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WORLD ECONOMIC FORUM

Nature Positive: Role of the Chemical Sector

INSIGHT REPORT

SEPTEMBER 2023

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Part of the World Economic Forum's *Sector Transitions to Nature Positive* report series, 2023

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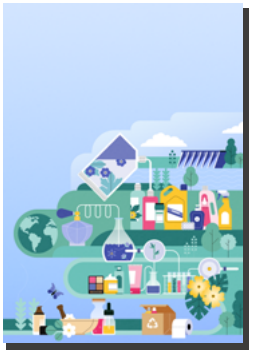
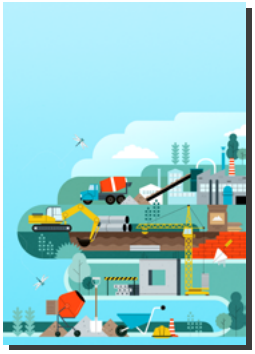


Nature Positive: Role of the Household and Personal Care Products Sector



Nature Positive: Role of the Cement and Concrete Sector

Contents

Forewords

Frank Terhorst
Executive Vice-President and Head, Strategy and Sustainability, Bayer Crop Science

Chemistry provides the key building blocks of our world. The chemical industry plays an important role in providing the products and solutions that meet the global population's needs. But it is vital that we support the needs of our planet, too.

We know that chemistry, whether human-made or derived from nature, comes with effects – both positive and negative. Here, rather than just mitigating unwanted side-effects, we can create nature-positive solutions that work with nature and provide net benefits to the natural world. And we can, and must, do so on a wider scale than ever before. As we edge closer to 2030, with ambitious climate goals and the Paris target in mind, it's time to ask: What's next?

The recommendations in this report give us a strong idea. Energy efficiency, water management, addressing pollution and innovating products, circularity and bioeconomy, restoration and transformation will all be keywords for industry leaders – even more so than they are now.

In the coming years, I anticipate these recommendations becoming crucial actions. Chemical industry companies will need to join efforts for collective action and showcase their efforts and outcomes in achieving nature-positive objectives. These factors could become significant differentiators in the eyes of customers and society, just as product safety, efficacy and price are already today.

Our actions need to be clearly defined, tangible and measurable. But to contribute to nature positive also means we must become transformational in scope and ambition. Currently, these two goals seem challenging to meet. That will not be the case in the future. We already have access to emerging technologies, knowledge, data and computational power, which are creating exciting possibilities. For example, new approaches using artificial intelligence in Bayer's R&D give us the means to "design" a small molecule that targets a specific plant protein responsible for a certain type of plant disease. This technology will offer a step-change in precision chemistry and sustainable performance. We aim for broader solutions, integrating chemistry into a full suite of advancements across various platforms and technologies to facilitate the transition towards a nature-positive world.

A transition on this scale isn't straightforward. It will take all our vision, collaboration and scientific innovation. My colleagues at Bayer and I have started this journey – and I am confident that others are doing the same.

I welcome this report and look forward to engaging not just within my own organization, but across the entire chemical value chain, to take up its recommendations to drive change and transformation towards a nature-positive, equitable and responsible world.

> **Man does not weave this web of life. He is merely a strand of it. Whatever he does to the web, he does to himself.**
>
> Chief Seattle, Indigenous Leader of the Suquamish and Duwamish people

John T. Colas
Partner and Vice-Chairman, Financial Services America, and Global Co-head, Climate and Sustainability, Oliver Wyman

Akanksha Khatri
Head, Nature and Biodiversity, World Economic Forum

On 6 July 2023, Earth recorded its hottest day on record, according to the World Meteorological Organization, during what is expected to be the hottest month ever. And 2023 is well on its way to becoming the hottest year. Ocean temperatures are higher than they have ever been in modern times, leading to rising sea levels, more intense storms and faster-than-usual ice loss in the Arctic in June, according to the National Snow & Ice Data Center in the US.

All this heat is taking a toll on people and nature. Thousands of people are dying from prolonged heatwaves, while the loss of habitats and breeding grounds accelerates on land and at sea. The World Economic Forum's *New Nature Economy 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. The world is at a tipping point and only aggressive action can pull it back from unimaginable suffering.

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.

The World Economic Forum, in collaboration with Oliver Wyman, has spent the past year gathering data and insights through research, expert consultation and industry interviews that have enabled us to prepare the *Sector Transitions to Nature Positive* series of reports. These focus on three sectors: chemicals, household and personal care products, and cement and concrete. This initiative is part of a broader collaborative effort with Business for Nature and the World Business Council for Sustainable Development.

Halting climate change and nature loss are inextricably intertwined. Therefore, corporate and investor action to address these twin challenges must also be complementary and push forward simultaneously. Investing in nature is more than just good risk management. Companies that take bold steps today towards a net-zero, nature-positive business model will undoubtedly enjoy competitive advantages. This will stem from more resilient and sustainable supply chains, a positive public image, innovative green products and greater support from the financial sector.

If we are to stay within safe and just Earth system boundaries and maintain a sustainable planet, there is no time to delay.

Executive summary

Today, the resources humanity is using are equivalent to that of 1.75 Earths.[1] Humans have exceeded seven out of eight globally quantified safe and just Earth system boundaries and risk crossing irreversible tipping points.[2]

Chemicals are essential to daily life and in nearly all industrial processes. For example, chemical-based fertilisers help feed the world's population. Catalysts and other specialty chemicals are essential to manufacturing life-saving drugs. Chemicals are used to make almost every consumer product, from cleaning solutions and clothing to automobiles and all things plastic. The $4 trillion global chemical sector provides essential materials for 95% of all manufactured goods worldwide.[3] It is also the largest industrial energy consumer and the third largest industry subsector in terms of direct carbon dioxide emissions.[4] So it is imperative that the chemical sector contributes to a nature-positive and net-zero future and operates within the Earth's safe and just system boundaries.[5]

The call for the transition to "nature positive" has never been louder. In 2022, 196 parties signed up to the Kunming-Montreal Global Biodiversity Framework (GBF), with the global goal to halt and reverse nature loss by 2030 and full recovery by 2050. Meanwhile, regulators are moving towards mandatory nature-related disclosures from companies.

The nature-positive transition is synergistic to companies' net-zero commitments. Nature-based solutions can contribute up to 37% of the emissions reductions required by 2030 to keep the global temperature increase below 2 degrees Celsius.[6] Accordingly, companies need solutions to address climate change and nature loss together.

For companies in the chemical sector, this is a unique opportunity to get ahead of regulation, proactively manage nature-related risks, build a sustainable and resilient supply chain and benefit from early commercial opportunities in the transition.

Many leading enterprises in the sector have already made nature and climate commitments and taken steps to reduce greenhouse gas emissions and decrease downstream discharge, waste or toxicity.[7,8] However, while recognizing these efforts, more needs to be done. The sector still contributes to drivers of nature loss, such as pollution, carbon emissions, freshwater use and land conversion across its value chain.[9]

This document 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.[10] The chemical sector has a key role to play in halting and reversing nature loss by 2030 – the mission at the heart of the GBF. Priorities include the following:

1. **Increase efficiency in the manufacturing process and expand the use of renewable energy.**

– This can be achieved via several avenues, including heat and energy efficiency gains through digitilization or automation of the manufacturing process, the recycling of heat or an improvement of heat distribution.

– The sector could also expand the use of renewable energy sources for power generation to reduce the depletion of natural resources and decrease its scope 2 greenhouse gas emissions. Tackling climate change is a major lever to support the transition to nature positive.

2. **Improve water stewardship through sustainable water management strategies and practices.**

– This can be achieved by better overall freshwater management and optimization of usage. Recycling water and introducing closed-loop systems in chemical plants can help with this optimization.[11]

– The sector should recognize the risks and possible consequences related to decreased water availability or quality in supply chains and incorporate opportunities to replenish watersheds into corporate water management plans (especially in regions experiencing water stress).

3. **Source responsibly and explore switching to sustainably sourced bio-based or recyclable materials.**

– Companies should proactively assess the impacts and risks associated with suppliers, especially when sourcing raw materials. Companies should also engage with suppliers to make them aware of their impact on nature and climate and maximize their sustainability performance.

– Lest they be left behind, companies should also look to become leaders in the sector by exploring the use of alternative feedstocks to reduce corporate carbon and nature footprints. But bio-based feedstocks carry their own set of risks that should be considered, so risk-based assessments and life-cycle analyses of bio-based products are needed to avoid or minimize trade-offs or unfortunate substitutions.[12]

4. **Support nature conservation and restoration and advocate for policy changes that protect nature.**

– Chemical companies need to work with organizations trying to conserve and restore nature within and beyond their value chains through nature-based solutions and/or ecosystem-based approaches. For example, they can develop green infrastructure such as wetlands. These can offer a natural and less expensive solution for the tertiary treatment of wastewater at chemical plants, depending on the chemical compounds produced and applicable regulatory restrictions.[13]

– The chemical sector also has a key role to play in contributing to a progressive regulatory and policy environment by engaging with policy-makers and joining ambitious business coalitions.[14]

5. **Expand circularity, product innovation and customer education on product use and disposal.**

– Companies need to better understand how the manufacturing process and products affect nature and biodiversity. They also need to minimize ecotoxicity through design, risk assessments, portfolio development, optimization of manufacturing process and end-of-life solutions.[15]

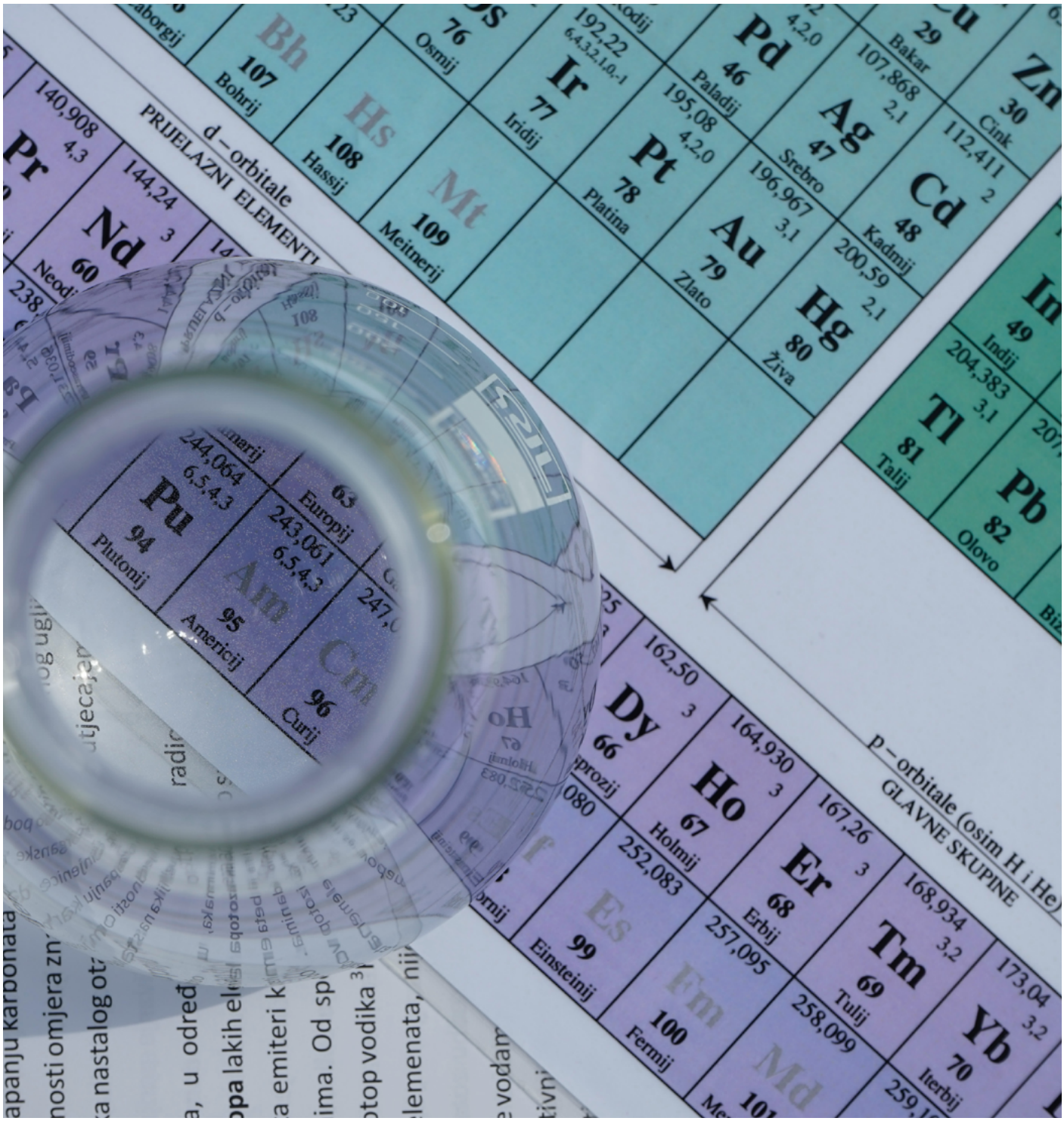
– While acknowledging these changes require significant investments and carry risks, companies can benefit from innovating their business models and introducing circular solutions and new products and services that avoid negative impacts on nature or serve the nature-positive transition of another industry.

– Companies that want to enlist the support of their downstream value chain can invest in campaigns that educate both business-to-business (B2B) and business-to-consumer (B2C) customers on product use and disposal to reduce the nature footprint of a product.

These priority actions could unlock more than $320 billion in annual business opportunities by 2030 for companies operating across the sector's value chain, presenting a significant opportunity for the chemical sector in the new nature-positive economy.

1 Introduction

Most of the world's top 500 companies have a climate target – but just 5% have one for biodiversity. Given how dependent the global economy is on nature, the private sector urgently needs to help halt and reverse nature loss this decade.



“ 37% of the emission reductions required by 2030 to keep global temperature increases under 2 degrees Celsius will come from nature-based solutions.

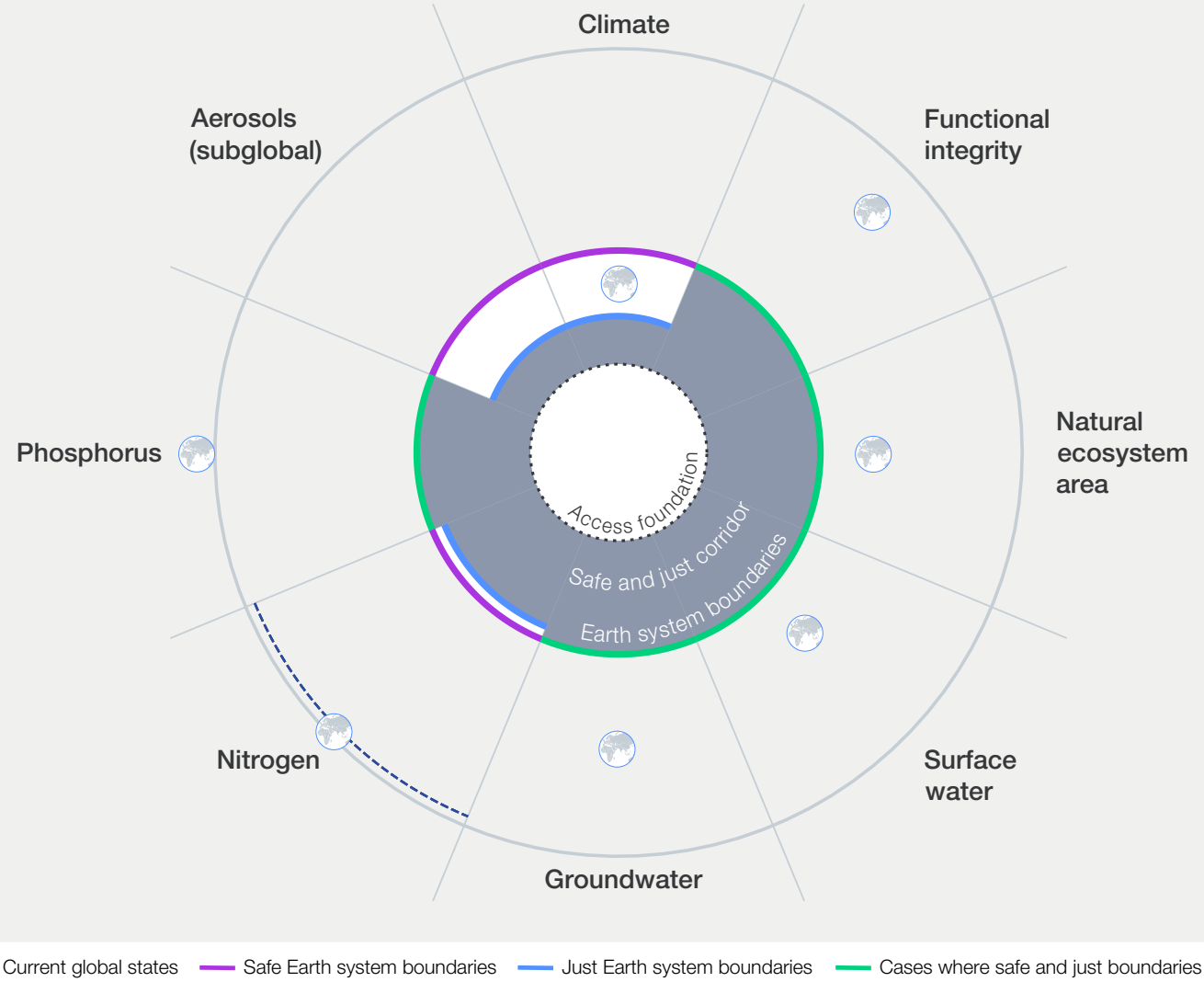
Nature is at a tipping point. Today, the resources humanity uses are equivalent to that of 1.75 Earths.[16] This means that the ecological footprint, a measure that sums up the demands for biologically productive areas like food, timber, fibre, carbon sequestration and infrastructure, exceeds the Earth’s capacity by 75%.[17]

Achieving net-zero emissions and tackling nature loss are two priorities, both for society and business, that are highly interdependent. Climate change is one of the five key drivers of biodiversity loss, according to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).[18,19] Land-use change, principally agricultural commodity-driven deforestation, contributes 12–20% of global greenhouse gas emissions.[20] At the same time, efforts to tackle climate change cannot succeed without safeguarding nature. It is estimated that 37% of the emission reductions required by 2030 to keep global temperature increases under 2 degrees Celsius will come from nature-based solutions.[21]

There is now global agreement that climate, biodiversity, surface water and groundwater are all components of the Earth’s vital systems[22] and climate goals cannot be reached without healthy and resilient nature. Razan Al Mubarak, UN Climate Change High-Level Champion for the United Nations Climate Change Conference (COP28) and Co-Chair of the World Economic Forum Champions for Nature community, acknowledged this in June 2023 when she declared that nature is “not ornamental, but fundamental” in the quest for a net-zero emissions and resilient future.[23] Standard setters have also begun to recognize the relationship between climate change and nature and are increasingly looking to align efforts, as seen in the linkages between the Science Based Targets initiative (SBTi) Forest, Land and Agriculture (FLAG) targets[24] and the targets for land from the Science Based Targets Network (SBTN).[25]

In May 2023, the Earth Commission published the first quantification of safe and just Earth system boundaries, developed by more than 40 researchers worldwide.[26] The eight boundaries encompass aerosols, biosphere, climate, freshwater and nutrients at global and local levels. Staying within these boundaries will require a transformation of societies and the global economy.[27] Seven of them have already been exceeded, including the boundaries for natural ecosystem area, groundwater and surface water (see Figure 1).

FIGURE 1 **Safe and just Earth system boundaries**



Source: Rockström, J. et al.[28]

1.1 Why nature matters for businesses

The importance of nature is swiftly rising for businesses in the real economy, as well as for the financial services industry and investors. The evidence for rising nature-related risks is mounting: in the *Global Risks Report 2023* by the World Economic Forum,[29] six out of the top ten risks are environment-related. Natural disaster, biodiversity loss and ecosystem collapse, as well as natural resource crises, were identified as the third, fourth and sixth most pressing global risks over the next decade, respectively. 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 can get ahead of the risks from nature loss can minimize disruption from incoming policy and regulatory requirements, proactively manage nature-related physical, transition and systemic risks,[30] and benefit from early opportunities to move towards nature positive.

FIGURE 2 **Key nature-related dynamics impacting businesses[31]**

The Kunming-Montreal Global Biodiversity Framework (GBF)

The agreement of the GBF in December 2022[32] 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. The GBF charts the path for biodiversity, in the same way the 2015 Paris Agreement did for climate change.

The GBF is expected to influence business action[33] through policy, regulation and financial incentives, especially Target 15 on mandatory assessment and disclosure, Target 16 on supportive policies for sustainable consumption choices, reducing overconsumption and waste generation, and Target 18 on eliminating environmentally harmful subsidies and aligning incentives.

Guidance and standards

Many regulators will soon require mandatory nature-related disclosure from companies. For example, the European Sustainability Reporting Standards (ESRS) under the Corporate Sustainability Reporting Directive (CSRD)[34] of the European Union (EU) will require companies in scope to disclose specific

> In the past two years, 140 financial institutions with €19.7 trillion in assets under management have signed the Finance for Biodiversity Pledge.

metrics for their *impact* on nature and biodiversity, as well as for their *exposure* to nature and biodiversity loss. The EU Taxonomy for Sustainable Activities has already identified activities such as "the protection and restoration of biodiversity and ecosystems" and "the sustainable use and protection of water and marine resources".[35]

Other nations are also introducing similar standards and regulations. For example, companies in India[36] are required by law to adequately identify, monitor and manage environmental risks and disclose material information, and must report on direct and indirect impacts on biodiversity in ecologically sensitive areas.

In July 2023, the International Sustainability Standards Board (ISSB) of the International Financial Reporting Standards (IFRS) Foundation published the General Requirements for Disclosure of Sustainability-related Financial Information (IFRS S-1) and the Climate-related Disclosure (IFRS S-2). Soon, ISSB may require companies to provide additional transparency on impacts and risks related to natural ecosystems and the just transition, according to ISSB's Chair Emmanuel Faber.[37] It is expected that ISSB's standards will be adopted by regulators and made mandatory in some jurisdictions in the near future.

> 64% of Gen Zs say they would pay more to purchase an environmentally sustainable product.

Companies are encouraged to start collecting data and build internal capacity according to voluntary disclosure frameworks to get ahead of the curve. For example, the Taskforce on Nature-related Financial Disclosures (TNFD) has been engaging companies over the past year and has developed guidance for companies to assess and disclose their impacts, dependencies, risks and opportunities associated with nature.[38]

Financial institutions and investors

Existing and prospective investors and other financial institutions are also taking actions on nature. In the past two years, 140 financial institutions with €19.7 trillion in assets under management have signed the Finance for Biodiversity Pledge.[39] Institutional investors are convening through the Nature Action 100 programme to engage with companies and policy-makers on nature.[40]

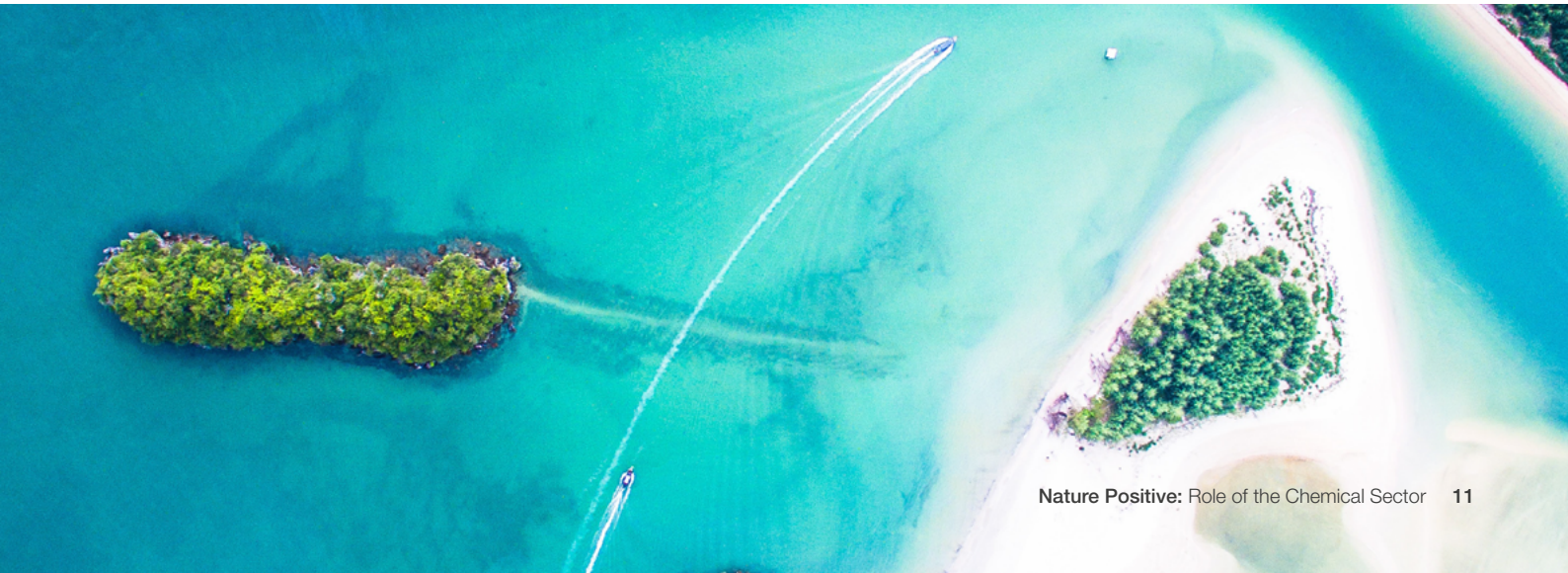
Financial institutions can play an important role in the nature-positive transition, by regularly screening and assessing investor portfolios for biodiversity risks, engaging with high-risk investees and mobilizing internal and external stakeholders (especially clients), developing investment policies and strategies, and sharing lessons and engaging in relevant initiatives such as TNFD and the Science Based Targets Network (SBTN).[41]

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,[42] loss of biodiversity 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 their purchasing behaviour in the past five years to become more sustainable.[43] Similarly, a survey conducted by Nielsen in 2018 indicated that over 81% of consumers worldwide feel strongly that companies should help improve the environment.[44]

Additionally, employees are elevating their expectations regarding their employers' commitment to protecting nature and biodiversity. For example, a global survey by Deloitte in 2022[45] found that protecting the environment remains a top priority for Gen Zs and millennials. They want to see their employers prioritize visible actions that enable employees to get directly involved, while 64% of Gen Zs said they would pay more to purchase an environmentally sustainable product.

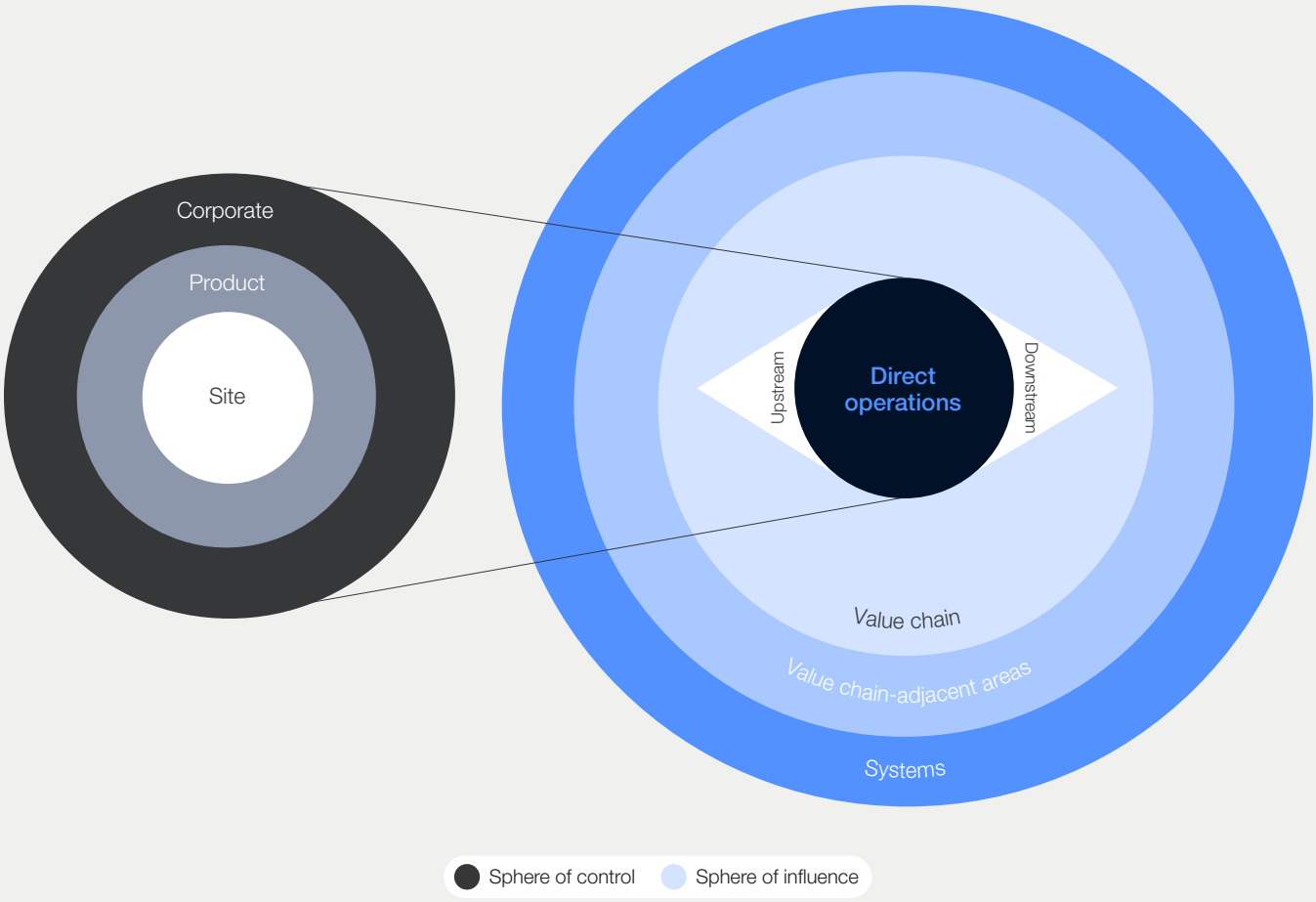


1.2 The current approach to nature and biodiversity

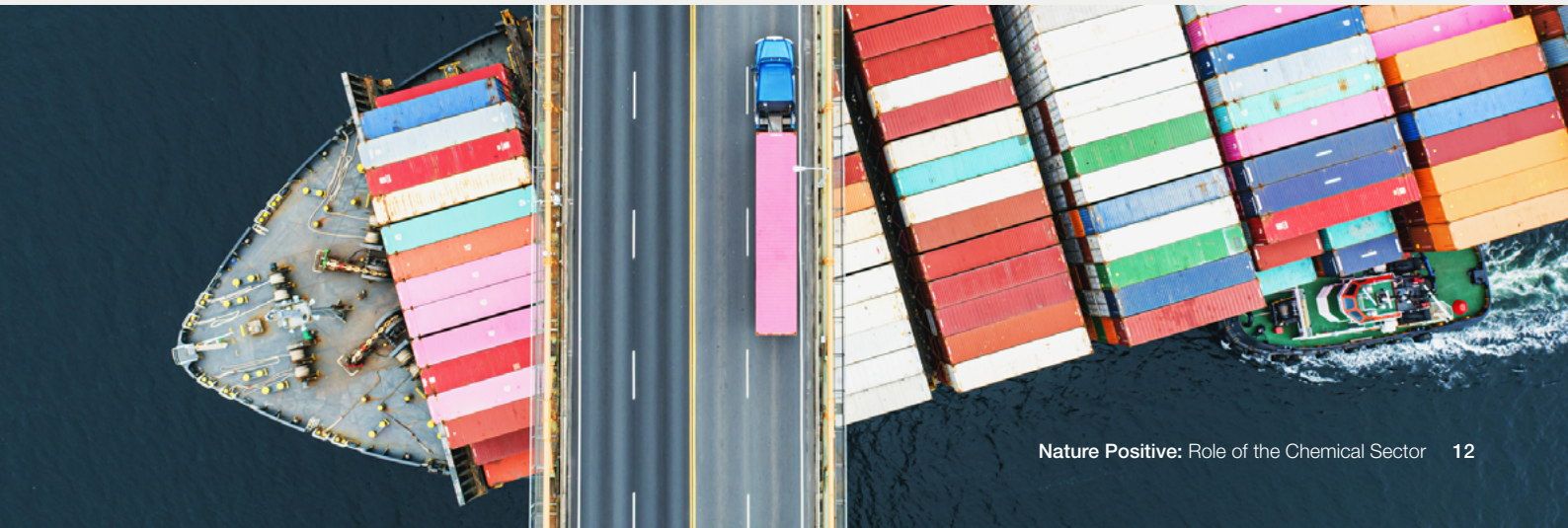
Despite the increased momentum on nature over recent years, not enough is being done. While 83% of Fortune Global 500 companies have climate change targets, only 25% have freshwater consumption targets and just 5% have targets for biodiversity loss.[46] Only 5% of companies have assessed their impacts on nature, with less than 1% understanding their dependencies.[47]

According to Business for Nature, "nature positive" represents a "global goal to halt and reverse nature loss by 2030 with a view of full recovery by 2050."[48] 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.[49]

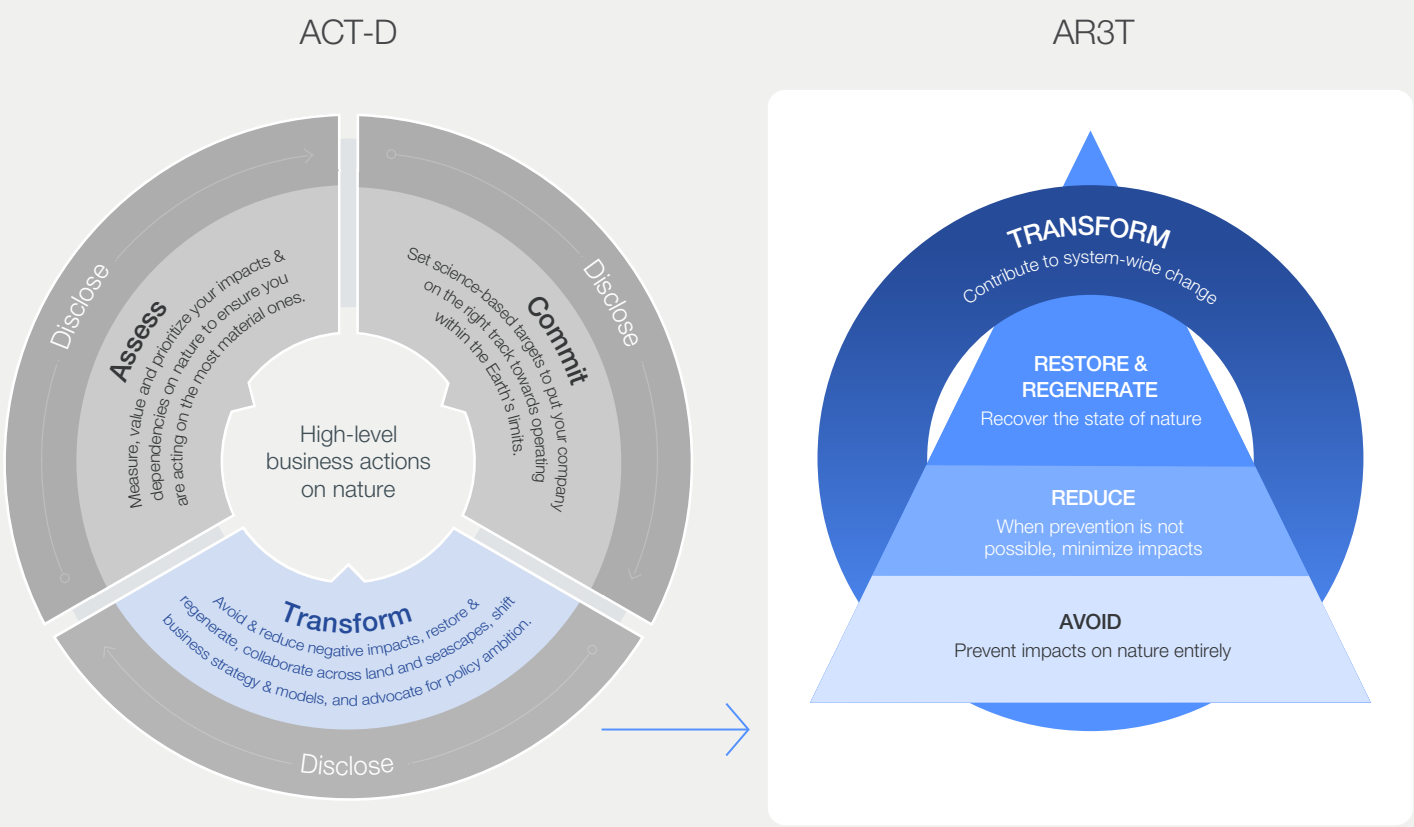


Nature is inherently complex and hence cannot be measured with a single metric or methodology. IPBES and SBTN define nature as "all non-human living entities and their interaction with other living or non-living physical entities and processes".[50] TNFD defines nature as encompassing four realms – land, ocean, freshwater and atmosphere – with biodiversity being "an essential characteristic of nature that enables ecosystem assets to be productive, resilient and able to adapt to change."[51]

Nature is also location-specific and not replaceable or fungible, making well-conceived actions all the more urgent. For instance, a tonne of CO_2 has the same impact on the atmosphere regardless of where it is, but the ecological value of a tree in the Amazon rainforest is not the same as that of a tree in the boreal forests.[52]

This report builds on the ACT-D high-level business actions developed by the global coalition Business for Nature: Assess, Commit, Transform and Disclose,[53] and the AR3T (Avoid, Reduce, Restore & Regenerate, Transform) mitigation hierarchy developed by the SBTN[54] (see Figure 4).

FIGURE 4 **ACT-D high-level business actions on nature and AR3T framework**



Source: Business for Nature and Science Based Targets Network.[55]

As per the **ACT-D framework**, businesses can and should act now to:

- **Assess:** Measure, value and prioritize their impacts and dependencies on nature to ensure they are acting on the most material ones.
- **Commit:** Set science-based targets to put themselves 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 and advocate for policy ambition.
- **Disclose** material nature-related information across all three high-level actions above.[56]

This report focuses on the Transform element of the ACT-D framework and outlines concrete sector-specific actions that companies are encouraged to take to contribute to the transition to nature positive.

It is important that these priority actions also follow the SBTN's **AR3T framework**, which encourages businesses to:

- **Avoid** and **Reduce** the pressures on nature loss, which would otherwise continue to grow
- **Restore** and **Regenerate** so that the state of nature can recover
- **Transform** underlying systems, at multiple levels, to address the drivers of nature loss[57]

1.3 The road ahead

Climate action has already laid a lot of the groundwork for nature and biodiversity action, but companies and financial institutions should now mobilize on a much shorter timeline and with greater urgency.

The World Economic Forum, along with Business for Nature and the World Business Council For Sustainable Development (WBCSD), is building out sectoral knowledge to support companies to prioritize their actions to contribute to nature positive. As nature impacts and dependencies differ significantly across real economy sectors, it is important to provide tailored, sector-specific analyses and guidance for companies to understand their relationship with nature and take actions. A repertoire of executive summaries of all sectoral guidance can be found on the Business for Nature website.[58]

The World Economic Forum, in partnership with Oliver Wyman, has in this first phase conducted in-depth analyses of three sectors: chemicals, cement and concrete, and household and personal care products. This report identifies and makes a business case for sector-specific priority actions for the chemical sector.

Business and finance do not operate in a silo. They need to take shared accountability and collaborate with many stakeholders – including governments, employees and citizens – towards the collective goal of a net-zero, nature-positive and socially equitable economy. With this in mind, the priority actions presented in this guidance are not designed to provide a complete and comprehensive pathway to reach the nature-positive goal, but will contribute to progress towards that goal. Transitioning from current systems to a new economic model necessitates a rethinking of many existing processes. However, it is crucial that this transformation does not exacerbate inequalities across different regions and socio-economic groups.

2 Where the sector is today

As the sector comes under growing scrutiny for its impacts on nature, companies need to transform business models and publicly report material nature-related information.

2.1 Sector overview

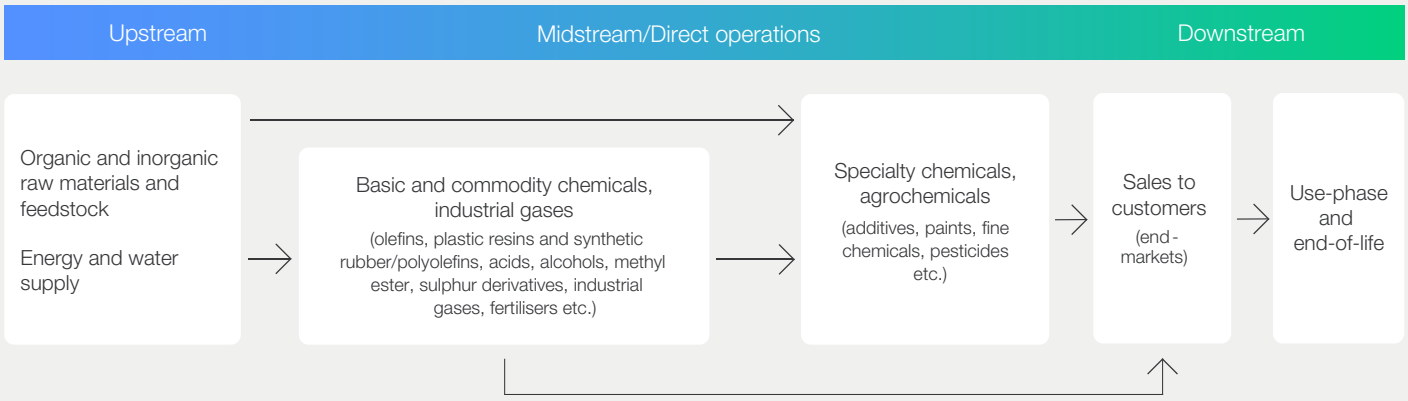
With global chemicals sales totalling around $4 trillion and providing essential materials for 95% of all manufactured goods worldwide, the chemical sector will be a crucial partner in the transition to a nature-positive and net-zero economy.

The sector has grown steadily, with a compound annual growth rate of 4% between 2011 and 2021,[59] a trend that is forecast to continue until 2030.[60] Notably, China is now the largest chemical producer in the world, responsible for 43% of global chemicals sales in 2021, with Europe and the US ranking second and third.

BOX 1 Definition of the chemical sector

The scope of this report is defined by the Sustainability Accounting Standards Board (SASB)'s Sustainable Industry Classification System (SICS): Resource Transformation – Chemicals.[61] This comprises companies that transform organic and inorganic feedstocks into more than 70,000 diverse products with a range of agricultural, pharmaceutical, construction, industrial and consumer applications. The chemical sector is commonly segmented into the following sub-sectors: petrochemicals and commodity chemicals; specialty chemicals; agrochemicals and fertilisers; and industrial gases. While these sub-sectors differ and do not always have the same end-markets, they share similar feedstocks and manufacturing processes and, therefore, commonalities in impacts and dependencies.

FIGURE 5 Simplified value chain of the chemical sector



Chemicals are essential to daily life and can be found in nearly all industrial processes. For example, fertilisers help feed populations globally and ensure food security; specialty chemicals such as catalysts are essential for manufacturing life-saving drugs; while the use of chemical-based products, such as in-house insulation, helps reduce greenhouse gas (GHG) emissions.

FIGURE 6 | **The chemical sector in numbers**

Sector in numbers

$4 trn annual revenues for chemical products

95% of all global manufactured goods derived from outputs

Sector accounts for

37% of all energy used in manufacturing in the US

6% of global annual greenhouse gas emissions

Sources: Cefic (European Chemical Industry Council), Petrochemicals Europe, U.S. Energy Information Administration, World Resources Institute.[62]

Like other sectors, the chemical sector depends on environmental assets and ecosystem services to function and grow, such as water supply, biomass, and mineral and energy resources. The sector also contributes to drivers of nature loss, such as pollution in manufacturing, downstream use and end-of-life phases, GHG emissions throughout the value chain, freshwater use and land conversion.

Much of the sector's efforts have focused on reducing the environmental impact of its direct operations and the products and services provided, such as downstream discharges, waste or toxicity. Although the sector has taken steps to reduce environmental impact, a promising opportunity remains for companies to further improve their relationship with nature.

The chemical sector has distinctive impacts across a few categories. It has a significant greenhouse gas footprint with its midstream players,[63] making it a hard-to-abate heavy industry. The sector also continues to be a source of pollution, having a marked impact on planetary boundaries such as nitrogen and phosphorous cycles and novel entities.[64] Environmental issues arise from, for example, the uncontrolled or inappropriate application of pesticides, the overuse of nitrate-based fertilisers, the discharge of pharmaceuticals into water bodies and the persistent nature of certain chemicals.

2.2 Progress is promising but needs to accelerate

As the sector gains a deeper understanding of its nature footprint, companies are pivoting their efforts towards nature positive. The broader context is also developing – for example, Target 7 of the Global Biodiversity Framework explicitly makes a call to "reduce by half both excess nutrients and the overall risk posed by pesticides and highly hazardous chemicals" by 2030.[65]

Some leading businesses have already set ambitious targets: by 2030, Ecolab aims to achieve a positive water impact by restoring water withdrawal and protecting at-risk watersheds;[66] INEOS has committed to advance towards sustainable chemical value chains with zero pollution;[67] BASF has committed to boost sustainable agriculture with clear and measurable targets by 2030;[68] Solvay has committed to decrease its impact on biodiversity by 30% and reduce its water intake by 25%, both by 2030;[69] and Bayer has committed to reduce the environmental impact of its crop protection portfolio by 30% by 2030.[70]

With an average of 4-6%[71] of annual sales invested in innovation, chemical companies are well-versed in R&D and product development and are starting to steer investment towards nature and biodiversity projects. For example, Solvay launched a new renewable materials and biotechnology platform to develop innovative and sustainable solutions on renewable feedstocks and biotechnology in 2023;[72]

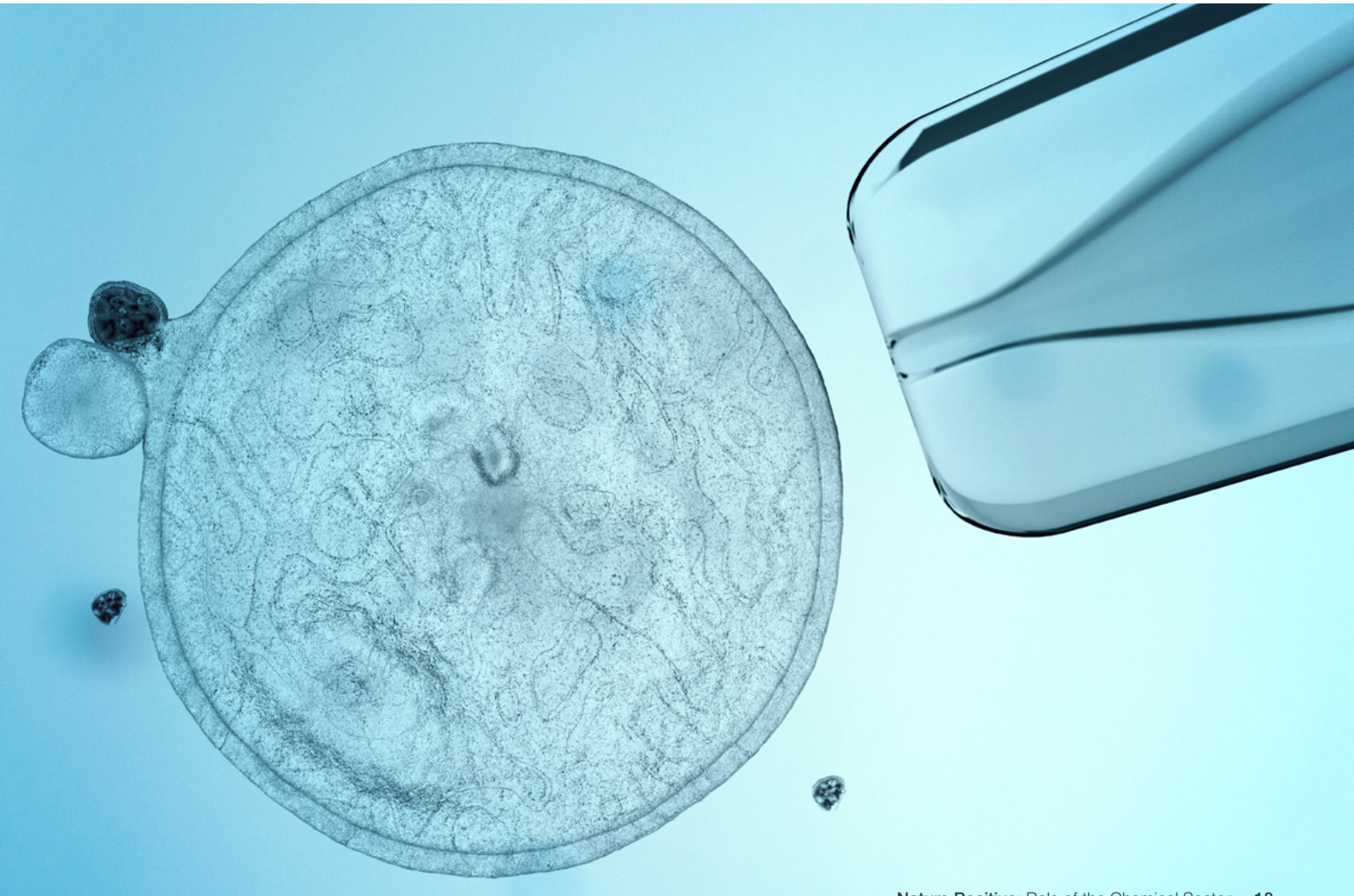
and in April 2023, Solvay and Ginkgo Bioworks launched a multi-year strategic collaboration to unlock synthetic biology as an enabler of more sustainable chemicals and materials.[73]

While recognizing these efforts, more needs to be done. Corporate leaders should start now to Assess, Commit, Transform and Disclose – as per Business for Nature's ACT-D framework – in a more systematic way. As noted in the Introduction, companies need to: 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 report material nature-related information. For more information on tools and guidance available for the ACT-D set of high-level actions, see Table 1.

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

Assess	Consult the Locate-Evaluate-Assess-Prepare (LEAP) approach from the Taskforce on Nature-related Financial Disclosures (TNFD).[74] Follow the technical guidance to assess and prioritize from the Science Based Targets Network (SBTN).[75]
Commit	Follow the technical guidance to set science-based targets for freshwater and land from SBTN.[76] For companies in land-intensive sectors, refer to Science Based Targets initiative (SBTi) Forest, Land and Agriculture Guidance (FLAG) to set science-based targets that include land-based emissions reductions and removals.[77] Use Business for Nature's commitment list to locate relevant commitments and connect corporate efforts to collective global action.[78]
Transform	Take inspiration from the World Economic Forum's *Sector Transitions to Nature Positive* series of reports;[79] invest resources and commit management to deliver against clear targets.[80]
Disclose	Consult the final recommendations from TNFD for nature-related risk management and disclosures, published in September 2023.[81]

Note: This table is non-exhaustive. For more tools and guidance, see High-level Business Actions on Nature.[82]



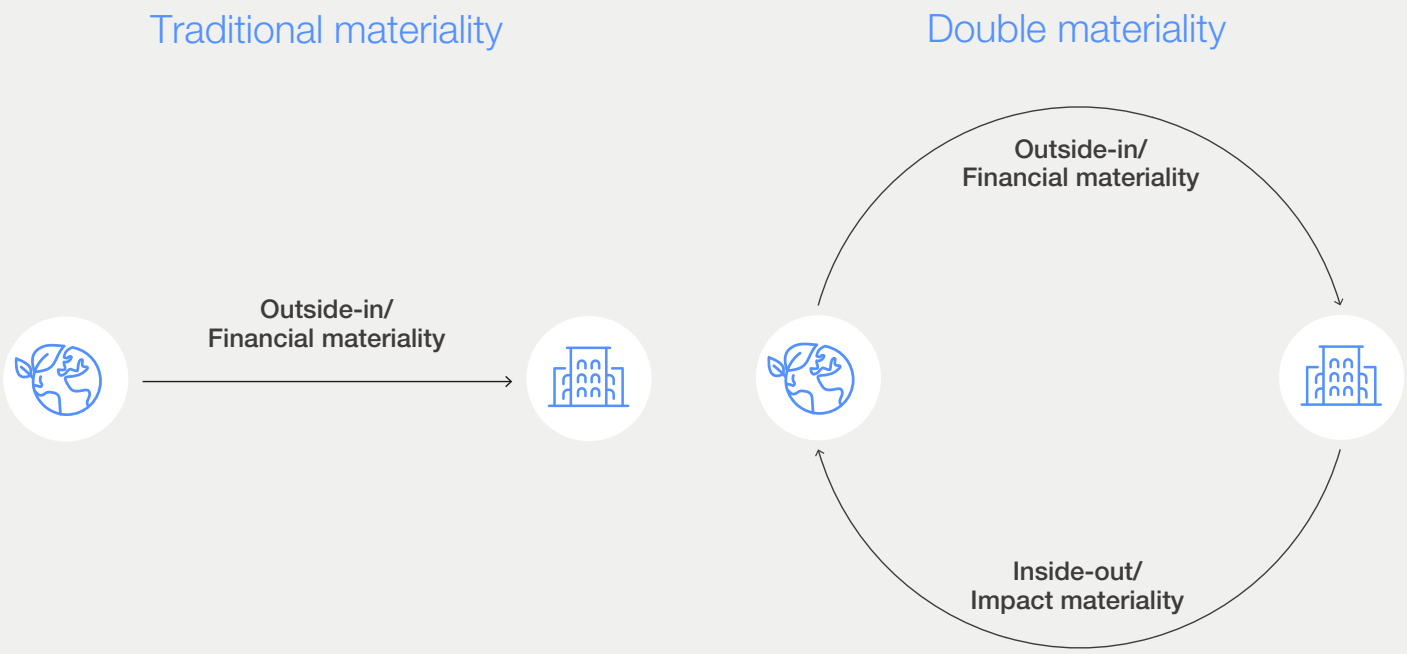
3 Nature-related impacts and dependencies

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

3.1 Double materiality

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

FIGURE 7 **Double materiality**



Source: World Economic Forum.[83]

The chemical sector is highly dependent on many environmental assets and ecosystem services:

- **Water:** Although the sector is increasingly looking to reduce overall water consumption and recycle wastewater, it continues to use freshwater as an essential resource.
- **Mineral and fossil resources:** Petroleum products and liquified natural gas are important feedstocks for the sector. Many chemicals are also dependent on mined resources such as platinum, palladium and rhodium. The sector's substantial energy demand is also derived mainly from fossil-based sources.
- **Biomass:** As the sector seeks to reduce its dependency on depletable resources, it increasingly uses renewable ones, such as biomass for energy production and bio-based feedstock. The sector also sometimes uses plant-based raw materials, such as wild medicinal plant species.

Consequently, most of the chemical sector's dependencies are hidden in its supply chain: according to the World Economic Forum's report *Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy*, more than 50% of the gross value-added of chemical company supply chains is highly or moderately dependent on nature.[84]

These dependencies strengthen the business case for investing in protecting and restoring nature to build sustainable and resilient supply chains and ensure the long-term viability of the business model. However, according to the 2019 global assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES),[85] the chemical sector continues to contribute to drivers of biodiversity loss such as pollution, greenhouse gas emissions, freshwater exploitation and land conversion due to the increasing use of bio-based feedstocks.[86] Chemical companies should avoid or mitigate these impacts on nature loss in their operations and value chains.

FIGURE 8 **Top four drivers of nature loss in the value chain of the chemical sector**

	Upsteam	Midstream/ Direct operations	Downsteam
Water use	✓	✓	
Pollution	✓	✓	✓
Greenhouse gas emissions	✓	✓	✓
Land-use change	✓	✓	

Note: See methodology in the Appendix.

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

The analysis on impact and dependencies presented in Chapter 3 is a sector-average analysis for companies in the chemical 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 dependencies and impacts using company-specific operational and supply chain information. TNFD's LEAP approach,[87] as well as the SBTN's Step 1 (screen and assess) and Step 2 (prioritize)[88] are useful frameworks to guide companies through their own assessment.

3.2 Water use

"9 kg of water is consumed for every kilogramme of hydrogen produced.

While most of the water used by the chemical sector is returned and therefore non-consumptive, manufacturing chemicals withdraws vast volumes of water. It can be water-intensive (especially for fossil fuel-based approaches) due to a range of technical processes, including the heating and cooling of plants, rinsing and distillation.

According to US non-profit CDP, which runs a global disclosure system on environmental impact, the sector has a water watch impact rating of "critical".[89] Europe's chemicals and petroleum refining industries account for 11% of freshwater use. Globally, the industry as a whole uses 5%-10% of freshwater resources.[90] Freshwater use can contribute to water stress, impacting local communities and creating competition for water between different users, such as agriculture or construction.

In addition, the transition to carbon-neutral energy sources may also impact water. For example, green hydrogen is a crucial decarbonization lever for some chemical companies. In ammonia production, which is typically a carbon-intensive process, green hydrogen can replace natural gas as the energy source. However, hydrogen production relies on water as a feedstock. While its use is less significant than for other industrial processes, with 9 kg of water consumed for every kilogramme of hydrogen produced,[91] the expected expansion of the hydrogen industry nevertheless has the potential to impact local freshwater ecosystems negatively.

The production locations of many players in the sector make careful water management all the more urgent. For example, BASF reported that 25% of its production sites were located in areas of water stress.[92] This adds to local competition for water and poses a risk to the business if freshwater becomes more scarce. With regulators increasingly introducing requirements for businesses to safeguard the availability of freshwater,[93] responsive action on water from the chemical sector is required.

3.3 Pollution

Overall, the chemical sector is taking action to manage toxic pollution levels. In many jurisdictions, more stringent rules on pollution levels have contributed to this trend. For example, chemical manufacturers achieved a 40% reduction in acidifying emissions between 2007 and 2019. Likewise, in Europe, the industry saw an overall decreasing trend of 51% in nitrogen and 66% in phosphorous emissions to water between 2007 and 2017.[94] The level of pollution depends on regulatory standards and enforcement in different regions.[95] The EU is leading with its safe and sustainable by design for chemicals and materials framework,[96] REACH (registration, evaluation, authorization and restriction of chemicals), CLP (classification, labelling and packaging regulations) and the upcoming sustainable use of pesticides regulation.[97]

> “ 22% of Europe’s surface water bodies and 28% of the groundwater area are significantly affected by diffuse pollution from agriculture.

However, hazardous releases from the chemical sector into the air, water and soil still exist, particularly in jurisdictions where regulatory standards and enforcement are weak.[98] The IPBES highlights that pollution is a crucial driver of change in the global state of nature, having a relative impact of 14% – the same level as climate change.[99]

Chemical pollution occurs along the entire value chain, especially in manufacturing, downstream use and end-of-life phases. In the manufacturing process, while atmospheric releases of chemicals from industrial sources have been declining in middle- and higher-income countries, toxic pollution remains a challenge in many places.[100] Moreover, industrial accidents continue to have major impacts. According to the Coalition to Prevent Chemical Disasters, the US saw 177 chemical incidents in 2021 and 186 in 2022.[101]

In the downstream application phase, pesticide residues and chemical runoff remain major concerns for soil, ecosystem and human health. Although agrochemicals have helped to increase food production significantly,[102] over-reliance on petrochemical and manure-derived fertilisers escalates nitrate concentrations, contributing to eutrophication. This results in biodiversity loss as oxygen levels are depleted.[103] Pollution containing heavy metals, microplastics and pesticides has also been found to cause physiological changes in fish.[104] The European Environment Agency reports that 22% of Europe’s surface water bodies and 28% of the groundwater area are significantly affected by diffuse pollution from agriculture.[105]

Lastly, the persistent nature of certain chemicals can lead to various environmental problems. For example, PFAS (per- and polyfluoroalkyl substances), often called “forever chemicals”, can remain in the soil, water or air for years or even decades and can be transported long distances from their source. Scientific studies have linked PFAS to adverse health effects in humans and animals.[106]

3.4 Greenhouse gas emissions

The sector generates about 7% of global and 20% of all industrial greenhouse gas emissions.

The chemical sector is a significant source of GHG emissions resulting from the sourcing of feedstock, manufacturing activities and the use and post-use stages of chemical products. In particular, the sector consumes significant amounts of fossil fuels, driven primarily by high manufacturing demand for energy and fossil feedstocks. Midstream chemical companies in the sector generate about 7% of global and about 20%[107] of all industrial GHG emissions. Three-quarters of the sector's emissions are generated by the production of just eight products.[108]

In the downstream phase, the use of nitrogen-based fertilisers in agriculture contributes substantially to emissions of nitrous oxide, an extremely potent greenhouse gas. The degradation of chemicals can also release GHGs like carbon dioxide or methane into the atmosphere, contributing to climate change.

Actions to address the sector's significant GHG emissions will become increasingly important in light of regulatory pressure. The European Commission's transition pathway for the chemical industry, published in February 2023, sets out a clear objective for the sector to achieve net-zero emissions by 2050.[109]

3.5 Land-use change

Land use accounts for 78% of the cumulative negative impacts (static impacts) from the chemical sector.

The chemical sector continues to shift to bio-based feedstocks to reduce its dependencies on fossil fuels. While the bio-based market is still small compared to traditional chemical products, growth is expected to pick up, especially in light of the broader push by governments to transition to a bioeconomy (such as the EU Bioeconomy strategy).[110] For example, one study estimates that the global use of biomass for bio-based materials and chemicals could grow from 1.24 billion tonnes in 2012 to 5.7 tonnes in 2050.[111] In the EU-28 market in 2019, the share of bio-based paints, coatings, inks and dyes already stood at 12.5% (for the whole product category), while the share of bio-based human-made fibres stood at 13%.[112]

However, bio-based feedstocks require significant areas of land for production and – if not sustainably produced – can drive soil degradation, land conversion and deforestation. According to CDC Biodiversité, land use accounts for 78% of the cumulative negative impacts (static impacts) from the chemical sector.[113] As future biomass potential is distributed unevenly worldwide, with most of the potential being in biodiversity-rich regions, biomass production must be sustainable.[114] With the bioeconomy expanding in many countries, land use is likely to be reviewed more stringently and regulations to protect land are expected.

Consequently, land use will be a key assessment criterion for regulators, customers and other stakeholders in understanding the sustainability of chemicals in the future. Sustainable biomass and bio-feedstocks are defined as being produced without triggering any destructive land-use change and with a life-cycle carbon footprint at least 50% less than fossil fuel alternatives.[115] Companies in the sector are encouraged to proactively address the land-use challenge to protect their business models, particularly as land competition increases.

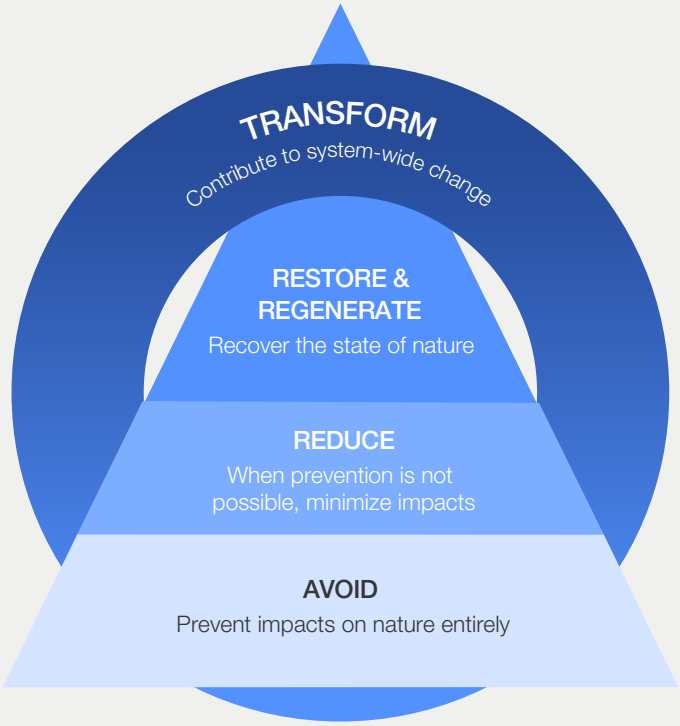
4 Five priority actions

By prioritizing manufacturing efficiency, water stewardship, responsible sourcing, nature conservation and circularity, the sector can unlock $320 billion per year of additional value by 2030.

There are five priority actions for the chemical sector to take (see Figure 9). Companies can contribute to a nature-positive future by prioritizing actions to: 1) increase manufacturing efficiency and use of renewables, 2) improve water stewardship, 3) source responsibly, 4) support nature conservation and restoration and 5) expand circularity, product innovation and customer education.

Given how much of the sector's impacts are upstream and downstream, these priority actions require companies to actively engage with suppliers, retailers, customers, consumers and industry peers to transform their value chains. While most of these actions are already being employed or gradually rolled out by businesses, this report calls for accelerated efforts in the chemical sector.

FIGURE 9 **Five priority actions for the chemical sector**



Priority Action 1

Increase efficiency in the manufacturing process and expand the use of renewable energy

Priority Action 2

Improve water stewardship through sustainable water management strategies and practices

Priority Action 3

Source responsibly and explore switching to sustainably sourced bio-based or recyclable materials

Priority Action 4

Support nature conservation and restoration and advocate for policy changes that protect nature

Priority Action 5

Expand circularity, product innovation and customer education on product use and disposal

"Undertaking the five priority actions for this sector could unlock $320 billion of annual cost savings and revenue upside by 2030.

The transition to a nature-positive business model presents enormous opportunities for companies in this sector. The Forum's *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.[116]

Of this amount, estimates show that undertaking the priority actions for the chemical sector could unlock more than $320 billion in annual cost savings and revenue upside by 2030 for businesses operating across the sector's value chain. In particular, enhancing the sector's manufacturing and energy efficiency, switching to alternative feedstocks and transforming its business model present significant business opportunities.

BOX 3

Opportunity sizing methodology to arrive at the $320 billion figure

The Forum's *Future of Nature and Business* report, 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 businesses). The sizing reflects the annual 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.[117]

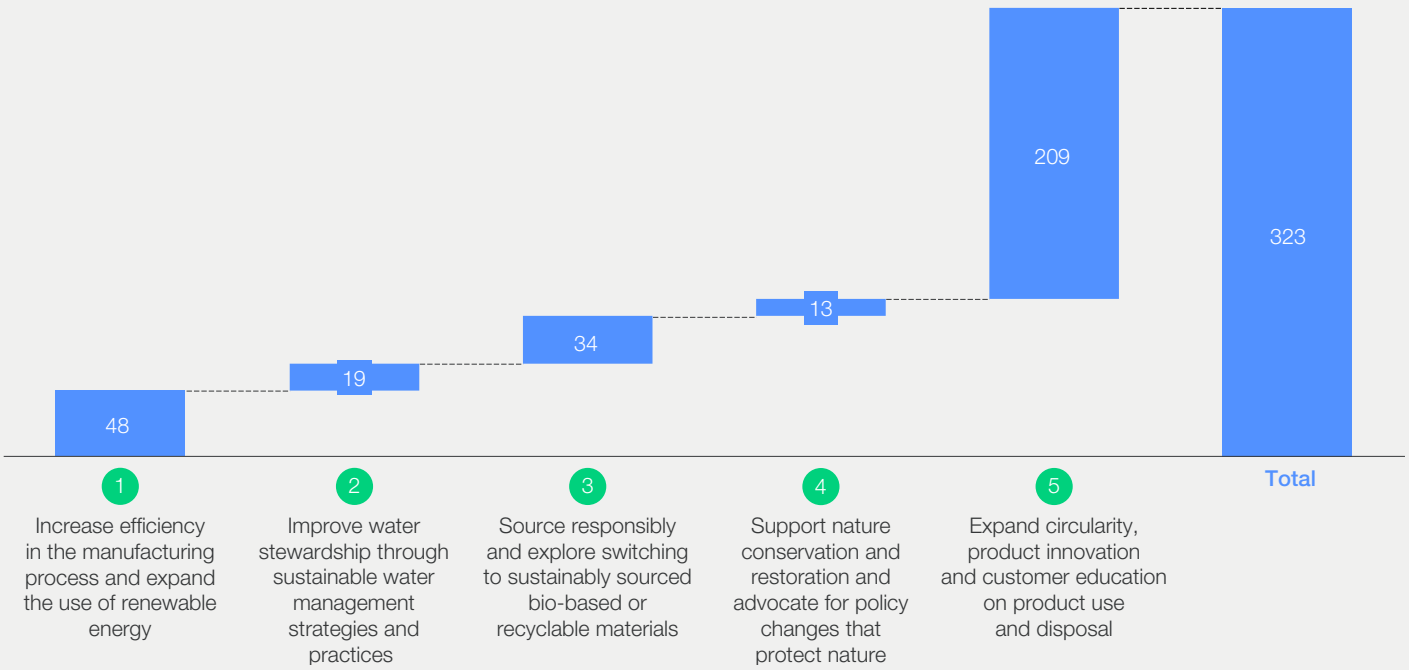
Identifying the business opportunity potential of the priority actions for the chemical sector followed a two-step approach. First, relevant opportunities were selected from the *Future of Nature and Business* report and mapped to the priority actions identified in this report. Second, the market potential for the chemical sector was estimated across each selected opportunity, using relevant adjustment factors such as the global GDP share of the chemical sector along its value chain for overarching sector opportunities (e.g. "wastewater reuse" opportunity)[118] or the relative role of the chemical sector for more specific opportunities relevant to the sector (e.g. "sustainable inputs" opportunity).[119]

This sizing approach may not cover the entire set of business opportunities that present themselves 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. For example, it did not assess cost savings related to energy-efficiency improvement in manufacturing that could generate billions of additional annual opportunities for the chemical sector by 2030.[120]

Further information on the methodology can be found in the Appendix.

FIGURE 10

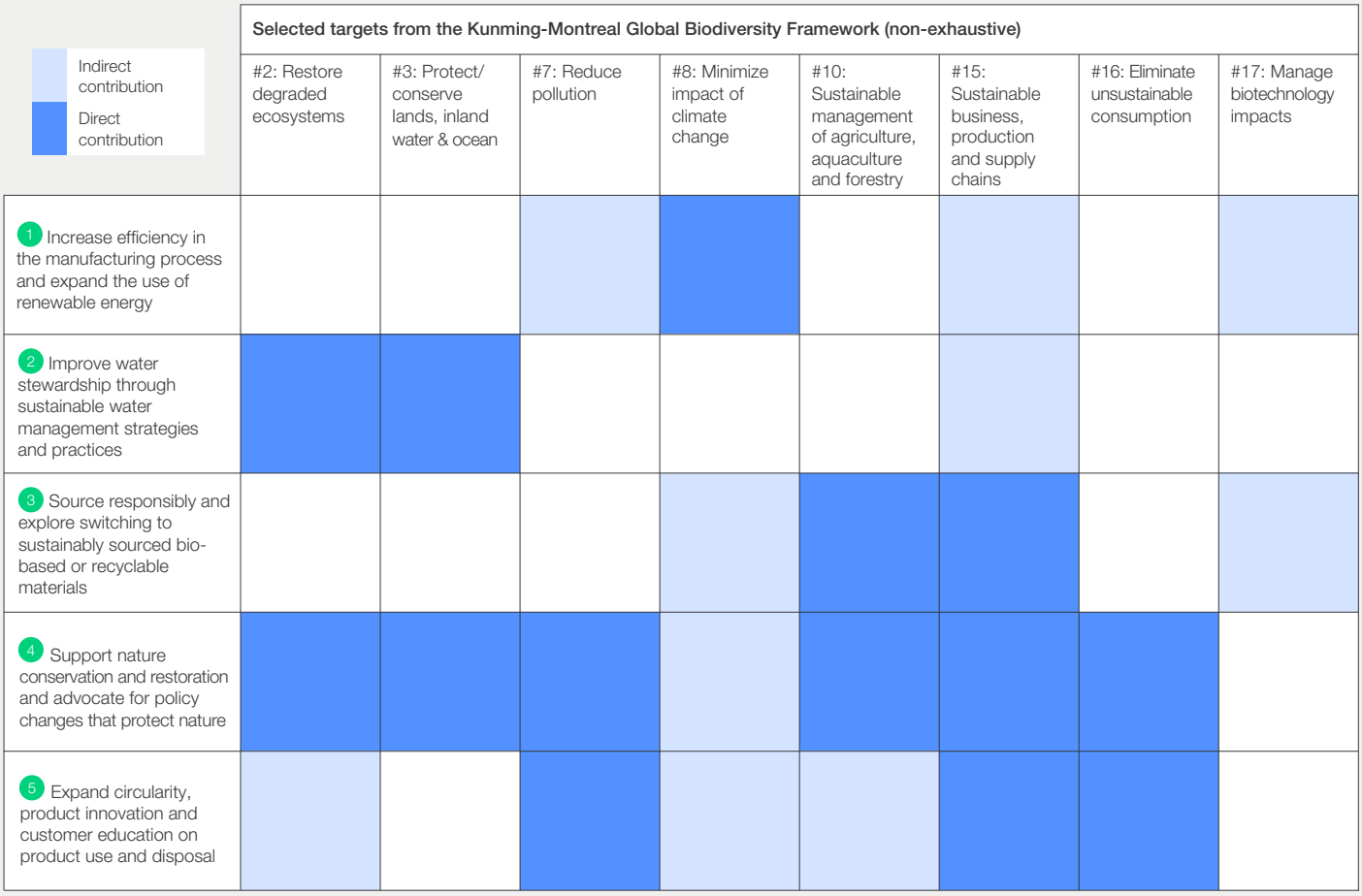
Business opportunities for the chemical sector, by 2030 ($ billion)



Taking these five priority actions both in company operations and in the wider value chain will help companies in the sector to avoid or mitigate the four drivers of biodiversity loss across the four nature realms. These actions will also contribute to the targets of the Kunming-Montreal Global Biodiversity Framework, which aims to halt and reverse biodiversity loss to achieve the global goal of nature positive (see Figure 11).

For each action, companies should also determine the baseline, set measurable and time-bound targets and report against the progress regularly to increase their accountability (see Chapter 5: Get started for more details).

FIGURE 11 **Mapping of five priority actions to GBF framework**



Priority Action 1

Increase manufacturing efficiency and use of renewables

Companies in the chemical sector recognized early on that increasing efficiency allows them to gain competitiveness in a global market and presents an opportunity to decrease their dependence on fossil fuels. In the EU, the chemical sector has been improving its energy efficiency significantly, evidenced by the 22% drop in total energy consumption in EU-27 countries since 1990. At the same time, the ratio between the energy consumption per unit of production was 45% lower than in 1990. However, the trend slowed significantly from 2001 to 2020.[121]

The chemical sector is encouraged to continue increasing efficiency by:

- Optimizing energy use and resource efficiency in the production process
- Increasing the use of renewable energy
- Leveraging novel manufacturing techniques to decrease dependence on fossil fuels

Tackling climate change, in particular reducing greenhouse gases, is a major lever to support the transition to nature positive.

Energy and resource-use efficiency improvements could contribute to achieving 40% of the chemical sector's long-term emissions reduction targets by 2030.

Optimizing energy use and resource efficiency in the production process

Improving the chemical sector's energy efficiency reduces its upstream dependence on natural resources, especially fossil fuels. This lessens the impacts on nature and biodiversity by decreasing natural resource depletion and disruptive upstream extractive activities; and it reduces the pollution that comes from energy generation and feedstock processing. This action also mitigates risks associated with policy and regulatory changes in fossil fuel or energy use and protects companies' business models from increasing energy and raw material costs.

While the chemical sector has been improving its efficiency across heat, energy, resource and water use for many years,[122] there is still potential to progress. For example, the International Energy Agency (IEA) highlights that further energy efficiency measures will be critical to achieving a net-zero chemical sector[123] and energy and resource-use efficiency improvements could contribute to achieving 40% of the sector's long-term emissions reduction targets by 2030.[124] To realize this target, the chemical sector is encouraged to combine its net-zero and nature-positive strategies. Solutions that are already being rolled out include:

- Digitalizing or automating manufacturing processes to increase natural resource-use efficiencies
- Transforming manufacturing processes, such as the steam cracker (direct electrification or hydrogen use)
- Recycling heat in manufacturing
- Innovating manufacturing processes to reduce energy and heat intensity
- Researching to discover new catalysts to reduce energy and heat intensity
- Improving heat distribution

In 2022, the US Government announced $2 billion in funding to launch the National Biotechnology and Biomanufacturing Initiative.

Increasing the use of renewable energy

The chemical sector continues to shift to renewable and biofuel energy sources. The substitution of fossil fuel-based energy generation with renewable energy will help the sector significantly reduce its contribution to depleting fossil fuels and decrease its scope 2 emissions. It will also reduce companies' exposure to fluctuations in fossil fuel availability and prices and prepare them for the introduction of policies and regulations aiming to shift dependencies away from fossil fuels.

Increasing the use of renewable energy can include switching to suppliers that provide energy from sources such as solar and wind power, waste or biomass, including biofuel (while acknowledging trade-offs and ensuring it is sustainably produced), as well as electrifying as much of the manufacturing process as possible.

Leveraging novel manufacturing techniques to decrease dependence on fossil fuels

While companies continue to optimize their manufacturing processes, they should also start taking more transformative actions where possible. In particular, new biomanufacturing opportunities[125] offer a more efficient approach to producing some organic chemical products. Biomanufacturing describes the use of engineered biological systems from microbes, animal or plant cells to produce a product. In the chemical sector, various applications exist, including agricultural chemicals, solvents and specialty products (e.g. pharmaceuticals).[126] The production of chemicals via biomanufacturing has the potential to reduce land and water use overall and generate fewer emissions than traditional, fossil fuel-based approaches.

Governments are recognizing the potential of biomanufacturing. In 2022, the US Government announced $2 billion in funding to launch the National Biotechnology and Biomanufacturing Initiative to support research and development efforts.[127] Other countries are following suit – for instance, in May 2023, the United Kingdom established a biomanufacturing fund to support commercial-scale vaccine and biotherapeutic manufacturing projects.[128] Increased access to funding highlights growing global recognition of biomanufacturing as a pivotal technology for the future.

Priority Action 2

Improve water stewardship

Optimized freshwater management could reduce companies' water withdrawal and consumption by up to 30% by 2030.

The sustainable use of the planet's water resources is increasingly important. Severe water scarcity already affects about half the global population for at least part of the year. Exacerbated by climate change, these numbers are expected to increase.[129] In the chemical sector, optimized freshwater management could reduce companies' water withdrawal and consumption by up to 30% by 2030.[130]

Improving water management, particularly in water-scarce regions, is increasingly important for firms as policy instruments are expected to be deployed to manage water scarcity. One example that has already been implemented is Australia's water market, where companies are allocated volumes of water they are allowed to extract in a single year and users can buy or sell water rights to encourage the best use of scarce water resources.[131]

BOX 4

Tools to improve water stewardship

Useful tools to help companies identify, assess, prioritize and take action on water-related material risks include:

- Aqueduct from the World Resources Institute (WRI)[132]
- WWF's Water Risk Filter[133]
- Technical guidance on freshwater published by SBTN[134]
- The Alliance for Water Stewardship (AWS) Water Stewardship Standard[135]

Actions to optimize freshwater management can include the following:

- Installing an integrated water system
- Upgrading water treatment systems to maximize water recovery
- Installing new technology to save and recycle water
- Creating water loop interfaces
- Completing a water audit to assess water use and management
- Recycling water and introducing closed-loop systems
- Designing air-cooled processes to replace those that are water-cooled

Companies can also take a watershed approach to preserve and replenish watersheds through local partnerships. For example, Dow identified six manufacturing sites as key water-stressed locations. At the Camp de Tarragona in Catalonia, Spain, Dow worked with the local industrial water distributor, Catalonia's water rights control board, Nalco and Veolia to implement a municipal wastewater reclamation programme to free up water for the UNESCO Ebro River Basin.[136] In another case, Solvay built an artificial water basin in the 1960s to provide freshwater to the Rosignano plant. This basin is now recognized as a nature reserve with over 3,000 animal and plant species living in the area, compared to 300 species before its construction.[137] By managing freshwater withdrawal, consumption and disposal, companies can protect against increasing risks of reduced water quality and availability and contribute to local communities.

Priority Action 3

Source responsibly

Companies should assess impacts and risks in their supply chains, in particular for renewable raw material sourcing, engage with suppliers to maximize their sustainability performance, and improve product transparency and traceability. This will allow users to make more informed decisions on purchase and usage.

Companies in the sector are increasingly shifting towards alternative feedstocks.[138] Bio-based feedstocks, for example, are typically divided into three different types:[139]

- First-generation materials made from traditional agricultural crops

The EU has launched a €2 billion public-private partnership to fund projects that advance competitive circular bio-based industries.

- Second-generation materials made from cellulosic crops, residue and waste products
- Third-generation materials made from non-traditional organisms, such as algae

Other recyclable and recycled feedstocks include use of waste as a resource to manufacture new products (see also priority action #5 related to circularity).[140]

Over 40% of circular innovation investments made by global chemical manufacturers in 2020 were related to bio-based or recycled material for feedstocks.[141] For example, Croda International, a British specialty chemical company,[142] reported using 67% bio-based raw materials in 2020[143] and has set a goal to reach 75% bio-based feedstocks by 2030 while enabling more land to be saved than is used to grow those raw materials.[144] BASF (among the largest chemical producers in the world) and Eni (an Italian multinational energy company) are collaborating to develop a new technology to produce bio-based propanol from biomaterials.[145]

Governments are likewise looking to support the expansion of sustainable bio-based feedstocks: 82% of countries assessed have policy measures that support capacity building and education for the bioeconomy, with 64% promoting innovation.[146] For example, Europe is demonstrating its commitment by launching a €2 billion public-private partnership between the EU and the Bio-based Industries Consortium to fund projects that advance competitive circular bio-based industries in Europe.[147] The EU Bioeconomy Strategy is also in place to strengthen and scale up bio-based sectors.[148]

However, this switch should incorporate a risk assessment of the chemicals and consider land-use competition for feed, food, fibre and fuel. Risk assessments and life-cycle analyses of bio-based products are needed to avoid unintended consequences on nature and biodiversity.

CASE STUDY 1

BASF/Henkel

In 2022, BASF and Henkel joined forces to replace their annual consumption of 110,000 tonnes of fossil-based ingredients with renewable carbon sources for feedstocks in Henkel's European Laundry & Home Care and Beauty Care businesses. The replacement of the feedstocks was piloted in 2021 and at scale will help Henkel reduce its nature and carbon footprints by avoiding natural resource depletion and atmospheric pollution, among others.[149]

BASF has set up its *Verbund* (intelligent connection) structure as part of its circular strategy and aims to increase its use of renewable and recycled feedstocks. The *Verbund* concept maximizes resource efficiency, drives the use of by-products as feedstocks elsewhere and offers opportunities to use renewable and recycled raw materials. This involves identifying non-fossil alternatives, finding renewable resources such as castor oils and recycling feedstocks (and chemically recycling waste themselves).[150]

Priority Action 4

Support nature conservation and restoration

> Scientists estimate that 60% of services provided by nature are already degraded or used unsustainably.

Conservation and restoration

Active engagement from companies in conserving and restoring nature will be a vital step in the sector's contribution to nature positive. Conservation prevents ongoing degradation, while restoration attempts to reverse previous degradation.[151] With an estimated 60% of services provided by nature already degraded or used unsustainably,[152] conservation alone is insufficient and restoration efforts should be employed.

In pursuing conservation and restoration efforts, companies should follow the mitigation hierarchy and start by addressing the impact of their own activities first. However, to ensure a comprehensive approach to addressing their effects on nature, companies should aspire to undertake efforts within their value chains and work with both suppliers and customers. They are also encouraged to start working beyond their value chains and contribute to a system-wide push to support nature. Companies can refer to the global standard for nature-based solutions published by the International Union for Conservation of Nature (IUCN), which proposes eight criteria and 28 indicators to deliver results that are "environmentally sound, socially just and economically feasible."[153]

Companies in the sector have already adopted initiatives to help support the restoration and conservation of nature. For example, BASF supports the "Coup d'Pousse" platform of the Bees Biodiversity Network (RBA) in France. The platform seeks to help bee populations and ensure they have the food they need by sowing pollen-bearing flowers on agricultural land.[154] Green infrastructure such as wetlands can present a natural and less expensive solution for the tertiary treatment of wastewater, depending on the chemical compounds and processes concerned and applicable regulatory restrictions.

Companies can also launch their own conservation and restoration programmes or support existing programmes to expand and raise their quality. For example, in the US, Corteva supports conservation programmes initiated by the National Fish and Wildlife Foundation (NFWF) to restore grassland habitat in the Southern Great Plains.[155]

CASE STUDY 2

Dow

Project Ybá, launched by Dow in collaboration with the Peabiru Institute and The Nature Conservancy, aims to contribute to social development and Amazon forest conservation. Dow owns 45,000 hectares of land in Brazil's Amazon rainforest, 80% of which is preserved native rainforest in line with the country's forest code.

In 2022, the Peabiru Institute identified 17 plant species as valuable to the cosmetics and pharmaceutical sectors. Cosmetics brand Natura & Co, a partner in the initiative, will purchase Andiroba seeds from a local farmers' association. The project plans to train the farmers, who are mostly women, in the commercialization of fruits and seeds sustainably extracted from the forest.[156]

In another initiative in the US, Dow converted 100 acres of an existing water treatment pond at the Seadrift manufacturing site into constructed wetlands. The wetlands provide tertiary treatment for approximately 5 million gallons a day of industrial wastewater. Compared to typical grey infrastructure that would cost $40 million, the initial and operational capital required for this wetland project was only $1.4 million, while saving energy and bringing other environmental benefits.[157]

Cross-sector collaboration to drive progressive action

Companies in the chemical sector have a role to play in advancing progressive policies and regulations that set minimum standards for sectors. These will contribute to achieving the goal of halting and reversing biodiversity loss by 2030 and help protect the long-term viability of the chemical sector by reducing the overexploitation of nature and driving the adoption of sustainable business models.

By joining ambitious and progressive business coalitions, chemical companies can foster sustainability, innovation and responsibility within the industry. Examples of these coalitions include:

- **World Economic Forum's Chemical and Advanced Materials Community – Low-Carbon Emitting Technology Initiative:** A first-of-its-kind chief executive-led chemical industry coalition focused on accelerating the development and upscaling of low-carbon emitting technologies for chemical production and related value chains.[158]
- **International Council of Chemical Associations (ICCA) – Responsible Care initiative:** An initiative that drives continuous improvement in health, safety and environmental performance.[159]
- **Together for Sustainability (TfS):** An initiative of chemical companies for sustainable supply chains that aims to develop and implement a global programme to assess, audit and improve sustainability practices within the supply chains of the chemical industry.[160]
- **Green Chemistry & Commerce Council (GC3):** A business-to-business forum that drives the commercial adoption of green chemistry by catalysing and guiding action across all industries, sectors and supply chains.[161]
- **European Chemical Industry Council (Cefic) – Sustainable Development programme:** An influential player – with direct membership of over 550 companies and nine associations – that drives and monitors progress on the EU Green Deal and contributes to the EU Safe and Sustainable-by-Design strategy, for example, using the WBCSD *Chemical Industry Methodology for Portfolio Sustainability Assessments (PSA)*.[162]
- **WBCSD – Chemicals Group:** An initiative with chemical company members to support them in advancing their ambitions on the *Sustainable Development Goal Roadmap*, providing greater coordination across business solutions.[163]
- **Business for Nature:** A global coalition that has launched campaigns such as "Make It Mandatory" that helped convince governments at the 2022 UN Biodiversity Conference (COP15) to adopt requirements for all large businesses and financial institutions to assess and disclose on nature.[164]

Innovative finance

According to a 2020 report on the global biodiversity funding gap, spending on biodiversity conservation is estimated at between $124 and $143 billion per year, against a total estimated biodiversity protection need of between $722 and $967 billion per year. This leaves a biodiversity financing gap of at least $600 billion per year.[165] Given public sector organizations alone are unlikely to foot this bill, the private sector has a key role to play in helping bridge the gap by investing in a nature-positive transition.

Target 19 of the Kunming-Montreal Global Biodiversity Framework proposes a number of innovative ways to mobilize resources from both the public and private sectors. For example, companies could consider investing in payment for ecosystem services, green or blue bonds, voluntary biodiversity certificates or credit markets and nature restoration funds. Through careful assessment of the advantages and disadvantages of available products, companies can contribute to meaningful biodiversity conservation that is aligned with their internal values and targets.[166]

Priority Action 5

Expand circularity, product innovation and customer education on product use and disposal

Chemical manufacturers can also engage in more transformative action and innovate their business models, including adopting circular models and introducing new products. Such transformative action will require chemical manufacturers to redefine their business strategies and invest significantly. These changes carry considerable risk and a successful transformation can only occur if businesses harness broad buy-in from all relevant stakeholders, including investors. Nevertheless, taking action today will enable companies to future-proof their business models by providing access to compelling business opportunities in the new nature-positive economy.

Companies are encouraged to minimize pollution through design, risk assessments, portfolio development, customer education and end-of-life solutions.

Various guidelines are available, such as:

- *Safe and sustainable by design chemicals and materials – Framework for the definition of criteria and evaluation procedure for chemicals and materials* (EU Joint Research Centre)[167]
- *Safe and Sustainable-by-Design: A Transformative Power* (Cefic)[168]
- *Framework for Portfolio Sustainability Assessments (PSA)* (WBCSD)[169]

Circularity

Moving to circular models in the sourcing of input materials and feedstocks, the design and manufacturing of products and the downstream use of chemicals is a crucial pillar of nature-positive action, as it reduces downstream waste and can lead to more efficient manufacturing processes. Circularity can, for example, expand into resource recovery activities and production of bio-based and biodegradable plastics.

Circular solutions are already gaining traction in the sector. LG Chem is investing $2.3 billion in businesses with solutions such as biomaterials and recycled materials.[170] Dow will transform plastic waste and other alternative feedstocks to create 3 million metric tons of circular and renewable outputs annually.[171] Similarly, BASF has committed to generating sales of €17 billion with solutions for the circular economy by 2030.[172] In parallel, Indorama Ventures has committed to doubling its recycling capacity by investing $1.5 billion in processing facilities, which includes a blue loan financing package of $300 million from three development finance institutions.[173]

Policy-makers are applying additional pressure to refresh the way materials are used in the economy, with a particular focus on plastic packaging. As policies are rolled out, chemical companies face the risk of dramatic reductions in demand for plastics and other materials and will need to update their business models. For example, the EU Green Deal's Circular Economy Action Plan focuses explicitly on leading global efforts for a circular economy[174] and the UN Environment Assembly's draft legal instrument to end plastic pollution explicitly discusses the circular economy.[175]

CASE STUDY 3

BASF

BASF has launched its ChemCycling project, which uses pyrolysis oil produced with recycled post-consumer plastic waste as a feedstock in manufacturing virgin-grade plastics.[176] The process uses BASF's mass balance approach, which allows for tracing all materials used to manufacture a product across the complex value chain in production facilities. Consequently, customers of end-products can determine the recycled feedstock used.[177]

BASF's technology partners supply it with pyrolysis oil from mixed plastic waste or end-of-life tyres.[178] In 2019, BASF invested €20 million into a partner whose plastics to liquids process converts waste plastics into a raw material comparable to virgin fossil fuel derived refined products. In 2020, the company invested €16 million into a partner that recycles tyres into raw materials such as pyrolysis oil and gas.

Business model transformation and expansion to new products and markets

With increasing pressure to reduce impacts on nature and biodiversity, chemical manufacturing companies are encouraged to acknowledge the need for further change and develop transition pathways that include rethinking their business models and product offerings. Such actions can be disruptive. To create business cases that capital markets recognize will require collaborative action, for instance partnerships between chemical manufacturers and firms in adjacent sectors.

Chemical manufacturers can expand their broader offerings along the sector's value chain to future-proof their business models. For example, to capture downstream business, they can expand into specialist waste management and resource recovery activities or provide services to consumers of chemical products, such as farmers.[179]

Moreover, they can revisit their product portfolios to introduce new planet-positive chemicals. In particular, researching and developing new products that serve the nature-positive transition of another industry presents significant market opportunities. One example is Henkel's sustainable surface treatment for aluminium processes that provides a toxic-free process for etch passivation and corrosion protection.[180] The product is chromium-free and reduces the user's carbon and water footprints, significantly diminishing the process's impact on nature. Similarly, Dow has developed a sustainable textile treatment that enables existing textile mills to retrofit their process and dye cotton using 50% less water, 90% less chemicals including dyes and 40% less energy, resulting in around 60% lower carbon emissions when compared to current cationic cotton dyeing processes.[181]

Agricultural chemical companies have a crucial role in supporting Target 10 of the Global Biodiversity Framework and Sustainable Development Goal (SDG) 2 by building a more sustainable agricultural sector that ensures food security and contributes to a nature-positive future. This could include researching and developing new products and services that continue to reduce the overall environmental impact of agriculture, such as eco-friendly pest control and technical advice. Companies can transform pest control and management methods by supporting chemical pesticide-free innovations, including:[182]

- Diversifying crops and practices to maximize ecosystem services
- Introducing eco-friendly pest control, such as integrating digital tools and machinery to control weeds and species
- "Odorscaping" to screen substances and plant species
- Introducing microbiota for plant protection and plant nutrition

Customer education

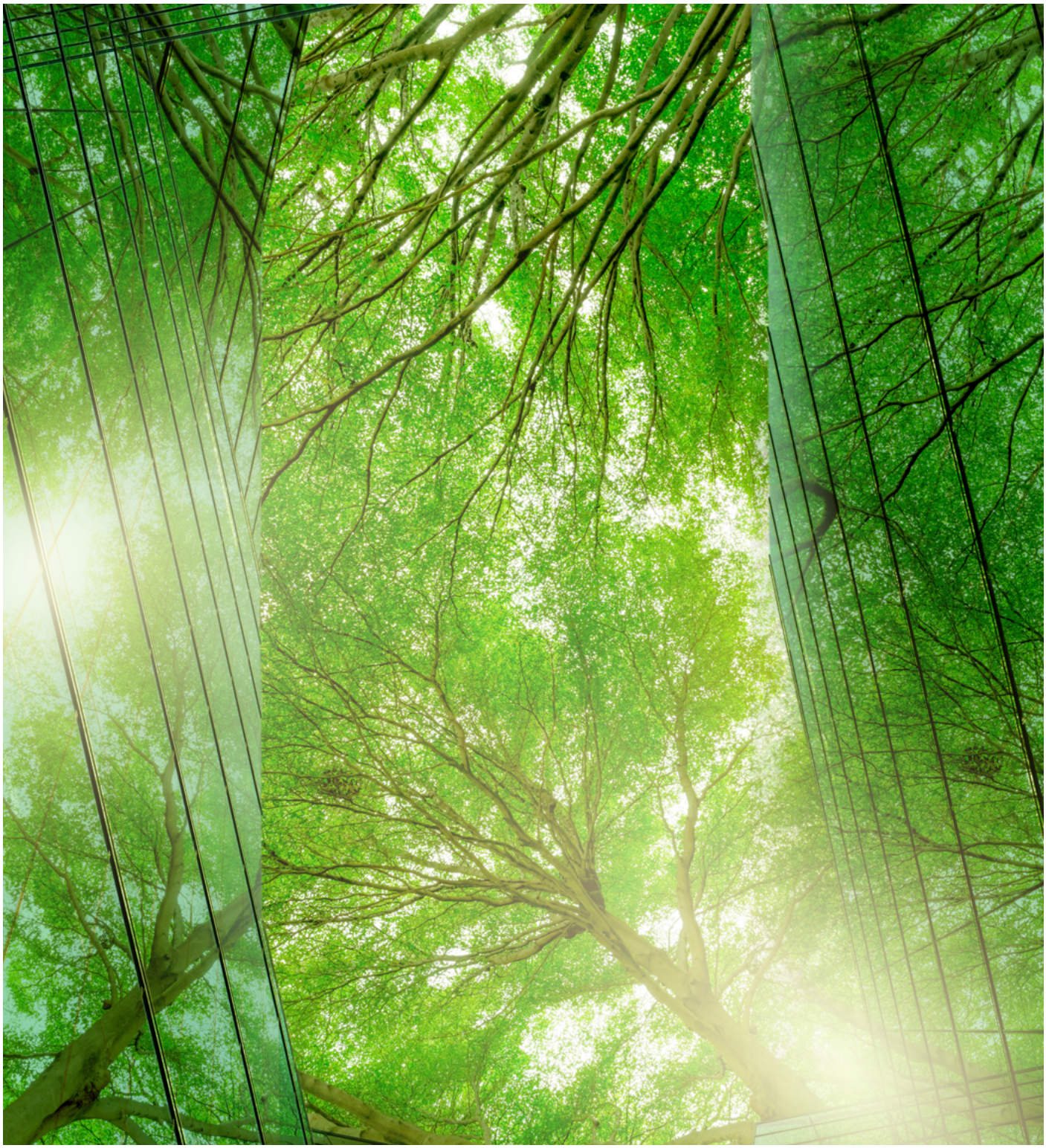
Companies are also encouraged to step up education campaigns for customers in both business-to-business and business-to-consumer segments to reduce pollution in the downstream phase.

Customer engagement can include the following:

- Informing customers on the best use of products to minimize environmental impact (including precision and micro-dosing to reduce the use of chemicals for agricultural chemical companies)
- Providing transparency on product environmental safety information and transparent labelling
- Incentivizing the use of products or methods that reduce environmental impact (such as promoting regenerative agriculture)
- Encouraging the correct disposal of products and packaging

5 Get started

The twin imperatives of addressing climate change and nature loss are highly interdependent. Companies should complement their net-zero plans by setting a credible nature strategy.



While many companies in the chemical sector have already embarked on the nature journey and embraced the five priority actions, achieving transformative business model changes and making genuine contributions towards a nature-positive world by 2030 demands significant time and resource investments from companies.

The journey to deliver net-zero emissions and tackle nature loss are two business concerns that are highly interdependent: 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 is synergistic to companies' net-zero commitments and should be integrated into their climate transition plans.

Guidance is emerging on both transition planning for net zero and ways to adapt those plans to integrate nature and biodiversity. Several institutions are working on such guidance, for example:

- **UK Transition Plan Taskforce (TPT)** created a new working group focused on nature in early 2023.[184]
- **Glasgow Financial Alliance for Net Zero (GFANZ)** has published a best practice framework for net-zero transition planning.[185] The framework has five themes or components: 1) Foundations, 2) Implementation strategy, 3) Engagement strategy, 4) Metrics and targets and 5) Governance.
- **WWF** has produced a step-by-step framework[186] to support the integration of nature into climate-related transition planning, building on the GFANZ framework. This framework starts by ensuring that climate-tackling actions do not come at the detriment of nature, emphasizes the importance of enhancing the co-benefits of natural climate solutions and seeks to align net-zero transition plans with nature-positive goals.

5.1 Align strategy with organizational maturity

An assessment of a company's organizational readiness and maturity can help it identify the most suitable guidance and tools to drive action and understand its performance on the nature-positive journey. Table 2 details recommended actions to deliver a nature-positive strategy mapped to an organization's level of readiness and maturity. These actions are broadly organized in line with GFANZ's five themes or components of net-zero transition planning mentioned above.

TABLE 2 | Mapping the components of a nature-positive strategy against organizational maturity

Component 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, SBTN's initial guidance for business and materiality screening tool, Aqueduct from WRI, TNFD's Getting started guidance, WWF's biodiversity risk filter and water risk filter, UNEP-FI's report on high-risk sectors and the Integrated Biodiversity Assessment Tool (IBAT)	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 Integrated Biodiversity Assessment Tool (IBAT)
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 National Biodiversity Strategies and Action Plans (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; foster 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 approach Validate commitments using third-party stakeholders	Detail and report on targets for nature-related risks and opportunities based on TNFD's management and disclosure framework Prepare for science-based targets on land and freshwater by using SBTN's Step 3: Measuring Baselines & Target Setting
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

5.2 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. This section takes a deeper look at the metrics and indicators available.

TNFD's LEAP approach

A good place to start is with the *Additional draft guidance for corporates on science-based targets for nature*, published jointly by TNFD and SBTN.[187] TNFD differentiates between assessment metrics and disclosure metrics along the four phases of the LEAP approach (see Figure 12):[188]

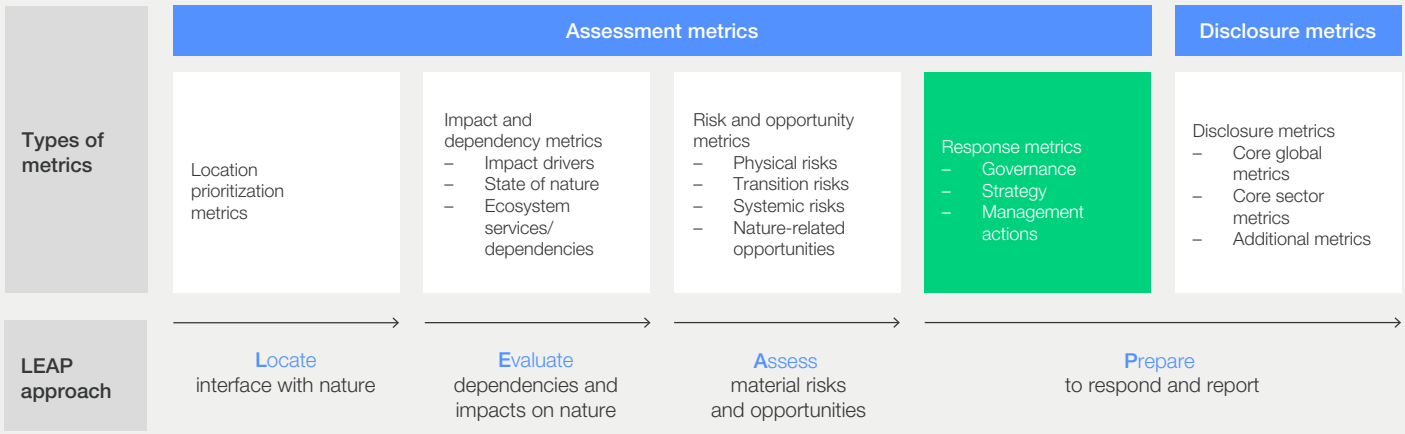
- **L**ocate interface with nature
- **E**valuate dependencies and impacts
- **A**ssess material risks and opportunities
- **P**repare to respond and report

TNFD's definition of assessment metrics includes "response metrics", which are what this chapter focuses on. These cover the internal reporting on an organization's actions, policies, commitments, plans and targets to manage nature-related dependencies, impacts, risks and opportunities – in both direct operations and the value chain.[189]

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 as well (see Table 3).

FIGURE 12 **Types of metrics in TNFD's LEAP approach**



Source: Adapted from TNFD's approach to metrics.[190]

TABLE 3 | **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, e.g.: – Investment in water management systems – Numbers of staff in the nature or sustainability team
Output and outcome indicators	Tangible results stemming from undertaking a priority action, e.g.: – Commitment to no conversion of natural ecosystems – % reusable, recyclable or compostable plastic packaging – % of raw material certified by commodity-specific certifications in the supply chain (that are identified as critical suppliers based on materiality assessment and volume)

Companies should define a set of indicators and metrics according to the mitigation hierarchy (Avoid & Reduce, Restore & Regenerate, Transform) to assess their activities and the impacts achieved.[191] Table 4 lists a number of sample indicators and metrics, aligned with the mitigation hierarchy, that can help business leaders as they start to develop their approaches for monitoring and measuring priority actions.

These sample indicators and metrics are a non-exhaustive set of indicative ideas. They can be applied at organization, product, service line and location levels. For more details, refer to TNFD's guidance on response metrics.[192]

TABLE 4 | **Sample indicators and metrics aligned with the mitigation hierarchy**

Mitigation hierarchy	Priority action	Indicative sample indicator/metric (non-exhaustive)
Avoid & Reduce	Efficiency gains	Investment into best available technology Energy intensity of a given unit of output
	Freshwater management	% of sites certified by ISO 14001* Performance against commitment to reduce water withdrawal and reduce water quality pressure** % of affected stakeholders meaningfully engaged on water-related issues*
	Reduce GHG emissions	% value chain emission reduction according to SBTi FLAG guidance
	Renewable energy	Share of renewables in energy mix per production site
	Conservation	Performance against commitment to no deforestation and conversion**
	Sustainable bio-based or other renewable materials & feedstocks	% of bio-based feedstock used to produce a given unit of output % of raw material certified by commodity-specific certifications in the supply chain (that are identified as critical suppliers based on materiality assessment and volume)
Restore & Regenerate	Restoration	Performance against commitment for biodiversity net gain % of affected stakeholders meaningfully engaged in area* Investment and extent of restoration of negatively impacted ecosystems*
	Customer education	Budget dedicated to education of farmers for correct use of fertilisers % of traceability of raw materials in the supply chain (that are identified as critical suppliers based on materiality assessment and volume)
Transform	Circularity	Circular material use rate* Number of knowledge products/research projects in circularity* Extent to which customers/suppliers are engaged in circular economy topics*
	Business model change	Investment in nature-related product/service lines/ technology* Number of sector-wide or multistakeholder initiatives supported*

* Aligned with TNFD v0.4 examples of response metrics

** Aligned with SBTN interim targets

5.3 Map the transition onto business functions

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

TABLE 5 **Mapping strategies and actions by business function**[193]

Business function	Potential strategies and actions required for a nature-positive transition
Sustainability	Develop the nature-positive strategy for the business (together with the strategy function) Obtain a holistic understanding of impacts and dependencies of the firm's operations and products Collaborate with other functions to drive the wider transition of the business Drive nature conservation and restoration initiatives (such as wetlands for wastewater purification) Promote collective sector-wide positive action, such as sustainable raw material sourcing or collaboration on bio-based or recyclable material research Monitor sustainable sourcing practices and raw material certification Support and enable collaborations with NGOs as well as industry initiatives
Finance and risk management	**Financial management** Revise capital planning assumptions for nature-positive related business cases (e.g. pay-off periods for investments may increase versus traditional capital expenditures) Consider impacts of nature-positive transition on balance sheet (e.g. high-polluting assets might have to be written off prematurely or written down on an accelerated timeline) **Investments** Increase capital spending on projects enabling the nature-positive transition of the business (e.g. retrofitting plants, supporting other nature-based solutions) – In particular, allocate funding to improve water stewardship measures, including water audits, wastewater recycling and water basin restoration Allocate budget for innovation spending, such as for circular innovations and research into bio-based or recycled material for feedstocks – Plan for the financial implications of incorporating circularity and sustainable product development Commit to investments in nature conservation, restoration and nature-based solutions in collaboration with NGOs and local communities **Financing** Consider that the cost of capital for high-polluting operations could increase Consider that availability of capital may become contingent on credible nature-positive strategies Leverage new sources of funding, such as green bonds and sustainability loans, nature-focused impact funds, blended financing and partnership with NGOs **Risk management and disclosure** Consider that new nature-related risks may emerge that need to be managed (see TNFD framework), for example: – Physical and supply chain risks, such as decreased water availability or quality in the supply chain – Transition risks including demand shifts, regulatory risks and reputational risks Prepare required nature-related disclosures for audited statements for CSRD (and potentially under forthcoming requirements of the IFRS Foundation's ISSB)

Business function	Potential strategies and actions required for a nature-positive transition
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 made Enhance efficiency of production processes (e.g. improved water management, including water recycling systems and close-loop systems in manufacturing; digitalization and automation in manufacturing processes; energy efficiency measures) Track water impacts (including usage and recycling) 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)
Sales and marketing	Promote products that have minimal impacts on nature and biodiversity and offer eco-friendly solutions, especially in sectors like agriculture Provide disclosure on impacts and dependencies of products, especially as customers may expect more information on nature footprint, which requires transparent and traceable supply chains Develop a holistic understanding of customer segments and willingness to pay for greener products
Investor relations	Disclose nature-positive initiatives and their impact on company performance (e.g. company commitments to water stewardship, sustainable sourcing and circular economy practices) Highlight contributions to global frameworks like the Kunming-Montreal Global Biodiversity Framework Manage investor engagement on nature topics
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)

6 Conclusion

As the world stands at a pivotal ecological juncture with the intertwined crisis of climate change and nature loss, the clarion call for the chemical sector is unequivocal: Lead the change.

International agreements, such as the Kunming-Montreal Global Biodiversity Framework and the UN's forthcoming treaty on plastic pollution, are corralling a global consensus on the urgency to tackle nature loss. Jurisdictions are tightening regulations to ensure more nature-friendly practices.

Embedded in everything from food systems to industry, the presence of the chemical sector is pervasive. The sector stands at a fork in the road. But only one route offers the chance of a long-term future in harmony with the planet.

Making the right choices need not cost the Earth. Companies that take a lead in sustainable decisions will improve the likelihood of business resilience and long-term value creation. Top priorities are easier to list than they are to execute: improve water stewardship, source and replace feedstocks responsibly, embrace circularity and introduce new products.

Nature-based solutions can address both climate change and nature loss, but companies should integrate their net-zero and nature-positive journeys so that climate action does not come at the expense of nature. Educating customers and nudging them towards more sustainable product use and disposal is paramount. Harnessing the power of partnerships, be they with NGOs, governments or local communities, can boost corporate efforts to support nature conservation and restoration.

With pressing concerns such as runaway deforestation and uncontrolled pollution of soils and seas, there is an urgent need for more robust, transformative corporate action. Now is the time for the sector to go beyond responding and complying – to champion a transformative, nature-positive trajectory.

Appendix

Definitions of nature positive

BOX 5 **Existing definitions of nature positive**

Guidance provider	Guidance description
Business for Nature	How business and finance can contribute to a nature positive future now
European Commission	European Business & Biodiversity Platform
Independent scientists	A Nature-Positive World: The Global Goal for Nature
International Union for Conservation of Nature (IUCN)	Towards an IUCN nature-positive approach: a working paper (under consultation)
Science Based Targets Network (SBTN)	SBTN Interim Targets "Nature-positive" – an opportunity to get it right
World Business Council for Sustainable Development (WBCSD)	What does nature-positive mean for business?

Chemical sector boundaries

The Sustainable Industry Classification System (SICS)[194] lists the chemical industry as part of the resource transformation sector. Consistent with the SICS description, the industry includes the manufacturing of all types of chemicals, including commodity chemicals, agricultural chemicals and specialty chemicals.

The sector begins at the upstream extraction and processing of feedstocks and energy supplies, through all of the manufacturing and synthesis processing, product packaging and direct downstream use of the products. The boundary restricts further processing of products into, for example, consumer goods, as this is defined as its own sector. Similarly, the upstream extraction of feedstocks from oil and gas is included to ensure the recommended actions consider the control chemical companies have in selecting and sourcing feedstocks. The upstream extraction is limited to avoid the consideration of impacts and dependencies from many sectors that chemical companies source from.

Impact and dependency analysis

The assessment of impacts and dependencies is mainly based on ENCORE and the SBTN sectoral materiality tool (SMT) (only covers upstream and direct operation) – high and very high materiality.

Other sources include: CDP Water Watch, WWF Water and Biodiversity Risk Filters, extensive desk research, academic reviews, company-specific insights and assessments, analysis by Oliver Wyman and Oliver Wyman 3D Carbon Accounting, analysis by the World Economic Forum and industry expert interviews.

Opportunity sizing

A detailed overview of the opportunity sizing conducted for the Forum's *Future of Nature and Business* report, published in 2020, can be found in its methodology note.[195]

This report has identified the following opportunities from the *Future of Nature and Business* report as relevant.

FIGURE A1 | **Nature-positive business opportunities for the chemical 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 chemical sector	Opportunity size for chemical sector ($ billion)
1 **Increase efficiency in the manufacturing process and expand the use of renewable energy**	 Technology in energy and extractives supply chains	30	Global direct, indirect, and induced GDP impact of chemical sector: 7%[196]	2.1
	 Expansion of renewables	650	Global direct, indirect, and induced GDP impact of chemical sector: 7%	45.5
2 **Improve water stewardship through sustainable water management strategies and practices**	 Wastewater reuse	50	Water use of chemical sector: 10%[197]	5
	 Natural systems for water supply	140	Water use of chemical sector: 10%	14
3 **Source responsibly and explore switching to sustainably sourced bio-based or recyclable materials**	 Technology in large-scale farms	195	Global direct, indirect, and induced GDP impact of chemical sector: 7%	13.65
	 Technology in smallholder farms	110	Global direct, indirect, and induced GDP impact of chemical sector: 7%	7.7
	 Sustainable forestry management	165	Global direct, indirect, and induced GDP impact of chemical sector: 7%	11.55
	 Sustainable substances in extraction	20	Global direct, indirect, and induced GDP impact of chemical sector: 7%	1.4
4 **Support nature conservation and restoration and advocate for policy changes that protect nature**	 Natural climate solutions	85	Global direct, indirect, and induced GDP impact of chemical sector: 7%	5.95
	 Restoring degraded land	75	Global direct, indirect, and induced GDP impact of chemical sector: 7%	5.25
	 Agroforestry	20	Global direct, indirect, and induced GDP impact of chemical sector: 7%	1.4
5 **Expand circularity, product innovation and customer education on product use and disposal**	 Bio-innovation	125	Estimated market potential for chemical sector: 75%[198]	93.75
	 Sustainable inputs	105	Estimated market potential for chemical sector: 75%[199]	78.5
	 Waste management	305	Global direct, indirect, and induced GDP impact of chemical sector: 7%	21.35
	 Resource recovery	225	Global direct, indirect, and induced GDP impact of chemical sector: 7%	15.75

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1. Global Footprint Network, Measure what you treasure, 2023, https://www.footprintnetwork.org/.
2. Rockström et al., Safe and just Earth system boundaries, Nature 619, 102-111, 31 May 2023, https://www.nature.com/articles/s41586-023-06083-8.
3. Sources:

   Cefic – European Chemical Industry Council, Chemical sector overview, 2021, https://cefic.org/a-pillar-of-the-european-economy/facts-and-figures-of-the-european-chemical-industry/profile/.

   Cefic – European Chemical Industry Council, The Journey Of Petrochemicals Explained: From Raw Materials To 95% Of All Manufactured Goods, 2023, https://cefic.org/media-corner/newsroom/the-journey-of-petrochemicals-explained-from-raw-materials-to-95-of-all-manufactured-goods/.
4. International Energy Agency (IEA),Chemicals overview, https://www.iea.org/energy-system/industry/chemicals.
5. Rockström et al., Safe and just Earth system boundaries, Nature 619, 102-111, 31 May 2023, https://www.nature.com/articles/s41586-023-06083-8.
6. The Nature Conservancy, Nature's Make or Break Potential for Climate Change, 15 October 2017, https://www.nature.org/en-us/what-we-do/our-insights/perspectives/natures-make-or-break-potential-for-climate-change/?src=social.multiple.site_globsol.cam_ncs.link_initative.d_oct2017.info_ncs3.
7. For example:

   BASF, Biodiversity and Ecosystems, https://www.basf.com/global/en/who-we-are/sustainability/we-produce-safely-and-efficiently/environmental-protection/resources-and-ecosystems/biodiversity-and-ecosystems.html.

   Air Products & Chemicals, Sustainability in Action: 2022 Sustainability Report, 2022, https://www.airproducts.com/-/media/airproducts/files/en/900/900-22-005-us-sustainability-report-2022.pdf?la=en&hash=5125FDEA8091B65E9F658A7B1A18C559).

   Air Liquide, Environmental data, https://www.airliquide.com/sustainable-development/environmental-data.

   Henkel, Regenerative Planet, https://www.henkel.com/sustainability/regenerative-planet.
8. For example:

   Releases of the persistent organic pollutants (POPs) first listed under the Stockholm Convention have decreased in most higher-income countries. Source: United Nations Environment Programme, Global Chemicals Outlook II: From Legacies to Innovative Solutions, 2019, https://www.unep.org/resources/report/global-chemicals-outlook-ii-legacies-innovative-solutions.

   In Europe, the industry saw an overall decreasing trend of over 51% in nitrogen and 66% in phosphorous emissions to water between 2007 and 2017. Source: Cefic – European Chemical Industry Council, Environmental Performance, https://cefic.org/a-pillar-of-the-european-economy/facts-and-figures-of-the-european-chemical-industry/environmental-performance/.
9. United Nations Environment Programme, 5 key drivers of the nature crisis [as identified by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment Reports], 2022, https://www.unep.org/news-and-stories/story/5-key-drivers-nature-crisis.
10. Business for Nature, High-level Business Actions on Nature, https://www.businessfornature.org/high-level-business-actions-on-nature.
11. World Economic Forum, Uplink, Openversum: Providing safe water through microfranchising and engineering, 2023, https://uplink.weforum.org/uplink/s/uplink-contribution/a012o00001pUSY9AAO/providing-safe-water-through-microfranchising-and-engineering.
12. European Commission, Joint Research Centre, Safe and sustainable by design chemicals and materials – Framework for the definition of criteria and valuation procedure for chemicals and materials, https://publications.jrc.ec.europa.eu/repository/handle/JRC128591#:~:text=The%20SSbD%20is%20an%20approach,human%20health%20and%20the%20environment.
13. Dow, Seadrift Constructed Wetlands: An Engineered Natural Technology Project, https://corporate.dow.com/content/dam/corp/documents/science-sustainability/066-00203-01-01-seadrift-constructed-wetlands-case-study.pdf.
14. For example, the ongoing negotiation towards the new global treaty to end plastic pollution, the Strategic Approach and sound management of chemicals and waste beyond 2020, and the EU Sustainable Use of Pesticide Regulation (SUR).
15. European Commission, Joint Research Centre, Safe and sustainable by design chemicals and materials – Framework for the definition of criteria and valuation procedure for chemicals and materials, https://publications.jrc.ec.europa.eu/repository/handle/JRC128591#:~:text=The%20SSbD%20is%20an%20approach,human%20health%20and%20the%20environment.
16. Global Footprint Network, Measure what you treasure, 2023, https://www.footprintnetwork.org/.
17. Global Footprint Network, https://www.footprintnetwork.org.

18. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), Models of drivers of biodiversity and ecosystem change, https://www.ipbes.net/models-drivers-biodiversity-ecosystem-change.

19. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), IPBES-IPCC Co-sponsored Workshop: Biodiversity and Climate Change – Scientific outcome, 2021, https://www.ipbes.net/sites/default/files/2021-06/2021_IPCC-IPBES_scientific_outcome_20210612.pdf.

20. London School of Economics and Political Science and Grantham Research Institute on Climate Change and the Environment, What is the role of deforestation in climate change and how can 'Reducing Emissions from Deforestation and Degradation' (REDD+) help?, 10 February 2023, https://www.lse.ac.uk/granthaminstitute/explainers/whats-redd-and-will-it-help-tackle-climate-change/#:~:text=Land%20use%20change%2C%20principally%20deforestation,of%20global%20greenhouse%20gas%20emissions.

21. The Nature Conservancy, Nature's Make or Break Potential for Climate Change, 15 October 2017, https://www.nature.org/en-us/what-we-do/our-insights/perspectives/natures-make-or-break-potential-for-climate-change/?src=social.multiple.site_globsol.cam_ncs.link_initative.d_oct2017.info_ncs3.

22. Global Commons Alliance, Safe and Just Earth System Boundaries published in Nature, 31 May 2023, https://globalcommonsalliance.org/news/earth-commission/safe-and-just-earth-system-boundaries-published-in-nature/.

23. United Nations Framework Convention on Climate Change (UNFCCC), H.E Razan Al Mubarak: Nature is not ornamental, but fundamental. LCAW opens with focus on nature and policy engagement, 27 June 2023, https://climatechampions.unfccc.int/h-e-razan-al-mubarak-nature-is-not-ornamental-but-fundamental-lcaw-opens-with-focus-on-nature-and-policy-engagement/.

24. Science Based Targets initiative (SBTi), Forest, Land and Agriculture (FLAG): Key requirements of the SBTi FLAG Guidance, https://sciencebasedtargets.org/sectors/forest-land-and-agriculture#:~:text=Key%20requirements%20of%20the%20SBTi%20FLAG%20Guidance&text=Set%20long%2Dterm%20FLAG%20science,term%20FLAG%20-science%2Dbased%20targets.

25. Science Based Targets Network (SBTN), Public consultation for the first land science-based targets, https://sciencebasedtargetsnetwork.org/resources/public-consultation-for-the-first-land-science-based-targets/.

26. Earth Commission, A just world on a safe planet: First study quantifying Earth System Boundaries live, 31 May 2023, https://earthcommission.org/news/publications/just-world-safe-planet/.

27. Rockström et al., Safe and just Earth system boundaries, Nature 619, 102-111, 31 May 2023, https://www.nature.com/articles/s41586-023-06083-8.

28. Rockström et al., Safe and just Earth system boundaries, Nature 619, 102-111, 31 May 2023, https://www.nature.com/articles/s41586-023-06083-8.

29. World Economic Forum, Global Risks Report 2023, 2023, https://www.weforum.org/reports/global-risks-report-2023/.

30. Taskforce on Nature-related Financial Disclosures (TNFD), TNFD Nature-Related Risk & Opportunity Management and Disclosure Framework, v0.4 Beta Release, Glossary of Key Terms, 2023, https://framework.tnfd.global/appendix/glossary-of-key-terms/.

31. Sources for Figure 2, as per captions in the figure:

    1) Global Biodiversity Framework

    Convention on Biological Diversity, Kunming-Montreal Global Biodiversity Framework, 2022, https://www.cbd.int/gbf/.

    Business for Nature, A wake-up call for business: Target 15 commits governments to require nature-related disclosure from large companies and financial institutions, 2023, https://static1.squarespace.com/static/5d777de8109c315fd22faf3a/t/63dbb7b33e5dfe3f115b2b88/1675343797338/Target+15+longer+reaction+FINAL.pdf.

    2) Guidance and standards

    Taskforce on Nature-related Financial Disclosures (TNFD), https://tnfd.global/.

    International Sustainability Standards Board (ISSB): Binnie, I., Global sustainability rules body steps up focus on biodiversity, Reuters, 14 December 2022, https://www.reuters.com/business/environment/global-sustainability-rules-body-steps-up-focus-biodiversity-2022-12-14/.

    EU Sustainability Reporting Standards (ESRS), https://www.efrag.org/lab3.

    Science Based Targets Network (SBTN), The first science-based targets for nature, https://sciencebasedtargetsnetwork.org/how-it-works/the-first-science-based-targets-for-nature/.

    3) Financial institutions and investors

    Nature Action 100, https://www.natureaction100.org/.

    Finance for Biodiversity Pledge, https://www.financeforbiodiversity.org/.

    4) Customers and employees

    Union for Ethical BioTrade (UEBT), Biodiversity Barometer, http://www.biodiversitybarometer.org/.

32. United Nations Environment Programme, Convention on Biological Diversity, Kunming-Montreal Global biodiversity framework, Draft decision submitted by the President, 2022, https://www.cbd.int/doc/c/e6d3/cd1d/daf663719a03902a9b116c34/cop-15-l-25-en.pdf.

33. World Economic Forum, The Post-2020 Global Biodiversity Framework and What it Means for Business, 2022, https://www.weforum.org/whitepapers/the-post-2020-global-biodiversity-framework-and-what-it-means-for-business.

34. European Financial Reporting Advisory Group (EFRAG), Public consultation on the first set of Draft ESRS, https://www.efrag.org/lab3.

35. European Commission, EU taxonomy for sustainable activities, https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en.

36. Ramos, J. and Sedilekova, Z., Biodiversity Risk: Legal Implications for Companies and their Directors, Commonwealth Climate and Law Initiative (CCLI), 2023, https://commonwealthclimatelaw.org/wp-content/uploads/2022/12/CCLI_Biodiversity_risk_paper_2022.pdf.

37. Segal, M., ISSB to Add Biodiversity, Just Transition Disclosures to Climate Reporting Standard, ESG today, 15 December 2022, https://www.esgtoday.com/issb-to-add-biodiversity-just-transition-disclosures-to-climate-reporting-standard/.

38. Taskforce on Nature-related Financial Disclosures (TNFD), TNFD Nature-Related Risk & Opportunity Management and Disclosure Framework, v0.4 Beta Release, 2023, https://framework.tnfd.global/.

39. Finance for Biodiversity Foundation, https://www.financeforbiodiversity.org/.

40. Finance for Biodiversity Foundation, Global investors developing new collaborative engagement initiative to drive nature action, 11 April 2022, https://www.financeforbiodiversity.org/global-investors-developing-new-collaborative-engagement-initiative-to-drive-nature-action/.

41. Sources:

    United Nations Environment Programme, Stepping Up on Biodiversity: What the Kunming-Montreal Global Biodiversity Framework means for Responsible Investors, Nairobi, 2023, https://www.unepfi.org/industries/investment/stepping-up-on-biodiversity/.

    UN Environment Programme Finance Initiative, Banking On Nature: What The Kunming-Montreal Global Biodiversity Framework Means for Responsible Banks, Geneva, 2023, https://www.unepfi.org/wordpress/wp-content/uploads/2023/01/21-Banking-on-nature.pdf.

42. Union for Ethical BioTrade (UEBT), UEBT Biodiversity Barometer: The Biodiversity Reckoning, 2022, https://static1.squarespace.com/static/577e0feae4fcb502316dc547/t/6409db549975dd4b6aa32da1/1678367585952/UEBT+Biodiversity+Barometer+2022.pdf.

43. Simon Kucher, Recent study reveals more than a third of global consumers are willing to pay more for sustainability as demand grows for environmentally-friendly alternatives, 25 October 2021, https://www.simon-kucher.com/en/who-we-are/newsroom/recent-study-reveals-more-third-global-consumers-are-willing-pay-more.

44. NIQ, Global consumers seek companies that care about environmental issues, 2018, https://nielseniq.com/global/en/insights/analysis/2018/global-consumers-seek-companies-that-care-about-environmental-issues/.

45. Deloitte, The Deloitte Global 2022 Gen Z and Millennial Survey: Striving for balance, advocating for change, 2022, https://www2.deloitte.com/content/dam/Deloitte/at/Documents/human-capital/at-gen-z-millennial-survey-2022.pdf.

46. McKinsey Sustainability, Where the world's largest companies stand on nature, 13 September 2022, https://www.mckinsey.com/capabilities/sustainability/our-insights/where-the-worlds-largest-companies-stand-on-nature.

47. World Benchmarking Alliance, Nature is a blind spot for major companies despite its importance for their operations and people, 5 December 2022, https://www.worldbenchmarkingalliance.org/news/nature-benchmark-press-release-2022/.

48. Business for Nature et al., How business and finance can contribute to a nature positive future now, October 2022, https://static1.squarespace.com/static/5d777de8109c315fd22faf3a/t/634d83b8e5d4747f24935a8c/1666024380378/Nature+Positive+Discussion+Paper_Final.pdf.

49. Science Based Targets Network, Science-Based Targets for Nature: Initial Guidance for Business, 2020, https://sciencebasedtargetsnetwork.org/wp-content/uploads/2020/09/SBTN-initial-guidance-for-business.pdf.

50. Sources:

    Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 4 May 2019, https://zenodo.org/record/6417333.

    Science Based Targets Network, SBTN Glossary of Terms, 2023, https://sciencebasedtargetsnetwork.org/wp-content/uploads/2023/05/SBTN-Steps-1-3-Glossary_2023.docx-1.pdf.

51. Taskforce on Nature-related Financial Disclosures (TNFD), TNFD Nature-Related Risk & Opportunity Management and Disclosure Framework, v0.4 Beta Release, Definitions of Nature, 2023, https://framework.tnfd.global/concepts-and-definitions/definitions-of-nature/.

52. World Economic Forum et al., Measuring Nature-positive Outcomes from Business Actions, 2022, https://www3.weforum.org/docs/WEF_Measuring_Nature_positive_Outcomes_from_Business_Actions_2022.pdf.

53. Business for Nature, High-level Business Actions on Nature, https://www.businessfornature.org/high-level-business-actions-on-nature. These actions have been developed in collaboration with leading organizations. They build on existing action frameworks and guidance, including the Natural Capital Protocol, the Science Based Targets Network Initial Guidance for Business, World Business Council for Sustainable Development (WBCSD) building blocks on what nature positive means to business, Business for Nature steps to become nature positive and the Taskforce on Nature-related Financial Disclosures (TNFD) Framework (currently in beta version).

54. Science Based Targets Network (SBTN), Science-Based Targets for Nature, Step 4. Act, https://sciencebasedtargetsnetwork.org/how-it-works/act/.

55. Sources:

Business for Nature, High-level Business Actions on Nature, https://www.businessfornature.org/high-level-business-actions-on-nature.

Science Based Targets Network (SBTN), Science-Based Targets for Nature, Step 4. Act, https://sciencebasedtargetsnetwork.org/how-it-works/act/.

56. Business for Nature, High-level Business Actions on Nature, https://www.businessfornature.org/high-level-business-actions-on-nature.

57. Science Based Targets Network (SBTN), Science-Based Targets for Nature, Step 4. Act, https://sciencebasedtargetsnetwork.org/how-it-works/act/.

58. Business for Nature, Sector actions for nature, https://www.businessfornature.org/sector-actions.

59. Cefic – European Chemical Industry Council, Europe is the second largest chemical producer in the world, https://cefic.org/a-pillar-of-the-european-economy/facts-and-figures-of-the-european-chemical-industry/profile/.

60. Allied Market Research, Basic Chemicals Market, 2021, https://www.alliedmarketresearch.com/basic-chemicals-market-A14984.

61. "Companies in the Chemical industry transform organic and inorganic feedstocks into more than 70,000 diverse products with a range of industrial, pharmaceutical, agricultural, housing, automotive and consumer applications. The industry is commonly segmented into basic (commodity) chemicals, agricultural chemicals, and specialty chemicals." Source: International Financial Reporting Standard (IFRS) Foundation's International Sustainability Standards Board (ISSB), SASB Sustainable Industry Classification System (SICS): Resource Transformation – Chemicals, https://sasb.org/standards/download/.

62. Sources:

Annual revenues – Cefic – European Chemical Industry Council, Europe is the second largest chemical producer in the world, 2021, https://cefic.org/a-pillar-of-the-european-economy/facts-and-figures-of-the-european-chemical-industry/profile/.

Percentage of manufactured goods – Petrochemicals Europe, Petrochemicals are contained in 95% of all manufactured goods, 2023, https://www.petrochemistry.eu/wp-content/uploads/2023/02/Petrochemistry-FlowChart2022_V06-FINAL.pdf.

Energy use – U.S. Energy Information Administration, Use of energy explained: Energy use in industry, 2018, https://www.eia.gov/energyexplained/use-of-energy/industry.php.

GHG emissions contribution – World Resources Institute, World Greenhouse Gas Emissions: 2019, 2019, https://www.wri.org/data/world-greenhouse-gas-emissions-2019.

63. Chemical companies as defined by SICS will be referred to as "midstream players" to differentiate them from companies that specialize in producing feedstocks or downstream customers of chemical companies such as consumer goods companies. Source: International Financial Reporting Standard (IFRS) Foundation's International Sustainability Standards Board (ISSB), SASB Sustainable Industry Classification System (SICS): Resource Transformation – Chemicals, https://sasb.org/standards/download/.

64. The planetary boundaries framework identifies nine planetary boundaries. The novel entities boundary refers to "entities that are novel in a geological sense and that could have large-scale impacts that threaten the integrity of Earth system processes." Source: Persson, L. et al., Outside the Safe Operating Space of the Planetary Boundary for Novel Entities, Environmental Science & Technology, 2022, 56(3), 1510-1521., https://www.sei.org/publications/outside-planetary-boundary-novel-entities/.

65. United Nations Convention on Biological Diversity, Press Release: COP15: Nations adopt four goals, 23 targets for 2030 in landmark UN biodiversity agreement, 19 December 2022, https://www.cbd.int/article/cop15-cbd-press-release-final-19dec2022.

66. Reig, P., T. Shiao, K. Vigerstol, C. Copeland, A. Morgan, C. Strong, R. Hamilton, R. Dobson and S. Walker, Setting Enterprise Water Targets: A Guide for Companies, UN Global Compact CEO Water Mandate, Pacific Institute, CDP, The Nature Conservancy, World Resources Institute and WWF, 2021, www.ceowatermandate.org/enterprise-water-targets.

67. INEOS, Sustainability Report 2022, 2022, https://www.ineos.com/globalassets/sustainability/sustainability-data/12-oct---ineos-sustainability-report-2022.pdf.

68. BASF, BASF commits to targets for boosting sustainable agriculture, 2020, https://www.basf.com/global/en/media/news-releases/2020/11/p-20-365.html.

69. Solvay, Solvay One Planet in action, https://www.solvay.com/one-planet/resources.

70. Bayer, Protecting Crops: Reducing Crop Protection's Environmental Impact, https://www.bayer.com/en/agriculture/reducing-agricultures-impact-environment.

71. Organisation for Economic Co-operation and Development (OECD), 40 Years of Chemical Safety at the OECD: Quality and Efficiency, 2011, https://www.oecd.org/env/ehs/48153344.pdf.

72. Solvay, Solvay launches new growth platform focused on renewable materials and biotechnology, 3 May 2022 https://www.solvay.com/en/press-release/solvay-launches-new-growth-platform-focused-renewable-materials-and-biotechnology.

73. Solvay, Solvay announces strategic collaboration with Ginkgo Bioworks and expands its R&I footprint in the United States, 4 April 2023, https://www.solvay.com/en/press-release/solvay-announces-strategic-collaboration-ginkgo-bioworks-and-expands-its-ri-footprint.

74. Taskforce on Nature-related Financial Disclosures (TNFD), LEAP – the risk and opportunity assessment approach, https://framework.tnfd.global/leap-the-risk-and-opportunity-assessment-approach/.

75. Science Based Targets Network, Step 1. Assess: https://sciencebasedtargetsnetwork.org/how-it-works/assess/ and Step 2. Prioritize: https://sciencebasedtargetsnetwork.org/how-it-works/prioritize/.

76. Science Based Targets Network, Technical Guidance 2023, Step 3: Measure, Set & Disclose – Freshwater, https://sciencebasedtargetsnetwork.org/wp-content/uploads/2023/05/Technical-Guidance-2023-Step3-Freshwater-v1.pdf and Land: https://sciencebasedtargetsnetwork.org/wp-content/uploads/2023/05/Technical-Guidance-2023-Step3-Land-v0.3.pdf.

77. Science Based Targets initiative (SBTi), Forest, Land and Agriculture (FLAG) Guidance, https://sciencebasedtargets.org/sectors/forest-land-and-agriculture.

78. Business for Nature, Businesses commitments for nature, https://www.businessfornature.org/commit.

79. World Economic Forum, Sector Transitions to Nature Positive series of reports, September 2023, https://www.weforum.org/reports/. industry-transitions-to-nature-positive-report-series.

80. Business for Nature, Sector actions for nature, https://www.businessfornature.org/sector-actions.

81. Taskforce on Nature-related Financial Disclosures (TNFD), TNFD Nature-Related Risk & Opportunity Management and Disclosure Framework, v0.4 Beta Release, 2023, https://framework.tnfd.global/.

82. Business for Nature, High-level Business Actions on Nature, https://www.businessfornature.org/high-level-business-actions-on-nature.

83. Definition of double materiality sourced from: Deloitte, Double Materiality: 5 challenging key aspects to consider, April 2023, https://www2.deloitte.com/content/dam/Deloitte/de/Documents/risk/Deloitte_Sustainability_Double_Materiality.pdf.

84. World Economic Forum, Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy, 2020, https://www.weforum.org/reports/nature-risk-rising-why-the-crisis-engulfing-nature-matters-for-business-and-the-economy/.

85. Díaz, S. et al., Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), 2019, https://www.ipbes.net/global-assessment.

86. Meanwhile, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is committed to developing a methodological assessment of the impact and dependence of business on biodiversity and nature's contributions to people in the next two years. Source: https://www.ipbes.net/business-impact.

87. The TNFD LEAP approach is an integrated assessment process for nature-related risk and opportunity management for businesses. It consists of four steps: (1) Locate your interface with nature; (2) Evaluate your dependencies and impacts; (3) Assess your risks and opportunities; and (4) Prepare to respond to nature-related risks and opportunities and report. Source: https://framework.tnfd.global/leap-the-risk-and-opportunity-assessment-approach/.

88. Science Based Targets Network, Technical Guidance for Step 1: Assess and Step 2: Prioritize, Draft for Public Comment, September 2022, https://sciencebasedtargetsnetwork.org/wp-content/uploads/2022/09/Technical-Guidance-for-Step-1-Assess-and-Step-2-Prioritize.pdf.

89. Carbon Disclosure Project (CDP), Water Watch – CDP Impact Index, 2023, https://www.cdp.net/en/investor/water-watch-cdp-water-impact-index/water-watch-download.

90. European Commission and CORDIS, Economically and Ecologically Efficient Water Management in the European Chemical Industry, 2016, https://cordis.europa.eu/article/id/151163-cutting-water-use-in-the-european-chemical-industry.

91. Beswick, R.R., Oliveira, A.M., Yan, Y., Does the Green Hydrogen Economy Have a Water Problem?, ACS Energy Lett. 2021, 6, 9, 3167–3169, https://pubs.acs.org/doi/10.1021/acsenergylett.1c01375.

92. BASF, Water, Management's Report, BASF Report 2021, 2021, https://report.basf.com/2021/en/managements-report/sustainability-along-the-value-chain/safe-and-efficient-production/water.html.

93. For example, the European Commission's new strategy on climate change adaption from 2021. See European Environment Agency, Water resources across Europe — confronting water stress: an updated assessment, 2021, https://www.eea.europa.eu/publications/water-resources-across-europe-confronting.

94. Cefic - European Chemical Industry Council, Environmental Performance, https://cefic.org/a-pillar-of-the-european-economy/facts-and-figures-of-the-european-chemical-industry/environmental-performance/.

95. United Nations Environment Programme, Global Chemicals Outlook II – From Legacies to Innovative Solutions: Implementing the 2030 Agenda for Sustainable Development, 2019, https://www.unep.org/resources/report/global-chemicals-outlook-ii-legacies-innovative-solutions.

96. European Commission, Joint Research Centre, Caldeira, C., Farcal, L., Garmendia Aguirre, I., et al., Safe and sustainable by design chemicals and materials: framework for the definition of criteria and evaluation procedure for chemicals and materials, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2760/487955.

97. European Commission, Sustainable use of pesticides, https://food.ec.europa.eu/plants/pesticides/sustainable-use-pesticides_en.

98. United Nations Environment Programme, Global Chemicals Outlook II: From Legacies to Innovative Solutions, 2019, https://www.unep.org/resources/report/global-chemicals-outlook-ii-legacies-innovative-solutions.

99. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), Global Assessment Report on Biodiversity and Ecosystem Services, 2019, https://zenodo.org/record/6417333.

100. Naidu, R. et al., Chemical pollution: A growing peril and potential catastrophic risk to humanity, Environment International, Volume 156, 2021, 106616, https://www.sciencedirect.com/science/article/pii/S0160412021002415.

101. Coalition to Prevent Chemical Disasters, https://preventchemicaldisasters.org/.

102. United Nations Environment Programme, Global Chemicals Outlook II: From Legacies to Innovative Solutions, 2019, https://www.unep.org/resources/report/global-chemicals-outlook-ii-legacies-innovative-solutions.

103. Demeneix, B.A., How fossil fuel-derived pesticides and plastics harm health, biodiversity, and the climate, The Lancet Diabetes & Endocrinology, Volume 8, Issue 6, 2020, Pages 462-464, https://www.sciencedirect.com/science/article/pii/S2213858720301169#bib6.

104. Ashworth, J., The deadly effects of sewage pollution on nature, Natural History Museum, 4 November 2021, https://www.nhm.ac.uk/discover/news/2021/november/the-deadly-effects-of-sewage-pollution-on-nature.html.

105. European Environment Agency, Drivers of and pressures arising from selected key water management challenges: A European overview, 2021, https://www.eea.europa.eu/publications/drivers-of-and-pressures-arising.

106. U.S. Environmental Protection Agency, PFAS Explained, https://www.epa.gov/pfas/pfas-explained.

107. United Nations Environment Programme, Global Chemicals Outlook II: From Legacies to Innovative Solutions, 2019, https://www.unep.org/resources/report/global-chemicals-outlook-ii-legacies-innovative-solutions.

108. These are: ammonia, ethylene, propylene, nitride acid, carbon black, caprolactam, soda ash and fluorochemicals. Source: Cefic – European Chemical Industry Council, https://cefic.org/app/uploads/2022/09/The-chemical-industrys-road-to-net-zero-Accenture-Study.pdf.

109. Accenture and NexantECA, The chemical industry's road to net zero: Costs and opportunities of the EU Green Deal, 2022, https://single-market-economy.ec.europa.eu/sectors/chemicals/transition-pathway_en.

110. EU Science Hub, The future of bio-based chemicals in the EU Bioeconomy, European Commission, 2019, https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/future-bio-based-chemicals-eu-bioeconomy-2019-01-23_en.

111. European Union, Sustainable Agriculture, Forestry and Fisheries in the Bioeconomy: A Challenge for Europe. 4th SCAR (Standing Committee of Agricultural Research) foresight exercise, 2015, https://scar-europe.org/images/SCAR-Documents/4th_SCAR_Foresight_Exercise.pdf.

112. Spekreijse, J., Lammens, T., Parisi, C., Ronzon, T. and Vis, M., Insights into the European market for bio-based chemicals, EUR 29581 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-01500-0, doi:10.2760/739561, JRC112989, https://publications.jrc.ec.europa.eu/repository/handle/JRC112989.

113. CDC Biodiversité, Factsheet – Chemical, 2022, https://www.cdc-biodiversite.fr/wp-content/uploads/2022/05/Fiche-benchmark-Secteur-de-la-chimie.pdf.

114. VCI, Biomass as a Resource for the Chemical Industry: Key findings of an IFEU study and conclusions of the VCI, 2007, https://www.ifeu.de/fileadmin/uploads/VCI_IFEU_Biomass_Chemical_Industry.pdf.

115. Center for Global Commons/Systemiq, Planet Positive Chemicals report, 2022, https://cgc.ifi.u-tokyo.ac.jp/en/topics/planet-positive-chemicals/.

116. World Economic Forum, New Nature Economy Report II: The Future Of Nature And Business, 2020, https://www3.weforum.org/docs/WEF_The_Future_Of_Nature_And_Business_2020.pdf.

117. Alpha Beta, Identifying Biodiversity Threats and Sizing Business Opportunities: Methodological Note to the New Nature Economy Report II: The Future of Nature and Business, 15 July 2020, https://accesspartnership.com/wp-content/uploads/2023/01/200715-nner-ii-methodology-note_final.pdf.

118. To cover the role of the sector along its value chain, the authors of this study have used the direct, indirect and induced GDP impact of the sector's core operations as a share of global GDP as an adjustment factor. In 2019, the sector contributed $5.7 trillion to global GBP, which represents a share of 7%. See Oxford Economics, The Global Chemical Industry: Catalyzing Growth and Addressing Our World's Sustainability Challenges, 2019, https://www.oxfordeconomics.com/resource/the-global-chemical-industry-catalyzing-growth-and-addressing-our-world-sustainability-challenges/.

119. For example, the "Sustainable inputs" business opportunity covers the market potential for biopesticides, biofertilisers and organic fertilisers. This a market that to a large extent has been captured by the chemical sector.

120. Roland Berger, Energy efficiency services: a key market in the European industrial landscape, 3 February 2019, https://www.rolandberger.com/en/Insights/Publications/Energy-efficiency-services-a-key-market-in-the-European-industrial-landscape.html.

121. Cefic – European Chemical Industry Council, Energy Consumption, https://cefic.org/a-pillar-of-the-european-economy/facts-and-figures-of-the-european-chemical-industry/energy-consumption/.

122. Efficiency gains in the EU chemical industry have contributed to a 55% reduction in GHG emissions between 1990 and 2019. Source: Eurostat, Final energy consumption in industry - detailed statistics, 2022, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Final_energy_consumption_in_industry_-_detailed_statistics#Chemical_and_petrochemical_industry.

123. International Energy Agency (IEA), Chemicals, https://www.iea.org/reports/chemicals.

124. Deloitte, The 2030 decarbonization challenge: The path to the future of energy, 2020, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/energy-resources/us-eri-chemicals-decarbonization.pdf.

125. World Economic Forum, Accelerating the Biomanufacturing Revolution, 2022, https://www.weforum.org/whitepapers/accelerating-the-biomanufacturing-revolution/.

126. Sources:

Clomburg, J., Crumbley, A.M. Gonzalez, R., Industrial biomanufacturing: The future of chemical production, Science, 6 Jan. 2017, Vol 355, Issue 6320, https://www.science.org/doi/10.1126/science.aag0804.

Bajpai, P., Biotechnology in the Chemical Industry: Towards a Green and Sustainable Future 2020, Science Direct, 2020, https://www.sciencedirect.com/book/9780128184028/biotechnology-in-the-chemical-industry#book-description.

127. The White House, FACT SHEET: The United States Announces New Investments and Resources to Advance President Biden's National Biotechnology and Biomanufacturing Initiative, 14 September 2020, https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/14/fact-sheet-the-united-states-announces-new-investments-and-resources-to-advance-president-bidens-national-biotechnology-and-biomanufacturing-initiative/.

128. Department for Science, Innovation and Technology, Notice – Biomanufacturing Fund (BMF): open to expressions of interest, Government of the United Kingdom, 25 May 2023, https://www.gov.uk/government/publications/biomanufacturing-fund.

129. United Nations Climate Action, Water – at the center of the climate crisis – Water Scarcity, https://www.un.org/en/climatechange/science/climate-issues/water#:~:text=About%20two%20billion%20people%20worldwide,and%20population%20growth%20(WMO).

130. Cefic – European Chemical Industry Council, Is water management the next priority for Europe and the chemical industry, 2023, https://news.cefic.org/article/is-water-management-the-next-priority-for-europe-and-the-chemical-industry.

131. Department of Climate Change, Energy, the Environment and Water, Australian water markets, Government of Australia, https://www.dcceew.gov.au/water/policy/markets.

132. World Resources Institute (WRI), Aqueduct, https://www.wri.org/aqueduct.

133. WWF Water Risk Filter, https://riskfilter.org/water/explore/introduction.

134. Science Based Targets Network, Technical Guidance 2023, Step 3: Measure, Set & Disclose – Freshwater, https://sciencebasedtargetsnetwork.org/wp-content/uploads/2023/05/Technical-Guidance-2023-Step3-Freshwater-v1.pdf.

135. Alliance for Water Stewardship (AWS), The AWS International Water Stewardship Standard 2.0, 2019, https://a4ws.org/the-aws-standard-2-0/.

136. Dow, Tarragona – Local partnerships for local growth, https://corporate.dow.com/content/dam/corp/documents/science-sustainability/066-00201-01-local-partnership-for-local-growth-case-study.pdf.

137. Solvay, Striving to combine biodiversity and industry in Rosignano, https://www.solvay.com/en/article/rosignano-biodiversity-in-the-chemical-industry.

138. Hickingbottom, S., BioVale asks if the future of commercial bio-based chemicals is now?, BioVale, https://www.chemicalindustryjournal.co.uk/biovale-asks-if-the-future-of-commercial-bio-based-chemicals-is-now.

139. Grabowski, A. Choosing the Best Material for Plant-Based Plastic, WWF, 16 May 2023, https://www.worldwildlife.org/blogs/sustainability-works/posts/choosing-the-best-material-for-plant-based-plastic.

140. Cefic – European Chemical Industry Council, Powering The Plastic Circular Economy, https://cefic.org/a-solution-provider-for-sustainability/chemical-recycling-making-plastics-circular/chemical-recycling-via-conversion-to-feedstock/plastic-waste-to-feedstock.

141. Jenner, F. and Rodysill, J., Chemical companies can leverage the circular economy to create long-term value, fueling dramatic social and environmental benefits, EY, 8 September 2021, https://www.ey.com/en_uk/chemicals/can-repurposing-drive-your-purpose-in-a-circular-economy.

142. Croda, Awards and certifications, https://www.croda.com/en-gb/sustainability/our-approach/awards-and-certifications.

143. Croda, Annual Report and Accounts 2020, 2020, https://www.croda.com/mediaassets/files/corporate/ar2020/croda-2020-annual-report--accounts-new.pdf?la=en-GB.

144. Croda, Sustainability Report 2021, 2021, https://www.croda.com/mediaassets/files/corporate/ar-and-sr-files-2021/croda-sustainability-report-2021.pdf?la=en-GB.

145. CHEManager, BASF and Eni to Develop Bio-based Propanol, 4 August 2021, https://www.chemanager-online.com/en/news/basf-and-eni-develop-bio-based-propanol#:~:text=2021%20%2D%20BASF%20and%20Eni%20have,a%20novel%20catalytic%20hydrotreatment%20process.

146. WBCSD, Circular bioeconomy: The business opportunity contributing to a sustainable world, 2020, https://www.wbcsd.org/contentwbc/download/10806/159810/1.

147. European Union, Circular Bio-based Europe Joint Undertaking (CBE JU), https://european-union.europa.eu/institutions-law-budget/institutions-and-bodies/institutions-and-bodies-profiles/circular-bio-based-europe-joint-undertaking-cbe-ju_en.

148. European Commission, Bioeconomy strategy, https://research-and-innovation.ec.europa.eu/research-area/environment/bioeconomy/bioeconomy-strategy_en.

149. Henkel, BASF and Henkel focus on renewable raw materials in Henkel's consumer goods products, 31 March 2022, https://www.henkel.com/press-and-media/press-releases-and-kits/2022-03-31-basf-and-henkel-focus-on-renewable-raw-materials-in-henkel-s-consumer-goods-products-1646496.

150. BASF, Raw Materials, Management's Report, BASF Report 2021, 2021, https://report.basf.com/2021/en/managements-report/sustainability-along-the-value-chain/responsible-procurement/raw-materials.html.

151. The Nature Education Knowledge Project, Conservation and Restoration, Greipsson, S. (Ed.), https://www.nature.com/scitable/knowledge/conservation-and-restoration-13228126/#:~:text=Where%20conservation%20biology%20is%20often,loss%20of%20our%20biological%20resources.

152. Fondation GoodPlanet, Biodiversity Conservation and Restoration, Action Carbon Solidaire, https://www.goodplanet.org/en/projet/biodiversity-conservation-and-restoration/.

153. IUCN, Guidance for using the IUCN Global Standard for Nature-based Solutions, 2020, https://portals.iucn.org/library/sites/library/files/documents/2020-021-En.pdf.

154. BASF, "Coup d'Pousse": a participation platform to save bees from hunger, 30 May 2018, https://www.basf.com/in/en/who-we-are/sustainability/whats-new/sustainability-news/2018/coup-d-pousse.html.

155. National Fish and Wildlife Foundation, Corteva Agriscience, https://www.nfwf.org/partnerships/corporate-partners/corteva-agriscience.

156. Dow, Press release: Dow completes critical milestone for Project Ybá in Brazil, a strategic sustainability project for balancing commercial growth with environmental conservation, 28 April 2022, https://corporate.dow.com/en-us/news/press-releases/dow-completes-critical-milestone-for-project-yba-in-brazil-a-strategic-sustainability-project-for-balancing-commercial-growth-with-environmental-conservation.html.

157. Dow, Seadrift Constructed Wetlands: An Engineered Natural Technology Project, https://corporate.dow.com/content/dam/corp/documents/science-sustainability/066-00203-01-01-seadrift-constructed-wetlands-case-study.pdf.

158. World Economic Forum Chemical and Advanced Materials Community, Low-Carbon Emitting Technology Initiative, https://initiatives.weforum.org/low-carbon-emitting-technologies-initiative/home.

159. International Council of Chemical Associations (ICCA), Responsible Care, https://icca-chem.org/focus/responsible-care/.

160. Together for Sustainability (TfS), https://www.tfs-initiative.com/.

161. Green Chemistry & Commerce Council (GC3), https://greenchemistryandcommerce.org/about-gc3/introduction.

162. Sources:

Cefic – European Chemical Industry Council, Sustainable Development programme, https://cefic.org/a-solution-provider-for-sustainability/.

WBCSD, Chemical Industry Methodology for Portfolio Sustainability Assessments (PSA), 2018, https://www.wbcsd.org/Programs/Circular-Economy/Resources/Chemical-Industry-Methodology-for-Portfolio-Sustainability-Assessments.

163. WBCSD, Chemicals Group, https://www.wbcsd.org/Sector-Projects/Chemicals-Group.

164. Business for Nature, Make It Mandatory Campaign, https://www.businessfornature.org/make-it-mandatory-campaign.

165. Estimate based on average value of ranges provided for each category of funding needs and sources; Deutz, et al., Financing Nature: Closing the Global Biodiversity Financing Gap, The Paulson Institute, The Nature Conservancy, Cornell Atkinson Center for Sustainability, 2020.

166. For example, in the voluntary biodiversity credit market, questions remain about the irreplaceability of unique ecosystems, time lag, enforcement, permanence and equitable benefit-sharing with local communities. Companies that are interested in exploring can start engaging in the design and piloting of high-integrity biodiversity credit markets to ensure they deliver just and equitable benefits for nature and people.

167. EU Joint Research Centre, Safe and sustainable by design chemicals and materials - Framework for the definition of criteria and evaluation procedure for chemicals and materials, 2022, https://publications.jrc.ec.europa.eu/repository/handle/JRC128591#:~:text=The%20SSbD%20is%20an%20approach,human%20health%20and%20the%20environment.

168. Cefic – European Chemical Industry Council, Safe and Sustainable by Design: A Transformative Power, 2022, https://cefic.org/app/uploads/2022/04/Safe-and-Sustainable-by-Design-Guidance-A-transformative-power.pdf.

169. WBCSD, Chemical Industry Methodology for Portfolio Sustainability Assessment (PSA), 2017, https://www.wbcsd.org/Projects/Chemicals/Resources/Framework-for-portfolio-sustainability-assessments.

170. KRW3 trillion. Source: De Guzman, D., LG Chem proceeds with sustainable materials investments, Green Chemicals Blog, 17 September 2021, https://greenchemicalsblog.com/2021/09/17/__trashed-2/.

171. Dow, Accelerating our sustainability commitments and targets, https://corporate.dow.com/en-us/science-and-sustainability/commits-to-reduce-emissions-and-waste.html.

172. BASF, Circular Economy, Management's Report, BASF Report 2021, 2021, https://report.basf.com/2021/en/managements-report/sustainability-along-the-value-chain/sustainable-solutions/circular-economy.html#:~:text=Circularity%20is%20a%20particular%20focus,carbon%20footprint%20of%20our%20products.

173. World Economic Forum, Unlocking the Plastics Circular Economy: Case Studies on Investment, 2022, https://weforum.ent.box.com/file/1091665975907?s=o984n3gtao1aul5v736z4umbqisr28io.

174. European Commission, Circular economy action plan: The EU's new circular action plan paves the way for a cleaner and more competitive Europe, https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en.

175. United Nations Environment Assembly of the United Nations Environment Programme, Draft resolution, End plastic pollution: Towards an international legally binding instrument*, UNEP/EA.5/L.23/Rev.1, 2022, https://wedocs.unep.org/bitstream/handle/20.500.11822/38522/k2200647_-_unep-ea-5-l-23-rev-1_-_advance.pdf?sequence=1&isAllowed=y.

176. BASF, ChemCycling, https://www.basf.com/global/en/who-we-are/sustainability/we-drive-sustainable-solutions/circular-economy/mass-balance-approach/chemcycling.html.

177. BASF, Driving circular economy with the mass balance approach: BASF joins forces with members of the Ellen MacArthur Foundation's CE100 network for White Paper publication, 10 May 2019, https://www.basf.com/gb/en/who-we-are/sustainability/whats-new/sustainability-news/2019/EllenMacArthurfoundation-White-Paper-Mass-balance.html.

178. Ellen MacArthur Foundation, Raw material producers - non-compostable plastics, Key Metrics, BASF, https://ellenmacarthurfoundation.org/global-commitment-2021/signatory-reports/rmpncp/basf.

179. Dijkstra, H. van Beukering, P., Brouwer, R., Business models and sustainable plastic management: A systematic review of the literature, Journal of Cleaner Production, Volume 258, 2020, 120967, https://www.sciencedirect.com/science/article/pii/S0959652620310143.

180. Henkel, Fewer process steps, reduced consumption and no toxicity labelling: Henkel offers sustainable and cost-efficient surface treatment for aluminum processors, https://www.henkel-adhesives.com/pl/en/applications/all-applications/industry-insights/henkels-surface-treatment-for-aluminum-processors.html.

181. Dow, Valuing Nature, Measuring our progress, https://corporate.dow.com/en-us/science-and-sustainability/2025-goals/nature.html.

182. Institut national de recherche pour l'agriculture, l'alimentation et l'environnement (INRAE) (National Research Institute for Agriculture, Food and Environment), https://www.inrae.fr/en.

183. Syngenta Group, Regenerative Agriculture, https://www.syngentagroup.com/sites/syngenta-group/files/regenerative-agriculture/Syngenta-Group-Regenerative-Agriculture-Infographic-English.pdf.

184. Transition Plan Taskforce (TPT), Transition Plan Taskforce moves into next phase, https://transitiontaskforce.net/transition-plan-taskforce-moves-into-next-phase/.

185. Glasgow Financial Alliance for Net Zero (GFANZ), Financial Institution Net-zero Transition Plans: Fundamentals, Recommendations, and Guidance, Final Report, November 2022, https://www.gfanzero.com/our-work/financial-institution-net-zero-transition-plans/. Full report accessible here: https://assets.bbhub.io/company/sites/63/2022/09/Recommendations-and-Guidance-on-Financial-Institution-Net-zero-Transition-Plans-November-2022.pdf. GFANZ's framework is primarily aimed at financial institutions but can also be applied to firms in the real economy.

186. WWF, Nature in Transition Plans: Why and How? How companies can consider climate and nature together in current transition planning, January 2023, https://www.wwf.org.uk/sites/default/files/2023-02/WWF_Nature_In_Transition_Plans_Feb23.pdf.

187. Taskforce on Nature-related Financial Disclosures (TNFD), Additional draft guidance for corporates on science-based targets for nature, Beta v0.3, November 2022, https://framework.tnfd.global/wp-content/uploads/2022/11/TNFD_Additional-Draft-Guidance_v0-3_v9C.pdf.

188. Assessment metrics are used internally by report preparers to inform management decisions, while disclosure metrics are intended to be published in disclosures for report users. 'Core' disclosure metrics are reported on a comply or explain basis.

189. Sources:

Taskforce on Nature-related Financial Disclosures (TNFD), The TNFD Nature-related Risk and Opportunity Management and Disclosure Framework, Beta v0.4, Annex 4.3 Disclosure Metrics Annexes, March 2023, https://framework.tnfd.global/wp-content/uploads/2023/03/23-23882-TNFD_v0.4_Annex_4.3_v3-1.pdf.

TNFD, Nature-related Risk and Opportunity Management and Disclosure Framework, Beta v0.4, Annex 4.7 Guidance on Response Metrics in the Prepare Phase of LEAP, March 2023, https://framework.tnfd.global/wp-content/uploads/2023/03/23-23882-TNFD_v0.4_Annex_4.7_v4-1.pdf.

190. Taskforce on Nature-related Financial Disclosures (TNFD), The approach to metrics, Version v0.4 Beta Release, March 2023, https://framework.tnfd.global/introduction-to-the-framework/tnfd-methodologies/approach-to-metrics/.

191. The Organisation for Co-operation and Development (OECD) defines an indicator as a: "Quantitative or qualitative factor or variable that provides a simple and reliable means to measure achievement, to reflect changes connected to an intervention, or to help assess the performance of a development actor". Source: https://www.oecd.org/dac/peer-reviews/Development-Results-Note.pdf.

192. Taskforce on Nature-related Financial Disclosures (TNFD), Nature-related Risk and Opportunity Management and Disclosure Framework, Beta v0.4, Annex 4.7 Guidance on Response Metrics in the Prepare Phase of LEAP, March 2023, https://framework.tnfd.global/wp-content/uploads/2023/03/23-23882-TNFD_v0.4_Annex_4.7_v4-1.pdf.

193. Adapted from: McKinsey & Company, The net-zero transition: What it would cost, what it could bring, https://www.mckinsey.com/capabilities/sustainability/our-insights/the-net-zero-transition-what-it-would-cost-what-it-could-bring.

194. International Financial Reporting Standard (IFRS) Foundation's International Sustainability Standards Board (ISSB), SASB Sustainable Industry Classification System (SICS), https://www.sasb.org/wp-content/uploads/2018/11/SICS-Industry-List.pdf.

195. See also: Alpha Beta, Identifying Biodiversity Threats and Sizing Business Opportunities: Methodological Note to the New Nature Economy Report II: The Future of Nature and Business, 15 July 2020, https://accesspartnership.com/wp-content/uploads/2023/01/200715-nner-ii-methodology-note_final.pdf.

196. See Oxford Economics, The Global Chemical Industry: Catalyzing Growth and Addressing Our World's Sustainability Challenges, 2019, https://www.oxfordeconomics.com/resource/the-global-chemical-industry-catalyzing-growth-and-addressing-our-world-sustainability-challenges/.

197. European Commission and CORDIS, Economically and Ecologically Efficient Water Management in the European Chemical Industry, https://cordis.europa.eu/article/id/151163-cutting-water-use-in-the-european-chemical-industry.

198. Oliver Wyman and World Economic Forum expert estimate.

199. Oliver Wyman and World Economic Forum expert estimate.

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