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CIO Special

Biodiversity:

the new playing field for ESG assessment

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01 Introduction

ESG is a term that has become increasingly established in the past few years. But what exactly is ESG investing? ESG investing is a conscious decision to take environmental, social and governance criteria into consideration in regards of investment decision-making. One can now say that ESG investing has become mainstream, accounting for more than 36% of total funds under management globally.[1] However, while the concept of ESG spotlights three specific pillars to today's business, the transition to fully sustainable business practices will require a yet-broader approach to ensure we can support the planet's health for generations to come as depicted in Figure 1.[2]

Figure 1: ESG vs. sustainability

Source: UNDESA, IPSF, Deutsche Bank AG. Data as of February 7, 2022.

ESG	vs. Sustainability
Risk Management Managing risks	Positive contribution Deploying capital for sustainable development
Narrow impact assessment Operational activities	Comprehensive assessment Impact of the products/services
Positive Contribution to one sustainability goal	Net positive Consideration of the overall net impact on sustainability goals
Current alignment Status quo of activities	Transition pathway Forward-looking transition for transformation

The widespread adoption of ESG criteria (e.g. identification, verification, or alignment of investment decisions and business practices) in capital markets and throughout all industries means that it has to be considered on a systematic basis. ESG means more information and thus a further dimension will be added to traditional financial statement analysis. Narrow financial analysis may increasingly be seen as just the "tip of the iceberg" of the risks and opportunities around companies.

In general, more information should lead to more effective markets and an efficient allocation with respect to supply and demand. Incorporating ESG should also allow a much more holistic decision-making process, better able to identify risks and to enhance the quality of investment decisions.

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Consideration of ESG criteria, however, creates challenges as well as potential rewards. Traditional investment theory assumes that prices in financial markets fully reveal all available information.[3] However, growing information flows (especially when they create a situation of "asymmetric information", i.e. one party knowing more than another) can prove unsettling, often leading to higher volatility and speculation.[4, 5] Behavioural finance and related models also suggest limits to traditional investment theory.

Current considerations of ESG principles in the investment decision-making process have also helped break an old assumption that ESG was associated with lower earnings expectations and higher risk (i.e. volatility). This may be because a previous focus on excluding "sin stocks" in the past has been replaced by more diverse and sophisticated approaches. We now know that ESG strategies can be resilient in times of crisis, from both a short-term and long-term perspective.

Nevertheless, valid questions remain about how ESG should be used in investment analysis. A pure ESG assessment on the basis of scores, ratings or exclusion criteria is unlikely to be sufficient on its own as a basis for decision-making. This is because it may not be fully up-to-date, may neglect certain risks, and may not fit easily within existing norms and processes. In addition, the economic dimension needs to be taken into account as ESG might stimulate economic growth by accounting for and promoting the use of natural resources ("natural capital") as well as implementing social and economic policies.[6]

In the context of taking the usage of natural resources into account, one has to consider the effects of our economic endeavours on our environment and especially the many species inhabiting it. Simply stated: we have to talk about biodiversity. Assessment of biodiversity loss, an increasingly important ESG area, may put a greater focus on current ESG shortcomings and also prompt some solutions. The degradation of biodiversity (biodiversity loss) creates risks (physical, transition, and liability risks) for all companies and industries in different ways and over a period. Hence, any ESG investment assessment needs to look at the entire (product) life cycle and across the whole supply chain of a company. Successful ESG analysis here would help to improve qualitative investment recommendations and decisions. This report focuses on how to do this by also considering nature-related risks. However, oftentimes ESG-related discussions still seem to be about fundamental questions about ESG as an investment concept. Even though perceptions around ESG have changed significantly recently, discussions among investors about broadening the spectrum of ESG discussion are still too rare.

ESG investment assessment needs to look at the entire (product) life cycle and across the whole company supply chain – while considering nature-related risk.

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02 Current ESG perceptions

Investors consider ESG in their decision-making for different reasons. Societal expectations (e.g. tangible impact on risks), regulatory requirements, and personal beliefs are amongst the top reasons for considering ESG. From an investor's point of view, one can say that ESG is perceived as an answer to the fundamental changes in society, regulation, and personal beliefs that we have seen in the last years. However, ESG is still fundamentally an investment concept. This means that "traditional" measurements (e.g. return and risk) are still important.

Return expectations differ amongst investors and have changed over time as depicted in Figure 2. In short, investors no longer assume that ESG will have a negative impact on portfolios. A global survey of our clients, conducted in March 2021, revealed that only 19% of those surveyed associated ESG investments with a lower performance as shown in Figure 3.

The Covid-19 pandemic has also accelerated the move to ESG as the majority of investors stated in our survey that the importance of ESG has increased in their opinion due to the Covid-19 outbreak.[7]

However not all investors seem to have fully incorporated ESG into their strategy. Our 2021 survey, for example, revealed that only 26% of SME companies strongly agreed that they have a dedicated ESG strategy.

Figure 2: Investor perceptions of ESG and financial performance is changing

Source: DWS, Deutsche Bank AG. Data as of November 26, 2020.

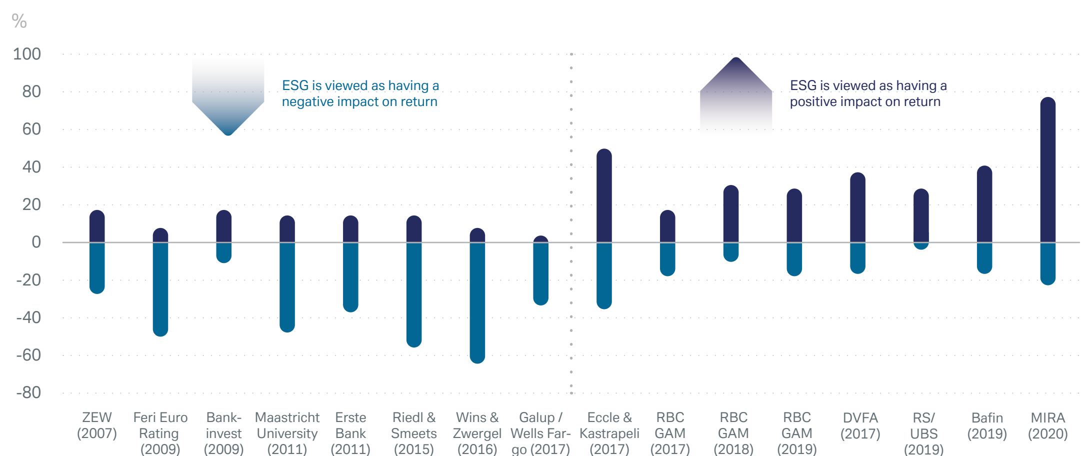

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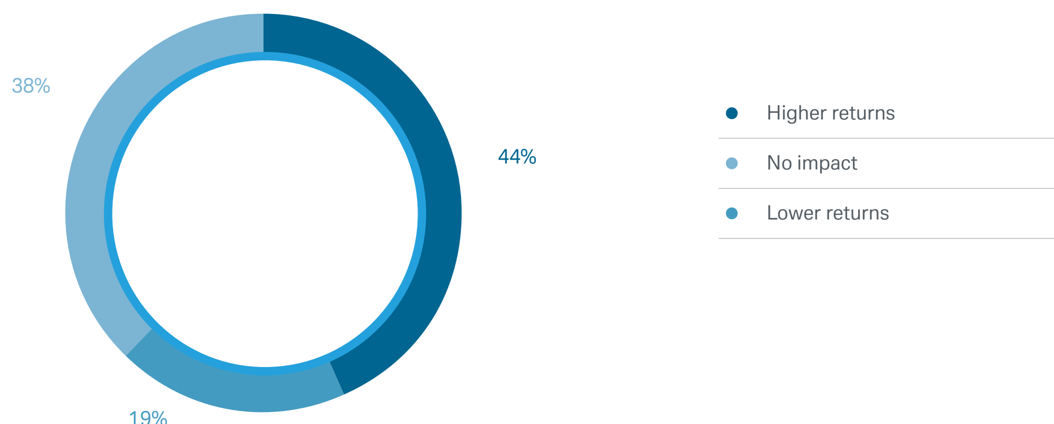
Figure 3: Performance assessment of ESG investment (client respondents in %)

Source: Deutsche Bank AG. Data as of April 20, 2021.



Real world performance seems to support this belief. For example, a meta-study (study of studies) by NYU Stern, covering more than 1,000 individual studies in the period between 2015-2020, shows in 58% of the cases a positive relationship between ESG and financial performance.[8] For investment studies typically focused on risk-adjusted attributes, such as “alpha” (outperformance of the overall market) or the Sharpe Ratio, on a portfolio of stocks, 59% showed similar or better performance relative to conventional investments. They also find positive results when reviewing climate change, low carbon, or studies related to financial performance.

However, the more one digs into the factors behind ESG performance, the more complex it becomes. Individual ESG factors, for example, may have varying impacts (positive and negative) over time. In the short term, the G-pillar tends to affect performance (e.g. through fraud). In the long term, the effect of the E- and S-pillars may be stronger. This is because these pillars tend to have a more cumulative effect and represent "erosion risks" for long-term performance.[9] There are multiple factors in play, some of which can be unexpected. The combination of ESG and employee satisfaction, for example, can lead to a large impact on company’s share value and financial performance as depicted in Box 1.

Box 1

Employee buy-in and ESG

Professor Dr. Aaron Yoon (Northwestern University, Kellog School of Management)

My co-author, Kyle Welch, and I performed a study comparing corporate ESG, employee satisfaction, and financial returns. Employee satisfaction has also been linked to positive financial impact but has rarely been studied with ESG.[10] We found that while ESG alone showed no impact on returns, and employee satisfaction had a small positive effect, the combination of these factors yielded the largest impact on firms’ share value and financial performance.

We examine the intersection of ESG and employee satisfaction, a supported predictor of positive stock returns. In particular, we explore whether ESG efforts instill a deeper sense of purpose in employees, boosting productivity and, ultimately, returns. We collected MSCI data on ESG ratings (related to 10 areas including climate change, human capital, and governance) and Glassdoor data for almost 1 million employee satisfaction between 2011-2018. We then compared an investment-portfolio comprising companies with high ratings on both ESG and satisfaction to other portfolio compositions on one-year-ahead stock performance and other measures including sales and profits.

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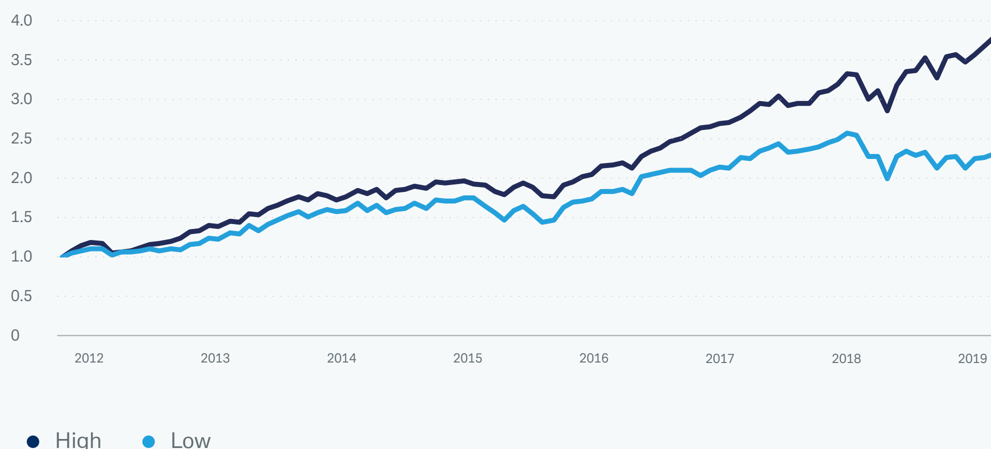
What we found sheds much-needed light on the connections among ESG, employee satisfaction, and financial value.

First, we showed that neither ESG practices nor employee satisfaction is sufficient to maximize value. In fact, we found that using ESG alone as an investment signal resulted in no meaningful improvement in returns. Using employee satisfaction alone yielded 2.2% higher returns. But the combination of ESG and employee satisfaction had a large effect. The portfolio of stocks with top ratings in both ESG practices and employee satisfaction generated 4.74% alpha per year, outperforming the portfolio with the lowest ratings in both categories that generated alpha of -1.77% by 6.50% per year. In essence, we found that implementing meaningful ESG and promoting employee engagement and satisfaction together improve financial returns as shown in Figure A.

Figure A: High ESG/CEO ability vs. low ESG/CEO ability (in USD)

Source: Welch, K. and A. Yoon. Do High-Ability Managers Choose ESG Projects that Create Shareholder Value? Evidence from Employee Opinions. Working paper. Data as of December 13, 2021.



Our findings show that corporations need employee buy-in to make their ESG initiatives work, and strong ESG efforts can yield more engaged, satisfied employees if people feel their employer's values align well with their own. That satisfaction, in turn, could enhance productivity, ultimately boosting returns.

In line with this logic, it is important to pay special attention to the "S" in ESG: social, or the people part. Indeed, most of the return effect we found was generated by firms' socially-focused investments. Companies that strive to treat employees, customers, and other stakeholders well – through focus on diversity, inclusion, and equal treatment of others – are more likely to reap the rewards of their ESG initiatives.

Perceptions on the impact of ESG on returns differ amongst investors and are changing.

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03 ESG assessment issues

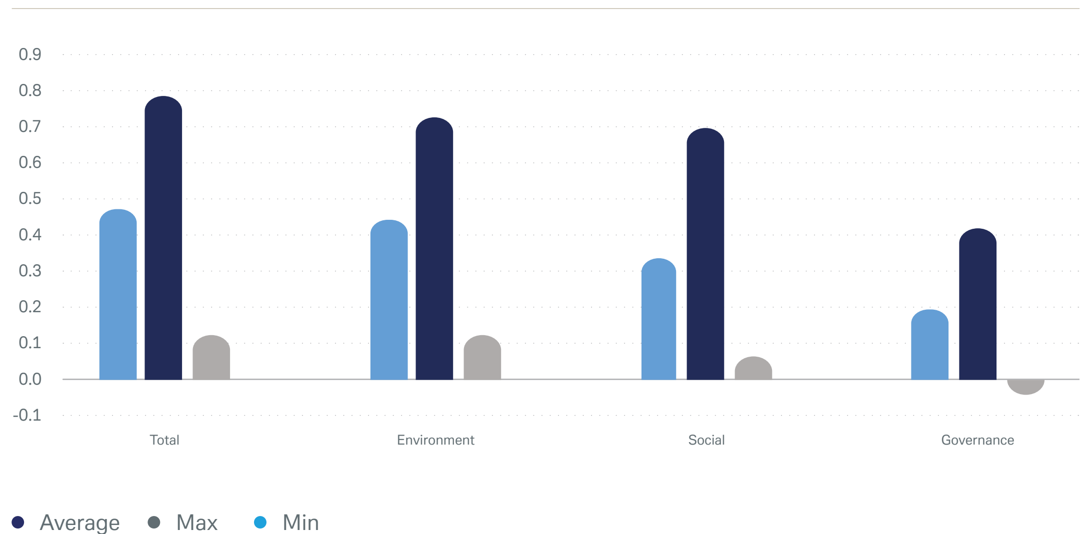
One of the key enablers for ESG investing is data. There are a number of specialized agencies who aggregate and analyse thousands of data points related to ESG factors, often producing ESG ratings, or scores to compare companies' ESG performance relative to peers in their sectors. They do this by analysing disclosed data or providing expectations of present and future projections.

While the existence of such ESG ratings and scores is critical for creation and assessment of ESG investment solutions, they are not without challenges. Four issues are summarised below:

- Rating harmonisation needs improvement. One overarching theme is the need for harmonization across rating agencies, with common minimum standards and the verification of existing industry standards. Currently, ESG ratings and scores of the same companies may vary between ESG rating agencies due to differing methodologies used, creating confusion and lack of comparability. Figure 4 shows particularly strong "disagreements" between ESG rating agencies as expressed by low correlations on the Social (0.33) and Governance (0.19) ratings on average.

Figure 4: Average, minimum, and maximum correlations across ratings providers

Source: UNPRI, Deutsche Bank AG. Data as of March 25, 2020.



● Average ● Max ● Min

Note: A perfect positive correlation (i.e. providers' assessments are the same) is represented by the correlation coefficient value of 1.

Correlations are also highly variable in different agencies' assessments of individual sectors as depicted in Figure 5. For instance, companies in the healthcare sector show the most similarity in their respective E-pillar ratings across different rating agencies – companies within the consumer durables sector show the least similarity. Progress towards more transparency and standardization is required to increase convergence on what ESG ratings and scores mean, independent of the ESG rating agencies. For this reason, the European Securities and Markets Authority (ESMA) emphasizes the need to meet the increasing demand for ESG ratings with corresponding regulatory requirements in order to ensure their quality and reliability.[11] A common definition of ESG ratings, covering the broad spectrum of possible ESG ratings currently offered, would help to make the regulatory framework more future-proof.

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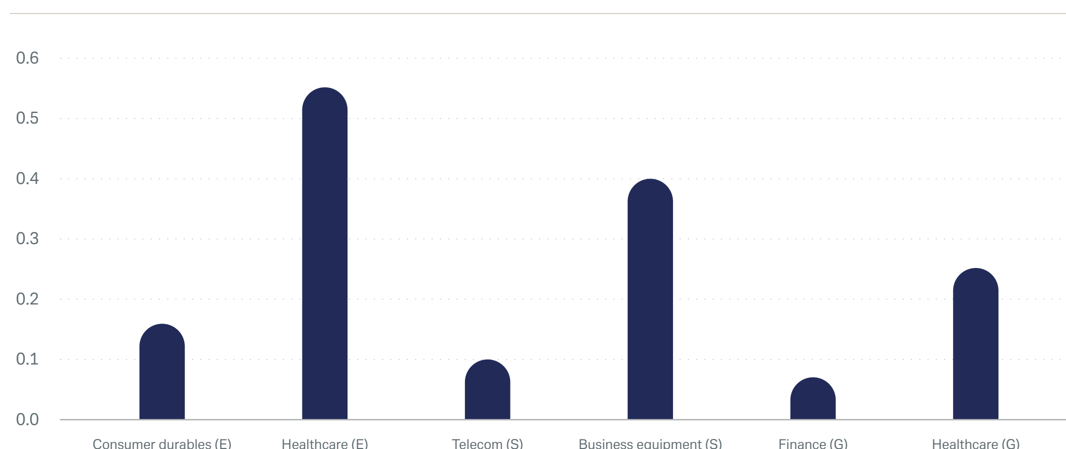
- "Best in progress" argument may need more weight. There should be increasing attention on how companies are improving and progressing on ESG rather than judging simply by the existing rating. For example, there should be more recognition for companies making the transition towards carbon neutrality, rather than judging them solely by a "weak" current ESG score, which is a snapshot in time. Weak ESG scores should not automatically be considered "bad" without taking a deeper look at the company's planned strategy and trajectory. According to classical portfolio theory, companies that show significant improvements in ESG could be more successful in the long-term if they have the right answers for tomorrow today and position themselves accordingly in terms of business strategy. This includes a forward-looking economic transition to a "net positive" model (putting more back into the environment or society than is taken out) by deploying capital for a sustainable and stable development.

- ESG scores need themselves to be sustainable. One concern is that ESG scoring may or may not reflect a company's pursuit or adherence to high ESG standards. Some high scores may reflect a company's marketing programme and disclosure efforts more than its true commitment to ESG and sustainability over the longer term. According to Goodhart's law, "when a measure becomes a target, it ceases to be a good measure".

Figure 5: Sectors with lowest and highest average correlation (by respective ESG category)

Source: UNPRI, Deutsche Bank AG. Data as of March 25, 2020.



Note: A perfect positive correlation is represented by the correlation coefficient value of 1.

- Exclusion criteria may create specific problems. Exclusion criteria which limit investment into sectors with perceived long-term ESG risks provide complementary insights that are not apparent from a purely "best-in-class" companies-based approach. But they can introduce their own distortions into an assessment, if quite major shifts in exclusionary criteria are accompanied by only small shifts in score. For example, companies with no business related to tobacco have an ESG score of around 6 in contrast to an only slightly lower ESG score for companies with over 50% of business related to tobacco.

Besides addressing these issues, we must further increase the meaningfulness of ESG as a concept. It is clear that the way how companies operate will change fundamentally. The way we do business is, with increasing pace, evolving towards an economy that puts sustainability into the core of its identity. In the course of this development, the way we make investment decisions will also change drastically. This means that we have to develop ESG towards a truly holistic approach. ESG has to be fully able to reflect all the criteria (with an emphasis on nature-related ones) investors will take into consideration when it comes to investment decision-making within the changing way of doing business. Biodiversity, or the prevention of biodiversity loss is going to be a key factor within the self-image of this reformed economy.[12] However, factoring biodiversity measures into ESG comes with its own challenges. As an investor, observing developments here and also understanding the challenges will be of great importance.

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04

Biodiversity adds new opportunities

There is increasing awareness of biodiversity loss as an issue but the subject still needs much more attention. Companies today continue to rely on natural resources while simultaneously impacting ecosystems. For the production of goods and services, ecosystem services are crucial, yet mostly unrecognized. As research suggests, many industries and sectors are threatened by biodiversity related risks. For example, roughly 38% of large publicly traded companies seem to be at least partially affected by habitat loss (sample size: 5,300 corporations).[13] But investors may still be struggling to factor biodiversity into their ESG strategy. For example, in our 2021 survey, only 23% of SMEs and large corporates strongly agreed that they factored biodiversity into their strategy.[14]

Biodiversity analysis makes it clear that there are different types of (nature-related) risk. For example, as natural capital is depleted, its capacity to provide ecosystem services on which companies depend is reduced either temporarily or permanently. This represents a physical source of risk for companies and their investors. Equally, the variety of responses to nature loss creates transition risk for companies. See Box 2 for more details on risk and regime shifts.

Box 2

Biodiversity, resilience, and regime shifts

Professor Dr. Albert V. Norström and Jean Baptiste Jouffray (Stockhol Resilience Centre)

Ecosystems and biodiversity are essential for human existence and ensuring a good quality of life.[15,16] They play a critical role in providing food and feed, energy, medicines and genetic resources and a variety of materials fundamental for people's physical well-being and for maintaining culture.

Most of the contributions of biodiversity to people are not fully replaceable, and some are completely irreplaceable.

Biodiversity also plays a key role in underpinning and bolstering ecosystem resilience.[17] Resilience is the capacity of a natural system to cope and adapt in the face of changing social or environmental conditions. Biodiversity builds resilience by providing flexibility, through the ability to respond in multiple ways to systemic changes and shocks, and provides sources of innovation for novel conditions. At the species level, functional groups, i.e., guilds of species performing similar ecological functions, provide the link between biodiversity and resilience. Two properties of functional groups are important in this context: response diversity and redundancy. Response diversity is the diversity of responses to environmental change among species within a functional group. Redundancy describes the capacity among species within a functional group to functionally replace each other. Management strategies that bolster these properties help prevent regime shifts by ensuring that critical system feedbacks are maintained in the face of unexpected shocks and disturbances to the system. Similarly, the spatial diversity of land- and seascapes is another critical element of biodiversity that helps maintaining resilience.

Unfortunately, biodiversity is being lost faster than ever before. For example, human actions are currently threatening more species with global extinction than ever before, and the global rate of species extinction is already at least tens to hundreds of times higher than it has averaged over the past 10 million years. This unprecedented loss of biodiversity is seriously threatening the resilience of natural systems around the world.[18, 19]

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While some natural systems respond to the loss of biodiversity and resilience with a gradual and linear degradation, the response can very often be sudden, catastrophic and almost irreversible. These types of events are often referred to as regime shifts - which are large, abrupt, persistent changes in the structure and function of ecosystems.[20] Regime shifts have been empirically documented in a variety of terrestrial and aquatic systems and studied in mathematical models. Regime shifts are the bane of managers and policy makers since they have substantial impacts on human economies and societies and are often difficult to anticipate and costly to reverse. For example, the collapse of the Newfoundland cod fishery in Canada in the early 1990s directly affected the livelihoods of about 35,000 fishers and fish-plant workers, and led to a decline of over USD200 million per annum in local revenue from cod landings.

Recent research is also highlighting how different types of regime shift are connected to one another across space and time. For example, one very common type of regime shift occurs when freshwater systems (lakes and rivers) shift to a degraded and eutrophied (high nutrient levels) regime. This can in turn trigger coastal hypoxia downstream and regime shifts in associated coastal ecosystems such as mangroves and coral reefs. Identifying the processes that connect different regime shifts and mediate the strength of these connections is vital for understanding the ability of ecosystems to respond to global changes such as climate change and increased habitat conversion.[21]

There is a clear need for improved knowledge and tools for managing regime shifts. In particular, we need a better understanding of the mechanisms underlying different regime shifts, their key drivers, impacts and potential intervention strategies. This can only be achieved through dialogue between science and ecosystem managers. Such knowledge will enable us to better assess which places on Earth are particularly vulnerable to specific regime shifts, and the conditions under which the likelihood of different regime shifts increases, in order to better direct management efforts. In addition, it will enable us to better assess the potential risks and costs of regime shifts in order to decide when it makes sense to take action to avert or precipitate a regime shift.

There is also a double-materiality of nature loss. First, nature is material to companies – if ecosystem services are degraded, company profitability and operations are at risk. But, second, companies can also have a materially negative impact on nature, warranting measurement and reporting. This reporting of negative impacts can, furthermore, indicate the exposure of the company to action from regulators, governments, litigators and consumers to protect and/or restore nature.

ESG metrics approach this issue (of multiple impacts from biodiversity loss) in various ways. For example, there are biodiversity and land use management scores which assess companies' performance in minimizing disturbances, protecting biodiversity and local heritage and engaging with local communities and environmental groups in their conservation efforts.

The financial sector has also developed a range of approaches to measure impact on biodiversity, as summarised in Figure 6.[22] These approaches are continually being refined by individual firms.

There is increasing awareness of biodiversity loss as an issue but the subject still needs much more attention.

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Figure 6: Measuring biodiversity loss

Source: Finance for Biodiversity Pledge, Deutsche Bank AG. Data as of January 2022.

	Metric	Measurement approach
CBF	Corporate Biodiversity Footprint	In order to fully capture the impact of a product and based in a life cycle analysis of the impact of their activities, CBF assesses the annual impact of corporates, financial institutions, and sovereign entities on global and local biodiversity.
BFFI	Biodiversity Footprint Financial Institutions	The investments of financial institutions in economic activities are evaluated by a biodiversity footprint. On a portfolio level, it allows the calculation of environmental pressures and the biodiversity impact of investment within the portfolio. This method can also be used on a asset class, company or project level.
STAR	Species Threat Abatement and Restoration metric	Abating threats and restoring habitat can reduce species extinction risk. This metric measures the contribution that investments can make in order to reduce this particular risk. Finance institutions and investors can make firm investment decisions with the purpose of conserving biodiversity.
GBSFI	Global Biodiversity Score for Financial Institutions	Based on the impact of different terrestrial and aquatic pressures on biodiversity, this score provides an overall aggregated vision of the biodiversity footprint of economic activities.
BIA-GBS	Biodiversity Impact Analytics powered by Global Biodiversity Score	Considering the full value chain of underlying companies, this score provides an overall and synthetic vision of the biodiversity footprint, portfolios, or indices.
ENCORE	Exploring Natural Capital Opportunities, Risks and Exposure	Provides a view of how economic activities might depend on or impact natural capital. Qualitative materiality ratings are used in order to identify these dependencies and impacts. The goal is to spot areas that require immediate action.

The underlying theme here is that holistically assessing a sustainable corporate strategy which goes beyond scores and exclusion criteria, is crucial. The risk of nature loss to organisations and the impact of those organisations on nature (the double-materiality of nature loss) should be measured, disclosed and managed as explained in Box 2.

Box 3

The double-materiality of nature loss

Dr. Nina Seega (Cambridge institute for Sustainability Leadership)

Human activity is driving the decline of natural capital. As natural capital declines, its capacity to provide ecosystem services on which company depends is reduced either temporarily or permanently. This represents a physical source of risk for companies and their financiers. Equally, the variety of responses to nature loss creates transition sources of risk for the organisations.

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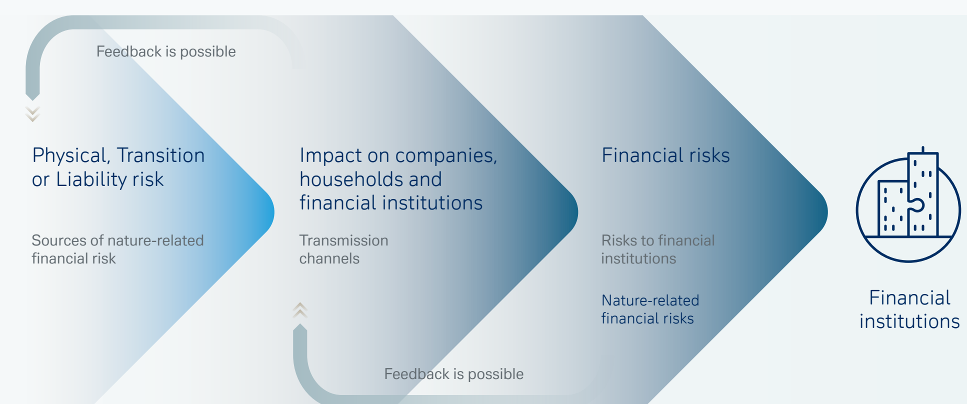
This points toward the “double materiality” of nature loss. First, that nature is material to companies – if ecosystem services degrade, company profitability and operations are at risk. Second, that companies can have a materially negative impact on nature, warranting measurement and reporting. This reporting of negative impact can, furthermore, indicate the exposure of the company to action from regulators, government, litigators, and consumers to protect and/or restore nature.

The links between nature-related risks, such as ecosystem service degradation, and the financial world can be traced via transmission channels as shown in Figure B. When an ecosystem service degrades it transmits into the financial world by undermining, for instance, the ability of the company to operate (e.g. soil degradation makes farmers acutely vulnerable to extreme weather). Equally, when a company negatively impacts nature it also becomes exposed to future transition or liability risks, such as environmental litigation, that in turn pose financial risks to banks, investors and insurers.

Figure B: Transmission of nature-related risks to financial institutions

Source: CISL. Data as of February 14, 2022.



The University of Cambridge Institute for Sustainability Leadership (CISL) published a Handbook in March 2021 for financial institutions to identify and assess nature-related financial risks.[23] Using this Handbook, financial institutions are assessing specific nature risks in their portfolios, based on existing data and scenarios. These assessments provide a starting point for discussion with portfolio companies about their exposure to, for instance, water stress and its (financial) consequences. This engagement is critical. It can make visible mitigation strategies the company has already taken or additional data that demonstrates a greater or lesser exposure to the source of the nature-related financial risk. Until portfolio companies are engaged, the extent of exposure to water stress remains unknown and so may be assumed to be greater than it actually is.

This leads us to the need for more consistent and verified environmental data to be publicly available. Such data can demonstrate the extent of exposure to nature risks, such as land degradation, and provide the starting point for the more challenging analysis about how the wider supply chain is connected to the primary exposure. For example, to what extent soft commodity buyers in Europe are exposed to land degradation in South America.

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This is one reason why the Taskforce for Nature-related Financial Disclosures (TNFD), and in particular the TNFD framework due 2023, is so critical. The TNFD will address the double materiality of nature loss and provide the guide through which disclosure can occur and the connection to the degradation of the natural world understood. In the process, TNFD also aims to address the data gap, adding to a largely blank canvas when it comes to the how specific company operations are exposed to nature-related risks in specific geographies. From water stress to pollinator population stability, the issues that arise from nature loss are highly context specific and often localised in their impact. Therefore, having granular information below the national or company level about the relationship between companies and the natural world is critical.

Finding the means to make this data publicly available is also vital, not just for the sake of efficiency in the assessment of risk, but also to ensure that it is not only well capitalised corporates or financial institutions that can recognise their exposure and understand its materiality. Today, the EU Copernicus project provides satellite data about land use change that can be utilised for deforestation risk assessments.[24] In the future, other such data can form the backbone of environmental credentials on top of which nature-positive companies, financial products and scalable nature-sensitive financial markets can be built.

Financial supervisors are moving to assess the financial risks posed by nature loss, with the Network for Greening the Financial System (NGFS) pursuing a research agenda to support members to fulfil their mandates to safeguard financial stability in the face of nature-related financial risks. Whilst the TNFD defines its framework, guides such as the Handbook produced by CISL and other publicly available information about ecosystem services, such as WRI Aqueduct, means financiers can also take action today to recognise and assess the materiality of nature loss. Financial institutions taking this action can kickstart the process of engagement with counterparties and, as such, are best placed to mitigate presently unmeasured financial risks in their portfolios.

The challenges our economy is facing seem to be dire and the urgency to change greater than ever before. Nevertheless, the transition comes with its own, specific hurdles.

Holistically assessing a sustainable corporate strategy which goes beyond scores and exclusion criteria, is crucial.

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05 The green paradox

The green paradox describes the possible occurrence of undesirable effects from climate or other environmental measures. The fear is that the measures we take to reduce CO_2 emissions might cause the exact opposite. One way this could happen is through fossil resource suppliers expanding their extraction as they anticipate lower prices in the future due to announced regulatory measures, thus increasing CO_2 emissions. The existence of the green paradox comes with implications, for example: the interests and possible responses of fossil resource suppliers must be taken into account as governments frame environmental measures.

Evidence for the occurrence of such a green paradox is plentiful. It is therefore important to fully understand the impacts of the measures we take, so we can understand how these undesirable effects can arise. In China for example, market segmentation has shown to be a hindrance to the effectiveness of measures aiming for carbon neutrality. Examining 30 different provinces during a span of 14 years, a study has shown that although environmental regulations on their own indeed can reduce carbon emissions, market segmentation means that the exact opposite can also happen.[25] In this case, market unification, an optimized industrial structure as well as a harmonized carbon reduction system would have been a way to effectively avoid the green paradox.

In Europe, a recent study observed the effects of various measures to combat climate change (such as environmental taxes or emission limits) and came to similar results.[26] A strong green paradox has resulted from the hiatus in the implementation of the European emission cap mechanism.

However, there are solutions that can be implemented in order to avoid this phenomenon. For example, different environmental standards across geographical regions have been shown to be a driver of the green paradox. Therefore, abolishing these disparities will increase the effectiveness of the measures we take. So including developing countries into the environmental discussion is crucial. In the field of scientific literature, many approaches besides that can be found. Introducing a tax seems to be a popular proposal: a sufficiently high taxation rate that might even decrease over time could be one way, for example, to reduce extraction incentives. Such innovation could make extracting fossil fuels in the future relatively more attractive, buying valuable time for the transition.

Understanding the green paradox is paramount to achieving the goals (e.g. net-zero) we are aiming for. Mankind is currently facing a fundamental paradigm shift, as environmental pressures will be accompanied by social and governance pressures as economies and sectors restructure to address multiple dimensions of change. Tensions between different desirable, but interdependent and conflicting, sustainability objectives arise when focusing on the leap to a sustainable future as depicted in Figure 7.

Two things are evident. Firstly, as we seek to achieve continued growth with the same (finite) resources, we still cannot price the full value of nature and all of its services and externalities. But moving to a new more sustainable path will first of all require transition inputs and services in order to achieve higher economic growth through a wave of new investments. Secondly, extreme weather events or natural disasters (such as wildfires or floods) will cause further disruptions which will not only negatively impact our economy, but also our overall quality of life. The economic and societal damage caused by these occurrences may serve as a catalyst to the ongoing developments towards a more sustainable economy.

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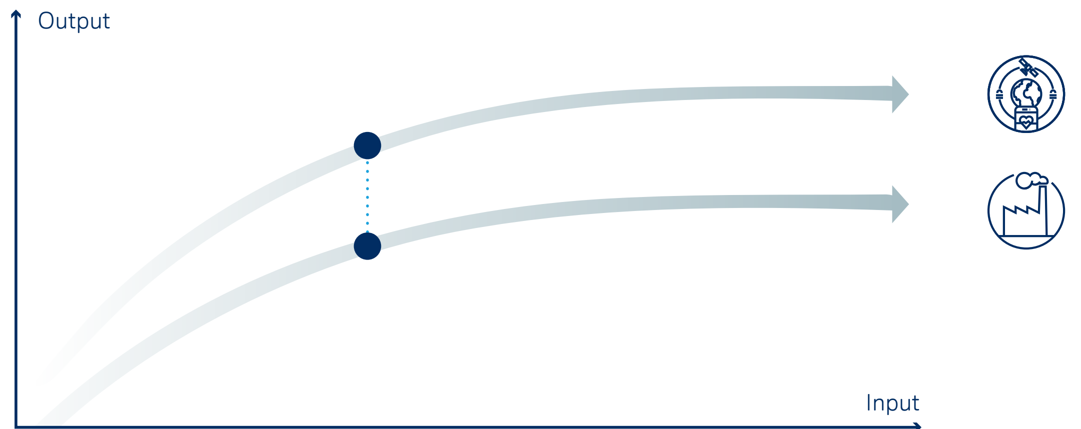
Figure 7: The leap to a sustainable economy

Source: Deutsche Bank AG. Data as of January 12, 2022.



Getting these inputs for a shift to a sustainable growth path will require some tough decisions. For example, the European Commission has started consultations on a draft for the EU taxonomy by providing a common set of definitions for sustainable investments for supporting the European Green Deal.[27] The proposal envisages designating nuclear power and natural gas as green investments to both contain the likely future increase in energy prices and accelerate the energy transition. Such a country or region-wide change can ultimately lead to a (new) regime shift with unknown impacts and potential intervention strategies.

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Getting ESG calculations right is also important because in many areas we may be close to tipping points.[28] These happen when a system is sitting on the boundary of two different states – and a small intervention then generates a controlled regime shift towards sustainability (or the opposite). In the situation our economy is facing right now, management of tipping points can involve ensuring that it makes more sense (sense from an economic point of view) for companies to preserve and restore natural capital rather than exploiting it by using, for example, Nature-based Solutions (NbS). The most prominent example of this is how carbon pricing and subsidy policies have tipped the costs of new coal power plants to make them uneconomic in most major markets. Such tipping points need to be carefully managed by central banks and other government agencies to enable the financial system as a whole to shift to more sustainable patterns in terms of capital allocation. This regime shift may need a change in the supervisory mindset.[29]

Enhancing the sustainability of socio-ecological systems (SESs) requires adaptive governance supported by polycentric structures (i.e. with multiple overlapping jurisdictions). However, adaptive governance of SESs across national boundaries can be challenging, as significant differences in institutional arrangements for resource management and adaptive governance capabilities may exist. The limitations of various institutional arrangements and the challenges of adaptive governance across borders are still poorly understood.[30]

Various initiatives are underway to improve the assessment, tracking and reporting of biodiversity finance flows. Nevertheless, data gaps and inconsistencies persist. To address this challenge the OECD suggests, for example, improving the consistency and transparency of the data reported to the Convention on Biological Diversity (CBD) by adapting the financial reporting framework to request further granularity.[31] Specifically, the template of the CBD financial reporting framework could be adapted to encourage countries to:

- Report quantitative data on biodiversity expenditure by individual category (e.g. government budgets, private, NGO), rather than reporting only the total amount.
- Distinguish between expenditure allocated to promote the conservation and sustainable use of ocean/marine biodiversity (SDG 14) and terrestrial biodiversity (SDG 15).
- Develop and agree on an internationally harmonised approach for assessing and tracking public biodiversity finance, building on existing frameworks and classification systems.
- Establish a common framework to assess and track private finance for biodiversity, drawing lessons from OECD’s Research Collaborative on Tracking Finance for Climate Action.

Getting such agreement in one area could facilitate progress in others.

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06 Conclusion

The integration of biodiversity into ESG assessments requires a significant enlargement to the concept of ESG and is therefore driving a serious change towards a sustainable economy. This cannot stop at the "E" (environmental) pillar – biodiversity has great relevance for both the "G" (governance) and "S" (social) pillars.

There are many elements to this integration process. For example, the Sustainability Accounting Standards Board (SASB) materiality map can be used to identify sectors for which biodiversity may be financially material. Using biodiversity as a filter in negative screening could exclude companies exposed to biodiversity-related controversies.

Getting the transition to a sustainable economy right is highly important and adds urgency to biodiversity's integration into ESG. Better understanding of the data around biodiversity should also help policymakers navigate through a series of tipping points to find the best path through to a nature-positive economy that recognises the value of natural assets.

ESG already enables financial analysis on a much more granular level. But as ongoing developments on biodiversity shows, there is even more we could take into consideration when making investment decisions. As political, societal and, economical efforts push further to fundamentally transform our economy, the way we invest will inherently change. Biodiversity could and should lead the way here.

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Bibliography

1. GSI Alliance (2021). GLOBAL SUSTAINABLE INVESTMENT REVIEW. Retrieved from: http://www.gsi-alliance.org/wp-content/uploads/2021/08/GSIR-20201.pdf. January 26, 2022.
2. UNDESA and IPSF (2021). Improving compatibility of approaches to identify, verify and align investments to sustainability goals. Retrieved from: https://g20sfwg.org/wp-content/uploads/2021/09/G20-SFWG-DESA-and-IPSF-input-paper.pdf. February 7, 2022.
3. Fama, E.F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. The Journal of Finance 25(2), 383-417.
4. Ross, S.A. (1989). Information and Volatility: The No Arbitrage Martingale Approach to Timing and Resolution Irrelevancy. The Journal of Finance 44(1), 1-17.
5. Cutler, D.M., J.M. Poterba, and L.H. Summers (1991). Speculative Dynamics. The Review of Economic Studies 58(3), 529-546.
6. Diaye, M.-A., S.-H. Ho, and R. Oueghlissi (2022). ESG performance and economic growth: a panel co-integration analysis. Empirica 49, 99-122.
7. Deutsche Bank Wealth Management (2021). Biodiversity loss: recognising economic and climate threats. Retrieved from: https://deutschewealth.com/en/our_perspective/cio-specials/biodiversity-loss-recognising-economic-and-climate-threats.html. February 14, 2022.
8. NYU Stern (2021). ESG AND FINANCIAL PERFORMANCE. Retrieved from: https://www.stern.nyu.edu/sites/default/files/assets/documents/NYU-RAM_ESG-Paper_2021%20Rev_0.pdf. January 26, 2022.
9. Giese, G., Z. Nagy, and L.-E. Lee (2021). Deconstructing ESG Ratings Performance Risk and Return for E, S and G by Time Horizon, Sector and Weighting. The Journal of Portfolio Management 47(3), 94-111.
10. Welch, K. and A. Yoon (2020). Do High-Ability Managers Choose ESG Projects that Create Shareholder Value? Evidence from Employee Opinions. Working paper.
11. ESMA (2021). ESMA CALLS FOR LEGISLATIVE ACTION ON ESG RATINGS AND ASSESSMENT TOOLS. Retrieved from: https://www.esma.europa.eu/press-news/esma-news/esma-calls-legislative-action-esg-ratings-and-assessment-tools. January 26, 2022.
12. Moody's (2021). Impact of biodiversity loss calls for better reporting of nature-related risks and opportunities. Retrieved from: https://esg.moodys.io/feedback-loop/impact-of-biodiversity-loss-calls-for-better-reporting-of-nature-related-risks-and-opportunities. February 14, 2022.
13. See 12.
14. See 7.
15. Brondizio, E., S. Diaz, J. Settele, and H.T. Ngo (2019). Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Retrieved from: https://zenodo.org/record/5657041#.Ygqksb3MKM8. February 14, 2022.
16. Díaz, S., U. Pascual, M. Stenseke, B. Martín-López, R.T. Watson, Z. Molnár, R. Hill, K.M.A. Chan, I.A. Baste, K.A. Brauman, S. Polasky, A. Church, M. Lonsdale, A. Larigauderie, P.W. Leadley, A.P.E. Van Oudenhoven, F. Van Der Plaat, M. Schröter, S. Lavorel, Y. Aumeerduffy-Thomas, E. Bukvareva, K. Davies, S. Demissew, G. Erpul, P. Failler, C.A. Guerra, C.L. Hewitt, H. Keune S. Lindley and Y. Shirayama (2018). Assessing nature's contributions to people. Science 359(6373), 270–272.

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17. Folke, C., S. Polasky, J. Rockström, V. Galaz, F. Westley, M. Lamont, M. Scheffer, H. Österblom, S.R. Carpenter, F.S. Chapin III, K.C. Seto, E. U. Weber, B.I. Crona, G.C. Daily, P. Dasgupta, O. Gaffney, L.J. Gordon, H. Hoff, S.A. Levin, J. Lubchenco, W. Steffen, and B.H. Walker (2021). Our future in the Anthropocene biosphere. Ambio 50, 834-869.

18. See 15.

19. See 16.

20. Biggs, R., T. Blenckner, C. Folke, L.J. Gordon, A. Norström, M. Nyström, and G.D. Peterson (2012). Regime Shifts. in Sourcebook in Theoretical Ecology (eds. Hastings, A. & Gross, L.), 609–617.

21. Rocha, J. C., G. Peterson, Ö. Bodin, and S. Levin (2018). Cascading regime shifts within and across scales. Science 362(6421), 1379-1383.

22. Finance for Biodiversity Pledge (2022). Finance for Biodiversity: Guide on biodiversity measurement approaches. Retrieved from: https://www.financeforbiodiversity.org/wp-content/uploads/Finance-for-Biodiversity_Guide-on-biodiversity-measurement-approaches.pdf. February 14, 2022.

23. The University of Cambridge Institute for Sustainability (2021). Handbook for Nature-related Financial Risks: Key concepts and a framework for identification. Retrieved from: https://www.cisl.cam.ac.uk/resources/sustainable-finance-publications/handbook-nature-related-financial-risks. February 14, 2022.

24. The Copernicus Land Monitoring Service (2022). Land cover and land cover changes in European countries in 2000-2018. Retrieved from: https://land.copernicus.eu/dashboards/clc-clcc-2000-2018. February 14, 2022.

25. Lai, A. and L. Cui (2021). Can Market Segmentation Lead to Green Paradox? Evidence from China. Working paper.

26. Tavares, A.R. and M. Robaina (2021). Drivers of the Green Paradox in Europe: An empirical application. Environmental Science and Pollution Research.

27. The New York Times (2022). Europe Plans to Say Nuclear Power and Natural Gas Are Green Investments. Retrieved from: https://www.nytimes.com/2022/01/02/business/europe-green-investments-nuclear-natural-gas.html. February 14, 2022.

28. Kedward, K., J. Ryan-Collins, and H. Chenet (2020). Managing nature-related financial risks: a precautionary policy approach for central banks and financial supervisors. Working paper.

29. See 28.

30. Tuda, A.O., S. Kark, and A. Newton (2021). Polycentricity and adaptive governance of transboundary marine socio-ecological systems. Ocean and Coastal Management 200, 105412.

31. OECD (2020). A Comprehensive Overview of Global Biodiversity Finance. Retrieved from: https://www.oecd.org/environment/resources/biodiversity/report-a-comprehensive-overview-of-global-biodiversity-finance.pdf. February 14, 2022.

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Glossary

Asymmetric information also known as "information failure," occurs when one party to an economic transaction possesses greater material knowledge than the other party.

Biodiversity means variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.

CISL stands for the University of Cambridge Institute for Sustainability Leadership.

Convention on Biological Diversity (CBD) is an international legal instrument for "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources" which has been ratified by 196 nations.

Correlation is a statistical measure of how two securities (or other variables) move in relation to each other.

ESG stands for Environment, Social, Governance, and is the acronym most commonly used for sustainable investments. They measure the sustainability and societal impact of an investment in a company or business.

ESMA stands for the European Securities and Markets Authority (ESMA), which is an independent European Union (EU) Authority that contributes to safeguarding the stability of the EU's financial system by enhancing the protection of investors and promoting stable and orderly financial markets.

EU Copernicus is the European Union's Earth Observation Programme. It is a leading provider of Earth observation data, which is used for services providers, public authorities and other international organisations.

European Green Deal were is a set of policy initiatives by the European Commission with the overarching aim of making Europe climate neutral in 2050.

EU taxonomy is a classification system, establishing a list of environmentally sustainable economic activities.

Governance (corporate governance) involves the processes of governing – whether undertaken by the government, firm, market, network – over a social system and whether through the laws, norms, power or language of an organized society.

Nature-based Solutions (Nbs) are actions to protect, sustain, restore natural and modified ecosystem and also address socio-environmental challenges.

Natural capital refers to the elements of the natural environment including assets like forests, water, fish stocks, minerals, biodiversity and land.

NGFS stands for "Network for Greening the Financial System", consisting of a group of Central Banks and Supervisors sharing best practices and contributing to the development of environment and climate risk management in the financial sector and to mobilize mainstream finance to support the transition toward a sustainable economy.

NGO are non-profit non-governmental organizations, typically one whose purpose is to address a social or political issue.

The Organisation for Economic Co-operation and Development (OECD) has 35 member countries and has the objective of encouraging economic progress and world trade.

The Principles for Responsible Banking (PRB) is a framework for ensuring that signatory banks' strategy and practice align with the commitment society has set out for its future in the Sustainable Development Goals (SDG) and the Paris Climate Agreement.

Sharpe Ratio represents the additional amount of return that an investor receives per unit of increase in risk.

SME's are small and medium-sized enterprises.

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Sustainable Development Goals (SDGs) were set in 2015 by the United Nations General Assembly and are intended to be achieved by the year 2030, it is a collection of 17 interlinked global goals designed to be a blueprint to achieve a better and more sustainable future for all.

Socio-ecological systems (SESs) can be defined as a coherent system of biophysical and social factors/ a set of critical resources (natural, socio-economic, and cultural) that regularly interact in a resilient, sustained manner.

The Sustainability Accounting Standards Board (SASB) is a non-profit organization founded to develop sustainability accounting standards.

TNFD stands for Taskforce on Nature-related Financial Disclosures, whose members seek to establish and promote the adoption of an integrated risk management and disclosure framework to promote worldwide consistency for nature-related reporting.

USD is the currency code for the U.S. Dollar.

Volatility is the measure of the fluctuation of financial market parameters such as share prices. The implied (included) volatility is the current volatility included in the option price and expected by the market. If the implied volatility, i.e. the expected fluctuations, is higher than the historical volatility, the warrant tends to be expensive compared to a theoretical value derived from the warrant theory. Historical volatility is calculated from the historical prices of the underlying. It is the average range of price fluctuation of a stock or an index during a certain period in the past.

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