WORLD ECONOMIC FORUM

Nature Positive:
Role of the Port Sector

INSIGHT REPORT

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Images: Getty Images

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Foreword

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A future-proof global port is dynamic, multifaceted and extends beyond traditional cargo handling. It focuses on sustainability, innovation, efficiency and adaptability while serving as a critical link in the global supply chain and contributing to the economic well-being of its region. This is fully aligned with the long-term ambitions of the Port of Antwerp-Bruges. Our aim is to be a lever towards a sustainable future and a world port that reconciles the needs of people with those of the climate, nature and the economy.

In addition to maximizing benefits for our customers and prioritizing safety, mobility and the quality of our environment, we are taking responsibility through an ambitious species protection program. Protected species are preserved, and scientifically substantiated population targets are pursued in suitable areas, all while easing the regulatory burden on companies operating in the port.

We strive to be pioneers. As a community builder, we prioritize partnerships that drive sustainability ambitions and innovation within the port platforms. Major challenges can only be addressed through collaboration and the collective efforts of a diverse range of actors. Through cooperation with non-governmental organizations (NGOs), we can monitor species conservation and manage the quality of their habitats.

This report provides a comprehensive overview and numerous examples of these nature-positive efforts that can coexist with economic activities. Given the vast areas we operate in, the opportunities for action are abundant, and we cannot overlook the impact on biodiversity or the relevance of nature-related risks. We must, therefore, identify the dependencies and impacts of the economy and society on nature. The tools and guidance provided in this report can facilitate a structured approach to addressing these issues.

As a result, sustainability cannot be confined to a single department or industry association; it must become an integral aspect that is structurally considered in every project or strategic decision.

Foreword

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

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

Global trade is reliant on the successful operation of a complex, interconnected system of supply chains, government bodies and private sector organizations, working together across borders to ensure the safe transport of vital goods and services to hundreds of millions of people around the world.

As our climate changes, higher temperatures, rising sea levels and more frequent and severe weather patterns will increasingly expose vulnerabilities in our infrastructure systems. Due to their proximity to both land and ocean, ports – particularly in small island developing states and the Global South – are uniquely impacted by these changes.

The Intergovernmental Panel on Climate Change (IPCC) estimates that if we continue on current projected trends, sea levels are expected to rise by 29-51 cm by 2100.[1] Without major mitigating intervention, a 40 cm rise in sea levels could possibly render the ports of Houston, Shanghai and Lazaro Cardenas completely unusable.

In order to meet these emerging threats, we must transform current approaches to port management and operations towards a culture that actively protects, restores and enhances natural ecosystems at scale.

Nature Positive: Role of the Port Sector explores the contribution of the sector to climate change and nature loss, including the impact of land and sea use, greenhouse gas emissions and pollution, etc. The report articulates a shared vision for a nature-positive port sector, offering an actionable framework for government departments, engineering and construction firms and shipping companies to make evidence-based decisions that will improve the resilience and sustainability of ports, now and into the future.

Like all critical infrastructures, ports are part of bigger social, technical and physical systems. By engaging a diverse group of sectoral experts, including Lloyd's Register Foundation and China Oceanic Development Foundation, this report ensures that recommendations are made with the safety of people at their heart.

The international community must take these insights and do everything it can to anticipate and mitigate these systemic risks to ports, build resilience and ensure a nature-positive future for global trade.

About the Nature Positive Transitions report series

Nature Positive: Role of the Port Sector is part of the World Economic Forum's Nature Positive Transitions report series that outlines the different pathways to halt and reverse nature loss by 2030 – the mission at the heart of the 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. For more information, please visit Nature Positive Transitions.

This report includes case studies from several port-anchored industrial clusters involved in the World Economic Forum's Transitioning Industrial Clusters initiative (TIC). With its focus on economic, social and environmental impact, TIC aligns closely with the Nature Positive Transitions report's mission. For more information, please visit Transitioning Industrial Clusters.

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 Offshore Wind 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

Businesses throughout the value chain should make joint efforts for a just and equitable nature-positive transition.

In a highly globalized world, port infrastructure and services are critical to keeping global supply chains functioning. As they continue to be constructed and expanded around the world, ports are not only vital to international economic activity but also contribute heavily to many countries' employment and economic growth. In total, 30 million people globally are employed in the port sector directly, and 90 million jobs are indirectly related to port ecosystems more broadly.

While ports contribute significantly to domestic and global economic and social development, they can also have substantial impacts on nature. Without careful planning, port construction can destroy land and water ecosystems. Likewise, port operations and economic activities downstream can lead to varying degrees of pollution, greenhouse gas emissions and species invasions. Given the growing volume of global trade, it is crucial for the port sector to take action and transform port operations and value chains to contribute to nature-positive global goals.

While recognizing that many ports have already made progress considering and addressing climate change and environmental pollution, the sector now requires systematic thinking and accelerated action to support nature-positive goals. Ports should be fully aware of their relationship with nature and consider the entire value chain when it comes to decision-making. This report summarizes the sector's key impacts and dependencies on nature and sets out sector-specific actions that corporate leaders can start to take now to transform their businesses, including:

1. **Sensitively plan port areas to minimize impacts on nature**: Ports should be planned in an integrated and coordinated way, aiming to simultaneously meet business and operational needs and minimize impacts and dependencies on nature.

2. **Enhance the use of clean energy, sustainable materials and advanced equipment and operating systems**: Optimize energy portfolio, improve or retrofit storage and refilling facilities to accommodate increasing quantities of green alternative fuels needed for green shipping, prioritize the use of advanced equipment and gradually replace ageing and carbon-intensive equipment, adopt energy-saving and environmentally friendly materials in port construction and operation, save and recycle freshwater to the maximum extent.

3. **Improve prevention and mitigation capacity against pollution and invasive species**: Optimize operations and implement advanced technologies to prevent and mitigate pollutants, formulate and implement emergency response plans to address incidents, improve monitoring systems to ensure the impacts on nature can be controlled and minimized as well as to identify incidents when happening, regulate and standardize prevention and control of invasive species.

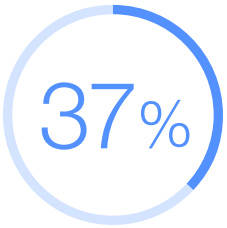
4. **Promote a circular economy and catalyse cross-sector collaboration in regulation, finance and innovation**: Commit to circular business models by maximizing the recycling of materials and building efficient supply chains; enhance cross-sectoral collaboration in submitting joint policy asks, setting industry standards and regulations, launching and contributing to nature-related initiatives, co-developing finance mechanisms with investors, etc.

5. **Actively protect and restore nature**: Establish and sustainably manage habitat areas, improve green coverage, enrich vegetation types, improve soil structure, restore degraded land, protect the natural coastline, and take part in compensating conservation and restoration activities such as marine species protection, mangroves planting, mudflats and seagrass beds conservation.

These priority actions could unlock more than $54 billion worth of annual business opportunities by 2030 for companies operating across the sector's value chain, presenting significant possibilities for the port sector in the new nature-positive economy.

Introduction

Most top companies have climate targets, yet only 5% 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.

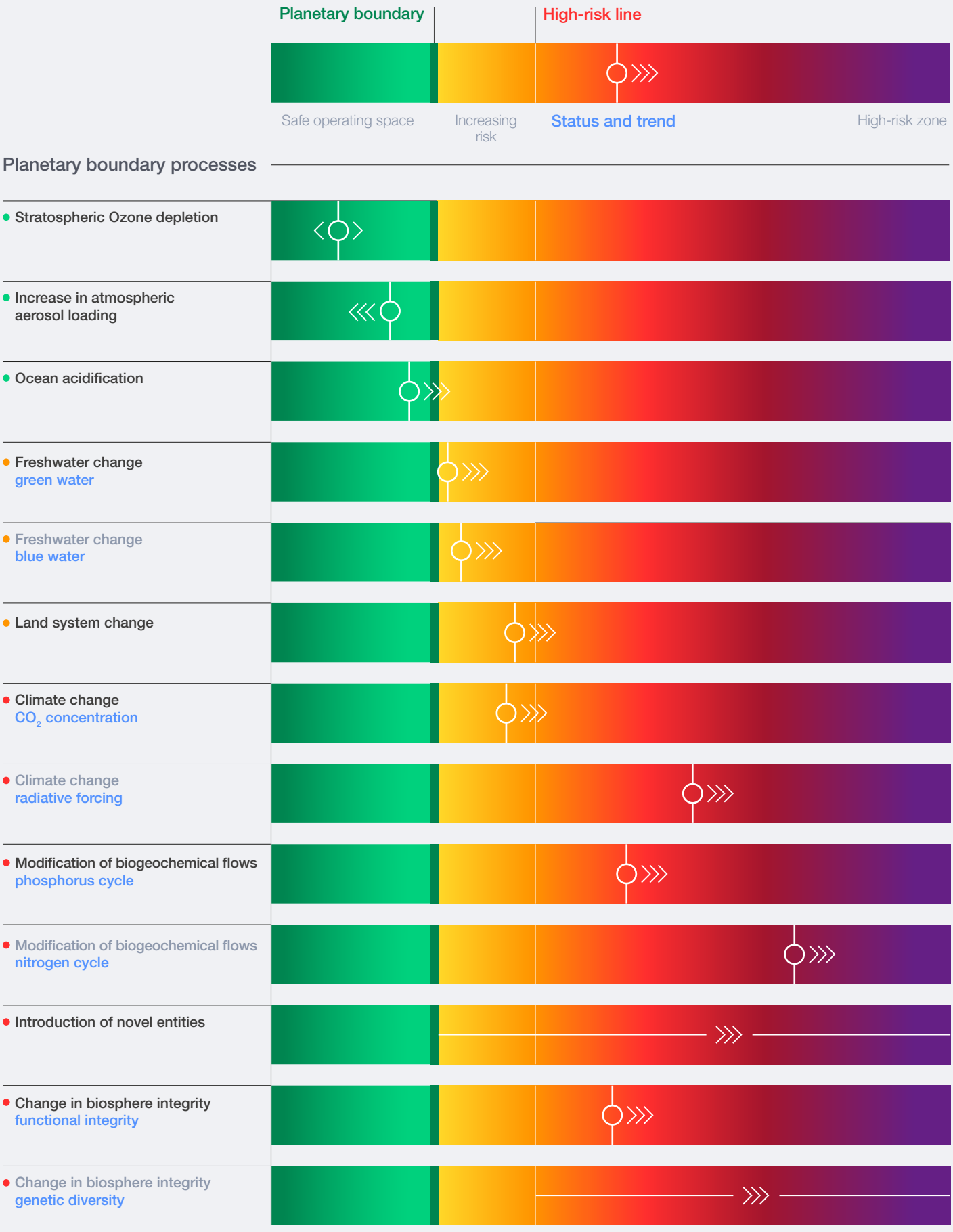
Nature is at a tipping point. Today, the resources humanity uses are equivalent to that of 1.75 Earths. This means that the ecological footprint, a measure that sums up the demands for biologically productive areas like food, timber, fibre, carbon sequestration and infrastructure, exceeds the Earth's capacity by 75%.[2]

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,[3,4] and in turn, land-use change, principally agricultural commodity-driven deforestation, contributes 12-20% of global greenhouse gas (GHG) emissions.[5] 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.[6]

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[7] and the land targets from the Science Based Targets Network (SBTN).[8] 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[9] (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 Risk Report 2025*,[10] 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,[11] 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). (n.d.). *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[12] 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)[13] under the EU's Corporate Sustainability Reporting Directive (EU CSRD) and the EU Taxonomy for Sustainable Activities[14] 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[15] and China,[16] 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),[17] which has seen at least 502 organizations, including 129 financial institutions, commit to getting started with voluntary reporting of their nature-related issues.[18]

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,[19] 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.[20]

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.[21] 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,[22] 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[23] 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.[24]

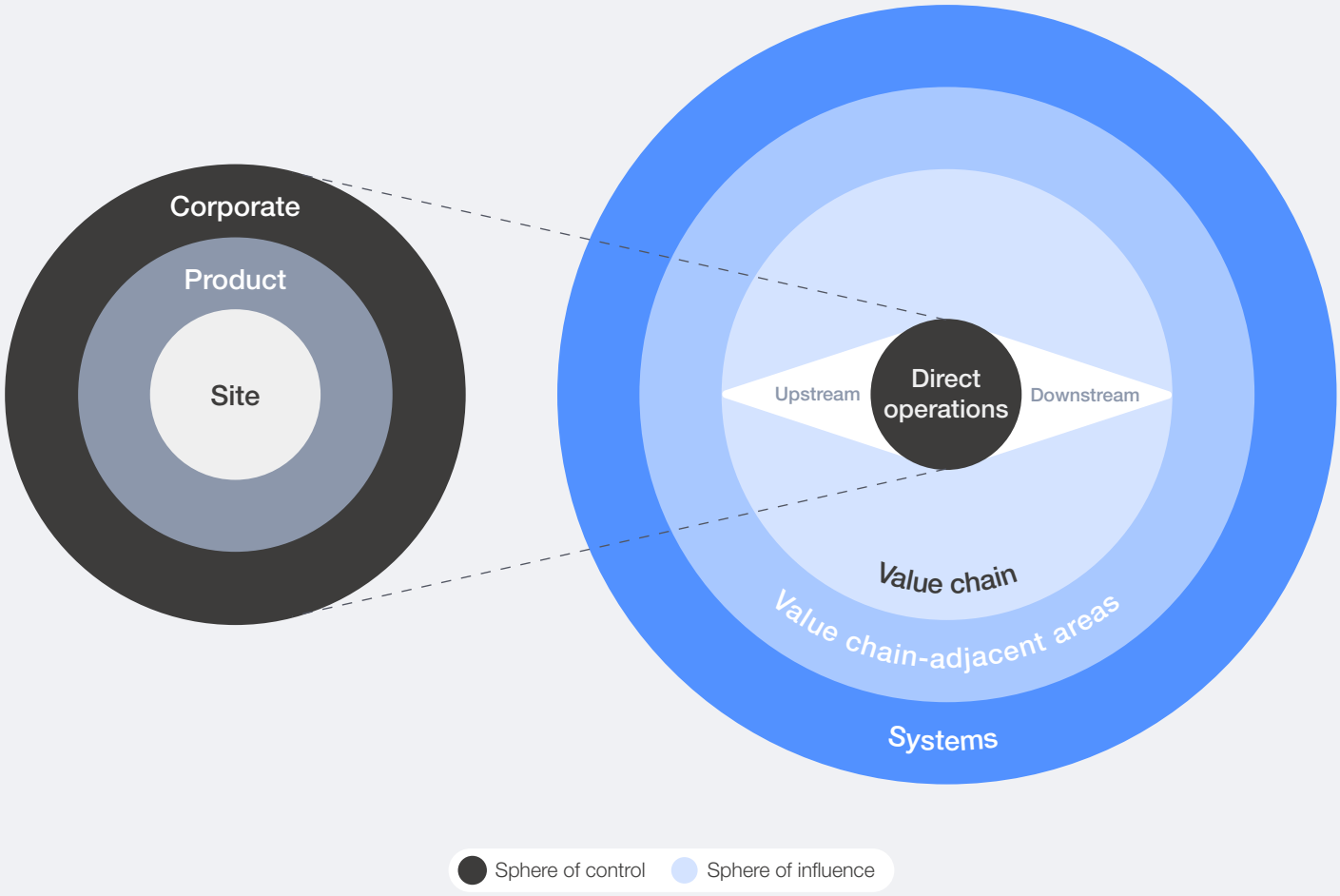
Additionally, employees are elevating their expectations regarding their employers' commitment to protecting nature and biodiversity. For example, a 2022 global survey by Deloitte[25] found that protecting the environment remains a top priority for Gen Zs and millennials, who want to see their employers 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 83% of Fortune Global 500 companies have climate change targets, only 25% have freshwater consumption targets, and just 5% have targets for biodiversity loss.[26] Only 5% of companies have assessed their impacts on nature, with less than 1% understanding their dependencies.[27]

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".[28] 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**



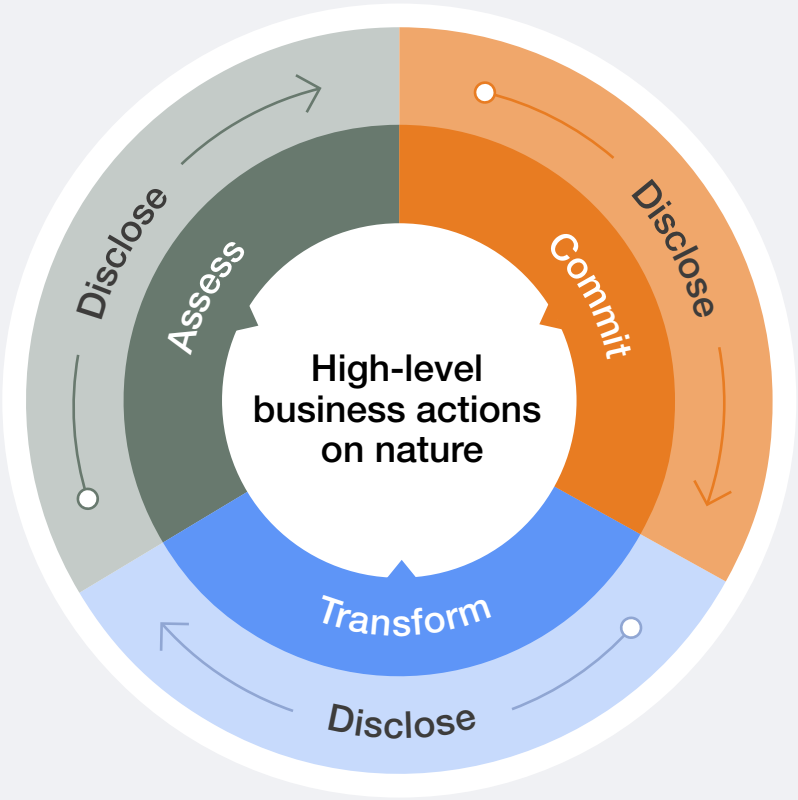
Source: Adapted from Science Based Targets Network (SBTN). (2020). *Science-Based Targets for Nature: Initial Guidance for Business, 2020*.

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 port sector.

1 Where the sector is today

Given the growing volume of global trade and the potential increasing impacts on nature, the sector must act urgently to contribute to nature-positive goals.

1.1 Sector overview

Port infrastructure and services are critical to keeping global supply chains functioning.[31] According to the UN Conference on Trade and Development (UNCTAD), maritime trade – facilitated by port operations – makes up 80% of global trade.[32] In many countries with limited land borders, such as the United Kingdom and Singapore, nearly all international trade passes through ports.[33]

In 2021, global maritime trade volumes reached 10.99 billion tons of goods traded, a 25% increase from 8.78 billion tons in 2011.[34] Despite fluctuating in recent years due to the impact of the COVID-19 pandemic and economic and geopolitical instability, global maritime trade is expected to grow in future – 2.4% in 2023 and 2.1% over the next five years[35] – increasing the demand for port operations. In particular, the demand for container transport is growing most rapidly: container port traffic in 2022 was approximately 840 million twenty-foot equivalent units (TEUs) globally, an increase of about 219% compared to 2002.[36]

BOX 1 Definition of the port sector

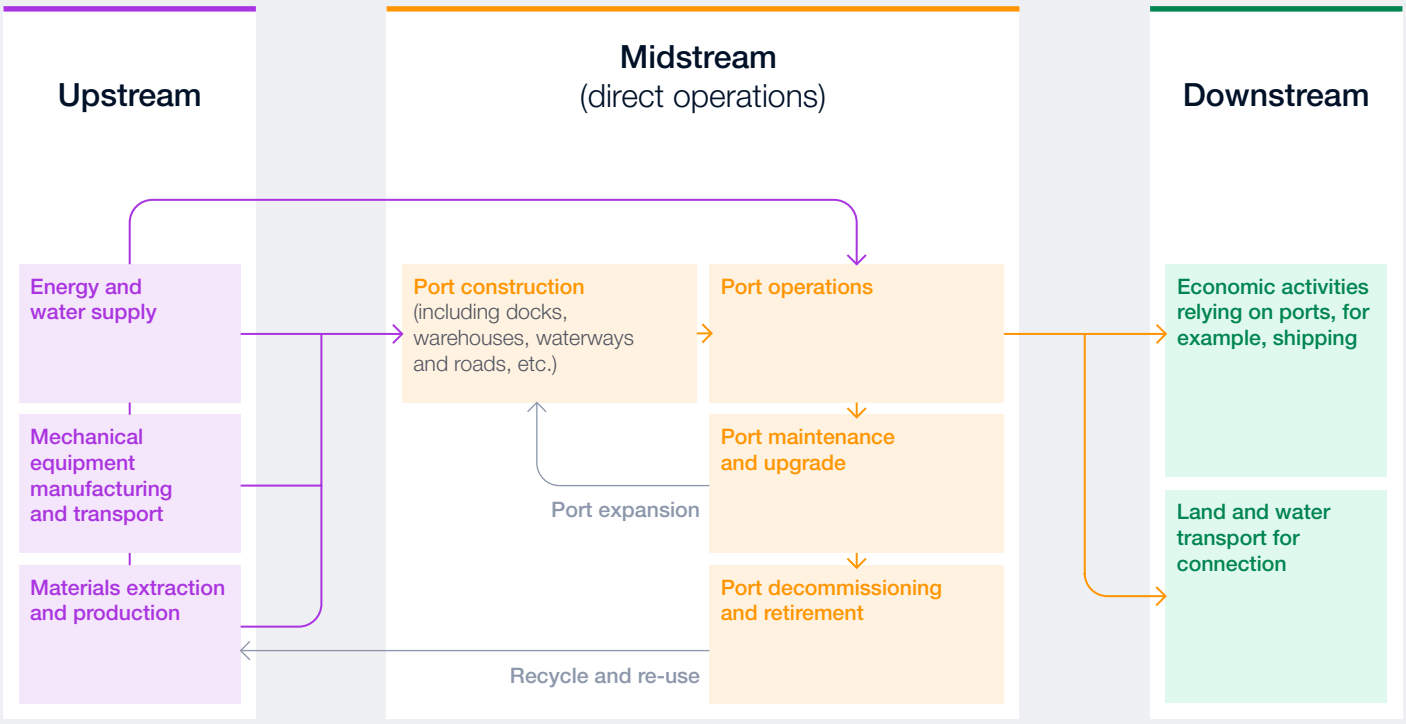
A port is a place where water and land meet, and ships can dock for commercial purposes of either handling cargo or passengers or taking care of the ship's requirements.[37] Many ports are recognized as significant industrial and energy hubs considering their extensive industrial activities. Ports are normally controlled, operated and run by a port authority, which sets the commercial tariff for the handling of ships, goods and passengers at that port. Depending on the types and scales, the port authority may contract with different companies to operate within a port, for example, terminal operators.

The port sector, for the scope of this report, is defined as encompassing the construction (of infrastructure) and operation (to provide services) phases of ports.

In addition, this report will consider the full value chain for ports, including the upstream industries that provide essential support and downstream economic activities that depend on the existence of ports.

For the purposes of this report and its focus on the overall port ecosystem, no official classification has been used. The definition involves several industries within Sustainability Accounting Standards Board's (SASB) Sustainable Industry Classification System (SICS), including Infrastructure – Engineering & Construction Services, Services – Professional & Commercial Services, and Transportation – Marine Transportation. This approach is strongly aligned with WBSCD's analysis of the built environment system.[38]

FIGURE 5 **Simplified value chain of the port sector**



Determining the precise number of ports globally is challenging due to discrepancies in definitions and classifications, as well as the continuous development of new ports, while others may be decommissioned or undergo changes in their operational status. The Marine Vessel Traffic database enumerates the names and geographical locations of 4,702 ports across 170 countries.[39] The World Port Index (WPI), published by the National Geospatial-Intelligence Agency (NGA) of the United States, offers comprehensive details on over 3,700 ports globally.[40] The Lloyd's List provides comprehensive information and key characteristics on 2,916 ports.[41]

Ports are being constructed and expanded around the world – the value of ongoing port construction projects was $496.5 billion in Q3 2024, from the early pre-planning stages (of announcement and study) through to execution. The value of projects being tracked in Sub-Saharan Africa and Middle East and North Africa (MENA) stands at $64.9 billion and $64.5, respectively, with 43.6% and 85.2% of projects in the execution stage.[42]

Ports are not only vital to international economic activity but also contribute heavily to many countries' employment and economic growth. Globally, 30 million people are employed in the port sector directly, and 90 million jobs are indirectly related to port ecosystems more broadly. It is estimated that, for every direct job in port operations, 3-4 additional jobs are created in related industries. In some African countries, up to 6% of employment is in ports, with Egypt, Morocco and South Africa seeing the highest port throughput.[43]

While ports contribute significantly to domestic and global economic and social development, they can have substantial negative impacts on nature. Without careful planning, port construction can destroy land and water ecosystems. Likewise, port operation and downstream economic activities can lead to varying degrees of pollution, greenhouse gas (GHG) emissions and species invasions.

Specifically, the dramatic changes in coastline and water use caused by port construction and operations have major impacts on the marine environment. For example, loss and pollution of natural coastal ecosystems during port construction can harm marine biodiversity and reduce nature's innate ability to protect coastal communities from flooding and storm surge, frequent dredging can suffocate benthic species (animals or plants that live in, on or near the bottom of a body of water) and disrupt the food chain, and shipping traffic can cause noise and water pollution that harm species.

Given the growing volume of global trade and the potential increasing impacts on nature, it is crucial for the port sector to take action and transform port operations and value chains to contribute to nature-positive global goals.

1.2 Progress is promising but needs to accelerate

The Alternative Fuels Infrastructure Regulation sets targets for the deployment of shore-side electricity supply for larger seagoing container and passenger ships.

International organizations and governments have long recognized the importance of mitigating environmental impacts, such as pollution and GHG emissions, from ports.

The International Convention for the Prevention of Pollution from Ships (MARPOL), adopted by the International Maritime Organization (IMO) in 1973, stands as a crucial international treaty dedicated to preventing marine and air pollution resulting from ship operations or accidents. Over the past five decades, it has played a pivotal role in effectively mitigating pollution and, while ships are within port boundaries, safeguarding port areas and their surrounding ecosystems. It also encourages member states to provide reception facilities at ports to support waste management and prevent pollution at sea.[44]

The International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention), entered into force globally on 8 September 2017. Since then, ships must manage their ballast water so that aquatic organisms and pathogens are removed or rendered harmless before the ballast water is released into a new location. This is expected to help prevent the spread of invasive species as well as potentially harmful pathogens.[45]

EU regulations also have impacts on the construction and operation of port infrastructure. For example, the FuelEU Maritime Regulation adopted in July 2023 sets maximum limits for the yearly average GHG intensity of the energy used by ships above 5,000 gross tonnage calling at European ports, regardless of their flag.[46] The Alternative Fuels Infrastructure Regulation, applicable since 13 April 2024, sets targets for the deployment of shore-side electricity supply for larger seagoing container and passenger ships in maritime ports and for inland waterway vessels.[47] From 2024, the EU Emissions Trading System (ETS) also covers carbon dioxide (CO_2) emissions from maritime transport, specifically 50% of emissions from voyages starting or ending outside of the EU and 100% of emissions from voyages between two EU ports and when ships are within EU ports. Shipping companies have to purchase and surrender (use) EU ETS emission allowances for each tonne of reported CO_2 (or CO_2 equivalent) emissions in the scope of the EU ETS system.[48]

of the gravel will be replaced by high-quality concrete pellets in the Port of Rotterdam.

However, less focus internationally has been on ports than on shipping, given ports are not internationally governed. Some leading ports have acknowledged their impacts on nature and have made their own commitments to take action. For example:

- Port of Darwin in Australia has issued a number of environmental protection plans, including an environmental management plan and minimum environmental expectations, to minimize the impact of arriving ships on the local ecosystems.[49]
- Port of Rotterdam in the Netherlands is constructing the Porthos carbon capture and storage (CCS) project, with which the CO_2 storage will reduce emissions from the companies in the port by 10%. It is also dedicated to the recycling of concrete particles in circular buildings by partially using recycled concrete in all construction works – 25% of the structural concrete base material (gravel) will be replaced by high-quality concrete pellets.[50,51]
- The Port of Singapore incentivizes GHG emission reduction in ships by offering up to 30% reduction in port dues for ships using zero- or low-carbon fuels.[52] The Mormugao Port in India is providing a discount on the port dues component of the vessel-related charges for the eco-friendly vessels calling at the Mormugao Port based on the environmental ship index (ESI) score given by the International Association of Ports and Harbours (IAPH).[53]

While recognizing that many ports have already made progress in considering and addressing climate change and environmental pollution, the sector now requires systematic thinking and accelerated action to support nature-positive goals. Ports should be fully aware of their relationship with nature and consider the entire value chain when it comes to decision-making.

With growing expectations from financial institutions, employees and customers, as well as anticipated new policy and regulation worldwide, the business case for action on nature has never been stronger. Corporate leaders should start 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.

The stages of ACT-D will also need to be supported by a range of other activities, including agreeing on definitions, determining materiality thresholds, mapping assets and operations, gathering information on existing nature-related activities, making the case for nature action internally within your organisation (beyond disclosure), and establishing the vision of success.

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**[54] and **prioritize**[55] from SBTN.
Commit	Follow the approach the International Union for Conservation of Nature (IUCN) is developing to **measure nature-positive**[56] and **set targets**. Set science-based targets, taking inspiration from the technical guidance provided for **freshwater, land, ocean and biodiversity** by SBTN.[57] 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;[58] invest resources and commit management to deliver against clear targets.[59]
Disclose	Consult the final **recommendations**[60] from TNFD for nature-related disclosures. For climate, refer to the ISSB guidance on disclosure of **sustainability-related financial information** and **climate-related disclosures**.[61] Use CDP's **disclosure platform**, which includes guidance on climate change, forests, water security, biodiversity and plastics.[62]

Note: This table is non-exhaustive. For more tools and guidance, see *High-level Business Actions on Nature* and *The Nature Strategy Handbook*.

2 Nature-related impacts and dependencies

Without corrective action, nature-related risks will escalate, threatening business models for a sector highly dependent on nature.

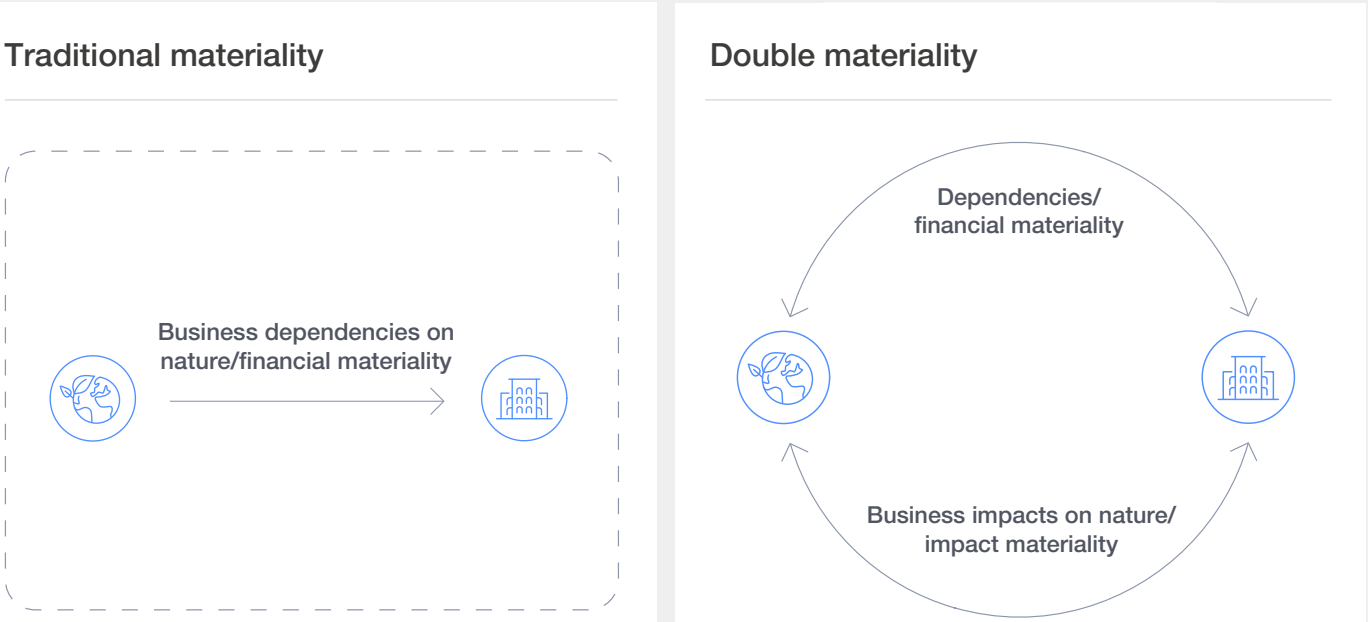
2.1 Double materiality

Ports can take action to accelerate the nature-positive transition if they better understand their interactions – both impacts and dependencies – with nature. By adopting double materiality decision-making to both their own operations and related economic activities in the entire port value chain, they could scale their contributions.

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 6). 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).

The port sector has high dependencies on nature, including environmental assets and ecosystem services.[63,64]

FIGURE 6 **Double materiality**



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

As large physical infrastructure, the construction and operation of ports depend primarily on available and high-functioning land and sea assets. Port terminals must be built on suitable coastlines, and distribution sites for stacking containers or storing goods require surrounding easily accessible land. Ship navigation and berthing require safe, open, functioning water systems. Port waters must be maintained at a certain depth for navigational safety, and high water quality is important for port infrastructure, ships and staff.

Some of the sector's dependencies are hidden in its value chain, especially in upstream activities and the transport of resources and people for port construction and operation.

Ports are situated at a critical juncture between land, sea and – frequently – rivers, making them particularly reliant on stable environmental conditions and vulnerable to extreme weather events. Overall, 86% of ports are exposed to more than three natural hazards, including cyclones and flooding,[65] and many ports are also at risk from rising sea levels due to global climate change.[66] Green infrastructure can provide a degree of protection against natural disasters such as storms and flooding. Mangrove forests are one of the best-documented examples of natural or green infrastructure, providing $ 250 million worth of flood protection in coastal regions where they grow.

Port operations depend on large amounts of energy to operate equipment and to supply ships with shore power. Currently, many companies are promoting a shift from traditional fossil fuels to electricity, with the aim to supply the majority from renewable sources. The increasing adoption of electric equipment – such as electric container cranes, hybrid tugs and autonomous vehicles – has led to a rising demand for electricity in ports. To mitigate the risk of sudden energy shortages that could potentially result in shutdowns of port operations and surrounding areas, ports are enhancing their self-sufficiency in electricity by developing generation and storage facilities for renewable energy. However, this shift may also have significant implications. Renewable installations (solar or wind) can affect terrestrial or marine ecosystems, while new hydropower projects are major contributors to freshwater species decline.

Ports also rely on natural resources such as minerals, energy and water throughout the entire value chain.[67] Some of the sector's dependencies are hidden in its value chain, especially in upstream activities and the transport of resources and people for port construction and operation.

Beyond their dependencies on nature to ensure successful port construction and smooth, functioning operations, ports also generate significant impacts on nature. The top four drivers of nature loss in the port sector include land/water/sea use changes, GHG emissions, pollution and invasive species. Ports should avoid and mitigate these impacts caused by their operations and economic activities throughout the value chain.

TABLE 2

Top four drivers of nature loss in the value chain of the port sector

	Upstream	Midstream (construction and operation)	Downstream
Land/water/sea use change	✓	✓	
Greenhouse gas emissions	✓	✓	✓
Pollution	✓	✓	✓
Invasive species		✓	✓

Pressure materiality rating (ENCORE): High Medium

Note: See methodology in the Appendix.

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 port sector, but company-specific impacts and dependencies will vary according to their specific 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,[68] as well as the SBTN's step 1 (assess)[69] and step 2 (prioritize)[70] are useful frameworks to guide companies through their own assessments.

The full methodology and results of this assessment can be found in the Appendix.

These impacts and dependencies strengthen the case for ports to invest in nature and transform their operations to contribute to global nature-positive goals beyond the level needed to comply with international and local environmental regulations.

2.2 Land, water and sea use change

The land area of some large ports can be as large as hundreds of square kilometres, with water/sea area extended to thousands of square kilometres beyond it.

Ports are located at the junction of land, water and sea, which are often critical habitats and breeding grounds for native endemic flora and fauna. The land area of some large ports can be as large as hundreds of square kilometres, with water/sea area extended to thousands of square kilometres beyond it. For example, the Port of Shanghai covers an area of approximately 3,619 square kilometres.[71] In addition to the construction of necessary terminals along the coastline, ports occupy substantial areas of adjacent land to build supporting facilities such as cargo yards, warehouses, roads and offices. The use of raw materials throughout the entire value chain can contribute to the loss of nature, so an overconsumption of natural resources could be a driver of nature loss due to the port sector.

Port construction and operation disturb and alter the use of land, water and sea, resulting in habitat destruction and increased siltation. If not properly managed, this could have additional impacts on ecosystem services – the heat island effect, exacerbating coastal erosion and flood risk, and water quality runoff.

One of the most significant physical impacts in port construction and maintenance occurs on the ocean floor. River, bay and ocean floors constantly change as currents and other environmental factors cause sediments to shift and accumulate. To ensure the safety of ship navigation and avoid ships running aground, ports need to regularly monitor the depth of the waterways and dredge if needed to maintain or deepen the port area. Additionally, ports may dredge to accommodate new routes or larger vessels, as well as to remove hazards to ships. Dredging can disturb and damage the sea floor, creating biodiversity loss and destruction of habitats.

Globally, 41% of ports have indicated that they intend to use more land for logistics and distribution activities, and 38% plan to expand their land use to accommodate non-fossil energy production.[72] As global maritime trade volumes increase, dredging is likely to follow to maintain ports and accommodate additional traffic. If the current trend continues, the land, water and sea use change caused by the development of ports will likely result in some species facing existential crises due to habitat loss.

Furthermore, ports can facilitate the trade of goods that may entrench unsustainable production practices, adversely affecting both nature and climate. Given that ports generate revenue from the products they handle, it is imperative for them to be aware of and accountable for the impacts of these goods.

2.3 Greenhouse gas emissions

A unified standard for GHG emissions reporting across the sector remains challenging.

GHG emissions of ports throughout the value chain remain significant, considering the number of ports worldwide and the growing demand for shipping. GHG emissions are produced from economic activities at every aspect of the value chain – upstream energy supply and equipment manufacturing; midstream port construction and terminal operations, which account for a relatively small share of GHG emissions;[73] and downstream transport and related economic activities, which account for the majority of emissions if shipping activity is taken into account.[74]

The methodology for measuring the GHG emission data in ports has not yet been standardized internationally. For example, questions remain as to the definition and scope of port activities in GHG emissions accounting and whether freight transport should be included. Shipping is a significant emitter. International shipping would be the sixth largest emitter of CO_2 if it were considered a country. Therefore, a unified standard for GHG emissions reporting across the sector remains challenging.

The IMO defines port boundaries as starting from the point at which a ship slows down while approaching from the high seas.[75] The European Federation for Transport and Environment (T&E) quantifies ports' GHG emissions from activities by ships at berth, including loading, unloading or refuelling activities. For example, T&E concluded that the Port of Rotterdam emits 13.7 million tons of CO_2 annually, while the Port of Antwerp emits 7.4 million tons.

It is worth noting that transport through ports remains the most efficient compared to alternatives like air and road transport, based on its relatively low energy consumption and GHG emissions per unit of carrying capacity. While the direct GHG emissions from port operations are relatively low, the efficiency of port operations has significant effects on the amount of GHG emissions from ships. Without efficient operation and good connections with a downstream transport network, delays of ships and cargo in the port can cause indirect GHG emissions.

2.4 Pollution

With the promulgation of relevant conventions and regulations by international organizations and governments and the increasing awareness of nature conservation within the port sector, progress has been made to mitigate pollution in and around ports. However, more needs to be done to improve pollution prevention and mitigation. Pollution in ports comes from a variety of sources, including water, air, solid, soil, noise and light pollution from the construction and operation of the port itself, as well as pollution due to incidents, such as oil and dangerous chemical spills.

- **Water pollution**: This is typically pollution from fuel-powering ships and oil carried as cargo. These pollutants can be spilt because of ship collisions, groundings, and improper loading, unloading and storage. In addition, dangerous chemicals carried by ships, raw sewage and domestic waste can pollute the port and surrounding water bodies.
- **Air pollution**: This is typically generated from a wide range of sources, including fuel-powered cargo handling equipment, ships, port vessels, trucks, railroad locomotives, passenger vehicles, power supply, etc. In addition to CO_2, nitrogen oxides (NO_x), sulfur oxides (SO_x), methane (CH_4), and particulate matter (PM) are also important sources of air pollution in port areas.[76]
- **Noise pollution**: This is generated by the operation of ships, transport vehicles and large machinery, including equipment loading and unloading. Irregular and high-decibel noise can affect surrounding residents and animals.
- **Light pollution**: This is caused by intensive illumination from construction activities, berthed ships, port operations, etc. Severe light pollution can disturb surrounding animals' foraging, breeding and migration, leading to disorientation and altered behavioural patterns.
- **Soil contamination**: Soil mixing caused by the port's construction and maintenance results in chemical changes in the soil. Additional soil contamination may occur from waste and the dredging process required to maintain the waterways.
- **Solid waste**: Port operations generate solid waste from different types of port activities, including glass, metals, plastics, wastepaper, wood, rubber, leather, etc. When offshore structures and ships reach the end of their productive life, they must be decommissioned and dismantled, recycled or disposed of. It is a complex and, in many cases, hazardous business.[77]

2.5 Invasive species

In the following 30 years, the risk of marine biological invasion will increase by a factor of 3 to 20.

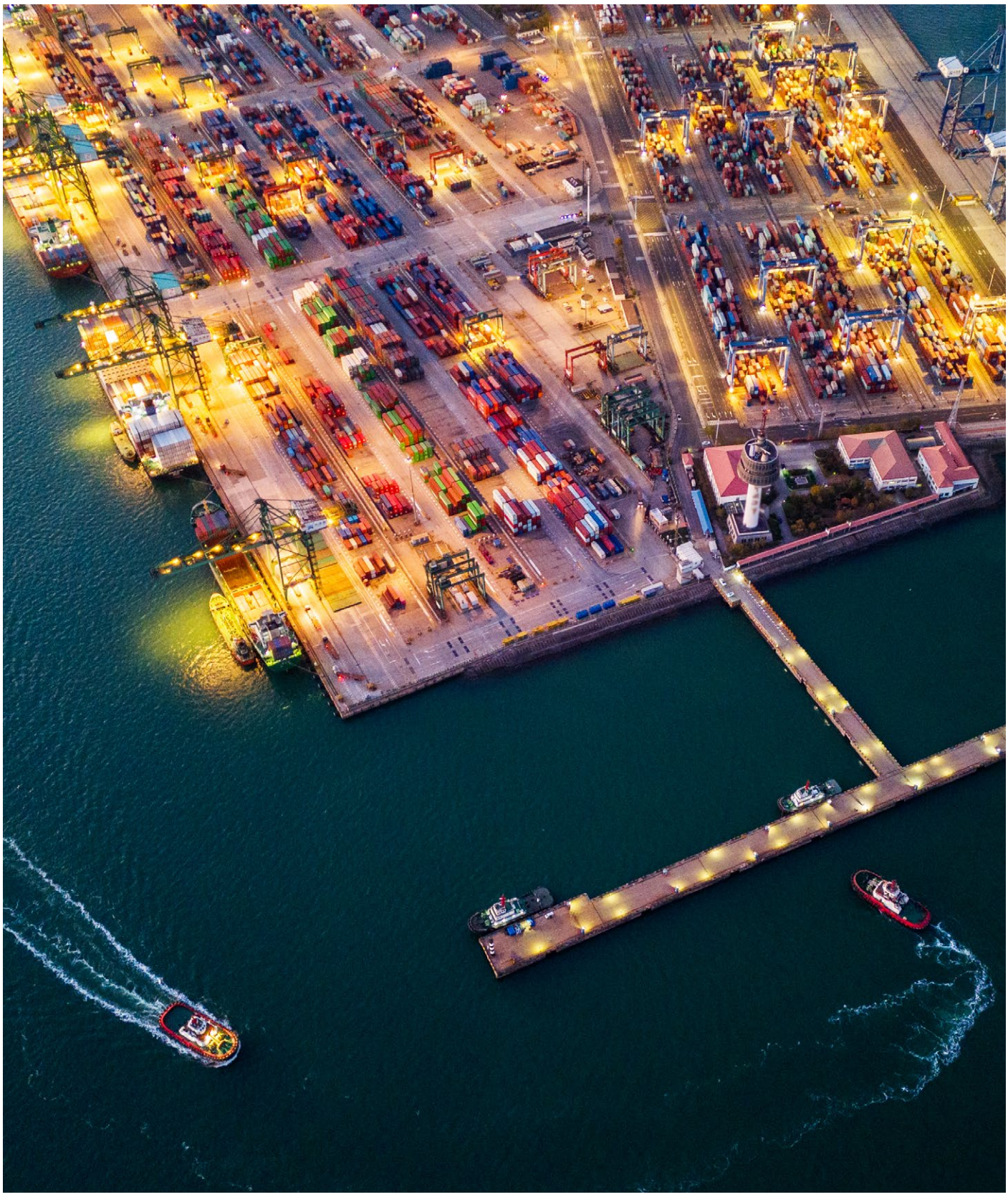
Due to their role in connecting countries and continents by cargo and passenger transport, ports elevate the risk of invasive species proliferation. It is estimated that more than 80% of the world's marine ecoregions are affected by at least one harmful invasive species.[78] They compete with local species for nutrients and living space and reduce local biodiversity. A 2020 study of global shipping and its effects on biological invasion projected that in the following 30 years, the risk of marine biological invasion will increase by a factor of 3 to 20.[79]

Invasive species arrive in ports mostly through three channels:

- **Ballast water**:[80] Plankton, microorganisms, bacteria and even small fish, as well as eggs, larvae or spores of various species, are pumped into ballast tanks and may be released into new environments as ships arrive in destination ports. For example, zebra mussels entered North America through ballast water and caused significant economic loss.[81]
- **Biofouling**: Algae, microorganisms, mussels, barnacles, etc., can attach to hull surfaces, as well as to propellers, rudders and compartments submerged in the sea. These species can follow the ships into new environments and colonize.[82] Studies have revealed over 2,000 common marine fouling species, which can increase the weight and resistance of the ship and result in unnecessary fuel consumption.[83] The use of anti-fouling paints on ships and terminals can provide a degree of protection against attachment, decay and fouling of those marine organisms. However, care must be taken to ensure that anti-fouling paints used are environmentally safe to avoid toxicity to other organisms.
- **Cargo carried**: Invasive animals, insects and plants arrive in new environments with cargo such as containers, logs and grain. They can be released to new environments during loading, unloading and storage if no screening or decontamination is conducted. They may also carry pathogens,[84] causing invasive species and plague transmission risks.

3 Five priority actions

By taking five priority actions on nature, the sector can unlock over $54 billion in value by 2030.



While some of these actions have already been adopted by leading businesses, this report calls for accelerated efforts in more countries and regions at a greater scale.

Considering the impacts and dependencies the port sector has on nature, a transition towards a nature-positive future is critical. Acknowledging the existing efforts businesses in the port sector have already made through extensive analysis and consultations, this report has identified five priority actions (see Figure 7) and calls for wider implementation to accelerate this transition:

- Sensitively plan port areas to minimize impacts on nature
- Enhance the use of clean energy, sustainable materials, and advanced equipment and operating systems
- Improve prevention and mitigation capacity against pollution and invasive species
- Promote a circular economy and catalyse cross-sector collaboration in regulation, finance and innovation
- Actively protect and restore nature

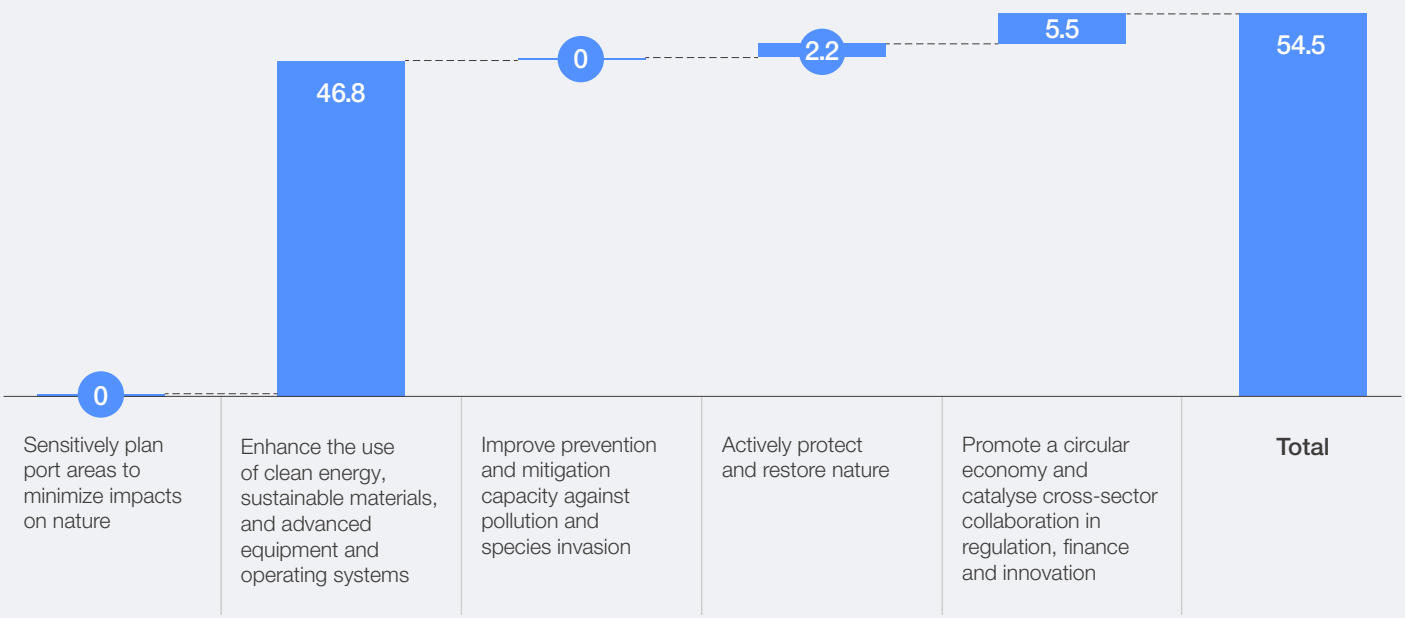
Given that the port sector's impacts and dependencies are reflected to varying degrees across the entire value chain, these priority actions call for businesses to actively engage with stakeholders, including government departments, engineering and construction firms, shipping companies, transport companies and industry peers to jointly facilitate the nature-positive transition of the value chain. A joint effort from stakeholders across the entire value chain is needed to incorporate the just transition and efforts to socially equitable outcomes. While some of these actions have already been adopted by leading businesses, this report calls for accelerated efforts in more countries and regions at a greater scale.

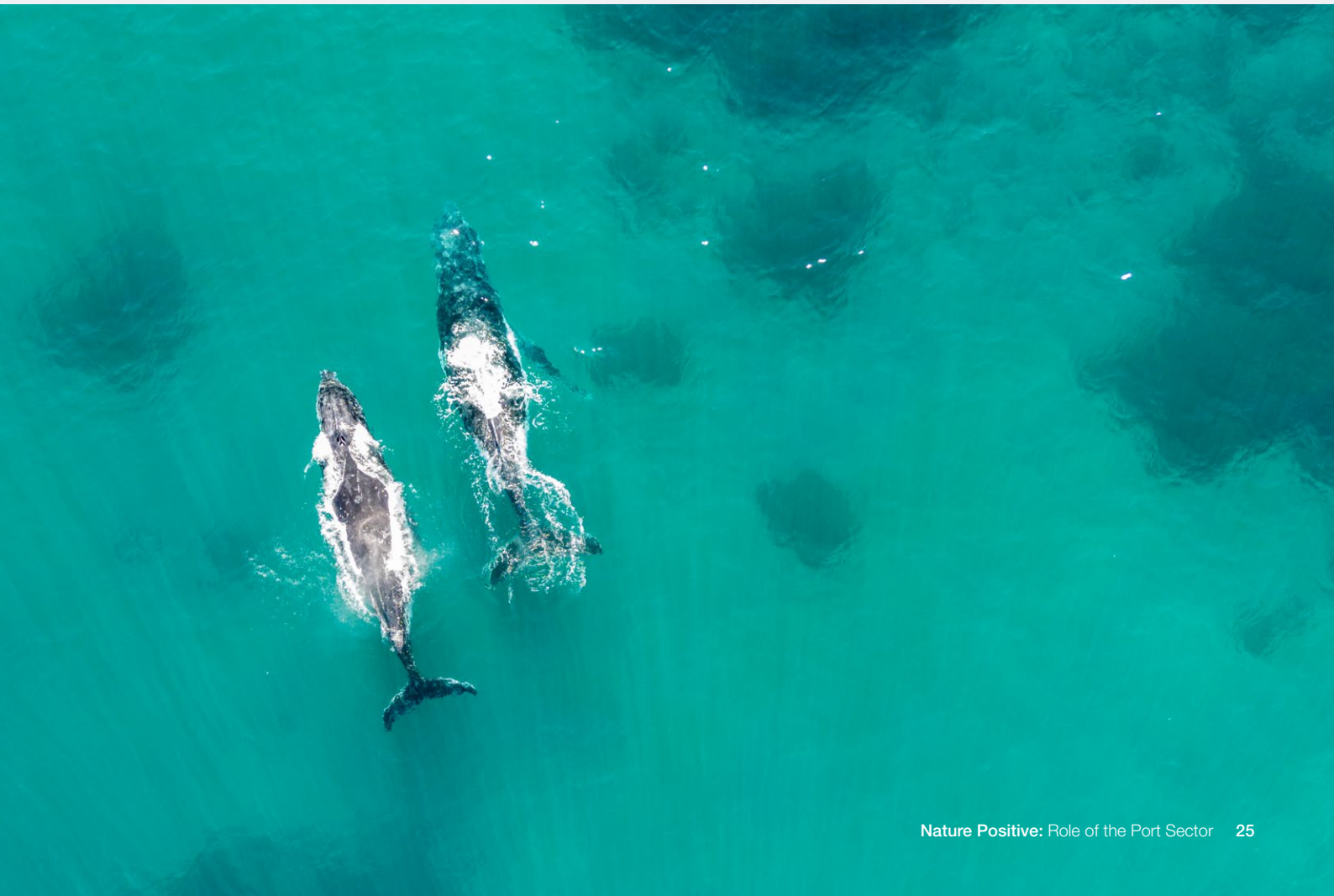
FIGURE 7 **Five priority actions for the port sector**

The nature-positive transition can also present enormous opportunities for companies in this sector. The Forum's 2020 *Future of Nature and Business* report estimated that a full nature-positive transition in the global economy could create $10.1 trillion of annual business opportunities by 2030. Of this amount, estimates show that undertaking the priority actions for the port sector could unlock more than $54 billion in cost savings and revenue upside by 2030 for businesses operating across the sector's value chain (see Figure 8 and Table 3).

However, estimates indicate the value associated with this transition could exceed the total valued opportunity, as the sizing approach did not cover the entire set of business opportunities that present themselves for the sector.

FIGURE 8 **Business opportunities for the port sector by 2030 ($, billion)**





To calculate the opportunity summarized in the waterfall in Figure 8, 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 port 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 the port sector	Opportunity size for the port sector ($ billion)
1 Sensitively plan port area to minimize impacts on nature			Ports sector share of global GDP: **2.60%**	
2 Enhance the use of clean energy, sustainable materials, and advanced equipment and systems	Energy efficiency – buildings	825		21.44
	Wastewater reuse	50		1.30
	Sustainable infrastructure financing	295		7.67
	Green long-range transport	220		5.72
	Fourth Industrial Revolution-enabled long-distance transport	75		1.92
	Energy efficiency - non-energy intensive sectors*	337		8.74
3 Improve prevention and mitigation capacity against pollution and invasive species				
4 Promote circular economy and catalyse cross-sector collaboration in regulation, finance and innovation	End-use steel efficiency	210		5.46
5 Actively protect and restore nature	Nature climate solutions	85		2.21

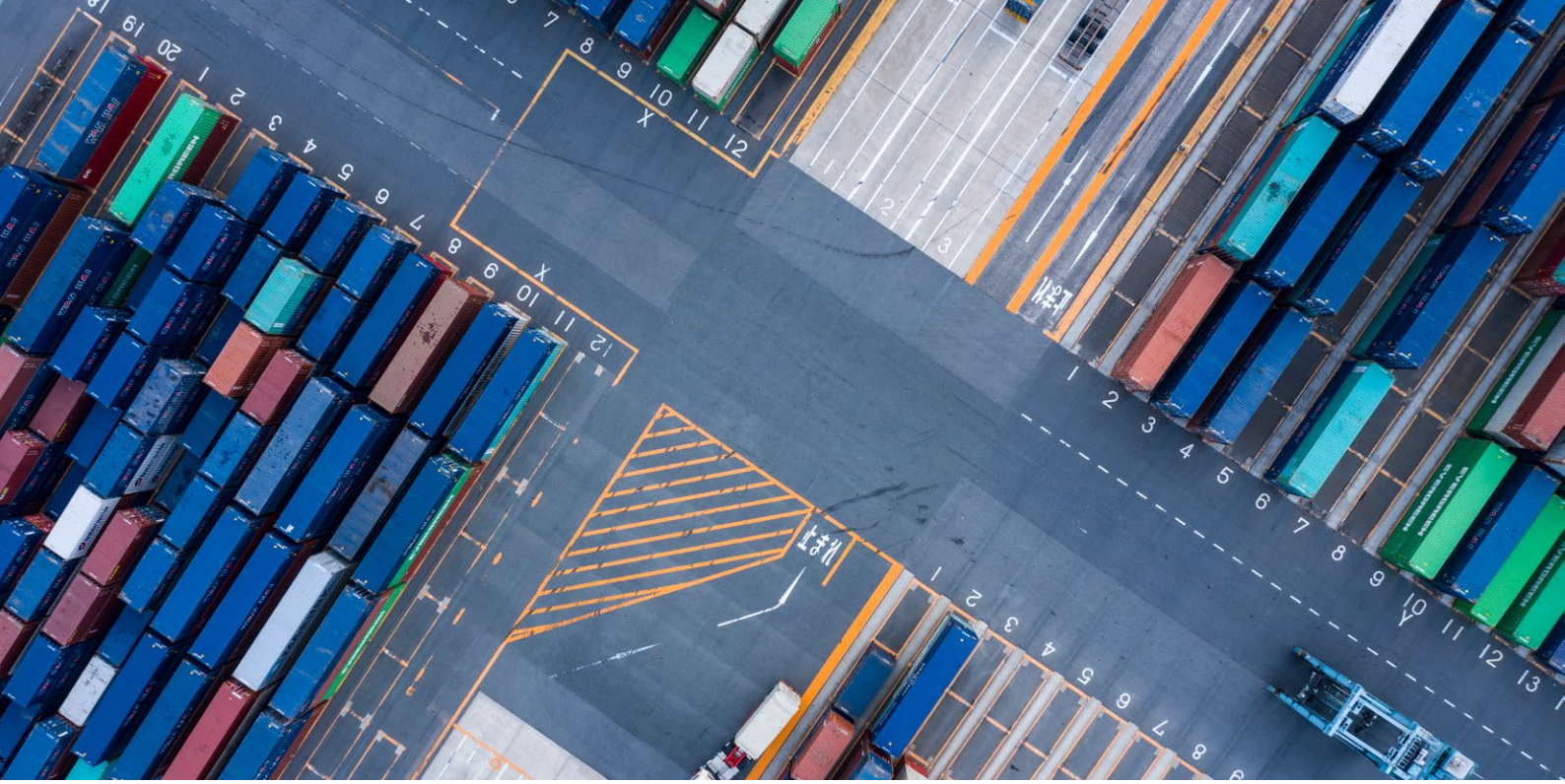
*Additional opportunity beyond *Future of Nature and Business* report analysis.

Taking these five priority actions across direct operations and the wider value chain will help companies in the sector avoid or reduce the four drivers of biodiversity loss (land/water/sea use change, GHG emissions, pollution and invasive species) across the four nature realms (land, ocean, freshwater and atmosphere), mitigate risks to operations and unlock commercial opportunities. These actions will also contribute to the targets of the Global Biodiversity Framework, which aims to halt and reverse biodiversity loss by 2030 (see Table 4).

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

	Selected targets from Kunming-Montreal Global Biodiversity Framework (non-exhaustive)										
	1 Plan and manage all areas to reduce biodiversity loss	2 Restore 30% of all degraded ecosystems	3 Conserve 30% of land, waters and seas	6 Reduce the introduction of invasive alien species by 50% and minimize their impact	7 Reduce pollution to levels that are not harmful to biodiversity	8 Minimize the impacts of climate change on biodiversity and build resilience	12 Enhance green spaces and urban planning for human well-being and biodiversity	14 Integrate biodiversity in decision-making at every level	15 Businesses to assess, disclose and reduce biodiversity-related risks and negative impacts	19 Mobilize $200 billion per year for biodiversity from all sources, including $30 billion through international finance	20 Strengthen capacity building, technology transfer, and scientific and technical cooperation for biodiversity
	Indirect contribution / Direct contribution										
1 Sensitively plan port area to minimize impacts on nature	Indirect		Direct				Direct	Indirect	Indirect		
2 Enhance the use of clean energy, sustainable materials, and advanced equipment and operating systems					Indirect	Direct	Indirect	Indirect			
3 Improve prevention and mitigation capacity against pollution and invasive species	Indirect		Direct	Direct	Direct			Indirect	Direct		
4 Promote a circular economy and catalyse cross-sector collaboration in regulation, finance and innovation	Direct		Indirect	Indirect			Indirect	Indirect	Direct	Indirect	Direct
5 Actively protect and restore nature		Direct	Direct		Direct		Direct	Indirect	Direct		

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 Sensitively plan port area to minimize impacts on nature

> The concepts of nature conservation and biodiversity protection should be integrated into all stages of the port life cycle, including planning, construction, upgrading and decommissioning.

Companies should follow the mitigation hierarchy at the site level, in a landscape context, taking into consideration direct, indirect and cumulative impacts. They should first **avoid** impacts, then **reduce** impacts, **restore**, and finally **compensate**[85] for unavoidable residual impacts.[86,87,88,89,90] Mitigation efforts should align with an NNL or BNG goal for each project.[91]

Making the most of limited port space to maximize port value chain efficiency and minimize impacts on nature requires both businesses and government to actively contribute to a nature-positive transition through careful planning. The concepts of nature conservation and biodiversity protection should be integrated into all stages of the port life cycle, including planning, construction, upgrading and decommissioning. Ports should be planned in an integrated and coordinated way, with an aim to simultaneously meet business and operational needs and minimize impacts and dependencies on nature.

The port sector is encouraged to minimize impacts and dependencies by striving to:

Avoid operating within areas of high biodiversity value to minimize impacts on natural ecosystems.

Ports and businesses across the entire value chain should avoid construction and operations within areas of high biodiversity value, such as Key Biodiversity Areas and Marine Protected Areas. Shipping channels need to be carefully planned to minimize impacts on local species' habitats from frequent ship movement and maintenance dredging. Overland structures should also consider their impacts on bird migration.

Plan and integrate port infrastructure and facilities sensitively to minimize land/water/sea use change.

Port infrastructure and facilities occupy large areas of natural land, coastline, water and sea. When planning a new port, developers should consider, wherever possible, making use of existing developed space to avoid land-use change. During redevelopment, infrastructure and facilities should be integrated, and the planning should consider potential additional space for clean energy facilities, if applicable, such as solar panels, wind turbines and energy storage facilities. If, due to historical reasons, the existence of a traditional port continuously has an impact on the Indigenous Peoples and the local environment, consideration can also be given to returning the land and finding a new suitable location for the port.

Further actions port developers can take to ensure nature-positive goals are considered in port planning:

- The port area should be adapted to local coastal conditions to minimize the amount of land/water/sea use change.

Ports are encouraged to use nature-based solutions and green infrastructure to provide disaster reduction services.

- The port's spatial arrangement should match the zoning of its different functions and optimize space use and connectivity between sections. Planning should fully consider nature. Natural conditions such as natural bays and deep troughs should be used to efficiently lay out wharves, harbour pools, fairways and anchorages to reduce the amount of construction work in the early stages and dredging and maintenance in later stages.
- Planning needs to consider the space for clean energy facilities, such as wind turbines and fundamentals.
- Make use of vertical space to accommodate facilities, such as air rail container transport and solar panels.

Plan ports in an integrated, coordinated way with upstream and downstream value chains, including efficient multi-modal transport networks, intensive industrial zoning, concentrated supply chains, etc.

Across the value chain, ports should implement the following actions to minimize land/water/sea use change:

- Position upstream and downstream industries in proximity to ports to optimize supply chain transport efficiency.
- Plan container, liquid and dry bulk cargo terminals to coordinate inbound rail, waterway and pipeline connections.
- Develop inland ports with direct and frequent connections to optimize cargo distribution.
- Ensure moderate separation between port transport collection and evacuation network from urban transport while arranging transition and buffer zones between ports and cities.
- Coordinate planning with external utilities services, such as power supply, waste management, wastewater treatment and water supply.
- Coordinate port planning and functions with other ports in the region to maximize efficiencies.

Integrating sustainable practices throughout the supply chain involves using advanced technologies and data analytics to optimize logistics, reduce emissions and minimize waste.

By facilitating collaboration among stakeholders, including shipping companies, local communities and environmental organizations, ports can implement initiatives that promote biodiversity, restore natural habitats and support local ecosystems. Ultimately, the goal is to shift towards a nature-positive port model that balances economic growth with ecological preservation, ensuring that port activities contribute positively to the environment.

Ports are also encouraged to use nature-based solutions and green infrastructure to provide disaster reduction services, particularly for river and coastal flooding and sediment/erosion control, which increases the need for dredging. All ports should evaluate opportunities to use these strategies to offset built infrastructure needs and improve performance.

CASE STUDY 1

DP World London Gateway Port and Logistics Hub

DP World London Gateway Port and its Logistics Hub provide a good example of how effective planning can successfully integrate measures into the master planning to minimize impacts on nature and enhance the environment, including:

- Rehabilitation of a former oil refinery site, including remediation of soils and groundwater.
- Construction of 3.4 km of open surface water drainage corridors and balancing ponds that are integrated into the landscaping strategy and design for the Logistics Park. These corridors provide important drainage infrastructure for the operations and habitats of a wide range of species, including protected and endangered water voles. This is a good example of working with nature to achieve engineering needs.
- Designation of DP World-owned land surrounding the operational areas as mitigation land provides over 80 hectares of habitat, including more than 50 ponds for the protected great crested newt. This also provides a green habitat corridor surrounding the development.
- To offset impacts associated with the port development, two locations were established for the construction of new intertidal wetland (mudflat) habitat through managed realignment of existing flood defences. These have been successfully implemented and monitored for several years, providing more than 80 hectares of important intertidal habitat for overwintering water birds and other species, together with additional land areas providing habitat that is enhanced through successful management strategies.

Priority action 2

3.2 Enhance the use of clean energy, sustainable materials and advanced equipment and operating systems

> In alignment with the IMO strategy to eliminate GHG emissions within this century, a nature-positive port should strive to become zero-emission.

The sustainable transformation of energy, materials, equipment and operating systems is an important action not only to contribute to a nature-positive transition but also to reduce energy use and improve operational efficiency, thereby reducing costs and enhancing ports' competitiveness.

In alignment with the IMO strategy to eliminate GHG emissions within this century, a nature-positive port should strive to become zero-emission. This ambitious goal involves adopting innovative technologies, sustainable practices and eco-friendly operations to minimize environmental impact, ultimately contributing to a cleaner and healthier planet.

Ports should optimize their energy portfolio by increasing the use of clean energy sources such as renewable electricity or by installing wind turbines, solar panels, geothermal energy solutions and tidal energy facilities within the port area where appropriate and feasible. Concurrently, it is essential to introduce and adopt advanced energy management solutions (e.g. smart grid management systems) alongside battery storage systems. For example, with the container terminals, PSA International aims to progressively transition all diesel-based container handling equipment to cleaner energy sources through electrification as well as low or zero-carbon sources, like hydrogen.

Within the wider port value chain, ships account for a significant share of GHG emissions. Many shipping companies have taken actions to promote the research, development and deployment of low- or zero-emission marine fuels and advanced propulsion technologies. To mitigate pollution and GHG emissions and to reduce fossil fuel dependency, ports should also improve or retrofit storage and refilling facilities to accommodate increasing quantities of green alternative fuels needed for green shipping, including methanol, hydrogen and ammonia. They should also invest in the use of shore power for ships in port.

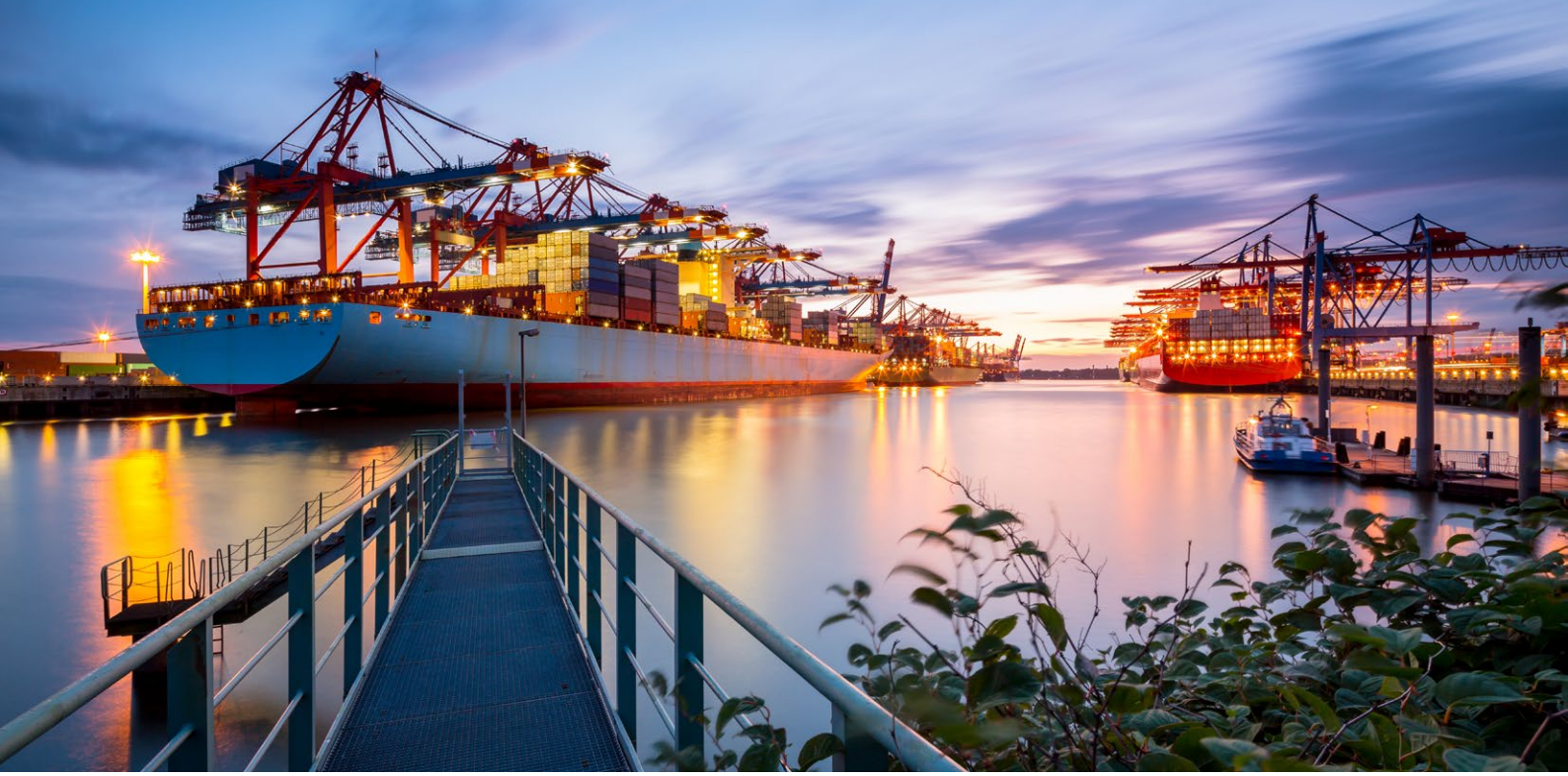
CASE STUDY 2

Tianjin Port

Shore power refers to a way of supplying electricity to ships from the onshore grid when the ship is moored at port. Compared with the traditional ship generator power supply method, the use of shore power has the advantages of pollution reduction, energy savings, noise reduction and reduced maintenance costs. Shore power can also effectively reduce fuel consumption when ships are at berth, thereby reducing GHG emissions, including carbon oxides, NO_x, SO_x and soot. Shore power is being implemented globally at an increasing speed to ports and different types of ships. The use of shore power requires ports, shipping companies and power suppliers to work together on building and maintaining infrastructure to ensure a clean and reliable power supply to the ships.

As a smart zero-carbon terminal, Tianjin Port Second Container Terminal is powered by a wind power and storage integration system, using 100% electric power, 100% green power and 100% green power self-sufficiency, realizing the carbon neutrality of the company's production and operation. The terminal is supported by green power, which includes three fixed shore power units and one 440-volt low-voltage mobile shore power unit, allowing up to three ships to connect simultaneously. With a maximum shore power capacity of 6,000 kVA (kilo-volt-amperes), these green shore power units help significantly reduce ship emissions, enhance the port's overall energy efficiency and improve its environmental sustainability.

Over the past few decades, container ships have experienced rapid growth, with their average capacity doubling in just one decade. The largest container ship currently in operation can carry 24,346 TEUs. As the shipping industry continues to evolve, ports are increasingly embracing the handling of megaships. Modernizing port infrastructure to support these mega-vessels presents an opportunity for integrating sustainable practices that mitigate environmental impact. Automation is becoming more prevalent: for example, Qingdao Port has established a fully automated container terminal as the world's first "hydrogen+5G" smart green terminal, achieving unmanned operations throughout the entire loading and unloading process with a maximum efficiency of 60.2 TEU per hour.[92]



The International Atomic Energy Agency is currently looking at the potential applications of small modular reactors (SMRs) for floating power plants and marine propulsion systems. This technology is on the cusp of being deployed on ships today, and it holds promise for contributing to the future energy mix within the maritime sector.[93]

Ports should prioritize the use of advanced equipment powered by electricity or other alternative fuels to reduce pollution and GHG emissions and gradually replace ageing and carbon-intensive equipment. Along with advanced equipment's improvement in operational efficiency and ports' growing capacity in clean power generation, impacts on nature can be minimized in value chain mid-stream operational activities. Ports can promote the use of the following advanced equipment: electric container cranes, hybrid tugs, clean energy vehicles (trucks, passenger vehicles, towing vehicles, etc.), charging posts, wind and solar-powered streetlights, remote excavators, and autonomous vehicles.

Adopting energy-saving and environmentally friendly materials in port construction and operation can contribute to the nature-positive transition by reducing energy consumption, waste pollution and natural resource use. Sustainable materials have additional benefits, including lowering operating costs, improving port profitability, enhancing public image and improving the working environment of employees. The selection of materials should consider characteristics such as wear and tear, durability, recycling, degradability, etc. Ports can adopt the optimal use of materials in the following ways:

- Adopt degradable materials.
- Use materials that can be recycled at their disposal.
- Consider life cycle cost and emissions in material selection.
- Procure locally sourced materials to minimize supply chain distance.
- Use recycled materials (e.g. from the demolition of existing projects).
- Treat wasted materials to meet environmental, health and safety standards.
- Select environmentally friendly materials that are harmless to humans and ecosystems.
- Optimize the design of material use while ensuring structural safety and durability.

To reduce dependencies on freshwater use in operations, ports should save and recycle freshwater to the maximum extent with advanced equipment and systems. In addition to civil water supply, ports can use other water sources, such as surface water, seawater desalination, water, reclaimed water, rainwater, etc. The following actions can be adopted by ports to improve their dependency on nature:

- Adopt water-saving appliances and implement water-saving systems to reduce water demand.
- Design water supply systems by zoning and use, separated based on quality and pressure.
- Build and upgrade rainwater and sewage collection and treatment systems to collect and treat water, which can then be used for operation activities such as watering green areas in the harbour, washing equipment and removing dust in dry bulk cargo yards with mist-spraying systems.

Priority action 3

3.3 Improve the prevention and mitigation capacity against pollution and invasive species

Pollution in ports has direct impacts on natural ecosystems, human health, fishery resources and tourism.

With almost 40% of the world's population living within 100 km of the coast,[94] pollution in ports has direct impacts on natural ecosystems, human health, fishery resources and tourism.

Ports should optimize their operations and implement advanced technologies to prevent and mitigate at least the following pollutants: wastewater (from ships, equipment and operations), dust, exhaust, solid waste, noise and light.

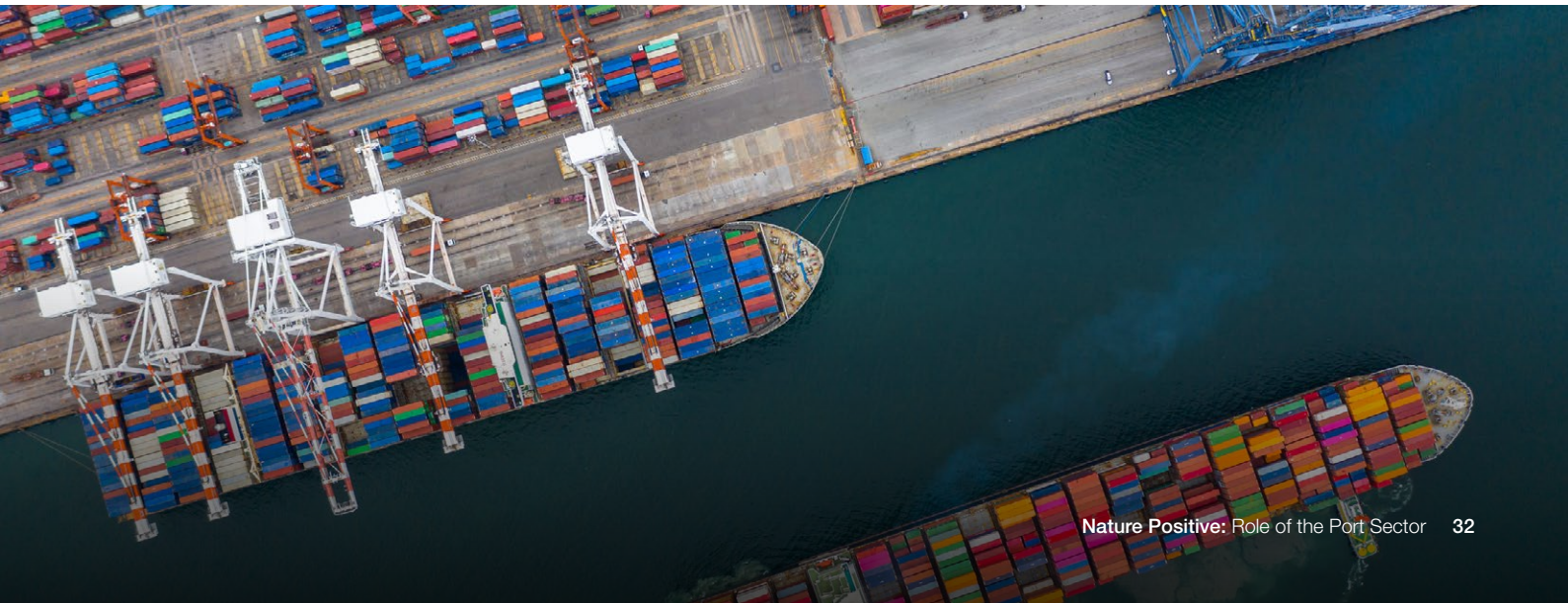
Ports should formulate and implement emergency response plans to address incidents, including oil and chemical spills. In this process, it is essential to consider anchorages located outside the ports. Emergency response forces must be adequately trained and stationed in close proximity to large-scale oil and hazardous chemical warehouses, as well as liquid bulk cargo terminals, to ensure pollutants can be managed swiftly and effectively in the event of an incident.

Ports should improve monitoring systems of the following items to ensure their impacts on nature have been controlled and minimized, as well as to identify incidents when happening:

- **Seawater**: Equip shore-based automatic monitoring microstations with a marine water environment intelligence monitoring system to conduct real-time monitoring of water quality.
- **Air**: Construct air quality microstations and online monitoring equipment for volatile organic compounds.
- **Wastewater**: Use a monitoring system to ensure any wastewater meets compliance requirements before discharging to civil pipework.
- **Hazardous waste**: Identify existing storage facilities for hazardous wastes, monitor storage warehouses, and ensure proper procedures at disposal sites and while leaving ports.
- **Biodiversity levels**: Set up underwater cameras, acoustic surveys and eDNA programmes to monitor biodiversity.

Ports should regulate and standardize the prevention and control of invasive species through the following actions:

- **Strengthen monitoring**: Establish a comprehensive species invasion monitoring network, regularly monitor the waters and facilities around ports, and promptly mitigate species invasion.
- **Strengthen ship quarantine and disinfection**: Ensure proper treatment of ships entering and leaving ports to prevent the spread of invasive organisms and reduce the risk of biodiversity loss.
- **Formulate and improve relevant regulations and standards**: Clarify the responsibilities and obligations of port departments and ship operating units to prevent and control species invasion in ports.
- **Improve international collaboration**: Collaborate with international organizations and other countries to jointly control transboundary species invasion and promote the development of global standards.



CASE STUDY 3

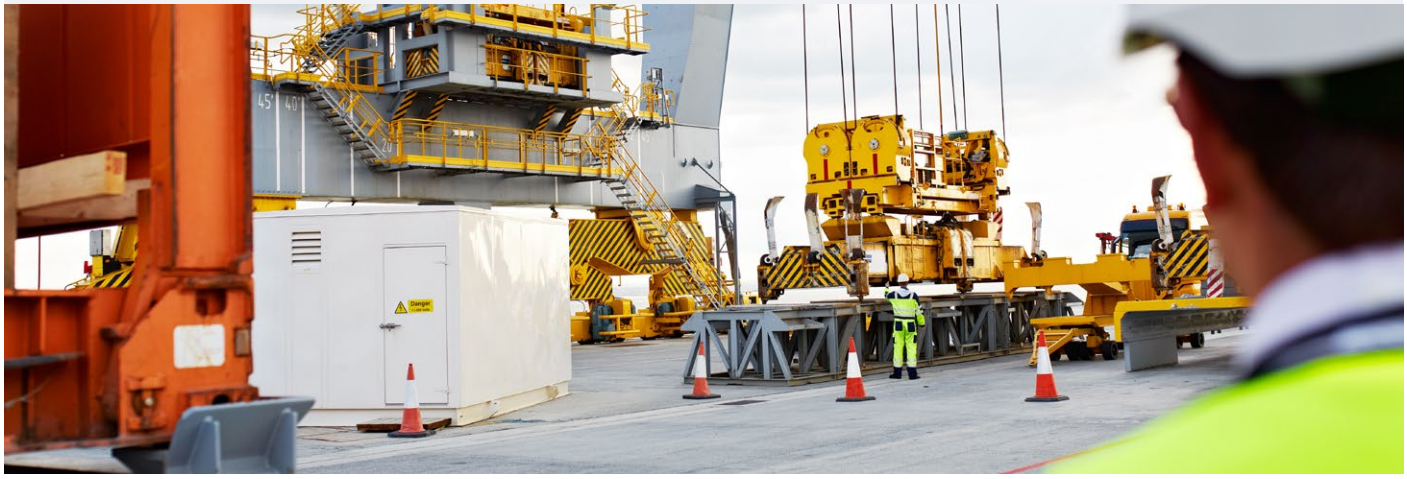
Maritime and Port Authority of Singapore

As more and more vessels begin running on new zero- and near-zero-emission fuels such as methanol and ammonia, it is important for ports to develop emergency response planning to ensure safe bunkering of these fuels. The Maritime and Port Authority of Singapore (MPA), together with industry partners and institutes of higher learning, has carried out several methanol bunkering exercises and trials involving an ammonia-fuelled vessel since 2023 in the Port of Singapore. This includes: 1) the ship-to-containership methanol bunkering operation for the Laura Maersk on 27 July 2023, 2) the ship-to-ship methanol bunkering operation for Stena Prosperous on 24 May 2024, 3) the simultaneous methanol bunkering and cargo operation (SIMOPS) on 27 May 2024 for Eco Maestro, and 4) two dual-fuelled ammonia fuel trials in March and May 2024 involving the Fortescue Green Pioneer.

In preparation for these operations, MPA organized: 1) Hazard Identification Study (HAZID) and Hazards and Operability Study (HAZOP) workshops to develop prevention, control and mitigation methods, and 2) table-top exercises to review existing safety measures and standards, identify potential gaps and new safeguards as well as strengthen cross-agency coordination for an effective response to any incidents.

During the operations, MPA also ensured that safety and emergency response measures were implemented by:

- Establishing a safety zone
- Positioning response vessels and customising firefighting programmes for all relevant stakeholders involved
- Working with various research organizations and institutions to conduct environmental, metocean and safety risk modelling
- Developing a plume model and deploying drones equipped with sensors and infrared cameras



Priority action 4

3.4 Promote a circular economy and catalyse cross-sector collaboration in regulation, finance and innovation

The port sector is encouraged to commit to circular business models, maximizing material recycling and building efficient supply chains to scale its contribution to a nature-positive transition.

The circular model, which abandons the traditional linear take/make/waste approach, can reduce the overall inputs of raw materials into the supply chain. It is also advantageous to increase productivity, reduce impacts on nature from waste and pollution, and significantly reduce dependency on natural resources. Recycled materials can be supplied to out-of-value-chain industries, such as construction. Integrated planning of industrial areas, as detailed in priority action 1, can further unlock the potential of the circular economy.

Businesses should enhance their cross-sectoral collaboration in the following areas to achieve common goals and accelerate the nature-positive transition:

Businesses should enhance their cross-sectoral collaboration to achieve common goals and accelerate the nature-positive transition.

The port sector can collaborate with other sectors in joint policy asks to seek political support from higher levels in promoting nature-positive transition.

- Businesses can collaborate to set industry standards and regulations, standardizing port operations to reduce their impacts on nature.
- Ports can collaborate in launching and contributing to nature-related initiatives. For example, according to the Global Maritime Forum, 44 green shipping corridor initiatives were already set up by the end of 2023.[95]
- Ports can engage with investors to develop finance mechanisms to enable a nature-positive transition. The Sustainable Blue Economy Finance Initiative hosted by the United Nations Environment Programme Finance Initiative (UNEP-FI) has developed a guide to help financial institutions identify the impacts, risks and opportunities in several marine sectors, including a chapter that covers ports.[96]
- Collaboration in technological innovation within and outside the port sector has the potential to accelerate the implementation of other priority actions.

From the perspective of ports as industrial and energy hubs, they would be able to play a larger and more innovative role in creating industrial clusters to develop/produce new circular materials with a focus on waste valorization. It is worth noticing that there are differentiated needs between ports in the global north versus the global south, which is particularly important when discussing finance and technology needs/support.

CASE STUDY 4

ÉcosystèmeD

Since 2019, the Port of Dunkirk and the Greater Dunkirk Urban Council, in collaboration with industrial stakeholders and academic institutions, have embarked on a collective initiative aimed at facilitating sustainable transformation across the region. This endeavour has led to the establishment of a shared organization known as ÉcosystèmeD, which is dedicated to guiding and executing a decarbonization roadmap while initiating, facilitating and coordinating technological solutions and individual as well as collective transformation projects.

In close partnership with port authorities and collaborative organizations, ÉcosystèmeD has focused on developing large-scale collective infrastructures within the port area:

- The existing industrial water network – already the largest in France – will be expanded through the use of non-conventional water sources from canals. Additionally, new resources, such as effluent from urban wastewater treatment facilities, will be integrated. Enhanced circularity among industries for water reuse will also be promoted.
- A shared CO_2 pipeline network will be developed to capture emissions from industrial plants for either permanent storage (CCS) or repurposing (carbon capture and use).
- An "industrial heat superhighway" will be established to recover waste heat from neighbouring industrial facilities. This superhighway will extend France's first urban heat network.

Collaborative efforts are further highlighted by strengthened partnerships among industrial companies facilitated by expert groups organized by ÉcosystèmeD. Discussions on emerging technologies, innovative processes, co-benefits and business-to-business (B2B) exchanges have become standard practice.

Priority action 5

3.5 Actively protect and restore nature

Ports and surrounding natural ecosystems can be effectively enhanced by actively conducting the following actions:

- **Protecting and sustainably managing habitat areas**: for example, conservation of fish spawning areas and nesting sites and establishment of artificial reefs.
- **Improving green coverage**: for example, reforesting unused land, establishing buffer zones around the perimeter of the port filled with native vegetation to act as a natural barrier against noise and water pollution, and implementing green roofs on buildings.
- **Enriching vegetation types**: for example, planting drought-resistant plants to reduce water use for irrigation, stabilize soil and prevent erosion.
- **Improving soil structure**: for example, adding organic soil amendments like compost, biochar or processed sludge to increase the soil's ability to retain moisture and nutrients.[97]
- **Restoring degraded land**: for example, reforestation, planting native vegetation, restoring wetlands, transforming degraded land into buffer zones, planting sand-binding vegetation, etc.
- **Protecting natural coastline**: for example, managing sediment buildup and erosion through careful dredging practices and creating living shorelines.[98]

Businesses in the sector can also take part in compensating conservation and restoration activities such as marine species protection, mangroves planting, mudflats and seagrass beds conservation.

CASE STUDY 5

"Port of Antwerp more natural" project

The Port of Antwerp-Bruges strives to achieve a balance between economic growth and consideration for nature. To protect and manage the nature reserves, it has been working with Natuurpunt, the largest nature conservation organization in Belgium, in the Antwerp port area since 2001. As part of the "Port of Antwerp more natural" project, Natuurpunt and Port of Antwerp-Bruges are also working to strengthen the ecological infrastructure in the port area without hindering the development of economic activity. Examples include establishing habitat areas for the natterjack toad, constructing a fish spawning area, establishing nesting sites for sand martins and many other actions for a wide range of different species.

Its 2014-2019 species protection programme set out measures for the conservation of 14 species, which resulted in 111 different projects. Some projects also took place in collaboration with private companies in the port. A new species protection programme has been drafted for the 2022-2027 period.

> Companies are encouraged to contribute to systems-wide conservation and restoration within and beyond their own value chains.

It is important to note that there are certain cases where compensation is not appropriate and should not be used.

In addition, companies are also encouraged to contribute to systems-wide conservation and restoration within and beyond their own value chains,[99] and target investments towards contributing to government targets under their National Biodiversity Strategies and Action Plans (NBSAPs). This includes investing in credible and effective nature-based solutions (through place-based conservation and restoration or landscape and jurisdictional approaches), and partnering with environmental NGOs, local governments, Indigenous Peoples and other local communities, such as through the World Economic Forum's 1t.org initiative. As supporting guidance, companies can refer to the *Global Standard for Nature-based Solutions* published by IUCN, which proposes eight criteria and 28 indicators to deliver results that are "environmentally sound, socially just and economically feasible".

Invest in innovative biodiversity financing mechanisms

A 2020 report estimated an average global biodiversity financing gap of $711 billion per year required for the protection, restoration and enhancement of nature,[100] 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 Global Biodiversity Framework proposes several innovative ways to mobilize public- and private-sector resources. For example, companies could consider investing in payment for ecosystem services, green or blue bonds, nature restoration funds and voluntary biodiversity certificates or credit markets.[101] Through careful assessment of the advantages and disadvantages of available products, companies can contribute to meaningful long-term biodiversity conservation that is aligned with both their internal values and targets as well as national objectives. The Forum has published a *Private Sector Roadmap to Finance and Act on Nature*.

4 Get started

The imperatives to tackle carbon emissions and nature loss are interdependent. Companies should integrate their nature-positive and net-zero strategies.

“Making transformative changes to business models by 2030 demands significant time and resource investments from companies.”

While many companies in the port sector have already embarked on the 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 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.[102] This document was launched for public consultation in October 2024.

4.1 Align strategy with organizational maturity

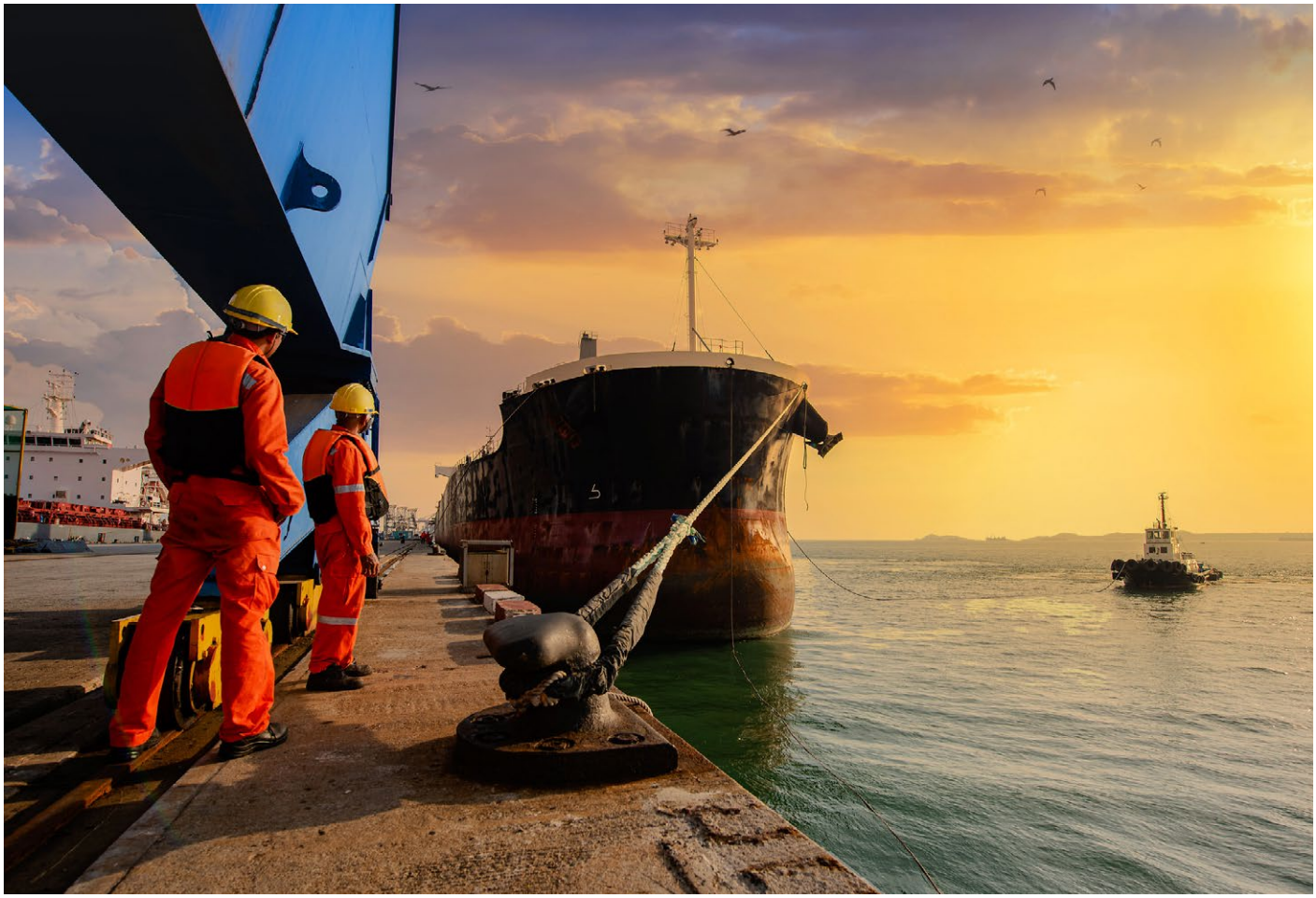
Assessing organizational readiness and maturity can help a company understand its performance on the nature-positive journey and identify the most suitable guidance and tools to drive action. Table 5 details recommended actions to deliver a nature-positive strategy mapped to an organization’s level of 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,[103] SBTN’s guidance for businesses, Aqueduct from WRI,[104] TNFD’s upcoming transition planning guidance, WWF’s biodiversity risk filter and water risk filter,[105] UNEP-FI’s report on high-risk sectors[106] and the Integrated Biodiversity Assessment Tool (IBAT).[107]	– 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.[108] – 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 a first port of call. A good place to start within TNFD's resources is the *Guidance for corporates on science-based targets for nature*, published jointly by TNFD and SBTN.[109] TNFD differentiates between assessment metrics and disclosure metrics along the four phases of the LEAP approach[110] (see Figure 9):

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

FIGURE 9 **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.[111]
- CSRD, 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, and 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.[112]

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 monitoring systems of seawater, hazardous waste, biodiversity levels, etc. – 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. Promote collective sector-wide positive action, such as maximizing the recycling of materials or waste valorization. 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 sustainability challenges within the firm and across its 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). Allocate budget for innovation spending, such as for circular innovations and research into bio-based or recycled material for feedstocks. 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. Leverage new sources of funding, such as green and blue 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 energy shortage – 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 IFRS Foundation's 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 construction and operation processes (e.g. adopt optimal use of materials, enhance the use of advanced equipment and operating systems) 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. energy portfolio optimization 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 UN'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 Global Biodiversity Framework are facilitating a global consensus on the urgency to tackle nature loss, and regulations are tightening to ensure more nature-friendly practices.

The port sector stands at a critical juncture in the transition to a nature-positive future. While some leading ports have acknowledged their impacts on nature and have made their own commitments to take action, the sector now requires systematic thinking and accelerated action to support nature-positive goals.

All parties with different roles and responsibilities in the port sector should be fully aware of their interrelationship with nature and consider the entire value chain when it comes to decision-making.

To lead in sustainability, businesses in the sector must prioritize avoiding and reducing the impacts on nature, working closely together to form a joint effort for a just and equitable nature-positive transition.

In the process of the energy transition towards a multi-fuel future, the changes in supply chains will lead to new challenges as infrastructure and practices change. The port sector needs to ensure that the net-zero transition is also nature positive.

Through collaboration with companies across the sector, with suppliers and customers, other industries, regulators, civil society and local communities, the port sector 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,[113] and follows a four-step process.

First, the relevant sub-industries were identified at an ISIC class level[114] for each stage of the value chain. After initially shortlisting the ISIC classes for the midstream section of the value chain (construction and operation), the ENCORE upstream and downstream "links" were used 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.[115]

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,[116] 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.[117]

Identifying the business opportunity potential of the priority actions for the port 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 port 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 port 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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