

BlackRock

Investment perspectives
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Capital at risk: nature through an investment lens

As natural resources come under growing strain, we see new risks and opportunities emerging for investors. An expanding data landscape will be key to tracking both.

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Summary

- The economy depends on natural resources. Their value derives not only from their use as direct inputs to production – such as timber for construction – but also for their benefits to society like living trees that help clean the air. **Economists use the term “natural capital” to refer to the total value that natural resources provide to the economy and to people.**
- Only a portion of natural capital’s value to the economy is priced into markets today. But **we expect asset prices will adjust to better reflect both the risks and opportunities linked to natural capital – a trend we are already starting to see.**
- The primary driver of this trend is increasing physical risks: **natural resources are increasingly strained, which pushes up costs for companies that rely on them.** Biodiversity loss is reducing nature’s resilience and productivity in many regions, further driving physical risks.
- In addition to these physical risks, **the policy response to natural capital stress is growing**, especially in Europe. Technological advances and shifts in consumer and investor preferences can also influence natural capital value in the market.
- **Fully accounting for natural capital-related risks in investment portfolios depends on overcoming challenges with data and analysis.** Right now, there is limited data on how exposed companies are to natural capital risks, but new corporate disclosure standards, data collection tools and models may help in the future. At BlackRock, we are also using new AI tools to help fill the data gap in the near term.
- **In addition to managing risks, many clients are interested in gaining exposure to natural capital-related opportunities.** They include solutions that: 1) use natural capital more efficiently – like precision agriculture; 2) support a circular economy by reducing and recovering waste – like businesses that use waste to create new goods; 3) restore nature – like reforestation; and 4) harness natural capital to generate new products or business models – for example, by using emerging synthetic biology alternatives.
- **Near-term capital allocation opportunities include thematic strategies and systematic signals, as well as nature- and biodiversity-themed green bonds.** In the longer term, we expect private markets to provide a significant opportunity for investing in natural capital solutions.

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Markets have long undervalued nature...

The economy depends on natural resources. They're central to production and manufacturing – think water, timber, metals and minerals. They help keep the earth livable – for example, trees remove carbon dioxide and other pollutants from the air. And they provide recreation and cultural benefits – like hiking and vistas. Given how fundamental they are to the economy, it might seem overwhelming to evaluate the many ways investors are impacted by natural resources. In this paper, we focus on breaking down the key concepts and methods for evaluating this topic as an investment issue.

The economic literature refers to the Earth's collection of natural resources as "**natural capital**" – much like the terms "built capital" for all human-made buildings and structures, or "human capital" for the skills and abilities of the labor force. Built capital and human capital provide streams of revenue. Similarly, natural capital provides a stream of benefits, or "**ecosystem services**", both through its direct use in production and through broader benefits to society and human wellbeing. "**Biodiversity**" refers to the variety of living species within a given region or ecosystem – a kind of diversification within nature that helps limit risk. See the chart below left for examples of natural capital and of ecosystem services – and how biodiversity cuts across both.

Markets have historically not been very good at capturing all of the value of natural capital and its services in market prices, especially where the underlying resource is shared rather than owned. For example, markets are relatively efficient at attributing a price to natural resources that one company can own and prevent others from using – like agricultural land. But they are less good at pricing natural resources that are shared and freely available – like wild bees and other pollinators, which are estimated to have an implicit annual global value of US\$195-387 billion (Porto et al, 2020).

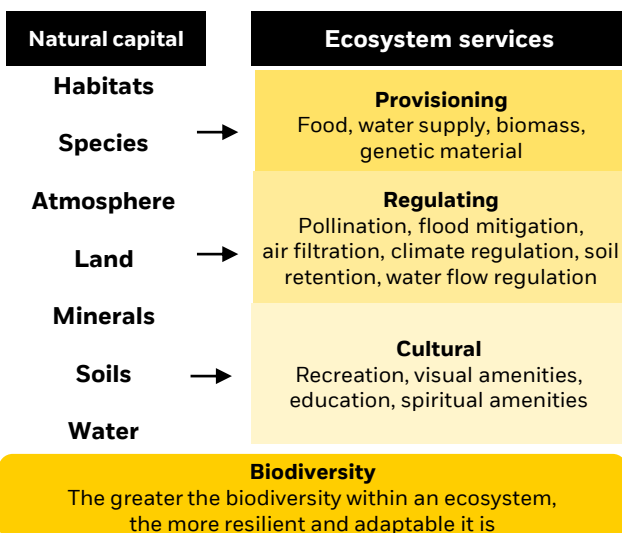
As businesses and people consume and have an impact on natural resources, many of these resources are coming under increasing strain, especially those whose value is not fully priced into markets. The chart below right shows that ecosystem services that markets are better able to value (orange bars) have typically been expanding in volume since 1900 – in some cases by 15% or more per decade – largely thanks to human intervention, while those that markets are less effective at pricing (yellow bars) have typically been shrinking. That shrinking may be because the underlying natural resource is diminishing in quantity – like declining pollinator populations. Or it may be because the underlying natural resource is diminishing in quality. For example, intensive crop farming can cause soil to lose nutrients like nitrogen.

Research shows that the depletion and degradation of natural resources through the industrial era has driven up costs for the markets that rely on them. For example, degraded soils require fertilizers to maintain the same level of crop production. Climate change is adding to that strain: for example, changing rainfall patterns and hotter temperatures contribute to more severe droughts and reduce the productivity of farmland and forests.

As these rising physical risks become increasingly evident and costs rise, policymakers in many countries are starting to respond. Investors and consumers are showing greater preference for businesses that manage natural resources more sustainably. Add in technological advances that could change the way natural resources are used and consumed, and we see a selection of drivers that all point to a potential repricing of assets linked to natural capital over the coming years. This is why it is key for investors to understand the nature-related risks in their portfolios. We explore each of these factors driving asset repricing over the following pages, before looking at ways to measure risk related to natural capital and considering investment opportunities.

Nature provides services

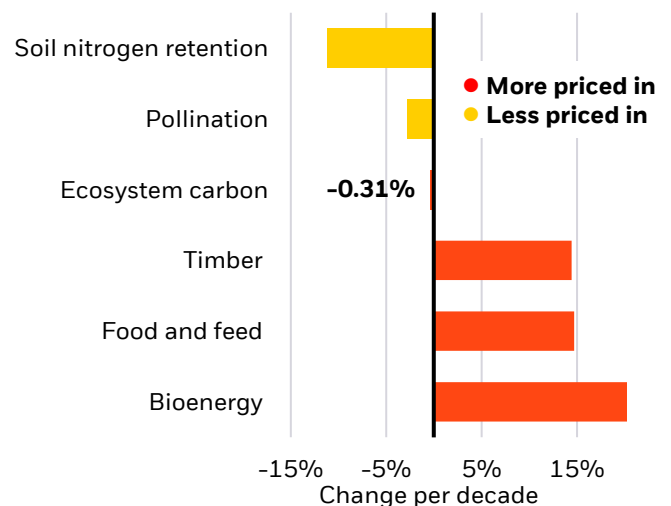
Types of natural capital and the services they provide



For illustrative purposes only. Source: BlackRock Investment Institute, [ENCORE, Taskforce on Nature-related Financial Disclosures](#), August 2024. Notes: The illustration shows various examples of natural capital – Earth's natural resources – and the services they provide.

Ecosystem services grow when better priced

Change in global ecosystem service volumes, 1900-2015



Source: BlackRock Investment Institute, Henrique M. Pereira et al. (2024), August 2024. Notes: The chart shows the average rate of change per decade, over 1900-2015, in the global amount of ecosystem services provided. An ecosystem is deemed "more priced in" by markets if over half of the total studies compiled in Brander et al. (2023) use market prices as one of the ways to assess the ecosystem service's value to society. We assume the studies labeled with "market pricing" and "hedonic pricing" tags qualify as using market prices.

...but are starting to price physical risks

The depletion and degradation of natural resources is already extracting a financial cost – and that cost is expected to grow. The World Bank estimates an economic loss of \$90–225 billion annually from 2030 under a “business as usual” scenario, caused by declining pollination rates, the loss of natural sources of carbon storage, fisheries and timber production. If a wider range of natural resources are considered and the rate at which they are being depleted accelerates, that economic loss could be even bigger. For example, wetlands help protect communities against flooding and hurricanes by absorbing storm water. Yet around 21% of global wetlands have been lost, mostly converted to cropland (Fluet-Chouinard et al, 2023). Food production is also under pressure: 85% of global arable land is experiencing some form of degradation, through erosion, salinization, soil compaction and pollution, resulting in over \$100 billion in lost agricultural output annually (Nkonya et al, 2016). Controlling and removing invasive species, the non-native organisms that disrupt local ecosystems, are also increasing operational costs for agriculture, forestry and infrastructure, by an estimated \$70 billion annually (Bradshaw et al, 2016).

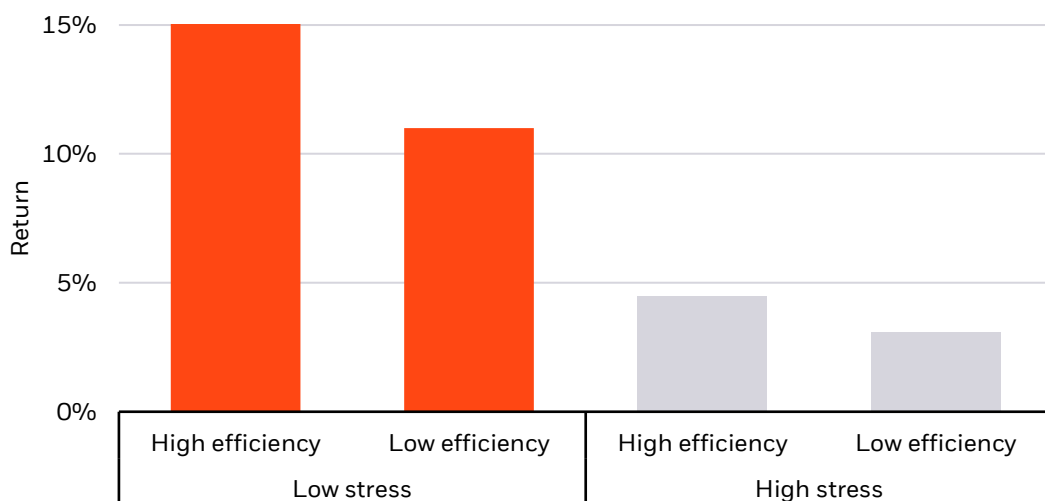
These physical risks are starting to impact the financial performance of companies. For example, our research shows that water stress is a material financial risk for many sectors. Water stress occurs when the demand for water is high compared to the amount of water available or when water quality is impaired. Our analysis shows that companies that use water efficiently have historically delivered higher returns than companies that are more water intensive – with the proportional difference in performance particularly pronounced between companies located in areas experiencing water stress. See the chart. History further shows that companies experiencing drought face greater risk of acute financial losses. For example, in 2022 90% of the western US was in drought, causing an economic loss of \$22 billion – including damage to buildings, agriculture and material assets as well as business interruptions and restoration costs, per NCEI estimates. The 2022 European drought caused a French utility to lose 30% of hydropower capacity, resulting in lost earnings of \$1.4 billion.

Some physical risks are also rising due to accelerating biodiversity loss, or the decline in the variety of living species in an ecosystem (IPBES, 2019). Lower biodiversity makes an ecosystem less productive, resilient and adaptable – meaning it cannot recover as quickly from things like extreme weather events, fires or diseases (Isbell et al, 2017). Biodiversity loss is caused by changes in land use, the extraction of natural resources, climate change, pollution and the introduction of invasive organisms. And it, too, can have large financial costs. For example, a study of 44 countries found that a 10% loss in biodiversity reduces the productivity of commercial forests by around 3%, putting the global value of biodiversity to commercial forestry at \$166–490 billion per year. A 2024 study identified biodiversity loss as one of the biggest drivers of harm from infectious diseases, more so than pollution and climate change. Why? More diverse animal communities can lower the risk of certain infections – like Lyme disease – being passed to humans (Millien et al, 2023).

We note that while we see growing evidence that real economy markets are starting to reflect the costs of natural capital strain, we have less evidence that financial markets are directly accounting for these emerging risk drivers. For example, our research finds that excess returns could be achieved by investing in companies with higher water efficiency in ways that financial markets are not yet accounting for. An important exception is rising insurance premiums and insured losses driven by intersecting climate and natural capital risks, like wildfires and floods, per a 2024 Swiss Re report.

Water efficiency bears fruit

Return on assets by water stress and water efficiency profile, 2023



Source: BlackRock Investment Institute, with data from MSCI and World Resource Institute, August 2024. Notes: The chart shows the return on assets from MSCI ACWI companies that report on their water withdrawals. We measure water stress as the regional ratio of total water withdrawals to total water availability, and efficiency is measured by water withdrawal intensity. Companies with less than median average water withdrawal intensity are considered “high efficiency.” Regions experiencing water stress are identified using the “baseline water stress” metric provided by the World Resource Institute Aqueeduct 3.0 tool. Each company’s water stress score is based on the water stress severity across the locations of their assets.

Policy, tech and preferences

Beyond rising physical risks, we see three additional drivers changing the way markets value natural capital in coming years: growing policy action, technological innovation and changing consumer and investor preferences. These drivers reinforce each other. For example, changing consumer preferences can motivate companies to invest in new technologies and solutions to meet those preferences and enable policymakers to implement more ambitious policies.

Policy action aimed at preserving, protecting and restoring natural resources is becoming more widespread, especially in Europe. See the chart. Policymakers are taking a combination of carrot and stick approaches, incentivizing the preservation of natural resources and creating costs where they are being used unsustainably. For example, the European Union’s [Deforestation Regulation](#) requires that certain agricultural commodities sold into the EU market, either domestically or from abroad, are not sourced from deforested areas. The EU estimates that the annual cost of complying with that regulation could reach \$2.8 billion. Supply chains are bifurcating between EU and non-EU markets, particularly for smallholder farmers who do not have the resources to provide geolocation data, [POTC research](#) finds.

Several countries, including the U.S., UK, France, Germany and Australia, have developed systems that grant credits to projects that restore nature and biodiversity. Those credits are tradeable and can be bought by companies to offset their activities that may have a negative impact on nature, such as real estate, infrastructure and oil and gas development. Data on the value of global nature- and biodiversity-related credit markets is scarce, but estimates suggest the market is small. Scaling those markets could prove challenging. Right now, credits can only be traded within small qualifying areas and are required to meet high standards for ecological improvement.

In many countries, mandatory or voluntary programs allow firms to purchase forestry and agriculture credits to offset their carbon emissions. In recent years, some mandatory programs have expanded restrictions on the use of offsets – for example, in California. Elsewhere, like in the EU, offset programs have been eliminated due to stakeholder concerns about offset quality and credibility. Yet voluntary markets continue to drive demand for forestry and agriculture credits, with their value reaching \$1.1 billion in 2022, according to Ecosystem Marketplace data.

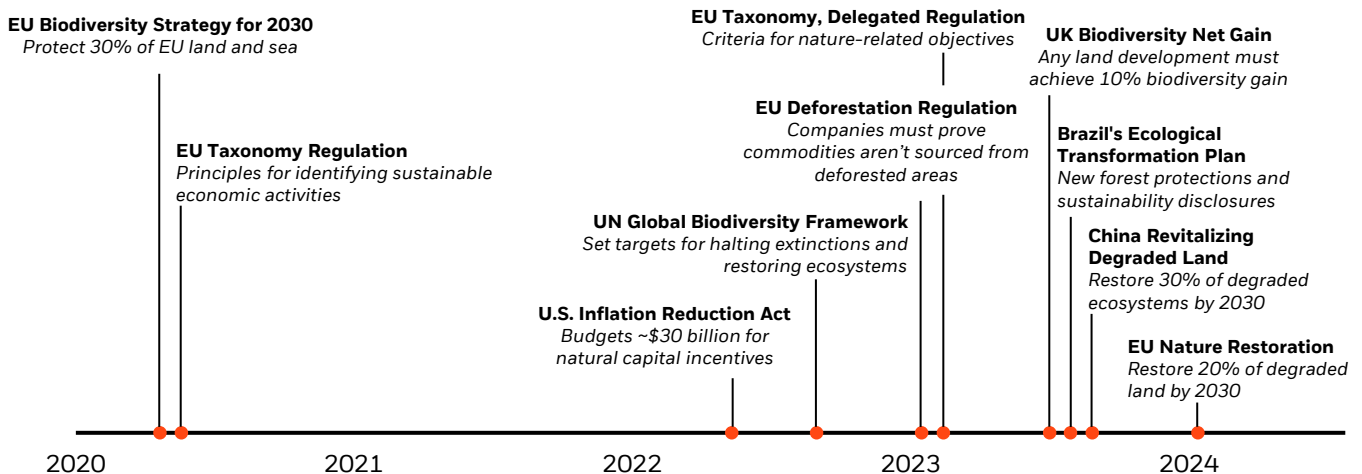
Policies supporting a circular economy can take pressure off nature by reducing waste and the extraction of natural resources. For example, the EU’s [framework](#) for disclosing sustainable economic activities includes criteria for identifying circular economy practices. Many [cities and regions](#) are also making zero-waste commitments.

As firms face rising physical risks and policy pressure, we expect to see greater investment in technology to reduce dependence on natural resources and avoid costs. For example, myriad solutions to water scarcity are being developed, including water treatment, conservation and efficiency solutions. Governments will likely seek private capital to address rising water risk: U.S. municipal spending on wastewater treatment alone could reach an estimated \$2 trillion by 2030.

Even with the strain on natural resources becoming more evident, growing policy support and promising technological advances, investment flows into funds labeled with natural capital-related topics remain low, with around \$70 billion in such funds in May 2023, Broadridge, GBI and Preqin data show. Yet data for equity risk premia, or the compensation investors want for risk, suggest investors could be starting to prefer issuers that are less exposed to biodiversity-related risks, especially since the UN Global Biodiversity Framework was announced in December 2022. A growing number of institutional investors are committing to assessing their impact on biodiversity and setting related targets. For example, Nature Action 100 was launched in 2023 and has over 200 participating institutions with over \$28 trillion in assets. Over 170 financial institutions have signed The Finance for Biodiversity Pledge, representing EUR 22 trillion in assets.

Growing policy action

Global environmental laws introduced since 2020



Source: BlackRock Investment Institute, European Commission, United Nations Environmental Programme, UK Department for Environment Food & Rural Affairs, Brazil Forestry Ministry, China’s 2024 State Council, August 2024. Notes: The illustration shows a timeline of key environmental and biodiversity policy from governments across the globe.

Measuring natural capital risks

Creating portfolios that take natural capital risks into account starts with having access to quality data. Investors need this data to track and assess portfolio and individual company risks. Yet individual companies can be exposed to natural capital in myriad ways, so how companies and sectors measure risk can also vary widely.

Market consensus has not yet been reached on which metrics most effectively reflect natural capital risk, and many of the existing metrics are based on a mix of estimated and disclosed company data. Corporate disclosures across many measures of natural capital exposure have so far been limited. See table below left. Certain metrics, like water use, are more widely disclosed. But even where these measures are disclosed, the information is rarely broken down by region – and that breakdown is needed to truly understand the extent of a company’s exposure to natural capital risk.

As a first step towards assessing risk exposure more effectively, investors have started using sector-level data on natural capital impacts and dependencies, with the help of frameworks like Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE) to identify portfolio “hot spots.” Many financial data vendors are also developing “biodiversity footprint” metrics – measures of an individual company’s biodiversity impact. Those measures are often based on a global ecosystem model that translates existing corporate ESG data (carbon emissions, air and water pollution, potential land use change impact and measures of resource use) into an estimated biodiversity impact. Data providers are also increasingly using satellite data and other remote sensing technology to increase data coverage and reduce the cost of measuring individual companies’ exposures to natural capital risks.

New corporate disclosure standards may help improve data quality. The Taskforce on Nature-related Financial Disclosures (TNFD) provides a framework on how to disclose natural capital risks. Policymakers could require firms to make nature-related disclosures in coming years, as has been the case with climate risks and the Taskforce on Climate-related Financial Disclosures (TCFD) framework. In the EU, the Corporate Sustainability Reporting Directive will require companies to disclose significant nature- and biodiversity-related impacts, risks and opportunities starting in 2025.

In an effort to supplement existing data and overcome some of the data limitations mentioned above, BlackRock is using artificial intelligence (AI) tools to evaluate natural capital risks and develop exposure scores for individual companies – using large language models to scan company publications, for example. We tag and analyze relevant sentences to help gauge a company’s awareness and management of many different types of nature-related risks and opportunities. By constructing standardized exposure scores, we seek to evaluate the extent to which exposures are correlated with a company’s current market value – and where there is potential for repricing. See the chart below right.

Corporate disclosures limited, but growing

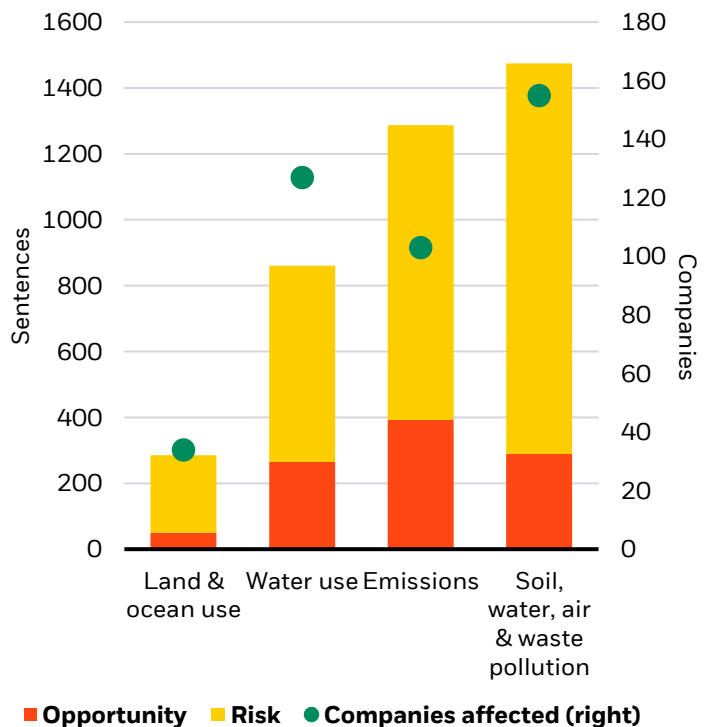
Data coverage of key nature-related metrics

Indicator		Data quality	Coverage
Climate	Emissions	Green	Green
Land and water use	Footprint	Red	Green
	Use	Green	Green
Pollution	Waste water	Red	Red
	Waste	Green	Grey
	Air pollutants	Red	Grey
Natural resources	Water withdrawal	Green	Green
State of nature	Extinction	Red	Green
	Ecosystem conditions	Red	Red
		Weaker	Better

Source: BlackRock Investment Institute, Taskforce for Nature-related Financial Disclosures (TNFD), August 2024. Notes: The table shows the data availability of various natural capital impact indicators as defined by TNFD, reflecting data qualities across several vendors. Coverage reflects how widely quantitative values are available for the MSCI ACWI universe. Weaker/better data quality reflects how much the values are based on estimates or models (low quality) versus company disclosures (high quality). Emissions are greenhouse gas emissions.

Top of mind

References to natural capital in 2023 annual reports



Source: BlackRock Investment Institute, August 2024. Notes: The chart shows analysis of 2023 corporate annual reports of S&P 500 companies, using large language models to identify natural capital impacts and dependencies (topics) as defined by ENCORE (in the 2018-2023 version that does not include supply chain considerations). The bars show the total number of sentences tagged for each topic, split by their relevance to either risks – like a water-related regulation with business impact – or opportunities – like a water treatment solution the company is offering. Emissions are greenhouse gas emissions.

Investing in natural capital solutions

As markets price in more of the value of natural resources, it will become more costly to consume them. That creates a strong incentive to use technologies or strategies that reduce or avoid those costs. And it provides an incentive to develop these technologies more quickly, particularly as policies and preferences evolve to support them. Some solutions are already rapidly decreasing in cost, thanks to advances in DNA sequencing and biomanufacturing, for example. We see investment opportunities in the companies that are developing such solutions – as well as in companies that make use of them.

We see four main types of “natural capital solution”:

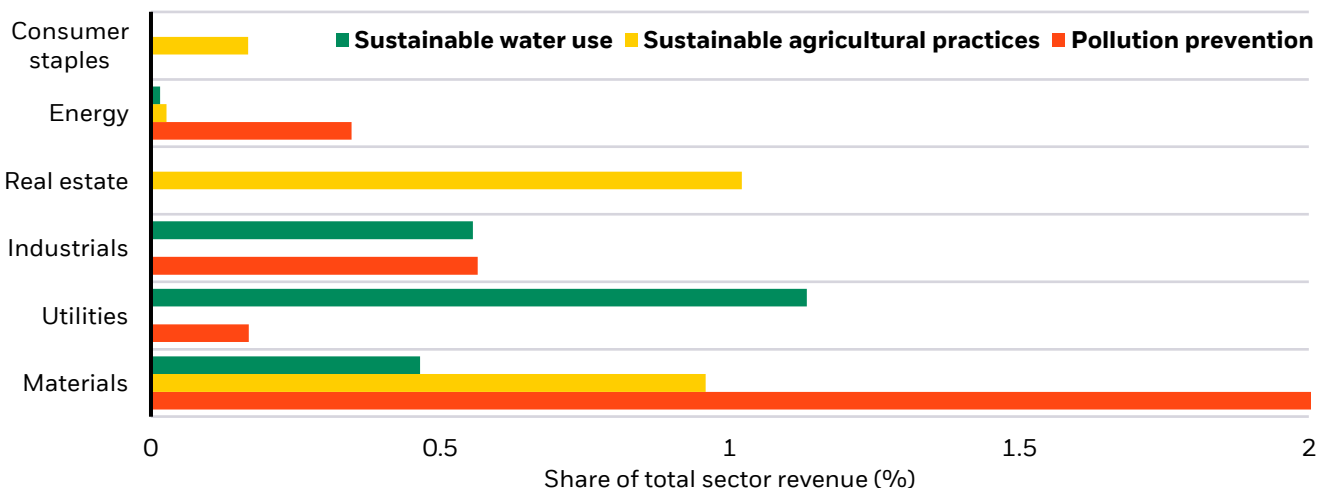
- Those that **use natural resources more efficiently**. For example, some farmers are using technology to gather data on the status of their crops to enable decision-making on planting, irrigation and fertilizers – an approach referred to as precision agriculture.
- Those that **support a circular economy** by reducing and recovering waste. This includes things like material recovery facilities that recycle plastic and other materials that would otherwise be sent to landfill.
- Those that **restore nature**. This refers to strategies like reforestation or regenerative agriculture that aim to replenish or restore natural resources.
- Those that **harness natural resources** to generate new products or business models. This refers to things like lab-grown bacteria that can dissolve microplastics pollution in the sea or synthetic materials that are biodegradable and can be used by the clothing industry to replace natural products like leather. Sustainable aviation fuels, derived from biodiesel, are another key example. They account for 25% of oil and gas companies’ investments in renewable fuels, May 2024 analysis by Bloomberg shows.

We see **AI** as a potential game-changer in scaling up natural capital solutions. In restoration activities for example, AI can analyze vast amounts of environmental data to identify degraded areas and predict the best restoration methods, optimizing reforestation and habitat recovery efforts. Precision agriculture benefits from AI through smart farming techniques that seek to minimize inputs like water and fertilizers, while maximizing outputs. In synthetic biology, AI can accelerate the design of new proteins, oils and other building blocks for creating a wide array of products, including fuels, self-healing cells and microbes that consume air and water pollution.

It is conceptually easier to identify companies involved in providing – or using – solutions than it is to measure a company’s exposure to natural capital risk because an investor only needs information on a company’s business model and revenue streams to get started. That should make this an easier place to start investing in natural capital as a theme, in our view. That said, market consensus has not yet been reached on what qualifies as a solution, but frameworks like the EU Taxonomy provide some direction. And data vendors are estimating how much of a company’s revenues are generated by broad sustainability activities like pollution prevention, sustainable water use and sustainable agricultural practices. See the chart. This represents only a subset of all the natural capital solutions we see in the market. If the analysis were to include more categories and if AI were deployed to analyze a greater volume of corporate text, we would expect the estimates of revenue share derived from sustainable activities to rise.

Revenue from sustainable activities

Share of total sector revenue derived from select sustainable activities, June 2024



Source: BlackRock Investment Institute, with data from MSCI, August 2024. Notes: The chart shows the share of total sector revenue generated from products or services with positive environmental impact, using MSCI Sustainable Impact Metric data for the MSCI ACWI universe. That data is built using company disclosures and analyst research and estimates. Pollution prevention activities include things like environmental remediation, waste treatment, pollution control and recycling. “Sustainable water” includes things like smart metering, water infrastructure, water recycling and drought resistant seeds. Sustainable agriculture includes, for example, certified agriculture and forestry activities.

Investment opportunities: now and future

We see key near-term opportunities in natural capital solutions. First, fundamental active funds focusing on circular economy solutions, water solutions and other natural capital themes can leverage analyst research to ensure company investees align with granular thematic criteria. Another way to deploy capital into this theme at scale is via green bonds focused on natural capital solutions. We have identified roughly \$350 billion of outstanding debt across biodiversity conservation, sustainable water, efficient technology, pollution prevention and sustainable natural resource management. The chart below left shows the rapid growth in issuance of such bonds over the last decade. The chart below right presents a breakdown of where the proceeds from bonds outstanding as of July 2024 have been deployed.

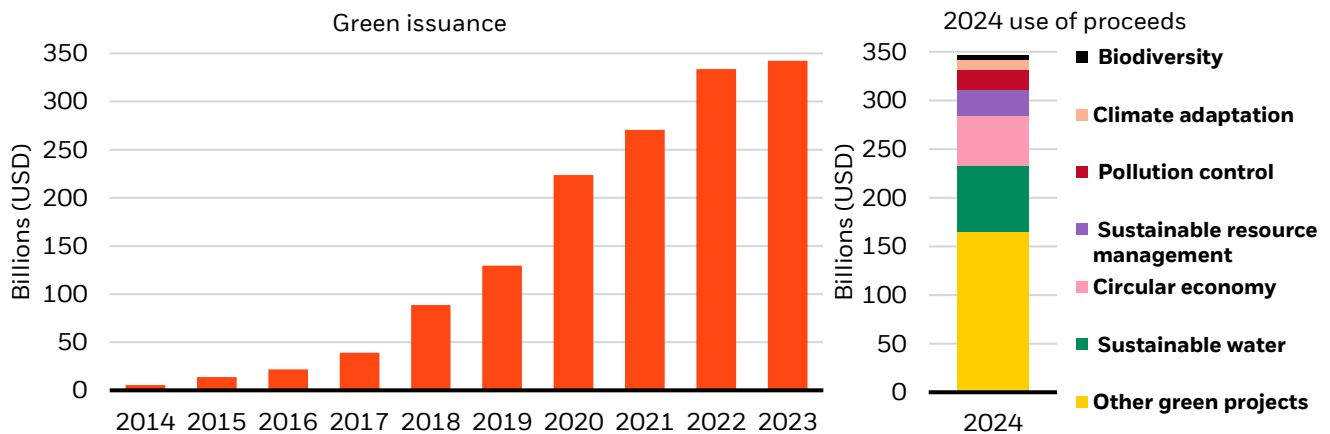
BlackRock is conducting proprietary research on natural capital investment signals, identifying companies poised for financial advantage in avoiding nature-related risks or leaning into opportunities. Those signals cover themes such as energy management, water management, waste management and biodiversity – and can feed into portfolio construction or support custom exposures. For example, our water stress signal incorporates granular geographical water stress data and highlights water efficiency, especially in high-risk areas. As discussed on page 4, this research identifies a link between a company’s water efficiency and its financial performance.

Longer term, we see private markets offering greater access to natural capital solutions. Opportunities are still nascent and fragmented, but large-scale transactions have taken place in recent years across themes like regenerative agriculture, sustainable timber management and coastal restoration. Technology evolution, spurred by AI advances and growing food demand, plus the potential for supportive policy, could present investment opportunities in technology providers and land assets. For example, indoor agriculture like greenhouses and vertical farms are now valued at \$40 billion, with projected sustained compound growth of 11% for the next decade, according to 2023 [research](#) by Fact.MR.

Biomaterials offer alternatives to petroleum-based and other non-renewable resources – with applications ranging from pharmaceuticals to aerospace. Forecasts suggest the biomaterials market could be valued at \$4 trillion by 2040. In agriculture, advances in AI and robotics are driving efficiencies via automated systems and machinery. The market encompasses sustainable production methods, precision agriculture and electric and autonomous machinery and could grow to over \$150 billion within the next decade, find [Yang et al, 2022](#). In the domain of water efficiency solutions, innovations like bio-enzyme-based dishwashing formulas are helping reduce water consumption, with significant market penetration in regions facing water scarcity, leading to category growth surpassing 20% in key markets.

Growing issuance

Outstanding biodiversity-themed green issuance and breakdown of 2024 use of proceeds



Source: BlackRock Investment Institute, data as of July 2024. Notes: The left-hand chart shows total outstanding issuance of biodiversity-themed green bonds over time based on the relevant universe identified by BlackRock’s Fixed Income (FI) ESG team using publicly disclosed data on issuers’ green bond allocations and the latest issuer documentation. The right-hand chart shows use of proceeds of outstanding biodiversity-themed green bonds as of July 2024 as allocated across biodiversity and natural capital themes, and other green bond expenditure. We define bonds as biodiversity-themed if 20% or more of their proceeds are used for projects that fall within green bond project categories identified by the FI ESG team.

Links with the low-carbon transition

Nature-related investment risks are closely connected to, but not the same as, low-carbon transition investment risks. In many ways, climate and nature-related risks can be addressed simultaneously: Climate change is one of the factors driving the depletion and degradation of natural resources. So, addressing climate change can also help reduce natural capital risks. Plus, some efforts to mitigate natural capital loss can also support decarbonization. For example, reforestation can help absorb greenhouse gases.

Yet managing these two types of risk can come with, sometimes complex, trade-offs: Some measures to mitigate climate risk can negatively impact nature. For example, biofuels could compete for agriculture and forest land. And efforts to bolster biodiversity could increase emissions in some cases. For example, natural forests can be less carbon-dense than intensively managed forests. Some investors may wish to jointly manage risks relating to natural capital and to the low-carbon transition in their portfolios.

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