



The Ocean: an essential pillar of planetary life

Ensuring a Sustainable Blue Economy

*Markus Müller, Chief Investment Officer ESG &
Global Head of Chief Investment Office*

Daniel Sacco, Investment Officer Europe

Index

1

Why change is needed

P. 3

- A. The Triple Planetary Crisis
- B. A Healthy Ocean: what they give us
- C. Definition: The Sustainable Blue Economy

2

Implementing the Sustainable Blue Economy

P. 19

- D. Knowledge
Ocean processes and value chains, natural capital, definitions and measurement
- E. Agreement
Global and regional targets, supply chain improvement, blue economy metrics
- F. Investment
Status Quo, financing possibilities, needs and opportunities, ecosystem services, why we need to invest

3

Appendix

P. 55



1

Why change is needed

The Triple Planetary Crisis

Climate change, pollution, and biodiversity loss are the three components of the [Triple Planetary Crisis](#). Each of these challenges has its own origins and effects and each issue needs to be tackled if we are to have a viable future on our planet.

A



The Triple Planetary Crisis



Climate Change

About **90%** of all anthropogenic carbon dioxide emissions come from fossil fuels. Energy, industry, transport, buildings, and agriculture release greenhouse gases into the environment. Climate change already causes droughts, water scarcity, wildfires, rising sea levels, flooding, and melting polar ice.



Pollution

Air pollution causes more than **7 million** premature deaths per year, making it the leading global cause of disease and morbidity. A shocking nine out of ten of Earth's inhabitants breathe air that exceeds WHO pollution guidelines.



Biodiversity loss

The deterioration of nature reduces ecosystem services and endangers natural capital. IUCN reports around 12,000 endangered species. Many biologists believe there are even more species at risk of extinction as the number of species is estimated at 1.75 million to **14 million**.

Healthy Ocean: what they give us

B

The Ocean regulates the climate, is a gigantic biodiversity reservoir and absorbs around 30% of the world's total carbon emissions, causing it to warm up and acidify with significant negative impacts on marine life.

Ocean provide key ecosystem services and benefits that are crucial for human wellbeing and the prosperity of the global economy, but these services are at risk from multiple stressors.



Why we need healthy Ocean 1/2



The air we breathe

The Ocean stores **50 times** more carbon dioxide than the atmosphere and produces over **50%** of the world's oxygen.⁸



Climate regulation

Covering **71%** of the Earth's surface, Ocean absorbs **93%** of heat and regulates climate weather patterns.¹¹



Food

3 billion people in the world depend on wild-caught and farmed seafood as a primary source of protein.⁹



Medicine

The Ocean provides ingredients for many medicinal products.



Transportation

More than **90%** of international commerce (by volume) is nowadays transported by sea.¹⁰



Recreation

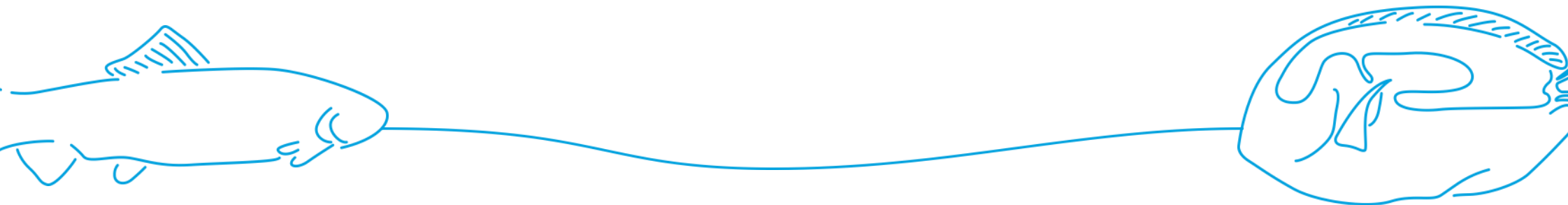
The Ocean provides many unique activities (e.g. kayaking, scuba diving, etc.).

Why we need healthy Ocean 2/2

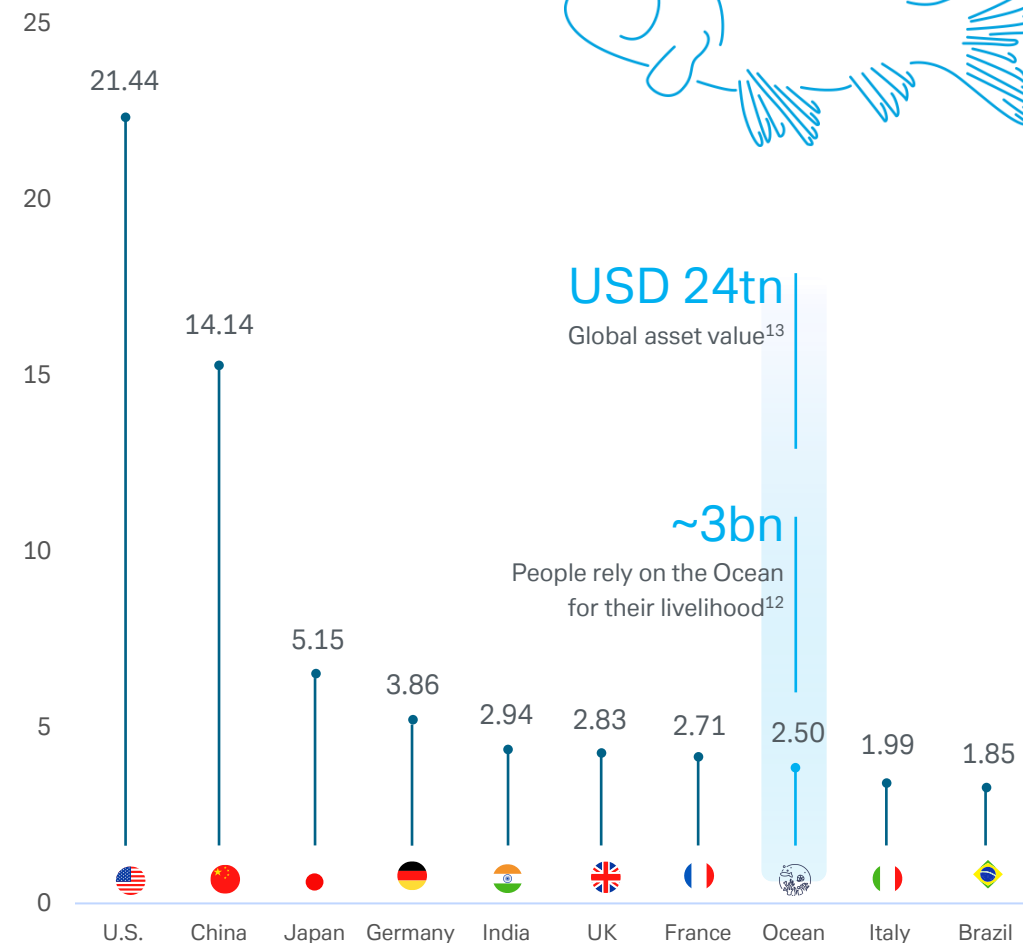
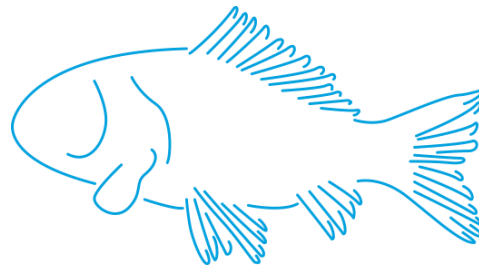
Ocean changes will worsen considerably if global temperatures exceed **1.5°C above pre-industrial levels**.

Major Ocean tipping points represent a clear example of **market failure** and will have system-wide effects that can be sudden, catastrophic and almost irreversible.

These are called **regime shifts**, large, abrupt, persistent changes in the structure and function of ecosystems.



Ocean health: the value of ecosystem services



Source: Deutsche Bank AG. Data as of September 2022.

USD 2.5tn

Goods and services¹³

Ocean's contribution to global economic development¹³

38% Developing sectors

30% Trade and shipping

04.4 Direct benefit

04.4 Services

Ocean health: the Coral Reefs example

Coral Reefs are considered a Nature-based Solution, i.e. actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.



Livihoods

- Providing food, tourism and other economic opportunities to **more than 500 million** people globally.¹⁴
- Climate-related loss of reef ecosystem services estimated to cost **USD500bn** annually by 2100.¹⁴
- According to a WWF analysis, coral reefs provide a net **USD30bn** in ecosystem services worldwide.¹⁵



Biodiversity

- Coral reefs support a higher concentration of species than any other marine environment, hosting more than **25% of all marine fish species**.¹⁶
- With about **4,000** species of fish, **800** species of hard corals and hundreds of other species, coral reefs can be considered the “rainforests of the sea”.¹⁷



Coastline protection

- Reefs defend coastlines from erosion and flooding with wave attenuation and the production/retention of sand.
- Healthy coral reefs reduce incoming wave energy by **~97%**.¹⁸
- Restoring a coral reef can provide flood protection at a **15th of the cost** of a tropical breakwater.

Ocean health: the Mangroves example



Blue carbon

- Less than **0.5%** of the Ocean's seabed is covered by vegetated habitats, but they account for **50% to 70%** of the carbon that is stored in those sediments.¹⁹
- Mangroves forests are estimated to be **5 times** more effective in storing carbon compared to terrestrial forests.
- Mangroves provide ecosystem services worth at least **USD1.6bn** annually that support populations and coastal livelihoods globally.²⁰

Carbon emissions from mangrove deforestation account for 10% of deforestation emissions globally, despite a land coverage of 0.7%.²¹



Biodiversity

- Mangrove forests provide habitats to a wide array of wildlife such as birds, fish, invertebrates, mammals, plants and an important spawning and nursery territory for juvenile marine species.
- It is estimated that over **80%** of global fish catches are reliant on mangrove forests.²²
- If mangrove forests are restored to their original state, it is estimated that fish populations would increase by half.

50,000 kg of fish are lost per year when one square kilometer of mangroves is deforested.²³



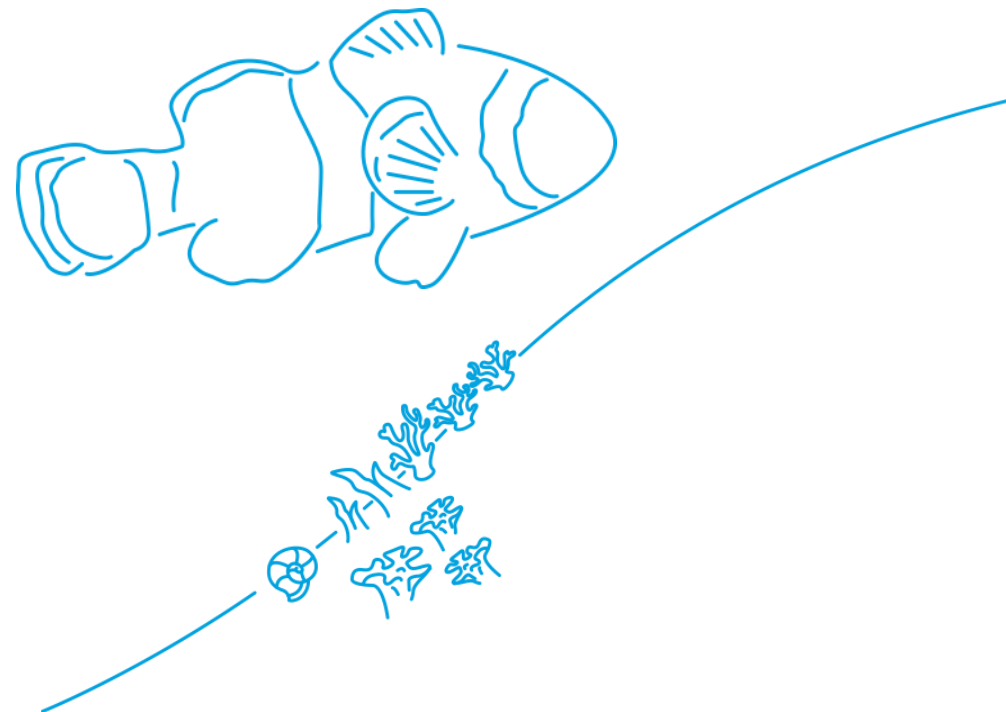
Risk reduction

- Mangroves significantly reduce annual and catastrophic damages and are a strong first line of defence for coastal communities.
- Florida mangroves prevented **USD1.5bn** in direct flood damages and protected over half a million people during Hurricane Irma in 2017, reducing damages by nearly **25%**.²⁴

Despite being a vulnerable species, mangroves have significant benefits for coastal areas in terms of flood protection and risk reduction.

Seafood sector landscape

- Currently, **50%** of fish stocks are thought to be fully exploited and **30%** of fish stocks to be overexploited.²⁵
- Seafood consumption continues to exceed population growth and growth in the consumption of all types of meat from terrestrial sources.
- However, the seafood industry is historically underinvested and has suffered from significant environmental and social externalities as a result of its development.
- According to the World Bank, fish catches might increase by **13%** and be worth an additional **USD85bn** annually if they were managed sustainably.²⁶
- As a result, the industry's long-term profitability, stability, and sustainability have been neglected.



Risks and costs in the seafood sector



Operational

- The financial effects of resource degradation related to poor management are already becoming apparent in the form of supply and price fluctuation for companies active in the seafood sector.
- Disease outbreaks in aquaculture have cost the sector more than **USD20bn** over the past ten years due to unsustainable management of farms, in addition to significant coastal pollution.



Reputational

- Political and media agendas are increasingly focused on **illegality, human rights violations, and seafood fraud**, which poses significant **reputational risks**, particularly for businesses with intricate supply networks.
- For instance, seafood supply chains in 55 nations across 5 continents have been discovered to use **forced labour**. Another study estimated that **20% of seafood has incorrect labels**.²⁷

Risks and costs in the seafood sector



Market

- Due to growing consumer awareness of environmental and social issues, seafood end-markets are evolving.
- One indication is the increase in sales of certified seafood, which is now **10 times** more popular than conventional seafood and reached **23mn tonnes** in 2016 compared to just **500,000 tonnes** in 2005.²⁸
- Businesses will lose market share if they are unable to provide seafood items that satisfy consumer demands.



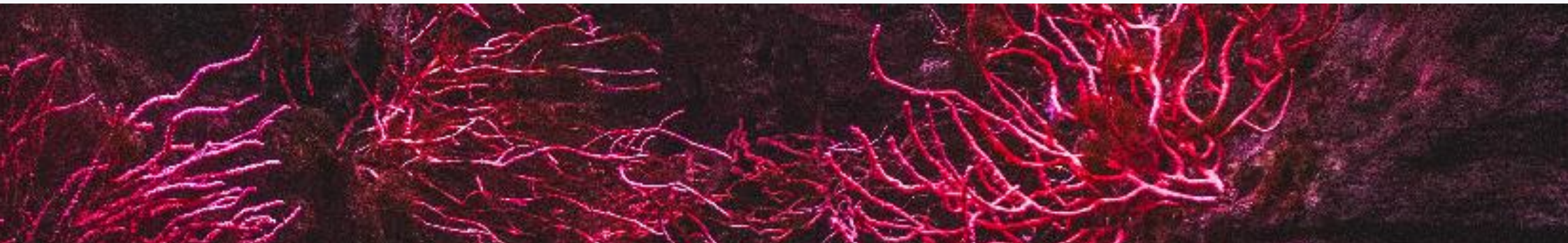
Regulatory

- Governments in major fish-consuming markets are acting in response to growing public outrage over problems with the seafood industry, including **illegality**, **labour**, and **human rights violations**.
- Regulations in the EU and the U.S. are becoming more stringent, and manufacturing or exporting nations are subject to sanctions if they fail to comply with the new regulations.

Definition: The Sustainable Blue Economy

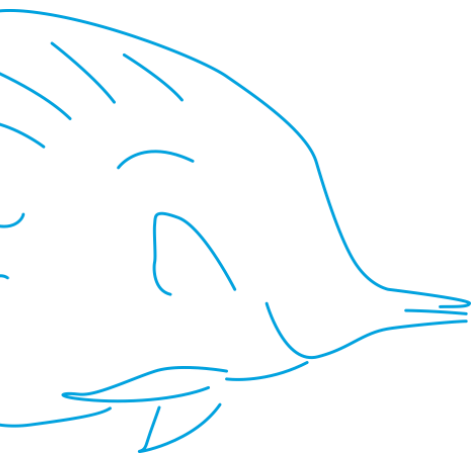
C

There are preconditions for the Sustainable Blue Economy: a transition of current Ocean activities and the inclusion of all stakeholders (particularly the Global South) in the development of new solutions and adaptation strategies.



Definition: Blue Economy

- The sum of the economic activities of Ocean-based industries, together with the assets, goods and services provided by marine ecosystems.
- This would include everything from shipping to coastal real estate to waste management. It includes sectors that are not sustainable in their current state.



Blue Economy sectors include



Tourism



Coastal Protection



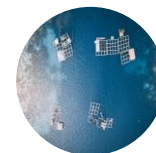
Consumer Goods



Energy & Resources



Shipping & Ports



Aquaculture & Wild catch fishing

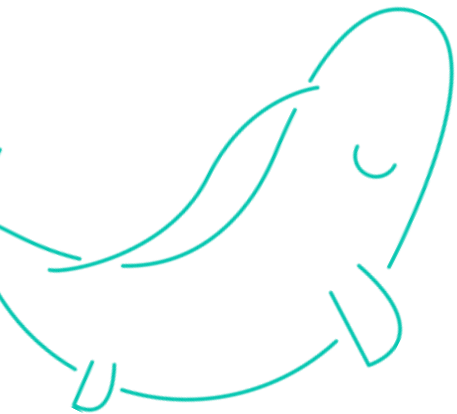
Definition: Blue Economy Transition

- A Blue Economy transition, where investors are encouraged to support changes in firms' activities and behaviors as they move towards sustainability.
- In order to get to a Sustainable Blue Economy, most businesses will need to reconsider their value chains while some will have to change them completely.
- Sustainable transformation will require both a stable regulatory environment and suitable financing conditions for the sectors.
- This phase entails a gradual reduction of principal adverse impacts on the Ocean and global emissions, moving towards nature positive outcomes, for businesses that are currently not sustainable.



Definition: Sustainable Blue Economy

- A Sustainable Blue Economy provides social and economic benefits for current and future generations; restores, protects and maintains diverse, productive and resilient ecosystems; and is based on clean technologies, renewable energy and circular material flows.
- It represents a subset of the broad Ocean economy with a focus on not harming the Ocean.
- A Sustainable Blue Economy will be an equitable one too, where individuals and Global South economies benefit fairly from Ocean conservation, development and investment.
- This concept takes into account a fair reallocation of costs of externalities created by Ocean use impacts but also a fair distribution of Ocean benefits and resources.





2

Implementing a Sustainable Blue Economy

Knowledge

Ocean processes and value chains, natural capital, definitions and measurement

D

04.1

The natural capital value chain

04.2

Understanding natural capital

04.3

Ocean processes

04.4

Rethinking Ocean value chains

The natural capital value chain

Linear economy

Unsustainable model based on “take – make – waste” which is pushing us towards our planetary boundaries



Take



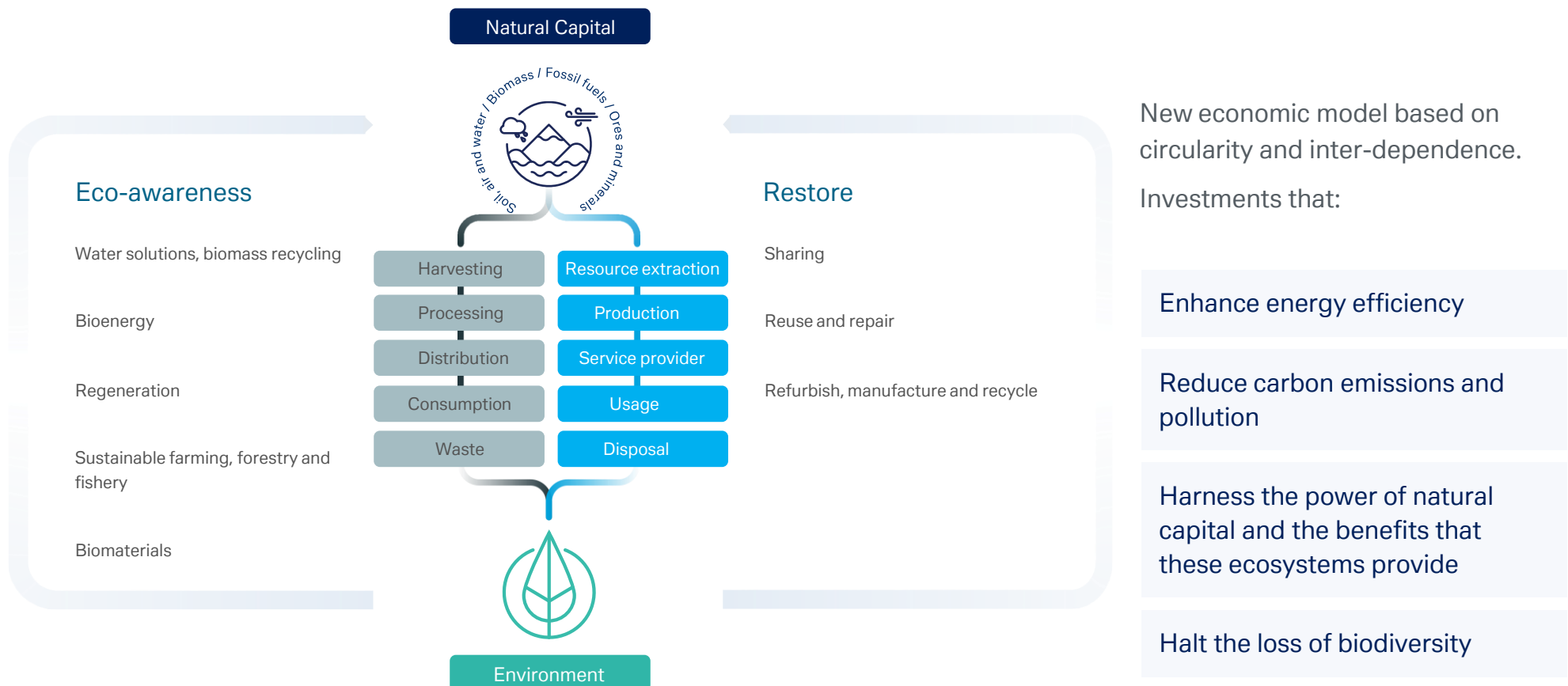
Make



Waste

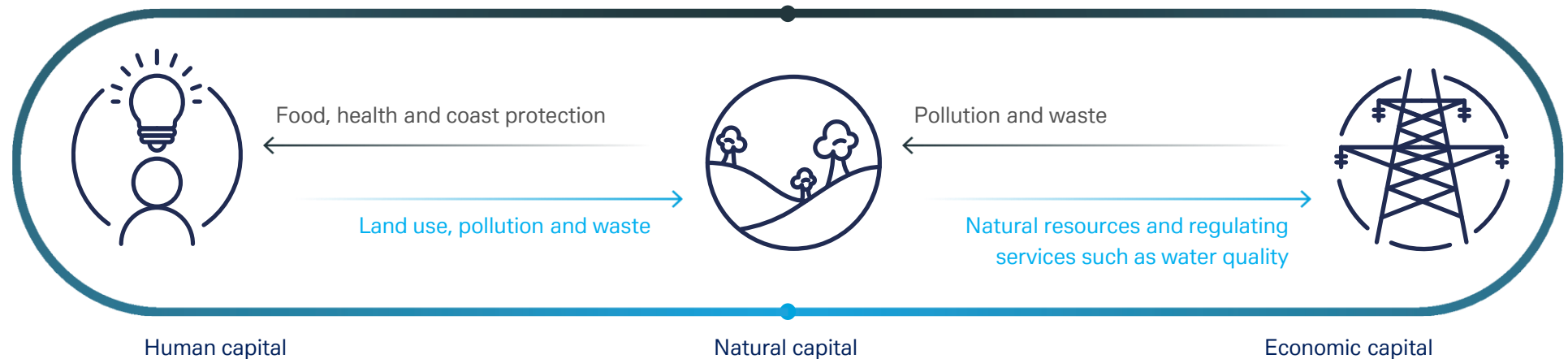
The natural capital value chain

Circular economy



Understanding natural capital

Interaction between the different kinds of capital



Natural capital

It involves understanding natural processes as both assets and inputs in our production.

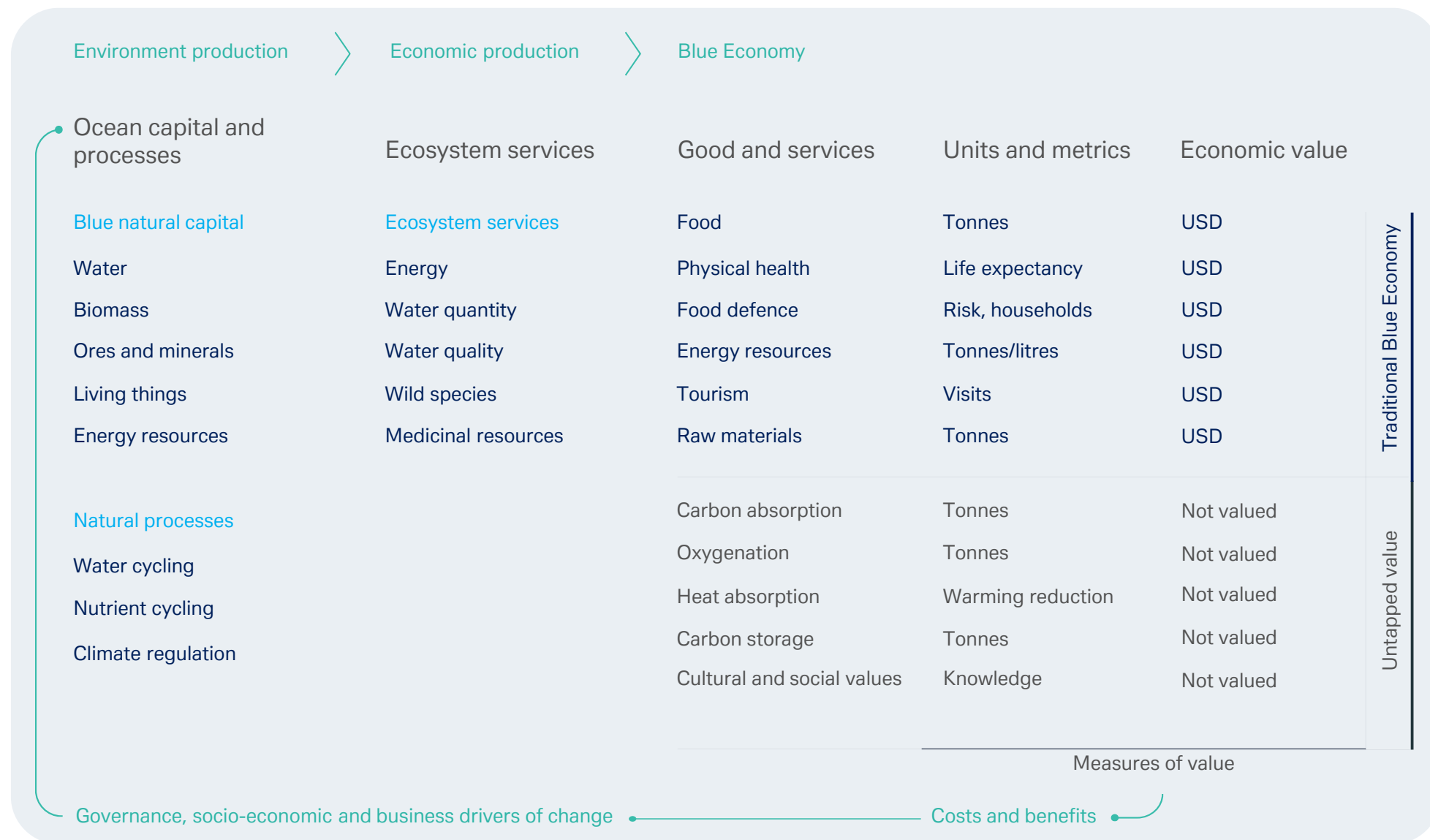
It is generally considered to comprise three principal categories: natural resource stocks, land and ecosystems.

Ecosystem services

Ecosystem services are the multitude of benefits that nature provides to society.

There are four major categories of ecosystem services: provisioning, regulating, cultural and supporting services.

Ocean processes



Rethinking Ocean value chains

We need to think about Sustainable Blue Economy businesses from 3 different angles, closely linked to one another.



Conservation

Making pure conservation an alternative



Innovation

Improving current value chains



Development

Disrupting the status quo completely

Rethinking Ocean value Conservation



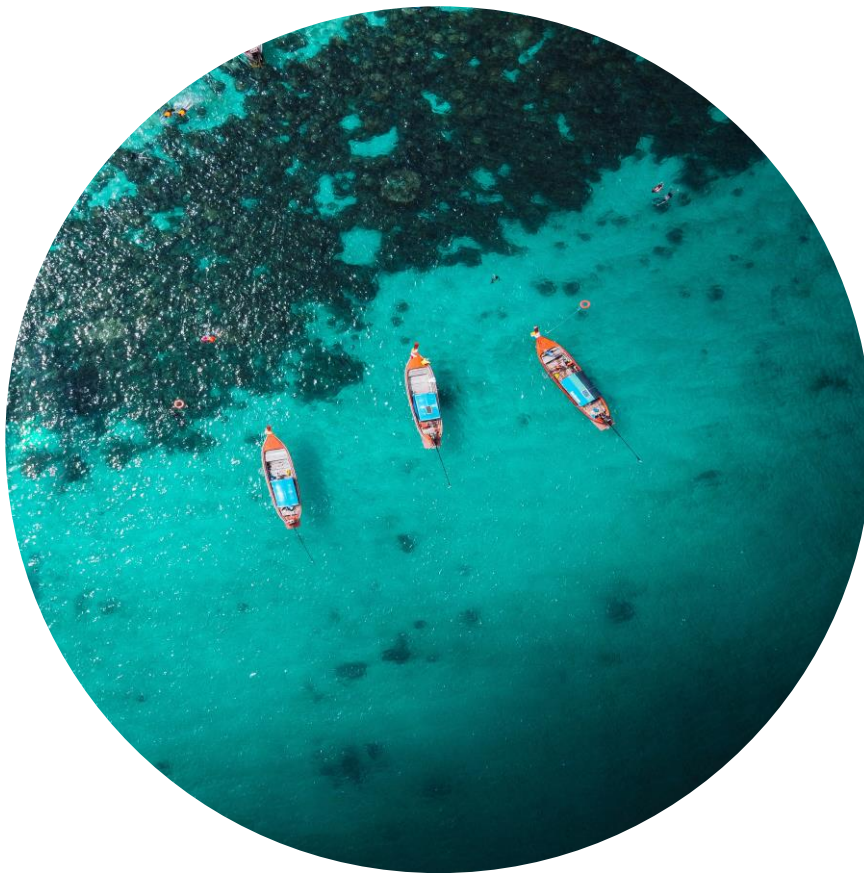
Grey Infrastructure

VS

Nature based solutions

- The concept of Natural capital highlights the importance of conserving the stock of natural assets and the consequent social and environmental benefits.
- Monetizing ecosystems services, as carbon absorption and increase in fish stocks for fisheries, would add the currently missing economic dimension.
- Pure conservation has to become an economic alternative in itself, i.e. it should be considered as a standalone sector.

Rethinking Ocean value Innovation



Aquaculture / Wild catch fishing

VS

Sustainable fishing and aquaculture

- Most Ocean businesses strongly rely directly on natural resources, like fishing and tourism.
- Across the whole spectrum of Ocean activities, sustainability efforts should be driven by limiting impact (e.g. ships' emission reduction technologies), fostering environmental resilience (e.g. sustainable aquaculture) and encourage climate and nature positive outcomes.
- Adapting current value chains is innovation.

Rethinking Ocean value Development



Energy Resources

VS

Renewable Energy

- Certain sectors require a complete redefinition of value chains to be considered sustainable, with the emergence of new sectors in place of established ones.
- A case in point is the Energy sector, where sustainability implies moving away from oil and gas to renewables like tidal energy.
- Community resilience or lab based fish production through bioreactors, just to cite a few, are other examples of technologies and strategies that could have substantial impact.

Agreement

Global and regional targets,
supply chain improvement, Blue
Economy metrics

05

05.1

A complex global framework

05.2

Existing global agreements on Ocean
biodiversity

05.3

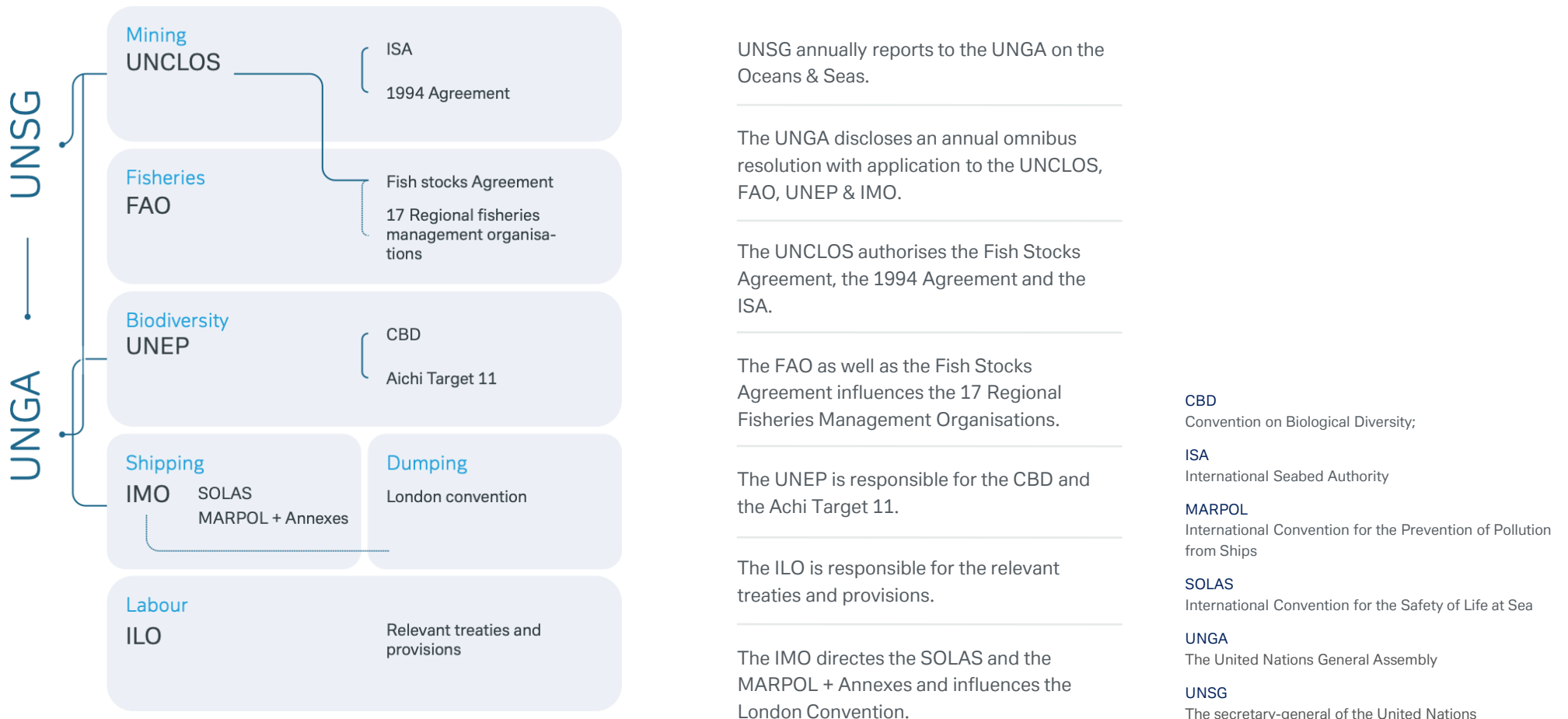
Establishing Blue Economy metrics

05.4

Reconsidering supply chain processes

A complex global framework

As seen in the graph below, there are various governing groups and institutions with objectives and ambitions established for navigating the blue acceleration. Ocean governance requires a paradigm change from a state-centric to a global approach that recognises the Ocean's and related players' embeddedness in the larger planetary system.



Source: GOC, Deutsche Bank AG. Data as of July, 2022.

Establishing blue economy metrics

One of the primary issues confronting the marine economy is the measurement and accessibility of data. Over 80% of our Ocean, according to NOAA, has not been mapped, observed, or otherwise studied.³⁰



Marine Spatial Planning

- Mapping marine areas is one of the most crucial considerations in making decisions to advance the Sustainable Blue Economy.
- In order to fulfil environmental, economic, and social goals—usually determined through a political process—MSP is a public procedure for assessing and disseminating the spatial and temporal distribution of human activities in marine areas.



Reporting and Disclosure

- A noteworthy concern is that ocean-specific assessments are frequently missing from defined standards and data on ESG-related issues.
- The great majority of stakeholders and relevant parties do not provide valid information and statistics regarding adherence to environmental or social norms.

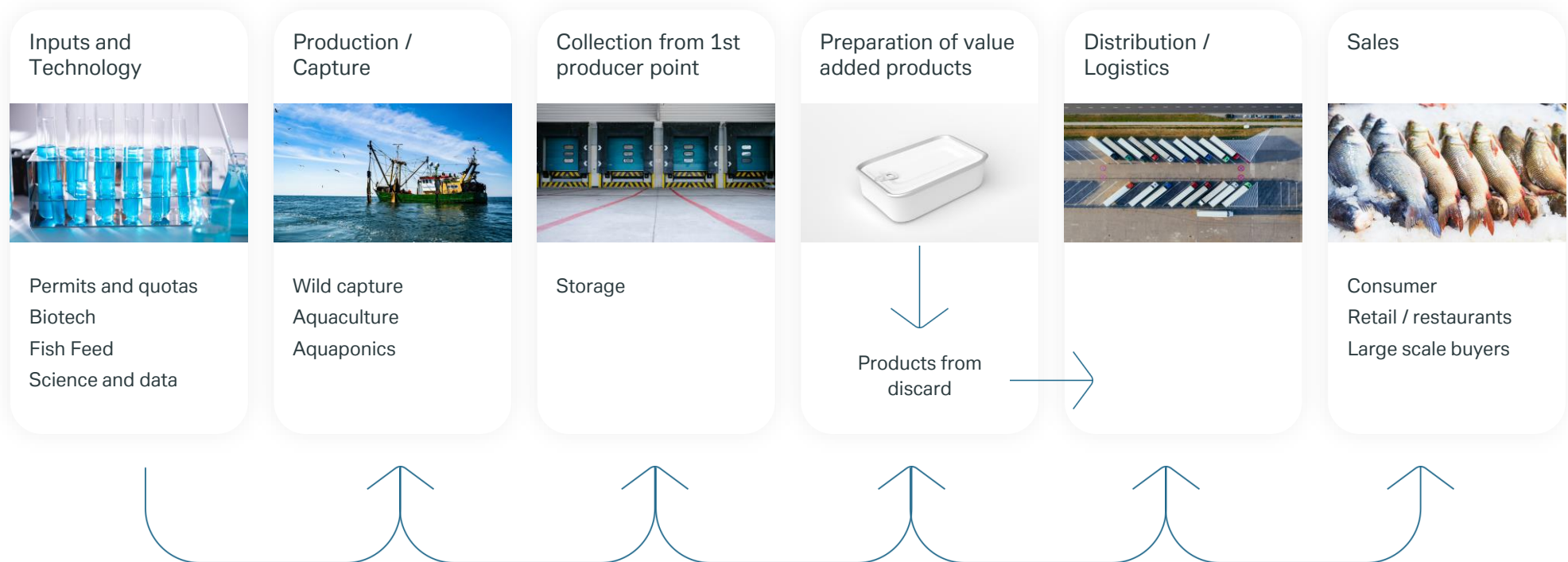


ESG and Impact Data

- Impact assessment necessitates taking the full value chain into account. Second order effects and complex linkages must be considered in this evaluation.
- A significant issue is that analyses particular to the Ocean are typically absent from the established criteria and data on ESG-related aspects.

Improving supply chain processes

The seafood products example



Improving supply chain processes

Sustainable practises examples



Implementing best practice

- Best practices should be established and supported at the supply chain's foundation. This can involve implementing enhancement initiatives and certification requirements that will reduce significant production risks.



Full-chain digital traceability

- Move to full-chain digital traceability to unlock quick and easy access to supply chain data to monitor compliance, reinforce management standards, and credibly prove sourcing claims in order to satisfy market demands.



Long-term contracts

- In order to minimize prices, strengthen the security of the supply of sustainable seafood, and support producers during the transition, long-term contracts should be introduced with suppliers and producers.

Investment

Status Quo, financing possibilities, needs and opportunities, ecosystem services, why we need to invest

06

06.1

Status Quo

06.2

Financing possibilities

06.3

Needs and opportunities

06.4

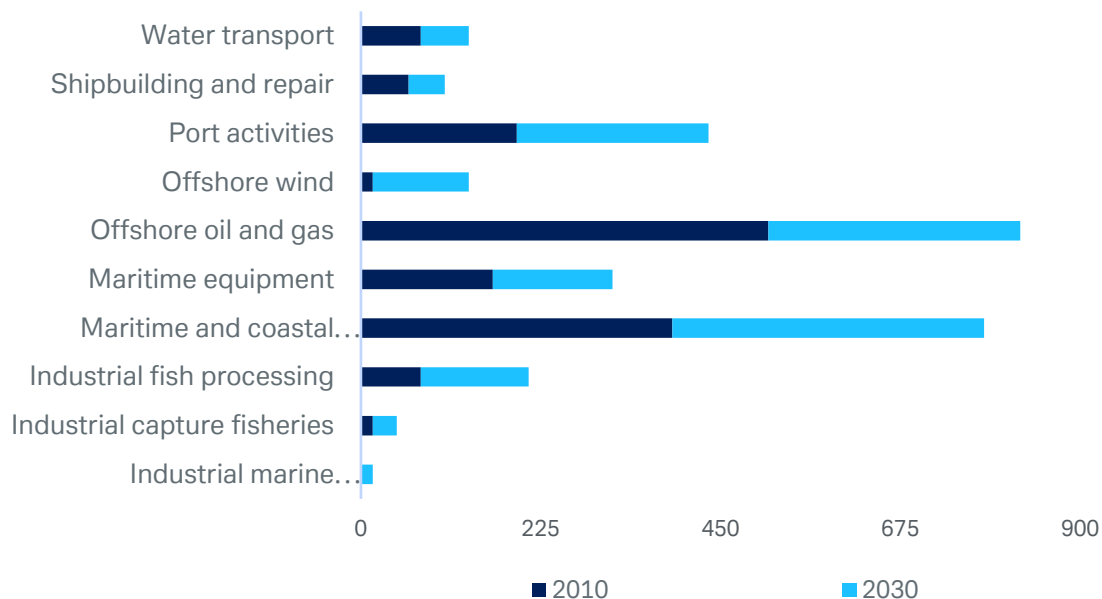
Ecosystem services

06.5

Why we need to invest

Status Quo limited progress so far

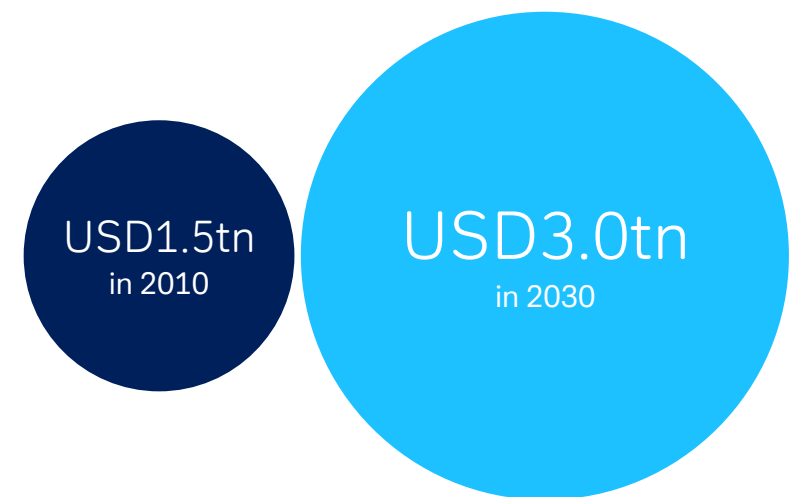
Investments to protect blue natural capital and to build resilience in vulnerable communities are small - despite the interconnectedness between a stable climate, a biodiversity-rich and healthy Ocean, and a resilient future.



Failures in other areas of development in the past should not be repeated in the future. Individual industries can indeed have a positive effect in the short term, but can cause serious damage to the blue economy.

Only 3-8% of climate finance is finding its way into nature, and by 2030, the total biodiversity financing gap could reach **USD600-800bn** per annum.³¹

The financing gap is even more pronounced for the Ocean. Less than **USD13bn** has been invested in sustainable projects, with minimal private sector financing.³²



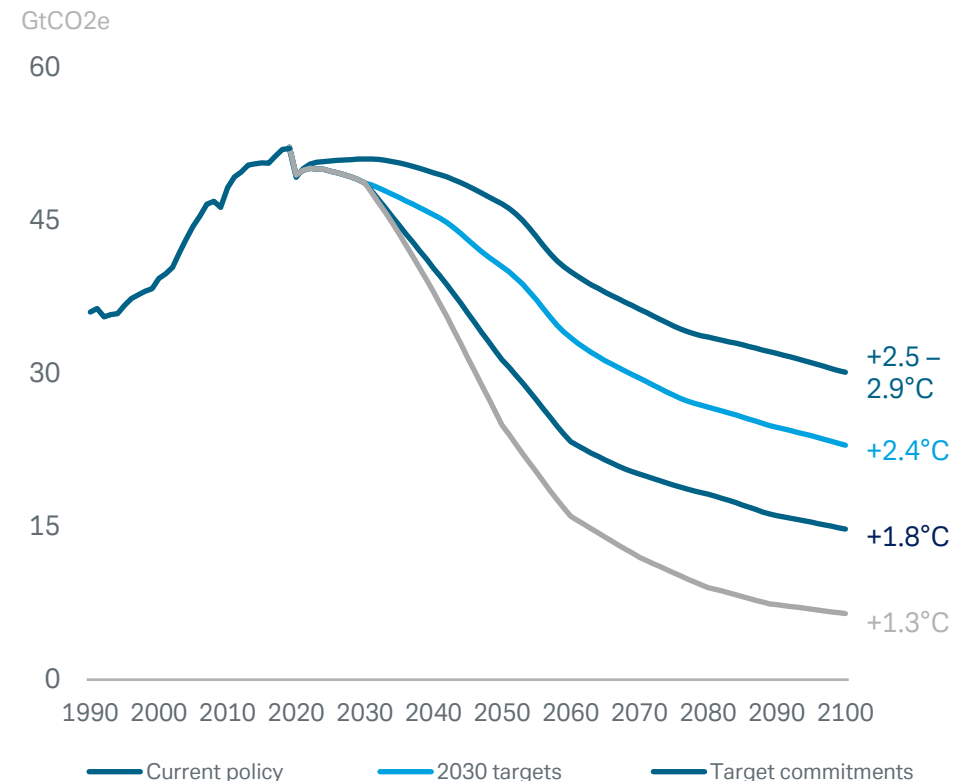
Source: Niehörster and Murnane (2018), Economist Intelligence Unit, Deutsche Bank AG. Data as of July 2022.

Financing possibilities

Blue Carbon Market

- Many businesses are using market-based strategies, particularly carbon credits, to lower their GHG emissions.
- According to a 2021 McKinsey research, demand for carbon credits is anticipated to multiply 15-fold by 2030, increasing the market's worth to [USD50bn](#).³¹
- There are now just four significant GHG crediting schemes that, following a stringent verification process, can grant carbon credits.
- Blue carbon credits can offer a market-based solution to climate change, but corporate investments must go beyond this technology to achieve net zero commitments.

Global Carbon Emission Output



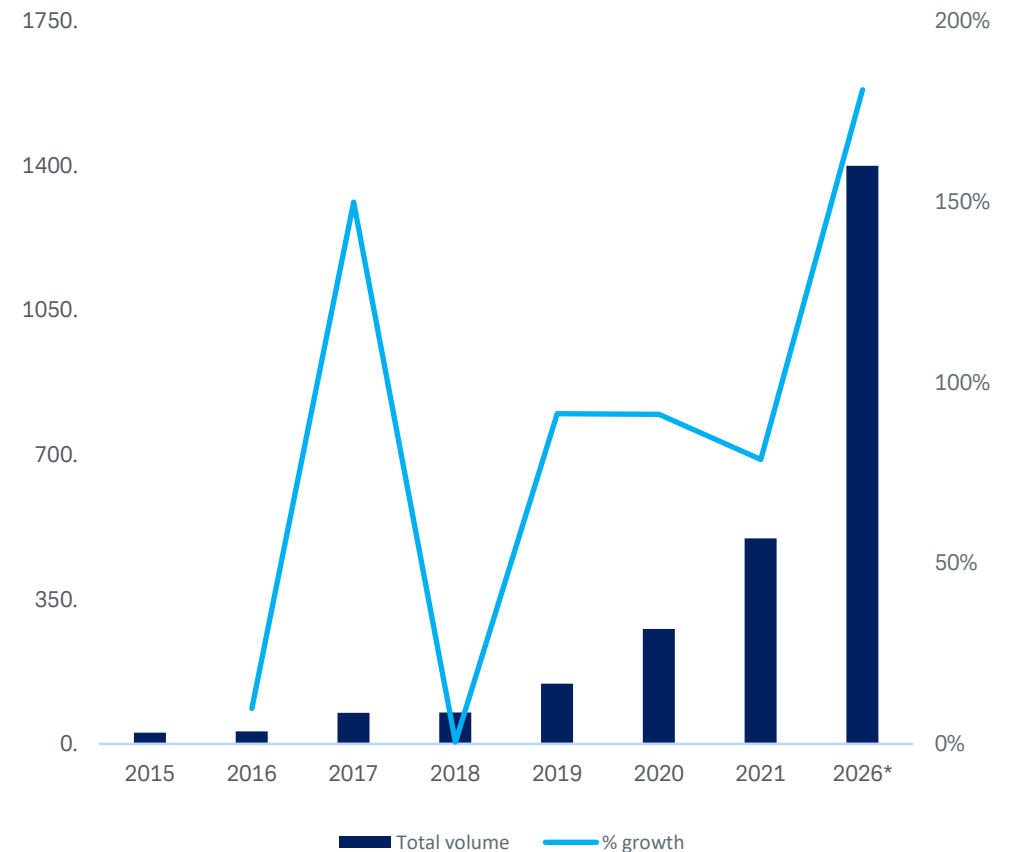
Source: Climate Analytics and New Climate Institute, Deutsche Bank AG. Data as of November 2021.

Financing possibilities

Fixed Income Market

- So-called "**Sustainable Bonds**" are a unique investment option that encourages large-scale financial flows towards a sustainable economy.
- Recently, **Blue Bonds** have become popular in this setting. Governments, development banks, and even private corporations can issue blue bonds, a subset of sustainability-linked bonds, to attract funds from private investors for marine and Ocean projects that benefit the environment, the economy, and the climate.
- Although the absence of uniform labels may cause confusion, the new sustainable bonds are demonstrating a significant beneficial development.

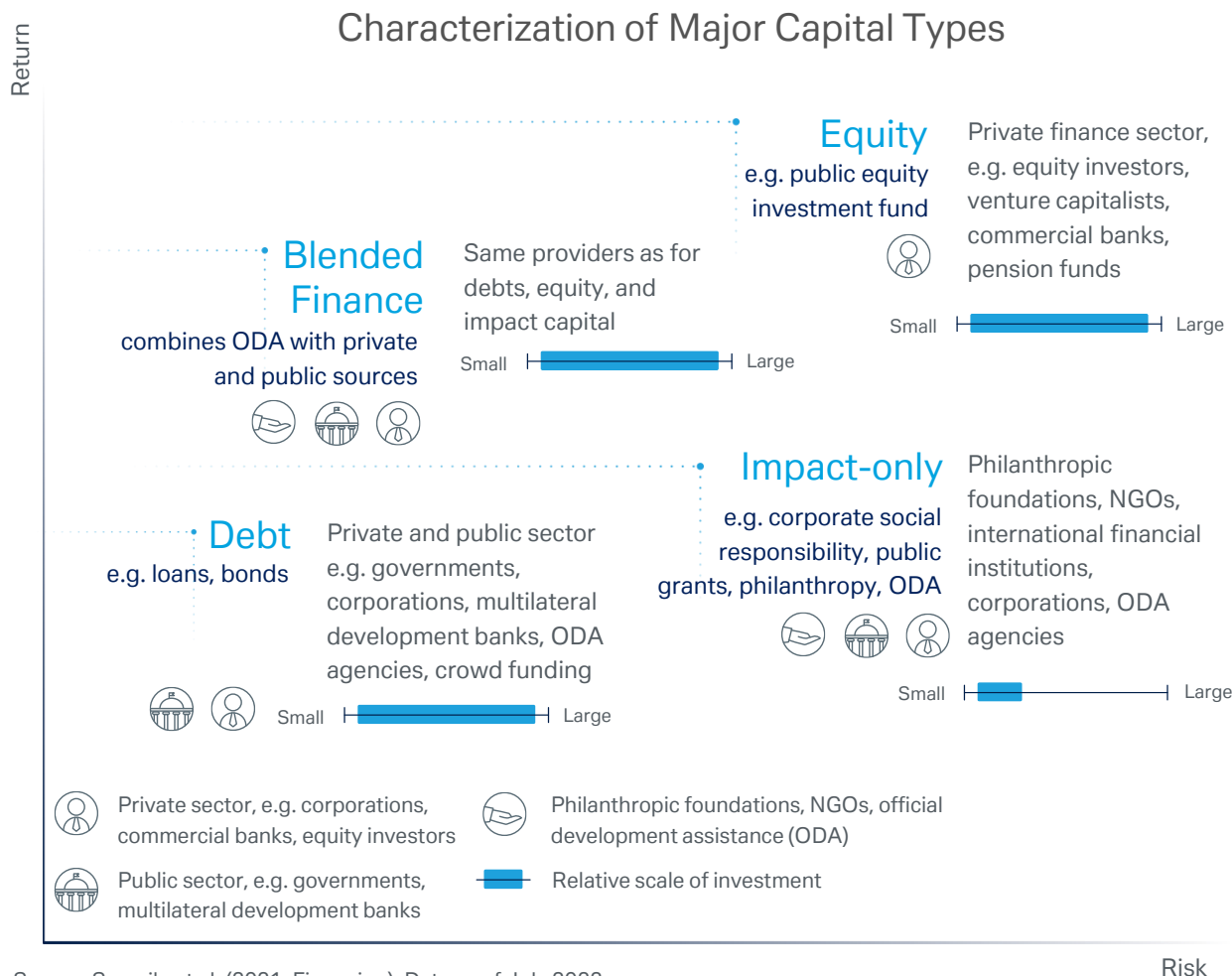
European Sustainable Bonds new issuance volume
In EURbn



Source: PwC Market Research Center, Eikon, Deutsche Bank AG. Data as of May 2022.

Financing possibilities

Equity market



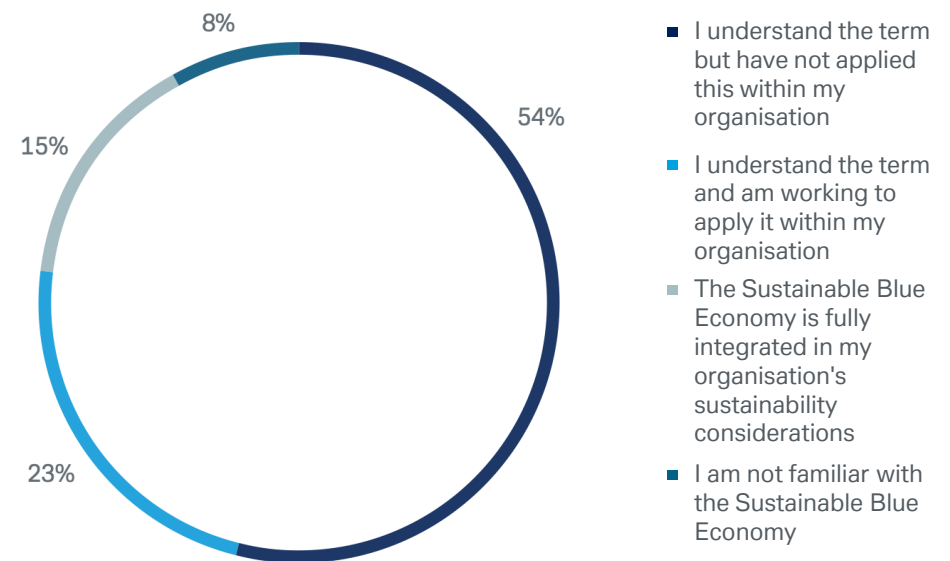
- There are very few products that explicitly address the Sustainable Blue Economy.
- Actively managed equities funds and ETFs are among the accessible options for investors. The majority of them were introduced between 2020 and 2021, and some already manage between **USD300mn** and **USD600mn**.³³
- The Blue Economy's investment potential is still in its infancy. Despite being a nearly unexplored investment theme, the early success of first endeavours indicates that investor demand is very high.

Source: Sumaila et al. (2021, Financing). Data as of July 2022.

Financing possibilities (1/2)

- The Sustainable Blue Economy investment universe within the liquid stock market is still extremely limited.
- It is currently hard to ascertain and quantify the actual contribution and influence of corporate economic activity on the maritime economy and Ocean. Furthermore, companies with a relationship to the Blue Economy only in tiny sub-segments of their service or product range are considered within this thematic investment landscape.
- While, as shown below, Blue Economy companies within the Euronext have been linked to a better financial performance relative to the broad market, developments like the EU Taxonomy will be necessary to set the guardrails for the investment universe. As we have Blue bonds, this could bring to the creation of “Blue equities”.

Familiarity with the Sustainable Blue Economy



Source: UN Environment Programme Finance Initiative (UNEP FI) Survey of Financial Professionals, Deutsche Bank AG. Data as of September 2022.

Financing possibilities (2/2)

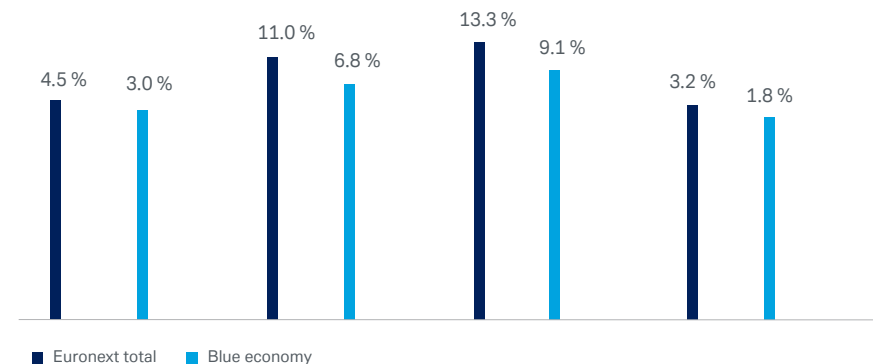
Regardless of their sustainability performance, there are 162 firms listed on Euronext markets in industries associated to the Blue Economy, i.e. that have a direct influence or reliance on oceans and water.

These firms have a market value of more than EUR675 billion, total sales of more than EUR840bn, and employ more than 1.4 million people.

Since 2015, there has been a 30% increase in the Blue Economy firms have been listed on Euronext marketplaces, a sum of 35 new companies. To put this sector into perspective, the Blue Economy's market capitalization on Euronext is just above the GDP of Belgium and close to the GDP of the Netherlands.

In the past years there has been improvement in sustainability reporting for large companies, with the number of companies disclosing sustainability indicators more than tripling from 2015 to 2019.

2015-2019 Compound Annual Growth Rate (CAGR)



Economic indicators for Blue Economy businesses are robust, and have grown significantly relative to the total economy. Over the period from 2015 to 2019, these companies saw:

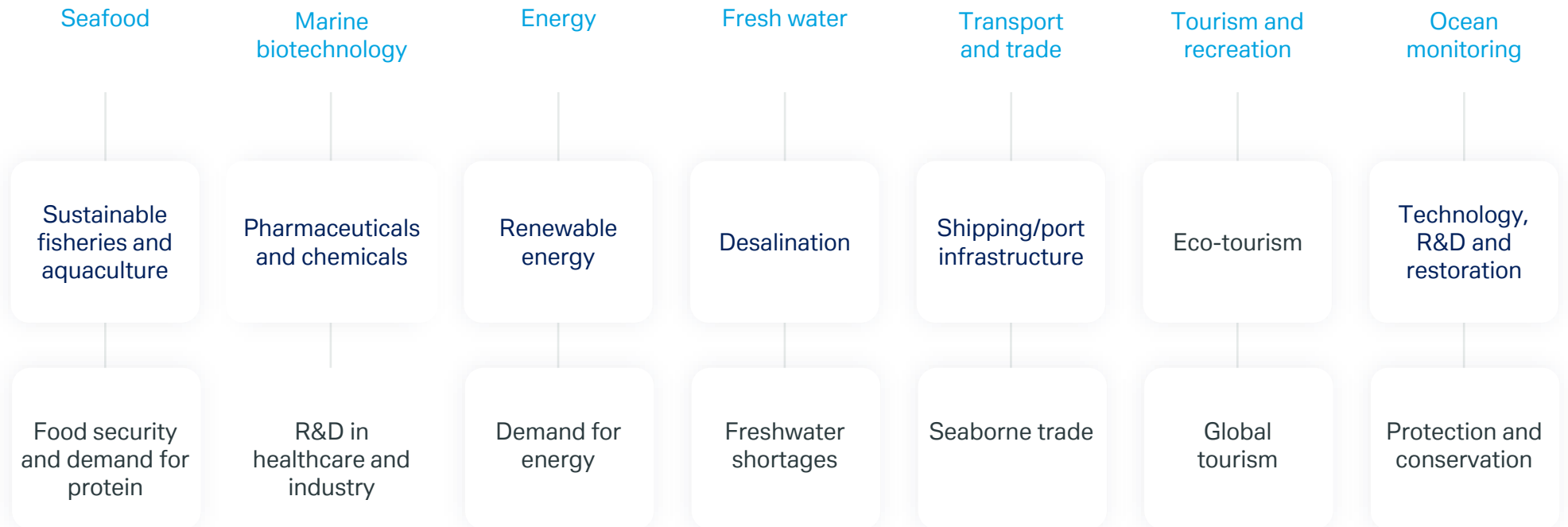
- Growth in revenue at an annual growth rate of 4.5 %
- Growth in EBITDA at 13.3 %
- Growth in employment at 3.2 %

Source: Bloomberg; Euronext; Companies' Websites; Deutsche Bank AG. Data as of August 2022

Needs and opportunities regarding Ocean services (1/5)



Ocean services



Growth drivers

Source: Niehörster and Murnane (2018), Economist Intelligence Unit, Deutsche Bank AG. Data as of July 2022.

Needs and opportunities regarding Ocean services (2/5)

Main areas

Sustainable seafood

- Sustainable Fisheries.
- Sustainable Aquaculture/Mariculture.
- Seafood Processing.
- Marine biotechnology/alternatives to fish protein.

Ocean conservation

- Marine flora & fauna (coral reefs, mangroves).
- Marine Protected Areas.
- Marine spatial planning.
- Blue Carbon (carbon sequestration/storage).
- Ecotourism.

Sustainable infrastructure

- Waste-water prevention and treatment.
- Sustainable Port Infrastructures.
- Maritime Traffic support and Advisory Systems.
- Maritime safety and surveillance.
- Coastal defence (seawalls).

Renewable energy

- Offshore-Wind.
- Tidal & Wave Energy.
- Sea Water Air Conditioning (SWAC).
- Ocean Thermal Energy Conversion (OTEC).
- Salinity Gradient.
- Floating solar.

Blue tech and circular economy

- Sustainable Vessels (decarbonisation, biofuels, ship repair and recycling).
- Chemical and plastic pollution prevention.
- Marine biotechnology.
- Hi-tech marine products and services.

Needs and opportunities regarding Ocean services (3/5)

Opportunities



- 20% growth of global fish demand by 2030 (30 million additional tons of fish per year).³⁴
- 7–20% growth per year of aquaculture economy.³⁵
- 80% of goods exchanged globally by shipping.³⁵
- For maritime shipping there is no known system-wide solution expected to halve emissions by 2050.
- Blue Biotech is a globally significant economic growth sector and viewed as one of the main pillars of bioeconomy.
- USD400bn–950bn socio-economic benefit of the MPAs regeneration.³⁵
- Market for carbon credits could be worth upward of USD50bn in 2030.³⁵
- Global Ocean-based electricity generation is still only 0.3%.³⁵
- 15 times increase of global Offshore wind capacity to 2040, with floating overtaking fixed.³⁵



Needs and opportunities regarding Ocean services (4/5)

Blue Natural Capital is the natural capital found in coastal and marine environments. It provides ecosystem services that yield a flow of benefits to people and sustain life on earth.

More than **50% of global GDP**, USD44tn of economic value, depends on natural resources.³⁶

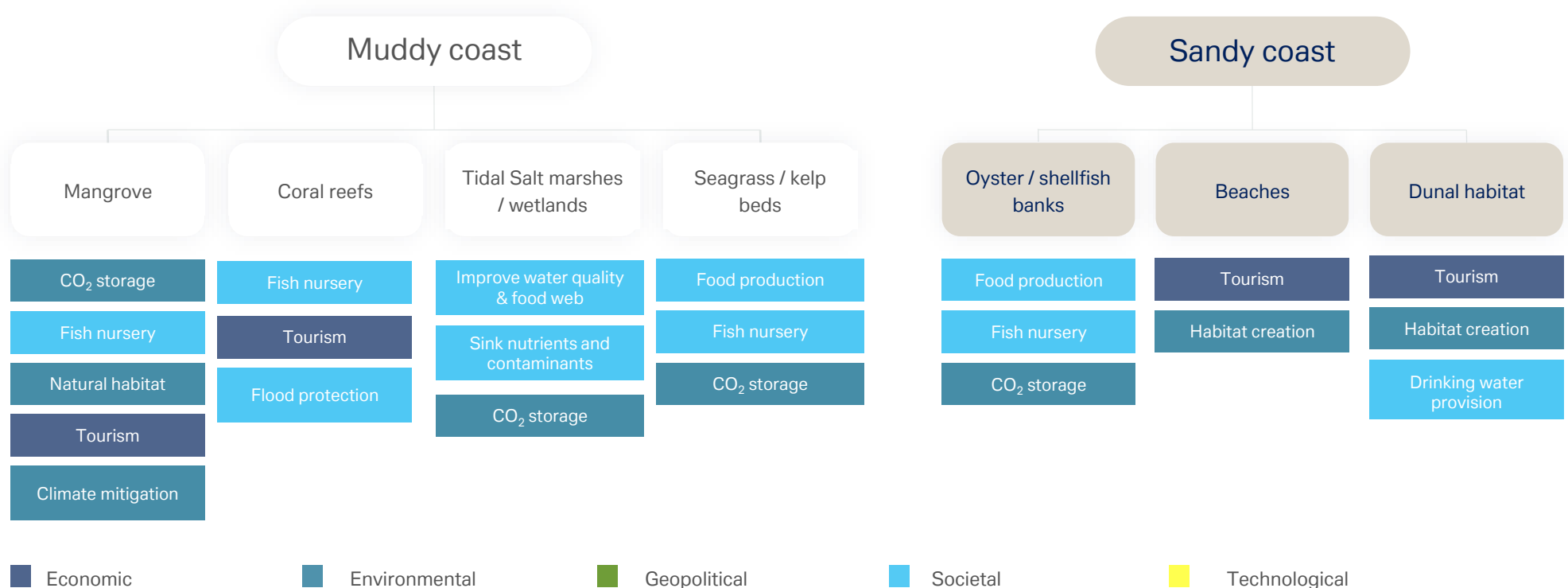
Ecosystem services have been estimated to be worth more than **one and half times global GDP**.³⁷



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

Needs and opportunities regarding Ocean services (5/5)

Coastal Blue Natural Capital



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

Ecosystem services Challenges (1/2)

The absence of future payment streams for ecosystem services with potential cash flows is one of the greatest hurdles to a Sustainable Blue Economy



- Future payment stream rights must be distilled based on research, verification, and regulation.
- Nature-based models need awareness, patient funding, a lot of testing, and technical assistance to develop and scale.
- Design a transactional framework.



For marine conservation specifically, it has been estimated that for every USD 1 invested in rebuilding marine life, around USD 10 are generated in economic return.³⁸

Ecosystem services Challenges (2/2)

The absence of future payment streams for ecosystem services with Potential Cash Flows is one of the greatest hurdles to a Sustainable Blue Economy



The investment case for ecosystem services

- The preservation and expansion of natural capital can become a shared objective and an investment opportunity for enterprises with the appropriate valuation and protection of ecosystem services.
- This would be accomplished by realizing the full value of the ecosystem products and services of natural assets through commercial transactions (in a way that does not harm the underlying stock) and channeling this revenue back to companies that are the custodians of these natural assets/have contributed to net positive environmental outcome.
- There has not been much investment flow into this field thus far. Nature-based models are not widely used due to a complicated web of information asymmetries and high transactions costs.

Ecosystem services Solution approach (1/2)



Asset ownership and fragmentation

- NbS frequently occur over large land and seascapes, spanning international borders.
- This makes their research and verification expensive, time-consuming, and perhaps dangerous.



Blue carbon focus and limitations

- Only a very small portion of natural assets' potential to store carbon has currently been given a value.
- Additional natural resources like tidal marshes and seagrass beds could be taken into consideration.
- To make ecosystem preservation truly sustainable, a wider range of ecosystem services must be recognised.

Ecosystem services Solution approach (2/2)



Standards and methodologies

- Landscape of project-specific validation procedures is difficult and expensive.
- Investors find it challenging to comprehend the impact and return standards in the blue sector, particularly the applicability of projects to their net-zero or ESG commitments.

“GDP does not include the depreciation of assets, for example, the degradation of the natural environment. We should remember that the ‘G’ in GDP stands for gross output of final goods and services, not output net of depreciation of assets.”

Sir Partha Dasgupta



Cost and availability of data

- Monitoring the preservation of natural capital requires laborious and time-consuming data collecting across a variety of metrics.
- Utilising remote sensors and data science can significantly improve project transparency, project integrity, and project accountability.

Monetisation of Ecosystem services does not equal monetisation of Nature and natural assets. Potential cash streams would be extracted from the flow of services and not ownership of the underlying asset.

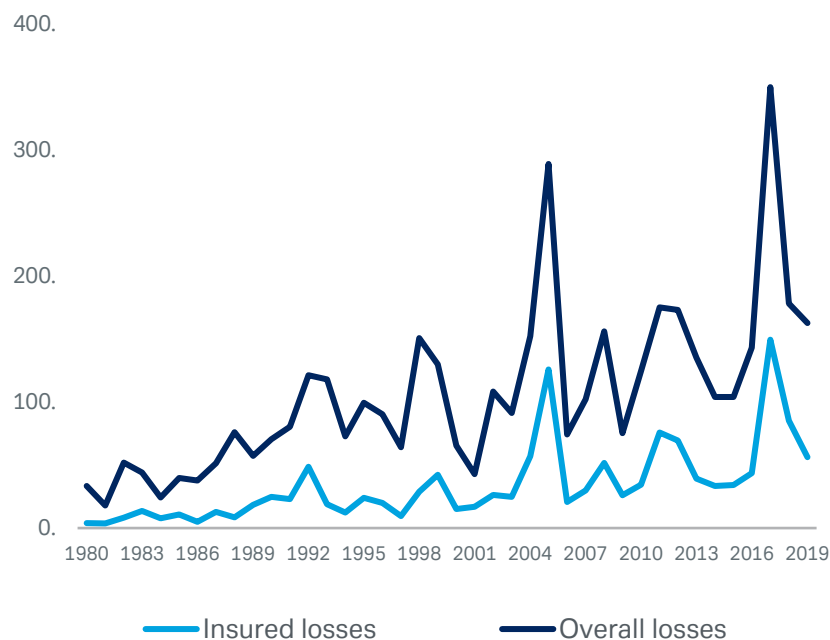
Why we need to invest

Rising risk of stranded Ocean assets (1/2)

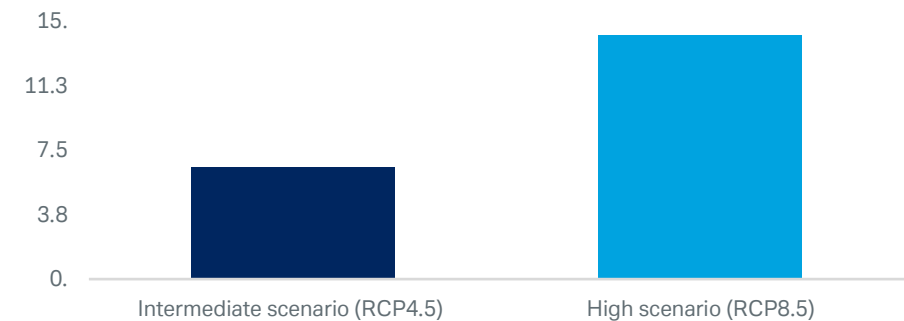
Ocean degradation is reflected in rising risks of stranded assets (due to for example increased extreme weather events or rising sea level) and disrupted fundamental economic activities (like the fishing industry due to overexploitation)

Rising costs from weather disasters

losses (inflation-adjusted, USDbn)



GDP loss due to rising sea level in different scenarios



Socioeconomic impact of rising sea levels:

- Expected economic cost of **USD14.2tn** in lost or stranded assets by end of the century³⁹
- **2 billion** people at risk of becoming refugees by 2100⁴⁰

Source: Munich Re, WWF, Deutsche Bank AG. Data as of September 2021.

Source: Hinkel et al. (2020). Projections of global-scale extreme sea levels and resulting episodic coastal flooding over the 21st Century. Nature Scientific Reports 10:11629. Deutsche Bank AG.

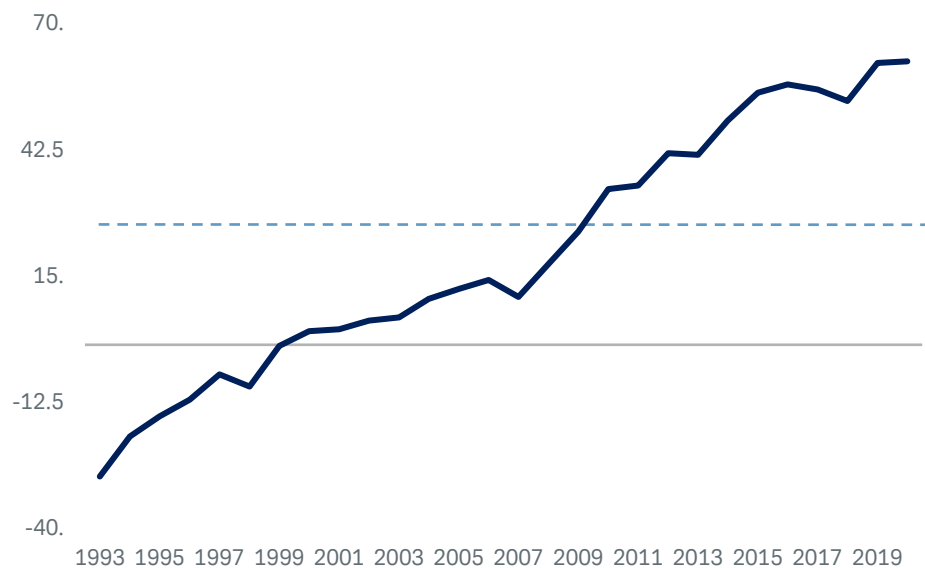
Why we need to invest

Rising risk of stranded Ocean assets (2/2)

Ocean degradation is reflected in rising risks of stranded assets (due to increased extreme weather events or rising sea levels) and disrupted fundamental economic activities (like the fishing industry due to overexploitation)

Rising sea levels and economic damage

Change in sea level (mm) compared to the 1993-2008 average



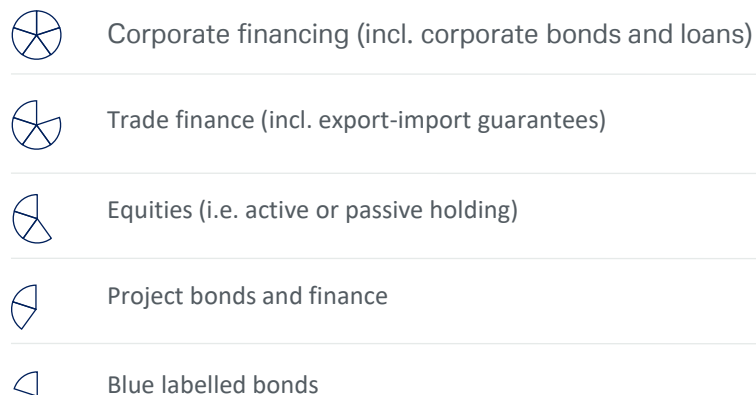
The largest impact on sea levels comes from ice melting. Rising atmosphere and Ocean temperatures have caused average sea levels to increase more than 21cm since the start of the 20th century.³⁹

Source: SNOAA, OECD, Deutsche Bank AG. Data as of August 2021.

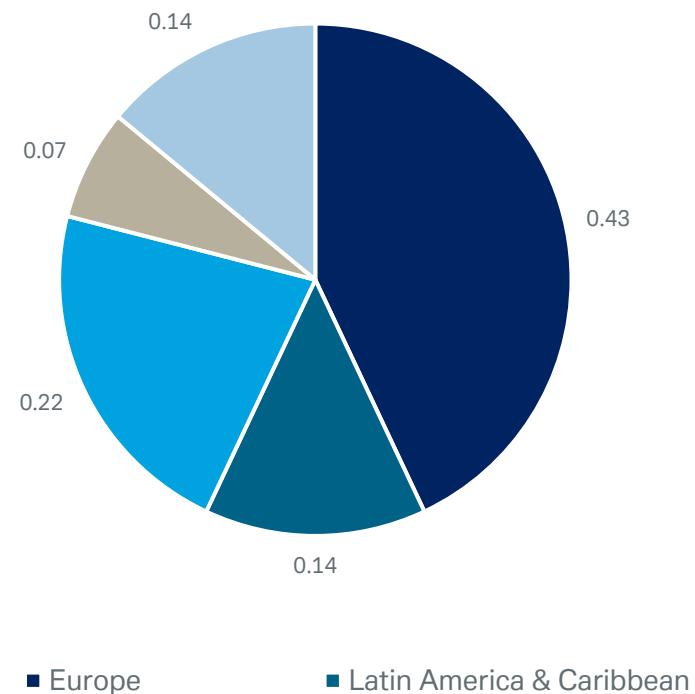
Why we need to invest

Valuable lessons from renewable energy (1/2)

Top 5 financial instruments



Marine renewable energy financing



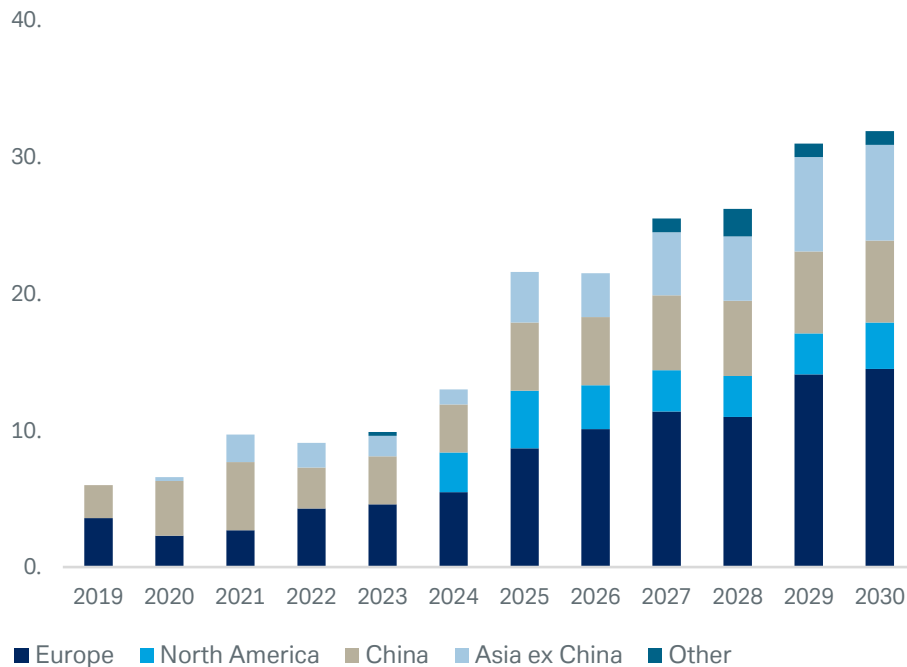
Source: UNEP FI, GWEC Market Intelligence, Deutsche Bank AG. Data as of September 2022.

Why we need to invest

Valuable lessons from renewable energy (2/2)

Global offshore wind growth

Net installations in GW



The average annual growth rate (CAGR) is forecast at **18.6%** to 2024 and **8.2%** to 2030

New annual installations will exceed the milestones of 20 GW in 2025 and **30 GW** in 2030

Offshore wind will contribute for around **20%** of total wind installations by 2025

Source: UNEP FI, GWEC Market Intelligence, Deutsche Bank AG. Data as of September 2022.

Key takeaways

1

The Ocean provides key ecosystem services that are crucial for human wellbeing and the prosperity of the global economy. Ocean's degradation and approaching tipping points are a clear example of market failure.

3

For the Sustainable Blue Economy to prosper, several enabling conditions are necessary. A cooperative and dynamic legal and regulatory framework is a first step. Establishing blue economy metrics is key – measurement and availability of data are one of the biggest challenges facing the marine economy.

2

A circular economy is based on investments that reduce carbon emissions and pollution, enhance energy efficiency, harness the power of natural capital and the benefits that these ecosystems provide, and halt the loss of biodiversity.

4

Blue Economy companies show healthy economic indicators and significant growth compared to the overall economy. While climate change and Ocean degradation clearly represent a threat for our economies and society, the transition towards a more sustainable world brings about significant economic opportunities.



References (1/3)

1. National Geographic. (2018, February). Industrial Fishing Occupies a Third of the Planet. Retrieved from National Geographic: <https://www.nationalgeographic.com/science/article/global-industrial-fishing-footprint>.
2. Aljazeera. (2020, June). More than a third of fish stocks are being overfished, FAO warns. Retrieved from Aljazeera: <https://www.aljazeera.com/economy/2020/6/8/more-than-a-third-of-fish-stocks-are-being-overfished-fao-warns>
3. Bloomberg. (2019, October). Half the World's Coral Reefs Already Have Been Killed by Climate Change. Retrieved from Bloomberg: <https://www.bloomberg.com/graphics/2019-coral-reefs-at-risk/?leadSource=uverify%20wall>
4. WWF, 2018. Living Planet Report 2018
5. World Animal Protection. (2019, September). Climate Change: The silent terminator that could make 50% of the world's species go extinct by 2100. Retrieved from World Animal Protection: <https://www.worldanimalprotection.ca/news/climate-change-silent-terminator-could-make-50-worlds-species-go-extinct-2100>
6. Our World in Data. (2021, February) The world has lost one-third of its forest, but an end of deforestation is possible. Retrieved from Our World in Data: <https://ourworldindata.org/world-lost-one-third-forests>
7. Indiatimes. (2020, September) In The Last 50 Years, Earth Has Lost 68% Of Wildlife, 85% Wetlands, All Thanks To Us Humans. Retrieved from Indiatimes: <https://www.indiatimes.com/news/india/last-50-years-earth-lost-68-percent-of-wildlife-85-percent-wetlands-because-of-humans-522447.html>
8. United States Census Bureau. (2022, June) National Ocean Month: June 2022. Retrieved from Census: <https://www.census.gov/newsroom/stories/Ocean-month.html>
9. WWF. (n. d.). Sustainable Seafood. Retrieved from WWF: <https://www.worldwildlife.org/industries/sustainable-seafood>
10. OECD. (n. d.). Ocean shipping and shipbuilding. Retrieved from OECD: <https://www.oecd.org/Ocean/topics/Ocean-shipping/>
11. Ocean and Climate. (2016, October). Ocean And Climate Scientific Notes. Retrieved from Ocean and Climate: https://www.Ocean-climate.org/wp-content/uploads/2016/10/internet-161024_ScientificNotes_Oct2016_BD_ppp.pdf
12. OECD. (n. d.). Ocean economy and developing countries. Retrieved from OECD: <https://www.oecd.org/Ocean/topics/developing-countries-and-the-Ocean-economy/>
13. UN Sustainable Development Group. (2022, June). 5 global actions needed to build a sustainable Ocean economy. Retrieved from UNSDG: <https://unsdg.un.org/latest/stories/5-global-actions-needed-build-sustainable-Ocean-economy>
14. Ocean Economist. (2022, May) Centring Indigenous-led governance of coral reefs. Retrieved from Ocean Economist: <https://Ocean.economist.com/governance/articles/prioritising-indigenous-led-governance-of-coral-reefs>
15. WWF. (2003, February) The economics of worldwide coral reef degradation. Retrieved from WWF: https://wwf.panda.org/wwf_news/?5961/The-economics-of-worldwide-coral-reef-degradation

References (2/3)

16. United States Environmental Protection Agency. (2022, June) Basic Information about Coral Reefs. Retrieved from EPA: <https://www.epa.gov/coral-reefs/basic-information-about-coral-reefs>
17. Earth.Org. (2022, September). What Are Coral Reefs and Why Are They So Important?. Retrieved from Earth.org: <https://earth.org/what-are-coral-reefs/>
18. USGS. (2014, May) Coral Reefs are Critical for Risk Reduction & Adaptation. Retrieved from USGS.gov: <https://www.usgs.gov/news/national-news-release/coral-reefs-are-critical-risk-reduction-adaptation>
19. Zarate-Barrera TG, Maldonado JH. Valuing blue carbon: carbon sequestration benefits provided by the marine protected areas in Colombia. PLoS One. doi: 10.1371/journal.pone.0126627.
20. WWF. (2017, May). Mangroves – A Life-saving Coastal Ecosystem. Retrieved from WWF: <https://www.mangrovealliance.org/wp-content/uploads/2017/10/more-information-on-Save-Out-Mangroves-Now-.pdf>
21. UNESCO. (2022, June). Message from Ms Audrey Azoulay, Director-General of UNESCO, on the occasion of the International Day for the Conservation of the Mangrove Ecosystem. Retrieved from UNESCO: <https://www.unesco.org/en/days/mangrove-ecosystem-conservation>
22. Beth A. Polidoro et al. (2010, April). The Loss of Species: Mangrove Extinction Risk and Geographic Areas of Global Concern. PloS One. <https://doi.org/10.1371/journal.pone.0010095>
23. Smithsonian. (2018, April) Mangroves. Retrieved from Smithsonian: <https://Ocean.si.edu/Ocean-life/plants-algae/mangroves>
24. The Nature Conservancy. (2019, October) Mangroves Reduce Flood Damages During U.S. Hurricanes, Saving Billions of Dollars in Property Losses. Retrieved from Nature.org: <https://www.nature.org/en-us/newsroom/mangroves-reduce-florida-flood-damages/>
25. Phys.org. (2012, July) 30% of fish stocks overexploited: UN agency. Retrieved from phys.org: <https://phys.org/news/2012-07-fish-stocks-overexploited-agency.html>
26. The World Bank. (2012, May). Hidden Harvest The Global Contribution of Capture Fisheries.
27. National Geographic. (2019, March) What is seafood fraud? Dangerous—and running rampant, report finds. Retrieved from National Geographic: <https://www.nationalgeographic.com/environment/article/study-finds-seafood-mislabeled-illegal>
28. WWF. (2019, June). Risk and opportunity in the seafood sector: The business case for sustainability.
29. NewScientist. (2022, April) How the ‘blue acceleration’ is supercharging Ocean exploitation. Retrieved from NewScientist: <https://www.newscientist.com/article/mg25433833-500-how-the-blue-acceleration-is-supercharging-Ocean-exploitation/>
30. National Oceanic and Atmospheric Administration. (n. d.) How much of the Ocean have we explored? Retrieved from NOAA: <https://Oceanservice.noaa.gov/facts/exploration.html>

References (3/3)

31. Paulson Institute. (2020, September). Financing Nature: Closing the Global Biodiversity Financing Gap. Retrieved from Paulson Institute: https://www.paulsoninstitute.org/press_release/financing-nature-closing-the-global-biodiversity-financing-gap/
32. United Nations, Inter-agency Task Force on Financing for Development, Financing for Sustainable Development Report 2021. (New York: United Nations, 2021), available from: [Financing for Sustainable Development Report | United Nations](#).
33. FERI Cognitive Finance Institute. (2022, June). Sustainable Blue Economy Transformation, Value and the Potential of Marine Ecosystems
34. McKinsey Sustainability. (2021, January) A blueprint for scaling voluntary carbon markets to meet the climate challenge. Retrieved from McKinsey: <https://www.mckinsey.com/capabilities/sustainability/our-insights/a-blueprint-for-scaling-voluntary-carbon-markets-to-meet-the-climate-challenge>
35. Undercurrent News. (2022, September) Global seafood consumption to grow 20% by 2030 on rising Asian demand. Retrieved from Undercurrent News: <https://www.undercurrentnews.com/2022/09/14/global-seafood-consumption-to-grow-20-by-2030-on-asian-demand/>
36. FERI Cognitive Finance Institute. (2022, June). Sustainable Blue Economy Transformation, Value and the Potential of Marine Ecosystems
37. Sustainalytics. (2022, May). Biodiversity loss and climate change call for a nature-positive economy – Stewardship may lead the way. Retrieved from Sustainalytics: <https://www.sustainalytics.com/esg-research/resource/investors-esg-blog/biodiversity-loss-and-climate-change>
38. Robert Costanza et al.. (2013, October) Changes in the global value of ecosystem services. Global Environmental Change, Volume 26, 2014, Pages 152-158, <https://doi.org/10.1016/j.gloenvcha.2014.04.002>.
39. Carlos M. Duarte, Susana Agusti, Edward Barbier, Gregory L. Britten, Juan Carlos Castilla, et al.. Rebuilding marine life. Nature, Nature Publishing Group, 2020, 2020, 580 (7801), pp.39-51. ff10.1038/s41586-020-2146-7ff. fhal-02502619.
40. Climate.gov. (2022, April). Climate Change: Global Sea Level. Retrieved from Climate.gov: <https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level>
41. Cornell Chronicle. (2017, June). Rising seas could result in 2 billion refugees by 2100. Retrieved from Cornell Chronicle: <https://news.cornell.edu/stories/2017/06/rising-seas-could-result-2-billion-refugees-2100>
42. OECD/FAO (2020), OECD-FAO Agricultural Outlook 2020-2029, OECD Publishing, Paris/FAO, Rome, <https://doi.org/10.1787/1112c23b-en>.

Recent ESG publications

Specials



[Energy Transition: the quest for emissions-free energy](#)



[India: on the cusp of energy transition](#)



[Nature-based Solutions and climate crisis](#)



[Ocean finance: redefining the value chain](#)

Nature Series



[Mangroves: why they need protection](#)

Presentation



[Land – A key Life Pillar](#)

Insights

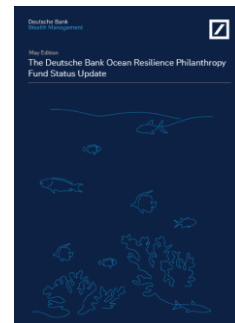


[Inflation remains sticky](#)



[Resilience versus recession](#)

Impact Report



[The Deutsche Bank Ocean Resilience Philanthropy Fund Status Update](#)

ESG Market Monitor



[ESG Market Monitor – Q2 2023](#)



Interested to find out more?

[Listen to our interactive podcasts!](#)

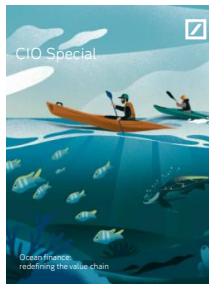
IPB CIO ESG content - 2022

Specials



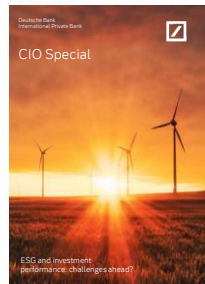
[Biodiversity: the new playing field for ESG assessment](#)

March 2022



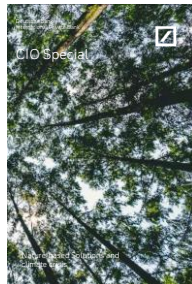
[Ocean finance: redefining the value chain](#)

June 2022



[ESG and investment performance: challenges ahead?](#)

July 2022



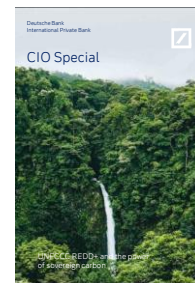
[Nature-based Solutions and climate crisis](#)

September 2022



[India: on the cusp of energy transition](#)

September 2022



[UNFCCC REDD+ and the power of sovereign carbon](#)

October 2022



[Energy and Asia: future challenges](#)

October 2022



[Commodities, the energy transition and ESG portfolios](#)

October 2022



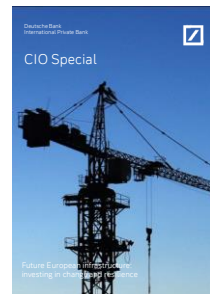
[Cities under threat: real estate investment and climate change](#)

November 2022



[ESG Survey 2022: Trends and concerns](#)

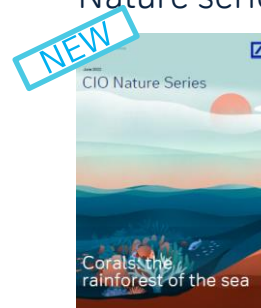
November 2022



[Future European infrastructure: investing in change and resilience](#)

December 2022

Nature series



[Corals: the rainforest of the sea](#)

June 2022

Impact report



[The Future Climate Coral Bank: Impact report](#)

October 2022

Presentation



[Ensuring a Sustainable Blue Economy](#)

October 2022

Podcasts



[Nature as a solution: working with nature towards ocean conservation and coastal resilience](#)

February 2022

[The future of work and the ReRo revolution](#)

July 2022

[Sovereign carbon credits](#)

November 2022

IPB CIO ESG content

Specials



[Making a positive impact](#)

April 2018



[The "E" in ESG](#)

April 2019



[The "S" in ESG](#)

November 2019



[The "G" in ESG](#)

August 2020



[ESG yesterday, today, tomorrow](#)

September 2019



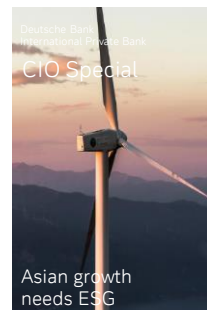
[Understanding the blue economy](#)

November 2020



[Exploring the E, S, and G in ESG](#)

December 2020



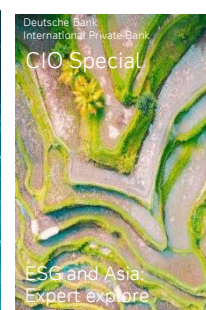
[Asian growth needs ESG](#)

February 2021



[Empowering the blue magic](#)

April 2021



[Asia and ESG: experts explore](#)

May 2021



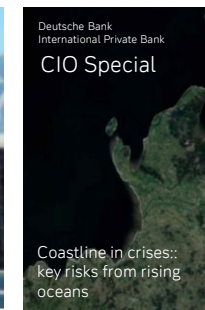
[Biodiversity loss](#)

May 2021



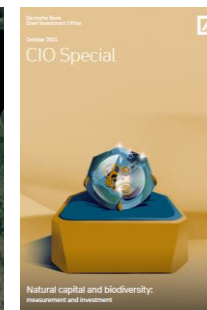
[Rethinking Infrastructure](#)

July 2021



[Coastlines in crises](#)

September 2021



[Natural capital and biodiversity](#)

October 2021

Podcasts



[The deep sea: Earth's final frontier for exploration and sustainable development](#)

July 2021

Newsletter

Internal **monthly** newsletters with ESG learning bites curated for you!

Topics include market insights, recent news, IPB + DB updates on ESG.
[All editions available here](#)



Please use the QR code to access a selection of other Deutsche Bank CIO reports (www.deutschewealth.com).

Authors (1/2)



Markus Müller

Chief Investment Officer ESG &
Global Head Chief Investment Office

Markus Müller is Global Head of the Chief Investment Office of the Private Bank, Deutsche Bank AG. In June 2022 he took over the role of Chief Investment Officer ESG in addition to his current function.

Markus is a member of Deutsche Banks Group Sustainability Council.

Markus began his career at Deutsche Bank in DB Research as executive assistant to the chief economist. During his studies at Muenster University in Germany, he acquired broad international experience with focus on China, later working as an Economist at Allianz Life Insurance in Shanghai. Markus has held teaching posts in corporate finance and economics, being a visiting scholar at the Frankfurt School of Finance and the University of Bayreuth as well as at the Banking and Finance Academy of the Republic of Uzbekistan in Tashkent. In April 2017 Markus Müller was asked by Germany's Federal Ministry for the Environment to join the advisory board of the "Carbon Bubble" project, which assessed and evaluated the risks of the transition towards a low-carbon economy for the German financial system.

In January 2019 Markus Müller published his first book under the title „Neo-Ordoliberalismus – Zukunftsmodell für die Soziale Marktwirtschaft“ at Springer-Gabler. His recent book he published in May 2021 under the title "Deutschland und China zwischen Kooperation und Konkurrenz".

Authors (2/2)



Daniel Sacco
Investment Officer EMEA

Daniel holds an Master of Science degree in Finance from Bocconi University (Milan) and a Master of Arts degree in Economics from Keio University (Tokyo), both obtained with honours. During his university studies, he started his professional career with the National Bank of Canada in Dublin, focusing on risk management controls for the banks' proprietary trading activities in derivatives markets.

He joined Deutsche Bank after an off-cycle internship at Mediobanca in the Private & Wealth Management division, working in the team dedicated to Italian Institutional Clients. At Deutsche Bank, he works in the Chief Investment Office of the International Private Bank at the London office, focusing on financial markets research and analysis and ESG/sustainability topics.

Important information (1/6)

General

This document may not be distributed in Canada or Japan. This document is intended for retail or professional clients only. This document is being circulated in good faith by Deutsche Bank Aktiengesellschaft, its branches (as permitted in any relevant jurisdiction), affiliated companies and its officers and employees (collectively, "Deutsche Bank").

This material is for your information only and is not intended as an offer, or recommendation or solicitation of an offer to buy or sell any investment, security, financial instrument or other specific product, to conclude a transaction, or to provide any investment service or investment advice, or to provide any research, investment research or investment recommendation, in any jurisdiction. All materials in this communication are meant to be reviewed in their entirety.

If a court of competent jurisdiction deems any provision of this disclaimer unenforceable, the remaining provisions will remain in full force and effect. This document has been prepared as a general market commentary without consideration of the investment needs, objectives or financial circumstances of any investor. Investments are subject to generic market risks which derive from the instrument or are specific to the instrument or attached to the particular issuer. Should such risks materialise, investors may incur losses, including (without limitation) a total loss of the invested capital. The value of investments can fall as well as rise and you may not recover the amount originally invested at any point in time. This document does not identify all the risks (direct or indirect) or other considerations which may be material to an investor when making an investment decision.

This document and all information included herein are provided "as is", "as available" and no representation or warranty of any kind, express, implied or statutory, is made by Deutsche Bank regarding any statement or information contained herein or in conjunction with this document. To the extent permissible under applicable laws and regulations, please note that we are making no representation as to the profitability of any financial instrument or economic measure. All opinions, market prices, estimates, forward looking statements, hypothetical statements, forecast returns or other opinions leading to financial conclusions contained herein reflect Deutsche Bank's subjective judgment on the date of this document. Without limitation, Deutsche Bank does not warrant the accuracy, adequacy, completeness, reliability, timeliness or availability of this communication or any information in this document and expressly disclaims liability for errors or omissions herein. Forward looking statements involve significant elements of subjective judgments and analyses and changes thereto and/or consideration of different or additional factors could have a material impact on the results indicated. Therefore, actual results may vary, perhaps materially, from the results contained herein.

Deutsche Bank does not assume any obligation to either update the information contained in this document or inform investors about available updated information. The information contained in this document is subject to change without notice and based on a number of assumptions which may not prove valid and may be different from conclusions expressed by other departments within Deutsche Bank. Although the information contained in this document has been diligently compiled by Deutsche Bank and derived from sources that Deutsche Bank considers trustworthy and reliable, Deutsche Bank does not guarantee or cannot make any guarantee about the completeness, fairness, or accuracy of the information and it should not be relied upon as such. This document may provide, for your convenience, references to websites and other external sources. Deutsche Bank takes no responsibility for their content and their content does not form any part of this document. Accessing such external sources is at your own risk.

To the extent permissible under applicable laws and regulations, this document is for discussion purposes only and is not intended to create any legally binding obligations on Deutsche Bank and/or its affiliates ("Affiliates"), and Deutsche Bank is not acting as your financial advisor or in a fiduciary capacity unless otherwise expressly agreed by Deutsche Bank in writing. Before making an investment decision, investors need to consider, with or without the assistance of an investment adviser, whether any investments and strategies described or provided by Deutsche Bank, are appropriate, in light of their particular investment needs, objectives, financial circumstances, the possible risks and benefits of such investment decision and instrument specifics. When making an investment decision, potential investors should not rely on this document but only on what is contained in the final offering documents relating to the investment. As a global financial services provider, Deutsche Bank from time to time faces actual and potential conflicts of interest. Deutsche Bank's policy is to take all appropriate steps to maintain and operate effective organisational and administrative arrangements to identify and manage such conflicts. Senior management within Deutsche Bank are responsible for ensuring that Deutsche Bank's systems, controls and procedures are adequate to identify and manage conflicts of interest. Deutsche Bank does not give tax or legal advice, including in this document and nothing in this document should be interpreted as Deutsche Bank providing any person with any investment advice. Investors should seek advice from their own tax experts, lawyers, and investment advisers in considering investments and strategies described by Deutsche Bank. Unless notified to the contrary in a particular case, investment instruments are not insured by any governmental entity, not subject to deposit protection schemes and not guaranteed, including by Deutsche Bank. This document may not be reproduced or circulated without Deutsche Bank's express written authorisation. Deutsche Bank expressly prohibits the distribution and transfer of this material to third parties. Deutsche Bank accepts no liability whatsoever arising from the use or distribution of this material or for any action taken or decision made in respect of investments mentioned in this document the investor may have entered into or may enter in future.

Important information (2/6)

The manner of circulation and distribution of this document may be restricted by law or regulation in certain countries, including, without limitation, the United States. This document is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of or located in any locality, state, country, or other jurisdiction, where such distribution, publication, availability or use would be contrary to law or regulation or which would subject Deutsche Bank to any registration or licensing requirement within such jurisdiction not currently met. Persons into whose possession this document may come are required to inform themselves of, and to observe, such restrictions. Past performance is no guarantee of future results; nothing contained herein shall constitute any representation, warranty, or prediction as to future performance. Further information is available upon investor's request.

Deutsche Bank Aktiengesellschaft ("Deutsche Bank AG") is authorized to conduct banking business and to provide financial services as set forth in the German Banking Act ("Kreditwesengesetz"). Deutsche Bank AG is subject to comprehensive supervision by the European Central Bank ("ECB"), by the German Federal Financial Supervisory Authority (BaFin) and by the Deutsche Bundesbank ("Bundesbank"), Germany's central bank.

Kingdom of Bahrain

For Residents of the Kingdom of Bahrain: This document does not constitute an offer for sale of, or participation in, securities, derivatives or funds marketed in Bahrain within the meaning of Bahrain Monetary Agency Regulations. All applications for investment should be received and any allotments should be made, in each case from outside of Bahrain. This document has been prepared for private information purposes of intended investors only who will be institutions. No invitation shall be made to the public in the Kingdom of Bahrain and this document will not be issued, passed to, or made available to the public generally. The Central Bank (CBB) has not reviewed, nor has it approved, this document or the marketing of such securities, derivatives, or funds in the Kingdom of Bahrain. Accordingly, the securities, derivatives or funds may not be offered or sold in Bahrain or to residents thereof except as permitted by Bahrain law. The CBB is not responsible for performance of the securities, derivatives, or funds.

State of Kuwait

This document has been sent to you at your own request. This presentation is not for general circulation to the public in Kuwait. The Interests have not been licensed for offering in Kuwait by the Kuwait Capital Markets Authority or any other relevant Kuwaiti government agency. The offering of the Interests in Kuwait on the basis a private placement or public offering is, therefore, restricted in accordance with Decree Law No. 31 of 1990 and the implementing regulations thereto (as amended) and Law No. 7 of 2010 and the bylaws thereto (as amended). No private or public offering of the Interests is being made in Kuwait, and no agreement relating to the sale of the Interests will be concluded in Kuwait. No marketing or solicitation or inducement activities are being used to offer or market the Interests in Kuwait.

United Arab Emirates

Deutsche Bank AG in the Dubai International Financial Centre (registered no. 00045) is regulated by the Dubai Financial Services Authority. Deutsche Bank AG -DIFC Branch may only undertake the financial services activities that fall within the scope of its existing DFSA license. Principal place of business in the DIFC: Dubai International Financial Centre, The Gate Village, Building 5, PO Box 504902, Dubai, U.A.E. This information has been distributed by Deutsche Bank AG. Related financial products or services are only available to Professional Clients, as defined by the Dubai Financial Services Authority.

State of Qatar

Deutsche Bank AG in the Qatar Financial Centre (registered no. 00032) is regulated by the Qatar Financial Centre Regulatory Authority. Deutsche Bank AG -QFC Branch may only undertake the financial services activities that fall within the scope of its existing QFCRA license. Principal place of business in the QFC: Qatar Financial Centre, Tower, West Bay, Level 5, PO Box 14928, Doha, Qatar. This information has been distributed by Deutsche Bank AG. Related financial products or services are only available to Business Customers, as defined by the Qatar Financial Centre Regulatory Authority.

Important information (3/6)

Kingdom of Belgium

This document has been distributed in Belgium by Deutsche Bank AG acting through its Brussels Branch. Deutsche Bank AG is a stock corporation ("Aktiengesellschaft") incorporated under the laws of the Federal Republic of Germany and licensed to carry on banking business and to provide financial services subject to the supervision and control of the European Central Bank ("ECB") and the German Federal Financial Supervisory Authority ("Bundesanstalt für Finanzdienstleistungsaufsicht" or "BaFin"). Deutsche Bank AG, Brussels Branch has its registered address at Marnixlaan 13-15, B-1000 Brussels, registered at the RPM Brussels, under the number VAT BE 0418.371.094. Further details are available on request or can be found at www.deutschebank.be.

Kingdom of Saudi Arabia

Deutsche Securities Saudi Arabia (DSSA) is authorized by the Capital Market Authority of the Kingdom of Saudi Arabia (CMA) with a license number (No. 37-07073). Deutsche Securities Saudi Arabia may only undertake the financial services activities that fall within the scope of its existing CMA license. DSSA registered office is at Faisaliah Tower, 17th floor, King Fahad Road, Al Olaya District Riyadh, Kingdom of Saudi Arabia P.O. Box 301806.

United Kingdom

This document is a financial promotion and is communicated by Deutsche Bank Wealth Management.

Deutsche Bank Wealth Management is a trading name of DB UK Bank Limited. Registered in England & Wales No. 315841. Registered Office: 23 Great Winchester Street, London, EC2P 2AX. DB UK Bank Limited is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority. Financial Services Registration Number 140848. DB UK Bank is a member of the Deutsche Bank Group.

South Africa

In South Africa, this material is distributed by Deutsche Bank Suisse SA authorized as a financial services provider (FSP) for the provision of Advice and Intermediary Services by the Financial Sector Conduct Authority of South Africa (FSCA) under registration no. 52190. Deutsche Bank Suisse SA is approved to operate a Representative Office by the Prudential Authority of the South African Reserve Bank (SARB).

Hong Kong

Deutsche Bank Aktiengesellschaft is incorporated in the Federal Republic of Germany and its members' liability is limited.

This material is intended for: Professional Investors in Hong Kong. Furthermore, this material is provided to addressee only, further distribution of this material is strictly prohibited.

This document and its contents are provided for information only. Nothing in this document is intended to be an offer of any investment or a solicitation or recommendation to buy or to sell an investment and should not be interpreted or construed as an offer, solicitation, or recommendation.

The contents of this document have not been reviewed by any regulatory authority in Hong Kong. You are advised to exercise caution in relation to the investments contained herein (if any). If you are in any doubt about any of the contents of this document, you should obtain independent professional advice.

This document has not been approved by the Securities and Futures Commission in Hong Kong (the "SFC") nor has a copy of this document been registered by the Registrar of Companies in Hong Kong, unless specified otherwise. The investments contained herein may or may not be authorised by the SFC. The investments may not be offered or sold in Hong Kong, by means of any document, other than (i) to "professional investors" as defined in the Securities and Futures Ordinance (Cap. 571 of the Laws of Hong Kong) ("SFO") and any rules made under the SFO, or (ii) in other circumstances which do not result in the document being a "prospectus" as defined in the Companies (Winding Up and Miscellaneous Provisions) Ordinance (Cap. 32 of the Laws of Hong Kong) (the "C(WUMP)O") or which do not constitute an offer to the public within the meaning of the C(WUMP)O. No person shall issue or possess for the purposes of issue, whether in Hong Kong or elsewhere, any advertisement, invitation or document relating to the investments, which is directed at, or the contents of which are likely to be accessed or read by, the public of Hong Kong (except if permitted to do so under the securities laws of Hong Kong) other than with respect to investments which are or are intended to be disposed of only to persons outside Hong Kong or only to "professional investors" as defined in the SFO and any rules made under the SFO.

Singapore

This material is intended for: Accredited Investors / Institutional Investors in Singapore. Furthermore, this material is provided to addressee only, further distribution of this material is strictly prohibited.

Important information (4/6)

United States

In the United States, brokerage services are offered through Deutsche Bank Securities Inc., a broker-dealer and registered investment adviser, which conducts securities activities in the United States. Deutsche Bank Securities Inc. is a member of FINRA, NYSE and SIPC. Banking and lending services are offered through Deutsche Bank Trust Company Americas, member FDIC, and other members of the Deutsche Bank Group. In respect of the United States, see earlier statements made in this document. Deutsche Bank makes no representations or warranties that the information contained herein is appropriate or available for use in countries outside of the United States, or that services discussed in this document are available or appropriate for sale or use in all jurisdictions, or by all counterparties. Unless registered, licensed as otherwise may be permissible in accordance with applicable law, none of Deutsche Bank or its affiliates is offering any services in the United States or that are designed to attract US persons (as such term is defined under Regulation S of the United States Securities Act of 1933, as amended). This United States-specific disclaimer will be governed by and construed in accordance with the laws of the State of Delaware, without regard to any conflicts of law provisions that would mandate the application of the law of another jurisdiction.

Germany

This information is advertising. The texts do not meet all legal requirements to ensure the impartiality of investment and investment strategy recommendations or financial analyses. There is no prohibition for the compiler or for the company responsible for the compilation to trade with the respective financial instruments before or after the publication of these documents. The information contained in this document does not constitute an investment recommendation, investment advice or a recommendation to act, but is intended solely for information purposes. The information does not replace advice tailored to the individual circumstances of the investor. General information on financial instruments is contained in the brochures "Basic Information on Securities and Other Investments", "Basic Information on Financial Derivatives", "Basic Information on Forward Transactions" and the information sheet "Risks in Forward Transactions", which the customer can request from the Bank free of charge. Forecasts are based on assumptions, estimates, opinions and hypothetical models or analyses. Although, from the Bank's point of view, they are based on adequate information, it may turn out in the future that they are not accurate or correct. Past performance or simulated performance is not a reliable indicator of future performance. Unless otherwise indicated in this document, all statements of opinion reflect the current assessment of Deutsche Bank, which may change at any time. Deutsche Bank assumes no obligation to update the information contained in this document or to notify investors of any available updated information. Deutsche Bank AG is a stock corporation ("Aktiengesellschaft") incorporated under the laws of the Federal Republic of Germany with principal office in Frankfurt am Main. It is registered with the district court ("Amtsgericht") in Frankfurt am Main under No HRB 30 000 and licensed to carry on banking business and to provide financial services. Supervisory authorities: The European Central Bank ("ECB"), Sonnemannstrasse 22, 60314 Frankfurt am Main, Germany and the German Federal Financial Supervisory Authority ("Bundesanstalt für Finanzdienstleistungsaufsicht" or "BaFin"), Graurheindorfer Strasse 108, 53117 Bonn and Marie-Curie-Strasse 24-28, 60439 Frankfurt am Main, Germany.

India

The investments mentioned in this document are not being offered to the Indian public for sale or subscription. This document is not registered and/or approved by the Securities and Exchange Board of India, the Reserve Bank of India, or any other governmental/ regulatory authority in India. This document is not and should not be deemed to be a "prospectus" as defined under the provisions of the Companies Act, 2013 (18 of 2013) and the same shall not be filed with any regulatory authority in India. Pursuant to the Foreign Exchange Management Act, 1999 and the regulations issued there under, any investor resident in India may be required to obtain prior special permission of the Reserve Bank of India before making investments outside of India including any investments mentioned in this document.

Italy

This report is distributed in Italy by Deutsche Bank S.p.A., a bank incorporated and registered under Italian law subject to the supervision and control of Banca d'Italia and CONSOB.

Luxembourg

This report is distributed in Luxembourg by Deutsche Bank Luxembourg S.A., a bank incorporated and registered under Luxembourg law subject to the supervision and control of the Commission de Surveillance du Secteur Financier.

Important information (5/6)

Spain

Deutsche Bank, Sociedad Anónima Española is a credit institution regulated by the Bank of Spain and the CNMV and registered in their respective Official Registries under the Code 019. Deutsche Bank, Sociedad Anónima Española may only undertake the financial services and banking activities that fall within the scope of its existing license. The principal place of business in Spain is located in Paseo de la Castellana number 18, 28046 - Madrid. Registered in the Mercantile Registry of Madrid, volume 28100, book 0. Folio 1. Section 8. Sheet M506294. Registration 2. NIF: A08000614. This information has been distributed by Deutsche Bank, Sociedad Anónima Española.

Portugal

Deutsche Bank AG, Portugal Branch is a credit institution regulated by the Bank of Portugal and the Portuguese Securities Commission ("CMVM"), registered with numbers 43 and 349, respectively and with commercial registry number 980459079. Deutsche Bank AG, Portugal Branch may only undertake the financial services and banking activities that fall within the scope of its existing license. The registered address is Rua Castilho, 20, 1250-069 Lisbon, Portugal. This information has been distributed by Deutsche Bank AG, Portugal Branch.

Austria

This document is distributed by Deutsche Bank AG Vienna Branch, registered in the commercial register of the Vienna Commercial Court under number FN 140266z. Deutsche Bank AG is a public company incorporated under German law and authorized to conduct banking business and provide financial services. It is supervised by the European Central Bank (ECB), Sonnemannstraße 22, 60314 Frankfurt am Main, Germany and by the Federal Financial Supervisory Authority (BaFin), Graurheindorfer Straße 108, 53117 Bonn, Germany and Marie-Curie-Strasse 24-28, 60439 Frankfurt am Main, Germany. The Vienna branch is also supervised by the Austrian Financial Market Authority (FMA), Otto-Wagner Platz 5, 1090 Vienna. This document has neither been submitted to nor approved by the aforementioned supervisory authorities. Prospectuses may have been published for certain of the investments mentioned in this document. In such a case, investment decisions should be made solely on the basis of the published prospectuses, including any annexes. Only these documents are binding. This document constitutes marketing material for informational and promotional purposes only and is not the result of any financial analysis or research.

The Netherlands

This document is distributed by Deutsche Bank AG, Amsterdam Branch, with registered address at De entree 195 (1101 HE) in Amsterdam, the Netherlands, and registered in the Netherlands trade register under number 33304583 and in the register within the meaning of Section 1:107 of the Netherlands Financial Supervision Act (Wet op het financieel toezicht). This register can be consulted through www.dnb.nl.

France

Deutsche Bank AG is an authorized credit institution, subject to the overall supervision of the European Central Bank and BaFin, the German Federal Financial Supervisory Authority. Its various branches are locally supervised, for certain activities, by the competent banking authorities, such as the Prudential Control and Resolution Authority (The ACPR) and the Financial Markets Authority (The AMF) in France. This document has been prepared for discussion purposes only. It is not a financial analysis document. The opinions expressed in this document may differ from those expressed by other departments of Deutsche Bank, including the financial analysis department. The manner of circulation and distribution of this document may be restricted by law or regulation in certain countries, including the United States. This document is not intended for distribution to, or use by, any person or entity who is a national of, or resident or located in, any country, state or jurisdiction where such distribution, publication, availability or use would be contrary to applicable laws and regulations or would subject Deutsche Bank AG or any of its subsidiaries to any additional registration or licensing requirements. Persons in possession of this document are required to inform themselves about and observe any such restrictions.

Important information (6/6)

This document and the information contained herein do not constitute investment advice, an offer, an inducement or a recommendation to engage in any transaction. This document is not and should not be considered a prospectus. Nothing in this document constitutes financial, legal, tax or other advice and no investment or other decision should be made solely based on this document.

Deutsche Bank AG therefore urges potential investors to seek independent advice from their own professional tax, legal, accounting and other advisers as to the appropriateness of the proposed transaction in light of their objectives, financial and operational resources or any other criteria prior to any investment decision, including the potential risks and rewards of the transaction, particularly where it involves foreign currency transactions, investments in countries other than France, high yield fixed income securities, hedge funds, commodities or private equity funds.

It is the sole responsibility of potential investors to obtain the documentation (prospectus, Term Sheets, subscription agreement, etc.) and information required to evaluate the investment and the risks involved. Deutsche Bank AG cannot be held responsible for any risks associated with the products mentioned in this document. They may not be suitable for all investors and/or may only be suitable for certain categories of investors.

Furthermore, the financial products mentioned in this document are only suitable for investors who have the knowledge and experience to evaluate and bear the risks inherent in an investment, including, financial, political and market risks, as well as the risk of losing the entire amount invested.

Past performance is not indicative of future performance and is not consistent over time. Nothing in this document constitutes a representation or warranty as to future performance.

Any reproduction, representation, distribution or redistribution, in whole or in part, of the contents of this document in any medium or by any process whatsoever, as well as any sale, resale, retransmission or making available to third parties in any manner whatsoever, is prohibited. This document may not be reproduced or distributed without our written permission.

© Deutsche Bank AG 2023

053146 060823