GINGR White Paper

Powering a Nature-Positive Future

A Renewable Energy Roadmap

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GINGR

Global Initiative for Nature, Grids and Renewables

An Introduction to GINGR

The Global Initiative for Nature, Grids and Renewables (GINGR) aims to support the just and sustainable energy transition by providing assessment tools to quantify contributions to Nature- and People-Positive goals. To facilitate this, we intend to develop monitoring and reporting systems that are globally aligned and standardised.

At GINGR, we are developing a comprehensive framework that allows actors within the energy system to report on progress towards biodiversity gains and co-created community benefits in the deployment of wind, solar and electricity grids. The GINGR Framework will support governments, the renewable energy industry, and the financial sector to achieve their energy, climate and biodiversity targets in a timely and socially responsible manner.

Through the efforts of several working groups with active participation from industry, NGOs, and academia, we plan to deliver robust and legitimate guidance and tools that support the final objective of a global standard in monitoring and reporting. Recognising the significant challenges posed by implementation, GINGR will develop a technical assistance hub to provide guidance and support, as well as a repository of best practices and lessons learnt.

The collaborative work on the GINGR Framework will be complemented by a series of publications which aim to provide ready-made solutions for companies, governments, and the financial sector. These publications also have the potential to bring more stakeholders together to share experiences and data, as well as to improve and enhance biodiversity around renewables and grid infrastructure.

GINGR is a collaborative initiative of the International Union for Conservation of Nature (IUCN) and the Renewables Grid Initiative (RGI).

Find out more on www.gingr.org.

Executive Summary

To address the urgent and interlinked crises of climate change and biodiversity loss, a whole-of-society approach is critical to achieve the goals of the Paris Agreement, the Kunming-Montreal Global Biodiversity Framework and the Sustainable Development Goals. The renewable energy sector has a considerable opportunity to contribute by reducing carbon emissions to mitigate the impacts of climate change, by halting and reversing biodiversity loss by 2030, and to achieve full recovery by 2050 by contributing to Nature-Positive.

To deliver the global goal of Nature-Positive, would require companies to mainstream nature and biodiversity within the entire renewable energy value chain, including mining, infrastructure development planning and siting, construction, operation, maintenance and decommissioning.

Companies in the renewable energy sector would need to incorporate strict sequential and iterative adherence to the mitigation hierarchy to address their direct impacts and those of associated industries. Priority should be given to developments that improve energy efficiency and promote energy conservation and sufficiency. Additional development following this should prioritise avoidance of any impact, followed by minimisation of impact, restoration and rehabilitation, and using offsetting only as the last resort when all the other steps have been sequentially followed.

Historic, cumulative and indirect impact should also be addressed through the mitigation hierarchy. Once all impacts associated with a company's operations have been ameliorated, additional benefits can be pursued through proactive conservation measures within and beyond individual project sites.

Other stakeholders, such as governments, lenders and civil society organisations, play a crucial role in this endeavour towards delivering the Nature-Positive goal by collaborating with the various actors and stakeholders within the renewable energy sector. This white paper outlines the steps necessary by which the energy sector could contribute to Nature-Positive.

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Introduction

The interlinked crises of climate change and biodiversity loss are wreaking havoc on our natural ecosystems. Human induced climate change is leading to sea level rises, an increased likelihood of extreme weather events, negative impact on biodiversity and ecosystems, melting of sea ice and permafrost, and risks to health, livelihoods, food security, water supply, human security and economic growth (IPCC, 2018).

Further, the loss of nature, destruction, degradation, and erosion of natural habitats is accelerating at an alarming rate, which is bound to have disastrous effects on the planet and people. Nearly one million animal and plant species are threatened with the risk of extinction from human activities, and 75% of the land surface has been significantly altered by human actions, with severe impacts on our livelihoods, economies, food security, health and quality of life worldwide (IPBES 2019). The loss of biodiversity also impacts the productivity and stability of natural ecosystems and the ecosystem services they provide. It undermines the abilities of the ecosystems to function effectively and efficiently and thus undermines nature's ability to support a healthy environment. This is particularly important as it impacts the ability to serve as natural carbon sinks, absorbing large amounts of greenhouse gas emissions and adapting to climate impacts (IPBES 2019).

Protecting ecosystems and sustainably managing their resources is essential. However, only the protection and sustainable management of the remaining landscapes and oceans is not enough. The degraded ecosystems and the benefits they provide must also be restored. By declaring the UN Decade on Ecosystem Restoration, governments have recognised the need to prevent, halt and reverse the degradation of ecosystems worldwide for the benefit of both people and nature. Without a strong ambition and roadmap, it is not possible to achieve the goals of the Paris Agreement or the Sustainable Development Goals.

The Kunming-Montreal Global Biodiversity Framework (KMGBF) adopted by the 15th Conference of Parties (COP15) to the Convention on Biological Diversity (CBD) set out a goal to 'halt and reverse biodiversity loss by 2030', and thereafter 'to put nature on a path to recovery for the benefit of people and planet by conserving and sustainably using biodiversity'. By 2050, the objective is that biodiversity is 'valued, conserved, restored, and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people'.

Whilst ambitious, it is essential that this global commitment goes beyond simply halting the ongoing loss of nature to actively rebuilding our damaged biosphere. The loss of nature is now so comprehensive that merely stopping further destruction will be insufficient to maintain the vital ecological functions that support complex life on the planet. The need to not just curtail damaging activities but to pursue measures that can lead to the full recovery of nature has been described as 'Nature-Positive' (Nature-Positive Initiative, 2023).

Achieving this goal of Nature-Positive will require a whole-of-society approach and, critically, an alignment of this goal with global economic activity. It will require that all economic sectors embrace a Nature-Positive ambition and make its realisation a core sectoral objective.

In 2023, the Nature-Positive Initiative (NPI), an alliance of conservation organisations, institutes, business and finance coalitions, further defined Nature-Positive as a global societal goal to 'halt and reverse biodiversity loss by 2030 on a 2020 baseline and achieve full recovery by 2050' (NPI 2023; see Figure 1.).

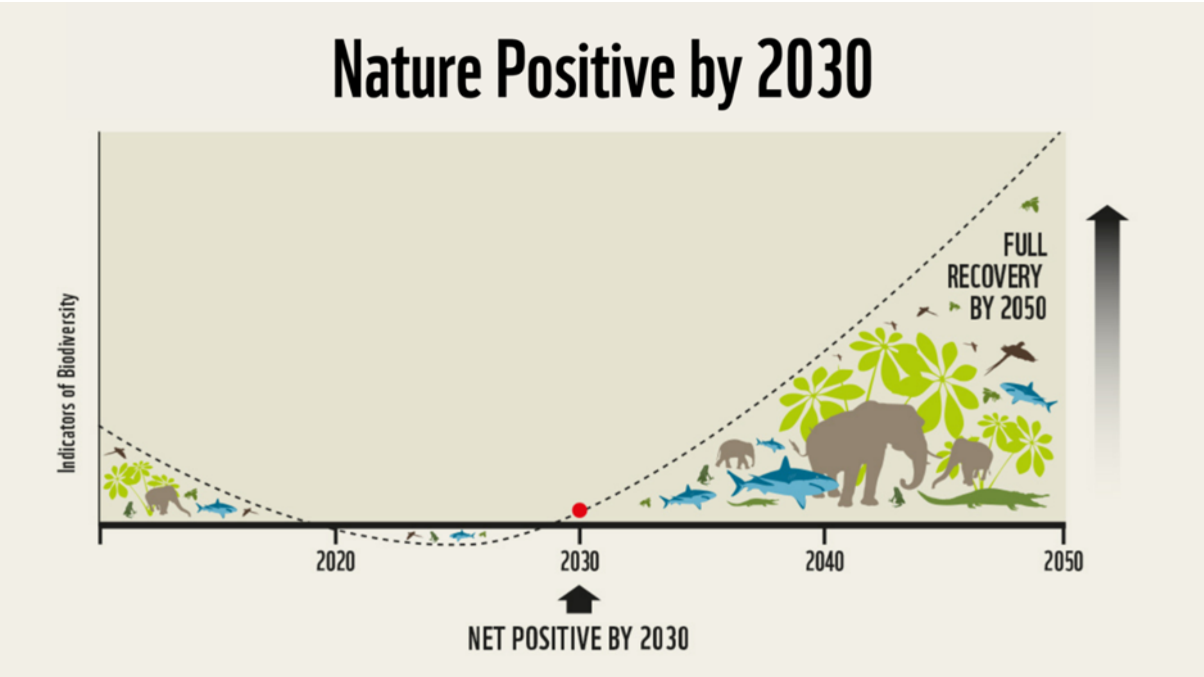

***Figure 1**. Figurative representation of the Nature-Positive goal (www.naturepositive.org)*

To demonstrate verifiable progress towards achieving the global goal for nature to "halt and reverse" nature loss by 2030 and measure the mission of the GBF, they introduced a set of draft State of Nature metrics in 2025 to assess the condition and extent of ecosystems, and species population size and extinction risk, including positive or negative changes. They have identified a small set of metrics that can act as an indication of nature's overall health, noting that measuring every aspect of nature is not feasible or practical. The universal indicators include ecosystem extent, ecosystem condition (measured by site condition and landscape condition), and species (composed of extinction risk).

The NPI has undertaken an extensive stakeholder engagement and consultation process with the aim to develop a consensus on the set of state of nature metrics for piloting. An initial framework was developed with a draft minimum set of terrestrial State of Nature Metrics, organised into a set of four universal indicators and five case-specific indicators. Each indicator has associated metrics with different granularity levels, and a set of trigger criteria was developed to identify where more tailored case-specific metrics are needed. This will be followed by further development of state of nature metrics for freshwater and marine ecosystems, as well as more work on core themes such as demonstrating nature-positive outcomes and measurements based on traditional knowledge.

These metrics pilots will help inform the development of guidance and how they can be embedded in existing frameworks and standards. They will also help companies in meeting Target 15 to monitor their impacts on biodiversity to progressively reduce negative impacts and increase positive ones.

Further, the Taskforce on Nature-related Financial Disclosures (TNFD) has also been developing standardised metrics and disclosure frameworks that enable businesses to assess and report their impacts on nature. Central to TNFD's approach is the LEAP framework, which focuses on four key dimensions: Location, Ecosystem, Assets, and People. This framework helps organisations identify where their activities have the most significant impacts on nature, assess the condition of ecosystems in those areas, evaluate how these impacts affect their assets, and understand the consequences for local communities and people (TNFD 2023).

This white paper aims to identify the necessary conditions to achieve a global energy sector which sufficiently contributes to the global Nature-Positive goal. Namely, an energy sector that has **halted and reversed the biodiversity loss associated with its operations and associated supply chains and, thereafter, is proactively contributing to the societal aim of full nature recovery.**

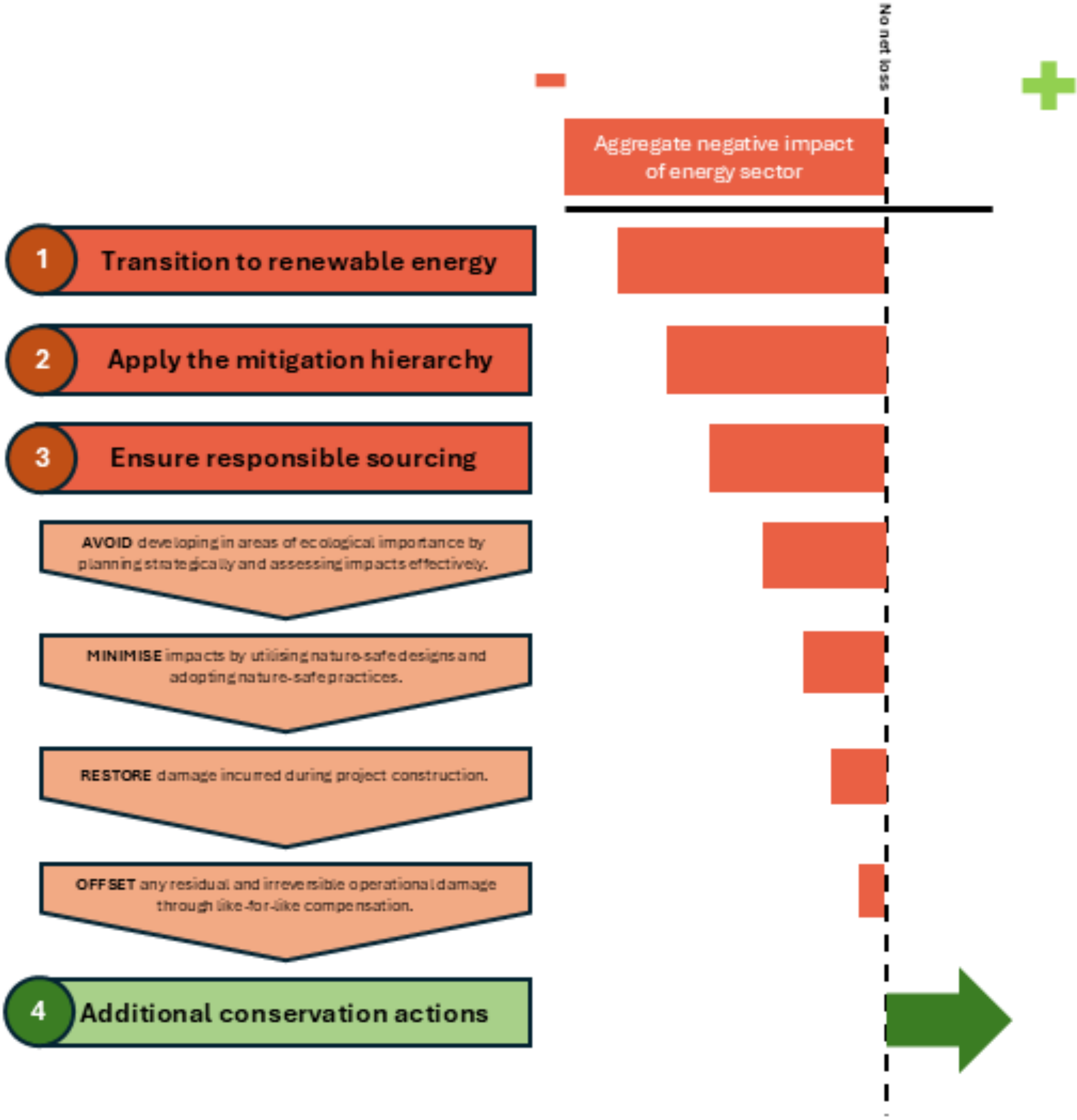

Figure 2. *A stepwise framework for achieving an energy sector that contributes to Nature-Positive. The aggregate negative impact of the energy sector should be remediated by steps 1-3. When the energy sector has reduced its impacts such that it is causing no net loss of biodiversity, it can move towards having an actively positive impact on nature through support for additional conservation actions that benefit biodiversity (step 4).*

Transition to renewable energy, principally wind and solar

The energy sector refers to the category of industries and companies involved in the production, extraction, refinement, transportation distribution, and sale of energy. This includes both traditional sources such as fossil fuels (oil, natural gas, coal), nuclear power and renewable sources (solar, wind, hydro, geothermal, modern bioenergy, ocean energy and others).

The burning of fossil fuels has led us to the brink of climate catastrophe, which in turn is one of the primary drivers of biodiversity loss. Therefore, the most critical step to achieve a global energy sector that delivers on Nature-Positive is the rapid cessation of fossil fuel use. Indeed, the Nature-Positive goal is incompatible with the continued use of fossil fuels (petroleum, coal and natural gas). Similarly, there are doubts as to whether nuclear power can be described as sustainable, given the long-term requirements to manage radioactive waste and the ongoing threats of proliferation. Consequently, any attempt at achieving an energy sector that delivers Nature-Positive must involve a transition to energy exclusively generated from renewable energy sources in particular wind, and solar. A global energy sector largely based on renewable energy is technically feasible, economically viable and a prerequisite for contributing to Nature-Positive.

Further, the International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA) have emphasised that the global renewable energy capacity must be tripled, and the rate of energy efficiency improvements doubled by 2030 to keep the goal of limiting global warming to 1.5°C within reach. At UNFCCC COP28, global leaders echoed this urgency by pledging to accelerate the deployment of renewables and enhance energy efficiency. The Global Stocktake outcome under the COP28 explicitly calls on governments to achieve, at a global scale, the tripling of renewable energy capacity and the doubling of energy efficiency improvements by 2030 compared to 2023 baselines.

Under the global pledge to triple renewable power capacity by 2030, renewable energy power capacity would need to increase from 4443 gigawatts (GW) by 2024 to over 11.17 TW by 2030. This indicates that over 1044 GW of average annual additions will be needed from now to 2030. Solar and wind will contribute around 89% of the needed renewable power expansion. Some 578 GW of solar capacity and 360 GW of wind capacity will be needed every year to keep the track aligning with the COP28 Tripling Target (IRENA, 2024 and 2025).

Whilst the most critical step to realising an energy sector that delivers Nature-Positive is ensuring energy production based on renewable resources, some forms of renewable energy generation, such as hydropower, can cause significant ecological damage and, therefore, achieving an energy sector that delivers Nature-Positive will require more benign technologies like solar and wind to predominate.

Compared to other forms of energy generation, wind and solar farms are generally less damaging to nature. They also utilise widespread and ubiquitous resources, allowing their expansion to be prioritised in areas of low biodiversity importance. That said, in some locations and for some taxa, wind and solar farms can pose a significant threat. For instance, some birds and bats are highly susceptible to collision with wind turbines. In addition to wind and solar farms, their associated infrastructure, like the grid network, plays a crucial role in enabling a sustainable and reliable energy system as we shift toward renewable energy sources. The transition to renewable energy will necessitate a substantial expansion of grid infrastructure, including a doubling of power lines globally. Power lines pose a serious problem for birds and other wildlife like bats, with large numbers killed through collision and electrocution (Bernardino et al., 2018). Poorly sited wind and solar infrastructure and associated powerlines are already driving some significant population declines and even putting some species at risk of extinction (Carrete, Tella, & González-Suárez, 2021; Husby, Rydell, & Lindström, 2024; Shobrak, Eid, Alshamli, & Alagaili, 2021; Tolvanen, Tarvainen, & Norokorpi, 2023; Ucero, Traba, Arroyo, & Suárez, 2024). In addition, the renewable energy transition will also require significant quantities of certain raw materials to manufacture the necessary infrastructure. The procurement of these materials also has a significant impact on biodiversity.

So, whilst an energy sector based predominantly on the exploitation of wind and solar resources will be considerably less impactful to nature than a sector based on fossil fuel use, it will still result in significant biodiversity impacts if not appropriately planned and operated.

Pathway to an energy sector that delivers Nature-Positive

As the first and fundamental step for the energy sector to deliver on Nature-Positive is a global transition away from fossil fuels to energy generated exclusively from renewable sources, principally wind and solar.[1]

Worldwide energy consumption continues to grow at an average rate of around 1% to 2% per year, with global energy consumption increased by 2.2% in 2024 (International Energy Agency, 2025). However, it is crucial to improve energy conservation, energy efficiency and reductions in excessive energy consumption (in developed countries where low efficiency and excessive consumption is still dominating) to make a swift transition away from fossil fuels. Whilst we must expect demand to continue in countries still pursuing universal access to energy, this must be offset by measures and incentives to reduce energy demand in richer countries. Curbing energy demand in the developed part of the world will not only reduce the need for new electricity generation, transmission and distribution infrastructure but also reduce demand for the raw materials required to build new energy generation facilities and distribution networks.

Better energy conservation, which seeks to reduce wasteful energy consumption, is paramount. This can be achieved by changing energy consumers' behaviour so that they use less energy or by adopting technologies that use energy more effectively, for example, by better insulating buildings so that they require less heating. The IEA recognises that efficiency is vital to the attainment of a Net Zero Emissions by 2050 Scenario. The World Economic Forum estimates that energy demand could be cut by 31% across all sectors if businesses take action to curb demand by 2030 (World Economic Forum, 2024). An equitable and ecologically sound energy transition will require not just greater energy efficiency but also a move towards energy sufficiency, wherein we seek to meet the energy requirements of the world's citizenry within the environmental limits of the planet. Therefore, retrofitting existing infrastructure should be prioritised to minimise energy waste, along with encouraging behavioural changes regarding energy consumption.

[1] References to energy infrastructure in the following text typically refer to windfarms, comprising of large three-bladed horizontal-axis wind turbines, photovoltaics (PV) solar facilities and the components of electric power distribution – transmission lines, distribution lines, substation and transformers.

STEP 1
A swift and comprehensive phase out of fossil fuel use and a transition to energy derived from renewable sources, primarily wind and solar, based on principles of energy efficiency and sufficiency.

Addressing the operational impact of the energy sector on nature: The importance of the Mitigation Hierarchy

The mitigation hierarchy is a stepwise framework used by industries to address their harmful impacts on biodiversity. The intention is that by first avoiding potential impacts, then by minimising unavoidable impacts and finally by offsetting any residual impacts, an industry can ensure ‘no net loss’ of biodiversity associated with its activities and may even achieve a ‘net gain’ outcome. The mitigation hierarchy is now established as international industry best practice and its use is formalised within the policies and standards of many governments, companies and financiers.

It is worth noting that each successive step on the hierarchy is considered less optimal, i.e. it is considered far better to avoid damage in the first instance and only adopt offset strategies as a last resort. Each successive step in the mitigation hierarchy should only be considered when it can be demonstrated that the preceding step has been fully applied. Effective implementation of each stage of the mitigation hierarchy is key to addressing the harmful biodiversity impacts associated with the energy sector and, therefore, for the energy sector to deliver Nature-Positive. The four key steps of this process – avoid, minimise, restore and offset – are described below.

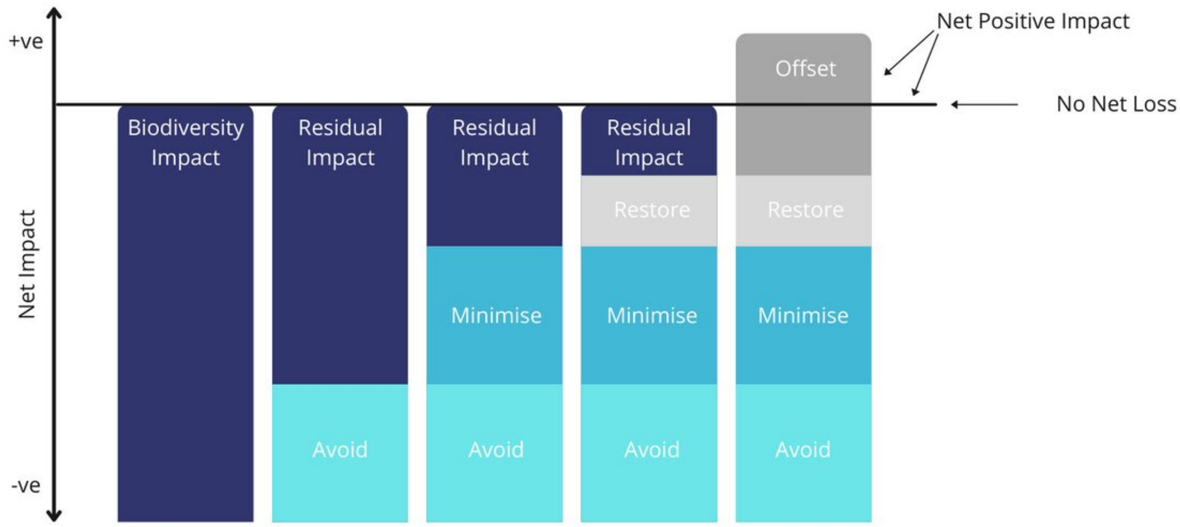

Figure 3. *Mitigation Hierarchy (The Biodiversity Consultancy)*

Avoid

The preeminent step of the mitigation hierarchy requires that every effort is made to avoid damage to nature by utilising the least impactful technologies and siting these away from areas of high biodiversity value.

In many parts of the world, the most ecologically and socially benign route to universal clean energy is through small-scale, decentralised and community-led projects rather than large-scale, centralised, utility-scale development. In many developing regions, clean energy could be delivered more quickly, with fewer impacts on nature, and with greater direct benefits to local communities, through the use of mini-grids and small-scale community solar. Even in more developed countries, community-scale wind and solar projects could limit both ecological damage and community resistance more effectively.

Large-scale renewable energy expansion should be targeted at urban, industrial, and agricultural landscapes of low ecological value. This includes the utilisation of rooftop solar on warehouses, distribution centres, office buildings, factories, retail outlets and private homes and the advancement of technologies such as solar parking canopies that integrate solar panels into existing carparks and agrivoltaics schemes that simultaneously use land for both harnessing solar radiation and for agricultural production.

Identifying landscapes of low ecological value in which to prioritise the expansion of renewable energy technologies requires strategic planning at a national or regional scale. Governments and the energy sector must ensure that they select sites for renewable energy expansion that are not only technically viable but also the most environmentally and socially low-risk available. Doing so requires the use of robust planning and site evaluation through Strategic Environmental Assessment (SEA) and Environmental Impact Assessments (EIAs), the identification of potentially high-risk areas through sensitivity mapping, and scenario modelling to assess the cumulative impacts of alternative development strategies (IUCN 2025, OCEaN 2024).

While the amount of new infrastructure needed to transition to renewable energy is considerable, it should be possible to find sufficient areas for development where impacts on nature are largely avoided. For instance, it has been estimated that generating Europe's electricity using only onshore wind and utility-scale solar facilities would require 2% of the continent's land area (Tröndle, 2020). Whilst 2% of Europe's land area constitutes many thousands of square kilometres, it should nevertheless be possible to accommodate new wind and solar infrastructure whilst avoiding those sites of greatest significance for nature if development is well planned.

Case Study: *Factoring in concerns for Critically Endangered North Atlantic right whales to avoid impacts during offshore wind energy site*

Many large-scale offshore wind developments on the East Coast of the USA are advancing in the permitting and construction process. This region also overlaps with the annual critical habitats and migration routes of the critically endangered North Atlantic right whale (Eubalaena glacialis, hereafter, NARW) annual critical habitats and migration routes. In order to recognise concerns and potential impacts for this species around renewable energy development and promote the best practices for NARW, several environmental organisations are expressing a greater need for a series of additional best practices during site characterisation, construction and operation of offshore wind farms.

Among other recommendations, one of the main recommendations included site selection **to avoid critical NARW habitat**, potential seasonal and temporal restrictions on construction (for example, during high densities of NARW presence and acoustic detections). Further recommendations included following the sequential steps of the mitigation hierarchy on minimising impact, such as:

- monitoring 1,000-mile exclusion zones during construction for NARW activity, vessel speed restriction to 10 knots for the lifetime of the project;
- use of effective acoustic real-time monitoring for needed enhanced mitigation;

- reduction of underwater noise during site characterisation and during construction through gravity foundations and/or noise reduction and attenuation measures; and,
- consideration of materials and installation methods.

Recommended best practices to better protect NARW also include commitments for additional scientific research and long-term monitoring, as well as contribution to wider conservation efforts for this species.

North Atlantic right whale and calf
Source: ©Florida Fish and Wildlife Conservation Commission

Minimise

Whilst deploying the right infrastructure in the right areas will significantly limit damage to nature, there will still be some unavoidable impacts. In some high biodiversity regions, it may prove difficult to find sufficient areas of low ecological value to accommodate all the required infrastructure. In addition, whilst powerline infrastructures can be routed around the most ecologically sensitive sites, the cumulative impact of such globally prolific infrastructure will always be high. In addition, there is a legacy of existing infrastructure, much of it designed and sited with little or no regard for nature.

Impacts that cannot be avoided can be greatly reduced, and sometimes eliminated, with appropriately designed technology and the adoption of nature-safe practices. These approaches range from painting turbine blades and undergrounding powerlines to innovative new technologies such as bladeless turbines. At wind farms, bird collision can be significantly reduced through turbine curtailment systems that utilise human observers and/or sophisticated cameras, radar and other sensors to identify approaching birds and stop the rotation of the blades so that the birds pass safely. Likewise, bird collisions with powerlines can be greatly reduced through the installation of Bird Flight Diverters (Renewables Grid Initiative, 2024). Using bubble curtains during the construction phase of offshore wind farms can help reduce underwater noise.

For the energy sector to deliver on Nature-Positive, it will require a considerable scaling up of the use of such solutions in new infrastructure and the wholesale retrospective application of such solutions across existing infrastructure.

Case Study: *Development of the Piling Protocol to minimise adverse impacts of underwater noise on Fauna*

Marine mammals, fish and turtles are at risk of impacts associated with underwater noise during wind farm construction. There are various abatement controls and approaches to minimise this risk.

Natural England, the Countryside Council for Wales, and the Joint Nature Conservation Committee (JNCC)—the UK's statutory conservation organisations—have developed best practices for mitigating the effects of piling on marine mammals. Known as the "piling protocol," this approach is also suitable for minimising impacts on marine turtles and basking sharks, aiming to "reduce to negligible levels the potential risk of injury or death to marine mammals in close proximity to piling operations." Examples of its implementation and adaptation are commonly found in environmental documents for offshore wind farms, often accessible online through individual project websites or the relevant government agency (such as the UK's National Infrastructure Planning portal or the U.S. Bureau of Ocean Energy Management).

The piling protocol is suitable for use in any region and can be easily adapted. It addresses the following considerations: the role, training and equipment requirements of the marine mammal observer (MMO); the mitigation zone; the pre-piling search; delay if marine mammals are detected in the mitigation zone; soft-start piling procedures; breaks in piling activity; acoustic deterrent devices (ADDs); and reporting protocols.

Restore

Some of the impacts associated with energy development are impermanent and can be remediated following construction. For instance, the construction of a wind farm might require that temporary roads be built to enable access for large turbine components. It is important that nature damaged by these short-term activities is subsequently restored to its previous condition or even enhanced.

Ultimately, all infrastructure has a finite lifespan and will require decommissioning or replacing. Indeed, many millions of tonnes of wind turbines and photovoltaic solar panels will be decommissioned in the coming decades. It is important that such materials do not end up in landfills and that former energy facilities are routinely rehabilitated to their original natural state. The energy sector should also aim to achieve a circular economy by recovering, recycling and reusing infrastructure when it is decommissioned and by restoring and rehabilitating nature to sites formerly utilised for energy production.

Offset

Ideally, the full implementation of the preceding stages of the mitigation hierarchy will have ensured ‘no net loss’ of biodiversity, and it will often be unnecessary to engage in biodiversity offsetting. Offset strategies are often expensive, complex and have high rates of failure, due to difficulty to measure, speed of recovery and often inability to fully recover. However, there are occasions when even after all attempts have been made to first avoid, and then minimise impacts and restore nature, there is likely to be some residual damage. In these instances, it will be necessary to compensate for that loss by implementing a commensurate conservation activity for the species and/or habitats being affected. It is important that these measures benefit the same biodiversity features as those affected, namely that they constitute a like-for-like replacement of lost nature. So, for example, if the development of a windfarm facility is predicted to result in ten unavoidable Saker Falcon *Falco cherrug* fatalities it will be necessary to instigate a conservation activity, such as insulating existing powerlines to reduce electrocution risk or installing nestboxes, such that these actions will increase the local population of the same species by ten or more individuals. Given the challenge in adequately replacing lost nature, and the undesirability of offsetting, it is advisable to aim for achieving overcompensation.

STEP 2

Apply the mitigation hierarchy (Avoid – Minimise – Restore – Offset) in a stepwise manner, ensuring that each successive step is only considered when the preceding step has been fully applied.

Addressing the impact of associated industries and the supply chain

For the energy sector to be truly Nature-Positive, it must not only ensure that its direct operations are positive for nature but that the same is true for the associated industries on which it relies. Technologies like wind turbines and solar panels utilise a large range of metals and minerals in their production. For instance, many turbines require rare earth metals such as neodymium. Electricity networks rely on minerals such as copper and aluminium, whilst batteries require elements such as lithium, nickel and cobalt. All these materials need to be mined from the ground. Mining operations not only have a significant impact on biodiversity through the direct destruction of habitat and contamination of soils and water with pollutants, but they can also have significant impacts on human health. For instance, the mining of rare earth elements can release fluoride and arsenic into the environment and has been linked to lowered birth rates and numerous diseases.

The energy sector must work with the mining industry and other associated industries in the supply chain to:

- Ensure responsible sourcing and high ethical standards throughout the supply chains.
- Move towards a circular economy based on resource efficiency, waste reduction, and material reuse and recycling.
- Decarbonise across associated industries.
- Find substitutes for the most environmentally impactful materials.
- Ensure that all associated industries fully adhere to the mitigation hierarchy (see next step).

STEP 3

Limit the damage caused by associated industries and across the supply chain through responsible sourcing and the establishment of a circular economy.

Supporting additional conservation actions

Once the damage to nature associated with the energy sector has been eradicated by phasing out the use of fossil fuels, curbing energy demand and promoting energy efficiency, and addressing the operational and associated supply chain impacts through strict adherence to the mitigation hierarchy, there exists considerable scope for the energy sector to proactively provide additional conservation benefits. Indeed, it is the provision of these additional conservation actions that can enable the energy sector to go beyond simply achieving 'no-net-loss' and realise an impact that truly delivers on Nature-Positive. It is vital that these conservation actions are supplementary and provide additional biodiversity gains. Support for additional conservation action should not be used to compensate for the negative impacts incurred by the sector (see Box 2). Supplementary conservation action can take the form of *in situ* biodiversity enhancement, ex-situ habitat restoration and species recovery and support for monitoring and research. Supplementary conservation actions are best delivered in partnership with local conservation bodies and communities.

In situ biodiversity enhancement

In situ biodiversity enhancements are actions taken at the project level (i.e. within the boundaries of a solar or wind farm) to restore or create habitats, and/or to benefit key species. They have been defined as the provision of 'genuine improvement of the natural heritage interest of a site or area through better management, or the addition of new or better habitats or features than currently present' (Rajvanshi et al. 2011). Considerable opportunities exist to enhance biodiversity in and around energy operations. The construction of energy infrastructure can be used as a catalyst to restore degraded habitats and reinstate species. Planned effectively, energy infrastructure can be designed to create habitat corridors and contribute to area-based biodiversity targets. For instance, native grass and shrub communities can be reinstated beneath powerlines and wind and solar facilities, especially in urban areas and landscapes dominated by intensive agriculture. Likewise, offshore wind farms can be used to create *de facto* protected areas in which fisheries activities are prohibited. Furthermore, offshore infrastructure can be modified to create artificial reefs, further helping to recover and replenish fish stocks. To ensure the maximum benefits, biodiversity enhancement measures should be factored into project planning and design early in the project cycle.

Case Study: *North Sea flat oyster restoration*

Source: ©The Rich North Sea

Wind farms can be designed in ways that take advantage of their multi-use capacity through the reserve and reef effects. By using nature-inclusive building materials in areas around offshore wind farms, where bottom trawling is prohibited, wind farms can be co-designed for oyster bed restoration. This can assist in mitigating biodiversity impacts and enhancing ecosystem services and functioning, including future seafood production, while meeting the economic demand for energy. The Ministry of Economic Affairs of the Netherlands has partnered with WWF, ARK Nature and Wageningen Marine Research, among others, to establish the Flat Oyster Consortium. This collaboration has carried out a pilot project to explore feasibility and optimise the design and management of flat oyster restoration in offshore wind farms in the Dutch North Sea. Due to overfishing and habitat destruction through bottom trawling and disease, the epibenthic shellfish reefs, which were once plentiful in the area, are now almost absent. By constructing artificial reef structures in the undisturbed seabed around wind farm foundations and supplementing the areas with flat oysters, the project was able to cultivate a functioning population of flat oysters and attract various fauna.

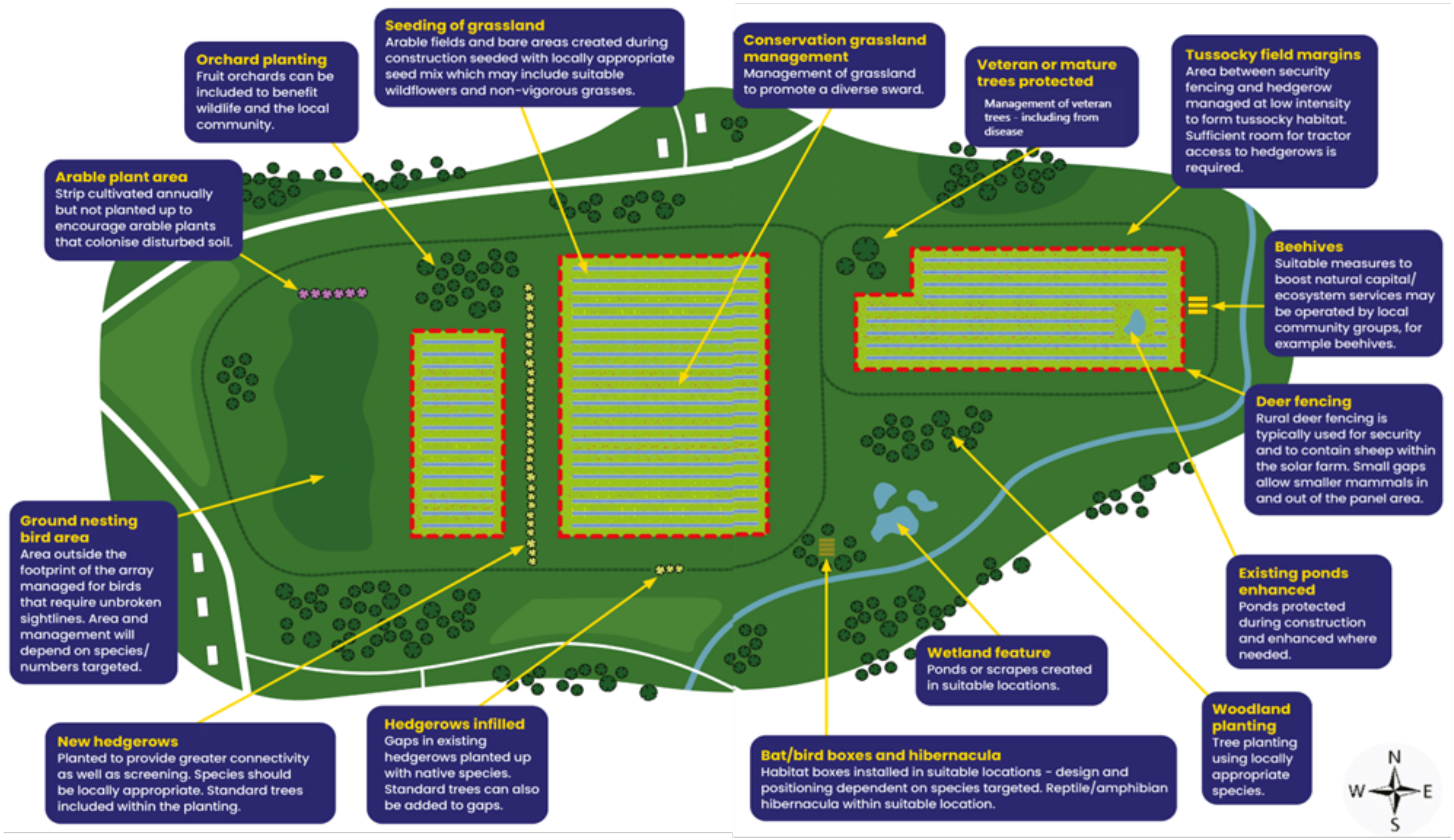

***Figure 4** Examples of opportunities for biodiversity enhancement at a hypothetical PV solar farm (Source: Solar Energy UK 2022 pp 24-25).*

Ex-situ habitat restoration and species recovery

On occasions, it may be concluded that a greater biodiversity gain can be achieved by supporting conservation actions outside the boundary of a project. For instance, it may be that restoring habitat or aiding species recovery in the wider landscape, or elsewhere along a migratory flyway, offers more significant conservation rewards. Ex situ conservation actions can also involve addressing key threats present in the wider landscape. For instance, an energy company might use its expertise to retrofit harmful energy infrastructure elsewhere along a flyway by burying or insulating power lines and thus reducing fatalities of migratory birds. Alternatively, it might support conservation measures to reduce other threats such as illegal hunting and poisoning. In the marine realm, offshore wind developers can support seabird conservation by funding invasive mammal eradication at breeding colonies or by providing additional nesting opportunities.

Support for monitoring and research

Vital to designing effective measures for reducing the impacts of the energy sector is better data collation, open data sharing and further research into the effectiveness of mitigation and offset strategies. In addition to data gaps, improved mitigation methods, including better real-time detection methods with validated field performance are also important. For instance, collating data on bird and bat fatalities at energy infrastructure and making it available to the scientific community can significantly help our understanding of collision and electrocution and how to address it. Similarly, research into the efficacy of different mitigation approaches, such as different types of Bird Flight Diverters that prevent bird collision with overhead powerlines, are vital to developing more effective solutions.

STEP 4

Support additional conservation action through *in situ* biodiversity enhancement, ex-situ habitat restoration and species recovery and support for monitoring and research.

Whose responsibility is it to deliver Nature-Positive?

Achieving a global energy sector that delivers Nature-Positive will require a whole-of-society approach with public, private, and civil actors, each with a role to play.

Governments must establish national and international targets for rapid renewable expansion and create the economic incentives to encourage investment in wind and solar. Governments must also legislate for greater energy efficiency and sufficiency and overhauling current regulatory frameworks to ensure nature-safe energy planning and development.

Avoiding Greenwashing

Support for additional conservation action is intended as a supplementary activity to be pursued only when negative impacts have been comprehensively eliminated (or at the very least are on course to be eliminated). If negative impacts are not directly resolved, then support for additional conservation action can be construed as greenwashing if it is used to suggest that the damage incurred by the sector has been satisfactorily compensated (see Figure 6).

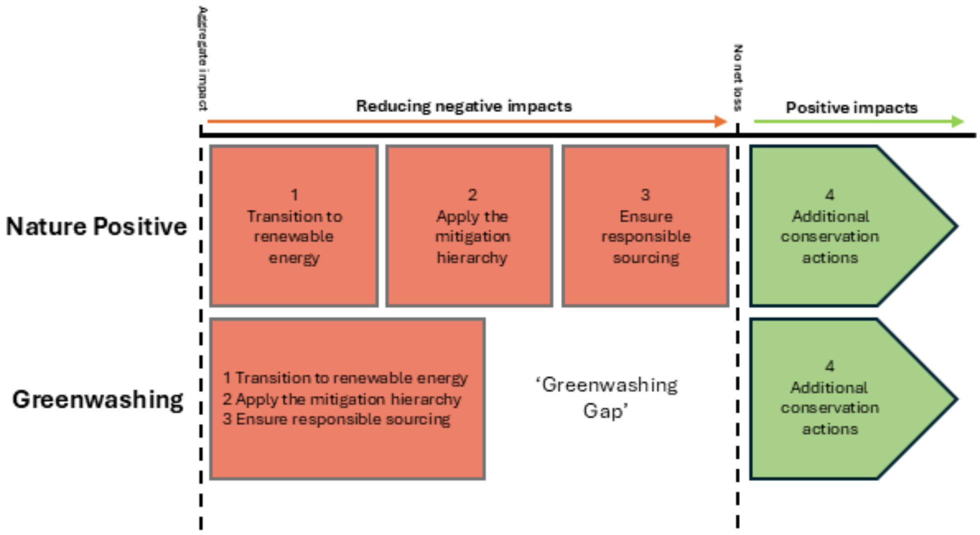

Figure 6. *It is important to fully ameliorate the negative impacts incurred by the energy sector before engaging in support for supplementary conservation action. If negative impacts have not been resolved, then supplementary conservation action could be construed as greenwashing.*

Governments should encourage broader corporate action by simplifying target setting, progress tracking and reporting at every level; introducing appropriate biodiversity-related regulatory requirements; and setting clear guidance for nature actions and outcomes to target. Governments should encourage practices to safeguard and enhance nature and biodiversity by integrating them within renewable energy tenders, such as introducing the use of non-price criteria within tenders. They must also use other policy instruments such as environmental permitting, mandating spatial planning, incorporating nature sensitivity mapping, the use of strategic environmental assessments (SEAs), cumulative impact assessments (CIAs) and environmental impacts assessments (EIAs), requirements of monitoring, data-sharing and disclosure, due-diligence requirements, establishment of go and no-go zones, among others, to push for corporates to embed nature and biodiversity concerns within their operational activities to adhere to the mitigation hierarchy and follow responsible sourcing throughout its supply chains.

Figure 7 illustrates how the earlier steps in achieving Nature-Positive require more responsibility at a sectoral and societal level, whilst the later steps tend to require greater responsibility from individual corporations. Step 5, support for additional conservation action, requires collaboration at the societal, sectoral and individual corporation level.

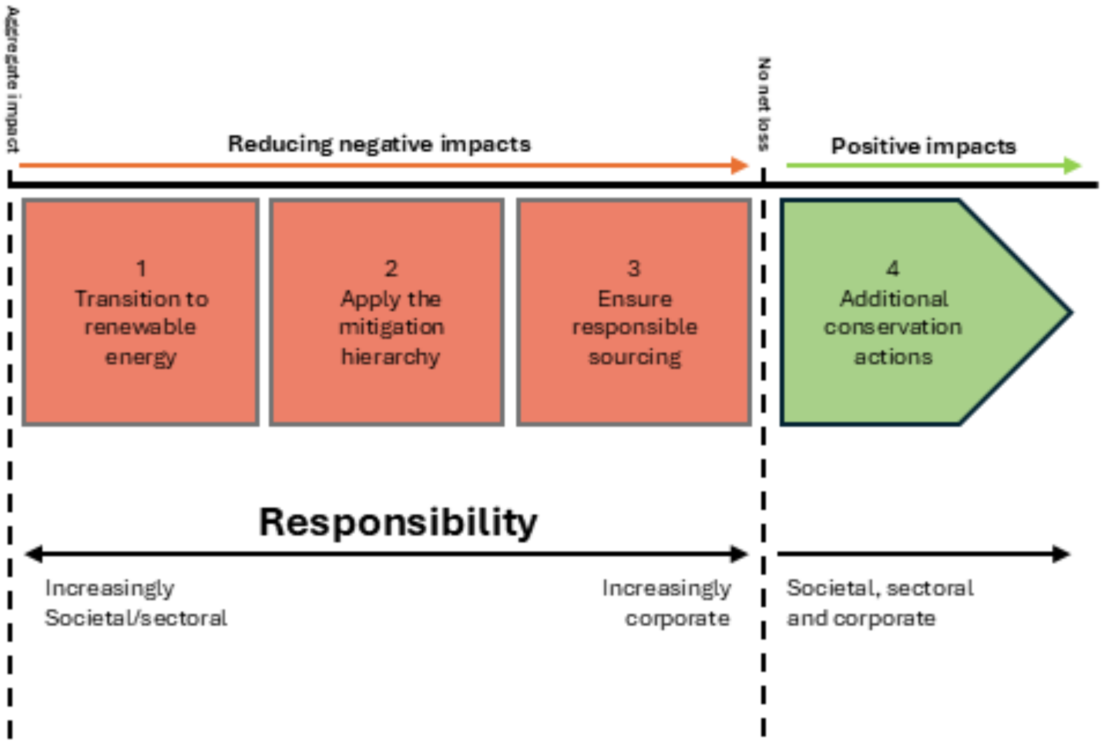

Figure 7. *How responsibility is distributed across the steps for achieving an energy sector that contributes to Nature-Positive.*

A whole-of-society approach can make it difficult to assign ultimate responsibility, and there is a risk of ‘buck passing’ as each actor perceives responsibility to reside elsewhere. Many energy companies and the lenders financing their activities profess to adhere to the mitigation hierarchy. Yet they rarely have sole agency in where and how energy infrastructure is delivered. For instance, developers and lenders are often not responsible for choosing locations for development. These decisions are made by the government.

Therefore, one of the fundamental first requirements of the mitigation hierarchy – to prioritise development in low-impact areas – is not directly within the purview of companies and lenders. For many governments, the principal factors influencing siting decisions of new energy infrastructure are land prices, existing land use and public acceptance, not impacts on nature. Even when implementing those elements of the mitigation hierarchy that fall within their scope of influence, developers are still limited by prevailing legislative frameworks and commercial realities. If the legislation does not specifically require that their operational impacts on biodiversity are minimised, and doing so would hamper competitiveness, companies are unlikely to employ costly technologies such as powerline burial or wind turbine curtailment.

Governments and lenders need to create economic conditions that reward companies that seek to support the creation of an energy sector that delivers on Nature-Positive. Governments should reassess energy subsidies and remove inefficient subsidies for fossil fuels to improve market efficiency, free up resources for investment in renewable energy and energy efficiency initiatives. This would create a level playing field for renewables, recognising that the relatively new sector which contributes to global good will need extra support.

Financial benefits in the form of incentives and subsidies for nature-safe practices must also encourage companies to catalyse action towards avoiding, managing, and mitigating nature loss. Lenders can play a huge role in directing financial flows, but so can governments by providing subsidies, implementing taxes, providing low-interest loans and grants, green investments and utilising other financing measures to direct financial flows towards delivering on relevant goals. For instance, green bonds as a financial instrument issued by banks, governments, or organisations, are becoming increasingly popular to raise money for projects with positive environmental impacts. However, they should be grounded in science-based, measurable outcomes. There should be Independent third-party verification, a solid baseline, and regular monitoring to track net improvements over time.

Case Study: *How government regulations contribute to an energy sector that delivers Nature-Positive*

Creating a bubble curtain around the offshore wind turbine installation to reduce the noise. Source: ©Hydrotechnik Lübeck

In Germany, a new Marine Spatial Plan for the German Economic Zone in the North Sea was introduced in 2021. It came into force to coordinate the growing conflict of maritime uses between space-intensive offshore wind farms and marine environmental protection goals, as well as traditional maritime uses such as shipping and fisheries. It contains provisions aimed at coordinating the individual uses and functions of shipping, the exploitation of resources, the laying of pipelines and submarine cables, scientific marine research, wind power production, fisheries and mariculture, as well as the protection of the marine environment. The spatial plan was also subject to a strategic environmental assessment (SEA), following the European directive on SEA (Directive 2001/42/EC). Broad public participation was secured through consultations with stakeholders from agencies and non-governmental organisations covering the following issues: marine environment and nature conservation, fisheries, energy, sand and gravel, shipping, military, tourism, leisure boating, and research.[2]

Further, since 2013, the Federal Ministry for the Environment (BMU) in Germany has put in place new piling regulations for the protection of these marine species, which has become a crucial aspect in the process of approving offshore wind farm projects in the country. To help protect the endangered harbour porpoise, the only cetacean species living in the German North Sea and Baltic Sea, a big bubble curtain was pioneered which lowers offshore wind farm construction noise to a safe threshold deemed safe for the species and other marine mammals like seals. The species is extremely sensitive to sound and uses echolocation by emitting ultrasonic clicks to navigate, hunt, communicate and avoid obstacles in the dark and murky waters. Hence, loud, man-made underwater voices, especially from wind farm construction can disturb

[2] https://maritime-spatial-planning.ec.europa.eu/practices/maritime-spatial-plan-german-eez-north-sea

these marine species. The bubble curtain, which is now widely used by many northern European countries like Germany, Denmark and the Netherlands, adheres to the strict rules and guidelines introduced in these countries for the protection of marine mammals during construction activities like piling.[3] In Germany, it has led to a substantial reduction of noise pollution from construction efforts while allowing renewable energy developments to thrive.[4] This demonstrates the role of government regulations in incorporating non-price criteria, like the protection of marine species in this case, renewable energy companies can be compelled to minimise the damage by mitigating their impacts (in case the 'avoidance' step of the mitigation hierarchy cannot be followed).

Civil society, including non-governmental organisations (NGOs), community groups and advocacy organisations, also plays a key role in shaping an energy sector that delivers Nature-Positive. Early engagement is needed with civil society stakeholders to identify and validate appropriate locations, impacts, mitigation measures, including the feasibility of offsets if all impacts cannot be avoided, minimised and restored. These groups can share expertise, concerns and recommendations to support effective policymaking and ensure environmental standards are integrated into renewable energy planning and decision making.

They can also provide capacity-building workshops, training and technical support to renewable energy actors on biodiversity conservation, environmental management and sustainability. Facilitating community engagement, they can bridge communication between energy developers and affected communities, and foster multistakeholder dialogues between governments, industry, and civil society to address local concerns.

Renewable energy projects should respect the Free, Prior, and Informed Consent (FPIC), and the rights of Indigenous Peoples and local communities (IPLCs) and honour local governance over lands, territories, water and resources. They must involve IPLCs in all development stages and support the restoration initiatives of IPLCs. Integrating their traditional knowledge, practices, and technologies in restoration efforts is essential to the energy sector that delivers Nature-Positive. All of this can avoid conflict, delays, and poor decisions. Most importantly, it puts people and ecosystems at the centre of planning.

[3] https://www.bbc.com/future/article/20231106-the-big-bubble-curtains-protecting-porpoises-from-wind-farm-noise
[4] https://www.mdpi.com/2077-1312/9/8/819

Key recommendations for industries, governments and civil society

For Industries

1. **Integrate the mitigation hierarchy and establish long-term monitoring:** Ensure the sequential and iterative implementation of the mitigation hierarchy, along with additional conservation efforts, across all project phases and value chain operations, and encourage associated industries to follow it. Establish robust, long-term adaptive monitoring systems throughout the lifecycle of the project to ensure long-term achievement of no net loss or biodiversity net gain goals. Further, coordination between generation, transmission and distribution actors is essential for effective application.

2. **Assess and address impacts throughout the value chain and ensure responsible sourcing:** Conduct comprehensive assessments of biodiversity, social, and environmental risks and impacts throughout the value chain – from material extraction and manufacturing to decommissioning. Integrate responsible sourcing and ethical standards by enforcing traceability, sustainability standards, and ethical labour practices.

3. **Ensure community engagement and respect FPIC:** Involve stakeholders early in the project planning phase and throughout the project lifecycle, respect and obtain FPIC, and integrate traditional knowledge and local priorities into project planning and decision-making.

For Governments

1. **Promote strategic site selection through spatial planning:** Incorporate spatial planning and use biodiversity sensitivity mapping tools to identify areas where developments would have the least impact, such as brownfields, industrial zones, or other areas with low ecological value.

2. **Mandate rigorous Strategic Environmental Impact Assessments (SEIAs) and baseline mapping:** Require the need to perform in-depth evaluations before approving renewable energy projects – not just for individual sites but also considering cumulative impacts across multiple projects within a landscape or

region and ensure developers apply the mitigation hierarchy to avoid, minimise and restore impacts, and offset only as a last resort.

3. **Strengthen regulatory frameworks and monitoring:** Develop and establish clear, robust regulations governing the siting, construction and operation of renewable energy projects, including inclusion of non-price criteria in tender processes, ensuring compliance with environmental and biodiversity standards. Require full lifecycle monitoring of environmental impacts, and integrate non-price criteria, such as biodiversity protection, community engagement, and social equality into procurement and permitting processes.

For Civil Society

1. **Advocate for robust biodiversity metrics:** Push for the integration of a clear, science-based set of metrics to measure and monitor biodiversity impacts – such as the State of Nature metrics, biodiversity net gain, or ecosystem health indicators. This will be the foundation for turning ambition into action, ensuring that efforts to restore and protect nature are real, measurable, and effective.

2. **Advocate transparency and inclusive decision-making:** Push for transparent, participatory planning and approval processes for renewable energy development and for community involvement in designing and implementing habitat restoration and biodiversity conservation measures linked to renewable energy projects.

3. **Promote best practices:** Push for the use of sensitivity mapping and strategic spatial planning to avoid ecologically sensitive areas for project development and partner with stakeholders to co-develop solutions that align renewable energy developments with biodiversity protection and ecosystem restoration goals.

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About GINGR
GINGR – the Global Initiative for Nature, Grids and Renewables aims to support the just and sustainable energy transition by providing assessment tools to quantify contributions to Nature- and People-Positive goals. To facilitate this, GINGR will develop monitoring and reporting systems that are globally aligned and standardised. GINGR is a joint effort by the Renewables Grid Initiative (RGI) and the International Union for Conservation of Nature (IUCN).

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