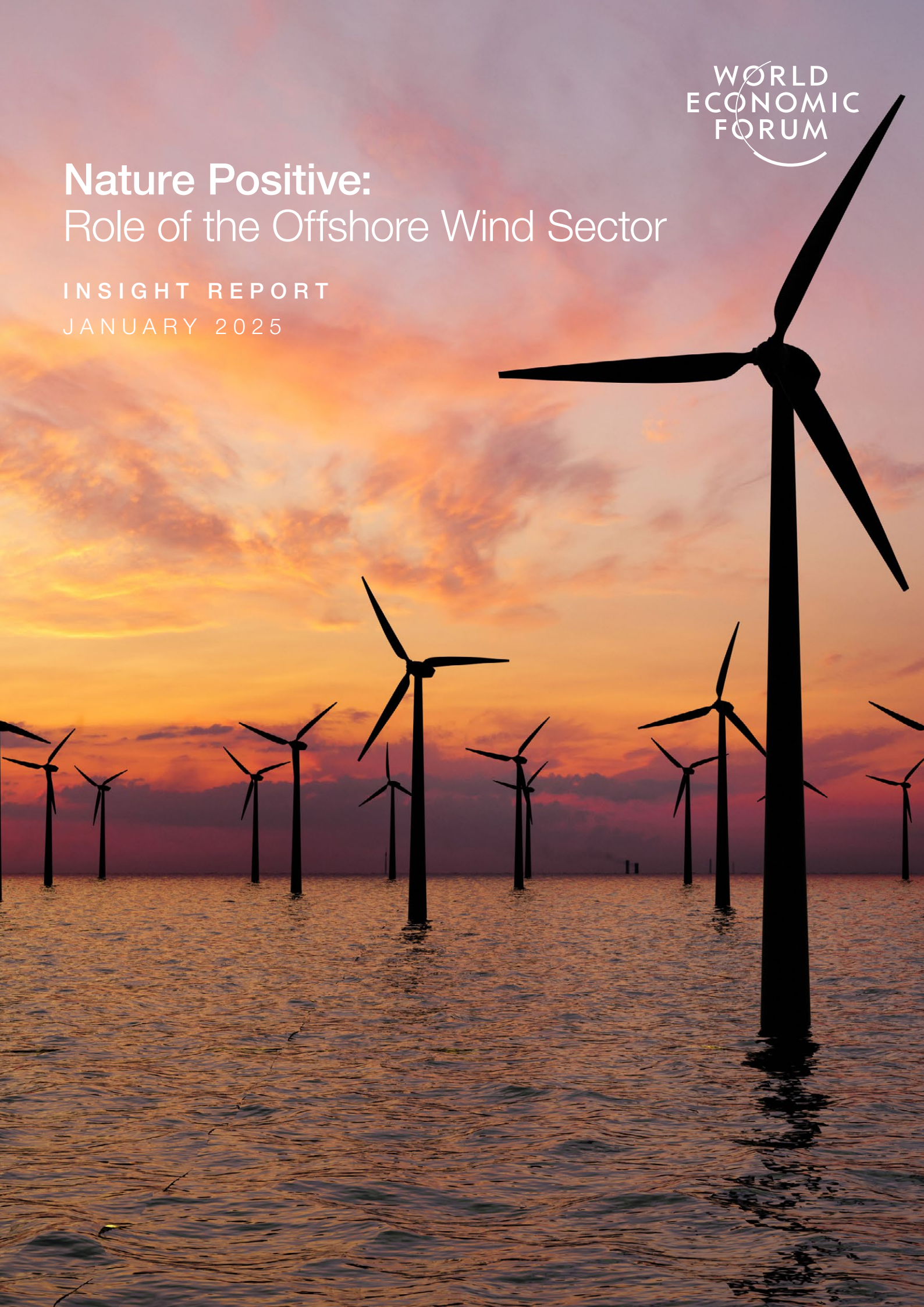

WORLD ECONOMIC FORUM

Nature Positive:
Role of the Offshore Wind Sector

INSIGHT REPORT

JANUARY 2025

Images: Getty Images, OceanImageBank

Contents

Foreword

Helene Biström
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Ocean renewable energy is key to meeting the Paris Agreement's goal of limiting global warming to 1.5ºC. As the most mature ocean-based energy technology, the large-scale expansion of offshore wind is critically needed to tackle climate change and yield benefits for communities and beyond. At the same time, this expansion will lead to a growing use of marine space and increasing interactions with marine ecosystems.

Since 196 parties agreed on the landmark Kunming-Montreal Global Biodiversity Framework in 2022, the case for integrated action across climate and nature has never been clearer. This leaves us with a very important question: how can we accelerate the rollout of offshore wind for the clean energy transition while ensuring it is positive for ocean health and contributes to nature recovery?

Understanding the environmental impact of our actions is essential to enabling offshore wind energy to coexist with nature. Our dedicated bioscience team at Vattenfall conducts ongoing environmental research and development, including crucial environmental impact assessments and mitigation, and enhancement strategies during offshore wind farm development and operation. Mitigation strategies, such as using bubble curtains around monopile installations, can reduce underwater noise that harms marine life. Additionally, increasing wind turbine blade visibility has proven effective in reducing bird collisions onshore and is now tested offshore.

We continue to test nature enhancement and nature-inclusive design methodologies (such as habitat creation within turbine foundations at our sites in the Netherlands) in collaboration with national non-governmental organizations and academic institutions. Early results show promising signs of ecological benefits.

But no single company can do this alone. Only through collective action, positive policy and financial shifts can we make meaningful progress in tackling the intertwined climate and biodiversity crises.

This requires a transformation of business operations that have nature and communities at heart. This report outlines the actions the offshore wind sector must take to transform business models towards a nature-positive approach. This includes a diligent application of the mitigation hierarchy across the project life cycle, responsible sourcing across the value chain, investment in nature-based solutions and innovation in product design that reduces material demand.

The transition will not be easy. It requires closer collaboration, not only within the offshore wind sector, but also with other ocean-dependent industries, governments, local communities and civil society. Our industry is in a strong position to become a major driving force in achieving global climate and biodiversity goals, inspiring others to follow.

Each of our organizations must therefore act on the recommendations put forward in the report. My colleagues at Vattenfall and I have already started this journey, and we invite our peers to do the same.

Foreword

Alfredo Giron
Head, Ocean Action Agenda,
World Economic Forum

Qin Haiyan
Secretary-General, Chinese
Wind Energy Association

Our planet stands at a critical crossroads. The climate and biodiversity crises are intensifying, with rising global temperatures, extreme weather events and widespread species loss threatening ecosystems and human well-being alike. The ocean, which covers more than 70% of Earth's surface and absorbs 90% of excess heat, is experiencing unprecedented warming and subsequent sea level rise. Over 500 marine "dead zones" have been identified globally, where reduced oxygen levels caused by warming and pollution make it impossible for most marine life to survive.

The climate and nature agendas are deeply interconnected. Climate change, driven by greenhouse gas (GHG) emissions, is accelerating the loss of biodiversity, disrupting habitats and altering the natural cycles of water and carbon. In turn, the degradation of nature reduces ecosystems' resilience and ability to sequester carbon, exacerbating climate change. Decarbonization cannot happen without consideration of nature.

The World Economic Forum's *Future of Nature and Business* report estimates that more than half of the world's gross domestic product (GDP) is moderately or highly dependent on nature and its services. This means that companies and investors cannot afford to delay actions that can reverse climate change and prevent nature loss any longer.

While the 2015 Paris Agreement and the 2022 Kunming-Montreal Global Biodiversity Framework (GBF) have provided governments and businesses with goals and targets, industries need sectoral guidance on strategic next steps. This is particularly true when it comes to preventing nature loss, which poses an inherently complex set of issues.

Over the past year, the World Economic Forum, together with our partners, has gathered data and insights through research, expert consultation and industry interviews. These efforts have enabled us to prepare the Sector Transitions to Nature Positive series of reports.

This report explores the contribution of offshore wind energy to a nature-positive economy, with examples and case studies demonstrating the progress made by the industry in collaboration with key stakeholders. It also lays out the road ahead.

While offshore wind developments have historically been concentrated in Europe, China has recently become the largest offshore wind producer. The new deployment, permitting and exploration of offshore wind has also accelerated in other parts of the world. As offshore wind infrastructure expands, we face challenges that demand innovative solutions and new approaches. From protecting vulnerable species and habitats to engaging with local communities and stakeholders, this report illustrates how we can harness this powerful technology to accelerate the green transition. It demonstrates the potential to protect biodiversity, restore ecosystems and deliver benefits to communities.

The insights in this report are more than a call to action – they offer a blueprint for aligning energy infrastructure with economic progress, social prosperity and environmental stewardship. Offshore wind offers a pathway to achieving this vision, but only if we make intentional, informed decisions that prioritize the health of our oceans and the diversity of life they support.

About the Nature Positive Transitions report series

Nature Positive: Role of the Offshore Wind Sector is part of the World Economic Forum's Nature Positive Transitions report series, which outlines the different pathways to halt and reverse nature loss by 2030 – the mission at the heart of the Kunming-Montreal Global Biodiversity Framework.

The series consists of three transitions: business sectors, cities and financial institutions. These reports highlight the relevance of nature-related risks, identify the impacts and dependencies of the economy and society on nature, and provide guidelines for business, city and financial institution leaders on key actions to accelerate the nature-positive transition.

The Nature Positive Transitions report series builds on the New Nature Economy Report Series. This report on offshore wind also builds on the World Economic Forum's 2024 briefing paper, *Clean Energy as a Catalyst for a Nature-Positive Transition* and the 2023 white paper, *Better Community Engagement for a Just Energy Transition: A C-Suite Guide*.

For more information, please visit:

- Sector Transitions to Nature Positive
- Nature-Positive Cities
- Responsible Renewables Infrastructure Initiative

Sector reports:

- Nature Positive: Role of the Cement and Concrete Sector
- Nature Positive: Role of the Household and Personal Care Products Sector
- Nature Positive: Role of the Chemicals Sector
- Nature Positive: Role of the Mining and Metals Sector
- Nature Positive: Role of the Automotive Sector
- Nature Positive: Role of the Port Sector
- Nature Positive: Role of the Automotive Sector China Deep-dive

Cities reports:

- Nature Positive: Guidelines for the Transition in Cities
- Nature Positive: Leaders' Insights for the Transition in Cities
- Nature Positive: Financing the Transition in Cities
- Nature Positive: Cities' Efforts to Advance the Transition – Durban

Finance reports:

- Financing the Nature-Positive Transition: Understanding the Role of Banks, Investors and Insurers

Executive summary

Clean energy must contribute to tackling climate change and nature loss, two interdependent priorities for both society and business.

Clean energy deployment can achieve 90% of the carbon dioxide (CO_2) emission reductions needed to meet the Paris Agreement's goal of limiting global warming to 1.5°C. Harnessing the ocean's abundant renewable energy, of which offshore wind is the most mature technology, can play a pivotal role. Offshore wind capacity has been increasing substantially – by 2030, it is projected to grow five-fold from the current 75 gigawatts (GW) to 380 GW and thirty-fold to 2,000 GW by 2050.[1,2] Investments in the sector have also increased, topping $77 billion in 2023.[3] These are forecast to rise to $350 billion in 2030 and $1.47 trillion in 2050, respectively.[4]

Meanwhile, the call for the nature-positive transition has never been louder. In 2022, 196 parties signed up to the Kunming-Montreal Global Biodiversity Framework (GBF), with the goal of halting and reversing nature loss by 2030 and achieving a full recovery by 2050. Furthermore, with the recent adoption of regulations such as the EU Nature Restoration Law or the UK Biodiversity Net Gain, the potential is clear for every economic sector to protect and regenerate nature.

In fact, many leading offshore wind businesses have already made nature and climate commitments and taken steps to address their potential impact on marine habitats, minimize their disturbances on species, and reduce greenhouse gas (GHG) emissions and pollution. Supported by public authorities, civil society and the scientific community, companies also strengthen cross-industry and multistakeholder collaboration to enhance knowledge and drive actions. While these efforts are promising, more must be done to roll out offshore wind in a way that provides jobs and benefits for local communities while protecting ecosystems.

This report summarizes the sector's key impacts and dependencies on nature and outlines sector-specific actions that corporate leaders can take to transform their businesses. The offshore wind sector has a key role to play in halting and reversing nature loss by 2030 – the mission at the heart of the GBF. Priorities include the following:

1. Avoid and reduce impacts of direct operations on nature; restore and compensate for unavoidable residual impacts in accordance with the mitigation hierarchy

2. Avoid and reduce impacts on nature from components and materials through responsible sourcing

3. Innovate product design to reduce material demand and support the nature-positive transition

4. Actively support nature restoration and invest in nature-based solutions beyond site level and value chain

5. Catalyse multistakeholder collaboration and contribute to wider policy and systems change

By 2030, these actions could unlock over $5.5 billion in annual business opportunities for companies across the sector's value chain, presenting a significant opportunity for offshore wind in the new nature-positive economy.

Introduction

Most top companies have climate targets, yet only 12% have one for biodiversity, despite the global economy's dependency on nature.

of the emissions reductions required by 2030 to keep global temperature increases under 2ºC will come from nature-based solutions.

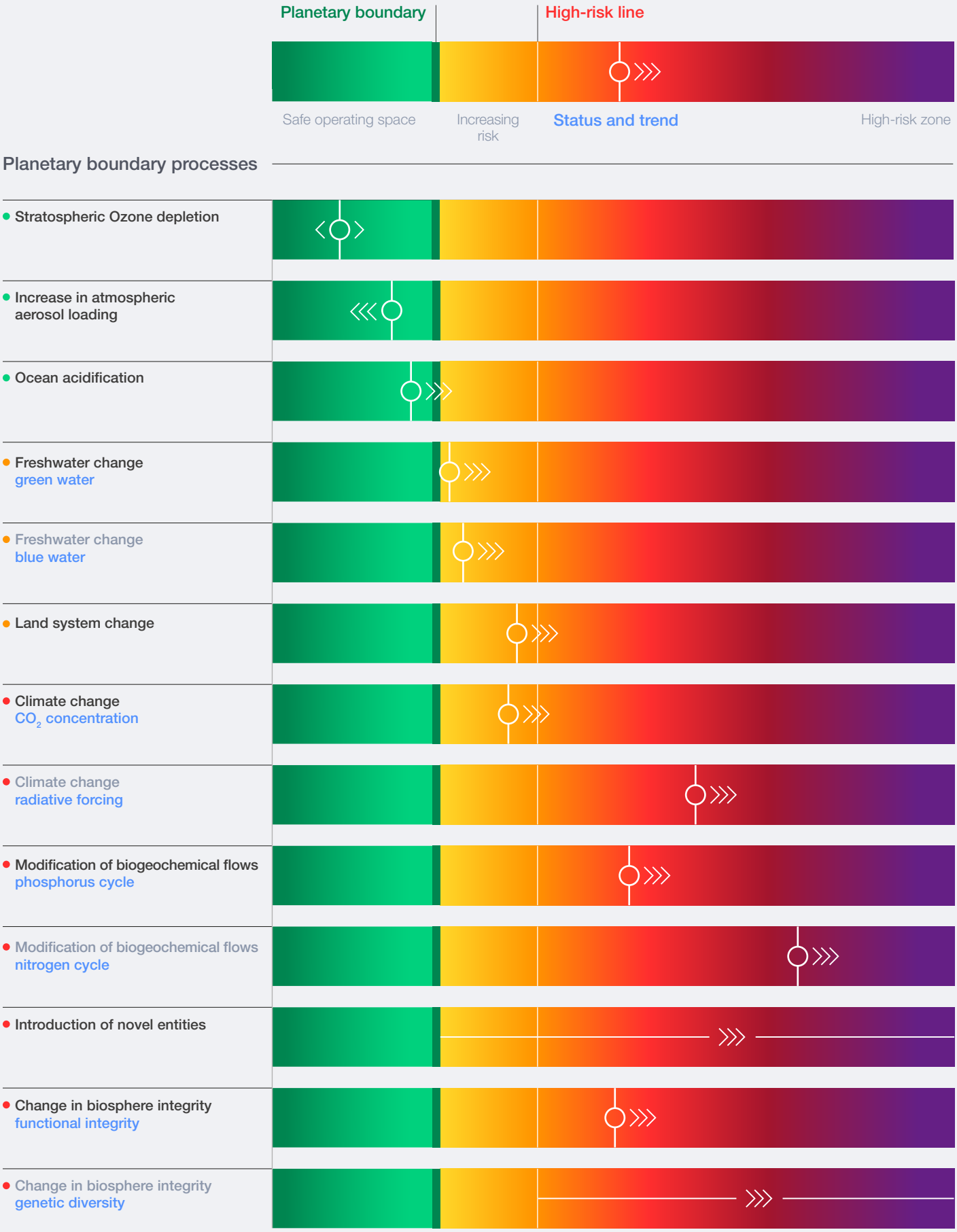
Nature is at a tipping point. Today, the resources humanity uses are equivalent to that of 1.75 Earths. This means that the ecological footprint, a measure that sums up the demands for biologically productive areas like food, timber, fibre, carbon sequestration and infrastructure, exceeds the Earth's capacity by 75%.[5]

Achieving net-zero emissions and halting biodiversity loss are highly interdependent priorities for both society and business. Climate change is one of the five key drivers of biodiversity loss,[6,7] and in turn, land-use change, principally agricultural commodity-driven deforestation, contributes 12-20% of global greenhouse gas emissions (GHGs).[8] At the same time, efforts to tackle climate change cannot succeed without safeguarding nature. It is estimated that 37% of the emissions reductions required by 2030 to keep global temperature increases under 2ºC will come from nature-based solutions.[9]

Recognizing the link between climate change and nature, standard setters are increasingly looking to align efforts, as seen in the linkages between the Science Based Targets initiative (SBTi) Forest, Land and Agriculture (FLAG) targets[10] and the land targets from the Science Based Targets Network (SBTN).[11] Efforts are also being made to integrate social and human rights perspectives to ensure that the nature transition is just, inclusive, and delivers tangible and sustainable benefits for people.

In September 2024, the Potsdam Institute for Climate Impact Research (PIK) published the first annual planetary health check, evaluating the status of the nine planetary boundaries – the Earth system processes essential for maintaining global stability, resilience and life-support functions – against safe operating limits. Overall, six out of nine planetary boundaries, such as land system change, freshwater change, and biosphere integrity, have already breached safe levels[12] (see Figure 1).

FIGURE 1 | **Planetary boundaries health check**



Source: Caesar, L., Sakschewski, B. et al. (2024). *Planetary Health Check: A Scientific Assessment of the State of the Planet*.

Why nature matters for businesses

The importance of nature for businesses and financial institutions is growing as the evidence for nature-related risks rises. In the World Economic Forum's *Global Risks Report 2025*,[13] five out of the top 10 risks over the next decade are environment related: extreme weather events, biodiversity loss and ecosystem collapse, critical change to Earth systems, natural resource shortages, and pollution.

In parallel, the calls for rapid change are getting stronger and more frequent, coming from policy-makers, regulators, investors, companies, consumers and citizens (see Figure 2).

Companies that anticipate the risks of nature loss can minimize disruption from incoming policy and regulatory requirements, proactively manage nature-related physical, transition and systemic risks,[14] including dependencies on ecosystem services and assets, and benefit from early nature-related opportunities.

FIGURE 2 **Key nature-related dynamics impacting businesses**

Global Biodiversity Framework

- In total, 196 parties agreed on the landmark Kunming-Montreal **Global Biodiversity Framework** in December 2022.
- Target 15 of the framework explicitly calls for **mandatory assessment and disclosure** and for businesses to reduce their negative impacts on nature.

Guidance and standards

- **Taskforce on Nature-related Financial Disclosures (TNFD)** issued sector-specific guidance for 8 sectors and financial institutions.
- **International Sustainability Standards Board (ISSB)** incorporated nature and biodiversity requirements.
- **EU's European Sustainability Reporting Standards (ESRS)** started in 2024.
- **Science Based Targets for Nature (SBTN)** released updated target-setting guidance.

Businesses

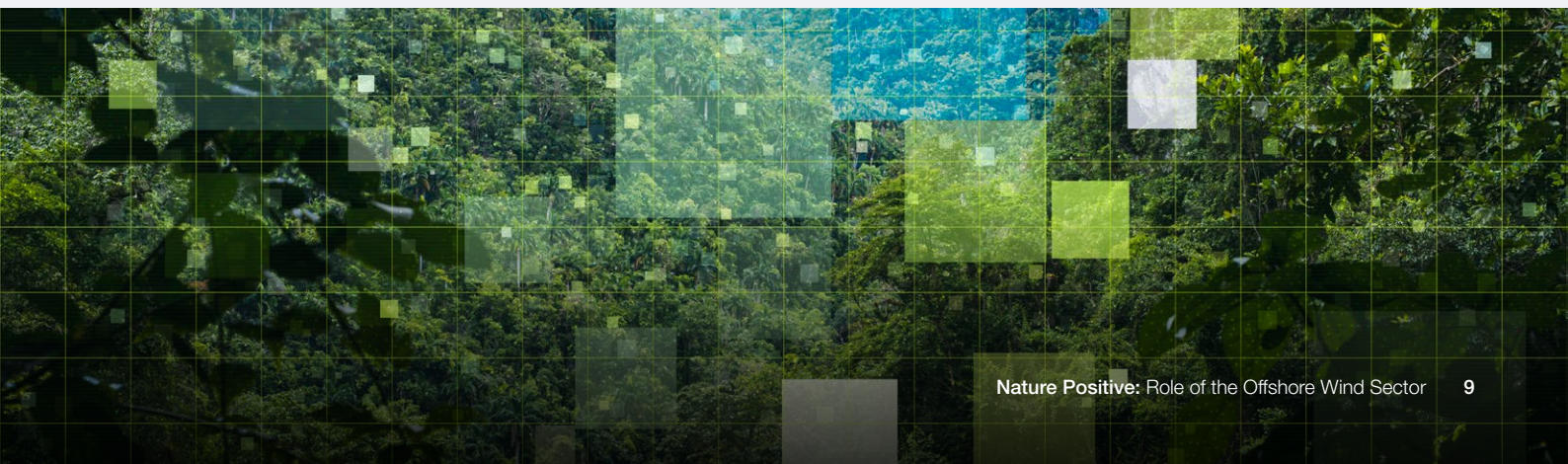
Customers and employees

- Recent studies show **85% of consumers** indicate that they have shifted their purchasing behaviour to be more sustainable in the past five years.
- The Union for Ethical BioTrade (UEBT) **Biodiversity Barometer** has shown consistent growth in biodiversity awareness among consumers over the past decade.

Financial institutions

- In total, 177 financial institutions with €22.1 trillion in assets under management signed the **Finance for Biodiversity Pledge.**
- **Nature Action 100** harnesses investor influence on businesses.

Source: Convention on Biological Diversity. (2022). *Kunming-Montreal Global Biodiversity Framework*; Business for Nature. (2023). *A wake-up call for business: Target 15 commits governments to require nature-related disclosure from large companies and financial institutions*; Taskforce on Nature-related Financial Disclosures (TNFD); Reuters. (2022, 14 December). *Global sustainability rules body steps up focus on biodiversity*; European Financial Reporting Advisory Group (EFRAG). *EU Sustainability Reporting Standards (ESRS)*; Science Based Targets Network (SBTN). *For companies*; Nature Action 100; Finance for Biodiversity Foundation; Union for Ethical BioTrade (UEBT). *Biodiversity Barometer.*



> In the past three years, 177 institutions with €22 trillion in assets under management signed the Finance for Biodiversity Pledge.

Global Biodiversity Framework

The agreement of the Kunming-Montreal Global Biodiversity Framework[15] in December 2022 set the ambition to halt and reverse biodiversity loss, calling for a collective effort from all sections of society on the four goals and 23 targets by 2030.

Guidance and standards

Many regulators will soon require mandatory nature-related disclosure from companies, with regulations like the European Sustainability Reporting Standards (ESRS)[16] under the EU's Corporate Sustainability Reporting Directive (EU CSRD) and the EU Taxonomy for Sustainable Activities[17] pushing businesses to disclose their **impact** on nature and their **exposure** to nature and biodiversity loss. Standards are also being adopted in countries like India[18] and China,[19] requiring companies to disclose material sustainability information.

Companies are encouraged to start collecting data and building internal capacity in alignment with voluntary disclosure frameworks like the Taskforce on Nature-related Financial Disclosures (TNFD),[20] which has seen at least 502 organizations, including 129 financial institutions, commit to getting started with voluntary reporting of their nature-related issues.[21]

Financial institutions

Financial institutions are also recognizing the risks associated with nature, for example, 36% of Dutch financial institutions' assets were found to be highly dependent on nature,[22] and starting to take action. In the past three years, 177 institutions with €22 trillion in assets under management signed the Finance for Biodiversity Pledge, and institutional investors are convening through the Nature Action 100 programme to engage with companies and policy-makers on nature.[23]

The nature-positive transition will unlock new business opportunities for financial institutions. Innovative nature financing mechanisms, including biodiversity credits, impact investments and blended finance mechanisms, have seen significant growth in the past years, including 10% growth between 2022 and 2023.[24] Governments are developing the market infrastructure to mobilize private finance for nature conservation and restoration. For example, in 2023, the UK government introduced the Biodiversity Net Gain (BNG) legislation,[25] mandating that all new development projects achieve a 10% net gain in biodiversity, and the Australian government is in the process of establishing a Nature Repair Market[26] to enable individuals and businesses to voluntarily invest in nature repair projects across Australian land, waters, or a combination of both.

Financial institutions can start taking action by building internal capacity to act on nature, developing financing policies, strategies and transition plans that favour nature (including sector-, location- or asset class-specific policies where appropriate), embedding nature in risk management systems, developing robust nature-related reporting systems, and engaging with high nature-impact and high nature-risk businesses.

Consumers and employees

Similarly, wider society and other stakeholders, such as employees and consumers, are raising their expectations for corporate action to protect nature and biodiversity.

In the Union for Ethical BioTrade's 2022 Biodiversity Barometer, biodiversity loss was the second most urgent environmental concern for consumers after climate change. In countries such as Brazil and China, the concern comes out on top, with 54% of consumers wanting information on a product's impact on biodiversity. A survey by Simon-Kucher & Partners in 2021 showed that 85% of consumers have made changes to make their purchasing behaviour more sustainable in the past five years.[27]

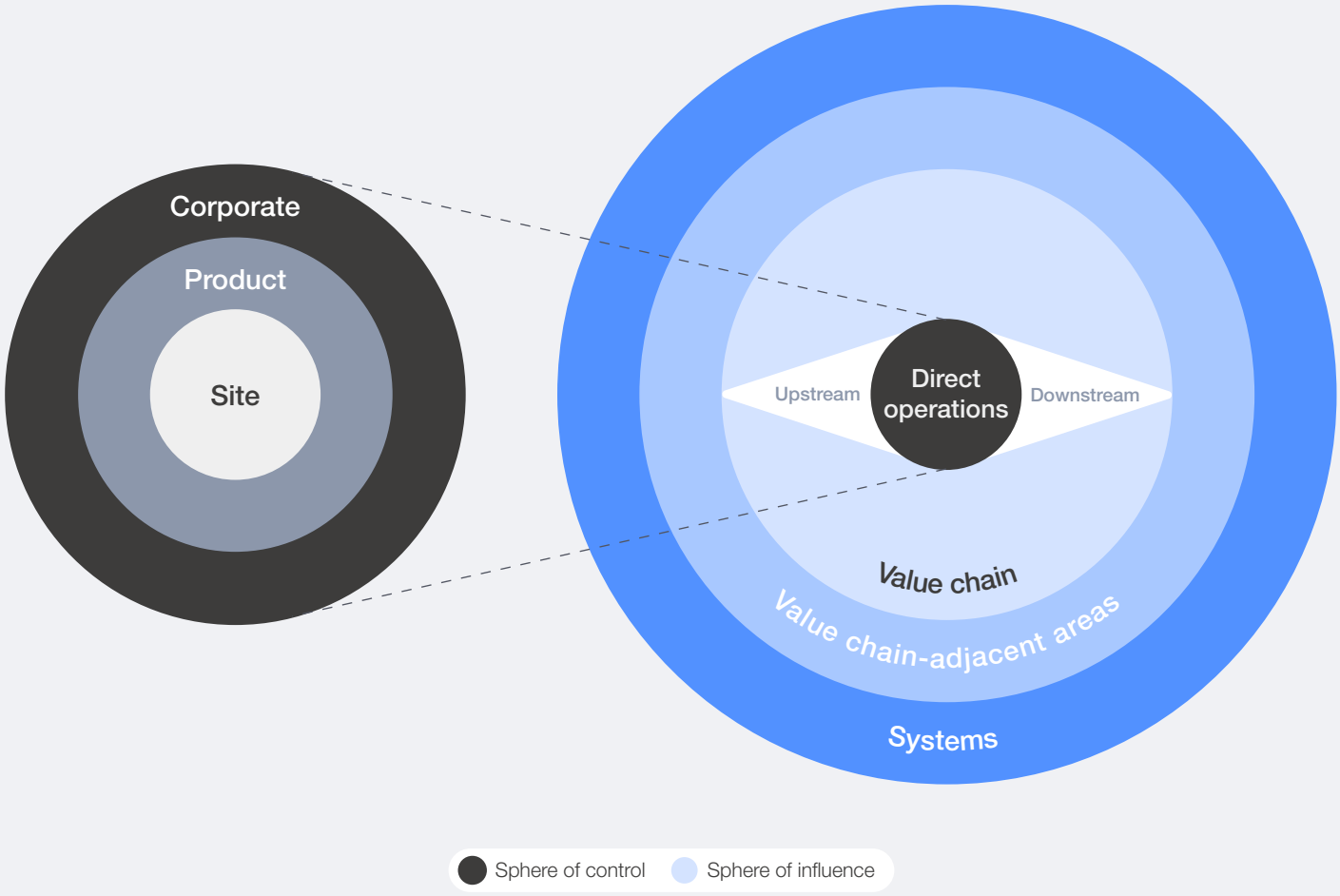
Additionally, employees are elevating their expectations regarding their employers' commitment to protecting nature and biodiversity. For example, a 2022 global survey by Deloitte[28] found that protecting the environment remains a top priority for Gen Zs and millennials, who want to see their employers prioritize visible actions that enable employees to get directly involved. A total of 64% of Gen Zs said they would pay more to purchase an environmentally sustainable product.

Setting credible nature strategies

Despite the increased momentum on nature over recent years, not enough is being done. While 78% of Fortune Global 500 companies have climate change targets, only 26% have freshwater consumption targets, and just 12% have targets for biodiversity loss.[29] Only 5% of companies have assessed their impacts on nature, with less than 1% understanding their dependencies.[30]

Companies can contribute to "Nature Positive" by establishing credible nature strategies, where "Nature Positive" represents a "global societal goal to halt and reverse nature loss by 2030 on a 2020 baseline, and achieve full recovery by 2050".[31] Individual companies, financial institutions and investors can contribute to this shared goal by adopting nature-positive strategies across their spheres of control and influence, including at sites of high-biodiversity importance, in their direct operations as well as across their value chains (see Figure 3).

FIGURE 3 | **Spheres of control and influence**



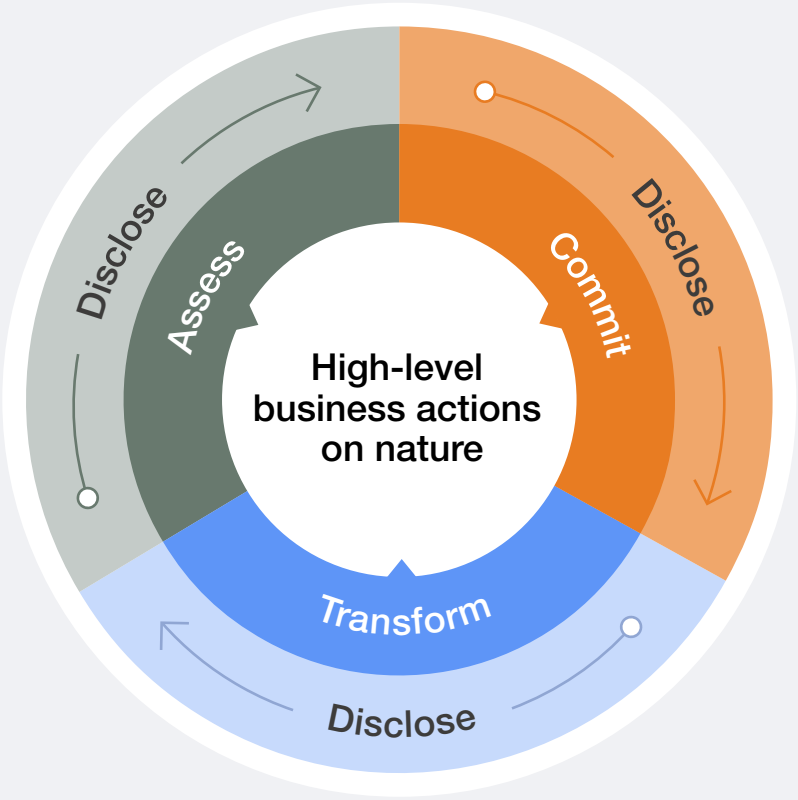
Source: Adapted from Science Based Targets Network (SBTN). (2020). *Science-Based Targets for Nature: Initial Guidance for Business, 2020.*

A credible corporate nature strategy should be built on four high-level steps: assess, commit, transform and disclose[35] (see Figure 4). Businesses can and should act now to:

- **Assess:** Conduct an initial materiality assessment to prioritize efforts; identify, measure, value and prioritize impacts and dependencies on nature; assess risks and opportunities; and consider climate and people within nature assessments.
- **Commit:** Define ambition and goals, and set transparent, time-bound, specific, science-based targets to put companies on the right track towards operating within the Earth's limits.
- **Transform:** Avoid and reduce negative impacts; restore and regenerate; shift business strategy and models; collaborate, both along value chains and at a landscape, seascape and river basin level; advocate for ambitious policies and initiatives; and embed nature within corporate governance.
- **Disclose:** Disclose material nature-related information across all three high-level actions above; seek out independent validation and verification to enhance the credibility of actions; and align reporting with major reporting standards such as TNFD, International Sustainability Standards Board (ISSB) or the EU's CSRD recommendations.

Momentum is building. In May 2023, 17 companies started a target validation pilot for the SBTN methods.[36] For more details, companies can refer to the *Nature Strategy Handbook*, a practical guide to support all businesses in developing a nature strategy.

FIGURE 4 | **ACT-D high-level business actions on nature**



Assess

Measure, value and prioritize your impacts and dependencies on nature to ensure you are acting on the most material ones.

Commit

Set science-based targets to put your company on the right track towards operating within the Earth's limits.

Transform

Avoid and reduce negative impacts, restore and regenerate, collaborate across land and seascapes, shift business strategy and models, embed nature in governance and advocate for policy ambition.

Note: Disclose material nature-related information across all three high-level actions above.

Source: Business for Nature. (n.d.). *High-level Business Actions on Nature.*

The need for a sectoral approach

As nature impacts and dependencies differ significantly across real economy sectors, sector-specific analyses and guidance can help companies understand their relationship with nature and the actions they can take to accelerate the transition to a nature-positive future.

To inform sectoral approaches, the World Economic Forum, alongside Business for Nature and the World Business Council for Sustainable Development (WBCSD), produced guidance on 12 global sectors as part of the initial phase of the Sector Actions Towards a Nature-Positive Future initiative. For each sector, the guidance outlines the priority actions companies should take to transform their operations and value chains to make a meaningful contribution towards the Global Biodiversity Framework and help halt and reverse nature loss by 2030.

In the second phase, the World Economic Forum has conducted analysis on four additional sectors: mining and metals, automotive, offshore wind and ports. This report identifies and makes the business case for sector-specific priority actions in the offshore wind sector.

1 Where the sector is today

As the sector expands rapidly, companies need to ensure that this growth generates benefits to both nature and local communities

1.1 Sector overview

By 2030, offshore wind capacity is projected to grow five-fold from the current 75 GW to 380 GW, and thirty-fold to 2000 GW by 2050.

At COP28, over 130 countries committed to tripling renewables capacity by 2030. Clean energy deployment has the potential to achieve 90% of the carbon dioxide (CO_2) reductions needed to meet the Paris Agreement's goal of limiting warming to 1.5°C.[34] Harnessing the ocean's abundant renewable energy, of which offshore wind is the most mature technology, can play a pivotal role in this achievement.

Offshore wind currently contributes to approximately 0.6% of the global power generation. It accounts for 7.5% of total wind energy, which accounts for 7.8% of total energy.[35,36] However, forecasts show that onshore and offshore wind could generate more than one-third of total electricity needs by 2050, according to the International Energy Agency's (IEA) net zero scenario.[37,38] Offshore wind, being one of the lowest CO_2-emitting energy sources,[39] could be a major driving force in achieving the Paris Agreement's goal, while also contributing to the Kunming-Montreal Global Biodiversity Framework.

To achieve these climate and nature goals, offshore wind capacity must increase dramatically, providing jobs and benefits for local communities while safeguarding ecosystems. By 2030, offshore wind is projected to grow five-fold from the current 75 gigawatts (GW) to 380 GW and thirty-fold to 2,000 GW by 2050.[40] Despite recent headwinds due to macroeconomic pressures and supply chain bottlenecks, offshore wind deployment is rising again in Europe and North America (though the US market is still nascent). Exploration and permitting have also accelerated in many emerging markets – notably Japan, South Korea, Australia, the Philippines, Viet Nam, Colombia and Brazil. Offshore wind developments have historically been concentrated in Europe's North and Baltic Seas, accounting for 45.3% of global capacity.[41] However, China has recently overtaken Europe as the largest offshore wind producer, representing 54.6% of global capacity.[42]

As well as potentially impacting marine and terrestrial habitats, the growth of offshore wind farms (and associated grid infrastructure) could drive resource extraction and pollution from upstream supply chain activities. This includes mining for rare earth minerals and metals that are essential for wind turbine components, as well as steel and concrete production. Offshore wind turbines, which must withstand harsh marine environments, are larger and heavier than their onshore counterparts, requiring more materials than many other clean energy technologies. The IEA points out that around 15.5 tonnes of critical minerals are needed for 1 megawatt (MW) of power generation by offshore wind, compared to 10 tonnes for onshore wind, 7 tonnes for solar and less than 3 tonnes for coal and gas.[43]

These facts emphasize the need to align energy production with the protection of biodiversity and marine ecosystems. With proper management, alongside government and corporate commitments to support biodiversity and ecosystem health, the risks from this expansion to the sea, land, habitats and species can be substantially minimized. Furthermore, active efforts from offshore wind developers and grid operators to restore and regenerate nature can deliver positive impacts.

BOX 1 Definition of the offshore wind sector

This report focuses on the offshore wind sector as a sub-sector of the Renewable Resources & Alternative Energy: Wind Technology & Project Developers industry outlined by the Sustainability Accounting Standards Board's (SASB) Sustainable Industry Classification System (SICS).[44] This comprises offshore wind development in all its phases: siting, designing and constructing offshore wind farms and related infrastructures; operations and maintenance; decommissioning/end of life; and the transmission and distribution of electricity generated by offshore wind.

In addition, this report will consider the offshore wind sector's upstream value chain, which encompasses industries such as mining and metals (for the supply of materials and rare earth metals for wind turbines), provision of machinery and transport equipment, provision of electrical equipment and components (cables and wires), marine transport, and ports and services. However, the analysis applies to these upstream activities only to the extent that they are directly linked to inputs and services for offshore wind, as well as to the engagement of offshore wind developers with upstream suppliers. For an in-depth analysis of nature-related impacts, dependencies and priority actions for the mining and metals and ports sectors, please refer to the Forum's *Nature Positive: Role of the Mining and Metals Sector* report and *Nature Positive: Role of the Port Sector* report.

The downstream market, which uses electricity produced by offshore wind, is currently outside the scope of this analysis.[45]

FIGURE 5 | **Simplified value chain of the offshore wind sector**

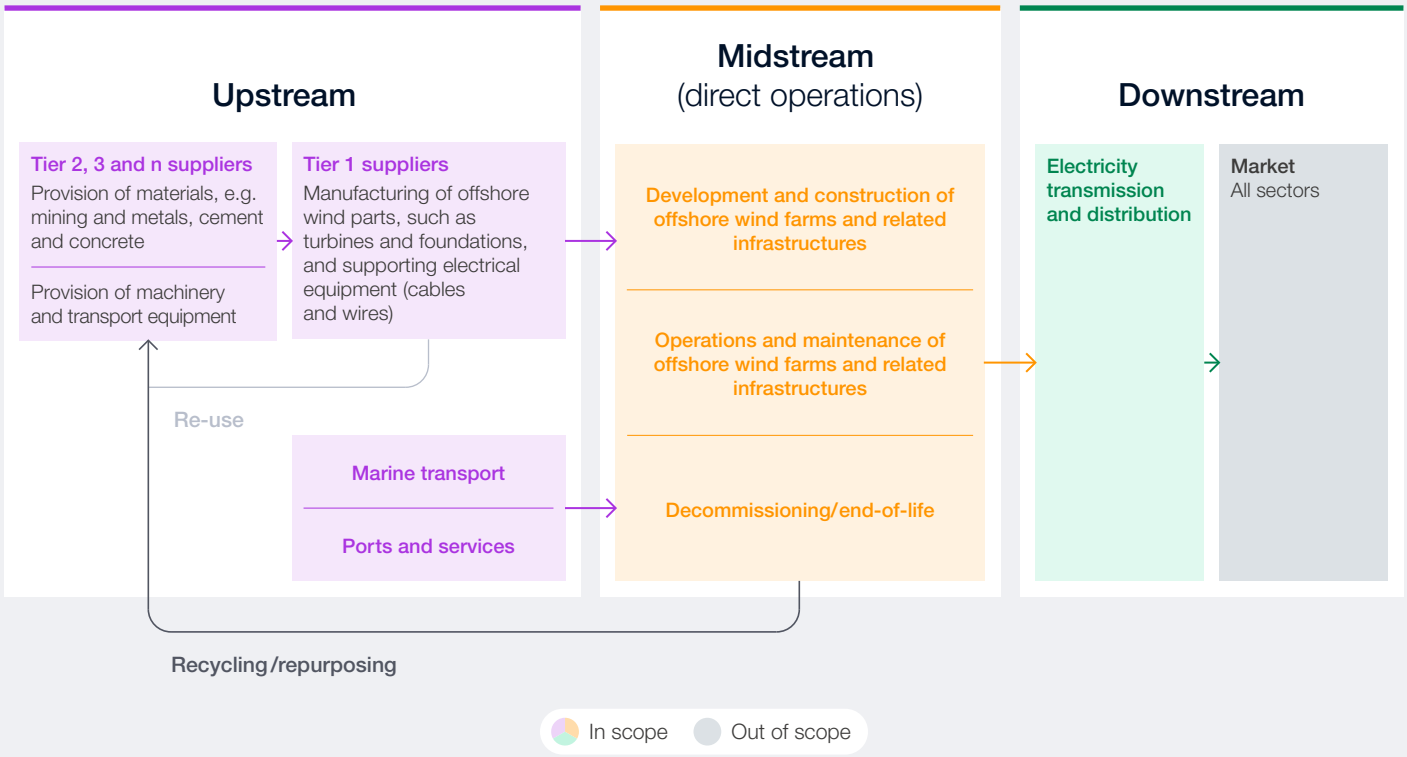
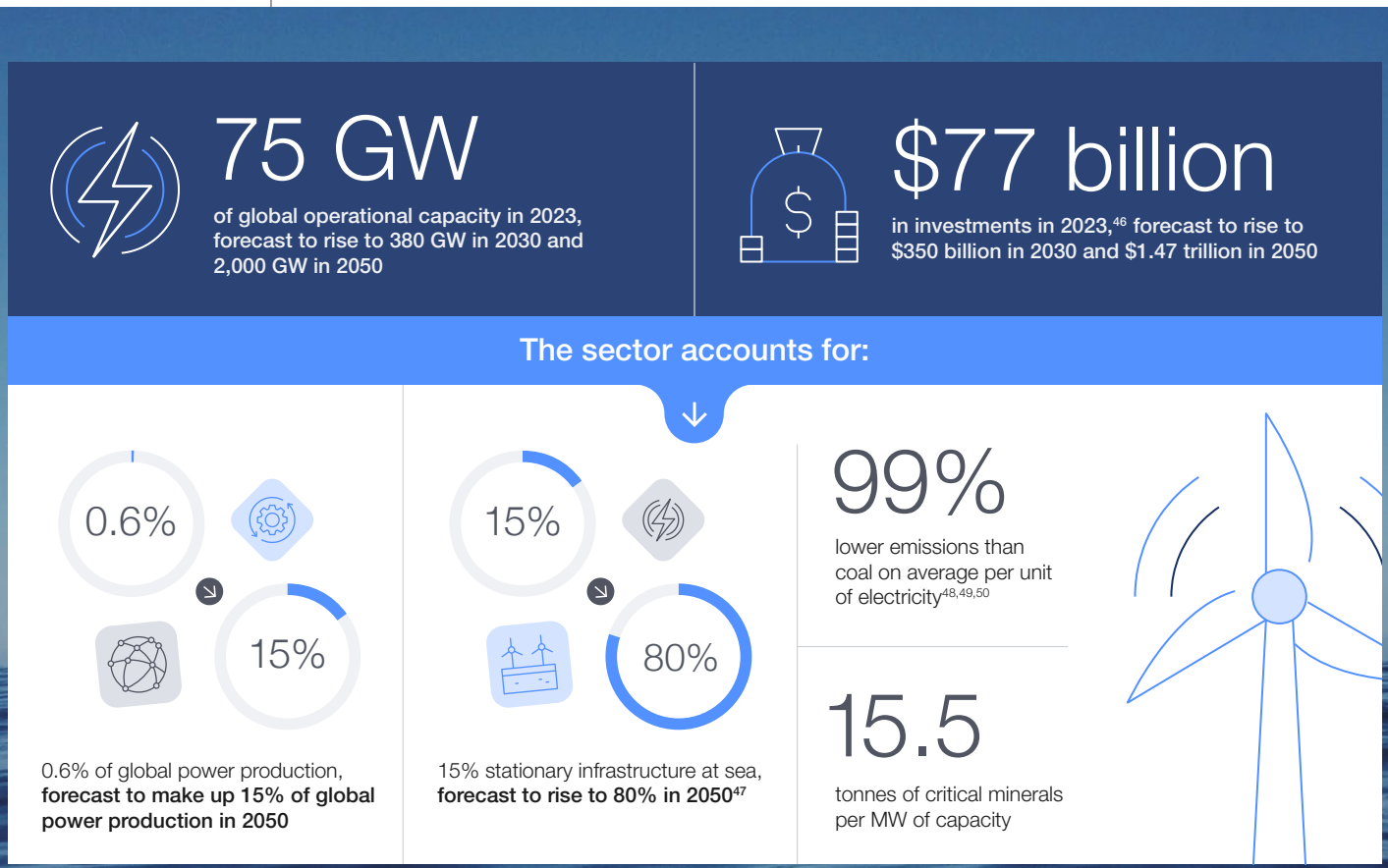


FIGURE 6 | **The offshore wind sector in numbers**



1.2 Progress is promising but needs to accelerate

Many corporate leaders in the sector have made nature commitments alongside climate targets.

Over the past two decades, economies of scale, technological developments and decarbonization financing support have propelled the young offshore wind industry to become one of the fastest-growing marine sectors. Wind turbines are increasingly becoming larger and more powerful and wind farms are being deployed farther out at sea.

As countries worldwide increase their commitments to scaling up offshore wind,[51] a growing emphasis is being placed on the conditions under which projects are implemented. In Europe, China and the US, developers must conduct environmental impact assessments (EIAs) for most projects during the screening and permitting process. Additionally, many countries are considering or implementing policy frameworks to encourage nature enhancement and restoration. Notably, there has been increasing consideration for non-price criteria in auctions, such as biodiversity protection, community engagement, cooperative ownership and system integration. This incentivizes developers to contribute to broader environmental and societal goals from the beginning. These criteria vary across jurisdictions and are primarily used in mature European markets, where the Netherlands, Norway, France, Denmark, Germany and Belgium have either trial-implemented non-price criteria in some auctions or considered them.[52,53]

As the policy landscape evolves, many corporate leaders in the sector have already made nature commitments alongside climate targets. As a TNFD early adopter, Iberdrola has set a target of "no net loss of biodiversity by 2030" and "having a net-positive impact on biodiversity in the financial year 2030".[54] Similarly, Ørsted has committed to a net-positive biodiversity impact for all new energy projects commissioned by 2030, which means the company will actively restore and enhance ecosystems in addition to avoiding and mitigating impacts.[55] To take this commitment further, Ørsted launched a framework to measure, track and report biodiversity impact across their project assets on World Ocean Day 2024. Meanwhile, Vattenfall has conducted a biodiversity footprint assessment with a full value chain perspective using the Global Biodiversity Score (GBS) tool as part of the pilot for SBTN.[56] Throughout the industry, companies also increasingly see the need for nature actions that are based on meaningful engagement and aimed at creating shared value with local communities.[57]

Many developers have focused on innovation in nature-inclusive design to create attractive marine habitats for species and the co-use of marine space. Last year, Mingyang Smart Energy launched the world's first wind and aquaculture integrated intelligent system, Mingyu No. 1, in China's Guangdong Province. Mingyu No. 1 is set to provide electricity for 23,000 households and nurture 150,000 fish from high-value species such as groupers and golden pomfret.[58]

While these efforts are substantial, more must be done in a more systematic way. Corporate leaders should start now to assess, commit, transform and disclose – as per the ACT-D framework – in a more systematic way. As noted in the introduction, companies need to: identify, measure, value and prioritize their nature-related impacts and dependencies across their value chains to ensure they act on the most material ones; set transparent, time-bound, specific, science-based targets when material; take actions to transform their businesses; and track performance to publicly disclose material nature-related information. For more information on tools and guidance available for the ACT-D set of high-level actions, see Table 1.

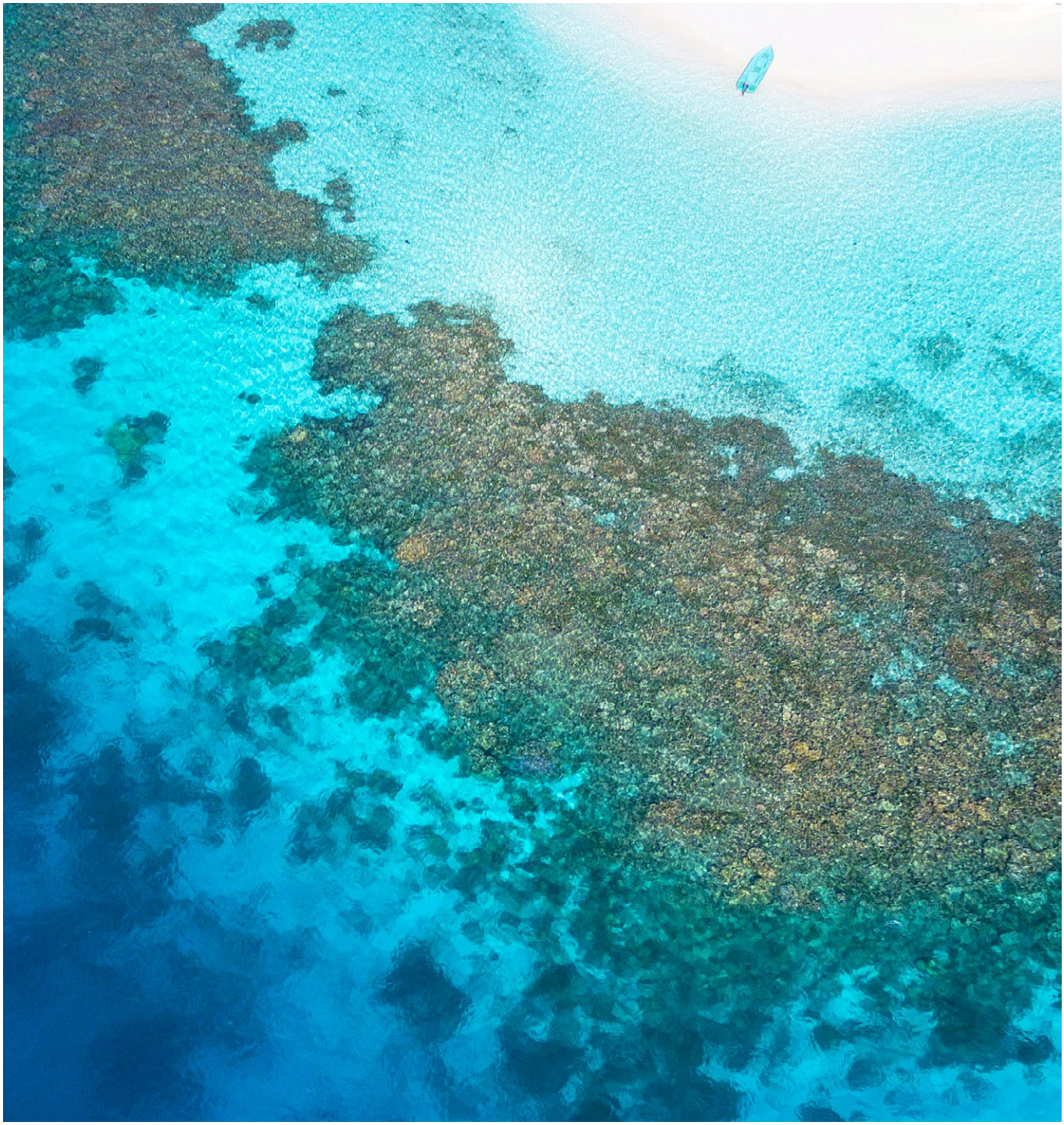
TABLE 1 | **Selected tools and guidance available for ACT-D high-level actions**

Assess	Consult the **Locate-Evaluate-Assess-Prepare (LEAP)** approach from TNFD. Follow the technical guidance to **assess**[59] and **prioritize**[60] from SBTN.
Commit	Set **No Net Loss** (NNL) or **Net Positive Impact** (NPI)/Net Gain targets at site level, using the International Finance Corporation's (IFC) Performance Standards for guidance.[61] Follow the approach the International Union for Conservation of Nature (IUCN) is developing to **measure nature-positive**[62] and **set targets.** Set science-based targets, taking inspiration from the technical guidance provided for **freshwater, land, ocean** and **biodiversity** by SBTN.[63] For **climate**, refer to the guidance from the Science Based Targets initiative (SBTi).
Transform	Take inspiration from the World Economic Forum's Nature Positive Transitions: Sectors report series;[64] invest resources and commit management to deliver against clear targets.[65] Consult sector-specific key actions as listed in: – The World Economic Forum's *Clean Energy as a Catalyst for a Nature-Positive Transition*[66] – United Nations Global Compact's *Net-Positive Biodiversity in Offshore Renewable Energy: Minimum Criteria and Recommendations for Action*[67] – Offshore Coalition for Energy and Nature (OCEaN)'s *Avoidance & minimisation of environmental impacts from offshore wind and grid infrastructure* 2024 report.
Disclose	Consult the final **recommendations**[68] from TNFD for nature-related disclosures. For climate, refer to the ISSB guidance on disclosure of **sustainability-related financial information and climate-related disclosures.**[69] Use CDP's **disclosure platform,** which includes guidance on climate change, forests, water security, biodiversity and plastics.[70]

Note: 1. This table is non-exhaustive. For more tools and guidance, *see High-level Business Actions on Nature*[71] and *The Nature Strategy Handbook*[72]; **2.** The concept of delivering biodiversity-positive actions at the project level is commonly referred to as Net Positive Impact (NPI) or net gain. NPI refers to the sequential, successful and iterative implementation of measurable actions to achieve net gain for prioritized biodiversity features. This occurs once NNL for those features is achieved at the project level. Nature-positive is a global goal measured in relation to a 2020 baseline by 2030. It is a combined global outcome that halts and reverses loss to nature, increases resilience and improves well-being with full recovery by 2050.

2 Nature-related impacts and dependencies

As companies transform their business models to support global nature-positive, net-zero commitments, understanding their nature-related dependencies and impacts is essential.



2.1 Double materiality

The principle of "double materiality", a concept at the heart of the EU's CSRD, defines a company's impact on the environment and its dependencies on it as highly interdependent (see Figure 7). In other words, the economic activities of businesses have impacts on both the environment and society (known as impact materiality), while concurrently, businesses also encounter risks (and opportunities) arising from their dependencies on the environment and society (known as financial materiality).

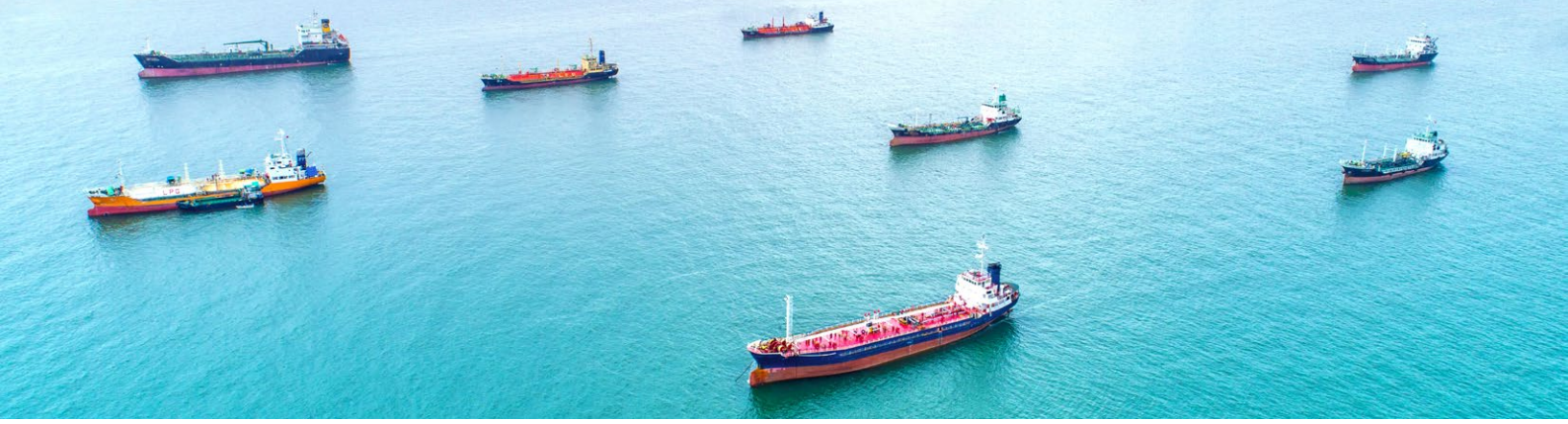
FIGURE 7 **Double materiality**

Source: World Economic Forum. Definition of double materiality sourced from: Deloitte. (2023). *Double Materiality: 5 challenging key aspects to consider*.

According to the World Economic Forum's 2020 report *Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy*, half of the world's gross domestic product (GDP) is moderately or highly dependent on nature.[73] All economic sectors are dependent on nature, though the degree of dependency may vary (e.g. construction, agriculture, and food and beverages are the largest highly nature-dependent industries). Many industries have significant "hidden" nature-related dependencies in their supply chain.

Like many other industries, offshore wind depends on a number of ecosystem services and environmental assets to function,[74] including global climate regulation, flood and storm protection, and, to a certain extent, mass stabilization and erosion control. Offshore wind farms are susceptible to extreme weather events such as typhoons, which can force the shutdown of wind turbines, delay vessels and port services, and cause damage to power transmission systems.[75] According to Allianz, cable damage or failure accounts for 53% of offshore wind losses by value in its main insurance markets.[76]

Offshore wind also depends on many environmental assets, and most of these dependencies are hidden in its supply chain. For instance, although wind power generation does not rely on water consumption, upstream supply chain players



(especially those involved in mining and metals and the manufacturing of components used in offshore wind) are highly dependent on freshwater resources, and moderately dependent on water flow maintenance and filtration services.

A functioning wind turbine and its foundation comprise 8,000 parts in total. The foundation and tower are predominantly made of steel, though concrete is sometimes used. The blades are composed of fibreglass, resin or plastics. Copper, aluminium and rare earth metals are also essential components.[77,78] The expansion of offshore wind will necessitate large quantities of these raw materials,[79] which typically require significant amounts of freshwater for their mining process.[80]

These dependencies strengthen the case for investing in nature protection and restoration to build sustainable, responsible and resilient supply chains and ensure the long-term viability of the business model. Offshore wind companies should avoid or mitigate the following nature-related impacts that are material in their direct operations and value chains.

TABLE 2 **Top drivers of nature loss in the offshore wind sector and its value chain**

	Upstream	Midstream (direct operations)	Downstream
Ocean and land use change	✓	✓	✓
Disturbances	✓	✓	✓
Pollution	✓		
Resource exploitation	✓		
Greenhouse gas emissions	✓		

Pressure materiality rating (ENCORE): High Medium

Note: This analysis is based on the pressure materiality rating from ENCORE and the SBTN sectoral materiality tool (SMT), following the IPBES's top drivers of nature loss and substantiated by literature review and consultation with business, civil society and academia. Analysis focuses on medium to high materiality.

BOX 2 **Conduct company-specific assessment of impacts and dependencies**

The analysis of impacts and dependencies presented in Chapter 2 is a sector-average analysis for companies in the offshore wind sector, but company-specific impacts and dependencies will vary according to their activities, supply chains and operational locations.

Companies will need to conduct assessments to locate their interface with nature and evaluate their impacts and dependencies using company-specific operational and supply chain information. TNFD's LEAP approach,[81] as well as the SBTN's step 1 (assess)[82] and step 2 (prioritize)[83] are useful frameworks to guide companies through their own assessments.

The full methodology and results of thi s sector-average assessment can be found in the Appendix.

2.2 Ocean and land use change

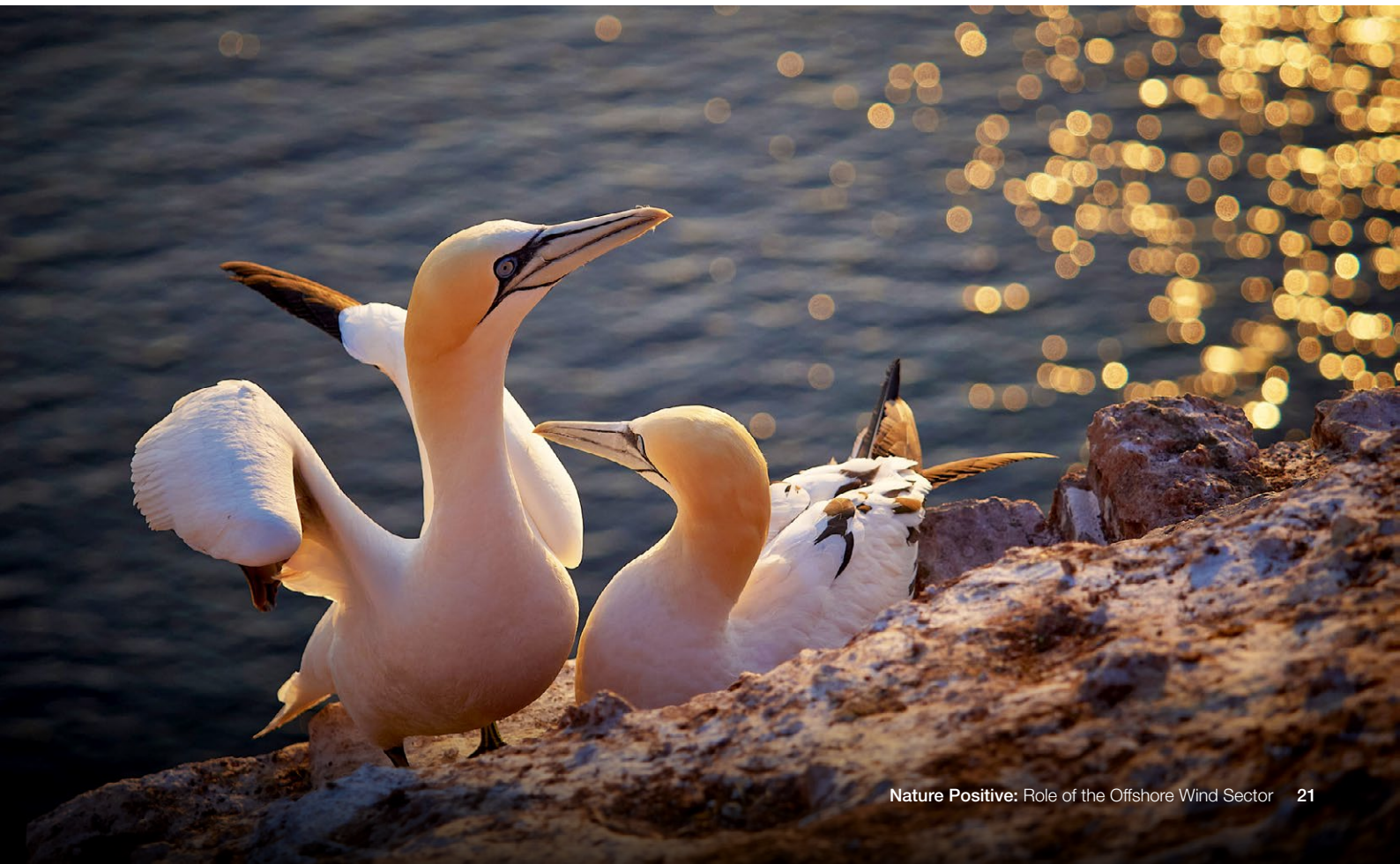
“ The hard substrate from offshore wind foundations can generate new habitats for marine organisms.

The most significant potential impact of offshore wind is the change in ocean and land use. The construction of bottom-fixed wind turbines can result in temporary or permanent changes in seabed structure and habitat loss for marine species. Construction and operations during sensitive seasons can also alter the habitats on which species depend for breeding, feeding and resting, therefore altering their behaviours.[84] Additionally, understanding how seabird species react to offshore wind farms varies across offshore wind markets and technologies. Studies show that responses range from complete avoidance to attraction. Attraction to wind turbine blades and grid transmission may increase the risk of collision, while avoidance may lead to displacement.[85,86] In addition to birds, offshore infrastructure can hinder the movement and routes of migratory marine species.[87]

While there is still much to understand about these impacts, it is clear that they must be considered across the offshore wind project life cycle. Careful spatial planning led by governments and mitigation measures taken by developers (such as blade visibility, bird deterrence, and slow-down or shutdown during migration/spawning seasons of bird and marine species) can minimize negative impacts.[88]

On the other hand, the hard substrate from offshore wind foundations can generate new habitats for marine organisms. Studies have shown an increase in the abundance of invertebrates, such as mussels, oysters and crabs around wind turbines, which in turn attract predator fish and marine mammals.[89,90,91] Furthermore, when bottom trawling is not permitted in offshore wind areas, the refuge effect for marine life is enhanced. If managed responsibly, these zones can serve as important spawning and nursery grounds.[92,93] According to DNV’s Spatial Competition Forecast, the amount of ocean space occupied by installations will grow five-fold by 2050, primarily driven by offshore wind.[94] The area occupied by fixed offshore wind will grow from about 9,000 square kilometres (km^2) in 2023 to about 242,000 km^2 by 2050. Meanwhile, floating offshore wind will grow from a low 15 km^2 in 2023 to more than 33,000 km^2 by 2050. Therefore, it is vital to ensure that these areas contribute to the overall health of marine populations.

With much attention having been placed on the impact of direct operations, it is also worth considering the impact that offshore wind can have on land and sea use through its supply chain. This is mostly land clearance and soil erosion from mining for minerals,[95] as well as sediment suspension and habitat disruption due to dredging,[96] which are needed for offshore wind components and structures. The impact of upgrading or extending ports’ infrastructure or building new port terminals to serve offshore wind development should also be considered. These activities should be managed responsibly to create economic opportunities without placing further pressure on natural ecosystems.



2.3 Disturbances

The cumulative effect of wind turbines in one area must be monitored and studied to mitigate possible impact on seabirds, fish, and marine mammals.

Disturbances caused by offshore wind can come from various sources, the most prevalent of which are noise and light.

Noise from pile driving during the construction phase is the most significant source. Overall noise levels are lower during the operation phase; noise from an operational offshore wind turbine is lower than ship noise in the same frequency range but remains constant over the turbine's 20 to 25-year lifespan. Despite this, the cumulative effect of many wind turbines in one area must be monitored and studied to mitigate their possible impact on fish and marine mammals.[97,98] This includes potential changes to their behaviour, such as swimming patterns or acoustic abilities. Marine mammals like whales and dolphins, which rely on sound for navigation and communication, can be particularly susceptible to this.[99,100]

Light disturbance must also be considered. Attraction to lighting, combined with poor weather conditions, can lead birds to fly at lower altitudes, increasing the risk of collision.[101] Light disturbance from onshore cable installation may also disrupt the nesting behaviour of marine turtles and disorientate hatchlings.[102] Furthermore, electromagnetic fields created by subsea cables can affect sensitive species, though there is still a significant gap in knowledge in this area.[103,104]

2.4 Pollution

Other areas of concern are chemical, plastic and debris pollution. Offshore structures are often coated with antifouling paints, which can leach toxic substances into the water and potentially harm marine organisms. There are also risks associated with service vessel operations, such as the accidental leak of hazardous fluids and the potential for collisions with marine mammals.[105] Construction and maintenance activities can generate plastic waste and other debris, which can enter the marine environment if improperly managed.

Further up the supply chain, the demand for offshore wind may drive potential land, freshwater and ocean pollution. This occurs when chemicals, heavy metals and highly saline or acidified wastewater from mining activities leach into nature. This can also happen with air pollution from steel production.

While approximately 90% of wind turbines are recyclable, their blades are made from polymer composite, primarily reinforced with glass fibre, which makes them extremely hard to break down. As the first wave of early commercial offshore wind installations approach their end of life, there is a risk that most of the blades will end up in landfills or be incinerated. Research by the University of Cambridge shows that turbine blades are set to account for 43 million tonnes of waste in 2050.[106]

It is worth noting, however, that there have been significant advancements in recycling options as the industry increases commitments to circularity. Offshore wind developers like Iberdrola, Ørsted and RWE, alongside wind turbine manufacturers such as Siemens Gamesa and Vestas, have tested new solutions on the ground and committed to reusing, recycling and recovering 100% of decommissioned blades.[107,108,109] Furthermore, with composite materials being used by multiple sectors, the wind industry is also exploring cross-sector collaboration with other composite-using sectors, such as maritime transport, aviation and automotive.[110]

2.5 Resource exploitation

> Offshore wind is one of the lowest water-consuming and carbon-emitting energy sources, yet the sector needs to address water use and GHG emissions in their supply chain.

Offshore wind makes little use of water and other resources in their direct operations. In fact, offshore wind power stands out as one of the lowest water-consuming energy sources, in contrast to water-intensive thermal power, natural gas or nuclear plants, where significant quantities of water are needed for cooling processes.[111,112] This is a significant advantage, especially as the energy sector accounts for at least 10% of global freshwater use,[113] at a time when water scarcity is a rising concern due to climate change and population growth.

However, sourcing minerals for offshore wind components requires the extraction of a large amount of water. Furthermore, a wide range of materials is required to produce machinery and equipment for construction, maintenance and decommissioning activities. The World Resources Institute found that 16% of critical mineral mines are in highly water-stressed areas, and in these locations, at least 40% of water supply is required each year to meet existing demand.[114] Consequently, upstream actions and tightened collaboration with suppliers to mitigate resource use are crucial as offshore wind companies evaluate their nature-related impacts.

2.6 Greenhouse gas emissions

Wind power is one of the cleanest energy sources, with a carbon footprint 99% smaller than coal-fired power plants, 92-98% smaller than natural gas and over 75% smaller than solar.[115] However, the input industry has a high carbon footprint, including GHG emissions from direct production processes (e.g. steel and concrete production), energy use from upstream industrial processes (e.g. mining extraction and production and equipment operation), emissions during installation (transport and assembly), and supporting services such as service vessels and ports operations.

Together with the Carbon Trust, a group of leading offshore wind developers has launched new industry guidance on how to measure the full carbon footprint of offshore wind farms.[116] The new methodology intends to improve comparability and transparency across the industry and help developers identify opportunities to reduce emissions further.

Overall, the offshore wind sector is making significant strides in addressing its impacts on nature, especially the ocean, where innovation is accelerating rapidly. While the industry must continue to consider its nature-related impacts, it is important to recognize that offshore wind provides a cleaner alternative to fossil fuels. Fossil fuels could pose more significant environmental risks, including a large carbon footprint, higher mining requirements, seabed disturbance, continuous noise from seismic activities and drilling, and incidents such as oil spills. Increasing offshore wind capacity is critical for the energy transition and must be carried out with sensitivity to nature impacts and dependencies.

3 Five priority actions

Taking five priority actions on nature can unlock over $5.5 billion in additional value for offshore wind by 2030.

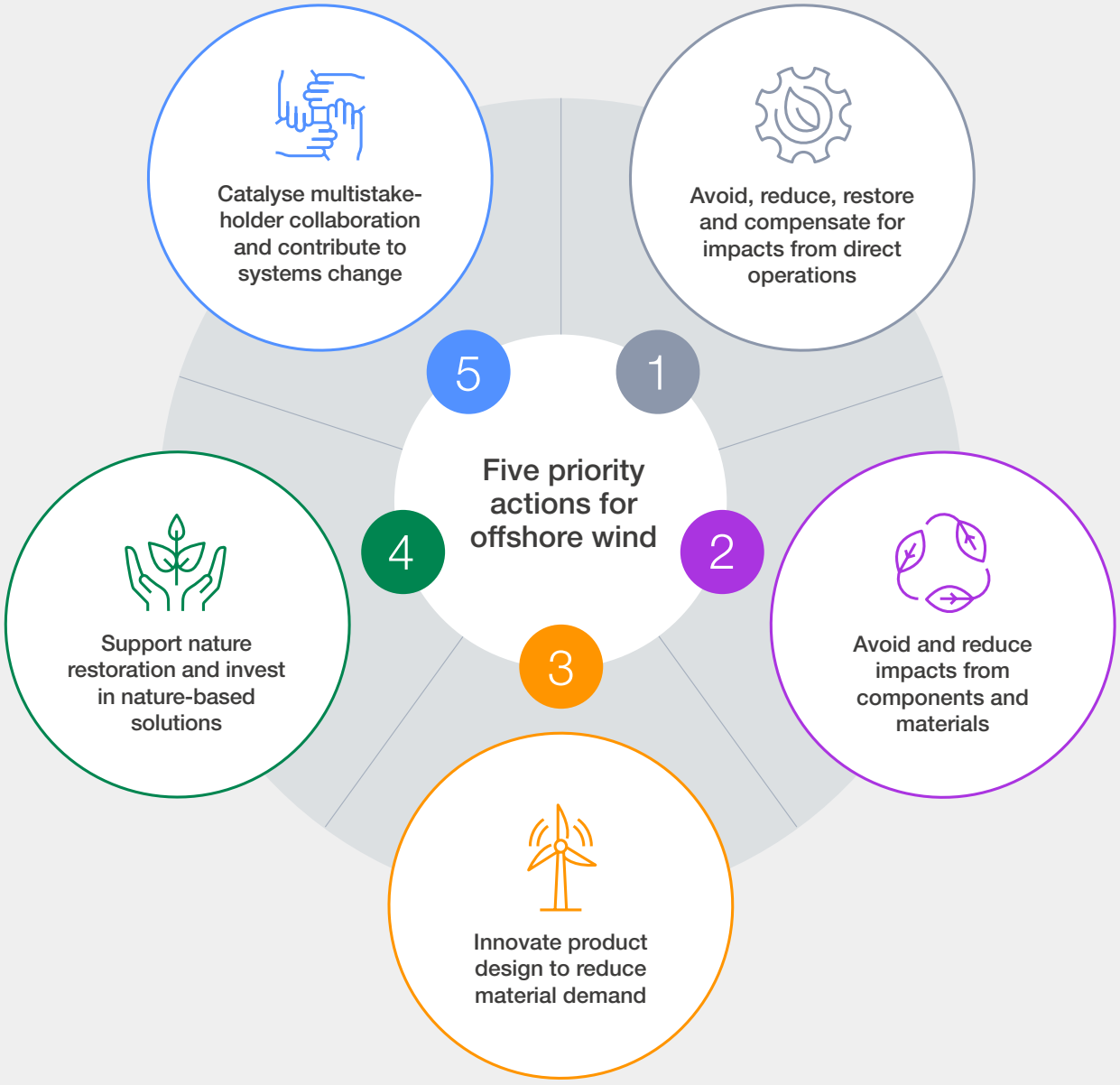
Undertaking the priority actions for the offshore wind sector could unlock over $5.5 billion in cost savings and revenue upside by 2030.

This report sets out five priority actions for businesses in the offshore wind sector to take (see Figure 8). Companies can contribute to a nature-positive future by prioritizing actions that:

1. Avoid and reduce impacts of direct operations on nature; restore and compensate for unavoidable residual impacts in accordance with the mitigation hierarchy
2. Avoid and reduce impacts on nature from components and materials through responsible sourcing
3. Innovate product design to reduce material demand and support the nature-positive transition
4. Actively support nature restoration and invest in nature-based solutions beyond site level and value chain
5. Catalyse multistakeholder collaboration and contribute to wider policy and systems change

These priority actions require companies to actively engage with suppliers, customers, peers and other industries to transform their value chains. **While many of these actions are already being employed or gradually rolled out by businesses, this report calls for accelerated efforts in the offshore wind sector.**

FIGURE 8 **Five priority actions for the offshore wind sector**



The nature-positive transition can also present enormous opportunities for companies in this sector. The Forum's 2020 report, *New Nature Economy Report II: The Future of Nature and Business*, estimated that a full nature-positive transition in the global economy could create $10.1 trillion of annual business opportunities by 2030. Of this figure, estimates show that undertaking the priority actions for the offshore wind sector could unlock over $5.5 billion in cost savings and revenue upside by 2030 for businesses across the sector's value chain.

The actual value of this transition could be higher than estimated, as the calculation did not account for all potential business opportunities in the sector.

FIGURE 9 **Business opportunities for the offshore wind sector by 2030 ($ billion)**

To calculate the opportunity summarized in the waterfall in Figure 9, the following opportunities from the *Future of Nature and Business* report were identified as relevant (see Table 3). Further information on the calculation methodology can be found in the Appendix.

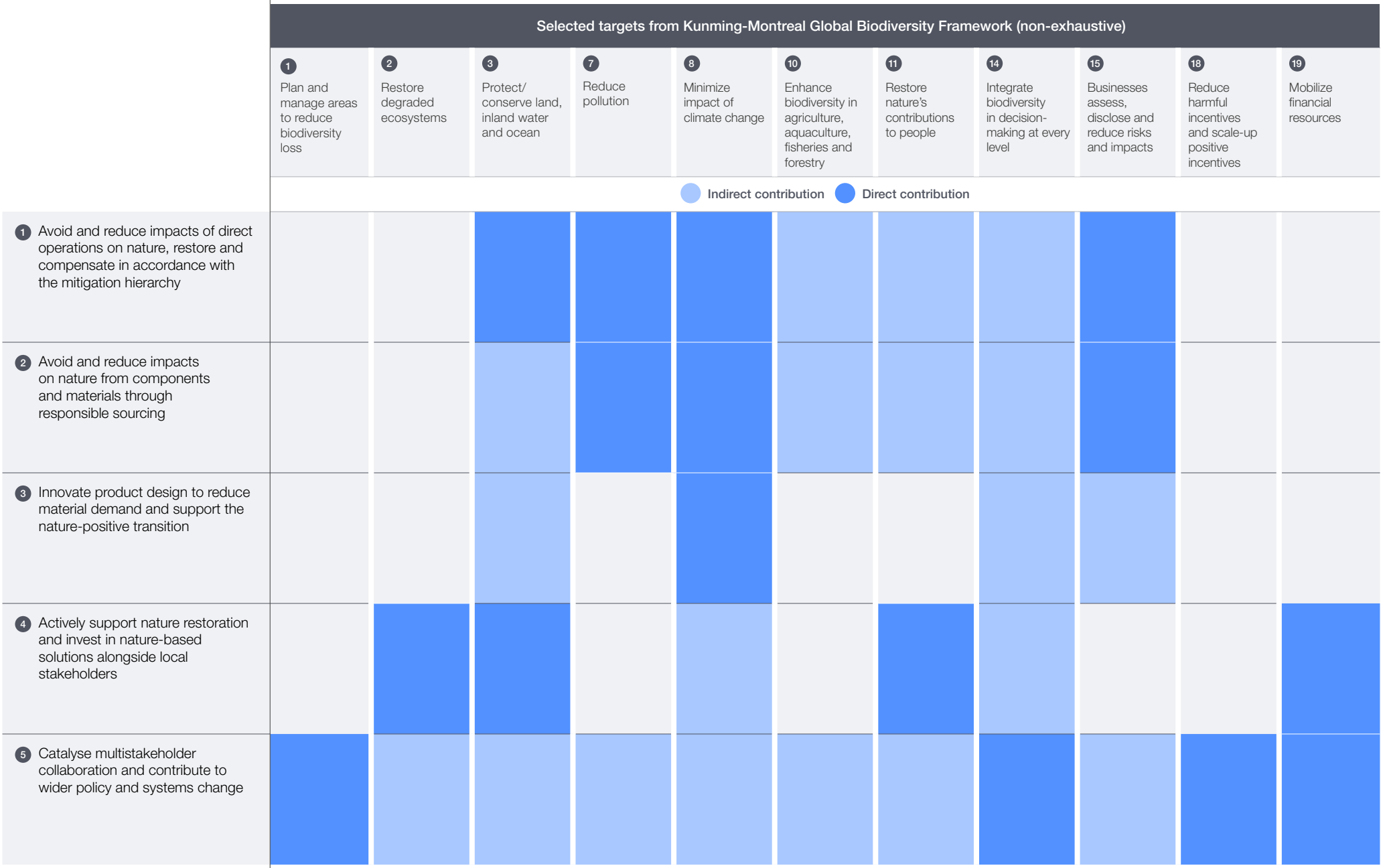
TABLE 3 **Deep-dive on business opportunities for the offshore wind sector**

Priority action	Business opportunity from *Future of Nature and Business* report	Original size in *Future of Nature and Business* report ($ billion)	Adjustment factor to size share of offshore wind sector sector	Opportunity size for offshore wind sector ($ billion)
1 Avoid and reduce impacts of direct operations on nature, restore and compensate for unavoidable residual impacts in accordance with the mitigation hierarchy	Energy efficiency – buildings	825	Calculated GDP impact on the global offshore wind sector in 2030: 0.18%	1.5
	Sustainable infrastructure financing	295		0.54
	Expansion of renewables	650		1.18
	Energy efficiency – non-energy intensive sectors*	337		0.61
2 Avoid and reduce impacts on nature from components and materials through responsible sourcing	Green long-range transport	220		0.4
	Fourth Industrial Revolution-enabled long-distance transport	75		0.14
	Additive manufacturing	135		0.25
3 Innovate product design to reduce material demand and support the nature-positive transition	End-use steel efficiency	210		0.38
	Sustainable substances in extraction	20		0.04
4 Actively support nature restoration and invest in nature-based solutions alongside local stakeholders	Sustainable aquaculture	115		0.21
	Bivalves production	15		0.03
	Nature climate solutions	85		0.15
5 Catalyse multistakeholder collaboration and contribute to wider policy and systems change	Technology in energy and extractives supply chains	30		0.05
	Wild fisheries management	40		0.07

*Additional opportunity beyond *Future of Nature and Business* report analysis.

Taking these five priority actions across both company operations and the wider value chain will help companies in the sector to avoid or reduce the top drivers of biodiversity loss (ocean and land use change, ecosystems disturbances, pollution, resource exploitation and greenhouse gas emissions) across the four nature realms (ocean, land, freshwater and atmosphere), mitigate risks to operations and unlock commercial opportunities. These actions will also contribute to the targets of the Kunming-Montreal Global Biodiversity Framework, which aims to halt and reverse biodiversity loss by 2030 to achieve the global goal of nature positive (see Table 4).

TABLE 4 | **Mapping of five priority actions to GBF framework**



For each action, companies should also set measurable and time-bound targets and report against the progress regularly to increase their accountability (see Chapter 4 for more details).

Priority action 1

3.1 Avoid and reduce impacts of direct operations on nature; restore and compensate for unavoidable residual impacts in accordance with the mitigation hierarchy

Many offshore wind companies already have biodiversity assessments in place for all current projects and have committed to the mitigation hierarchy principles of avoiding, reducing, restoring, and – if all avoidance and mitigation measures have been employed – offsetting or compensating for negative impacts on nature. Companies should follow the mitigation hierarchy sequentially at the site level, in a landscape context, considering direct, indirect and cumulative impacts. Mitigation efforts should align with an NNL or NPI goal for each project (see Box 3).[117]

BOX 3 Principles for applying the mitigation hierarchy

The mitigation hierarchy is a four-step decision-making framework designed to support the mitigation of nature impacts. To improve the application of the mitigation hierarchy, The Nature Conservancy identified six principles to guide its application:[118]

- **Landscape context**: Apply the mitigation hierarchy in a landscape context, considering direct, indirect and cumulative impacts.
- **Goal**: Mitigation policy goals at the national, regional and/or local level should ensure the mitigation hierarchy is applied to support conservation objectives and drive accountability for application. As of 2016, over 100 countries had or were developing national mitigation policies that require offsets or enable the use of offsets.[119]
- **Mitigation hierarchy steps**: The steps should be followed sequentially – avoid, reduce, restore and then compensate for impacts.
- **Limits to offsets**:[120] There are limits to what can be offset, and impacts that cannot be offset should be avoided as this may be the only means to prevent irreplaceable loss.
- **Sustainable outcomes**: Mitigation should support long-term, durable outcomes.
- **Stakeholder engagement practices**: Mitigation should follow best practices for stakeholder engagement, guided by the following principles for meaningful and inclusive stakeholder engagement – inclusiveness, transparency, rights-based approaches, and science and traditional knowledge.

> Maximizing the socioeconomic impacts of offshore wind for local communities should be prioritized as part of the nature strategy.

Avoid development in biodiversity hotspots

Companies should collaborate early and often with local and regional stakeholders, Indigenous communities, and environmental and scientific groups to identify areas of high ecological and cultural value. It is essential to avoid marine-protected areas, key biodiversity areas and areas of critical habitat. While critical factors such as wind resources, water depth and distance from the coast must be considered, companies can employ habitat mapping tools and work with governments to arrive at sound marine spatial planning to select sites that prioritize minimal environmental disturbance.

Furthermore, maximizing the socioeconomic impacts of offshore wind for local communities should be prioritized as part of the nature strategy. In fact, offshore wind developers are increasing community engagement, focusing on delivering shared value for wider local stakeholders and society through local upskilling, job creation, co-ownership, improved infrastructure and clean energy access for disadvantaged groups.[121] Various guidelines and databases exist to support companies in this regard (see Box 4).

BOX 4 **Selected guidance on community engagement**

- TNFD's 2024 publication, *Guidance on engagement with Indigenous Peoples, Local Communities and affected stakeholders*[122]
- SBTN's stakeholder engagement guidance[123]
- Forest Peoples Programme's Guidance on good faith consultation and negotiations with Indigenous and Tribal Peoples and communities[124]
- The World Economic Forum's 2023 white paper, *Using a People-positive Approach to Accelerate the Scale-up of Clean Power: A C-Suite Guide for Community Engagement*[125]
- EU Horizon Europe project *JustWind4All's Database of Participatory Practices and Social Innovations in Wind Energy Developments*[126]

Avoid, then reduce, impacts across project life cycle

During all phases of project construction, operations and decommissioning, the adoption of measures to avoid and minimize harm should become standard practice. Companies can reduce known pressures on species and habitats and minimize seabed disturbance. For example, companies could select low-impact technologies and materials (e.g. quiet foundations) and plan construction activities with consideration for feeding and breeding seasons. Cabling is also an important element – there are opportunities to reduce seafloor disturbance and the number of points of interconnection at the coast by, for example, planning for meshed transmission options. In addition, implementing adaptive management practices for monitoring impacts on biodiversity during and after construction, and adjusting operations based on the findings, can demonstrate industry commitment to continuous improvement and learning.

As the industry grows and research and innovation advance, it is essential that new technologies contribute to the reduction of negative nature-related impacts. For example, while traditional noise mitigation measures include the deployment of bubble curtains or other noise barriers, Ørsted has successfully piloted a new installation technology at its offshore wind farm in Germany that would replace pile driving. This new method could reduce

> By rolling out nature-inclusive design, offshore wind farms can create marine shelters and re-introduce native species.

underwater noise levels by 34 decibels, up to 99% compared to the most frequently used method.[127] It would also reduce the impact of construction on the seabed and potentially be more cost-effective by replacing pile driving with lighter structures.

Strengthen restoration and regeneration approaches

Conservation prevents ongoing degradation, while restoration attempts to reverse previous degradation.[128] With an estimated 60% of services provided by nature already degraded or being used unsustainably,[129] conservation alone is insufficient. Restoration efforts must be employed.

Leading developers are already proactively implementing nature enhancement and restoration efforts at a site level. By rolling out nature-inclusive design, such as optimized scour and cable protection, artificial reefs and water replenishment holes,[130] offshore wind farms can create marine shelters and reintroduce native species.[131] Developers can also use materials and coatings that are beneficial for the growth of native species while preventing invasive species from colonizing turbine structures.

Prominent examples of nature-inclusive design include Vattenfall's Hollands Kust Zuid in the Netherlands, RWE's Kaskasi offshore wind farm in Germany, Equinor's Hywind in Scotland, Ørsted's Borssele I & II in the Netherlands, and the successful re-introduction of flat oysters by the Rich North Sea in the Blauwwind wind farm.[132]

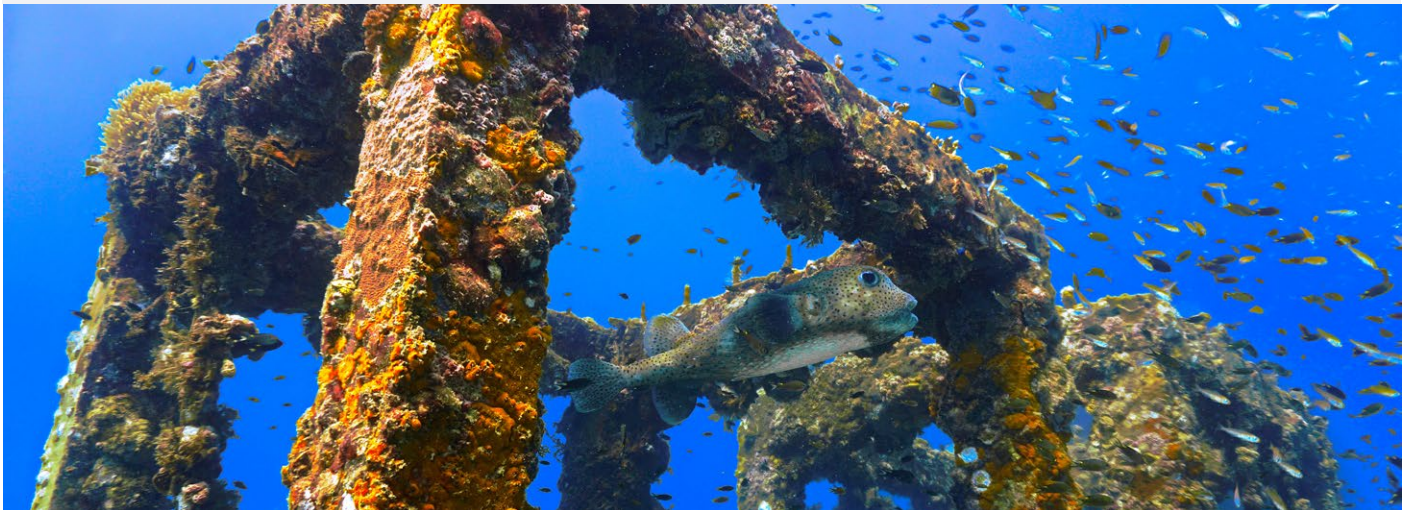
Compensate for unavoidable residual impacts

When companies have taken steps to rigorously apply the mitigation hierarchy, they should compensate for unavoidable residual impacts as a last resort after all other attempts at preventing or reducing impacts have been considered.[133] Efforts should be aligned with an NNL or NPI goal for each project. It is important to note that there are certain cases where compensation is not appropriate and should not be used. Compensation efforts should follow specific principles, such as those outlined by The Nature Conservancy,[134] UNEP,[135] IUCN,[136] and the Business and Biodiversity Offsets Programme (BBOP),[137] including additionality, equivalency, location and temporal considerations.

CASE STUDY 1

How Ørsted collaborates with scientists on nature-inclusive solutions

Ørsted collaborated with the Rich North Sea and Wageningen Marine Research to gain more knowledge on species behaviour and movement in the Dutch part of the North Sea. Ørsted provided four locations around one wind turbine within the Borssele I & II wind farm, where concrete pipes were placed as artificial reefs. Two of these sites have their own scour protection. Scientists from Wageningen Marine Research studied the behaviour of Atlantic cod and European lobster around these reefs in 2021 and 2022, using acoustic tags coupled to acoustic receivers. Studying the behaviour of species that inhabit offshore wind farm areas can lead to a better understanding of their hiding and area use preferences, and how these habitats develop. The project aimed to expand knowledge on artificial reef designs and the behaviour of cod and translocated European lobsters in this environment. Behavioural patterns revealed that cod used the artificial reefs extensively, with residency times of over several months, high site fidelity and extensive use of the structures as hiding places. As for the translocated European lobsters, the residency and fidelity associated with the artificial reefs was limited, despite some individuals exemplifying use of the structure over several days, including hiding. The results indicate that placing larger structures with a broad range of type of crevices can benefit species such as cod. It is one of Ørsted's key efforts to help widen the evidence base on how 'nature-inclusive solutions' could be used in offshore wind farms, in collaboration with scientists and environmental groups.



CASE STUDY 2

How Goldwind integrates nature considerations into business operations

In 2021, Goldwind introduced the Measures for the Sustainable Management of Biological Natural Resources, a comprehensive framework outlining processes for biodiversity risk identification, impact assessment, monitoring, habitat protection and compensation management. These measures have guided the company's sustainability efforts ever since.

When transporting unit components, Goldwind minimizes the negative impact on the marine ecosystem by strictly controlling pollutant emissions from transport vessels, planning efficient routes to avoid marine ecological reserves and using low-noise, low-vibration transport methods.

During offshore wind farm construction, the company employs precise construction techniques and uses digital technology simulations to significantly reduce hoisting times, minimizing the impact of large-scale and long-term construction activities on seabed terrain and marine life.

In the operational phase, intelligent sensors and video surveillance installed throughout the wind farm create a comprehensive monitoring network. This system tracks bird and marine life activity in real time, enabling a deeper understanding of potential environmental impacts and the development of effective mitigation strategies.

Priority action 2

3.2 Avoid and reduce impacts on nature from components and materials through responsible sourcing

Companies should support suppliers to aim beyond carbon and expand LCAs to important nature-related impacts, such as pollution, resource use, and waste and water management.

Beyond their own direct operations, companies should engage with their suppliers to tackle pollution and freshwater extraction from mining and metals, as well as electrical and machinery materials and waste production, throughout the value chain. When evaluating procurement opportunities, companies should prioritize suppliers with nature strategies in place, whenever possible. As many companies may engage with the same suppliers, sector-wide cooperation among offshore wind developers and grid operators can signal collective demand and create stronger incentives for suppliers to act.

In order to get started on addressing nature impacts in their supply chain, companies can take the following actions:

- Conduct a holistic analysis of impacts, dependencies, risks and opportunities in supply chains, starting by assessing sourcing of high-impact commodities
- Transparently disclose nature-related information in their supply chains
- Incorporate nature-related considerations into procurement criteria and supplier assessments
- Engage with suppliers to maximize their sustainability performance; collaborate with industry associations and other companies to signal nature-oriented incentives to suppliers, and improve product transparency and traceability

At this stage, many suppliers will have made commitments and taken action to reduce GHG emissions (which is an important contribution to fighting nature loss) but may not have expanded their scope to include broader nature topics. GHG emissions are a good place to start supplier engagement, including the use of zero-emissions technology and low-carbon solutions whenever possible (e.g. clean fuel and electric vessels or low-carbon steel). To do this, it is recommended to conduct life cycle assessments (LCAs) for all offshore wind assets to improve understanding and transparency of carbon emissions.

However, companies should support suppliers to aim beyond carbon and expand LCAs to important nature-related impacts, such as pollution, resource use, and waste and water management. For instance, EDP,[138] Iberdrola,[139] Ørsted,[140] RWE[141] and Goldwind[142] have been working with manufacturers and circular economy start-ups to find progressive solutions for the recycling and retirement of wind blades to lower nature impacts in the supply chain.

CASE STUDY 3

How Shanghai Electric advances circularity to reduce nature impacts

In its product development process, Shanghai Electric Wind Power integrates green management throughout its product life cycle, aiming to minimize resource consumption, reduce environmental impact and maximize renewable materials. It focuses on addressing recyclability and noise issues in wind turbines by developing “green blades” through improvements in blade design, materials and recycling.

In November 2023, the company partnered with key players to develop recyclable resin for blades, committing to a 95% or higher material recovery rate. By selecting eco-friendly materials, it ensures over 95% of the blade’s composition is sustainable without altering the original design or manufacturing process. In terms of blade design and recycling, Shanghai Electric Wind Power tackles the issue of wind turbine noise through comprehensive low-noise turbine design. Additionally, the company is working towards achieving 100% recyclability of blade materials after decommissioning, advancing green solutions for wind power.

Priority action 3

3.3 Innovate product design to reduce material demand and support the nature-positive transition

Offshore wind structures could also present an opportunity for testing nature-enhancing technologies in real-life conditions, especially for the marine ecosystem.

In the young and fast-growing offshore wind industry, innovative product design is crucial to improving efficiency, quality and market expansion. It could also be transformative in mitigating nature-related impacts and dependency, supporting the nature-positive transition.

Companies are already investing in technologies that are kickstarting the shift in the sector's business models. At the core of this transition is material innovation, which aims to improve the functionality of offshore wind turbines while reducing their environmental impacts and designing for nature enhancement. For instance, offshore wind structure designs that require fewer materials (e.g. lattice structures that use less steel) and those that are easier to disassemble improve practicality, potentially save costs and allow for better recycling and reuse.[143,144] For example, Vestas has recently introduced their modular "click-on" nacelle design, which addresses the challenges of transporting large offshore wind components, facilitates customization and upgrades, and makes reuse easier.[145]

One of the most significant innovations that could transform the industry and its impact on nature is the development of floating wind technologies. Floating wind is opening new sites for offshore wind installation in deeper waters (between 60-1,000 m). These locations farther out at sea typically have the advantages of stronger winds and lower competition with other marine industries such as shallow-water fishing and aquaculture.[146] Furthermore, floating wind has a lower impact on ocean use and noise than fixed-bottom turbines, as it requires less seabed infrastructure and avoids pile driving. The mooring of the anchors and subsea cables can also serve as artificial reefs for invertebrates and small fishes.[147]

While these technologies have potential nature-related benefits, other risks to nature may arise and must be proactively considered. For example, while floating turbines may reduce seabed disturbance, they may introduce new challenges, such as species entanglement. Partnerships between offshore wind companies and start-ups and accelerators are crucial to enhance biodiversity knowledge and facilitate investments in nature innovation while supporting business model improvement. These should be sought before a new technology is deployed on-site to facilitate learning and further innovation across the wider industry. Coalitions such as the 1000 Ocean Startups provide a platform to connect the key players needed to accelerate innovation for ocean health.

Offshore wind structures could also present an opportunity for testing nature-enhancing technologies in real-life conditions, especially for the marine ecosystem. For example, Vattenfall collaborated with start-up Spoor to implement artificial intelligence (AI) technology that records the 3D flight behaviour of seabirds in the immediate vicinity of their offshore wind farm off the coast of Aberdeen. The information and data will be used to advance the understanding of collision risks and improve the planning of new offshore wind farms.[148]

CASE STUDY 4

How RWE innovates and supports start-ups for marine biodiversity

Since 2022, RWE has launched regular innovation competitions[149] with the aim of recognizing start-ups that develop solutions to improve the impacts of offshore wind farms on marine biodiversity, circularity or system integration. The award helps winners accelerate the commercialization of their solutions, offering grant money, expert knowledge and the potential opportunity to deploy their technology at one of RWE's sites. RWE's latest competition on floating wind focused on the promotion of co-use to support local marine users (especially fisheries) and measures to address impact on wildlife.

ARC Marine, the winner of RWE's Floating Wind Co-use Competition 2022, is known for their innovative Reef Cubes[150] that create artificial reefs for marine life, offering a plastic-free and low-carbon alternative to concrete. RWE is currently testing these nature-inclusive design reefs in the Swedish Baltic Sea, in collaboration with Linnaeus University and cable service provider Baltic Offshore Kalmar. The goal is to see how the artificial structures can create an attractive marine habitat, particularly for blue mussels, algae and fish species.[151]

Priority action 4

3.4 Actively support nature restoration and invest in nature-based solutions alongside local stakeholders

Contribution to systems-wide conservation and restoration beyond site level is vital in the sector's contribution to nature positive.

In pursuing conservation and restoration, companies should start by following the mitigation hierarchy at a site level and addressing the impacts of their own activities. Yet, cross-industry contribution to systems-wide conservation and restoration beyond the site level with wider stakeholders is also vital to the sector's nature-positive efforts. The nature-inclusive design of wind farms can benefit certain species and habitats at the site level; however, off-site restoration may provide greater benefits to migratory species than on-site action.

There are many forms of marine restoration, which often need to complement each other to give optimal results. For example, Birdlife International outlines examples of marine restoration measures in the European seas with added socioeconomic gains, from the restoration of coastal, sand dune and seagrass meadows to the restoration of fish migration paths and seabird nesting sites.[152] By supporting these efforts, offshore wind developers can contribute to the overall health of these marine ecosystems and create opportunities for local communities. This necessitates cross-industry collaboration as well as industry-science partnerships.

The multi-use of offshore wind farms, in collaboration with local marine users and through marine spatial planning, should be explored. Seaweed, mussel and oyster farming, passive crab fisheries and other types of fish farming are potentially economically viable activities. They can also generate blue biomass with fewer user conflicts while mitigating eutrophication and climate change. Ørsted is also currently piloting the integration of sustainable aquaculture activities in their Anholt offshore wind farm.[153] Meanwhile, the first seaweed harvest has just begun at Vattenfall's offshore wind farm, Kriegers Flak (the largest in Scandinavia to date), in collaboration with mussel and seaweed producers and Danish universities.[154]

In addition, companies are encouraged to invest in credible and effective nature-based solutions, either through place-based conservation and restoration or through landscape and jurisdictional approaches. This involves partnering with environmental non-governmental organizations (NGOs), local governments and Indigenous Peoples. A 2020 report estimated an average global biodiversity financing gap of $711 billion per year required for the protection, restoration and enhancement of nature,[155] where the private sector has a key role to play in helping bridge this gap by investing in a nature-positive transition.

Target 19 of the Kunming-Montreal Global Biodiversity Framework proposes a number of innovative ways to mobilize resources from both the public and private sectors. For example, companies could consider investing in blue and green bonds, nature restoration funds, restoration of blue carbon ecosystems (mangroves, salt marshes and seagrasses),[156] and voluntary biodiversity certificates or credit markets.[157] Through careful assessment of the advantages and disadvantages of available products, companies can contribute to meaningful biodiversity conservation that is aligned with their internal values and targets.[158]

CASE STUDY 5

How Attentive Energy supports the Billion Oyster Project

In 2023, Attentive Energy partnered with New York City's Billion Oyster Project to support marine ecosystem restoration in New York Harbor. This collaboration focuses on restoring oyster reefs, which are crucial to the local marine environment. Once abundant in the harbour, oysters play a crucial role in water filtration and shoreline protection, with each oyster filtering up to 50 gallons of water daily and creating natural barriers against erosion.

The partnership helps expand the Billion Oyster Project's restoration efforts by providing financial and educational resources. These initiatives aim to restore a billion live oysters to the harbour by 2035, but also promote community involvement, engaging students and volunteers in hands-on restoration activities. This collaboration highlights the integration of renewable energy and marine restoration, demonstrating how the offshore wind industry can contribute to ecosystem rehabilitation. Attentive Energy's commitment to sustainability through this project underscores the power of corporate-community partnerships in driving long-term ecological resilience.

Priority action 5

3.5 Catalyse multistakeholder collaboration and contribute to wider policy and systems change

There are a number of alliances that bring together industries, governments, civil society, academia and other stakeholder groups to promote the timely deployment of offshore wind projects and grid infrastructure while protecting and restoring marine ecosystems. Some examples include the World Economic Forum's Responsible Renewables Infrastructure Initiative, the Offshore Coalition for Energy and Nature (OCEaN), the Global Initiative for Nature, Grids and Renewables (GINGR), the Global Offshore Wind Alliance (GOWA) and Ocean Energy Pathway.

> Offshore wind companies can collectively call for more progressive policies and regulations that set the minimum standards for the sector on nature.

Companies should use these alliances to drive system change. Specifically, through these platforms, companies can:

Call on governments to strengthen nature-related policy

Offshore wind companies can collectively call for more progressive policies and regulations that set the minimum standards for the sector on nature. Companies can advocate for governments to:

- **Develop inclusive marine spatial planning** that helps select the right sites for the deployment of offshore wind, to maximize the benefits for nature and people. This should be done in collaboration with local communities and offshore wind businesses as well as other marine sectors such as fisheries, aquaculture, ports and shipping. The High Level Panel for a Sustainable Ocean Economy countries, for instance, have started implementing an integrated approach to ocean management by developing Sustainable Ocean Plans.[159]

- **Support the operationalization of nature-related targets**, such as site-level NNL or NPI targets, for example, by providing guidelines on metrics (e.g. habitat classification for equivalency) and building supporting infrastructure (e.g. compliance mitigation systems and regulated biodiversity offset markets).

- **Enhance regional and cross-border cooperation** that adopts an integrated approach to offshore wind project rollout and ecosystem-based management. This approach can enhance the planning and execution of projects while greatly benefiting the monitoring of marine migratory species that cross the waters of several jurisdictions. In Europe, the North Seas Energy Cooperation[160] is an example of such collaboration. In the US, the Regional Wildlife Science Collaborative for Offshore Wind (RWSC) supports regional cooperation in data collection and research activities.

- **Deploy blended finance instruments, including concessional loans and equity**, to enhance the global competitiveness and financial viability of offshore wind projects, especially in emerging markets.[161]

Collaborate on data sharing and innovative research and development

There are significant knowledge gaps in the marine environment and data collection can be very costly. Data-sharing partnerships between businesses, research institutions and environmental organizations is therefore crucial to fill biodiversity knowledge gaps and boost scientific understanding of the ocean. This will ultimately drive innovative, beneficial research and development for companies and identify opportunities for habitat protection and restoration. Data sharing, however, needs to follow clear principles to ensure that the efforts are justified and that the data can be harmonized and effectively used (e.g. standard procedures in terms of data gathering, format, accessibility and compatibility).

Furthermore, while the offshore wind sector is in a strong position to contribute to the data repertoire, collaboration with other sectors is essential to the understanding of cumulative impacts across the seascape. Organizations such as HUB Ocean are collecting and harmonizing large amounts of ocean data on a collaborative platform with the aim of benefiting both the environment and ocean-dependent industries. Multistakeholder efforts to strengthen data collection and sharing mechanisms have also accelerated, such as the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization's (UNESCO-IOC) Ocean Decade Corporate Data Group,[162] the Crown Estate's data sharing platform[163] and the Global Biodiversity Information Facility.

Collaborate to harmonize impact assessments and monitoring and evaluation frameworks

Companies should collaborate to build a common approach to assessing and reporting impacts on nature in the sector. A unified framework across offshore wind stakeholders to evaluate, quantify and report on nature-related impacts will enable consistent and transparent evaluations across the sector. It will also guide better tenders and permitting processes for governments and support financial institutions in aligning their financing with demonstrably sustainable practices.[164,165] A number of initiatives have emerged to support companies in this gap. For example, the World Economic Forum's Responsible Renewables Infrastructure Initiative[166] is working with industry leaders and civil society organizations to create a consensus on measuring the impact of renewables infrastructure on nature and people. From there, it will guide infrastructure buildout on the ground as well as government auctions and permitting processes.

4 Get started

The imperatives to tackle carbon emissions and nature loss are interdependent, requiring companies to integrate their nature-positive and net-zero strategies.

The nature-positive transition aligns closely with companies' net-zero commitments and should be integrated into their climate transition plans.

While many companies in the offshore wind sector have already embarked on their nature journey and embraced the five priority actions, making transformative changes to business models by 2030 demands significant time and resource investments from companies.

Delivering net-zero emissions and tackling nature loss are highly interdependent goals. Climate change is a main driver of biodiversity loss, and efforts to tackle climate change cannot succeed without safeguarding nature. Therefore, the nature-positive transition aligns closely with companies' net-zero commitments and should be integrated into their climate transition plans. Likewise, companies should ensure that social objectives are integrated for a just and equitable nature-positive transition.

Guidance is emerging on how to develop nature transition plans or adapt net-zero transition plans to include nature and biodiversity commitments and objectives supported by several institutions. For example:

- **It's Now for Nature's** *Nature Strategy Handbook* is a practical guide to support businesses across sectors in developing a nature strategy.
- **TNFD** will publish new guidance in 2025 on recommendations for nature transition plans for real-economy companies and financial institutions. This document was launched for public consultation in October 2024.
- **CDP and the World Wide Fund for Nature (WWF)** are developing transition planning recommendations, including practical guidance on tools and methodology.
- **Glasgow Financial Alliance for Net Zero (GFANZ)** has published a framework for net-zero transition planning for financial institutions and will release guidance on integrating nature into these plans in early 2025.[167] This document was launched for public consultation in October 2024.

4.1 Align strategy with organizational maturity

Assessing organizational readiness and maturity can help a company understand its performance on the nature-positive journey and identify the most suitable guidance and tools to drive action. Table 5 details recommended actions to deliver a nature-positive strategy mapped to an organization's level of readiness and maturity.

TABLE 5 **Mapping the components of a nature-positive strategy against organizational maturity**

Components of a nature-positive strategy	Organizational maturity	
	Starting and developing	Advanced and leading
Summary	– Identify nature-related issues – Set a high-level ambition and/or targets for nature – Present stand-alone actions on nature	– Integrate nature into strategy and governance – Assess impacts and dependencies for all potentially relevant realms – Set measurable and science-based targets for nature – Implement strategic action, redefine industry business models and mobilize the whole value chain
Foundations	– Employ sectoral averages for high-level screening to discern priority effects on nature – Use secondary data for materiality assessments to gauge priority impacts and nature dependencies, considering factors like environmental pollution – Use tools and guidance such as ENCORE,[168] SBTN's guidance for businesses, Aqueduct from WRI,[169] TNFD's upcoming transition planning guidance, WWF's biodiversity risk filter and water risk filter,[170] UN Environmental Programme Finance Initiative (UNEP-FI)'s report on high-risk sectors[171] and the Integrated Biodiversity Assessment Tool (IBAT)[172]	– Refine materiality assessment by measuring impacts and dependencies on nature using primary operations data and environmental indicators, and undertake an in-depth analysis of significant risks and opportunities, understanding their influence on financial statements – Maintain a comprehensive grasp of organizational resilience with an actionable plan for managing nature risks and opportunities – Perform thorough valuations of all priority areas, considering trade-offs, using value chain data and recognizing the mutual benefits for business and society – Use tools and guidance such as ENCORE, SBTN's step 1 – assess, step 2 – prioritize and TNFD's LEAP approach, Aqueduct from WRI, WWF's biodiversity risk filter and water risk filter, UNEP-FI's report on high-risk sectors and the IBAT

TABLE 5 **Mapping the components of a nature-positive strategy against organizational maturity** (continued)

Components of a nature-positive strategy	Organizational maturity	
	Starting and developing	Advanced and leading
Implementation strategy and engagement strategy	– Develop sustainable procurement policies with suppliers that have nature-focused elements – Prioritize actions to avoid and reduce negative impacts in the company's direct operations and upstream supply chain – Implement initial traceability for primary suppliers – Be aware of NBSAPs and recognize the interdependence of nature and climate in advocacy efforts	– Adopt a circular strategy and embrace regenerative principles by linking capital to nature-positive outcomes and by involving all stakeholders, including employees, clients and customers – Establish advanced traceability for key materials and ensure supplier alignment, expand traceability throughout product life cycle and encourage innovative supplier collaborations – Engage actively in NBSAPs, champion nature-positive outcomes and advocate for integrated reforms benefiting nature, climate and society
Metrics and targets	– Set nature-positive goals on a timeline using the SMART (specific, measurable, achievable, relevant and time-bound) approach – Validate commitments using third-party stakeholders	– Detail and report on targets for nature-related risks and opportunities based on TNFD's Recommendations[173] – Prepare for science-based targets on land and freshwater by using SBTN's step 3 – set targets
Governance	– Assign a management member for nature-based risks, ideally overseeing both climate and nature – Incorporate nature into environmental risk management, especially within enterprise risk management (ERM), environmental, social and governance (ESG) and sustainability teams – Train governance roles on the connection between nature and wider ESG risks	– Ensure board or senior management ownership of nature actions – Tie performance on nature and climate to leadership incentives – Set up governance structures for managing, reporting and overseeing nature-based risks and actions on nature across the organization, including informing relevant board-level committees

4.2 A deeper look at metrics to support decision-making

Companies need to track and publicly report on their actions against relevant metrics to strengthen their credibility and ensure they deliver an effective transition.

TNFD's LEAP approach

TNFD offers sector-specific and sector-agnostic guidance on metrics, which should be the first port of call. A good place to start within TNFD's resources available is the *Guidance for corporates on science-based targets for nature,* published jointly by TNFD and SBTN.[174] TNFD differentiates between assessment metrics and disclosure metrics along the four phases of the LEAP approach[175] (see Figure 10):

- **L**ocate interface with nature
- **E**valuate dependencies and impacts
- **A**ssess material risks and opportunities
- **P**repare to respond and report

FIGURE 10 **Types of metrics in TNFD's LEAP approach**

	Assessment metrics				Disclosure metrics
Types of metrics	**Location prioritization metrics** – Ecosystem integrity – Biodiversity importance – Physical water risks – Other corporate data	**Impact and dependency metrics** – Impact drivers – State of nature – Ecosystem services/ dependencies	**Risk and opportunity metrics** – Physical risks – Transition risks – Systemic risks – Nature-related opportunities	**Response metrics** – Governance – Strategy – Management actions	**Disclosure metrics** – Core global metrics – Core sector metrics – Additional metrics
LEAP approach	**Locate** interface with nature	**Evaluate** dependencies and impacts on nature	**Assess** material risks and opportunties	**Prepare** to respond and report	

Source: Adapted from Taskforce on Nature-related Financial Disclosures (TNFD). (2024). *Recommendations*.

Guidance on nature measurability is fast developing:

- The Capital Coalition's Align Project has issued a suite of publications on measuring and valuing biodiversity.[176]
- CSRD, the Global Reporting Initiative (GRI) and TNFD's disclosures are organized around a series of metrics that can be used to anchor company assessments and support disclosure. These should be complemented with what the TNFD LEAP approach calls "response metrics" – the internal reporting on an organization's actions, policies, commitments, plans and targets to manage its nature strategy.
-
- CDP's corporate questionnaire also enables companies to disclose on climate change, deforestation, water security, plastics and biodiversity. CDP is partially aligned with the TNFD disclosure recommendations and is working towards full alignment.
- WBCSD has developed sector-specific metrics to measure the state of nature, pressures and responses of the forestry, agri-food, built environment and energy sectors. In 2025, it plans to develop additional metrics for the pharma and chemicals sectors.
- The Nature Positive Initiative is developing indicators and metrics to define the state of nature and contributions to "nature-positive" outcomes. It will be launched in January 2025.

Differentiating between input and output indicators

There are a number of dimensions to indicators and metrics. They should be both qualitative and quantitative. They should also measure inputs and processes and – importantly – outputs and outcomes (see Table 6).

Companies should define a set of indicators and metrics according to the mitigation hierarchy (avoid, reduce, restore, compensate) to assess their activities and the impacts achieved.[177]

TABLE 6 **Input and output indicators and examples**

Indicator type	Example
Input and process indicators	Resources and activities that are deployed by a business in service of a certain priority action, for example: – Investment in nature-inclusive design – Number of knowledge products/research projects conducted by a company
Output and outcome indicators	Tangible results stemming from undertaking a priority action, for example: – Commitment to no conversion of natural ecosystems – Percentage of reusable, recyclable or compostable plastic packaging – Percentage of raw material certified by commodity-specific certifications in the supply chain (that are identified as critical suppliers based on materiality assessment and volume)

4.3 Map the transition on to business functions

Mapping the nature-positive transition on to distinct company functions requires a holistic approach to ensure that every division synchronizes its strategies with nature-positive aspirations.

TABLE 7 **Mapping strategies and actions by business function**

Business function	Potential strategies and actions required for a nature-positive transition
Sustainability	Develop the nature-positive transition plan for the business (together with the strategy function) Obtain a holistic understanding of impacts and dependencies of the firm's operations and products Collaborate with other functions to drive the wider transition of the business Drive nature conservation and restoration initiatives (such as wetlands for wastewater purification) Promote collective sector-wide positive action, such as sustainable raw material sourcing or collaboration on bio-based or recyclable material research Monitor sustainable sourcing practices and raw material certification Support and enable collaborations with NGOs as well as industry initiatives
Strategy and corporate development	Develop the nature-positive transition plan for the company (together with the sustainability function) Conduct horizon scanning and comprehensive market research for new opportunities related to the nature-positive transition (e.g. markets, products, processes, technologies) Evaluate the risks and returns associated with more disruptive opportunities (e.g. circularity approaches, new products) and identify business cases in new nature-positive economies Drive necessary organizational changes to align business operations with the requirements of the new nature-positive economy (e.g. establish cross-functional teams to address both climate and nature challenges internally and across your supply chain)

TABLE 7 | **Mapping strategies and actions by business function** (continued)

Business function	Potential strategies and actions required for a nature-positive transition
Finance and risk management	**Financial management** Revise capital planning assumptions for nature-positive related businesses cases (e.g. pay-off periods for investments may increase versus traditional capital expenditures) Consider impacts of nature-positive transition on balance sheet (e.g. high-polluting assets might have to be written off prematurely or written down on an accelerated timeline) **Investments** Increase capital spending on projects enabling the nature-positive transition of the business (e.g. retrofitting plants, supporting other nature-based solutions) – In particular, allocate funding to improve nature-inclusive design Allocate budget for innovation spending, such as for circular innovations and research into bio-based or recycled material for feedstocks – Plan for the financial implications of incorporating circularity and sustainable product development Commit to investments in nature conservation, restoration and nature-based solutions in collaboration with NGOs and local communities **Financing** Consider that the cost of capital for high-polluting operations could increase Consider that availability of capital may become contingent on credible nature-positive strategies Use new sources of funding, such as green bonds and sustainability loans, nature-focused impact funds, blended funding and partnership with NGOs **Risk management and disclosure** Consider that new nature-related risks may emerge that need to be managed (see TNFD framework), for example: – Physical and supply chain risks, such as decreased water availability or quality in the supply chain – Transition risks including demand shifts, regulatory risks and reputational risks Prepare required nature-related disclosures for audited statements for CSRD (and potentially under forthcoming requirements of the ISSB)
Procurement	Ensure procurement decisions are aligned with sustainability imperatives and strategy Engage closely with upstream suppliers to discuss impacts and dependencies, as well as priority actions, and co-develop implementation strategies Develop innovative working models or partnerships with suppliers to support the transition (e.g. upfront payments or co-financing)
Research and development (R&D)	Invest in research for new nature-positive products and production techniques Introduce new metrics to track the effect of R&D spending related to the nature-positive transition of the business, in addition to financial returns from R&D spending
Operations (own)	Identify relevant indicators and establish applicable metrics as well as define the respective target ambition and baseline for each and subsequently report publicly on progress Enhance efficiency of production processes (e.g. digitalization and automation in manufacturing processes; energy efficiency measures; recycling and re-use, nature-inclusive design) Engage in conservation and restoration initiatives
Operations (supply chain management)	Identify relevant indicators, establish applicable metrics, define the respective target ambition and baseline for each and subsequently report publicly on progress made Collaborate with suppliers for sustainable sourcing and improved traceability Support suppliers (where possible) in taking nature-positive actions for their own operations
Human resources	Upskill workforce on nature and biodiversity topics (where relevant) Hire relevant external expertise (e.g. additional human resources might be required to prepare for upcoming nature-related reporting and disclosure requirements)

TABLE 7 | **Mapping strategies and actions by business function** (continued)

Business function	Potential strategies and actions required for a nature-positive transition
Sales and marketing	Promote products that have minimal impacts on nature and biodiversity and develop solutions that both reduce nature impact and offer additional utility or benefits to consumers Provide disclosure on impacts and dependencies of products, especially as customers may expect more information on nature footprint, which requires transparent and traceable supply chains Develop a holistic understanding of customer segments and willingness to pay for greener products
Investor relations	Disclose nature-positive initiatives and their impact on company performance (e.g. company commitments to water stewardship, sustainable sourcing and circular economy practices) Highlight contributions to global frameworks like the Kunming-Montreal Global Biodiversity Framework Manage investor engagement on nature topics to ensure transparency on priorities from both sides
Public affairs	Advocate nature-positive action in the public space Collaborate with policy-makers, regulators and other standard-setters to develop effective, progressive policies, regulations and standards supporting the transition of the sector (e.g. the United Nation's global plastics treaty)

Source: Adapted from McKinsey & Company. (2022). *The net-zero transition: What it would cost, what it could bring.*

Conclusion

International agreements such as the GBF are corralling a global consensus on the urgency to tackle nature loss, and regulations are tightening to ensure more nature-friendly practices.

The offshore wind sector stands at a critical juncture in the transition to a nature-positive future. The industry must find ways to balance the rapid growth of offshore wind capacity while mitigating the potential impacts on marine habitats and species. While leading companies have made nature and climate commitments, more must be done to ensure offshore wind development is both responsible and beneficial to local communities while safeguarding biodiversity.

To lead in sustainability, the offshore wind sector must reduce the impact of operations and materials, innovate in product design, and actively support and invest in nature restoration efforts.

By collaborating with companies across the sector, suppliers, customers, fellow industries, regulators, civil society and local communities, the offshore wind industry can champion a transformative shift that aligns with global biodiversity goals, securing a sustainable future for both business and the planet.

Appendix

Impacts and dependencies analysis

The sector-average assessment of the top drivers of nature loss shown in Table 2 is mostly based on ENCORE and followed a four-step process.

First, the relevant sub-industries were identified at an ISIC Class level for each stage of the value chain. After initially shortlisting the ISIC Classes for the midstream section of the value chain (direct operations), the ENCORE upstream and downstream "links" were leveraged to map each midstream ISIC Class to relevant upstream and downstream ones. A manual review was also conducted to identify any other relevant categories.

Second, the ENCORE "pressures" were mapped to the five IPBES drivers of biodiversity and ecosystem change.

Third, for each stage of the value chain and IPBES driver, an average of the ENCORE "pressure materiality rating" was computed across all the ISIC Classes where a materiality value was assigned (i.e. not N/A or ND). This was summarized in Table 2 for those with medium, high or very high materiality.

Finally, this output was tested with business, civil society and academic industry experts via interviews and consultation workshops, and the final ratings were adapted based on feedback provided.

The impact and dependency descriptions in Chapter 2 also leverage the ENCORE "pressure materiality ratings", "pressure links", "dependency materiality ratings" and "dependency links" datasets, alongside several other sources. These include CDP Water Watch, WWF Water and Biodiversity Risk Filters, academic papers, civil society reviews, company-specific insights and assessments, analysis by the World Economic Forum and industry expert interviews and consultation workshops. The results of this analysis were then leveraged to inform the development of the priority actions.

Opportunity sizing

The Forum's *Future of Nature and Business* report,[178] published in 2020, identifies about 60 major business opportunities in the nature-positive economy and estimates their respective market sizes (defined as concentrated shifts in profit pools that generate specific opportunities for business). The sizing reflects the annual additional opportunity in 2030 based on estimated savings (e.g. value of land saved through restoration) or revenue upside (e.g. new market potential for new products). For each opportunity, the incremental size of the opportunity in a nature-positive versus a business-as-usual scenario is measured. The opportunities selected are based on existing, commercialized technologies. A detailed overview of this sizing can be found in the methodology note for the *Future of Nature and Business* report.[179]

Identifying the business opportunity potential of the priority actions for the offshore wind sector followed a two-step approach. First, relevant opportunities were selected from the Future of Nature and Business report and mapped to the priority actions identified in this report (see Table 3). Second, the market potential for the offshore wind sector was estimated across each selected opportunity, using relevant adjustment factors such as the sector's share of global GDP for sector-agnostic opportunities or the total excluding the mining and metals sector's share of global GDP for circularity-related opportunities.

This sizing approach may not cover the entire set of business opportunities for the sector. For example, the market potential of new technologies under development was not considered in the original 2020 report and is, therefore, not covered in this report. Similarly, the 2020 report did not aspire to exhaustively cover all present opportunities.

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