful. **Highlighting trade-offs** between competing objectives (e.g., economic growth through tourism expansion vs. biodiversity preservation), guiding decision-makers to make balanced, informed choices.
DIAGNOSIS	**Baseline assessment** with SEA using existing data to map existing biodiversity, land use and ecosystem conditions to inform planning. An element can also be the mapping of environmental pressures. **Identify vulnerabilities**, such as areas prone to habitat fragmentation, ensuring that plans are designed to mitigate these risks. **Highlighting opportunities** for biodiversity enhancement, such as ecosystem restoration opportunities, ensuring that planning addresses current ecological gaps contributes positively to ecosystems.	**Mapping problem interconnections** and thus, providing a systems-level diagnosis, showing the interconnections between e.g., land-use intensity, biodiversity, and other environmental factors, helping to pinpoint root causes of ecosystem degradation. **Root cause identification** to help identify how past planning decisions have contributed to biodiversity decline, guiding planners to make informed decisions to avoid repeating past mistakes.

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STRATEGY	**Exploring various development scenarios** (e.g., low-impact urban development vs high-density development), and assessing how alternatives affect ESS, biodiversity and human well-being. Important for decision-makers to understand the trade-offs and benefits. **Evaluating alternatives with the goal of minimizing environmental impacts**, ensuring that the best possible mitigation strategies are integrated into the plan. **Encouraging the inclusion of enhancement options in plan alternatives**, such as alternatives that prioritize green infrastructure, habitat connectivity, or nature-based solutions.	**Scenario testing of options** by modelling how different planning scenarios affect biodiversity, ESS and other environmental factors, providing a visual understanding of trade-offs and synergies between alternatives. **Feedback loop exploration** showing how different alternatives may trigger positive or negative feedback loops, helping decision-makers select the most sustainable and resilient options.
PROPOSALS	**Shaping priorities into feasible plans** by ensuring that environmental priorities, such as biodiversity conservation and sustainability goals, are embedded into final planning proposals. **Integrating mitigation measures** into the strategic plans, ensuring that risks of biodiversity loss are minimized at a systemic level. **Including biodiversity enhancement measures**, turning environmental priorities into feasible plans, such as initiatives focused on restoration projects or habitat creation.	**Analysis of qualitative effects**, helping to forecast both positive and negative consequences of proposed plans. **Assessing the effectiveness of different mitigation and enhancement strategies**, showing how well they integrate into the overall system, showing potential outcomes and unintended consequences.
PROJECTS/ PLANS/ REGULATIONS/ RESOURCES	**Guiding the formulation of regulations** that support biodiversity protection within the plan. **Guiding formulation of project-level requirements**, ensuring all necessary mitigation measures are built into subsequent development projects and regulations. **Guiding the allocation of resources** for biodiversity enhancement measures, ensuring that funds are directed towards e.g., ecosystem restoration or the creation of green infrastructure.	**Showing effects of investments in biodiversity** (e.g. green infrastructure) and how they can alleviate pressures in other areas (e.g. storm water management), highlighting cascading positive effects **Highlighting interdependencies in the plan**, such as investment in one part of the system (e.g., habitat restoration) can generate benefits across other ecosystem services.
IMPLEMENTATION	**Establishing monitoring frameworks** to help track whether biodiversity mitigation and enhancement measures are effectively implemented.	**Help tracking feedback loops during implementation,** providing insights into whether measures are working as intended or if adjustments are needed. **Supporting adaptive management** by visualizing how changing conditions (e.g., climate variability) may require adaptive management.

EVALUATION	**Evaluating the success of the implemented plans** in achieving biodiversity, and sustainability goals. SEA evaluates systemic outcomes, while EIA focuses on project-specific impacts. **Providing feedback on mitigation measures**, whether they are working as intended, providing feedback for future adjustments if necessary. **Providing feedback on enhancement measures**, assessing whether they have been effective, ensuring that future plans build on these successes or make adjustments where needed.	**Monitoring long-term outcomes** by tracking key biodiversity indicators and system responses, providing ongoing feedback for future planning cycles. **Creating learning loops** where feedback informs implementation and evaluation informs future planning processes, ensuring continuous improvement.

Table 1 Integration of SEA, EIA, and the Causal Loop Tool across key stages of the Spatial Planning Process.

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Conclusion

The report demonstrates how the integration of SEA and EIA, and the Causal Loop Tool within spatial planning can significantly strengthen biodiversity-focused decision-making. By embedding these tools throughout each stage of the spatial planning process, practitioners can incorporate critical environmental insights that support sustainable development and ecological resilience.

The full potential of this integration lies in aligning SEA and EIA with complementary instruments in spatial planning, such as zoning regulations and financial incentives. When combined, these tools provide a cohesive structure that supports biodiversity-enhancing decisions and aligns planning with sustainability. This multi-instrumental approach empowers spatial planning to become a powerful driver of transformative change for biodiversity conservation and sustainable development.

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Enhancement and mitigation measures for biodiversity in Environmental Assessment – a catalogue

PRACTICE NOTE

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1. Technical references

Project Acronym	BIOVALUE
Project Title	Biodiversity Value in Spatial Policy and Planning: Leveraging Multi-level Transformative Change
Project Coordinator	Maria Rosário Partidário University of Lisbon - Instituto Superior Técnico mariapartidario@tecnico.ulisboa.pt
Project Duration	July 2022 – June 2025 (36 months)

Deliverable No.	n.a.
Dissemination level*	Public
Work Package	WP 2 – Environmental Assessment Instruments (EAI)
Task	T2.2 – Systematising how biodiversity is considered in EIA and SEA
Lead beneficiary	AAU
Contributing beneficiary/ies	n.a.
Due date of deliverable	n.a.
Actual submission date	28 November 2024

v	Date	Beneficiary	Author
1.0	xx. November 2024	AAU	Emilia Ravn Boess, Lone Kørnøv

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2. Introduction

Identifying and implementing enhancement and mitigation measures is a core component of the Environmental Assessment (EA) process and allows for addressing and acting upon identified potential environmental impacts. These measures can be categorized according to the mitigation hierarchy – a structured framework originally proposed as a hierarchy of measures for mitigating identified negative impacts (Damiens et al. 2021), but also increasingly recognized for its potential to foster positive impacts through enhancement measures (Larsen et al. 2018). The hierarchy is composed of enhancement, avoidance, minimization, restoration and offsetting measures, each described in their respective sections in chapter 4 of this report.

While both the Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) directives mandate mitigation to address adverse impacts, they do not explicitly require the enhancement of potential positive impacts on biodiversity. This catalogue, therefore, goes beyond these regulatory requirements by including both enhancement and mitigation measures. The objective is to strengthen the proactive integration of biodiversity considerations and goals within EA practice, encouraging these considerations at the early stages of planning and project design.

The purpose of this report is to provide a catalogue of biodiversity-related enhancement and mitigation measures observed in spatial planning-related EAs. The catalogue is intended as an inspiration, not an exhaustive list, reflecting current mitigation practice as a guide for planners and EA practitioners. The measures presented in this report are merely those recommended by EA reports, but it does not delve into whether these measures have been implemented nor whether they have attained the intended consequences.

Through the catalogue, rooted in spatial planning contexts, these measures can be applied broadly to the entirety of the planning process. For instance, they can be considered in planning during initial design phases if wanting a more proactive application and a closer alignment between EA and strategic planning.

For a more detailed exploration of this integration, a complementary report within the BioValue project investigates how SEA and EIA can be embedded in the spatial planning process to enhance biodiversity outcomes through procedural and content-based alignment (Kørnøv, 2024). The report also introduces the Causal Loop Tool, which is linked to three biological principles identified in the project's deliverable D2.2: quality of the area, total area available for habitats, and connectivity between habitats. These leverage points represent critical opportunities where spatial planning can actively enhance biodiversity (see Kørnøv et al., 2024).

This complementary report also guides where and when enhancement and mitigation can be included throughout planning stages – from policy setting to evaluation –to support adaptive, resilient planning cycles that prioritize biodiversity and sustainability.

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3. Applied methodology

The enhancement and mitigation catalogue is created on the basis of an analysis of XX EA reports from Denmark, Portugal, Spain and Germany. These reports were found in relation to other analyses performed in the BioValue project. The catalogue of measures is inspired by a two-step process. Firstly, a general analysis was performed for the four countries as a segment of a causality analysis. Secondly, a more detailed analysis of enhancement and mitigation measures was performed for spatial planning EAs (both SEAs and EIAs) in Denmark.

3.1. General analysis across four countries

The documented mitigation measures were firstly identified as part of a causality analysis, aimed at exploring the causal relations between activities in EA, impacts, significance, mitigation measures and monitoring initiatives. The causality analysis first indicated whether an enhancement or mitigation measure was applied because of an identified impact and thereafter categorized the measure according to the mitigation hierarchy (enhancement, avoidance, minimization, restoration, off-setting).

3.2. Detailed analysis of EA reports in Denmark

The more detailed analysis also focused on uncovering the type of enhancement and mitigation measure (whether it was related to design, new technologies, location, etc.), who the recipient of the measure is, the requirement strength of the measure (is it described that the measure "must", "should" or "can" be implemented?), and at what level in the planning process the measure is expected to be implemented. The catalogue presented in this report only draws upon what the enhancement and mitigation measure is and not how it is being applied, described, nor its recipient. The further analysis of these results can be found in Kørnøv et al. (2025, *upcoming*).

3.3. Leverage points for biological principles

The enhancement and mitigation measures have been linked to corresponding biological leverage points, referencing work described in D2.2. In D2.2, three leverage points that enhance biodiversity and can be influenced by spatial planning are identified. These are quality of the area, the total area available for habitat, and the connectivity of these habitats. The linking of measures and leverage points brings with it an assumption that the measures either enhance, avoid, minimize, restore or off-set impacts that to varying degrees have consequences for the biological leverage points. The most relevant one has been linked, but it should be noted that as D2.2 shows, the biological leverage points are interconnected and affecting one has indirect consequences for the other two.

4. Catalogue

The following sections present the catalogue of enhancement and mitigation measures according to the mitigation hierarchy. Each table consists of the measure, an overall category and the biological leverage point that the measure primarily is targeted.

4.1. Enhancement

Enhancement refers to measures that are implemented to improve the current conditions, meaning that they are not necessarily prompted by the identification of a negative impact, as mitigation measures typically are. As such, they are proactive in their application and have the potential to generate net-gain conditions for biodiversity.

Table 1 Catalogue of potential enhancement measures.

ENHANCEMENT		
Overall category	***Enhancement measure***	***Biological leverage point***
Development of new nature	Developing new ponds, grassy areas, forests, etc. as habitats for species	Area for habitat
Development of new nature	Converting land-use from agricultural land to nature areas	Area for habitat
Development of new nature	Locating projects on areas that used to be agricultural areas, which are not characterized as breeding and resting areas for protected species.	Area for habitat
Development of new nature	Developing new areas designated as either national protected areas and/or as Natura 2000	Area for habitat
Regulation and permissions	Prohibiting hunting in a nature area	Quality of area
Regulation and permissions	Prohibiting the construction of fencing around developments (e.g. PV parks) to allow large animals, such as deer, to pass through the project area	Connectivity

Regulation and permissions	Ceasing drainage of wetlands to increase water levels	Quality of area
Maintenance and tending of vegetation	Allowing the wild growth of unprotected nature areas to create coherency with surrounding protected areas	Area for habitat
Maintenance and tending of vegetation	Planting trees within project area, such as within newly established parking lot	Area for habitat
Maintenance and tending of vegetation	Planting local vegetation beneficial to species	Area for habitat
Maintenance and tending of vegetation	Clearing the protected heath and adjacent area to improve the chances for the adjacent area to become protected heath	Area for habitat
Maintenance and tending of vegetation	Regular cleaning of ponds and lakes that are habitats to species	Quality of area
Maintenance and tending of vegetation	Regular trimming and mowing of vegetation in plan/project area	Quality of area
Maintenance and tending of vegetation	Trimming vegetation around a pond or lake to provide better light conditions for species	Quality of area
Maintenance and tending of vegetation	Using sheep for trimming of nature areas to provide better conditions for resting and foraging areas for amphibians and species-rich vegetation for insects and small animals	Quality of area
Wildlife corridors	Developing new living fences to connect previously unconnected areas	Connectivity
Design/technologies	Using fallen trees and rocks from a removed fence to make a new living fence	Connectivity
Pollution and treatment	Decreasing eutrophication in water bodies, especially those used as habitats for species	Quality of area
Pollution and treatment	Converting land-use to organic farming and replacing the use of fertilizers and pesticides with grazing sheep	Quality of area

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4.2. Avoidance

Unlike enhancement, the remaining mitigation measures are reactive attempts to handle identified negative impacts. Avoidance measures, at the top of the mitigation hierarchy and also the preferred mitigation type of the reactive measures, are meant to prevent a negative impact from happening in the first place.

Table 2 Catalogue of potential avoidance measures.

AVOIDANCE		
Overall category	***Mitigation measure***	***Biological leverage point***
Land-use	Establishing mixed land-use, such as combining renewable energy infrastructure and nature	Area for habitat
Preservation of nature	Securing the land-use designation of an area to nature and prohibiting development on that area	Quality of area
Preservation of nature	Securing the protection of protected lake in converting from recreation to urban purposes	Quality of area
Preservation of nature	Securing that recreative access to the coast does not conflict the function of the ecological corridor	Connectivity
Preservation of nature	Securing the conditions and quality of protected nature when the nature areas border new project development	Quality of area
Preservation of nature	Securing the conditions and quality of protected nature in the decommissioning of projects	Quality of area
Preservation of nature	Preserving existing wildlife corridors and passages	Connectivity
Additional assessment	Securing the assessment of impacts on unprotected nature (e.g. unprotected stone and soil dikes) in future environmental assessments of later plans or projects	N/A
Additional assessment	Determining the likelihood that trees designated for felling are home to bats	N/A
Regulation and permissions	Prohibiting the reduction of nature areas, such as forests, through the local plan	Area for habitat
Regulation and permissions	Prohibiting the construction of infrastructure (e.g. solar panels, fencing, vegetation belts) or other technical facilities within protected areas and protected forest	Area for habitat

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Regulation and permissions	Using the local plan to prohibit the construction of infrastructure (e.g. solar panels, fences, vegetation belts) or other technical facilities in areas designated as protected areas or protected forest	Area for habitat
Regulation and permissions	Dispensation from the local plan regarding changes to nature areas (e.g. a new path) to guarantee that hibernation sites are not disturbed	Quality of area
Regulation and permissions	Prohibiting afforestation on low-lying areas with potential for rewetting	Area for habitat
Regulation and permissions	Ensuring that discharged water meets requirements for discharge permits	Quality of area
Regulation and permissions	Securing the protection status of protected nature areas	Quality of area
Regulation and permissions	Avoiding afforestation that can negatively impact protected nature through shadows, falling of large amounts of leaves, changed hydro-morphology, etc.	Quality of area
Regulation and permissions	Prohibiting the felling of trees with hollows with the potential of being breeding and resting areas for species, such as bats	Area for habitat
Regulation and permissions	Prohibiting the construction of buildings or other infrastructure within wildlife corridors	Connectivity
Regulation and permissions	Prohibiting hunting within the plan and project area during operation	Quality of area
Regulation and permissions	Receiving permission from the EPA to decommission a building with regards to potential presence of bats	Area for habitat
Alternative locations	Designating a new location for developments and associated vegetation so that it does not interfere with the river protection line	Area for habitat
Alternative locations	Placing the development such that it does not disrupt the connectivity of the nearby wetlands and forest area	Connectivity
Design/technologies	Raising the wire fence approx. 20cm to ensure that smaller animals can pass under and move through project area, e.g. a PV park and thereby forage between solar panels	Connectivity
Design/technologies	Planting local species for grass areas occupied by a development, e.g., PV parks	Quality of area
Design/technologies	Using local vegetation in vegetation belts to ensure that food availability for species is not worsened	Connectivity

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Design/technologies	Establishing a fence around ponds to avoid traffic close to the pond	Quality of area
Design/technologies	Establishing rainwater basins with the option of post-polishing the water	Quality of area
Design/technologies	Adaptation of new forest to the surrounding landscape	Quality of area
Design/technologies	Ensuring the implementation of fences with a large mesh size that allow for the passage of smaller animals	Connectivity
Buffer zone/distance requirements	Establishing a buffer zone (construction-free zone) between protected nature areas (e.g. Natura 2000, water bodies, forests), the development (e.g. PV parks, roads), associated technical facilities (e.g. transformers), fencing and transportation paths (e.g. for construction work)	Quality of area
Buffer zone/distance requirements	Establishing grassy areas or vegetation belt with local species between affected households and the project areas	Quality of area
Buffer zone/distance requirements	Keeping a distance to protected nature while decommissioning buildings	Quality of area
Buffer zone/distance requirements	Establishing a construction-free zone along water bodies to ensure the function of the wildlife corridor and the individual and genetic exchange of species	Quality of area
Pollution and treatment	Conducting the construction phase so that it does not pose a risk for increased emission of harmful substances, fertilizer, etc. that have the potential to spread to protected nature areas	Quality of area
Pollution and treatment	Prohibiting the use of harmful substances in the operation and maintenance of a project (e.g. in cleaning and maintaining solar panels	Quality of area
Pollution and treatment	Implementing criteria to avoid the contamination of water	Quality of area
Pollution and treatment	Equipping infrastructure with technical solutions for preventing pollution, (e.g. transformers for PV parks with measures to prevent emissions of oil, such as hermetically sealing them, mounting a container that can collect oil masses from the transformer or installing a spill tray at the bottom of the transformer)	Quality of area
Pollution and treatment	Placing hay bales between the construction site and nearby bodies of water to prevent washing out of sediments from construction	Quality of area

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Pollution and treatment	Establishing precipitation facilities to oxygenate pumped water if it contains more than 0.2mg/l ferrous iron before discharging into streams	Quality of area
Pollution and treatment	Securing that drainage from roads does not end in nature areas to prevent pollution	Quality of area
Requirement for construction	Storing of construction material at a safe distance from bodies of water to avoid erosion and washing out to surface water during heavy rains	Quality of area
Requirement for construction	Placing construction sites, side roofs and displaced soil outside of the protected forest	Quality of area
Requirement for construction	Designing construction that happens nearby protected forest in such a way that prevents the harm of outermost trees (branches, trunks or roots)	Quality of area
Requirement for construction	Establishing a fence around trees if working nearby (fence should be at a distance equalling the width of the tree's crown) to avoid damaging the oak tree's roots and compromising the soil around it	Quality of area
Requirement for construction	Avoiding traffic near the banks of ponds, lakes, streams and rivers to avoid damaging the embankment and spreading sediments into the surface water	Quality of area

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4.3. Minimization

Minimization measures refer to those that are applied to reduce a negative impact, when that impact cannot be avoided in the first place. Therefore, implementing minimization measures results in an overall 'net-loss' for biodiversity, but has decreased the severity of that loss.

Table 3 Catalogue of potential minimization measures.

MINIMIZATION		
Overall category	**Mitigation measure**	**Biological leverage point**
Preservation of nature	Protecting trees for nesting	Quality of area
Preservation of nature	Using local plans and future project approval to ensure that future development, such as new housing and urban expansion, does not impose significant impacts to protected nature and nature values	Quality of area
Regulation and permissions	Requiring additional dispensation (e.g. from the EPA) to fell trees that occupy bats	Quality of area
Regulation and permissions	Obtaining additional permission (e.g. from EPA or forest owner) if trees in protected forest need to be trimmed or felled	Quality of area
Regulation and permissions	Obtaining additional permissions according to the Water Framework Directive if rainwater seeps into water bodies	Quality of area
Alternative locations	When rerouting streams, allowing the existing stream to run freely and connecting it with the new stream segment only when the new segment is completed	Connectivity
Design/technologies	Establishing an amphibian fence (temporary or permanent) to keep amphibians away from project area (e.g. a road)	Quality of area
Design/technologies	Establishing a fine-mesh fence that is higher than the current vegetation to keep small mammals (e.g. birch mice) from entering the construction site	Quality of area
Design/technologies	Establishing a fence along both sides of a road to minimize the risk of wild animals colliding with traffic	Quality of area
Design/technologies	Ensuring that small mammals can pass through the established wire fence through, for instance, a larger mesh	Connectivity
Design/technologies	Raising wire fences to ensure that smaller animals can pass under and move through the project area	Connectivity

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Design/technologies	Planting a living fence by a newly established wire fence that can act as a wildlife corridor and removing the wire fence when the vegetation has reached its full height	Connectivity
Design/technologies	Designing bridges to match surrounding landscape	Quality of area
Design/technologies	Girdling of trees and boring holes for bats to occupy	Quality of area
Design/technologies	Controlling recreational traffic from parking area by establishing a path system that has the least impact on protected pastures	Quality of area
Design/technologies	Ensuring that bodies of water are designed with embankments	Quality of area
Design/technologies	Implementing smaller and dryer underlay pipes	Connectivity
Design/technologies	Laying out geotextiles on unvegetated slopes to control erosion during project construction (e.g. roads)	Quality of area
Design/technologies	Using solar panels with antireflective surfaces	Quality of area
Design/technologies	Using camera traps prior to construction to determine the presence of species and determine the need for further mitigation measures	N/A
Design/technologies	Installing motion-censored short-term lighting where construction site disturbs species (e.g. bats) and placing or angling them away from the impacted areas and using shadow-casting shades for the lights	Quality of area
Design/technologies	Establishing wildlife corridors to connect nature areas fragmented (by e.g. infrastructure and roads) and to guide wildlife away from development	Connectivity
Wildlife corridors and crossings	Establishing wildlife crossings (such as culverts, tunnels, bridges, underpasses) to ensure the passage of wildlife (e.g. amphibians, small mammals, large mammals)	Connectivity
Wildlife corridors and crossings	Constructing water-based passages so that they have the same conditions as the original bed of the water body	Quality of area
Wildlife corridors and crossings	Establishing an undeveloped strip along bodies of water, fields and roads to allow large animals to navigate in the area	Connectivity
Maintenance and tending of vegetation	Planting broad-crowned oaks every 50-100m along living fence and maintaining a ratio of 1:5 trees and bushes	Quality of area

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Maintenance and tending of vegetation	Constructing living fences to be dense and at a minimum breadth of 10m to allow them to function both as a breeding and resting area for species and as a corridor	Quality of area
Maintenance and tending of vegetation	Allowing 1/3 of the living fence to be undisturbed for 7-10 years and thereafter trimming every few years and keeping a minimum height of 3-4m	Quality of area
Maintenance and tending of vegetation	Avoiding trimming the living fence all at once, and instead, trimming in sections and allowing fruit-bearing trees and bushes to be present always	Quality of area
Maintenance and tending of vegetation	Prohibiting the use of machines for trimming living fences	Quality of area
Maintenance and tending of vegetation	Maintaining pastures by scything the pastures twice annually to reduce nutrients in the soil and enhance conditions for a variety of flora and fauna	Quality of area
Maintenance and tending of vegetation	Using local vegetation with a mix of species with characteristics that make them ideal as habitats and foraging areas (long flowering periods, good fruit ripening during the entire summer period, climbing plants, black berry bushes whose tangled structure, thorns and long growth periods are especially good for the protection and foraging opportunities for smaller mammals)	Quality of area
Maintenance and tending of vegetation	Planting trees in areas that are temporarily used for construction of project once the construction period is completed	Quality of area
Maintenance and tending of vegetation	Planting vegetation to shield infrastructure (e.g. PV parks)	Quality of area
Pollution and treatment	Ensuring that initiatives for planting new vegetation do not lead to large emissions of nutrients to ponds, lakes, streams and rivers	Quality of area
Pollution and treatment	Implementing sand traps to remove sand and heavier sediments that sink to the bottom of streams and rivers	Quality of area
Pollution and treatment	Ensuring that crossings over bodies of water, should they be necessary during construction, minimize the risk of erosion and emission of sediment into ponds and lakes	Quality of area
Pollution and treatment	Using local plans and project approval to ensure that rainwater treatment does not significantly impact the nearby streams and rivers	Quality of area
Pollution and treatment	Setting requirements for rainwater treatments, such as the establishment of rainwater basins or seepage of rainwater on own registered land	Quality of area

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Pollution and treatment	Purification of harmful substances and particles resulting from diverted road water	Quality of area
Seasonal and/or timed construction	Scheduling construction to happen outside of the breeding and resting/hibernation period for species	Quality of area
Seasonal and/or timed construction	Scheduling the felling of trees to be outside the breeding season for bird and bat species	Quality of area
Seasonal and/or timed construction	Removing ponds for amphibians and draining and lowering groundwater outside of the breeding period for amphibians	Quality of area
Seasonal and/or timed construction	Scheduling the construction of a new road outside of migration seasons	Quality of area
Seasonal and/or timed construction	Reducing construction activity during night hours in which nocturnal species, such as otters and amphibians, are most active	Quality of area
Requirement for construction	Dragging felled trees into nearby forest areas instead of removing them from the site to establish new habitats for insects and fungi	Quality of area
Requirement for construction	Distributing driving plates during construction that can be removed	Quality of area
Requirement for construction	Auditing of environmental conditions (incl. the felling of trees and layout of workplace) during the construction phase on especially valuable locations	N/A
Requirement for construction	Gathering of seeds from pastures prior to construction	N/A
Requirement for construction	Locating construction site that requires safety lighting at a safe distance from areas with bats or other protected species	Quality of area
Requirement for construction	Removing the vegetation and top layer of soil prior to construction (for potential redistribution following construction)	Quality of area
Requirement for construction	Placing soil in protected forests only when strictly necessary and with regard for landscape, nature and recreation in the rest of the forest	Quality of area
Requirement for construction	Filling and levelling holes following the termination of construction work or leaving at least one slanted slope or with a board to allow prevent trapping small species (e.g. birch mice)	Quality of area
Requirement for construction	Locating construction site, associated roads and storage area away from habitats, e.g. in fields that are regularly plowed and do not function as habitats	Quality of area

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Requirement for construction	Establishing a temporary fence around construction work that border protected areas	Quality of area
Monitoring	Monitoring species during the operation of infrastructure to determine whether there is a need to continue mitigation measures in the future	N/A
Monitoring	Registering species by the living fence and by wind turbines	N/A

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4.4. Restoration

Restoration measures are applied when negative impacts cannot be avoided nor minimized with the intention of bringing biodiversity conditions back to original conditions in the impacted area or for the impacted species. These measures are often a matter of regeneration of areas following caused damage, but it is not guaranteed that conditions will be the same as before.

Table 4 Catalogue of potential restoration measures.

RESTORATION		
Overall category	***Mitigation measure***	***Biological leverage point***
Regeneration	Regenerating the soil quality in areas that will be occupied temporarily for project construction in order to regenerate nature of the same natural quality as before, by, for instance, removing the topsoil for storing and redistribution following the construction phase	Quality of area
Regeneration	Regenerating pastures using rich subsoils and removing the mulch from the construction area and leaving sandy and gravel materials on the site.	Quality of area
Regeneration	Regenerating nature areas used temporarily during construction to conditions prior to project development	Quality of area
Maintenance and vegetation	Planting the same local species on project area to replicate habitat conditions of the area prior to project development	Quality of area
Requirement for construction	Conducting construction work as carefully as possible to increase chances for restoration of areas	Quality of area

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4.5. Offsetting

Impacts can also be offset, in which, e.g., biodiversity is compromised in one area and regenerated in another. It is not guaranteed that conditions will be the same as before the damage was enacted.

Table 5 Catalogue of potential offsetting measures.

OFFSETTING		
Overall category	***Mitigation measure***	***Biological leverage point***
Replacement nature and areas	Replacing compromised habitats (e.g. ponds, lakes, rivers, streams, forests, heaths, wetlands) with new habitats of the same habitat type in a different location and with vegetation that considers the species they accommodate	Area for habitat
Replacement nature and areas	Replacing lost living fences and wildlife corridors with new living fences and wildlife corridors that connects to existing living fences and wildlife corridors	Area for habitat
Replacement nature and areas	Using local soil to establish replacement dikes that is not too compact (no clay unless combined with wood shavings)	Area for habitat
Replacement nature and areas	Identifying and protecting trees in a nearby forest area equal to the number of trees suitable for bats that are felled in construction of the project	Area for habitat
Regulation and permissions	Enforcing a compensation ratio of 1:2	Area for habitat
Regulation and permissions	Prohibiting land-use change of replacement areas in the future	Area for habitat
Regulation and permissions	Prohibiting the use of pesticides and fertilizers on replacement pastures	Quality of area
Regulation and permissions	Strengthening the protection status of the compensated forest	Quality of area

Location	Locating replacement ponds on both sides of a potential barrier	Area for habitat
Location	Locating compensated nature on agricultural land (potentially rewetted by blocking drains or gutters), preferably on agricultural land that borders protected nature areas to create best conditions for the mobility of species	Area for habitat
Requirement for construction	Removing and relocating amphibians from impacted areas to new habitats by carefully removing piles of rocks and dead vegetation from the project area and placing them in other suitable locations to minimize impacts on amphibians and insects that e.g. hibernate in rocks and vegetation	Area for habitat
Seasonal and/or timed construction	Establishing replacement habitat for species (e.g. amphibians) one year prior to the removal of their current habitat	Area for habitat

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5. Conclusion

This catalogue provides a structured overview of enhancement and mitigation measures that can be applied in environmental assessment to support biodiversity within the spatial planning process. By incorporating both traditional mitigation and proactive enhancement measures, the catalogue encourages planners and EA practitioners to address biodiversity considerations early in the planning process. The measures are linked to key biological leverage points – habitat quality, habitat area, and connectivity – emphasizing their interdependencies and reinforcing a systems-based approach to biodiversity resilience.

Through this catalogue, the BioValue project aims to inspire a more holistic use of EA tools, fostering sustainable planning practices that not only mitigate adverse impacts but also create positive environmental outcomes.

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Tiering of Environmental Assessment in spatial planning: Analysis of two case studies on and offshore

PRACTICE NOTE

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1. Technical references

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This report and its contents are an expression of the authors' knowledge and conclusions and do not necessarily represent all BioValue partners.

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2. Introduction: Tiering within EA and relevance for spatial planning

Recognizing that spatial planning takes place across different governance levels poses the question of how and to what extent these different levels interact in order to produce coherent and embedded planning. Environmental assessment (EA) has the potential to support coherence through spatial planning, by cascading information about potential impacts, their significance, how to mitigate them, etc., onto the different levels of planning and ultimately securing their presence in decision-making. The 'communication' between levels within EA, more formally referred to as tiering, is the "*deliberate, organized transfer of information and issues from one level of planning to another*…" (Arts et al. 2011, p.417) and can help determine the extent to which the strategic levels of assessment, namely strategic environmental assessments (SEAs), 'communicate' with lower-tier assessments of projects, namely environmental impact assessments (EIAs). Thus, this report explores the extent of tiering within EA reports related to spatial planning, with particular attention to what insights regarding biodiversity are tiered through the planning process.

Although there is a consensus amongst EA academics that tiering is significant for allowing "…*the right issues to be considered at the right time"* (Therivel & González 2021, p. 1) and ensuring that "*different assessments… build on and complement each other*" (European Commission 2013, p.17) then there is still little research on its presence in practice. This study highlights illustrative examples that demonstrate current practices of tiering in Danish EA practices with the purpose of uncovering how tiering can be leveraged as an approach to support biodiversity efforts and inclusion of biodiversity matters in decision-making. It consists of two case studies designed to examine the tiering of biodiversity contents between different planning levels and their corresponding EAs. The first case study illustrates spatial planning onshore, referring to a Municipal Plan and subsequent plans and projects. The second case study concerns spatial planning at sea. In Denmark, spatial planning at sea was granted attention in 2021, with the country's first Maritime Spatial Plan providing comprehensive and holistic planning for the entire Danish marine area.

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3. Applied methodology

The following chapter describes the methodology in terms of identifying relevant EA reports on both SEA and EIA levels, followed by the three analyses, i. identifying the direction of the tiering (whether it moves from SEA to EIA or vice versa), ii. identifying the strength of tiering (whether tiering is implemented or disrupted), and iii. the subject of the tiering (what information is being tiered).

3.1. Identification of reports

The study draws upon two cases of spatial planning – one regarding municipal planning and corresponding projects on land (onshore) and another on spatial planning at sea (offshore). The reports were found using the digital report repository, EA-Hub.

Tiering onshore
The case concerned with tiering onshore draws upon spatial planning within the municipality of Skive in Denmark, which is classified at the Local Administrative Unit (LAU) level 2. The analysis investigates the Municipal Plan and lower-level SEA and EIAs Table 1 shows the levels of planning involved in the case, along with the associated reports.

Table 1 Planning levels and related EA reports in the onshore tiering case.

Level	*Title of report*	*Year*
Higher-level SEA	SEA of Skive Municipal Plan 2016-2028 (*Miljøvurdering af Skive Kommuneplan 2016-2028*)	2016
Lower-level SEA	SEA of the Framework Local Plan 272 for GreenLab Skive (*Miljøvurdering af Rammelokalplan 272 for GreenLab Skive*)	2016
Lower-level SEA and EIA	EIA for Skive GreenLab Biogas Aps and SEA of Proposal for local plan 275 – Biogas plant at Kåstrup (*"VVM-redegørelse for Skive GreenLab Biogas Aps" samt "Miljøvurdering af forslag til lokalplan 275 - Biogasanlæg ved Kåstrup"*)	2017

Tiering offshore
The case concerned with tiering offshore looks first and foremost at the recent SEA of the Maritime Spatial Plan (MSP). Because this strategic plan is made after several lower levels of planning have been implemented in the area, there are several lower-tier SEAs and EIAs that have been conducted prior to the implementation of the MSP but occupying the same area. Instead of finding preselected EAs as was done with the land-based analysis described above, this analysis was more inductive, starting with the SEA of the MSP and finding the lower-tier SEAs and EIAs it references. Doing so provided a better understanding of how a more retroactive strategic planning document is informed by and uses lower-tier planning levels.

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Table 2 Planning levels and related EA reports in the offshore tiering case.

Level	*Title of report*	*Year*
Higher-level SEA	SEA of proposed amendments to the Danish Maritime Spatial Plan (*Miljøvurdering af forslag til ændring af Danmarks Havplan*)	2023
Related EA reports referenced in the SEA of the MSP		
Lower-level SEA	Geological storage of CO_2 on land and near the coast. The Energy Ministry environmental report for the environmental assessment of the plan for areas for CO_2 storage (*Geologisk lagring af CO2 på land og kystnært Energistyrelsen miljørapport for miljøvurdering af plan for områder til CO2 lagring*)	2023
Lower-level SEA	Plan for urban development and infrastructure for Østhavnen, including Lynetteholm. Environmental report – Strategic Environmental Assessment. *(Plan for byudvikling og infrastruktur til Østhavnen, herunder Lynetteholm. Miljørapport – Strategisk Miljøvurdering.)*	2022
Lower-level SEA	Natura 2000 significance assessment of plan for urban development and infrastructure for Østhavnen, including Lynetteholm. *(Natura 2000-væsentlighedsvurdering af plan for byudvikling og infrastruktur til Østhavnen, herunder Lynetteholm.)*	2022
Lower-level SEA	Natura 2000 impact assessment of the plan for urban development and infrastructure for Østhavnen, including Lynetteholm. *(Natura 2000-konsekvensvurdering af plan for byudvikling og infrastruktur til Østhavnen, herunder Lynetteholm.)*	2022
EIA	Lynetteholmen – Environmental Impact Assessment Report *(Lynetteholm - Miljøkonsekvensrapport.)*	2020
EIA	Lynetteholmen – Natura 2000 Significance assessment. *(Lynetteholm – Natura 2000-væsentlighedsvurdering.)*	2020
EIA	Urban development of Stejlepladsen. Environmental impact report. Report to the development company Stejlepladsen. *(Byudvikling af Stejlepladsen. Miljøkonsekvensrapport. Rapport til Udviklingsselskabet Stejlepladsen.)*	2020
EIA	Krieger's Flak Offshore Wind Farm. Marine Mammals. EIA Technical Report. *(Kriegers Flak Offshore Wind Farm. Marine Mammals. EIA-Technical Report.)*	2015
EIA	Bornholm Offshore Wind Farm. EIA statement. Part 2: The marine environment *(Bornholm Havvindmøllepark. VVM-redegørelse. Del 2: Det marine miljø)*	2015
EIA	Bornholm Offshore Wind Farm. EIA statement. Part 2: The marine environment *(Bornholm Havvindmøllepark. VVM-redegørelse. Del 2: Det marine miljø)*	2015

There are two reports that could not be identified as the SEA of the MSP merely mentions them without citing the report. This includes an EIA for an offshore wind farm that includes the collection of marine mammals and a screening of a test facility for wave energy that determined that no EIA was necessary.

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3.2. Direction of tiering

The insights that are being tiered can travel in different directions throughout the planning levels. They can be tiered 'up' in which insights travel from lower tiers to higher tiers and tiered 'down' in which insights travel from higher tiers to lower tiers. They can also be 'delegated', in which data collection, assessments, mitigation measures, etc. are assigned at one level of planning to another. Lastly, 'horizontal' tiering refers to the integration of other planning documents not necessarily related to spatial planning. The instances of tiering identified through the reports for both case studies were analysed according to the tiering direction they exhibit in relation to planning and EA structures. Figure 1 shows how these directions are represented in the analysis figures in Chapters 4 and 5.

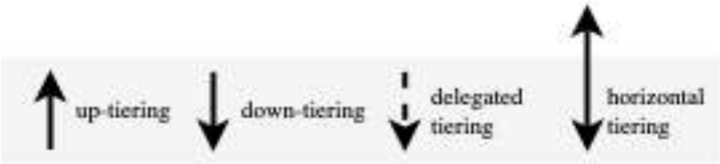

Figure 1 The directions of tiering.

3.3. Strength of tiering

The strength of tiering in this study differentiates between how explicit the tiering is established and whether it is successfully achieved or somehow disrupted along the way. The strength of tiering has been appointed as *strong, weak* and *disrupted* tiering. These are represented visually in the analysis figures by coloured arrows. The green arrows represent strong tiering in which tiering is explicit stated and clearly refers to higher- or lower-tiered EAs. The yellow arrows show weak tiering examples in which the tiering is not explicitly mentioned, but the contents of the reports can be interpreted as tiering between EAs. The red arrow shows disrupted tiering, in which tiering is not successfully implemented.

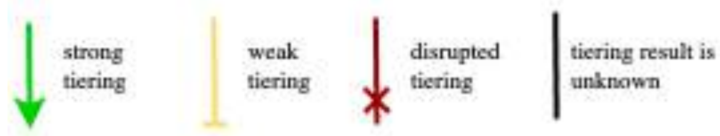

Figure 2 Strengths of tiering.

Subject of tiering

Each report was reviewed in terms of the content being tiered. The 'content' from the EA reports was divided into the following categories described in Table 4. The questions provided are those used to determine the direction of tiering.

Table 3 Categories of tiered content in EA reports and guiding questions for determining tiering directions.

Themes	Questions
Data	Does the lower-tier EIA/SEA repeat the higher-tier SEA data or refer to the higher-tier SEA for those data? Does the EIA/SEA repeat horizontal-tier SEA data?
Alternatives	Is there any indication of alternatives having been scoped out at the higher-tier SEA stage? Do the alternatives considered in the lower-tier EIA/SEA clearly 'tier down' from the alternatives considered in the higher-tier SEA?
Assessment	Does the higher-level SEA delegate assessments to a lower-tier SEA/EIA?
Mitigation	Does the lower-tier EIA/SEA refer to mitigation measures set by higher-tier SEA? Does the higher-tier SEA set requirements for mitigation measures at lower-tier EIA? Does the SEA set requirements for mitigation measures at horizontal-tier EIA?
Enhancement	Does the higher-level SEA identify potential for enhancement and require/suggest lower-tier SEA and EIA to address these?
Cumulative impacts	Does the higher-level SEA identify cumulative impacts and require/suggest lower-tier SEA and EIA to address these?
Monitoring	Does the monitoring section refer to or duplicate higher-tier SEA monitoring measures? Does the monitoring section set requirements for monitoring in future EIAs?

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4. Results – Onshore tiering

This chapter shows the analysis results pertaining to the EAs on land, referring to tiering between the SEA of the Municipal Plan, the SEA of the Framework Local Plan, and the combined SEA of the Local Plan and EIA of the Biogas project. The results are divided into the different subjects of tiering accompanied by a figure illustrating the contents of what is being tiered.

4.1. Data

Data from the higher-level SEAs are effectively used in lower-tier SEAs and EIA. Specifically, the collection of data on protected species is delegated through the SEA of the Municipal Plan, which is then successfully carried through at the lower-tier SEA level. The data is subsequently integrated into the combined SEA and EIA, where it plays a crucial role in defining baseline conditions and determining potential impacts.

Furthermore, the combined SEA and EIA draws upon mappings of existing nature areas, including the presence and conditions of streams, ponds and meadows, established through the SEA of the Framework Local Plan. These mappings support a detailed understanding of the environmental context at lower planning levels. Lastly, the SEA of the Framework Local Plan uses an external assessment stating that the local streams are in poor condition and are not suitable as habitats. This assessment is directly referenced in the combined SEA and EIA, highlighting how findings from higher-tier assessments are explicitly carried forward to substantiate conclusions at the project level.

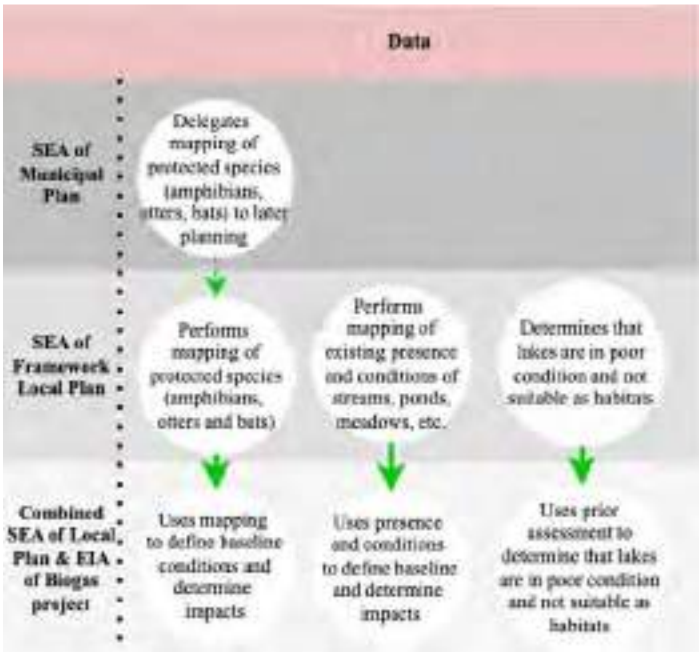

Figure 3 Flow of data and delegation from higher to lower-tier SEA and EIAs in municipal spatial planning.

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4.2. Alternatives

The tiering process is explicit considering the identification and assessment of alternatives, as the lower-tier SEAs and EIA clearly mention that the alternatives considered are based on earlier decisions made in the higher-tier SEAs. This concerns the consideration of different criteria, referring to GreenLab and constituent projects, including the location of a biogas plant, the location of transportation infrastructure, alternative energy systems, natural gas pipelines, etc., in which alternatives considered throughout the SEA of the Municipal Plan trickle down to the SEA for the Framework Local Plan and lastly, to the combined SEA and EIA for the Local Plan and Biogas project.

Furthermore, the SEA for the Municipal Plan draws upon alternatives originally mentioned in an external Biogas Plan. For another component of the plan, namely the construction of wind turbines, different alternatives and corresponding criteria are also explored in the SEA of the Municipal Plan and successfully trickle into the SEA of the Framework Local Plan. The combined SEA and EIA concern the Biogas plant and does therefore not plan for the same area as occupied by the wind turbines, and whether the alternatives and criteria are used again in the project-level is unknown.

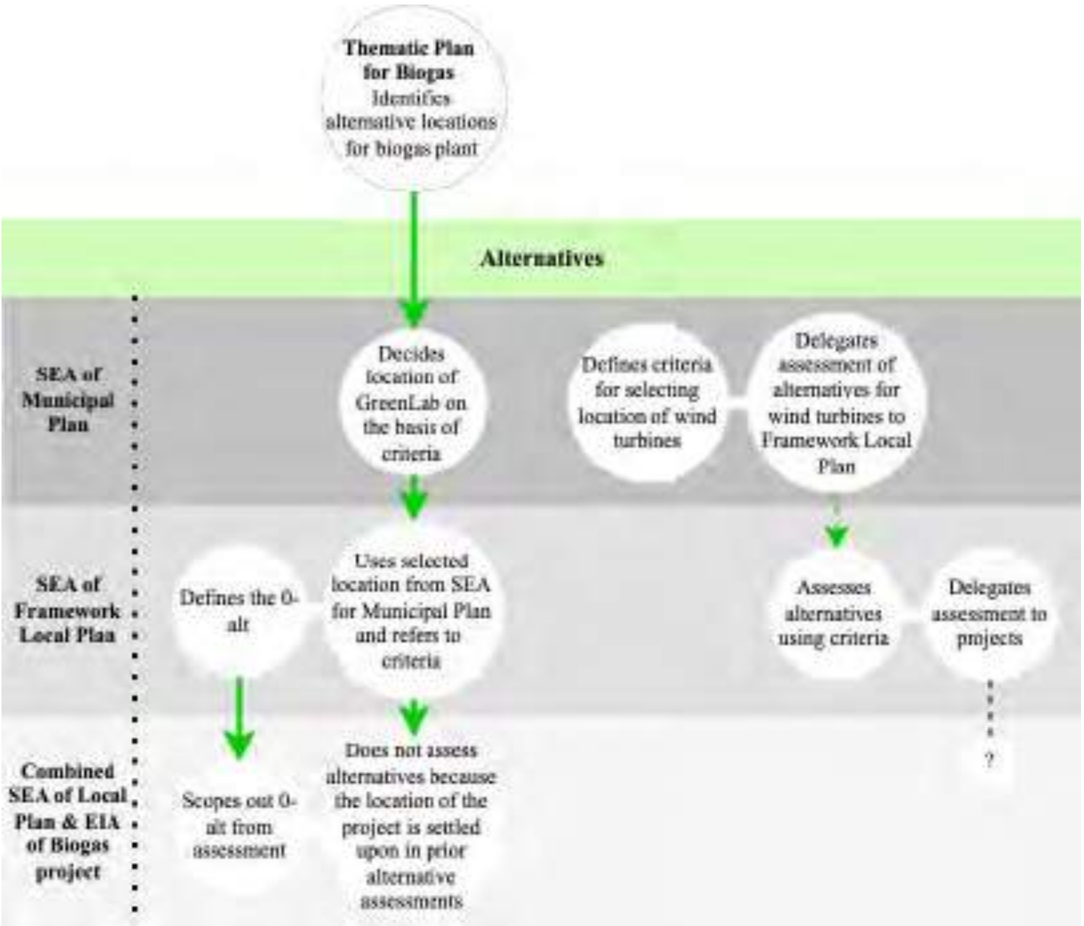

Figure 4 Tiered approach to alternatives identification and assessment across planning levels.

4.3. Assessment of impacts

The assessment of impacts concerning impacts on protected species, in this case, bats, as well as the conditions and quality of nature areas, including meadows, streams and ponds are assigned at the higher-tier SEA. The SEA of the Framework Local Plan makes an assessment on bats, determining that the plan area is not at high risk as a habitat for bats, as well as on the conditions of the nature areas, determining that the ponds and lakes are not suitable as habitats. Additionally, the SEA of the Framework Local Plan also concludes that no ponds will need to be removed in the area and that any lakes that are potentially decommissioned will not have an impact on amphibian populations. The project level directly references the assessments made in the SEA for the Framework Local Plan and generates new assessments regarding pollution of surface water. but does not generate supplementary detailed assessments as otherwise delegated.

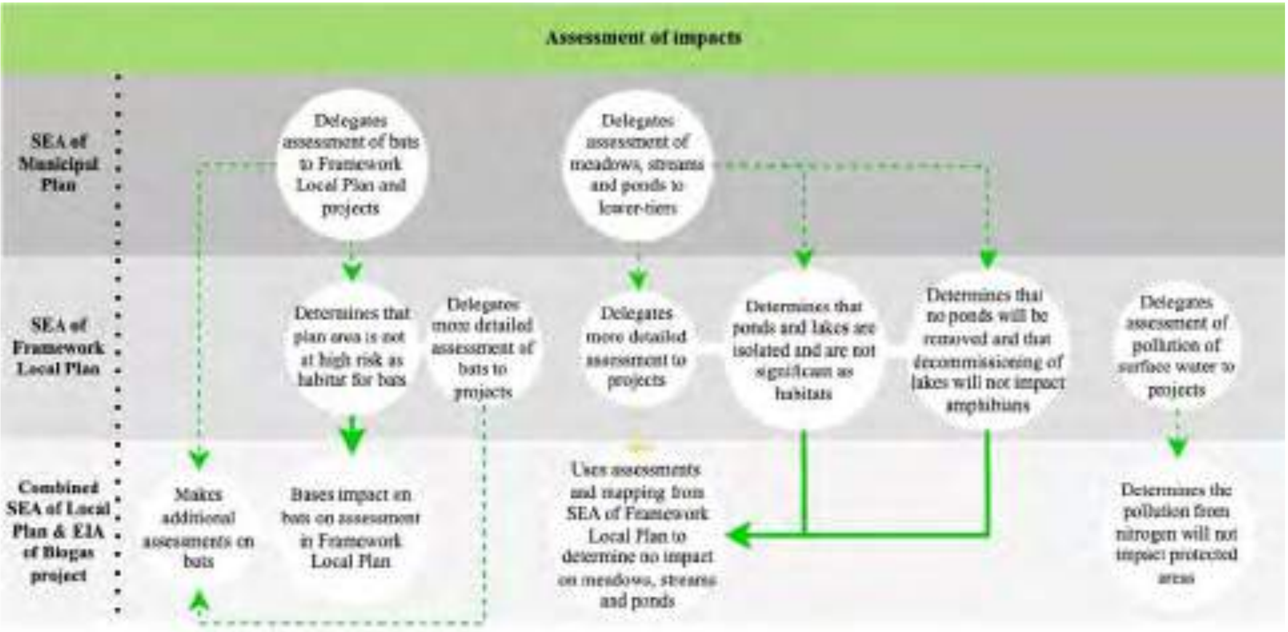

Figure 5 Assessments of impacts across tiered planning levels.

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4.4. Cumulative impacts

The identification of cumulative impacts begins with the SEA for the Municipal Plan, which provides a list of potential cumulative impacts pertaining to the plan and leaves the identification of relevant mitigation measures up to later levels of planning and project development. The SEA of the Framework Local Plan recognizes these proposed impacts and assesses them to be positive, which then means that no mitigation measures are proposed. The implementation of the positive cumulative impacts is granted to a non-mandatory Nature Plan for the planned area. The Nature Plan falls outside the scope of this study. Albeit, due to another research project, it is known that the nature development – considered as enhancement and biodiversity positive measures – was implemented. The combined SEA for the Local Plan and EIA for Biogas project makes no mention of the cumulative impacts originally identified by the SEA for the Municipal Plan, nor of cumulative impacts on bats otherwise requested by the SEA of the Framework Local Plan.

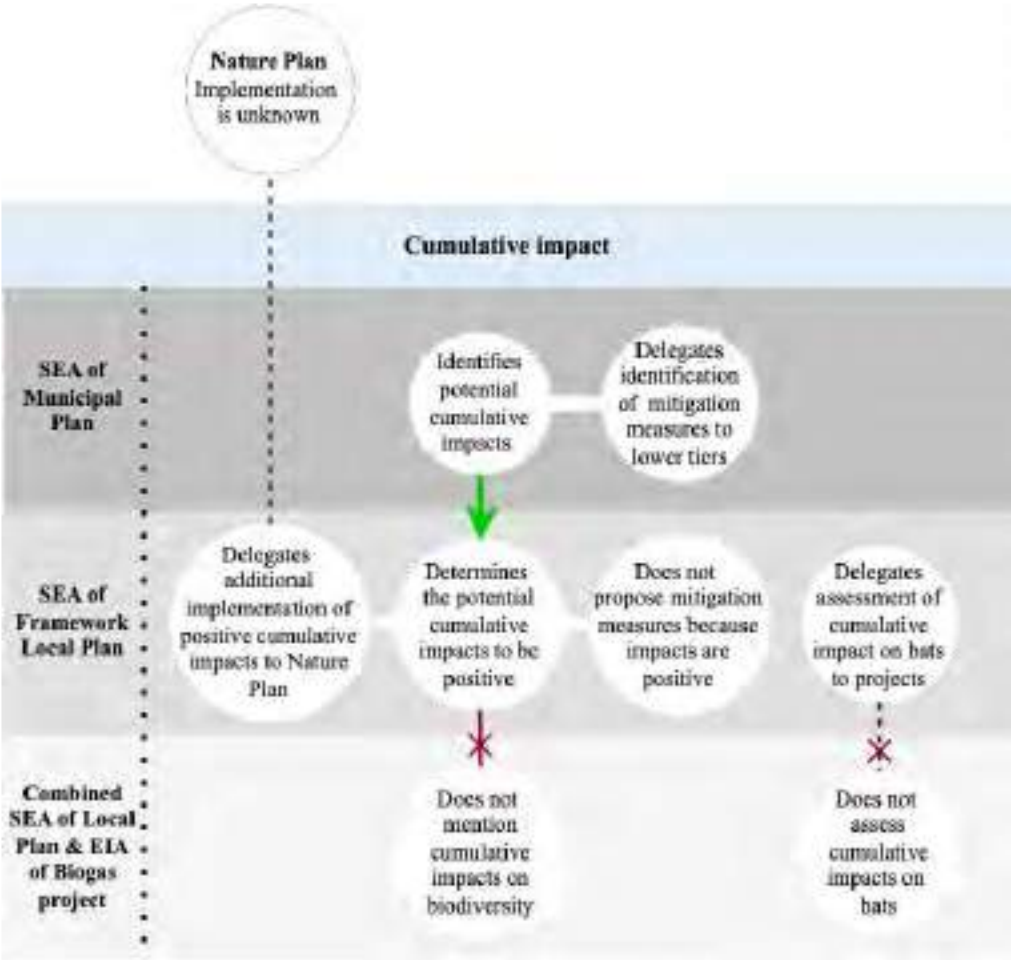

Figure 6 Tiered assessment and delegation of cumulative impacts cross planning levels.

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4.5. Mitigation measures

Proposed mitigation measures are successfully tiered from the higher-level SEAs to the lower-tier EAs. The SEA of the Municipal Plan secures rivers, meadows and wildlife corridors as construction-free zones and the SEA for the Framework Local Plan both secures the construction-free zone and establishes a buffer zone around the protected nature areas, including around rivers as habitat for otters. The combined SEA and EIA takes mitigation measures into account, but because the project area does not interfere with protected areas, deems the construction-free zones and buffer zones irrelevant for the project. It is uncertain as to whether other EIAs for which the protected areas are more pertinent have implemented the measures.

The SEA of the Municipal Plan states that the restoration and improved quality of surface waters as well as the replacement of impacted ponds and lakes should be addressed in the Framework Local Plan and projects. The SEA of the Framework Local Plan in turn states that measures to reduce the risk of pollution to rivers as well as the replacement ponds and lakes should be addressed on the project-level, and the project-level deems no impact on the areas and as such, that mitigation measures are unnecessary. Mitigation measures concerning bats and their habitats (e.g. mapping of existing habitats and species, establishing protection of and the development of new resting and breeding areas) is tiered from the SEA of the Municipal Plan to the SEA of the Framework Local Plan and is further assigned to the project-level, which concludes that the project area is not at high risk as habitat for bats and does consequently not propose any mitigation measures. Lastly, maintenance of vegetation is not mentioned in neither the SEA of the Framework Local Plan nor the combined SEA and EIA, despite being proposed in the SEA of the Municipal Plan.

Figure 7 Delegation and implementation of mitigation measures across different planning levels.

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4.6. Enhancement measures

Enhancement measures are first presented in the SEA for the Municipal Plan, proposing that the plan area has potential for improving the connectivity of nature areas, such as meadows, pastures, forests and wetlands. The same potentials for enhancement are again mentioned in the SEA for the Framework Local Plan but it does not make mention of the strategic location of replacement ponds for the purpose of connectivity. Another enhancement example is the delegation of enhancing the quality of streams to lower planning and project levels. The combined SEA and EIA, while concluding that the streams are of bad quality, does not propose measures to enhance them.

Furthermore, the SEA of the Municipal Plan also expresses a need to regard external plans, namely the River Basin Management Plan and the Municipal Action Plan, when enhancing the quality of the river. This reference underscores the potential for horizontal tiering, linking internal planning goals with broader environmental frameworks to achieve cohesive enhancement outcomes. Nevertheless, the project level opts out of implementing the enhancement measure and does not, as a result, regard the Management and Action Plan.

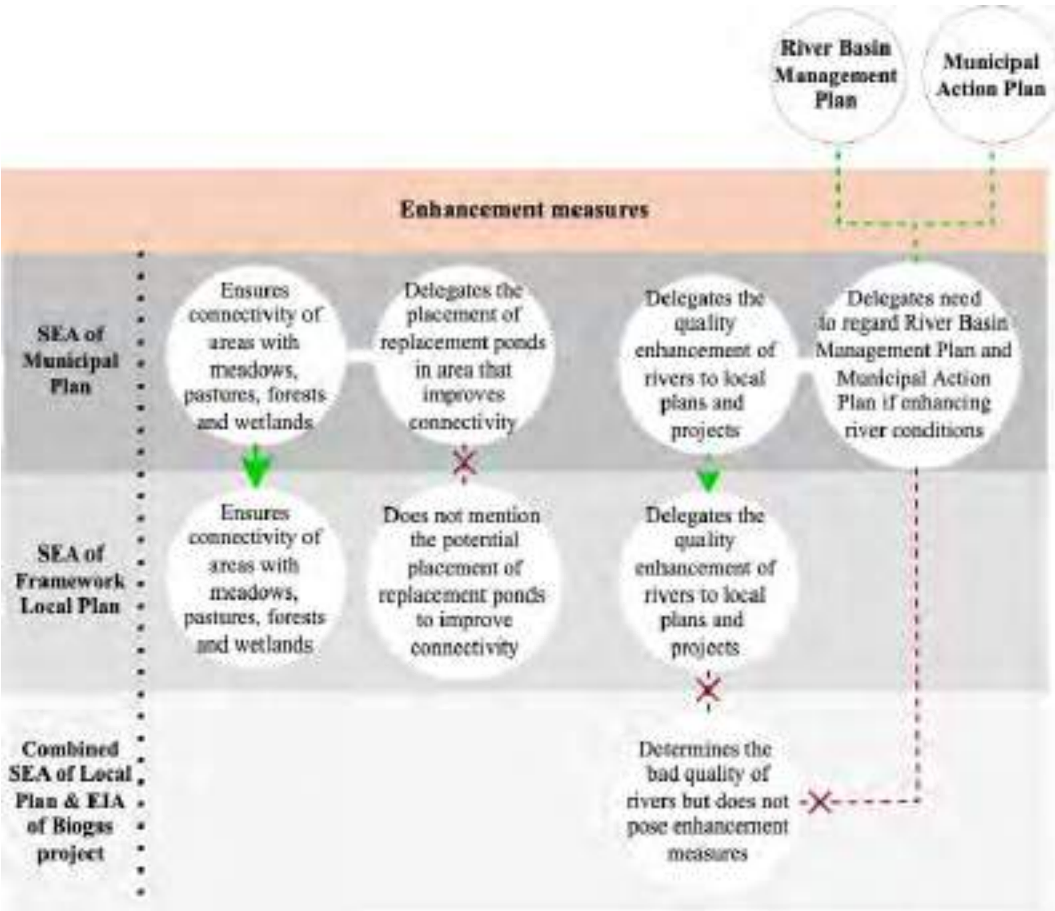

Figure 8 Delegation and implementation of enhancement measures across tiered planning levels.

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4.7. Monitoring

The SEA of the Municipal Plan proposes monitoring initiatives (although not related to biodiversity) and states that the decision to implement the appropriate monitoring should be done at lower tiers, where the impacts are assessed. The SEA of the Framework Local Plan refers to these same monitoring initiatives as presented in the higher-tier SEA and proposes an additional measure for monitoring the presence of bats. While the SEA of the Framework Local Plan concludes that the area is not at high risk as habitat for bats, it proposes monitoring for the presence of bats to supplement the current data. It further delegates the decision of which monitoring measures should be implemented to project levels. The combined SEA and EIA, while assigning monitoring measures for various impacts, does not assign biodiversity-related monitoring measures for bats. Although not explicitly stated, it is most likely because the project area is not determined at high risk as habitats for bats and that bats will not be prevented from using the area during the operation of the Biogas plant.

Figure 9 Delegation and implementation of monitoring measures across different planning levels.

5. Results – Offshore tiering

This chapter shows the analysis results pertaining to tiering offshore, referring to the insight from lower-tier EAs that the SEA of Denmark's first Maritime Spatial Plan draws upon. The results are divided into the different subjects of tiering accompanied by a figure illustrating tiering subjects.

5.1. Data

The SEA of the MSP draws upon several EIAs regarding the use of data to inform impact assessments. The data from the project level is firstly data regarding similar project types as those proposed within the MSP area and is therefore a transfer of knowledge regarding how biodiversity is impacted by different activities and assist in being able to assess potential impacts. In this case, the EIAs do not necessarily need to concern areas now occupied by the MSP. Secondly, it is data regarding the presence of various species within the MSP area, identified through EIAs for projects now enclosed within the MSP. Concerning the former, the SEA of the MSP uses observations from an EIA from 2015 assessing impacts of an offshore wind farm to draw conclusions regarding the flying height of cranes around wind turbines and that they will not be impacted by the construction of wind turbines in the plan area. The SEA for the MSP also to noise calculations made for an EIA for a new highway in an area not associated with the MSP, which are used to conclude that seabirds near the highway proposed as part of the MSP will inevitably be impacted by noise levels. Regarding former EIAs for projects that are now within the MSP area, the SEA refers to an EIA that has registered bats in the area and another that, using acoustic stations, has detected porpoises in the area. This data on the presence of bats and porpoises are used to describe baseline conditions for the MSP.

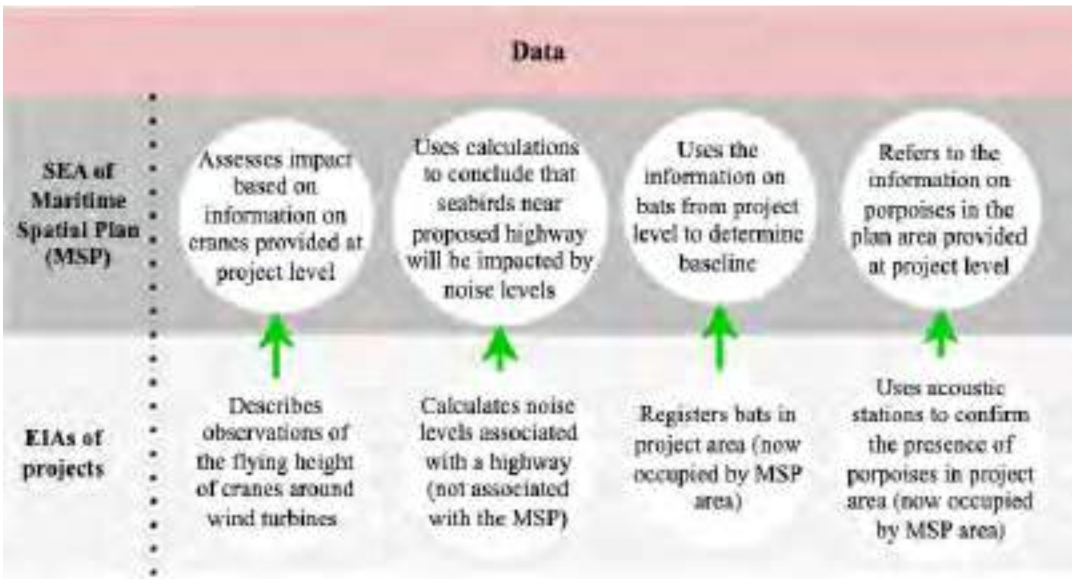

Figure 10 Up-tiering of data across different planning levels.

5.2. Assessment of impacts

When assessing impacts, the SEA of the MSP also draws upon prior assessments made in either lower-tier SEAs or EIAs. An SEA from 2023 has pointed out and assessed impacts of 3 marine areas for carbon capture that are now encapsulated by the MSP and deemed that these marine areas will bring about fewer impacts than the terrestrial carbon capture areas. This assessment is used in the SEA for the MSP to determine impacts for carbon capture on these three areas. When assessing impacts of a land reclamation project, the SEA of MSP also directly refers to 3 SEAs and 2 EIAs previously conducted for the reclaimed land, some of which are assessments performed specifically for protected areas (Natura 2000). While not specifying which assessments are made in which report, the SEA of MSP explicitly adopts these same assessments to conclude that the MSP will not impact protected areas significantly.

The last example concerns a screening on the project level, which determines that a projected test facility for a wave power plant does not require an EIA. The SEA of the MSP uses this screening to conclude that the power plant will not have significant impacts.

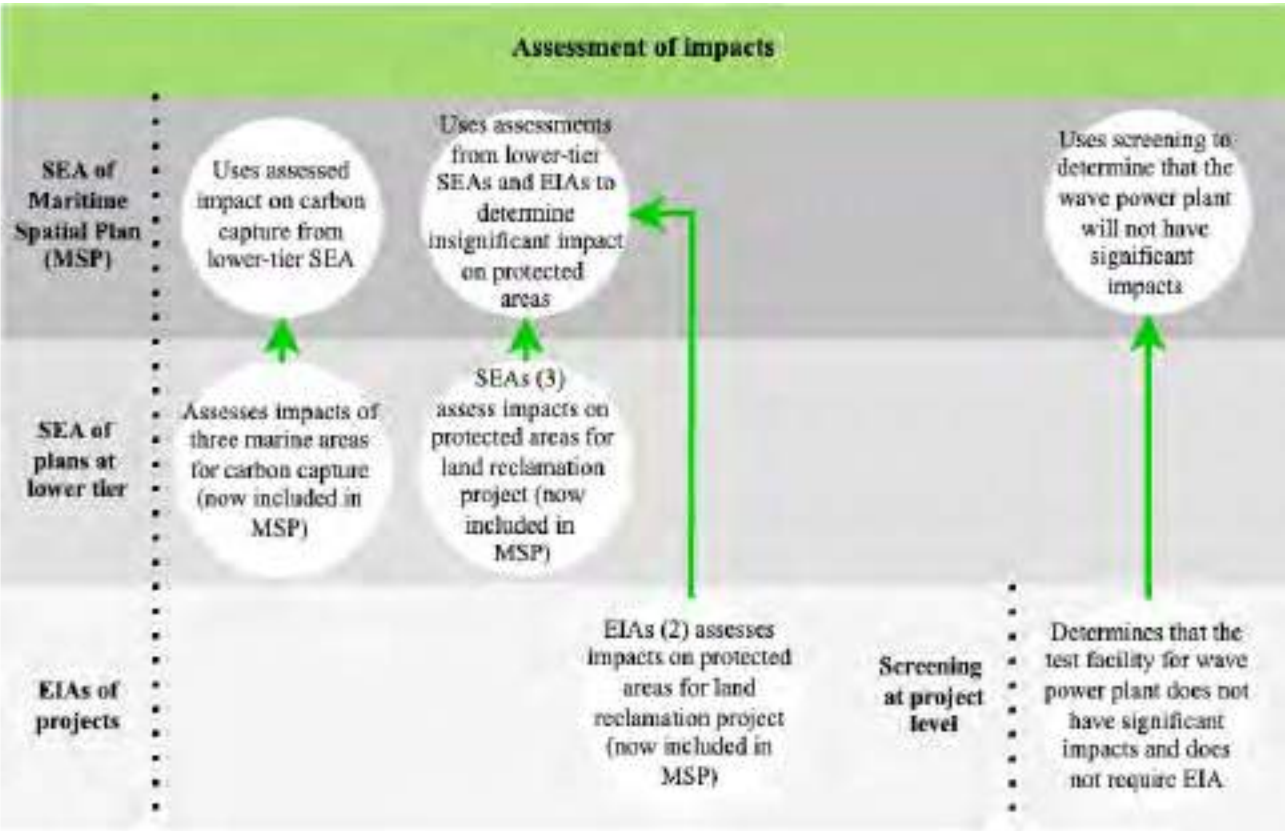

Figure 11: Up-tiering of assessments across different planning levels.

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6. Conclusion

This report summarizes the main findings regarding current tiering practices on the basis of two case studies in Denmark. The first case concerns EAs for onshore spatial planning (an SEA for a Municipal Plan and subsequent plans and projects) while the second case concerns EAs for offshore spatial planning (an SEA for a Maritime Spatial Plan and associated plans and projects). The findings demonstrate that tiering takes place in both case studies. Onshore EAs pass insights regarding data, alternatives, assessment of impacts, mitigation measures, enhancement measures, cumulative impacts, and monitoring initiatives between the planning levels. In the EAs at sea, it is solely data and the assessment of impacts that are passed from the lower-tier SEAs and EIAs to the SEA of the Maritime Spatial Plan. This is likely to do with the timing of the planning process itself, in which planning for the onshore EAs was initiated at higher-tier SEA levels with a Municipal Plan, followed thereafter by EA of embedded lower-tier plans and projects. On the other hand, the higher-tier spatial plan was initiated retroactively in the planning process, after the implementation of lower-tier plans and projects.

This report provides detailed insights into the content that is tiered and maps how these insights, assessments, data, etc. travel between planning levels and the accompanying text delves further into describing these tiering circumstances. The findings demonstrate as such that levels of planning do effectively communicate with one another concerning a wide array of topics and The examples provided throughout this report can act as inspiration for EA practices in terms of the content that can be tiered as well as how different EA levels can adhere to one another. Furthermore, it also shows that not all tiering attempts are successful, demonstrating a potential for improvement and that is necessary to be attentive to opportunities for tiering where both relevant and beneficial for aligning EA and spatial planning levels.

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