eurelectric

POWER PLANT

POWER PLANT 2.0

A guidebook to electrify in harmony with nature

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Contents

Executive summary

The world is witnessing an unprecedented environmental decline with more frequent extreme weather events and rapidly growing biodiversity loss. This happens at a time when Europe's power system is experiencing a dramatic transformation to reach the EU's decarbonisation targets of doubling renewables capacity by 2030 and dominating the grid mix. While raising the bar of our decarbonisation efforts, there is a global ambition to ensure biodiversity is restored and adequately protected by 2050. This ambition is supported by the EU Biodiversity Strategy.

Decarbonising the electricity sector fights both biodiversity loss and climate change

Renewable energy sources and power grid infrastructure stand out as crucial means to address these interconnected issues.

From a broader perspective, building new clean and renewable capacity is essential to mitigate climate change and decarbonise our economy. A renewables-based scenario could lower biodiversity losses by 75% compared to continuing with business-as-usual, according to WWF and BCG (2023).

At a project scale, renewable energy and grid projects can have a positive impact on nature by prioritising sustainable practices and operations that are friendly to biodiversity. Furthermore, the use of methods that consider biodiversity in the location, design and operation of renewable projects can bring commercial benefits. These include an enhanced reputation and corporate biodiversity leadership, and a reduced risk of consent refusal.

Biodiversity integration: a strategic approach for nature-friendly infrastructure

Eurelectric commissioned a Guidebook to support developers and system operators in scaling up nature-inclusive practices across the lifecycle of their projects. The Guidebook introduces 'biodiversity integration' as a strategic approach for renewable energy and grid developers to make a positive impact on nature.

Biodiversity integration is based on the mitigation hierarchy, a sequential approach to avoid, minimise, restore, and offset negative biodiversity impacts, and lead to a net gain biodiversity outcome where possible. Such practices range from non-measurable positive actions to measurable no net loss or net gain outcomes. The attainable outcome may vary based on factors such as project specifics, magnitude of impact, site constraints, feasibility of mitigation measures or national framework conditions.

When integrating biodiversity, developers may face challenges such as conflicts among stakeholders, constrained available land, increased costs, limited scientific data, absence of standards in biodiversity assessment approaches, and complex interactions among different ecosystems within projects. To navigate these challenges, robust application of the mitigation hierarchy is crucial. Learning from how local communities value biodiversity, providing adequate finance, and adapting to site-specific locations are additional key success factors.

New infrastructure build-out offers a wealth of opportunities to benefit biodiversity

With over 80% of European habitats in poor condition, new infrastructure buildout offers great opportunities to enhance nature (European Commission, 2022). Site selection provides the greatest opportunity to avoid negative biodiversity impacts. Developing projects in areas of low-biodiversity-value such as brownfields, degraded lands and redevelopment areas can result in minimised impacts and better outcomes for biodiversity with less or the same amount of remediation and offsetting efforts.

Nature can be protected across all the lifecycle stages of renewables and grids

The Guidebook consists of a set of twelve principles which can broadly be grouped as shown in the table overleaf. The Mitigation Hierarchy has to be followed. The rest of the principles strengthen biodiversity integration and represent best practice. Project proponents should consider, demonstrate, and justify how each of the principles have been applied to deliver better outcomes for biodiversity, while ensuring the smooth functioning of the power plant project.

Principle	Rationale
1 Adhere to the mitigation hierarchy 2 Avoid adverse impacts on irreplaceable biodiversity 3 Make a measurable contribution to biodiversity	**Principles describing the sequential process of measurable change:** The mitigation hierarchy is a foundational principle that must be applied and underpins all other principles. Irreplaceable biodiversity is included as a separate but related principle to emphasise its importance. Metrics can aid measurement of these changes.
4 Achieve additional conservation outcomes 5 Contribute to conservation priorities 6 Achieve ecological equivalency 7 Address risks 8 Be inclusive and equitable	**Principles supporting the identification of the right measures:** Adherence to the mitigation hierarchy allows a range of options to be considered. While all principles are interlinked, these in particular support the best possible outcome for biodiversity while ensuring these in particular support the best possible outcome for biodiversity while ensuring the smooth functioning of the respective generation or distribution infrastructure.
9 Optimise for multiple benefits 10 Secure long-term outcomes 11 Be transparent 12 Exchange science and knowledge	**Principles supporting positive information flow and long-term benefits:** These principles ensure that projects inform and are informed by stakeholders and best practice. Benefits are secured for the long-term and, where possible, across the environment, society and economy.

The principles were inspired by internationally recognised approaches and a survey sample was administered to 25 project developers of the wider Eurelectric membership. Recommended actions to implement the principles are set out for each of the lifecycle stages, site/route selection and screening, design consenting and permitting, construction, operation, and decommissioning across renewable energy and distribution grid technologies and, where appropriate, for individual technologies. Further recommendations specific to distribution grids, solar, onshore and offshore wind, and hydropower, including pumped storage hydropower, are provided to complement existing guidance. Therefore, the Guidebook can be used by the power sector to apply/adopt targeted biodiversity integration practices throughout the project lifecycle and for different renewable energy and distribution grid projects.

Some of these key actions for each project stage are outlined in this overview:

- **Site/route selection and screening:** Review conservation plans and align designs with priorities. Engage stakeholders and set long-term objectives. Focus efforts on avoiding impacts on sensitive features, estimate biodiversity losses and gains, consult local experts, and share data among stakeholders. For example, for distribution grids, consider alternative routes for overhead lines that avoid ecologically sensitive areas and limit habitat fragmentation.
- **Design consenting and permitting:** Establish a multidisciplinary team, assess biodiversity needs, and communicate objectives in the Biodiversity Management Plan (BMP). Identify restoration measures, mitigate risks, and engage stakeholders for equitable participation. Implementation includes ecosystem impact evaluation, long-term agreements, and consultation with communities. For instance, for solar, cluster solar arrays into blocks with buffer zones to avoid impacting sensitive areas along migratory corridors.
- **Construction:** Implement the Biodiversity Management Plan (BMP) with tailored control measures and communicate roles. Update calculations based on as-built data and review works against design objectives, adjusting as needed. Ensure alignment with nature conservation plans, maintain a risk register, document stakeholder feedback, and provide training for construction operatives. To illustrate this, an offshore wind project could reduce underwater noise during construction and create a temporary safety exclusion zone around turbine locations.
- **Operation:** Protect habitats and species with appropriate measures, brief site personnel, and ensure compliance with the BMP. Report changes from the baseline. Collaborate with stakeholders for effective management, while documenting their feedback. As an example, hydropower operators can establish operating rules that consider the natural flow conditions to facilitate fish migration.
- **Decommission:** Establish new baseline and management plans. Undertake relevant actions from previous stages, restore the site, and engage subsequent landowners. Prioritise securing high-value biodiversity features, retain records, and evidence the outcomes.

The power sector is already taking action.

In this Guidebook we share 15 case studies of where the sector has integrated biodiversity into their projects. This Guidebook draws from this experience and shows the potential for mainstreaming biodiversity integration.

Quantitative methods

The appendices include an analysis of metrics used to quantify and convey effects on biodiversity within a European context, along with suggestions for selecting the most suitable methodology for your project.

Open questions for industry and policy makers

The Guidebook helps the industry to scale up biodiversity integration into their projects and achieve the best outcome for biodiversity. However, there are still open questions for industry and policymakers to mainstream these practices. These include: the lack of harmonisation in biodiversity assessment approaches, the need for rewards and incentives for integrated electricity projects that are still in competition against other polluting energy projects, and addressing the skills shortage in the ecology sector.

Introduction

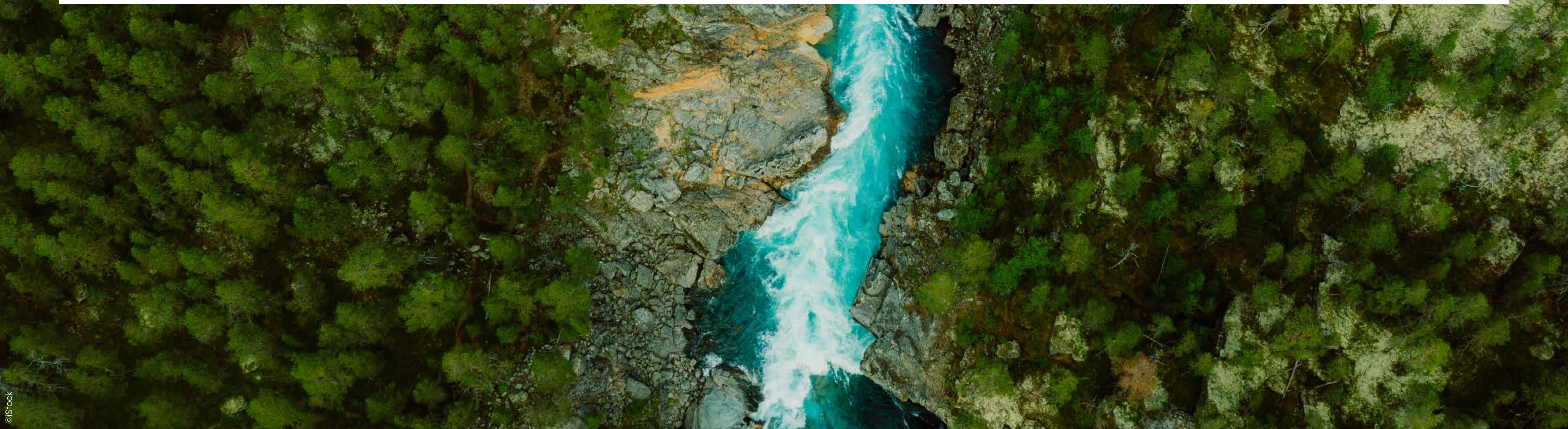
Nature is deteriorating globally at a faster rate than ever before in human history (IPBES, 2019). Up to 1 million species are threatened with extinction (IPBES, 2019) and global wildlife populations have decreased by at least 69% since 1970 (WWF, 2022). The world currently faces the twin and inter-related climate and biodiversity crises, both of which pose a significant risk to developers and system operators, including Eurelectric members' activities and the environment, economy, and society they operate in. Climate change is estimated to have caused around €4 trillion in economic losses to date (WWF & BCG, 2023).

The EU Biodiversity Strategy builds on a global ambition that by 2050 all the world's ecosystems are restored, resilient, and adequately protected (EU, 2020). The Strategy recognises that business as usual within the current energy systems needs to change – as this is responsible for more than 75% of the EU's greenhouse gas emissions (EU, 2018). Renewable energy sources (RES) and supporting energy infrastructure as well as storage facilities offer one of the key interventions for mitigating the twin and inter-related climate and biodiversity crises. Within a renewables-focussed decarbonisation scenario, projected risks to biodiversity, natural systems and ecosystems are up to 75% lower, climate change-related land loss and degradation is 50% lower, and there is 67-75% less poverty risk (WWF & BCG, 2023).

75%

lower predicted biodiversity loss from rapid transition to renewables

Adapted from WWF & BCG, 2023



Transitioning towards a renewable energy focussed and fully decarbonised power system will improve overall societal wellbeing (WWF & BCG, 2023). To reach Europe's climate goals (Eurelectric, 2023), solar needs a 5.6-fold increase, offshore wind 5.3-fold, and onshore wind 2.3-fold, forming the primary generation sources. Hydropower generation remains stable but provides increasing strategic flexibility to integrate wind and solar. About one-third of the power sector's decarbonisation will go into grid investments for new demand and renewables. However, renewable energy developers, grid operators and asset owners understand that RES and related infrastructure development can still have specific direct, adverse impacts on biodiversity. They are therefore complying with existing EU and national biodiversity legislation, including:

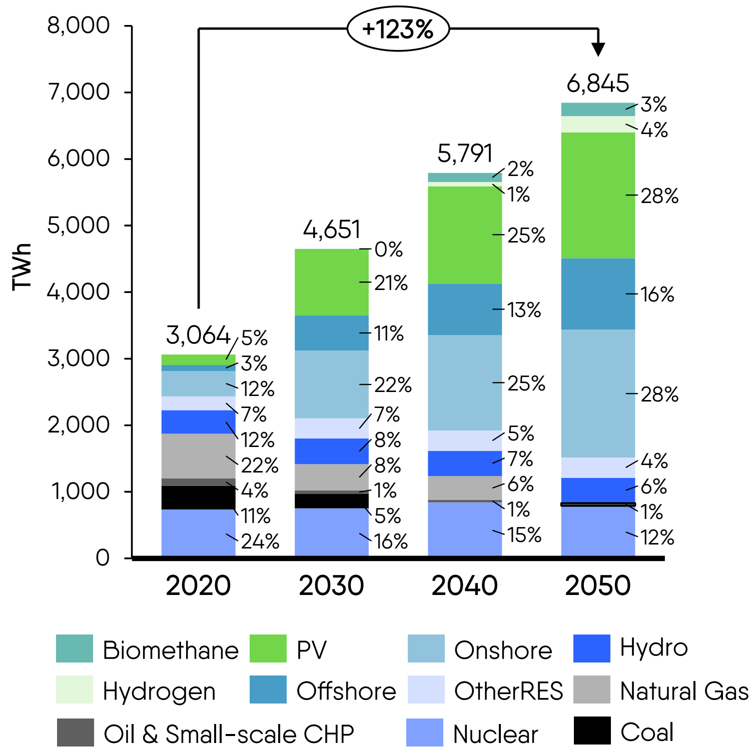
- Habitats Directive;
- Birds Directive;
- Water Framework Directive;
- Taxonomy Regulation;
- Corporate Sustainability Reporting Directive;
- Environmental Impact Assessment Directive;
- Preparing for the application of the Nature Restoration Law; and
- New permitting framework embedded in the Renewable Energy Directive.

The sector is often going a step further, aligning with international non-binding guidance and initiatives, such as:

- International Union for Conservation of Nature (IUCN) & The Biodiversity Consultancy: Industry Guidance for Early Screening of Biodiversity Risk (Solar, Onshore Wind and Offshore Wind);
- Nature Positive (including Roadmap to Nature Positive: Foundations for the Energy System);
- Taskforce for Nature-related Financial Disclosures; and
- Global Biodiversity Framework.

REPowerEU policy plan inspired scenario for transition in energy generation, with significant increases in solar and wind.

Electricity generated in REPowerEU-inspired (TWh)



Adapted from Eurelectric (2023)

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Power sector motivations to mainstreaming biodiversity

Biodiversity integration offers renewables and grid developers and operators an approach to help solve the biodiversity crisis and demonstrate compliance with the requirements of new and forthcoming regulations. There are significant benefits to shifting operational practices and investing in biodiversity-enhancing business models, such as:

- Improving reputation;
- Being a market differentiator;
- Reducing consenting risk;
- Reducing risks of delays and cancellations due to public concern;
- Enhancing stakeholder relationships;
- Inspiring investor confidence and trust;
- Increasing public acceptance;
- Transparently documenting biodiversity measures;
- Providing public and operational benefits such as climate and disaster resilience;
- Potentially reducing generation curtailments as well as operational costs; and
- Income generating opportunities.

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Biodiversity integration – Renewables and distribution grid deployment can benefit nature

Beyond the benefits derived from reducing carbon emissions, renewables and grids deployment can contribute to supporting biodiversity through good design and responsible operations, re-investments/re-powering, or decommissioning, e.g. by:

- Retaining natural habitats and protecting the species that depend on them as far as possible by minimising habitat destruction and land conversion; and
- Supporting wildlife by providing new habitats and feeding grounds whether on or offsite (particularly in previously disturbed/degraded sites), as well as incorporating wildlife-friendly design features. Over their multi-decade lifespan, renewable power installations entail minimal human interference and can serve as sanctuaries for various species and native flora.

Biodiversity integration includes a range of approaches that promote a positive contribution to nature from renewables and grids development. It is based on the mitigation hierarchy, a sequential approach to avoid, minimise, restore, and offset negative biodiversity impacts, and enhance where possible.

Biodiversity integration also captures a spectrum of opportunities for a development, from non-measurable positive action to measurable no net loss or net gain outcomes. While the process of integration is standardised in this Guidebook, the outcome may vary depending on the project, site-specific constraints, feasibility of mitigation measures and local and national regulations.

64% of respondents have internal policies on biodiversity integration which go beyond statutory requirements.

Guidebook development and navigation

Methodology

In developing the Guidebook, WSP undertook:

1. **A literature review** – targeting international, EU and national policy, legislation, methodologies, guidance, and standards relating to biodiversity, including protection and enhancement. It also reviewed four businesses' approaches to enhancing biodiversity which go beyond current environmental compliance.
2. **Interviews** – used to collect information from key industry experts, academia, Non-Governmental Organisations (NGOs) and individual Eurelectric members. A standardised set of questions explored themes related to: country-specific legislative biodiversity requirements; guidance for conserving and enhancing biodiversity; commonalities and divergences between sector opportunities and challenges; case study examples of work to conserve and enhance biodiversity during operations; and drivers for conserving and enhancing biodiversity.
3. **Workshops** – used to discuss the findings of key stages of the project i.e.: the literature review; the creation of the principles; and the interview process and analysis. Feedback was collated from experts on proposed elements of the Guidebook and their opinions considered throughout the whole Guidebook creation process.
4. **A survey** – to 25 developers and operators, providing an opportunity to Eurelectric's wider membership for Eurelectric's wider membership to respond to Guidebook recommendations.
5. **Wider consultation** – undertaken with additional organisations in industry and nature conservation. This consultation does not imply endorsement.

76% respondents said a guidebook for the industry would help their business implement biodiversity integration.

Scope of the Guidebook

The Guidebook is to be used as a European-wide non-binding charter of guiding principles on biodiversity integration practices and success factors. It can also serve as a blueprint for other regions since biodiversity ambitions are obviously a global endeavour. It is specific to solar, on- and offshore wind, hydropower including pumped storage hydropower, and distribution grids projects. It is to be used at the project-level. Other decarbonised power generation technologies such as nuclear, biomass as well as transmission grids are not in scope of this Guidebook

The Guidebook does not replace ample guidance available on regimes that may be required to develop and operate within regulatory requirements (such as Environmental Impact Assessment [EIA]) but is intended to be complementary to these.

Structure of the Guidebook

The Guidebook consists of a set of principles for guiding biodiversity integration to deliver better outcomes for biodiversity. This is supported by key success factors and challenges at each stage of a project's lifecycle (site/route selection and screening, consenting/permitting/design/re-powering, construction, operation, and decommissioning). Case studies are interwoven throughout for contextual support, evidence, and inspiration. The principles and opportunities/challenges/success factors at each lifecycle stage are set out as those which are applicable across all RES and distribution grid technologies and as those which are specific to the respective technologies. The technology-specific design options are not exhaustive and are not a replacement for technology-neutral actions. Actions are to be considered in light of site-specific details and additional examples can be found in the Further Guidance Section.

Therefore, the Guidebook can be used by the power sector to guide targeted biodiversity integration approaches throughout the project lifecycle and across RES and distribution grid projects.

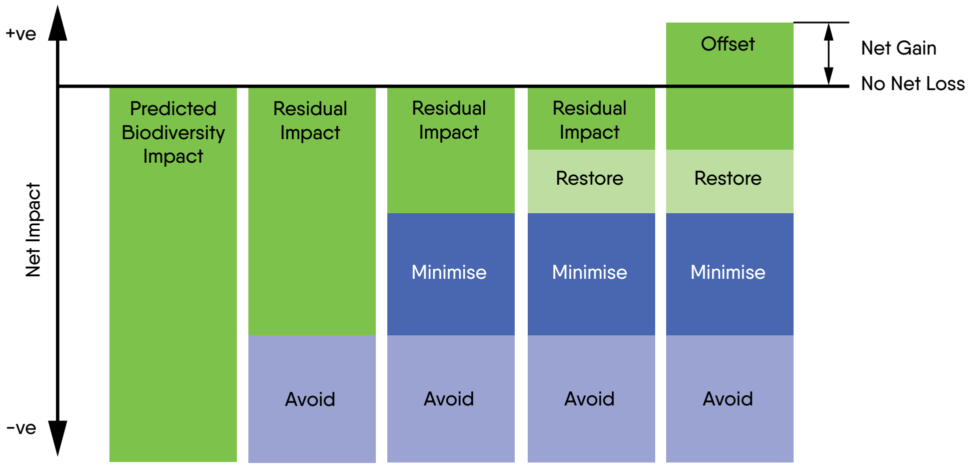
The principles

The principles presented in this Guidebook provide a framework to guide biodiversity integration. They have been inspired by internationally recognised approaches, including those listed in the Further Guidance Section. This Guidebook has adapted them for renewable energy and distribution grid projects in consultation with key industry project partners. Case studies illustrate approaches and successes across the project life cycle.

The principles should be applied using expert ecological knowledge and at a level proportionate to the scale of the anticipated adverse impacts of the project. Project proponents should consider, demonstrate, and justify how each of the principles have been applied.

The first principle (*Adhere to the mitigation hierarchy*) is foundational and has to be followed when developing any RES and grid distribution projects. The rest of the principles strengthen biodiversity integration and the more principles that can be adhered to the better. There are strong inter-linkages between the principles and when applied together they represent a best practice approach to biodiversity integration.

Mitigation hierarchy



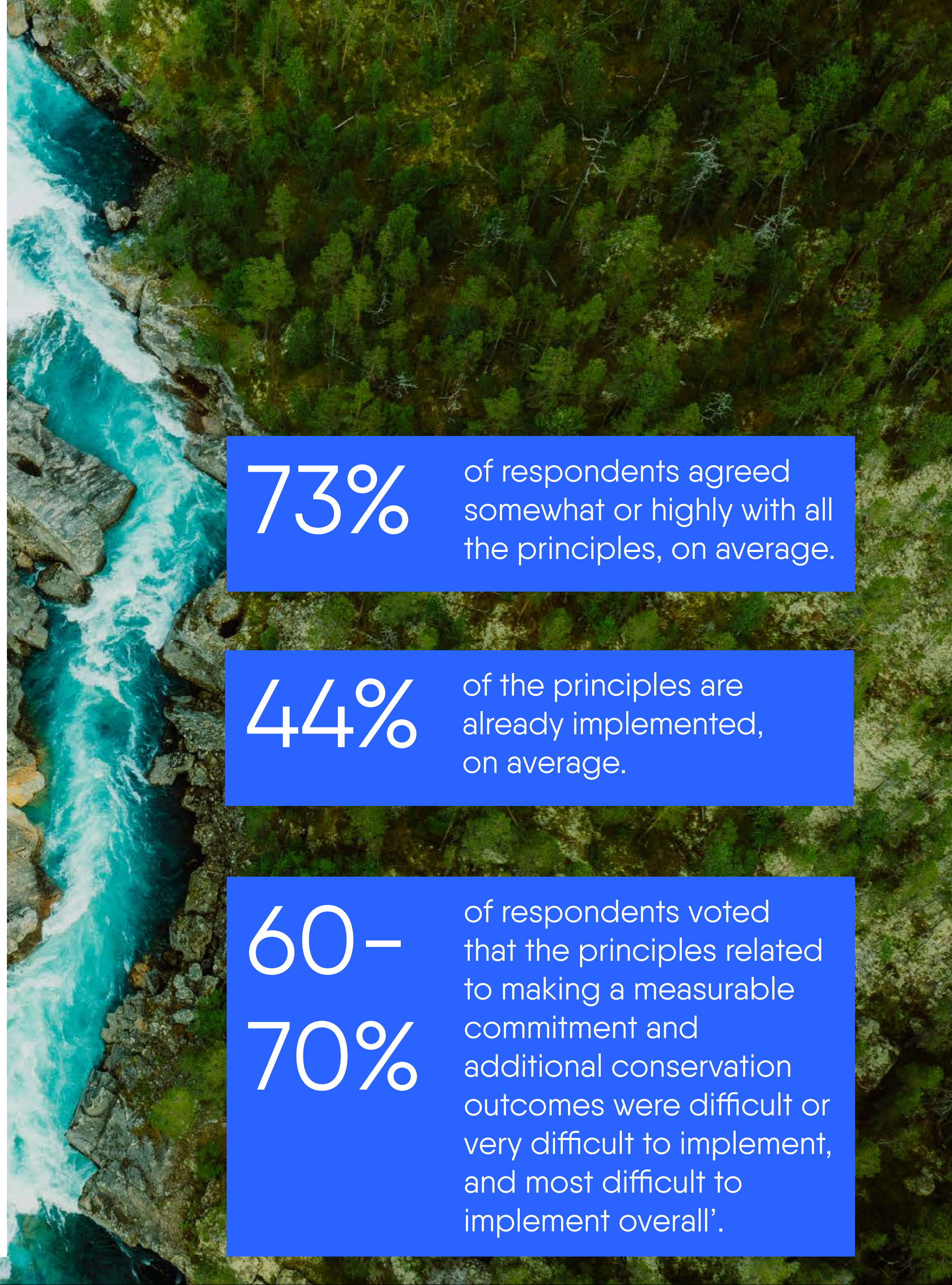
The twelve principles can broadly be arrange into three groups:

- **Principles 1, 2 and 3** relate to implementing a sequential process of measurable change. This is based on the Mitigation Hierarchy but emphasising measurable contributions and the importance of irreplaceable biodiversity.
- **Principles 4, 5, 6, 7 and 8** support the identification of the right measures, including through stakeholder engagement. These principles have particular emphasis on the additional biodiversity benefits of on or offsite measures.
- **Principles 9, 10, 11 and 12** relate to positive information flow and long-term benefits. These principles have particular emphasis on ensuring that projects inform and are informed by stakeholders and best practice. They also ensure that measures are secured for the long-term and to achieve multiple-benefits.

Recommended actions that demonstrate the application of principles across the project lifecycle are provided in this Guidebook (see the Actioning the Principles Section). Some actions are relevant to more than one principle. For clarity, actions have been assigned to the principles they are most aligned with.

The principles

1 Adhere to the mitigation hierarchy	As far as possible avoid and minimise adverse impacts on biodiversity. Where adverse impacts cannot be prevented, restore biodiversity features of concern that have been degraded or damaged by project activity. Only as a last resort, and in agreement with external decision-makers where possible, offset residual losses that cannot be prevented or restored. If offsetting losses within the development footprint is not possible or does not generate the most benefits for nature conservation, then offset biodiversity losses outside of the consenting boundary.
2 Avoid adverse impacts on irreplaceable biodiversity	These impacts cannot be offset.
3 Make a measurable contribution to biodiversity	Biodiversity integration achieves measurable conservation outcomes.
4 Achieve additional conservation outcomes	Achieve conservation outcomes above and beyond results that would have occurred if the project had not taken place. Design and implement biodiversity measures which avoid displacing activities harmful to biodiversity in other locations.



73% of respondents agreed somewhat or highly with all the principles, on average.

44% of the principles are already implemented, on average.

60–70% of respondents voted that the principles related to making a measurable commitment and additional conservation outcomes were difficult or very difficult to implement, and most difficult to implement overall'.

5 Contribute to conservation priorities

Design biodiversity measures to contribute to local, regional, national, and / or EU biodiversity conservation priorities, which are formally captured in relevant, published plans.

6 Achieve ecological equivalency

Adverse biodiversity impacts are restored on a like-for-like or better basis. Ecological structure and function that support biodiversity values are maintained and enhanced.

7 Address risks

Mitigate difficulty, uncertainty, and other risks to achieving biodiversity integration, including considering the time, difficulty, location, and users for implementing biodiversity measures. Add contingency, account for and justify the methods used to mitigate risk when estimating biodiversity losses and gains.

8 Be inclusive and equitable

Engage relevant stakeholders early, and involve them in designing, implementing, monitoring, and evaluating the approach to biodiversity integration. Achieve biodiversity integration in partnership with stakeholders where possible and share the benefits fairly among stakeholders.

9 Optimise for multiple benefits

Design of biodiversity measures which include ecosystem services that add wider environmental benefits to the locality, build in climate resilience, integrate other uses and generate social value where possible.

10 Secure long-term outcomes

Design and implement a project to use an adaptive management approach, incorporating monitoring and evaluation; with the objective of securing outcomes that last at least as long as the lifetime of the project and ideally, beyond.

11 Be transparent

Design and implement a project and communicate its methods, assumptions, and expected results to the relevant stakeholders and decision-makers in a transparent and timely manner.

12 Exchange science and knowledge

Design and implement a project using a documented process informed by sound science and which considers traditional knowledge, where appropriate. Foster transfer of knowledge and data gained by a project to the industry and scientific communities and contribute to the body of literature. Facilitate education, training, and innovative practices in biodiversity measures through the project where possible.

Application of principles

Challenges, opportunities, and success factors common across renewable energy and distribution grid projects

Research and stakeholder engagement has identified benefits that can be derived from biodiversity integration (‘opportunities’) and obstacles or issues that need to be overcome when implementing it on projects (‘challenges’). Specific measures or considerations that result in effective integration are here referred to as ‘success factors’. Key examples are summarised below.

Challenges

- Conflicts between stakeholders, policies, project demands and priorities can complicate conservation objectives for biodiversity;
- Available scientific data and research opportunities may be behind the pace of required development, limited or slow to be integrated into guidance, which means biodiversity is not effectively surveyed, assessed, or monitored and adverse impacts are not fully understood;
- Priorities need to be balanced to provide the best outcomes for nature, whilst also delivering on other legislative, community and social requirements which may conflict with biodiversity integration in the immediate term;
- Lack of guidance and standards in biodiversity assessment approaches make it difficult to make comparisons between projects and mitigation measures, and to assess impacts and monitor and evaluate progress towards objectives and local authority requirements;
- Understanding and incorporating the dynamic interactions between different ecosystems, species, and natural processes into projects is complex; and
- There can be increased costs associated with reducing adverse or increasing positive impacts to biodiversity (e.g. acquiring additional land).

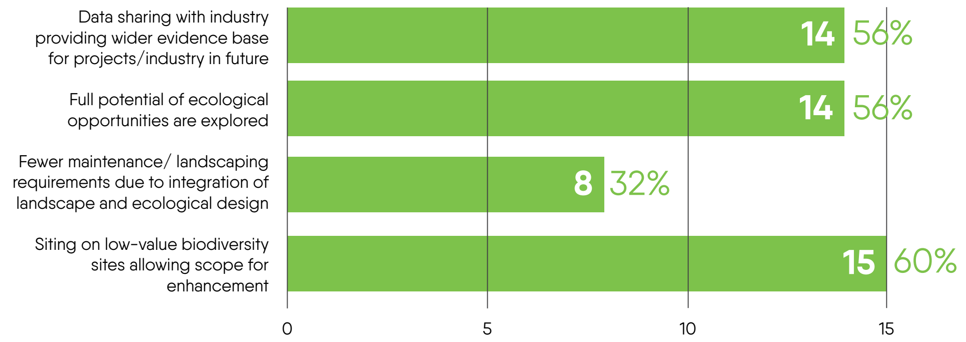
84% of respondents reported that integrating biodiversity into their projects is more costly compared to those that do not.

A lack of suitable guidance and conflicting stakeholder objectives were the main barriers to biodiversity integration reported by survey respondents.

Opportunities

- Supporting accelerated project deployment through early and robust integration of biodiversity in design and, where possible, advanced delivery of restoration or offset measures;
- Prioritising areas of low-biodiversity-value such as brownfields, degraded lands and redevelopment areas when choosing the project location can reduce negative impacts and increase potential gains to biodiversity (see Delivering better outcomes through site selection);
- Considering biodiversity alongside other project requirements can lead to better outcomes overall, for example integrating biodiversity measures into natural landscape design;
- When well designed, biodiversity measures can offer wider environmental enhancements via ecosystem services, for example through the integration of nature-based solutions and enhanced carbon storage in vegetation and soils as well as benefits to project infrastructure, e.g. surface water management and screening;
- Working with local stakeholders and communities and using their specific regional knowledge can lead to better outcomes for biodiversity, local communities, and the economy as well as for de-risking project development;
- Establish a positive reputation through successful process and the outcome of biodiversity integration and stakeholder engagement. This may lead to a smoother consenting process for the developers current and future projects;
- Development is an important source of data collection and knowledge creation. Better mechanisms for data-sharing and knowledge transfer would benefit the whole industry, including policy makers, NGOs, and workforce development; and
- Facilitate an improved knowledge base and reporting accuracy/capacity with regard to biodiversity and ecosystems under the CSRD.

What are the main opportunities to embedding biodiversity into the design of your developments? (25 responses)



Siting development on areas of low value for biodiversity was the main opportunity reported by survey respondents.

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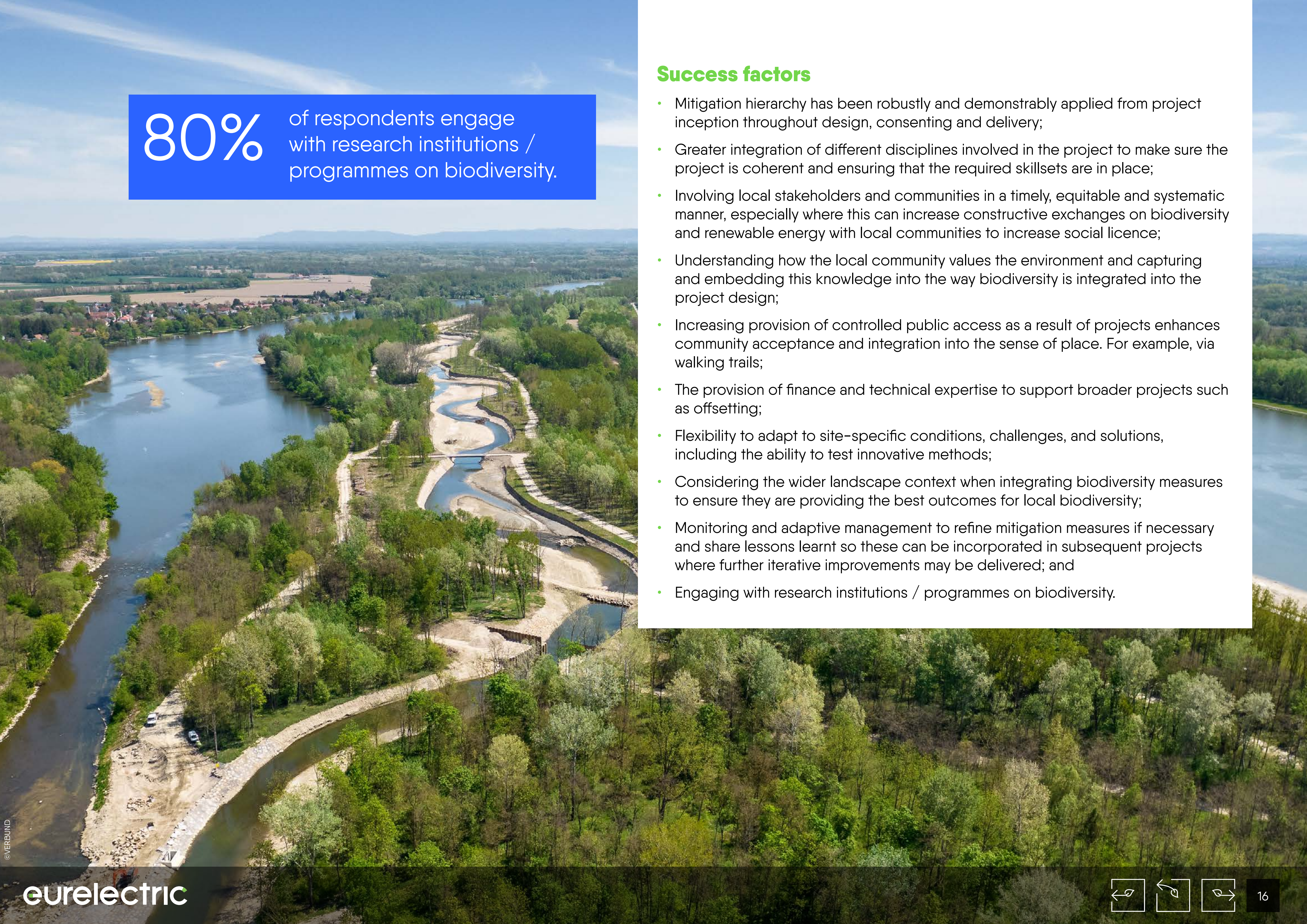

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80% of respondents engage with research institutions / programmes on biodiversity.

Success factors

- Mitigation hierarchy has been robustly and demonstrably applied from project inception throughout design, consenting and delivery;
- Greater integration of different disciplines involved in the project to make sure the project is coherent and ensuring that the required skillsets are in place;
- Involving local stakeholders and communities in a timely, equitable and systematic manner, especially where this can increase constructive exchanges on biodiversity and renewable energy with local communities to increase social licence;
- Understanding how the local community values the environment and capturing and embedding this knowledge into the way biodiversity is integrated into the project design;
- Increasing provision of controlled public access as a result of projects enhances community acceptance and integration into the sense of place. For example, via walking trails;
- The provision of finance and technical expertise to support broader projects such as offsetting;
- Flexibility to adapt to site-specific conditions, challenges, and solutions, including the ability to test innovative methods;
- Considering the wider landscape context when integrating biodiversity measures to ensure they are providing the best outcomes for local biodiversity;
- Monitoring and adaptive management to refine mitigation measures if necessary and share lessons learnt so these can be incorporated in subsequent projects where further iterative improvements may be delivered; and
- Engaging with research institutions / programmes on biodiversity.

Delivering better outcomes through site selection

Site location opportunity

Site selection provides the greatest opportunity to identify, acquire and develop sites with a comparatively lower biodiversity baseline and avoid negative biodiversity impacts. Selecting a low baseline biodiversity value site (b) can result in a smaller predicted biodiversity impact when compared with a higher baseline value site (a), for the same project type and extent. Continuing to apply the mitigation hierarchy can further reduce the residual impact. Better outcomes for biodiversity can then be achieved with the same amount of offsetting effort. In this illustrative example, a greater net gain is achieved on a lower baseline value site for the same amount of offsetting.

The Mitigation Hierarchy

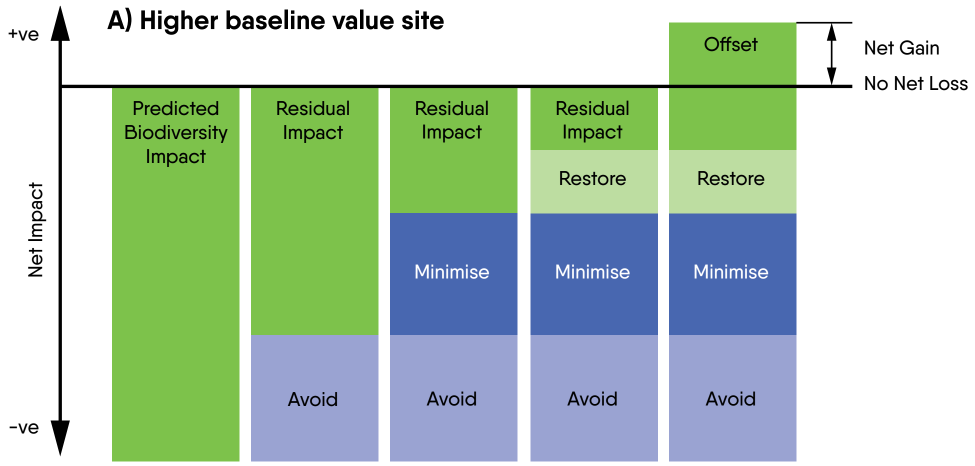
The mitigation hierarchy is a hierarchical approach that limits as far as possible the negative impacts on biodiversity from development by first avoiding, then minimising, restoring and finally offsetting. Prevention (avoidance and minimisation) should be applied to the maximum extent practicable before remediation (restoration and offset).

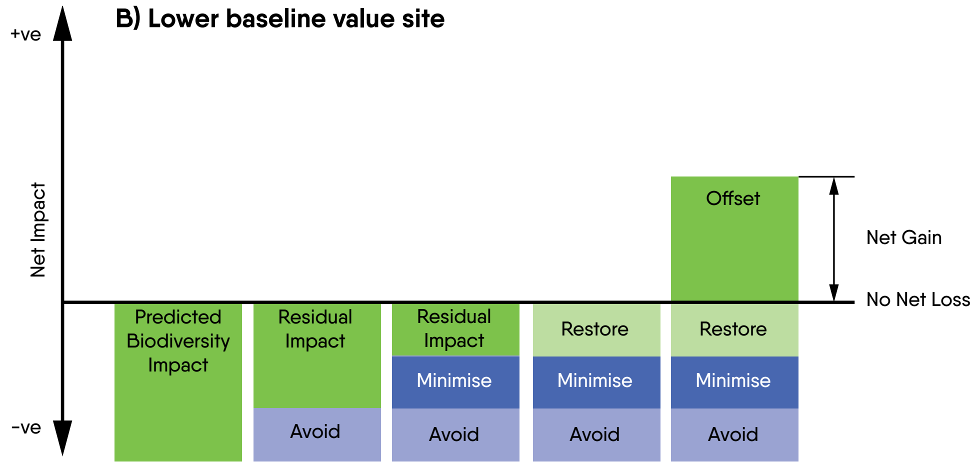
Baseline

A biodiversity baseline is required to understand the impacts a project may have on biodiversity. It is defined in the glossary in the Appendices and further clarification is provided here. The baseline represents a point in time, where change can be understood by comparing with another point in time. It is described for a defined area, which is typically the consenting boundary.

For a new project, the baseline represents the biodiversity that is there before development. For existing operational assets, and for repowering and recommissioning, the baseline represents the biodiversity inclusive of the operational infrastructure. Re-commissioning (wherein no physical changes are proposed to standing infrastructure) is considered to be effectively the same as repowering in the context of this Guidebook.

Illustrative example





Protecting biodiversity across the project lifecycle

This section identifies the specific challenges, opportunities and success factors that occur at each of the life cycle stages. Specific actions to address these and integrate biodiversity are summarised in the Actioning the principles section.

Site/route selection and screening

Specific challenges and opportunities

Balancing the costs of the project with the potential environmental solutions.

Integrating landscape and biodiversity objectives from the outset of the project can often provide both biodiversity and wider benefits with less overall effort.

Suitable locations for renewable energy and grid projects within strategically identified and mapped areas, which avoid key negative biodiversity and community impacts, could accelerate deployment.

Stakeholder preference to locate projects away from human settlement / agricultural receptors, can lead to pressure to develop in marginal or remote areas of typically higher biodiversity value.

Specific success factors and positive practices.

Screening for ecosystem services as well as biodiversity may identify additional opportunities for design to enhance services for the local community and the resilience of the development. Robust and early stakeholder engagement can de-risk projects.

60% of respondents work with selected partners to help develop measures to improve biodiversity.

@SSE Renewables by Thomas Plant

Design, consenting and permitting

Specific challenges and opportunities

Reduce project development risks through effective biodiversity integration approaches / strategies.

Integration aids preparedness for projects proposed in regions where local planning policy mandates specific biodiversity requirements for developments, including no net loss and net gain.

The amount of land available for renewable energy and grid projects, as well as any biodiversity offsets, can be constrained due to other environmental or socio-economic factors, as many regions in EU Member States are densely populated.

Specific success factors and positive practices

Multi-disciplinary working starts early so that experts work together to find and embed solutions into the design of a project reducing delays later in the project programme. For example, including engineers, landscape architects and ecologists. Careful consideration of the local context, renewable energy objectives and relevant spatial planning priorities can reduce location-based conflicts. Involve relevant stakeholders in the integration of biodiversity early in the design and consenting process, so that they are adequately engaged, and constructive decisions can be made.

Construction

Specific challenges and opportunities

Protection of biodiversity features during construction requires effective handover from design teams to contractors; effective monitoring throughout construction; and an adaptive approach to solve problems on a day-to-day basis. Agreed mitigation measures may not perform as envisaged during design and consenting stages, necessitating iterative changes to deployed measures and oversight / monitoring by experienced specialists.

Specific success factors and positive practices

Novel construction techniques can reduce adverse impacts to biodiversity, such as temporary land-take, and the requirement to restore and offset for losses. Establishing clear environmental specifications to be signed by all on-site work companies can ensure accountability.

Operation

Specific challenges and opportunities

Monitoring the long-term effects of the development on biodiversity and adapting the management plan to address any opportunities for improvement or adverse impacts that might be detected.

Refine stocking densities of livestock to maintain and enhance structure and species-diversity of habitats where infrastructure is co-located with active (and sanctioned/leased) agricultural practices.

Integration of nature-based solutions such as natural flood management can enhance resilience and therefore reduce operational disruptions.

Specific success factors and positive practices

Investment in and use of new digital technologies such as artificial intelligence can enable more efficient data processing, analysis and monitoring. Relevant stakeholders are part of the decision-making process for the management and monitoring of a site.

Decommissioning

Specific challenges and opportunities

Following decommissioning, sites may be sold, so the developer may no longer have ownership or control of the site and is no longer able to influence decisions in relation to its biodiversity. Opportunities for major biodiversity gains on sites, which may be decommissioned or retired, which can be retained, restored, and secured for biodiversity in the long-term. Potential for Nature-Based Solutions to contribute to remediation of contaminated sites. Potential opportunities for reducing decommissioning costs through biodiversity integration.

Specific success factors and positive practices

Improving biodiversity when restoring areas unavoidably degraded or damaged during decommissioning infrastructure removal. Involving stakeholders in the decision-making and monitoring processes and engaging the subsequent site landowners on key biodiversity areas and features to secure their future. Ensuring subsequent landowners are aware of the sites biodiversity value and exploring contractual arrangements to secure long-term biodiversity benefits.

Case study:
VERBUND LIFE Projects

Project: VERBUND LIFE Projects, including:

- LIFE+ Traisen;
- LIFE+ Network Danube;
- LIFE Network Danube Plus;
- LIFE Riverscape Lower Inn;
- LIFE Project Blue Belt Danube Inn

Location: River Danube and River Inn, Austria and Germany

Cost: LIFE+ Traisen = 30 million EUR, LIFE Network Danube Plus = 19 million EUR, LIFE Riverscape Lower Inn = 24 million EUR, LIFE Blue Belt Danube Inn = 52 million EUR. Funded by the European Union LIFE programme

Dates: Planning to spend 280 million EUR by 2027, some project parts ongoing until 2029

Objectives: Improve ecological connectivity around existing hydropower plants in the Danube and River Inn and link Natura 2000 areas. Improve habitat conditions and species conservation status for endangered fish, wetland fauna and flora, and breeding, resting, and wintering bird species.

Measures undertaken: Created a 10km new river corridor at Traisen. Straightened sections of the river were broken up to create a larger natural river ecosystem connected to tributaries and floodplains typical of the Danube. The floodplain was lowered at 60m, creating 60ha of new floodplain. 30ha of dry grassland was also created. It took 15 years in design, planning, financing, and obtaining authority permits since conceptualisation, whereas the measures have been under construction for 3 years. Restored river habitats and created bypass rivers at HPP Ottensheim-Wilhering, HPP Greifenstein, and HPP Abwinden-Asten. For example, a 14.2km bypass river at Ottensheim was created in 2016 to enable fish migration and provide high-quality key habitats, which contributes to the Water Framework Directive and the Habitats Directive. The fishway was designed to integrate and restore natural water bodies, creating and improving habitat connectivity. Restored fish connectivity at Ering on the river Inn by creating a 2.6km bypass fishway (slope max 4.7%, discharge 2-12 m3 / s) and creating spawning and nursery grounds, as well as the construction of an island tributary system with flat banks, oxbow lakes, and dismantling of the river with water stones and fortified shore. Created a 13km bypass channel at Altenwörth with engineered log jams and sufficient flow to secure river dynamics. A wetland was also created, and four additional fishways reconnected fish from the river to floodplains.

Results: LIFE+ Traisen witnessed the number of onsite bird species increase from 72 in 2009 to 111 in 2018, with common kingfisher (*Alcedo atthis*) breeding pairs increasing from 1 to 7, sand martin (*Riparia riparia*) colonising steep riverbanks, high dragonfly (*Anisoptera*) densities, and 60ha of softwood and willow (*Salix*) forest created. The general ecological status of fish increased from bad to good. The site at Altenwörth saw sand martin breeding pairs in tubes increase from 63 in 2022 to 169 in 2023, with common kingfisher (*Alcedo atthis*) and little ringed plover (*Charadrius dubius*) territories establishing exclusively within the restored river sections. The fish biomass increased from < 50 kg to > 300 kg/h.

Natural fish pass, Altenwörth, VERBUND

Success factors:

- Stakeholder Consultation
- Scientific Justification
- Site specific solutions
- In-house technical expertise and thorough design
- Obtaining public acceptance
- Well established cooperation between developers and administrations
- Collecting and using high-quality data
- Knowledge sharing / lessons learned

Case study:
Statkraft Talayuela 2

Project: Statkraft Talayuela 2

Location: Talayuela, Cáceres, Extremadura, Spain

Cost: 260,000 EUR

Dates: Operational since 2023

Objectives: Landscape integration, harmonising the solar plant with the surrounding landscape. Preserving all the holm oak (*Quercus ilex*) species within the project boundary and implementing measures to preserve biodiversity. Maintaining an open dialogue with the local community on biodiversity.

Measures undertaken:

During Design, Consenting and Permitting
Structure piling when installing the panels to avoid using concrete. Avoiding herbicide use for vegetation control, to avoid damaging the aquatic environment with toxic run-off. Restoration of affected land and habitats, including spreading topsoil and improving pastures with leguminous and grass seeds in areas disturbed during canalisation and roadmaking. All trenches in the construction phase were provided with escape routes to prevent the trapping of wildlife. Installed bird collision avoidance measures on enclosures and on transmission line, including reflective plates on fencing, anti-collision devices such as luminous rotating blades with ultraviolet light on the evacuation power line, and bird-saving spirals installed every 10m on all conductors and ground cable. Installed nest boxes for owls (*Tyto*) and kestrel (*Falco*) on 5m high wooden supports with a foundation of 1 m for greater stabilisation. Installed refugia for reptiles and arthropods. Planting a perimeter of natural vegetation for screening. Creation of a 19ha fenced forest reserve, surrounded by temporary fencing to exclude herbivores, and promote tree and shrub growth. Pond construction for the European pond turtle (*Emys orbicularis*). Fenced, 2,000 m^2 and <1m deep, and with trunks and ramps for resting and access. Creation of a 5,000 m^2 pond with a 1.5m slope preparation for European bee-eaters (*Merops apiaster*). The first 5cm of the slope will be removed each year in late March, to prevent hardening and to refresh the slope wall. Installation of bat (*Chiroptera*) shelters with anti-climbing systems to deter predators.

Operation
Monitoring of bird mortality on the lines and trackers throughout the life of the plant. Searches will be conducted along a predetermined route with a specialised canine unit biweekly in winter and bimonthly for the rest of the year.

Decommissioning
Complete restoration of the land to its original state, including reestablishment of the original runoff, maintaining the original land topography, and returning the land to its pre-project vocation. Dismantling and the removal of all debris and waste will be overseen by an authorised manager. These measures will be carried out in a period of less than 9 months from the end of the plant activity. A restoration plan must be submitted one year before the end of the activity, detailing the different actions that will allow the land to be left in its original state. This plan must be approved prior to its execution by the environmental body, which will carry out the modifications it deems necessary.

Results: Conserved all existing ecosystems and preserved 81 existing holm oak (*Quercus ilex*) trees within the project area.

Talayuela II solar park, Statkraft

Success factors:

- Establishing a robust site plan biodiversity activities and processes helped avoid deviations or major challenges;
- Considering and implementing lessons learnt from previous projects;
- Undertaking a multidisciplinary approach that considered all requirements and recommendations to design, build, and operate the project; and
- Double fencing some areas helps protect and facilitate the successful implementation of natural screens to reduce the visual impact of the plant.

Case study:
illwerke vkw AG pumped storage hydropower plant "Obervermuntwerk II"

Project: illwerke vkw AG pumped storage hydropower plant "Obervermuntwerk II"

Location: Montafon, Vorarlberg, Austria

Cost: >10 million EUR

Dates: Implemented 2014-2018

Objectives: An existing hydropower plant was expanded with a new pumped storage hydropower facility with a capacity of 380 MW. Careful attention was paid during the design, the planning, and implementation phases to minimise the environmental impact and to integrate biodiversity measures wherever possible and appropriate.

Measures undertaken:

During site selection
Making the most out of existing infrastructures, the pumped storage power plant was conceived to utilise two reservoirs of an existing hydropower plant, maximizing the energy-economic potential of the available water volumes, without the need to build a new dam. Thereby, avoiding the development of additional water extraction points and minimising the impact on water bodies.

During design, consenting and permitting
New habitats for the black grouse were created at a sufficient distance from the plant through targeted clearing and vegetation management. Relocation of an alpine moor away from the impact area. Disassembling an aboveground penstock and substituting it with an underground tunnel, restoring the habitats to natural conditions. Restoring impacted areas to natural conditions using only local materials to limit the introduction of non-native species, and using local seeds obtained from mowing nearby alpine grasslands.

During construction
A comprehensive monitoring programme was used to carefully check both the excavated material and the drainage water to detect deviations at an early stage and avoid any negative effects on the environment.

Results: The transplanted bog has adapted successfully to its new environment. The black grouse populations have remained stable in the face of construction activity, showing no significant changes, and have embraced the additional habitats created. The areas affected by the construction phase display few signs to distinguish them from the natural surroundings.

Challenges:

- Avoiding creating additional negative environmental impacts during dismantling of the penstock; and
- Additional flora which required protection was identified during project works, necessitating adaptive planning and additional consent with monitoring and documents for the EIA.

Moorland relocation, illwerke vkw

Success factors:

- A proactive approach to biodiversity integration;
- Comprehensive environmental monitoring;
- Utilization of locally available materials; and
- Restoration measures outside the actual project area.

Case study:
SSER Griffin Wind Farm

Project: SSER Griffin Wind Farm (68 turbines, 2,500 ha)

Location: Aberfeldy, Scotland

Cost: ~100,000 GBP per year for the habitat management plan, plus a one-off initial upfront cost of a few million pounds

Dates: 2008 – onwards

Objectives: Maintain, enhance, and/or extend moorland, bogs, conifer free buffers around lochs and watercourses, areas of semi-natural and riparian woodland and scrub. Safeguard and enhance the black grouse (*Lyrurus tetrix*) population of the site. Safeguard the breeding raptor population on site. Create places of shelter for pine marten (*Martes martes*) and otter (*Lutra lutra*).

Measures undertaken:

During Design, Consenting and Permitting
Allowed heathland vegetation to regenerate naturally in brash and inter-brash areas. Improved forest structure through deliberate retention of some commercially viable species (e.g., *Pinus sylvestris*) beyond their optimal felling age, permanent retention of stands where possible, selected thinning, and feather edging future re-stock areas. Created a mosaic of heather age classes in the powerline way leave via heather burning or flail mowing for black grouse. Removed, lowered, or marked fences to reduce black grouse collisions. Retained sediment lagoons to encourage breeding amphibians and provided supplementary aquatic planting. Installed pine marten boxes.

Operation
Controlling bracken encroachment and maintaining appropriate level of grazing to prevent scrub encroachment and encourage a diverse sward structure. Controlling conifer regeneration around waterbodies and courses. Monitoring and maintaining planting areas and artificial habitats (e.g., otter holts), monitoring key species populations, monitoring flight activity to reduce propeller collisions. Developing and utilising an SSER BNG toolkit for site appraisal.

Results: A 66% uplift in biodiversity units when compared to pre-construction levels. Planted 12,000+ native broadleaved trees (since 2012). A stable and increasing black grouse population. Wetlands created from construction settlement ponds provide ideal habitats for otters (a European protected species and a target species). Increased prey species for pine martens.

Otter on camera trap at Griffin Wind Farm, SSER

Success factors:

- Having a dynamic Habitat Management Plan; and
- Demonstrating successful delivery of the Habitat Management Plans' objectives through monitoring and periodic reviews enabled recommendations to be defined and provided evidence for the granting of adaptive management options by NatureScot.

Actioning the principles

Introduction

This section of the Guidebook summarises recommended actions for implementing the principles throughout the project life cycle. The section is broken down into life cycle stages.

Site/route selection and screening → Design, consenting and permitting → Construction → Operation → Decommissioning

Actions for each life cycle stage that can be applied across all RES and distribution grid technologies are described against the principle they most closely relate to. These are followed by examples of technology-specific actions.

Case studies have been added throughout this section to provide context and inspiration.

The project life cycle stages have been added as a navigation aid at the bottom of the Actioning the principles section. It highlights which stage a page relates to and can be clicked on to navigate between life cycle stages.

Site/route selection and screening

This section, on site/route selection and screening, recommends actions taken before the consenting and permitting stage. It is intended to help inform the decision to go to that next project stage.

Actioning the principles – all technologies

Principle	Actions
1 M **Adhere to the mitigation hierarchy**	Prioritise brownfields / industrial areas, built environment and intensive / improved agricultural land for development. Search and identify key locations (Appendix III) for biodiversity, through consultation with public officials and relevant stakeholders at local and national levels, and using tools such as publicly available GIS datasets (as well as existing in-house data). Identify and avoid key migratory routes for species of international, national and local conservation priority. Identify and avoid key sites for congregatory species. Demonstrate how these have been avoided as far as possible such as using public data or in-house bespoke / heatmap solutions to create wildlife sensitivity mapping. Where adverse habitat impacts cannot be avoided or minimised by site/route selection: • Identify what habitats may require restoration and offset within the site, what structure and function they have and what species are likely to be associated with them; and • Identify the potential need for, and the availability / proximity of, offset sites and what habitat, species, structure, and function are likely to be associated with them.

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Actioning the principles – all technologies

Principle	Actions
2 Avoid adverse impacts on irreplaceable biodiversity	Undertake actions for irreplaceable habitats as per principle 1. Where a net gain outcome is desired, irreplaceable habitat loss must be avoided. No net loss and net gain for habitats that are not irreplaceable can still be sought and should be communicated as part of communication of the project to the public and relevant stakeholders.
3 Make a measurable contribution to biodiversity	Identify and use appropriate calculations / metrics (see also Appendix II) to make broad estimations of potential losses and gains of biodiversity using existing data sets and results from preliminary field surveys. These may be targeted at most vulnerable habitats or species, e.g. Annex I habitats and Annex II and IV species (European Commission, 1992). Demonstrate where options selection has been informed and updated accordingly. Where feasible, preferentially select the site/route with the lowest baseline biodiversity value. Establish a plan for biodiversity features to identify steps required to achieve positive outcomes for biodiversity. Set design objectives and include consideration of the budget and programme. Where a net gain outcome is desired, include a net gain target within the strategy.
4 Achieve additional conservation outcomes	Undertake due diligence checks of the proposed site or route to determine whether there are any funded plans or legal commitments already in place. If there are any, establish whether the proposed development has the potential to provide conservation outcomes that are additional to the existing requirements.

Principle	Actions
5 Contribute to conservation priorities	Review national and local plans, projects and sites for nature conservation and identify potentially sensitive environmental features for further assessment according to likely adverse impacts of the development. Identify opportunities presented by habitats within the site or route and the species that might use these, as well as the constraints they may pose to the proposed development. Conduct preliminary ecological surveys for the identification of high-value biodiversity, where appropriate. Undertake due diligence on the presence of high value biodiversity, including consultation with relevant experts. Consider biodiversity aspects in the EIA, where appropriate. Consider how design options could align with the objectives of EU (i.e. the European Biodiversity Strategy), national and local conservation priorities (e.g. how can a proposed design support pollinators). Where a net gain outcome is desired, consider which baseline measurements may be required.
6 Achieve ecological equivalency	Integrate considerations for any required ecological equivalence offset into the site design from the outset. Consider how this will interact with other policies which may need to be met as part of the next project stage (Design, Consenting and Permitting).

Actioning the principles – all technologies

Principle	Actions
7 Address risks	Land requirements for potential biodiversity measures have been considered, this includes budget and expertise for potential land agreements or purchase. Where a net gain outcome is desired, early consideration is given to the potential habitats and species that could be targeted for enhancements.
8 Be inclusive and equitable	Set out a stakeholder engagement strategy to identify steps required to meaningfully engage stakeholders. Identify whether the development is likely to be within a zone of influence of indigenous people and include within the strategy as a key group for early engagement. Set out a mechanism to integrate feedback of stakeholders into the biodiversity integration strategy.
9 Optimise for multiple benefits	Consider opportunities and constraints for multiple benefits including from ecosystem services, such as flood alleviation, improved air quality, surface water management and additional land use, such as agriculture etc. Identify broad objectives for delivering multi-benefits and integrate into design principles.
10 Secure long-term outcomes	Methods of securing biodiversity measures in the long-term are considered within the biodiversity integration strategy. Including identifying internal resourcing and succession planning for tracking / monitoring.
11 Be transparent	Set a target for biodiversity features and establish a strategy with steps to achieve biodiversity. Where a net gain outcome is desired for the project, this should be documented. The method of documentation allows updates to be made throughout the project as further information and other objectives of the project inform the design. The net gain commitment and documentation process are communicated to the design team and relevant stakeholders. Document the site/route selection and screening process, and demonstrate how final design options have been selected to avoid, as far as possible, sensitive biodiversity features.
12 Exchange science and knowledge	Inform the site/route selection and screening stage with available scientific and industry data. Consult relevant experts to interpret data and try to access further, non-public data. Identify opportunities for sharing data across relevant stakeholders such as contributing any non-sensitive biodiversity data gathered during preliminary surveys to national databases.

Site/route selection and screening

This section provides examples of additional actions at the Site/route selection and screening stage that are specific to individual technologies. Key actions for wind farms are appropriate across onshore and offshore facilities.

Actioning the principles – technology specific

Onshore & offshore wind

The actions presented below are relevant for both wind technologies

- Identify other existing and planned wind farms around the project to arrange ecological corridors between farms and/or projects to provide species with passage through the site; and
- Where not possible to avoid key migratory routes, consider curtailment and factor into project feasibility.

Distribution grids

- Consider longer /alternative routes for OHLs that avoid ecologically sensitive areas and limit habitat fragmentation;
- Consider upgrading existing circuits to avoid the need for new corridors;
- Where wildlife collision is assessed as being an increased risk, use undergrounding of cables, ideally along roads and other existing linear developed ground to avoid and minimise collision impacts and factor into project budget and programme. Whilst remaining cognisant of scenarios where cable trenching may increase adverse effects to sensitive habitats (therefore negating any benefit to collision reduction);
- Preferentially use trenchless methodologies, such as horizontal directional drilling and other innovative solutions to avoid discrete biodiversity features and factor this into the project budget and programme; and
- Consider smart grid infrastructure and forward spatial planning of grid development to reduce future interventions, implement the efficiency first principle and minimise land use in the first place.

Solar PV

- Appropriate actions for solar parks are already addressed within the 'all technologies' section.

Hydropower

- Identify and preferentially avoid areas of key freshwater habitats or species. Prioritise sites on altered or impaired river stretches and consider powering/repowering/upgrading opportunities for existing structures;
- Align with regional water management strategies and explore synergies (e.g. flood and drought protection plans, water framework management plans); and
- Consider restrictions in power generation (e.g. due to provision of ecological flows) in the economic analysis of the project.

Case study:
BayWa r.e. 70ha ground-mounted solar park

Project: BayWa r.e. 70ha ground-mounted solar park

Location: South-West France

Cost: 850 000 EUR (330 000 EUR for construction and 520 000 EUR for operation)

Dates: Began in 2010, operational since 2017

Objectives: Adhere to the mitigation hierarchy, with a net gain in biodiversity

Measures undertaken during site/route selection: The developer worked in partnership with the local municipality to identify suitable areas during the site screening process. A forest area was selected for development as the habitat had already been degraded by several storms, reducing adverse impacts on existing biodiversity.

Other measures: Small holes were made in fences to allow wildlife to pass through the site. Frequent rotation of onsite sheep grazing to manage the vegetation such that it preserves vegetation key for the life cycle of a protected butterfly species, the false ringlet (*Coenonympha oedippus*). Restored 173ha of degraded wetlands offsite in partnership with a local environmental organisation.

Results: Increases in target species both onsite and in the surrounding area, including false ringlet (*Coenonympha oedippus*), Dartford warbler (*Sylvia undata*), and oblong-leaved sundew (*Drosera intermedia*).

Challenges:

- Finding compensation areas of the required size that do not conflict with agricultural land or tourist areas;
- Continued financing of key compensatory measures as inflation increases costs;
- Managing the solar plant with ecological principles whilst considering higher fire risks and contradictory requests from local authorities; and
- Bringing together all local stakeholders regularly within the monitoring committee and taking their opinions into account in the management of the site.

Success factors:

- Site-specific solutions, with the design and technological solutions evaluated and adapted as knowledge of the site advanced during environmental studies and monitoring;
- In-house technical expertise and working as a project team, which includes operational engineers and environmental experts, enabling all project constraints to be considered collaboratively;
- Compliance with the mitigation hierarchy;
- Well established cooperation between developers and administrations. The project was presented several times to the administration before and after submitting the building permit, in order to adapt operational choices and strengthen its acceptability; and
- Monitoring with a local environmental organisation and a stakeholder committee to adapt measures.

Perimeter passageway for wildlife, BayWa r.e.

Case study: VERBUND LIFE Projects (interconnecting and improving Nature 2000 habitats around existing hydropower plants)

Project: VERBUND LIFE Projects (interconnecting and improving Natura 2000 habitats around existing hydropower plants)

Location: Austrian Danube

Cost: Undertake river restoration, de-sedimentation, and bypass river creation to improve ecological connectivity, habitat condition, and species populations in the Danube, linking existing Natura 2000 areas.

Challenges:

- Land availability:
  - Some large local landowners (e.g. federal state church), but also owners of very small river stretches;
  - Landowners are less willing to sell land under current market conditions
- Clashing of different stakeholder goals;
- Project location in designated habitat areas, e.g., Natura 2000 sites; and
- Time-consuming negotiations with land owners/neighbourhood and authorities.

Bypass river, VERBUND

Success factors:

- Consulting stakeholders and appeasing concerns with site-specific nature-based solutions;
- In-house ecological and technical expertise and thorough design;
- Site-specific solutions; and
- Cooperation with stakeholders.

Design, consenting and permitting

Introduction

This section summarises actions for implementing the principles at the design, consenting and permitting stage of a project. The following table sets out actions that can be taken across all technologies.

Actioning the principles – all technologies

Principle	Actions
1 M **Adhere to the mitigation hierarchy**	Site-specific assessment is undertaken to confirm the presence or absence of key ecological features identified at the Site/route selection and Screening stage, including the use of site-specific surveys. Site-specific surveys identify and value habitats and species on-site in accordance with good practice guidance and regulations at local, national and EU levels and should be undertaken by competent practitioners (e.g. professional ecologists with appropriate experience). Based on site-specific survey information, avoid key locations and high-value biodiversity as far as possible. Where adverse impacts on habitat can be avoided: • Identify opportunities and determine objectives for habitat enhancements. Where adverse impacts on habitat cannot be avoided at this stage: • Identify relevant, effective, and evidence-based mitigation measures to reduce adverse direct and indirect impacts; and ensure these are comprehensively included in the design and construction methodologies submitted as part of the consent application; and • Determine extent, type and quality of habitat negatively impacted and requirements for restoration and offset measures. Where a net gain is desired: • Determine the appropriate scale, type, and location of offsets to meet net gain objectives and facilitate this through additional land footprint acquisition / leasing at the project site that can be explicitly used for biodiversity action. Communicate presence of key locations and high-value biodiversity features to the wider project team for continued integration into design iterations. As the design progresses, micro-site infrastructure to avoid and minimise impacts to biodiversity. Produce a plan (e.g. CEMP or EIA report) to protect retained and enhanced biodiversity features during the Title phase. Include measures which are directly informed by the requisite measures of the EIA Biodiversity Chapter, EcIA report or Habitats Directive Assessment report, such as: • Appropriate scheduling of works; • Physical barriers, pollution prevention; • Pre-works checks, briefings, and site supervision; • Include biodiversity-related roles and responsibilities for site management and personnel; • Include straightforward instructions on achieving biodiversity integration and mitigation; and • Include illustrated maps and plans.

Actioning the principles – all technologies

Principle	Actions
2 **Avoid adverse impacts on irreplaceable biodiversity**	Site-specific assessment is undertaken to Confirm presence or absence of irreplaceable habitats identified at the Site/route selection and Screening stage, including the use of site-specific surveys. Based on site-specific survey information, irreplaceable biodiversity loss is avoided as far as possible. Where irreplaceable habitat loss cannot be avoided, steps to minimise, restore and offset impacts are identified as above. Where a no net loss or net gain is desired: irreplaceable habitat loss must be avoided because it cannot be offset. No net losses and net gain can still be sought for non-irreplaceable habitats.
3 **Make a measurable contribution to biodiversity**	Establish the project's biodiversity baseline through site-specific assessment and survey (as above). Use the baseline to predict biodiversity outcomes against the project design post-development. An ecologist should advise on the most suitable quantification methodology for determining the biodiversity baseline, such as a suitable metric for the required data inputs, and how the methodology conforms to relevant EU, national and locally specific guidance. Where the methodology deviates from standing guidance, this should be justified and documented. Use the same method as used at Site/route selection and Screening to make site-specific estimations of potential losses and gains of biodiversity using site-specific data as appropriate. See Appendix II for a review of several available biodiversity metrics. The quantitative assessment should complement a qualitative assessment of biodiversity impacts; a description of biodiversity that could be affected by the project and an explanation of its wider ecological context. Demonstrate where design has been informed by biodiversity-related constraints / features .and updated accordingly. Where a net gain outcome is desired: • Validate the net gain target within the strategy made at the Site/route selection and Screening stage. The assessment should identify assumptions and limitations to the site-specific surveys. Assumptions and limitations should be considered in the next steps of the project and resolved where possible. Where not possible, a precautionary approach to assessment and design should be undertaken.
4 **Achieve additional conservation outcomes**	Where the development overlaps a site / existing scheme that has published plans to achieve improved biodiversity objectives, the development must demonstrate whether the development can provide conservation outcomes that are additional to those that are in place or already funded and/or sufficiently resourced. Confirm and communicate clearly if the project's biodiversity efforts are additional benefits to the site or existing plans.

Actioning the principles – all technologies

Principle	Actions
5 **Contribute to conservation priorities**	Project design for biodiversity comprises a multi-disciplinary team which could include different experts in natural sciences. Project team agrees design principles and communicates to wider team and relevant stakeholders. Feedback is actioned and incorporated where feasible. Design principles include how the principles of this Guidebook are applied to the specific project. Project team engages consultants with appropriate qualification, experience and local knowledge to assist in the design of development plans. Determine the extent of adverse impacts to sensitive biodiversity features identified at the site/route selection and screening stage. Determine requirements for biodiversity measures to be on-site or offsite (within or outside the zone of influence). Confirm how and where offsetting will be undertaken, e.g., by the developer; in partnership with others; through a third party; through supporting / funding existing or planned schemes by identifying additional outcomes. Engage external partners and stakeholders on offsetting as early as possible. Design objectives are created by using site surveys, design principles, and an iterative process during impact assessment / consenting. Design objectives relate to opportunities presented by biodiversity features present and are captured within consent and permitting documents (e.g. BMP, EIA report). This may be combined with landscape objectives (e.g. water framework plan, Natura 2000 site management plan) where there are synergies. Project design considers biodiversity features where they pose a constraint to future operation / maintenance and makes recommendations as to how this is managed. Demonstrate within the consent and permitting documents how design objectives align with the objectives of EU, national and local conservation priorities. Undertake further surveys as necessary to inform the design and feasibility of biodiversity mitigation measures. Plan and execute as appropriate. Impact assessment demonstrates material positive effects to biodiversity receptors, where appropriate. Biodiversity loss should consider bespoke and locally appropriate habitat solutions, to ensure local biodiversity losses are appropriately restored and offset.
6 **Achieve ecological equivalency**	Where adverse impacts on habitat cannot be avoided or minimised, identify relevant, effective, and evidence-based measures. These measures should ensure habitat is restored or habitat loss is offset with the same habitat type in the ecological context of the site and as locally as possible. Where not possible / appropriate, restore or offset with habitat that provides a similar a function to the habitats lost, and is appropriate in the ecological context of the site, considering known and likely use of the habitat by species associated with them.

Actioning the principles – all technologies

Principle	Actions
7 **Address risks**	Assess feasibility of maintaining, enhancing, and creating habitats; assess feasibility of attracting desired species and habitats (e.g. such as through soil sampling). Assess the economic viability of the BMP. Ensure funding for both financial and personnel will be available to manage and monitor habitats in line with the requirements set out within the consent and permitting documents for the lifespan of the project, and ideally beyond. Engage with local experts and relevant authorities to ensure the project is following national, regional, and local biodiversity requirements. Explicitly consider climate change resilience within design principles, so that biodiversity features retained, enhanced and created are likely to establish and mature with climatic changes. Identify where habitats can be created and enhanced in advance of construction works to reduce time lags between losses and gains reaching maturity. Secure area (land), including that required for offsetting, through legal mechanisms to deliver biodiversity measures over the lifetime of the project, including defining roles for the local communities in implementing measures where possible. Largely source construction materials regionally to reduce environmental impact and prevent the introduction of alien species. Ensure project design considers and minimises any adverse impacts to biodiversity features at the operational stage and decommissioning stage.
8 **Be inclusive and equitable**	Facilitate consultations, both internally and with external contractors, relevant stakeholders including the local community, indigenous people (where appropriate), local government and local environmental representatives such as charities or non-governmental organisations during the design process. Document feedback and how feedback has been actioned. Share as appropriate with stakeholders and design team. Demonstrate how benefits from biodiversity measures are to be equitably shared. During production of the consent and permitting documents: • Consult relevant stakeholders to further develop biodiversity plans; • Identify opportunities for local community / stakeholder involvement in the future of the biodiversity features; • Identify where stakeholders could have a formal role / responsibility; and • Partner with appropriate or invested stakeholders where appropriate, create roles / responsibilities identified and complete on formal agreements. Create mechanism for ongoing stakeholder participation and feedback on implementation of the consent and permitting documents.

Actioning the principles – all technologies

Principle	Actions
9 **Optimise for multiple benefits**	Assess the adverse natural capital/ecosystem services impact of proposed design and identify opportunities for wider environmental (natural capital) benefits from biodiversity measures. For example, carbon sequestration and flood alleviation through targeted habitat creation and nature-based solutions. Use learnings from principle 8 to inform principle 9, as local stakeholders are well-placed to guide on delivering multiple benefits. Consider how the project will affect the wider landscape and conduct a landscape level impact assessment where significant adverse impacts beyond the consenting boundaries are to be expected. This could include working with local stakeholders and landowners to ensure mitigation is contributing towards regional biodiversity priorities and is addressing issues of habitat fragmentation.
10 **Secure long-term outcomes**	Agreements with partners, contractors, third parties required to deliver biodiversity measures are secured for the long term. BMP should include the following information: • A biodiversity management and monitoring activity matrix, which outlines the monitoring and management activities which will be required to achieve the stated biodiversity value on site for the lifespan of the project - this should also outline who will be responsible for undertaking and reporting on the management and monitoring activities; • Measures required to offset habitat loss through the creation and enhancement of habitats which have greater ecological value than the baseline habitats; • Data from the proposed development landscape plan and baseline assessment for the project and proximal/interdependent third-party projects with their own BMPs/mitigation measures; • Mechanisms to manage and future-proof datasets for the long-term; • Landscape plans and habitat maps which identify and locate areas that have been assessed for biodiversity; and • Clearly present the planned and granted measures so that it is understood and actionable by responsible teams. Allow for monitoring progress to be reported and to adapt management plans if needed. Implement version control standards. Ensure the latest reports and landscape plans are suitably named to reflect the iteration that the plans relate to, and that the most recent version will be used for assessment. Save information in an agreed secure platform, accessible for all relevant project team members. Implement succession planning, as necessitated by staff promotion and turnover.

Actioning the principles – all technologies

Principle	Actions
11 **Be transparent**	Promote reporting standards for biodiversity related reporting. Provide the baseline according to the required quantitative assessment approach (see also Appendix II). Provide accompanying landscape plans in an appropriate digitised format, including GIS, Portable Document Format (PDF), and Computer-aided Design (CAD). Include full workings of the baseline measurement with evidence e.g., dated photographs. Include competencies of the surveyors who undertook the surveys. These could be included in multiple reports such as an EIA. Allow both regulators and local communities to view the project design. Ensure biodiversity commitments and outline management plans are made publicly available at an appropriate time and with enough time to allow for stakeholder / public considerations and concerns to be addressed.
12 **Exchange science and knowledge**	Inform impact assessment, design principles and design objectives with most recent/up-to-date available scientific and industry data. Consult relevant environmental specialists with knowledge on the local environment throughout the project. Consult external specialists on the best technology available to minimise adverse impacts on biodiversity within the project design. Consult local experts on opportunities for biodiversity integration where possible. Engage local communities during the design process for biodiversity integration of the project, for example in the creation of accessible biodiversity features such as boardwalks in rough areas of ground / vegetation for wheelchair users. Make survey data available in a suitable format to the scientific and industry communities. Where feasible, share species and habitat raw data with the public via national biodiversity data management platforms.

Design, consenting and permitting

This section provides examples of additional actions at the design, consenting and permitting stage that are specific to individual technologies.

Actioning the principles – technology specific

Onshore wind

- Avoid sensitive areas through relocation of turbines, access roads, cabling, or other infrastructure;
- Consider the density of the turbines in relation to the species identified or likely to be using the site;
- Align turbines parallel to, and not across, main bird or bat migration routes or general flight lines; and
- Arrange turbines in clusters with corridors between them, and consider other wind farms surrounding the project, to provide passage through the site and between farms and projects.

Offshore wind

Adapted from (IUCN, 2021):

- Avoid sensitive areas through careful siting of offshore foundations / turbines; export cable and the cable landfall location; and onshore access roads, etc.;
- Consider size / power rating of offshore wind turbines as it has implications for the project layout / configuration; avoid and minimise its potential adverse impacts on biodiversity;
- Consider nacelle height, rotor blade length, distance of the rotor blade between the blade tip and the ground, and visual and audio deterrents used in-relation to avoid and minimise impacts to known migratory routes;
- Consider effects of the choice of foundation type in relation to adverse construction impacts, e.g., consider use of 'quiet' foundation types (gravity bases or suction buckets / caissons), which are floated out to position and submerged, to avoid and minimise adverse noise impacts on marine biodiversity;
- Understand the potential for seabed scour, which adversely impacts biodiversity, and apply preventative measures as opposed to remedial measures that can be costly and difficult to successfully apply for biodiversity;
- Select cable protection material to be similar to the seabed environment; and
- Consider the local sand wave field and sediment transport such that secondary scour is reduced / avoided downstream during alignment and installation.

Actioning the principles – technology specific

Distribution grids

- Avoid key locations for biodiversity through route design;
- Preferentially apply undergrounding of cables or cable trench along existing road networks where trenching does not have more of an impact on biodiversity;
- Use latest technologies for cables such as solid XLPE cables, to reduce risk to biodiversity from cable leaks;
- Use trenchless technologies such as horizontal directional drilling as far as possible to avoid highly sensitive biodiversity features such as river crossings;
- Where overhead lines are required, and following a risk profile assessment, use bird diverters or other technologies to increase visibility;
- Consider the use of mitigation measures for electrocution such as within pole design, insulation, using raised perches and perching deterrents;
- Use opportunities to retrofit bird deterrents where overhead line upgrades are required; and
- Deploy alternative pole and conductor specifications for increased resistance to storm fall damage, in place of timber cutting options.

Solar PV

Adapted from (IUCN, 2021):

- Cluster solar arrays into blocks, employing adequate buffer zones between them, and fencing each block individually to avoid impacting sensitive areas along migratory corridors.

Hydropower

- Check possibilities to improve river morphology and connectivity of tributaries, wetlands, and floodplains;
- Manage sediment regimes to prevent up and downstream disruptions and habitat degradation;
- Ensure fish passage and migration routes by favouring nature-oriented bypass channels with diverse functions, structures, and habitats over technical fish ladders, if local conditions permit; and
- Seek use of low-impact equipment (e.g. fish friendly turbines) to minimise negative effects to aquatic life.

Case study:
Hafslund Tolga hydropower plant

Project: Hafslund Tolga hydropower plant

Location: Tolga, Glomma River, Norway

Cost: 1,8 million EUR

Dates: 2018-2021

Objectives: Establishment of safe fish migration routes past a new hydropower plant.

Measures undertaken: Installed a slanted trash rack with a 15mm light opening to prevent fish swimming into the turbines. Installed two diverters with a total of 2m3/s flow capacity at top of the trash rack to guide fish safely past the intake to below the dam. Up and downstream migration was secured through two fish passages. The main passage is a vertical slot fish ladder with a 5m^3/s flow capacity, providing migration opportunities for all present fish species. Additionally, there is a more natural passage with a 3m^3/s flow capacity. At large water flows, migration is also possible over the entire length of the intake dam. Through minimum flow requirements (12 m^3/s in summer and 7 m^3/s in winter) water is secured in the fish passages all year round.

Results: Local stakeholders satisfied with the process and solutions. The effects of the measures are monitored through a survey programme. There has been no negative impact on fish populations indicated thus far. Positive fish trends indicated by increases sale of fishing licences.

Challenges:

- The licence application for the plant was met with notable opposition from fishing associations, local stakeholders, and environmental authorities. The objections were largely related to expected negative impacts on fish and fishing. In order to obtain a licence it was crucial to include solutions maintaining safe upstream and downstream fish migrations; and
- Exact monitoring of fish migration in the fish passages will require invasive methods limiting the migration.

Tolga hydropower plant, Hafslund

Success factors:

- Use of best available competence to develop best possible solutions;
- Implementing environmental solutions in the early project stages, ensuring thorough planning and beneficial technical solutions;
- No invasive fish counting implemented, but rather a programme monitoring fish populations and fishing activity in the influence area; and
- Obtaining public acceptance by implementing effective measures for fish migration.

Case study:
BayWa r.e. Spitalhöfe (Pfaffenweiler) solar park

Project: BayWa r.e. Spitalhöfe (Pfaffenweiler) solar park

Location: Pfaffenweiler, Germany

Cost: 25 000 EUR

Objectives: Developed biodiversity enhancing measures in collaboration with local nature conservation organisations, experts, and authorities.

Measures undertaken: Created native flower islands. Installed nesting boxes. Developed grassland for sheep grazing. Preserved fruit trees. Planted hedges and individual trees as site screening. Established a wildlife corridor through the centre of the solar field. Created habitats for reptiles and small mammals.

Results: The project sets an example of how farming and the renewable energy sector can work together by using smart policy-solutions and achieve increasing land-use efficiency, biodiversity, climate change adaptation, and mitigation. The design measures were supported by a local environmental NGO.

Challenges:

- Conflict of land-use interests with agricultural stakeholders;
- Creating a positive understanding of the biodiversity concept across all parties;
- Persuading political stakeholders to engage; and
- In a poly-crisis environment, interdisciplinary policies would be needed.

Sheep grazing at Spitalhöfe Solar Park, BayWa r.e.

Success factors:

- Involve all relevant stakeholders before the decision-making process; and
- Identify and enable strong local support groups to act in favour of the project

Case study:
BayWa r.e. approaches to increase wind farm biodiversity

Project: BayWa r.e. approaches to increase wind farm biodiversity

Location: Across France

Cost: 50 000 EUR (for funding agro-eco measures)

Objectives: Supported local farmers with agroecological measures and highlighted the developer's biodiversity considerations to authorisers.

Measures undertaken: Organised workshops with local farmers and the Agricultural Chamber to define and launch measures (including natural corridors, purchasing of equipment for soil conservation agriculture, and training). Established multi-year monitoring programmes for biodiversity and agricultural productivity.

Results: Successful partnerships with over 10 different local stakeholders, including with chambers of agriculture, local NGOs, and hunting associations, plus 15 agricultural approaches launched across France.

Challenges:

- Maintaining sufficient levels of farmer involvement throughout the long-term project;
- Finding the right local technical partners to help develop the approach and promote it among local farmers; and
- Integrating the environmental and agricultural issues of the approach, as agricultural landowners sometimes view environmental actors as obstacles to their activities.

Clos Neuf wind farm, BayWa r.e.

Success factors:

- Understanding the local farmers' needs and being consistent in actioning the measures helped the project be supported and not just accepted;
- Involving and regularly communicating with relevant local stakeholders and farmers in all decision-making processes; and
- Ensuring long-term follow-ups using scientific methodologies and local structures.

Case study:
VERBUND PV LA Solana

Project: VERBUND PV LA Solana

Location: Cáceres, Extremedura, Spain

Dates: Operational since 2022

Objectives: To reduce the negative impact generated by the construction and operation of the plant on local biodiversity throughout the life of the plant.

Measures undertaken: Natural vegetation control through livestock. Installation of 4 bird nests, 3 insect houses and 3 amphibian shelters. Creation of a flora reserve in the Sierra de Gredos Special Area of Conservation (SAC) containing endangered species of flora. Correction of water streams to minimise impacts on reptiles and amphibians. Reforestation and the installation of vegetation screens along the perimeter fence. Installation of passageways in the perimeter fence for the movement of small fauna.

Results: Maintenance of grassy areas through sheep grazing has been successful, as have the insect and amphibian refugia, with evident use of the structures.

Challenges:

- Deciding upon the location of the flora reserve, and creating the legal figure for its regulation and administration for conservation purposes, was a lengthy process; and
- High mortality rates in the vegetation screen due to the climatic condition during its summer installation.

Sheep grazing at La Solana, Verbund

Success factors:

- Ensuring the effectiveness of the measures through monitoring and adaptive management; and
- Sharing the lessons learnt.

Case study:
VERBUND Pinos Puente

Project: VERBUND Pinos Puente

Location: Andalucía, Spain

Dates: Operational since 2022

Objectives: Preserving biodiversity in the face of habitat loss and increased risks of collision mortality due to the development.

Measures undertaken: Reforestation with native bushes and trees along boundaries, plus the installation of vegetation screens along the perimeter fence. Installation of passageways for small fauna in the perimeter fence and the addition of signalling plaques to minimise wildlife collisions with the fence. Installation of two nesting boxes for lesser kestrel (*Falco naumanni*). Maintaining low herbaceous vegetation for fauna to shelter and traverse in areas not affected by the construction.

Results: Installation of nesting boxes for lesser kestrels proved successful, with reports from on-site staff that 10 pairs have been spotted using the structures.

Challenges:

- Contradicting regulations from different regional and state administrations, specifically with regards to the location and positioning of the vegetation screen;
- Increased costs associated with integrating biodiversity, such as the maintenance of implemented measures throughout the project life cycle;
- Maintaining the reforested areas and installed vegetation screens in good condition throughout the project life cycle, due to the harsh conditions; and
- Promoting spontaneous use of the nesting boxes by lesser kestrel.


Pinos Puente nesting installation, Verbund

©VERBUND

Success factors:

- Monitoring mitigation measures, adaptively managing them for refinement;
- Sharing the lessons learnt;
- Researching and understanding the surrounding territory and its requirements;
- Promoting connectivity between natural and modified habitats via ecological corridors, facilitating wildlife movement and counteracting habitat fragmentation; and
- Locally publicising the biodiversity measures undertaken and their success, including costs and methods.

Case study:
BayWa r.e. ground-mounted solar park

Project: BayWa r.e. ground-mounted solar park

Location: Andalucía, Spain

Cost: ~300 000 EUR

Dates: Implementation to commence 2024

Objectives: Improving biodiversity and local habitat conditions onsite. Establishing monitoring to enable effective adaptive management strategies that provide benefits for the ecosystem and community.

Measures undertaken: Installation of perimeter vegetation screens and planting grass to provide wildlife shelter and/or ground nesting whilst also reducing the plant's visual impact. Installation of 15 nest boxes on posts for barn owls (*Tyto alba*) and common kestrels (*Falco tinnunculus*) and the construction of 2 nesting towers for lesser kestrel (*Falco naumanni*), listed as Vulnerable in the Spanish Red Book of birds. Provisioning of rock piles for amphibians, reptiles, and small mammals to shelter. Construction of 3 ponds to provide habitats for amphibians. Installation of 13 water troughs (tanks with a capacity of 220 litres connected to a concrete basin so that water is permanently available) for wildlife along the outskirts of the facility. These are periodically refilled, especially during summer months, with water of a proven quality, and annually checked and disinfected. Provisioning of 8 perches along the plant's perimeter for bird of prey species. Improvement to the condition of 35 ha of steppe habitat, including increasing the area of natural vegetation and ecosystem services they provide as an additional development compensation measure.

Challenges:

- Obtaining project acceptance from local administration and stakeholders.

Solar park in Andalucía, BayWa r.e.

©BayWa r.e. (image taken by Eva Jao)

Success factors:

- Applying biodiversity measurement methodologies aligned with proven methodology that allows BayWa r.e. to obtain reliable results on which to base future measures to be implemented;
- Developing a social action plan to increase the acceptance of the project and contribute to local sustainable development goals. Through a multi-faceted approach which included stakeholder workshops, reconnaissance tours of the environment and the preparation of field notebooks, voluntary workdays, citizen participation laboratories to tackle local challenges, and partnering with local universities to form an interdisciplinary research group whose findings will ultimately inform a comprehensive and bespoke site strategy;
- Gaining a detailed understanding of the existing problems and proposing tailored conservation measures aligned with the real needs of the area, instead of generic measures; and
- Adaptively managing and modifying biodiversity integration measures in response to evolving circumstances during the project phases.

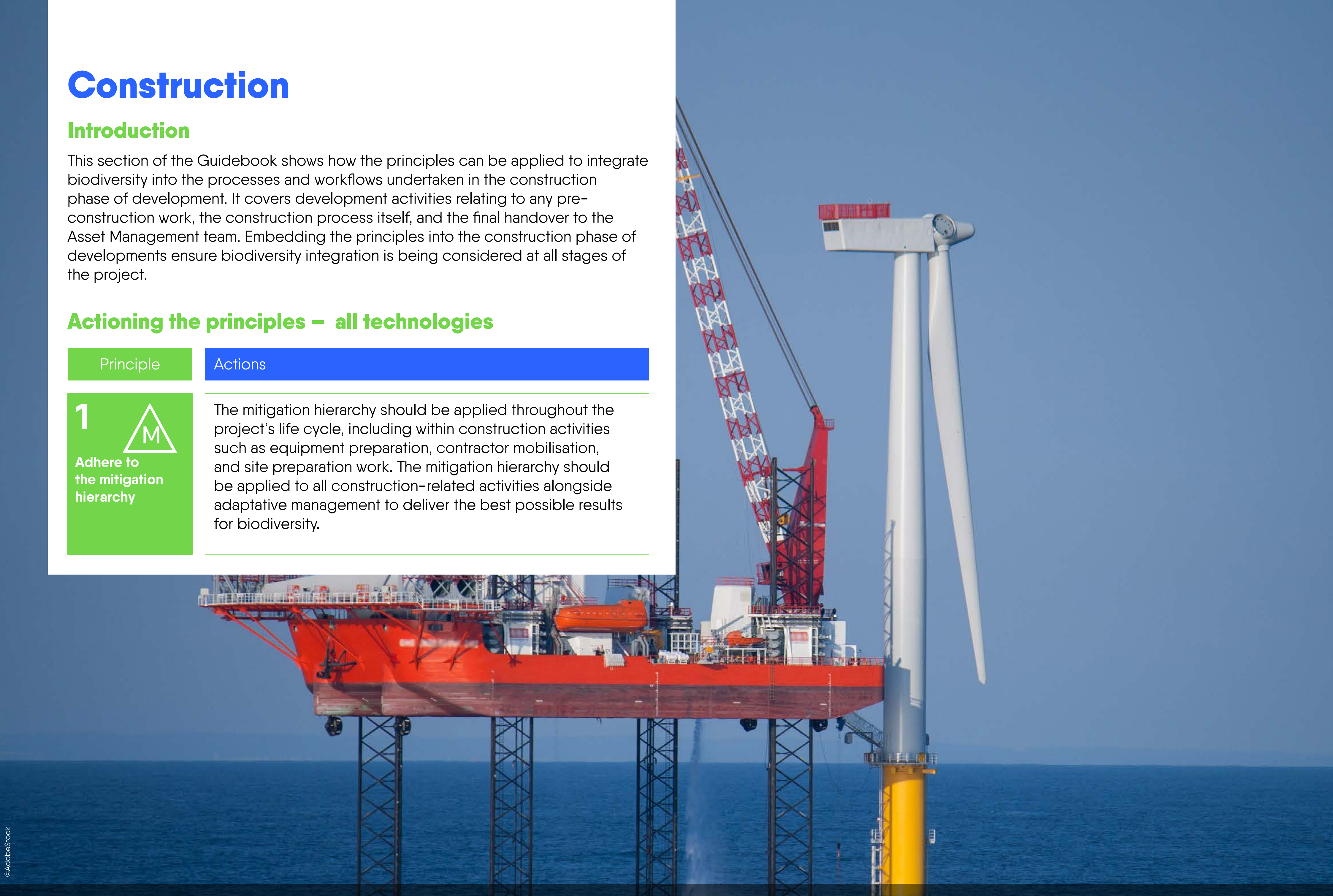
Construction

Introduction

This section of the Guidebook shows how the principles can be applied to integrate biodiversity into the processes and workflows undertaken in the construction phase of development. It covers development activities relating to any pre-construction work, the construction process itself, and the final handover to the Asset Management team. Embedding the principles into the construction phase of developments ensure biodiversity integration is being considered at all stages of the project.

Actioning the principles – all technologies

Principle	Actions
1 M Adhere to the mitigation hierarchy	The mitigation hierarchy should be applied throughout the project's life cycle, including within construction activities such as equipment preparation, contractor mobilisation, and site preparation work. The mitigation hierarchy should be applied to all construction-related activities alongside adaptative management to deliver the best possible results for biodiversity.



Actioning the principles – all technologies

Principle	Actions
2 **Avoid adverse impacts on irreplaceable biodiversity**	Implement the objectives produced at the Design, Consenting and Permitting stage: • Protect retained, enhanced, or created habitats from construction activities with a particular emphasis on avoiding adverse impacts to irreplaceable habitats; • Include instructions on the requirements for preserving irreplaceable habitats and the importance of implementing the provided instructions at relevant pre-construction meetings; • Ensure irreplaceable habitat extent is clearly shown on a map and is easily accessible for relevant team members. Before construction begins, physically delineate areas to avoid through the use of protective barriers with signage; • Ensure the management of works is overseen by a competent, qualified person; • Collect evidence / documentation that the consent is being implemented throughout the construction phase; • Communicate the biodiversity feature requirements via both: site documents and site briefings to construction staff; and • Document any deviations and the rationale for these, with agreement from a competent person. The mitigation hierarchy can be considered within three controls: (IUCN, 2021 and Cross Sector Biodiversity initiative [CSBI], 2015). As advised by a competent person consider the following Work scheduling controls (IUCN, 2021): • Consider seasonal and diurnal patterns of species when scheduling construction, particularly noisy / vibration activities. For example, important/essential feeding, breeding, rearing, spawning and/or migratory periods; • Schedule habitat clearance, grading, and road construction activities outside the breeding or hibernation periods of species as defined in national legislation and/or guidance; and • Schedule construction or maintenance works requiring machinery access across wetlands or soft ground (e.g. floodplains) for drier seasons to reduce habitat damage, whilst remaining cognisant of aforementioned constraints which may arise in such habitats during drier seasons (e.g. ground nesting birds, ephemeral sensitive flora). **Abatement controls** (IUCN, 2021): • Install sensitive lighting plans for construction lighting, for example avoiding lighting sensitive wildlife areas; • Implement soil erosion and sedimentation control measures; and • Have a pollution prevention plan and any necessary equipment including spill kits in place. *Continued overleaf*

Actioning the principles – all technologies

Principle	Actions
	Operational controls: • Designate access roads, machinery and lay-down areas to minimise vegetation loss and disturbance to the soil; • Where possible, use manual methods such as hoeing or hand-pulling to clear the ground of vegetation where specific, sensitive biodiversity features have been identified • Install sufficient drainage works or clear-spanning of watercourses under all access roads to reduce freshwater habitat fragmentation and avoid flooding land or damaging nearby waterbodies; • Install exclusion fencing around sensitive areas; • Implement good tidy site practice to avoid negative impacts on wildlife including covering excavations when not in use, keeping tools locked up, and reducing soil compaction by minimising and controlling speed of vehicle movements and using low ground pressure vehicles, particularly during wet weather and wet soil conditions and using defined site tracks/roads/matting routes and access/egress points; • Prohibit travel on unauthorised roads; • Use ecologically harmless lubricants in machine (e.g. excavators, trucks) applications; • Prevent invasive species entering or leaving the area by washing down equipment and using weed management and / or implementing site-specific biosecurity / Invasive Species Management Plans on sites with pre-existing invasive species infestations; • Where spoil is to be re-used, use as soon as possible to avoid it becoming new habitat for ground-nesting/dwelling species; and • Where spoil is not able to be re-used, ensure it is removed from site under the appropriate regulatory controls, to avoid it becoming new habitat for ground-nesting/dwelling species.
3 Make a measurable contribution to biodiversity	Update the digital design plan in line with as-built data showing all the retained, enhanced, and newly created habitat on site using GIS or CAD. Include all areas of seeding, planting, and habitat installations such as bird / bat boxes / fish passes, and pre-existing biodiversity features (for example known nesting sites). Update initial calculations / metrics to estimate the as-built losses and gains of biodiversity. Use initial calculations / metrics to measure changes across the life of the project from the baseline.

Actioning the principles – all technologies

Principle	Actions
4 Achieve additional conservation outcomes	Review biodiversity enhancement and creation works against design objectives for additional outcomes (e.g. native, certified, and locally sourced seeding mix used). Undertake remedial measures where necessary to align with objectives.
5 Contribute to conservation priorities	Use relevant calculation method in Appendix II biodiversity works against design objectives for alignment with relevant published plans of nature conservation priorities (e.g. habitat creation for salmon is an objective, has it been created as per the design specification). Undertake remedial measures where necessary to align with objectives. Capture how biodiversity will be protected, adverse effects minimised, restored, offset, or enhanced as part of the construction works through the updating of relevant documents. Clearly inform all teams and site personnel involved in construction of their obligations and the biodiversity measures to be accomplished in line with the consent and permitting documents. Ensure biodiversity integration is being tracked during construction phases and communicate the progress to the wider project team.
6 Achieve ecological equivalency	Ensure habitats which are affected temporarily within the construction phase are restored to the same habitat type where possible. Where not possible, ensure other habitats are incorporated as part of the regional biodiversity conservation priorities. Offset with habitat that provides as similar an ecological function to the habitats lost, taking into account known and likely use of the habitat by species associated with them.

Actioning the principles – all technologies

Principle	Actions
7 Address risks	Implement biodiversity integration activities before losses occur. Where this is not possible, minimise and justify time lag between biodiversity loss and integration. Maintain a risk register. Detail the type and level of risks for achieving biodiversity integration and where applicable biodiversity net gain. For example, this could include a risk that the construction requirements mean a habitat will be negatively impacted where previously it wasn't, and design needs to be altered accordingly. Provide mitigation measures in relation to each risk and how this would be handled to avoid additional costs and delays or other project implications Communicate construction requirements of the CEMP to all relevant personnel of the construction team, including external contractors and internal construction crews. Include: • Who is responsible for specific parts of mitigation; and • Which mitigation measures should be done and when. If construction is to be developed in stages, it is recommended that the CEMP (or similar) addresses this and ensures biodiversity mitigation measures are clearly stated for each phase. This could include outlining areas where construction works are prohibited and where biodiversity integration activities will be undertaken. Site audits undertaken by contractors for developers could ensure measures have been applied. Provide an obligations summary as part of the handover process to external contractors working on site and to the subsequent site owner.
8 Be inclusive and equitable	Engage stakeholders throughout the construction phase and document all stakeholder participation and feedback. This could include stakeholders being involved in site walkovers or progress meetings.
9 Optimise for multiple benefits	Review biodiversity measures against design objectives for delivery of multi-benefits (e.g. information boards for public; that they have been created / installed as per the design specification).

Actioning the principles – all technologies

Principle	Actions
10 Secure long-term outcomes	Ensure post-construction sign-off for biodiversity is only given once the ecologist is satisfied that the habitats have been created to the required specification as set out within the BMP. Deviations to specifications should be agreed with the ecologist and documented in the BMP. Ensure habitats are being developed in accordance with the methods and timing outlined in the BMP, i.e. in the correct seasonal window. If adaptive management needs to be undertaken this should also be raised at these visits. Implement restoration work optimally as part of demobilisation from site by the main contractor (as opposed to coming back to site at a later date) on areas that have been temporarily affected by construction, using a phased approach concurrent with construction activities. Have a contingency plan in place for restoration work potentially required in subsequent years should the project be demobilised, and the contractor stood down / removed from the contract.
11 Be transparent	Retain and share relevant documentation, including the BMP, with relevant stakeholders, including the landowner, where this is not the developer. Revise and update the BMP with the as-built biodiversity features and share with relevant stakeholders as appropriate.
12 Exchange science and knowledge	Provide adequate training and technical support to ensure that construction operatives, site managers, and project managers can implement designs and processes. Ensure the best available solutions for biodiversity integration are being used within the construction phase. Take part in knowledge sharing with experts, contractors, and the wider engineering / construction sector to find innovative solutions to help avoid and minimise biodiversity losses.

Construction

This section provides examples of additional actions at the construction stage that are specific to individual technologies.

Actioning the principles – technology specific

Onshore and offshore wind

Adapted from (IUCN, 2021):

The majority of the following measures are applicable to offshore wind.

- Safety zones should be established, and checklists can be used for the management of artificial light and protection of marine turtles and migratory species;
- Establish good waste management practices in construction and operational phases to minimise collision risk for scavenging birds such as vultures;
- Account for the presence of marine mammals during the installation process by conducting marine mammal monitoring;
- Manage vessel movements and activities;
- Follow the 'piling protocol' to aid marine mammals;
- Reduce underwater noise during construction and create a temporary safety exclusion zone around turbine locations, by using Acoustic Deterrent Devices (ADDs), reflection, absorption, and shielding, bubble curtains, 'shell-in-shell' systems, and noise damping systems;
- Drill preferentially to piling as generally less noisy. Suction caisson and other quiet foundation types avoid the need to drill / pile completely;
- Use jet ploughing only where seabed sediments are suitable;
- Use Horizontal Direct Drilling to lay cables where suitable; and
- Adjust piling energy, and quiet foundation types.

Distribution grids

- Avoid carrying out construction works and/or stringing of overhead lines in peak periods of bird migration and during breeding periods of high-sensitivity ground-nesting species (like hen harriers).
- Avoid burying cables in dispersal times for species of conservation priority if they have been identified on site (e.g. when amphibians move out of water bodies post egg laying);
- Avoid horizontal directional drilling activities at sensitive timings and in sensitive areas where identified biodiversity features are in proximity. Where horizontal directional drilling is implemented under or close to highly sensitive watercourses, utilise non-polluting alternatives to traditional bentonite lubricants;
- Understand and minimise adverse visual and noise impacts of horizontal directional drilling where used; and
- Backfill trenches made for cable installations as soon as possible and carefully strip vegetation intact and reinstate following trenching.

Actioning the principles – technology specific

Solar PV

Appropriate actions for solar parks are already addressed within the 'all technologies' section.

Hydropower

- Ensure that limit values for water quantity (e.g. minimum flows) and quality (e.g. suspended sediments) are not exceeded.

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Case study:

BayWa r.e. 17ha (14,6 MW) ground-mounted solar park of Fontenet 2

Project: BayWa r.e. 17ha (14,6 MW) ground-mounted solar park of Fontenet 2

Location: Department of Charente-Maritime, municipality of Fontenet

Cost: 45 000 EUR

Dates: The project began in 2017, works during 2021-2022, operational since Q2 2022

Objectives: Adhere to the mitigation hierarchy in a former military camp where there were strong ecological issues (protected butterflies, bird nesting, rare habitats). Avoid adverse impacts on irreplaceable habitats (functional dry lawns). Address risks, be inclusive and equitable, and be transparent.

Measures undertaken: Sensitive biodiversity areas were identified during environmental studies for the permit application. Dry lawns were identified, which large blue butterflies (*Phengaris arion*) utilised for reproduction. These habitats and species are rare locally and required specific protection. Avoiding impacts on sensitive areas during works by marking them on the ground as sensitive and informing site workers to avoid these areas. Provided environmental site specifications summarising measures for biodiversity, pollution risks, noise, etc., with location maps. These specifications were read and signed by the construction site companies and monitored by an external ecological study office. The reports were also shared with local authorities. Implemented a construction schedule which avoided the most sensitive period for local biodiversity, especially the breeding period. Planted hedges on the edge of the park (native, locally-sourced trees), and seeded to encourage vegetation growth, with a local environmental NGO (Conservatoire d'Espaces Naturels de Nouvelle-Aquitaine) which takes the seeds from natural meadows nearby. Assessed the implementation of environmental measures on site and launched monitoring for the operational phase after agreement with the local authority.

Results: Areas set-aside for environmental protection are well preserved and monitoring has revealed the presence of the large blue butterfly (*Phengaris arion*).

Challenges:

- Involving works personnel in the protection of biodiversity, particularly for the avoidance of set-aside areas;
- Conducting the majority of works during the less favourable autumn and winter months, and encountering possible construction delays, to respect wildlife breeding seasons; and
- Limiting soil impact during construction to allow rapid recovery and growth of vegetation and to limit erosion.

©BayWa r.e.

Fontenet 2 solar park, BayWa r.e.

Success factors:

- Regular communications with on-site works personnel;
- Engaging an external expert to implement ecological measures, for continued environmental monitoring throughout the operational phase, and to publish regular progress and status reports;
- Partnerships with local NGOs helped define and implement environmental measures; and
- Involving stakeholders, especially local authorities.

Case study:
Mitigation Hierarchy in SSER's offshore wind farms

Project: Mitigation Hierarchy in SSER's offshore wind farms

Location: UK

Cost: N/A

Dates: 2008 – onwards

Objectives: To apply the mitigation hierarchy to minimise the environmental impact of offshore SSER projects throughout their lifecycle phases, whilst also fostering innovation and knowledge-sharing within the renewable energy sector.

Measures undertaken: Note that the following construction measures are general approaches across SSER projects and do not all refer to a single project. Selecting foundations that do not require impact piling, such as bucket foundations, or using vibro-piling or coffer dams to reduce noise levels that may negatively impact marine mammals. Furthermore, utilising noise abatement systems (e.g., Big Bubble Curtains) and monitoring for marine mammals to ensure none are within a starting distance before noisy works begin. Using advanced trenchless technology such as horizontal directional drilling (HDD) to avoid impacts on subtidal and intertidal habitats at landfall. Using directional lighting, such as directing vessel deck lighting towards working areas only and keeping this to the minimum level required to facilitate safe operations, to avoid nocturnal seabird and migrant disturbances during nocturnal construction activities. Employing vessel management plans, such as working within existing shipping routes where possible and limiting vessel speed, to reduce potential disturbance or injury to marine mammals and foraging seabirds.

Challenges:

- Addressing cumulative impacts on designated sites can lead to compensation options under the Habitats Directive Regulations.

SSER Offshore Wind Farm

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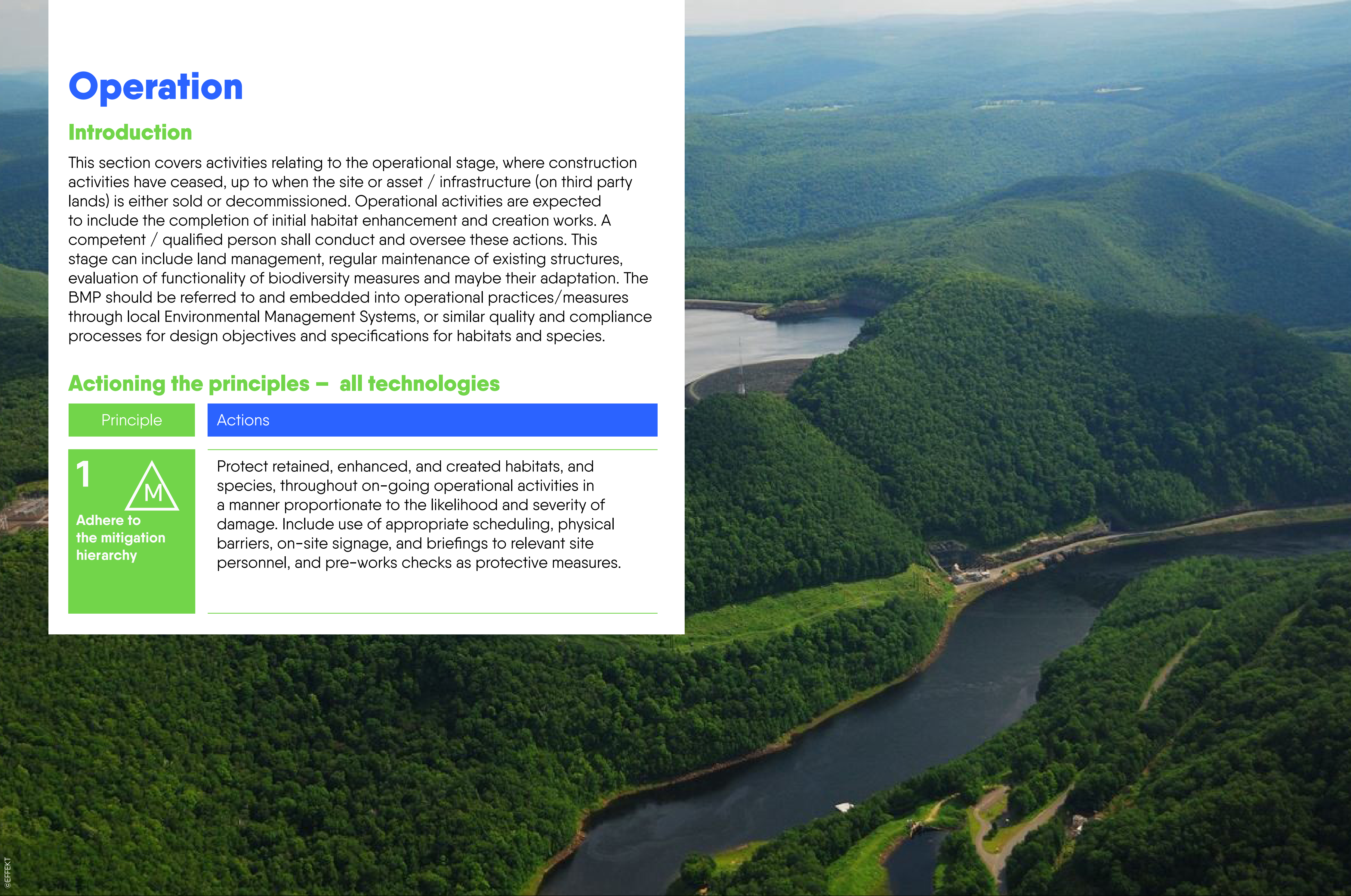
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Operation

Introduction

This section covers activities relating to the operational stage, where construction activities have ceased, up to when the site or asset / infrastructure (on third party lands) is either sold or decommissioned. Operational activities are expected to include the completion of initial habitat enhancement and creation works. A competent / qualified person shall conduct and oversee these actions. This stage can include land management, regular maintenance of existing structures, evaluation of functionality of biodiversity measures and maybe their adaptation. The BMP should be referred to and embedded into operational practices/measures through local Environmental Management Systems, or similar quality and compliance processes for design objectives and specifications for habitats and species.

Actioning the principles – all technologies

Principle	Actions
1 M **Adhere to the mitigation hierarchy**	Protect retained, enhanced, and created habitats, and species, throughout on-going operational activities in a manner proportionate to the likelihood and severity of damage. Include use of appropriate scheduling, physical barriers, on-site signage, and briefings to relevant site personnel, and pre-works checks as protective measures.

Actioning the principles – all technologies

Principle	Actions
2 Avoid adverse impacts on irreplaceable biodiversity	Confirm that irreplaceable habitats are sufficiently protected from damage during operation and management works, in line with the BMP. Ensure all relevant site personnel are briefed on the requirements and measures to avoid adverse impacts on irreplaceable biodiversity, in line with the BMP. Retain irreplaceable habitat maps and survey records and provide these in any changes of ownership / management during the project's operations.
3 Make a measurable contribution to biodiversity	Undertake monitoring for habitats and species, at regular intervals post-construction. Monitoring and response measures are to include: • Evidence the area / length, type, and condition of habitat created or enhanced; • Using relevant calculations / metrics to report changes in biodiversity from the defined baseline in line with the BMP; • Evidencing the species-specific installations and their condition; • Evidencing species populations engaging with the site; and • Briefing relevant site personnel on the biodiversity objectives and requirements. Distribute relevant supporting documentation to site personnel, such as designs, plans, and specifications.
4 Achieve additional conservation outcomes	Use relevant measurement methods (see Appendix II) to evidence and report on additional changes in biodiversity from the defined baseline trajectory, in line with the BMP.

Principle	Actions
5 Contribute to conservation priorities **6 Achieve ecological equivalency** **7 Address risks**	Ensure that measures have been taken in line with the BMP and that the specific habitats have been created/enhanced, using qualified ecologists. Ensure and evidence that habitats to be retained on site as part of the BMP are sufficiently protected from damage during operation and management works. • Ensure monitoring includes recording whether management actions have been undertaken as planned; • Ensuring habitat types and features are achieving the planned condition, ecological structure, and function as per the BMP; • Ensure the correct technical infrastructure, i.e. machinery and equipment required for habitat management, is available, present and in suitable condition; • Replace habitats that failed to establish and correspondingly update and adapt the BMP, ensuring contingency budget is available to address establishment failures and procurement frameworks in place to facilitate this; and • Report on and internally communicate any corrective adaptions or updates to the BMP and the rationale for any such changes, with timelines, roles, responsibilities, and competency requirements, to maintain the desired trajectory towards biodiversity targets within the anticipated timescale. In addition, take opportunities to utilise material from site maintenance where waste compliance allows, e.g. vegetation cuttings to create invertebrate log piles / amphibian hibernacula. If possible, create diverse structures via structural elements such as stone piles, stone walls, hedges with local plants, deadwood, trees and tree groups.

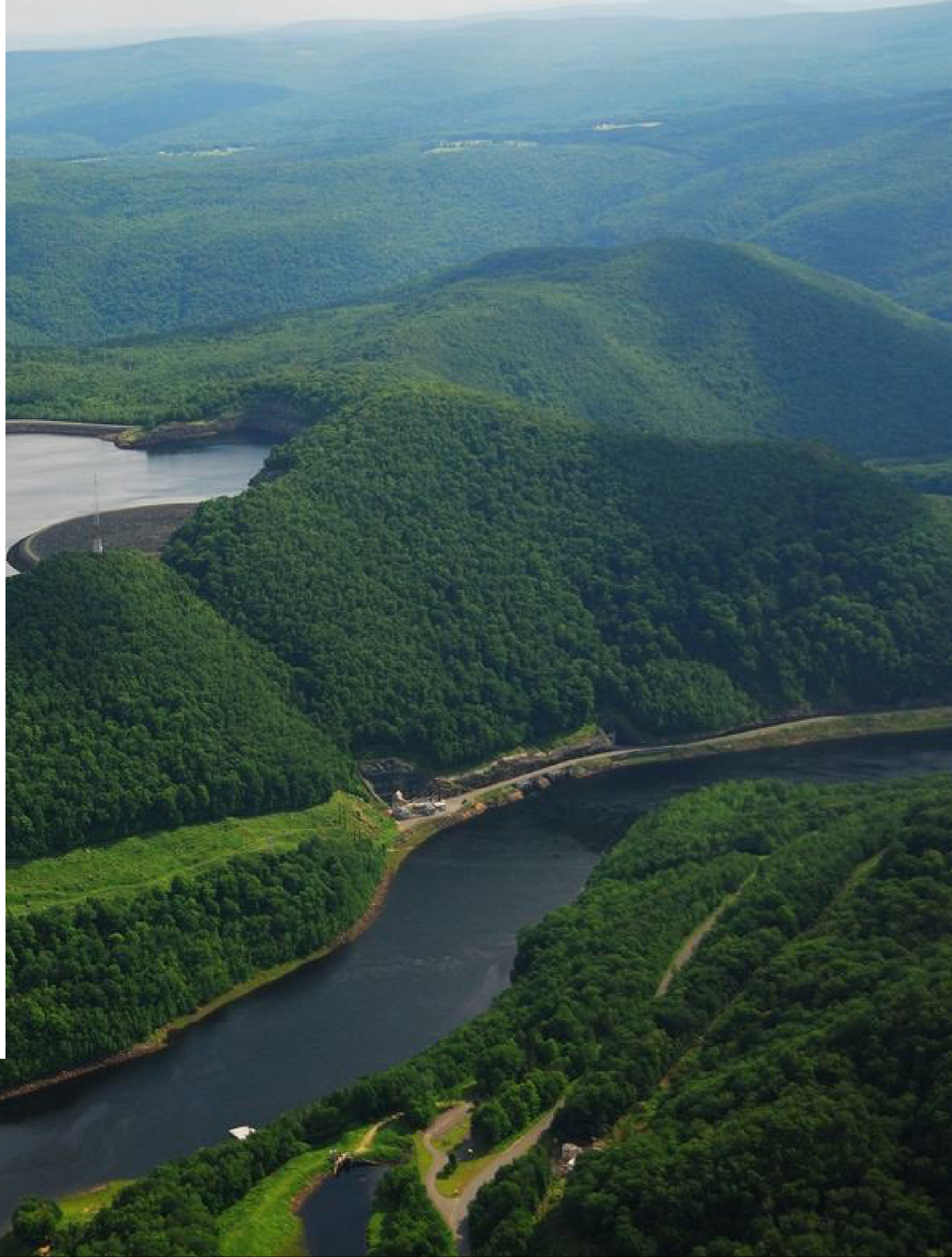
Actioning the principles – all technologies

Principle	Actions
8 Be inclusive and equitable	Partner with any suitable stakeholders and invested parties in the management and monitoring processes once operational or identified through earlier project stages. Record all additional stakeholder involvement and feedback on the operational process.
9 Optimise for multiple benefits	Implement and review biodiversity integration measures that deliver other environmental benefits as identified in earlier stages. Undertake calculations / metrics / tools to monitor and report the estimated wider environmental, climatic resilience, and social benefits generated during the operational phase by biodiversity integration measures.

Principle	Actions
10 Secure long-term outcomes	Ensure management and monitoring is in line with the BMP throughout the entire operational phase. BMP is reviewed at regular intervals (e.g. every 5 years) to: • Identify practices that are effective at maintaining the condition of habitats / installations and should be continued, and ineffective practices which should be updated or discontinued; and • Ensure systems are in place to guarantee the succession / ownership of the BMP with subsequent staff cycles. Identify practices in the implementation of the plan which are effective and should be continued and expanded if possible, or else are ineffective and should be updated or discontinued. Report and communicate any corrective adaptions or updates to the BMP and the rationale for any such changes during the operational phase to all relevant parties. Update the relevant decommissioning elements of the BMP; considering what opportunities and constraints exist for biodiversity at this stage and how habitats can be retained and maintained. Assess repowering options, opportunities and risks based on updated BMPs evolution.

Actioning the principles – all technologies

Principle	Actions
11 **Be transparent**	Clearly communicate biodiversity objectives and the ongoing requirements and measures of the BMP to all relevant personnel. Consult stakeholders, where relevant, on changes made to habitat management and monitoring, especially where a target outcome is unlikely to be achieved and is required to be changed. Report and clearly communicate biodiversity results and corrective actions to maintain trajectory towards the BMP's biodiversity targets, both internally and to relevant stakeholders, to ensure they are actioned punctually and that all parties are aware of the correct measures. Monitoring reports, survey records, and management interventions related to the BMP shall be retained and shared in any changes of ownership / management during the project's operations. An obligations summary should also be included at handovers.
12 **Exchange science and knowledge**	Evidence and data relating to the biodiversity outcomes delivered during the operational process shall be made available to relevant third parties and bodies, including successes, challenges, and lessons learnt. This will include: • Monitoring reports; • Survey records; • Management interventions; and • Performance against BNG/ NNL targets. Train contractors to undertaken certain management and monitoring tasks where appropriate, e.g. identifying and managing invasive species presence.



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Operation

This section provides examples of additional actions at the operation stage that are specific to individual technologies.

Actioning the principles – technology specific

Onshore and offshore wind

The actions presented below are all relevant for onshore wind and the majority for offshore.

- Evaluate and implement the introduction of cut-in speeds;
- Evaluate and implement use of curtailment at most appropriate times, e.g., aligned to peak; migratory times of conservation priority species;
- Paint turbine blades a suitable colour and pattern (where legislation allows) to increase visibility to birds;
- Use an acoustic deterrent device (where legislation allows); and
- Regularly mow around the turbines to minimise attracting birds or bats.

Distribution grids

- Use opportunities to retrofit bird diverters informed by a risk profile assessment where maintenance is required;
- Implement a sustainable route management considering the natural biotopes along the power lines so that the areas can serve as breeding and feeding grounds; and
- Support the function of the areas under the pylons or other steel towers as refuge for a variety of local plants and animals.

Solar PV

- Manage soil erosion with regular seeding;
- Adopt a vegetation maintenance regime which is conservation friendly i.e. if nesting birds are present on site do not mow grassland areas in spring and summer months;
- Maintain grassland areas using a lower stocking density; and
- Conduct regular inspections and surveys to check for signs of wildlife injury, mortality, or behaviour change and implement corrective actions, such as adjusting the panel angle, orientation, or spacing, to reduce the risk of collisions or electrocution.

Hydropower

- Incorporate biodiversity enhancing measures into routine maintenance of dams and dikes;
- Establish operating rules that consider the natural flow conditions to facilitate fish migration;
- Maintain ecological flows that are vital to diverse aquatic ecosystems;
- Ensure water quality and habitat integrity when implementing sediment management measures; and
- Manage the green areas around water bodies extensively, if possible, and avoid chemical pesticides.

Case study:
Hafslund Hunderfossen hydropower plant

Project: Hafslund Hunderfossen hydropower plant - optimisation of minimum flow, gate manoeuvring and non-intrusive fish counting.

Location: Gudbrandsdalslågen River, Norway

Cost: 70 000 EUR per annum (estimated cost based on energy production lost due to minimal flow).

Objectives: Improve the migration of nationally valuable brown trout (*Salmo trutta*) past the dam, as well as improving spawning and nursing conditions on the minimum water stretch downstream.

Measures undertaken: Implementing a voluntary new water manoeuvring regime with increased minimum water flows to improve spawning and growth conditions. Attraction floods to stimulate migration by mimicking naturally occurring patterns. Optimised gate manoeuvring for improved migration, with minimal loss of energy generation. Replaced the fish ladder's manual trap and handling with an automatic fish counter, to improve data quality in a non-intrusive manner.

Results: A large increase in wild trout numbers passing the fish ladder. Between the 1960s and the 2000s, the five-year average rarely exceeded 250 trout per year. After implementing the measures, a new record for fish migration was set in 2023 with 1,561 trout passing the dam. To compensate for reduced natural recruitment, the authorities imposed a requirement for 15,000 cultivated two-year-old trout to be released upstream of the dam annually. Due to the success of the measures and increase in wild trout natural recruitment, the obligation to stock fish was removed in 2023.

Challenges:

- The hydropower plant was built in the 1960s and has had a significant, negative impact on the trout population, leading to public demand for the improvement of conditions for the trout; and
- Retrofitting an old power plant reduces the number of available i.e. cost-effective solutions at hand.


©Hafslund

Hunderfossen hydropower plant, Hafslund

Success factors:

- Long-term monitoring data and extensive research as a basis for assessment and implementation of the measures;
- Having detailed historic scientific data, knowledge of long-term conditions, and detailed, specific local knowledge and expertise;
- Good post-measure monitoring to reveal the impacts; and
- A holistic approach to habitat bottleneck by understanding the interconnectedness of the individual challenges hindering fish migration.

Case study:
illwerke vkw AG transformer station

Project: illwerke vkw AG transformer station

Location: Bürs, Vorarlberg, Austria

Cost: 65.000 EUR for biodiversity planning, implementation, seedbed preparation, woody planting, meadow casting, large tree transplantation, etc.

Dates: Realised in 2015

Objectives: Landscape external areas in and around the 11.15 ha transformer station to promote biodiversity by establishing species-rich planting under the technical facilities, whilst also meeting the relevant safety and maintenance requirements.

Measures undertaken: Seeded 1.4ha during May with a 'best' seed mix selected from 15 different producers. Transferred meadow cuttings to a 0.5ha area of the facility. Planted 900 wild shrubs as a natural boundary to the facility, including native wild *Rosa* species. Adaptive mowing and shrub cutting schedules, as necessary. Occasional inspections are carried out with experts, including counts of established plants and sighted animal species.

Results: After implementation, ecologists identified over 70 different plant species within less than an hour that had developed in the plant.

Challenges:

- On the one hand, the requirements of the authorities must be met, but the solutions must also be sustainable, practicable and easy to maintain;
- Substrate requirements: Establishment of a meadow that also supports heavy machinery (< 8 tonnes) for maintenance work (even in wet conditions); and
- Distance rules: The spacing of the system components of the transformer station must be planned accordingly to ensure sustainable management of the areas below.

Transformer station, Bürs, illwerke vkw

Success factors:

- Optimising costs through near-natural land management (reduced mowing); and
- Utilising the established meadows as an area to obtain further seeds for the region.

Case study:

Statkraft ripping to enhance fish habitat in River Suldalslågen

Project: Statkraft ripping to enhance fish habitat in River Suldalslågen

Location: Rogaland County, Norway

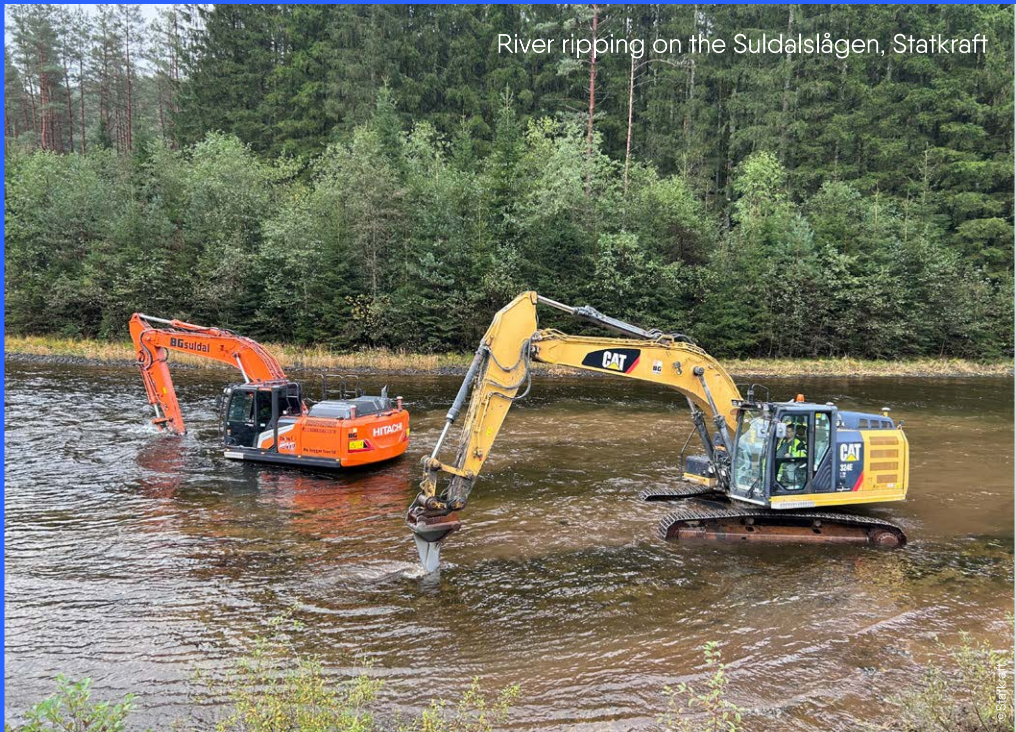
Cost: N/A, but was low-range and included surveillance, administration, machine costs, and monitoring

Dates: 2021-2024

Objectives: Enhance the habitat conditions and improve the natural reproduction levels of Atlantic salmon (*Salmo salar*) in a river designated as nationally important for salmon. Two large hydropower production schemes upstream have led to reduced flow during summer and less peak floods, causing fouling of the riverbed, in particular affecting shelter and breeding areas for fry. Lack of such habitats is regarded the main bottleneck to the natural reproduction of salmon in the river. One way to improve this is through ripping, which is a mechanical removal of fouling and sediments clogging the riverbed by excavators. By ripping and improving natural reproduction of salmon it is also a goal to phase out stockings and prevent possible epigenetic effects, while at the same time strengthening the salmon population.

Measures undertaken: Conducting a pilot ripping project to garner knowledge and experience. Acquiring the necessary permits, regarding which period to execute the work, gaining permission to reduce water flow to operate the excavators safely, and accessing the suitable river areas. Mapping suitable areas and reaching agreements with landowners on where heavy machinery could access the river. Undertaking a large-scale ripping project along the entire river.

Results: Follow-up investigations of the pilot project in 2019 and ripping performed in 2021 have shown 2-3 times greater densities of fry in the ripped areas as compared to reference stations. No negative effects from the work were observed downstream. Given the general low nutrient content and low temperatures in the river, fouling processes are relatively slow and the positive effects of ripping are expected to last for many years before a need to repeat.



River ripping on the Suldalslågen, Statkraft

Success factors:

- Performing a pilot project and building upon research and design knowledge;
- Thorough mapping of suitable areas for ripping, avoiding areas with clay and silt which can cause harm downstream and pose security risks to operators, and paying particular attention to spawning areas, cultural heritage sites, and infrastructure;
- Dialogue with landowners, the fishing community, and the municipality;
- Seeking clarity from authorities regarding all necessary permits;
- Timing works to avoid crucial periods to biodiversity, to minimise conflict with stakeholders, and to adapt to variations in unregulated waterflow;
- Utilising local services providers; and
- Long-term monitoring.

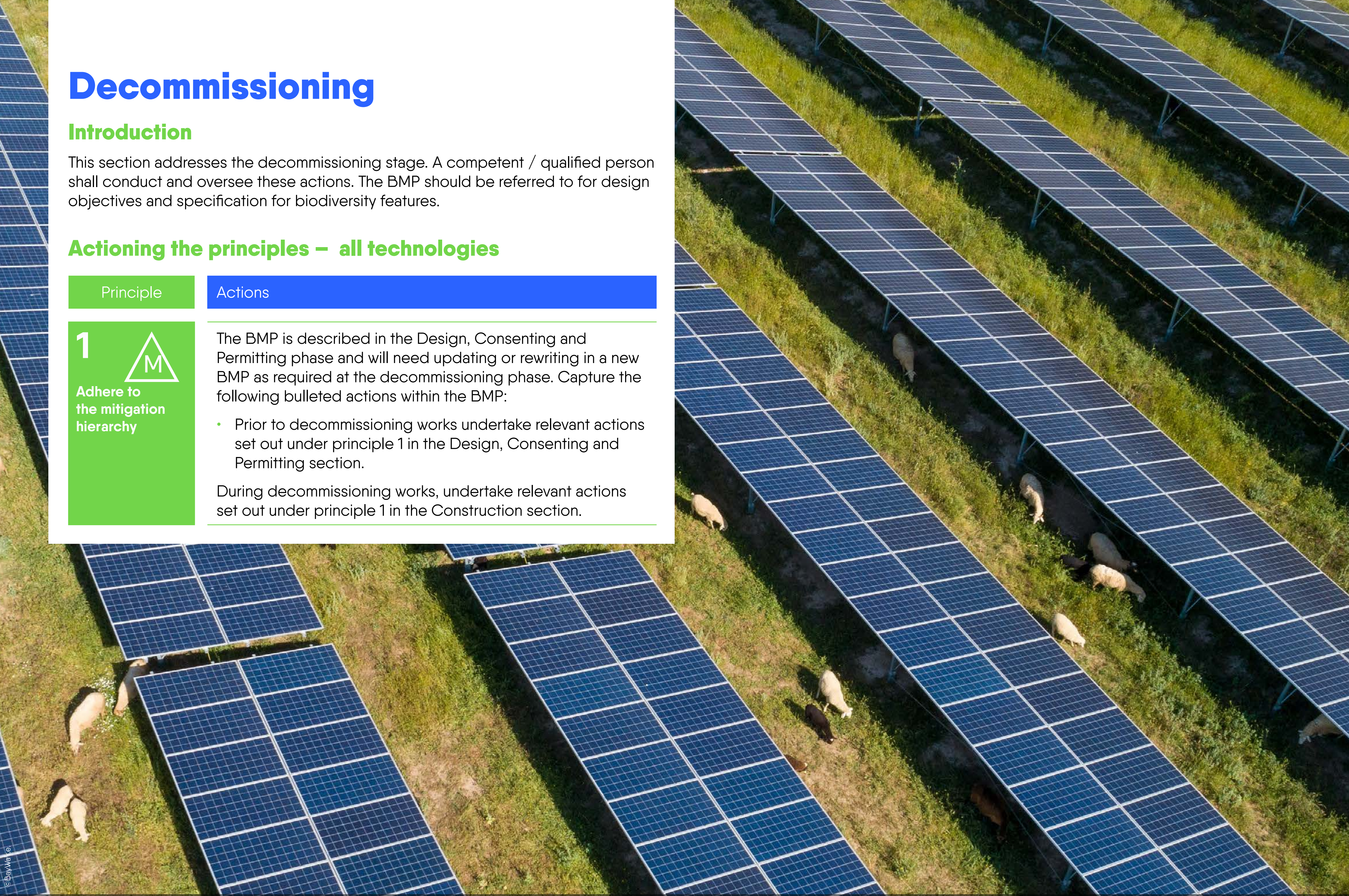
Decommissioning

Introduction

This section addresses the decommissioning stage. A competent / qualified person shall conduct and oversee these actions. The BMP should be referred to for design objectives and specification for biodiversity features.

Actioning the principles – all technologies

Principle	Actions
1 M **Adhere to the mitigation hierarchy**	The BMP is described in the Design, Consenting and Permitting phase and will need updating or rewriting in a new BMP as required at the decommissioning phase. Capture the following bulleted actions within the BMP: • Prior to decommissioning works undertake relevant actions set out under principle 1 in the Design, Consenting and Permitting section. During decommissioning works, undertake relevant actions set out under principle 1 in the Construction section.



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Actioning the principles – all technologies

Principle	Actions
2 **Avoid adverse impacts on irreplaceable biodiversity**	Prior to decommissioning works undertake relevant actions set out under principle 2 in the Design, Consenting and Permitting section. During decommissioning works, undertake relevant actions set out under principle 2 in the Construction section. In addition: Advise the subsequent site landowner on the extent and value of onsite irreplaceable habitats and ensure there is clarity on the requirements and measures to avoid negative impacts post-decommissioning. Retain and share records of monitoring reports, survey records and management interventions on irreplaceable habitats with subsequent site landowners.
3 **Make a measurable contribution to biodiversity**	Establish what the decommissioning objectives are for biodiversity. This could be defined by the terms of the prior development consent and could be to restore the site to the pre-construction state, if known, or to an alternative state. In refining and implementing the detail of the decommissioning, the project should follow the mitigation hierarchy and use appropriate metrics to quantify change in value in support of project-wide reporting. Objectives should be reviewed considering the latest ecological surveys and assessments. Prior to decommissioning works, and subject to the terms of the prior consent, undertake the following to demonstrate project-wide changes to biodiversity: • Update mapping of habitats / installations and species features with GIS / CAD; and • Update relevant calculations / metrics to establish status of biodiversity on site; assess against the baseline pre-development to provide project-wide change in biodiversity. Post-decommissioning works undertake the following to demonstrate the change in biodiversity: • Update mapping of habitats / installations and species features removed, retained, enhanced, or created with GIS / CAD; • Update, relevant calculations / metrics to establish status of biodiversity on site; assess against the pre-decommissioning baseline; • Where a net gain is required, restore any unavoidable biodiversity loss during the decommissioning process to maintain pre-development design objectives, in line with reinstatement requirements and the BMP; and • Ensure that the specific habitats have been established /enhanced before handover in management to the subsequent site landowner. This will include reporting on net gains with relevant biodiversity calculations / metrics that considers the extent, type, and condition of habitat created or enhanced.

Actioning the principles – all technologies

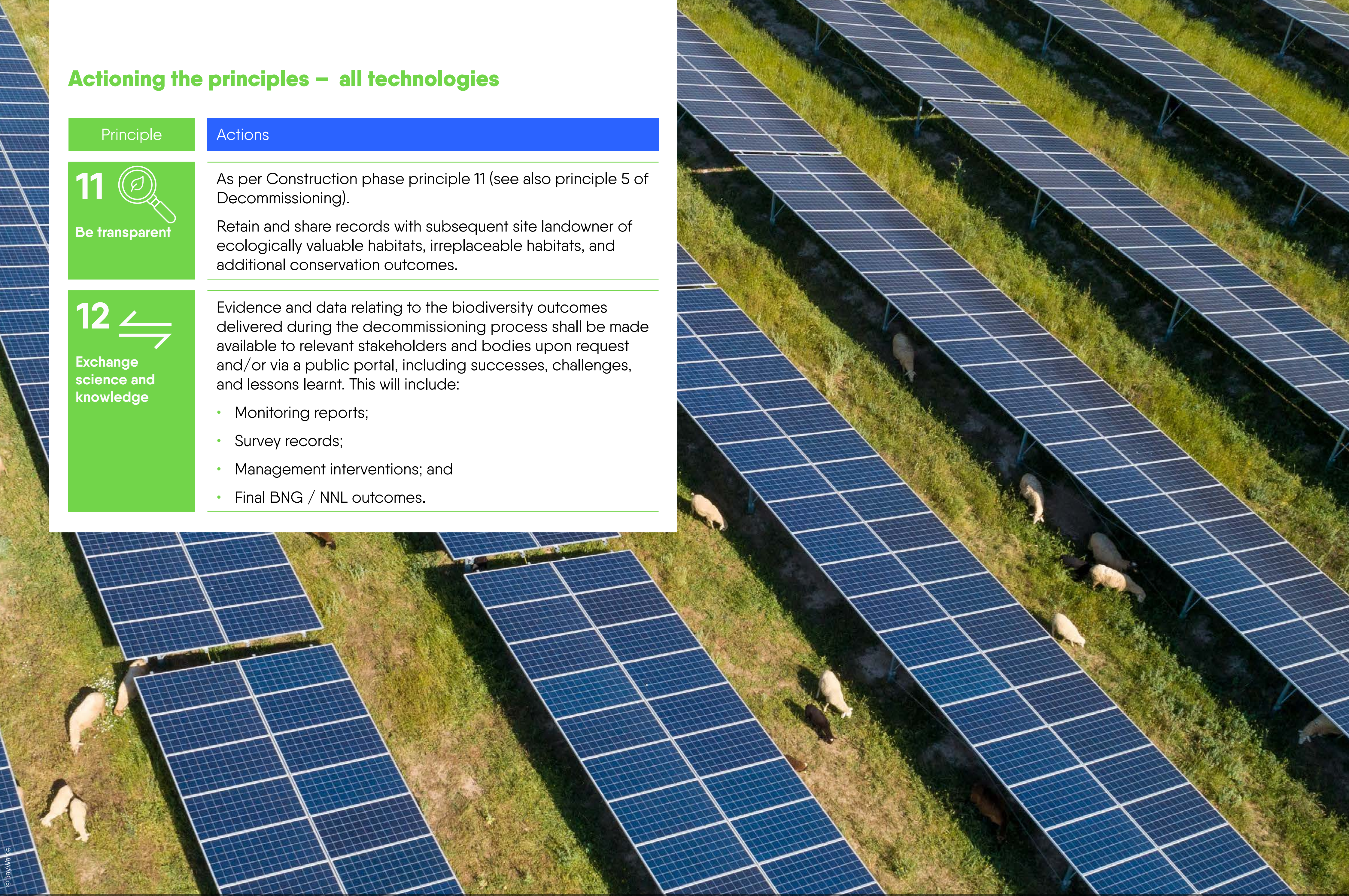
Principle	Actions
4 Achieve additional conservation outcomes	Conduct discussions internally and with relevant stakeholders regarding the value and future of ecologically valuable habitats that are recognised as additional to decommissioning biodiversity objectives agreed to in the prior development consent, and capture in the BMP. Inform and advise contractors on the required retention of any ecologically valuable habitats considered to be additional. Protect these biodiversity features from damage during decommissioning. Advise the subsequent site landowner on the extent and value of additional conservation outcomes / ecologically valuable habitats. Provide recommendations as to how these might be maintained.

5 Contribute to conservation priorities	Prior to decommissioning works:
	• Identify constraints and opportunities for biodiversity in accordance with the proposed use of the site and current conservation priorities, including exploring opportunities to repurpose assets for biodiversity as part of site retirement;
	• Engage with the subsequent site-owner where possible, to discuss biodiversity objectives and to update the decommissioning elements of the BMP together to ensure that biodiversity measures at this stage can be maintained; and
	• Update BMP, or capture within a new BMP for this stage, revised objectives and specifications for biodiversity as necessary. Include:
	  ◦ Pre-works surveys to inform objectives, specifications, and proposed management;
	  ◦ Habitats to be removed, retained, enhanced or created;
	  ◦ Work schedule for decommissioning biodiversity works and management; and
	  ◦ Budget, resources, roles, and responsibilities for ongoing management, in agreement with third parties and the subsequent site-owner.
	
	During decommissioning works:
	• Implement the BMP according to the prescriptions therein.
	
	Monitor biodiversity in line with the BMP throughout the entire decommissioning phase and implement corrective measures where required, updating the BMP.

Actioning the principles – all technologies

Principle	Actions
6 Achieve ecological equivalency	Prior to and during decommissioning, undertake relevant actions set out under principle 6 in the Design, Consenting and Permitting section.
7 Address risks	Understand adverse impacts of decommissioning activities on biodiversity features. Phase changes to biodiversity features where possible to reduce the negative impacts of changes to species. Where changes to habitats may be required, identify how structure or function can be maintained alternatively. Implement adaptive / corrective measures where required and update the BMP.
8 Be inclusive and equitable	Prior to decommissioning works and prior to the update of existing / creation of the new BMP, incorporate relevant actions under principle 8 of the Design, Consenting and Permitting section. In addition, specifically engage with the subsequent site landowner.

Principle	Actions
9 Optimise for multiple benefits	Explore, document, and deliver opportunities for other environmental benefits according to habitats identified for retention, restoration, offset or enhancement due to decommissioning works. Delivery of these benefits should be in line with the proposed future use of the site. Conduct discussions regarding their value and future, internally and with relevant stakeholders. Include consideration of climate resilience and social value provided by site biodiversity features. Ensure there is clarity on what will happen to habitats providing notable environmental, climate, or social benefits post-decommissioning. Advise contractors of biodiversity features providing notable environmental benefits and ensure their protection.
10 Secure long-term outcomes	Prioritise securing biodiversity features post-decommissioning: • Identified as high-value according to EU, nationally and locally published conservation objectives; and • With notable environmental benefits post-decommissioning. Engage with, and provide recommendations to, the subsequent site landowner, prior to and throughout the decommissioning phase, on the long-term management of habitats present onsite.



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Actioning the principles – all technologies

Principle	Actions
11 Be transparent	As per Construction phase principle 11 (see also principle 5 of Decommissioning). Retain and share records with subsequent site landowner of ecologically valuable habitats, irreplaceable habitats, and additional conservation outcomes.
12 Exchange science and knowledge	Evidence and data relating to the biodiversity outcomes delivered during the decommissioning process shall be made available to relevant stakeholders and bodies upon request and/or via a public portal, including successes, challenges, and lessons learnt. This will include: • Monitoring reports; • Survey records; • Management interventions; and • Final BNG / NNL outcomes.

Decommissioning

This section provides examples of additional actions at the decommissioning stage that are specific to individual technologies. Key actions for solar parks are already addressed in the previous section that covered actions across all technologies.

Actioning the principles – technology specific

Onshore wind

- Minimise habitat disturbance during foundation removal.

Offshore wind

- Minimise adverse underwater noise impacts on sensitive marine species associated with vessels and infrastructure removal actions such as submerged cutting.
- Minimise the potential for striking marine mammals with vessels.
- Minimise seabed habitat disturbance during foundation and cable removal (e.g., associated with using a jack-up rig).
- If a significant ecological community has colonised / developed on the hard substrate of the introduced offshore wind farm, consider leaving key habitat structures in place.

Distribution grids

- Leave old underground cables in-situ to reduce excavation impacts (after they have been drained and capped in the case of fluid-insulated cables).
- Where retired sites are being retained (not sold) following decommissioning/disconnection from grid, consider options for the repurposing of physical infrastructure and buildings for biodiversity. Additional benefits from circular economy perspective.

Hydropower

- Consider potential loss of sensitive (secondary) habitats that have developed around and due to the plant over the years of operation.

Case study:
ESB Networks retired substation

Project: ESB Networks retired substation

Location: Ireland

Cost: Circa 50 000 EUR for the civil and landscaping costs. As this approach supplanted the standard method of removal of all standing infrastructure, site levelling and stoning of compound, costs were approximately half of the typical budget for the decommissioning for such a retired site.

Objectives: Trialled an alternative decommissioning method to enhance site biodiversity and decrease costs from the standard approach which makes a site safe and surfaces it with stone for an average of 100 000 EUR.

Measures undertaken: Walled-up the defunct control building and incorporated small slits for bat (*Chiroptera species*) access into roof crevices. Fitted nesting boxes for barn owl (*Tyto alba*) and kestrel (*Falco tinnunculus*) to the retired steel towers. Sowed native flower species and planted native trees around the site. Removed non-native *Leylandii* trees and retained the deadwood on site for insects, fungi, and lichen.

Results: The approach secured the site, successfully established vegetation and increased site utilisation by birds and pollinators, and was significantly cheaper (50 000 EUR) than the standard decommissioning process.

Challenges:

- Protracted dry weather following initial planting works required additional watering of saplings that was not originally envisaged and led to failures; and
- Aligning biodiversity measures with the safety, access, and long-term maintenance requirements of sites.

Nest box installation on retired steel tower, ESB Networks

Success factors:

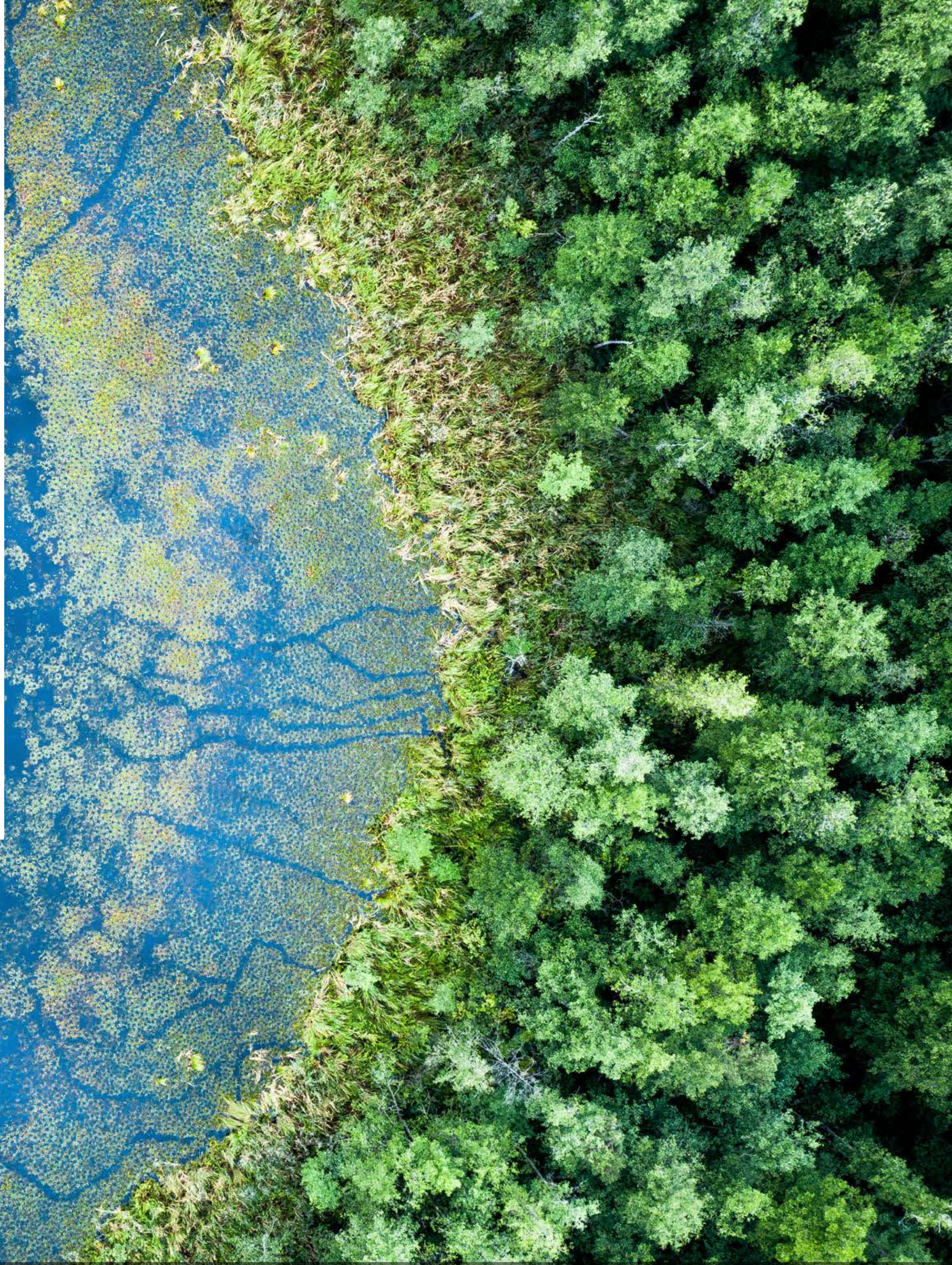
- A proactive and iterative engagement with the contractor;
- Reducing waste from site and demands for inputs (e.g. stone);
- Sourcing local native plants and seeds; and
- Opportunities to deliver outreach to local communities and schools on biodiversity actions.

A look into the future – follow up research questions

Renewable energy and associated infrastructure have an important role to play in mitigating the twin crises of climate change and biodiversity loss. This Guidebook helps the electricity sector contribute further to this role by integrating biodiversity into their projects. However, there are still several questions to solve in the journey to mainstream biodiversity-integration practices while avoiding longer timescales or higher costs for the deployment of new capacity, including:

- How can data-sharing and knowledge dissemination across the industry and stakeholders be improved?
- Which funding tools can be used to cover the biodiversity integration premium?
- How can methodologies for quantifying and comparing biodiversity changes, considering local conservation priorities, scalability, and efficiency be possibly harmonised?
- What strategies are most effective for ensuring efficient reporting?
- How could the skills gap within the power and ecology sectors be addressed?

Industry, policymakers and civil society are fated to work together to accelerate the climate transition while respecting nature. Eurelectric has developed a corresponding set of policy recommendations to contribute to this ongoing debate and for the coming years, see separate file here.



Appendix I: Glossary

The language used to describe biodiversity and actions for biodiversity need to be clear and consistently used. Below terms are defined for the purpose of this Guidebook. They draw from a range of international industry guidance and standards, but it is acknowledged that terminology can vary across organisations, sectors, and settings.

Agrivoltaics	Projects that use land for both agriculture and solar photovoltaic systems (WWF & TBC, 2023).
Baseline	A biodiversity baseline is established/assessed by studies (desktop and field-based) defined by work done to collect and interpret information on the biodiversity feature occurring at a site, their current condition, trends, and value before a project commences (see Protecting biodiversity across the project lifecycle section for further clarification).
Biodiversity	Biological diversity [biodiversity] means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (UNEP, 1992).
Biodiversity feature	Used to collectively refer to a discrete item that is part of biodiversity, such as habitats and species.
Biodiversity integration	A concept of how biodiversity is considered, designed, and embedded into the project as a whole (including both on and offsite locations). It captures an overall aim to provide better outcomes for biodiversity and a spectrum of possible ambitions; from non-measurable or measurable positive actions to measurable "no net loss" or further to "net gain".
Biodiversity metric	A biodiversity metric is a standardised technique for measuring change in biodiversity value.
Biodiversity Management Plan (BMP)	Is a live document created as part of the project design and implementation process. It captures the details on biodiversity features of value to be retained, restored, created, and enhanced (e.g. in the EIA process). It includes design objectives, management and monitoring prescriptions, work schedule, roles, and responsibilities of those delivering the BMP and includes legal or financial mechanisms for securing the long-term implementation of the plan.
Biodiversity net gain (BNG)	BNG is a concept wherein any biodiversity loss arising from a project is measurably restored and offset to exceed the baseline level, such that the development results in a better state of biodiversity than before the development.
Biodiversity value	Biodiversity value is the quantification of biodiversity quality following an assessment by a competent person, such as using a biodiversity metric or in the EIA process.
Construction Environment Management Plan (CEMP)	Provides details and specifications for practical measures intended to avoid or minimise adverse effects on the environment during the construction process (CIEEM, 2017).
Congregative species	Species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis.

Critical habitat	Areas of high biodiversity value, as defined by the International Finance Corporation (IFC), and which includes one or more of: • habitat of significant importance to critically endangered or endangered species; • endemic and / or range-restricted species; • highly threatened and / or unique ecosystems; • key evolutionary processes; and • globally significant concentrations of migratory and/or congregative species (International Finance Corporation [IFC], 2012). Critical habitat may also be defined as irreplaceable habitat.
Development footprint	The physical area that a proposed development occupies once completed.
Ecological equivalency	The term is synonymous with the concept of 'like-for-like'. In this context it refers to delivering biodiversity compensation which is equivalent in type, amount and condition of the biodiversity being lost and that accounts for the location and timing of losses (Construction Industry Research and Information Association, 2019).
Enhancement	An increase or improvement in biodiversity quality or value.
Inclusive	Relevant stakeholders are identified and engaged through full and effective participation, including access to information.
Irreplaceable habitats	Species populations, habitats, or ecosystems which are very difficult (or take a very significant time) to restore, recreate or replace once destroyed, due to their: age, uniqueness, diversity or rarity (adapted from UK Gov).
Migratory species	Species with populations that cyclically and predictably cross one or more habitats and / or national jurisdictional boundaries.
Minimisation	Minimisation is actions taken to reduce the adverse effect of impacts to biodiversity from development or operational activities of an asset.
Mitigation hierarchy	The ecological mitigation hierarchy is a core concept applied to approaches and assessments of adverse impacts to biodiversity. It has been variously defined by different bodies (e.g. the IFC within Performance Standard 6, European Bank for Reconstruction and Development within Performance Requirement 6, and the Business and Biodiversity Offset Programme). The mitigation hierarchy is a hierarchical approach that guides users, ensuring the best outcome for biodiversity and limiting as far as possible the negative impacts on biodiversity from development by first avoiding, then minimising, restoring and finally offsetting. Prevention (avoidance and minimisation) should be applied to the maximum extent practicable before remediation (restoration and offset).
Mitigation measures	A collective term for all activities taken to implement the stages of the mitigation hierarchy i.e., avoidance, minimisation, restoration and offset.
Nature-based solutions	Actions to address societal challenges through the protection, sustainable management and restoration of both natural and modified ecosystems, benefiting both biodiversity and human well-being (International Union for the Conservation of Nature [IUCN], 2016).
No net loss	Biodiversity loss is measurably restored and offset to the same level as the baseline.
Restoration	Restoration is considered to consist of the activities required to re-establish biodiversity back to the baseline state that was lost because of a development's (or asset's) direct adverse impacts on biodiversity features of concern that have been degraded or damaged by project activity.
Offsetting	Offsets constitute measurable conservation gains, deliberately achieved to balance or exceed any significant biodiversity losses that cannot be countered by avoiding or minimising adverse impacts from the start, or addressing the damage done through restoration (adapted from Business and Biodiversity Offsets Programme [BBOP], 2018). They include activities to achieve no net loss or net gain within or outside of the development consent boundary.

Appendix II: Quantitative methods for assessing impacts on biodiversity

Metrics are useful tools to measure and communicate impacts on biodiversity. The table overleaf sets out a review of metrics that can be used in the European context.

The suitability of a metric can vary depending on, for example, habitat type, local / national regulations and priorities. Bespoke methods may be required. These factors should be considered when deciding on which metric to choose for a project:

- Whether the metric covers the relevant geographic location.;
- Whether a specific type of habitat or species (e.g., for a coastal development) is to be assessed;
- Whether there are locally specific requirements (this is not an exhaustive review, therefore it is advised to check locally);
- Whether the metric is well established; and
- Whether reporting change across projects and countries is an important requirement. If so, choose a single standardised metric framework with flexibility to respond to local data (e.g. STAR, BNGC or adapted Statutory Biodiversity Metric).

It should be noted that the following is not an exhaustive review. Developers should choose the most appropriate metric for their project.

Metric	Source	Advantages	Disadvantages	Metric focus (species / habitats / ecosystems)	Includes the protected status of species / sites?	Well established and / or widely used?
Statutory Biodiversity Metric	Natural England	• Its geographic focus is for England, but it could be easily adapted for use across Europe. It can be both simplified and added to • Ecological soundness alongside practical implementation • Embeds the UK BNG good practice principles in its design/function • Open-source and Microsoft Excel-based, therefore easy to use and access • The logic behind the compensation calculations is clearly shown • Editable distinctiveness bandings and condition scores (e.g., in the presence of non-native species)	• Does not directly account for protected species • Does not account for habitat degradation during construction or operational works, although this could be modified • Does not allow assessing unavoidable losses of irreplaceable habitats. The definition of irreplaceable habitats will differ across nations and adverse impacts on irreplaceable habitats may need different bespoke measures and clearance in different nations • Developing habitat-specific assessment criteria would be time-consuming	Habitats / Species	Yes	Yes
Biodiversity Net Gain Calculator (BNGC)	Arcadis	• Endorsed by the European Commission and applicable across European nations and economic sectors • Flexible scoring approach which considers the local ecoregional context • Can consider the presence of non-native invasive species • Replicable across sites • Simple, easy to communicate results • Publicly available	• Only accounts for land-use as the driver for biodiversity loss, and does not directly account for protected species • Scores cannot be aggregated over sites due to the scoring approach being tailormade and local context-specific for each site. This may complicate comparisons with potential offset sites • Requires site visits from expert ecologists to assign a non-standardised 0-1 habitat score	Habitats / Species	Yes	Yes - Recently published, but has been applied by the European Commission and has been successfully applied in various countries and sectors, such as aviation, industry, real estate and the financial sector
Biotope Valuation (BV) / Biotope points (BKompV)	Federal Ministry for the Environment, Germany	• Developed based on well-established approaches already used across Germany • Simple and practical approach • Numerous biotopes for input • Can also account for indirect biodiversity impacts	• Limited transparency in the calculations or sufficient risk contingency for biodiversity creation (e.g., time to achieve target condition biotopes or ease of delivery) • Limited biotope condition criteria	Habitats / Species	Yes	Yes (in Germany)

Metric	Source	Advantages	Disadvantages	Metric focus (species / habitats / ecosystems)	Includes the protected status of species / sites?	Well established and / or widely used?
MERCIe	Onema / Center Eco Functional and Evolutionary, Montpellier	• Contextualises the location / connectivity of the site within the wider landscape • Adapted from the UMAM method which is widely applied for wetland habitats in the State of Florida, USA	• Only for assessing wetland systems	Habitat	No	Yes (in France). Referenced by the French Office for Biodiversity
EcoVal	Battelle	• Can be used to anticipate likely changes in ecosystem quality due to changing drivers and human activities	• Only for assessing marine systems • Follows a statistical model, making the calculations complex to follow for non-expert users	Species / Habitats / Ecosystems	Yes	In use since 2009. Referenced by the French Office for Biodiversity
Eco-points	N/A	• Can be used to assess terrestrial, freshwater and marine habitats	• Application limited to a specific region in Germany • Difficult to access and find supporting information outside of Germany, therefore also a calculation methodology lacking in transparency	Habitats	Yes	Yes (in Baden-Württemberg, Germany)
BREEAM Change in Ecological Value Calculator	BREEAM	• Integrates the Biodiversity Metric 4.0 into its scoring system (although it has not yet been updated in line with the official Statutory Biodiversity Metric) • A methodology guidance note provides supporting information on the calculation	• Specific to developments working towards the BREEAM standard • Does not consider protected site status • Part of the BREEAM assessment and therefore behind a pay-wall	Habitats	No	Yes

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Metric	Source	Advantages	Disadvantages	Metric focus (species / habitats / ecosystems)	Includes the protected status of species / sites?	Well established and / or widely used?
STAR (Species Threat Abatement and Restoration metric)	IUCN	• Well established and developed alongside expert collaborations with >50 multinational organisations • Versatile • Comparable STAR scores • Scalable and replicable across locations (although typically applied at scales greater than individual development projects) • Open-source • Transparent calculation method • Can utilise both regional and global (such as the IUCN Red List Category) data • Links impacts to biodiversity integration measures (i.e., the specific threats of restoration actions). • Desk-based analyses - does not require site visits	• Relies upon the availability of species data • Score weightings are biased towards threatened species, potentially missing the importance of non-threatened species ecological functions and underestimating biodiversity in some areas • Currently only considers mammal, avian, and amphibians' taxon data • Does not run compensation calculations · • Complex relationships and trade-offs between different aspects of biodiversity and ecosystems may be overlooked by the relatively simplistic STAR scores	Species	Yes	Yes
Normative Biodiversity Metric	Ecometrica	• User-friendly • Well established use for calculating biodiversity changes for specific project assets • Incorporates species and ecosystem pristineness • Adaptable, dependent upon the level of regional data availability	• Potentially overly simplified approach to biodiversity measurements • Not open-source • Score weightings are biased towards threatened species, potentially missing the importance of non-threatened species ecological functions • Biased towards mammals • Potentially underestimates the importance/ potential of human-modified habitats for biodiversity • Limited habitats/ecosystem types • Does not run compensation calculations	Species / Ecosystems	Yes	Yes

Metric	Source	Advantages	Disadvantages	Metric focus (species / habitats / ecosystems)	Includes the protected status of species / sites?	Well established and / or widely used?
SSE Renewables Biodiversity Net Gain Toolkit (adapted from Defra's Statutory Biodiversity Metric)	SSE Renewables	• Embeds UK BNG best practice principles into design/function • Open source including technical user manual • Land carbon calculator included within toolkit • Addresses the challenge of developing on peatland and enables a transparent calculation of impact / compensation / enhancement requirements • Considers peatland habitats that are in a moderate condition or less as being suitable for improvement and not considered irreplaceable • Includes project optioneering functionality to inform design decisions and land requirements for the project • Uses Phase 1, UKHab and Fossitt habitat classifications therefore is aligned with classifications commonly used in the UK and Ireland • Allows the assessment of irreplaceable habitats within the toolkit	• Does not consider species • Further development of the assessment criteria to habitat connectivity is required • Does not constitute a full Natural Capital assessment • Application limited to the UK	Habitats	Yes	Widely used by SSE in Scotland and, more recently, Ireland

Appendix III: Key locations for biodiversity to be considered in studies

The following are examples of key locations for biodiversity. Key locations should be considered when undertaking studies to inform biodiversity integration, in consultation with relevant datasets, stakeholders and public officials.

- Irreplaceable habitat;
- IUCN Protected Areas Categories Ia (strict nature reserve), Ib (wilderness area) and II (National Park);
- Key Biodiversity Areas which consist of Important Bird and Biodiversity Areas; · Important Marine Mammal Areas (IMMAs);
- Ramsar sites;
- Natura 2000 sites;
- Marine Protected Areas and other relevant types of exclusion zones or controlled areas;
- Ecologically or Biologically Sensitive Areas (EBSAs);
- Particularly Sensitive Sea Areas (PSSA); and
- Critical habitat (as defined per IFC, 2012).

Appendix IV: Further guidance

Further key guidance related to biodiversity integration in RES development projects is provided below and according to the principles they relate to.

Resource	Principle											
	1. Adherence to the mitigation hierarchy	2. Avoid adverse impacts on irreplaceable biodiversity	3. Make a measurable contribution to biodiversity	4. Additional conservation outcomes	5. Contribute to conservation priorities	6. Achieve ecological equivalency	7. Address risks	8. Be inclusive and equitable	9. Deliver multiple benefits	10. Long-term outcomes	11. Be transparent	12. Science and knowledge exchange
BBOP (Business & Biodiversity Offset Programme) – Standard on Biodiversity Offsets												
British Standard Institute (BSI): 8683:2021 Process for designing and implementing biodiversity net gain												
Building Research Establishment (BRE): National Solar Centre Biodiversity Guidance for Solar Developments												
Building Research Establishment Environmental Assessment Methodology (BREEAM)												
European Commission – Measures to Mitigate Impacts of Hydropower Use on Aquatic Environment – Draft Guidance Document on Hydropower Development & Nature 2000 – Consultation Meeting 8 July 2015, Brussels												
European Commission – The requirements for hydropower in relation to EU Nature legislation. A summary												
European Commission – Guidance document on wind energy developments and EU nature legislation												
European Investment Bank – Environmental, Climate and Social Guidelines on Hydropower Development												

Resource	Principle											
	1. Adherence to the mitigation hierarchy	2. Avoid adverse impacts on irreplaceable biodiversity	3. Make a measurable contribution to biodiversity	4. Additional conservation outcomes	5. Contribute to conservation priorities	6. Achieve ecological equivalency	7. Address risks	8. Be inclusive and equitable	9. Deliver multiple benefits	10. Long-term outcomes	11. Be transparent	12. Science and knowledge exchange
Guidance document on wind energy developments and EU nature legislation												
Hydropower Sustainability Alliance (Hydropower Sustainability Guidelines on Good International Industry Practice, Biodiversity and Invasive Species Guidelines)												
Hydropower: applying the mitigation hierarchy to manage biodiversity risks												
Integrated Biodiversity Assessment Tool												
Integrated Biodiversity Assessment Tool (IBAT) Briefing Note: Considering Biodiversity for Solar and Wind Energy Investments												
International Financial Corporation (IFC) - Performance Standard 6 (PS6)												
International Hydropower Association Limited: Hydropower Sustainability Guidelines												
IUCN - Mitigating biodiversity impacts associated with solar and wind energy development												
IUCN & The Biodiversity Consultancy: Industry guidance for early screening of biodiversity risk- Solar												
IUCN & The Biodiversity Consultancy: Industry guidance for early screening of biodiversity risk – Offshore wind												
IUCN: Global Standard for Nature-based Solutions (NBS)												
IUCN: Planning Offshore Wind Projects [France]												

Resource	Principle											
	1. Adherence to the mitigation hierarchy	2. Avoid adverse impacts on irreplaceable biodiversity	3. Make a measurable contribution to biodiversity	4. Additional conservation outcomes	5. Contribute to conservation priorities	6. Achieve ecological equivalency	7. Address risks	8. Be inclusive and equitable	9. Deliver multiple benefits	10. Long-term outcomes	11. Be transparent	12. Science and knowledge exchange
Marine data exchange												
IUCN and The Biodiversity Consultancy: Mitigating biodiversity impacts associated with solar and wind energy development												
SolarPower Europe – Solar, Biodiversity Land Use: Best Practice Guidelines												
SolarPower Europe (2021) - Solar Sustainability: Best Practices Benchmark												
The Biodiversity Consultancy & World Wide Fund for Nature (WWF): Nature-safe Energy: Linking energy and nature to tackle the climate and biodiversity crises												
The Biodiversity Consultancy: A cross-sector guide for implementing the Mitigation Hierarchy												
The Biodiversity Consultancy: Solar energy managing biodiversity risks – industry briefing note												
Wildlife Sensitivity Mapping Manual 2020												
World Bank - Environmental and Social Standard 6 (ESS6)												
World Business Council for Sustainable Development: Roadmap to Nature Positive → Foundations for the energy system												
National Peatland Strategy 2015–2025 (Ireland)												

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