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Towards a sustainable ocean: where there's a will, there's a wave

Foreword

I am delighted to present to you Standard Chartered's latest sustainability study "Towards a sustainable ocean: where there's a will, there's a wave".

The ocean is a vital tool in the fight against climate change, absorbing almost all the planet's excess heat and a quarter of global carbon dioxide emissions. It also supports the livelihoods of billions of people globally. 40 per cent of the world's population rely on fish for their daily protein intake, more than 30 million are employed in the blue economy or in sectors exposed to the ocean, and 80 per cent of global trade is carried across the ocean. The WWF estimates that the overall value of the ocean to society is more than 50 per cent of global GDP.

Yet the scale of investment does not yet match the scale of opportunity. A World Economic Forum report on Sustainable Development Goal 14 ("Life Below Water") financing in 2022 estimated a cumulative funding gap of at least USD900 billion between now and 2030.

The good news is the right foundations are being laid to turn the tide on the issue of underinvestment in our ocean. In this report, we argue that a range of sustainable finance vehicles are available to mobilise capital at scale towards the blue economy and that key barriers to investment – such as investor concerns over data availability and lack of clear policy frameworks – are gradually being overcome.

We leverage the unique databases of the Ocean Impact Navigator and The Earthshot Prize to showcase some of the thousands of innovative start-ups that are engaged in creating a more sustainable blue economy, and which represent the growing universe of ocean-focused solutions that offer potential opportunities for investment.

Most importantly, we highlight that there is a vast array of solutions across a range of blue economy sectors which can support the transition of the real economy to more nature-positive practices. This is arguably one of the most material levers that we can pull in delivering progress towards the Global Biodiversity Framework target of halting and reversing nature loss.

With this report, we aim to deepen engagement with the ocean and to catalyse the mobilisation of finance towards the blue economy by highlighting the tools and solutions that are available today. I hope that this report provides you with a helpful framework for identifying and prioritising existing and emerging opportunities that can support the much-needed transition to a sustainable ocean economy.

Marisa Drew

Chief Sustainability Officer, Standard Chartered

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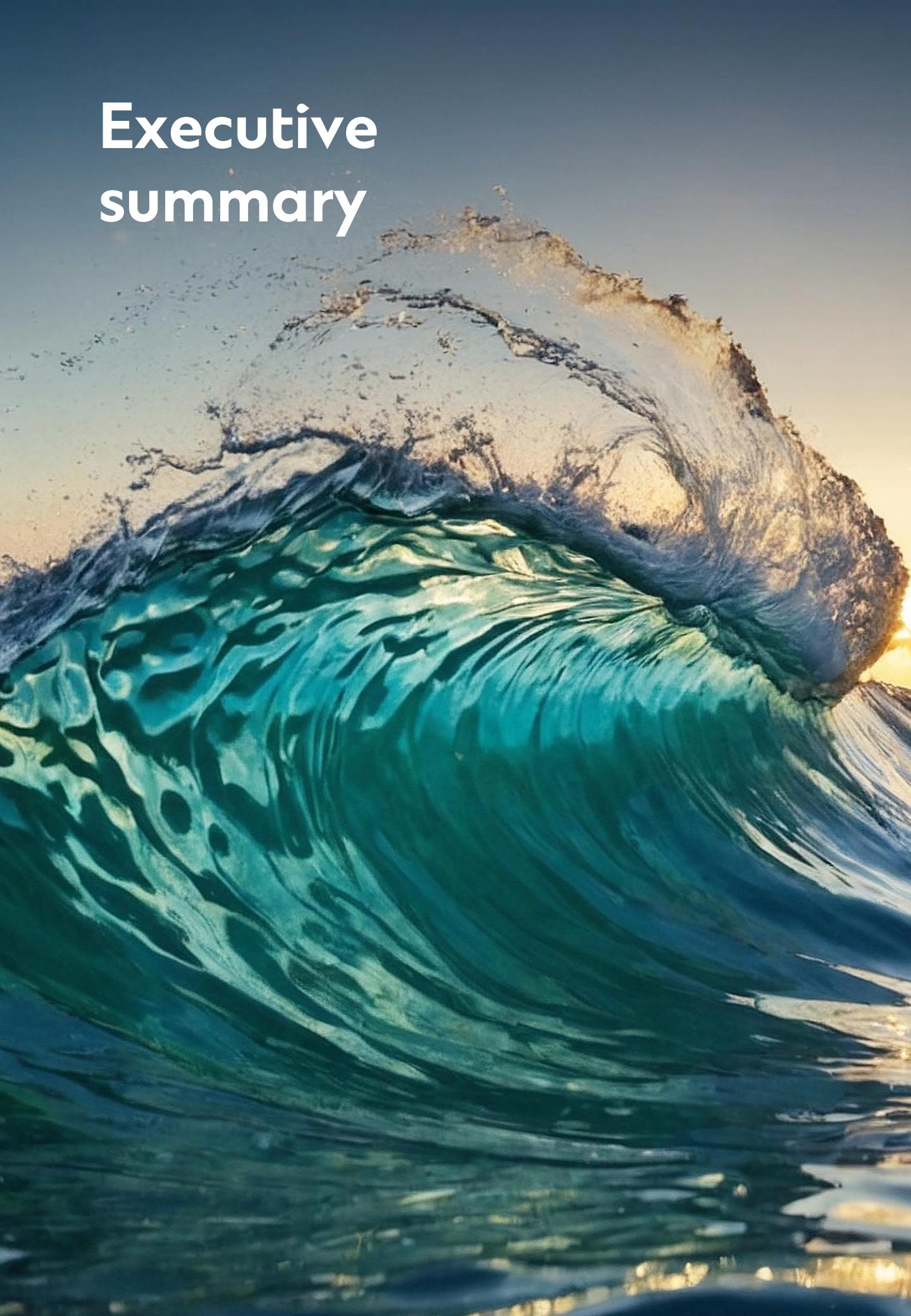


Executive summary

This report offers a practical guide to the existing and emerging business opportunities that can support the much-needed transition towards a sustainable ocean economy. We argue that key barriers to investment in our ocean – such as investor concerns over data availability and a lack of clear policy frameworks – are gradually being overcome, and that a range of sustainable finance vehicles are available to support the mobilisation of capital at scale. Crucially, we demonstrate that there is a sizeable and rapidly-growing universe of ocean-related solutions that offer opportunities for businesses, investors and lenders to play their part in halting and reversing nature loss.

A sustainable blue economy is of the highest importance

A sustainable planet is not possible without a sustainable ocean, in our view. The ocean is a vital tool against climate change, generating 50 per cent of the world's oxygen and absorbing over 25 per cent of human-caused carbon dioxide as well as almost all excess heat. The economic impact of an unsustainable ocean cannot be overstated: 40 per cent of the world's population relies on fish for more than 20 per cent of their daily animal protein consumption, and more than 30 million people are directly employed in blue economy jobs. The development of a sustainable ocean is of particular importance for the global south as it provides job opportunities, food security and supports climate resilience.

The tide is turning on blue economy financing

Meeting the investment requirements associated with creating a sustainable blue economy could require USD1.5 trillion of sovereign funding and USD1 trillion of private market investments. Investments into the blue economy have historically been low, but our analysis suggests that this has started to change. Blue economy equity deal flow has risen threefold between 2017 and 2023 while blue bond issuance levels almost doubled between 2022 and 2023. The volume of debt-for-sustainability swaps is also increasing. Related funds allocated to environmental projects during the 2021-2023 period equalled that of the entire 1995-2020 period. We expect this momentum to continue to grow, driven by growing investor appetite, the maturing of blended finance mechanisms including debt-for-sustainability swaps, and increased blue debt issuance and equity raising by blue economy-exposed companies.

This is underpinned by improved ocean governance

Governance of the ocean is improving as indicated by a dedicated water-related Sustainable Development Goal (SDG 14: Life below water); the recent adoption of the Kunming-Montreal Global Biodiversity Framework by more than 190 countries; the development of country-based blue economy programmes across all continents; and the emergence of ocean programmes set up by industry bodies. The development of data analytical tools including the use of drones, robotics, artificial intelligence and censoring technologies will help deepen the understanding of the ocean. This in turn should help boost investor confidence, in our view, by enhancing the effectiveness of governance and regulation of the blue economy.

A wave of solutions are available to transition the blue economy

This report highlights almost 70 solutions that aim to make the blue economy more sustainable. This includes solutions that are helping transform business practices in the real economy across sectors including ocean renewables, shipping, aquaculture, fishing, pollution and waste control, alongside emerging sectors such as sea tech, habitat restoration and conservation, as well as blue carbon. Blue economy sectors with strong near-term growth prospects in our view include sea tech, renewable energy, sustainable shipping, and aquaculture.

Summary of blue economy exposed solutions

In this report we highlight some of the solutions that aim to make the various blue economy sectors more sustainable. Based on our analysis of almost 300 companies and organisations exposed to the blue economy, we have found almost 70 different types of solutions across the eight key blue economy sectors. In Appendix C we show the constituents of the blue economy sectors.

Figure 2: Overview of solutions most often associated with blue economy sectors

Blue economy sector	Key solutions	
Blue carbon	Biochar production from seaweed	Ocean alkalinity enhancement
	Micro algae-based carbon capture	Seaweed-based carbon capture
Pollution and waste	Algae based solutions	Plastic alternatives
	Biodegradable pads	Plastic and waste recycling solutions
	Biopesticides	Plastic to apparel solutions
	Bioplastics	Reducing chemical spillage solutions
	Bricks from recycled plastic	Reusable packaging
	Circular logistics	Waste collection and processing
	Fishing gear solutions	Waste to protein solutions
	Methane reduction (seaweed)	Water monitoring, filtering and cleaning solutions
Renewable energy	Cable manufacturers	Offshore wind
	Floating solar	Seaweed based biofuel
	Hydropower turbines	Solar power-based desalination
	Ocean waste to energy	Wave technologies
Restoration and conservation	Blue carbon credit-driven approach	Seaweed-driven conservation efforts
	Coral reef restoration solutions	Urchin-driven conservation
	Mangrove restoration solutions	Wave barrier technology-focused
	Monitoring technologies for conservation	Wetland-focused conservation
Seatech	Aquaculture technologies	General efficiency software
	Deep sea mapping	Mobile and radio connectivity
	DNA mapping for sea species	Modelling and data analysis
	Early warning tech (wind, wave, weather)	Monitoring technologies
Sustainable fishing	Aquaculture solutions	General farm management
	General efficiency software	Monitoring and data analysis

Blue economy sector	Key solutions	
Sustainable food	Alternative feed	Insect based solutions
	Aquaculture infrastructure solutions	Nutrient delivery solutions
	Aquaculture optimisation technologies	Protein alternatives
	Cold storage solutions	Seaweed farming solutions
	Disease treatment	Shrimp farming optimisation
	Feeding optimisation	Water treatment solutions
	Fish health solutions	
Sustainable shipping	Automated ship inspection and cleaning	Hybrid shipping
	Clean fuel solutions (hydrogen, sail, solar)	Navigational optimisation software
	Electric shipping	Sustainable antifouling solutions
	Fleet management software	Sustainable fuel, biofuel

Strong growth in sustainable ocean solutions

Strong growth in sustainable ocean solutions

A growing range of reports have been published during the past few years that focus on the challenges faced by the ocean, and how these may impact the planet's sustainability. In this report we provide our view on these issues too, however, we only do this in the final chapter. We believe that focusing on what makes the ocean sustainable is more important and too often overlooked. The first three chapters of this report therefore focus on the positives.

In this chapter, we provide a deep dive into the growing range of solutions that improve the various sectors exposed to the ocean or the so-called blue economy. The following chapter argues that improving governance of the ocean makes a sustainable ocean more likely. The next chapter then discusses the financing needs associated with a sustainable ocean and shows that blue-economy-related investment activities are growing across all asset classes.

The blue economy covers many interrelated sectors

The ocean is relevant to a wide range of economic activities, and these are made up of a very significant number of sub-sectors. Each of these can help address climate change and ocean-related sustainability challenges. We have grouped the key exposed industries by ocean service and type of activity in Figure 3.

Figure 3: Components of a sustainable blue economy

Type of activity	Ocean service	Industry	Key growth drivers
Harvest of living resources	Seafood	Fisheries	Food security
		Aquaculture	Protein demand
	Marine biotechnology	Pharmaceuticals, chemicals	R&D for healthcare and industry
Extraction of non-living resources, generation of new resources	Minerals	Seabed mining	Demand for minerals
	Energy	Oil and gas	Demand for alternative energy sources
		Ocean renewables	
	Fresh water	Desalination	Fresh water demand
Commerce and trade	Transport and trade	Sustainable shipping	Growth in global trade
		Ports	
	Tourism and recreation	Ocean tourism	Growth in tourism demand
		Coastal development	Urbanisation, regulation
Response to ocean health challenges	Ocean monitoring	Technology and R&D	R&D in ocean technologies
	Carbon sequestration	Blue carbon	Need to store carbon, develop carbon markets
	Coastal protection	Habitat protection and restoration	Achieve long term environmental targets
	Waste disposal	Assimilation of nutrients and waste	Protect marine ecosystem sustainability

Source: Standard Chartered

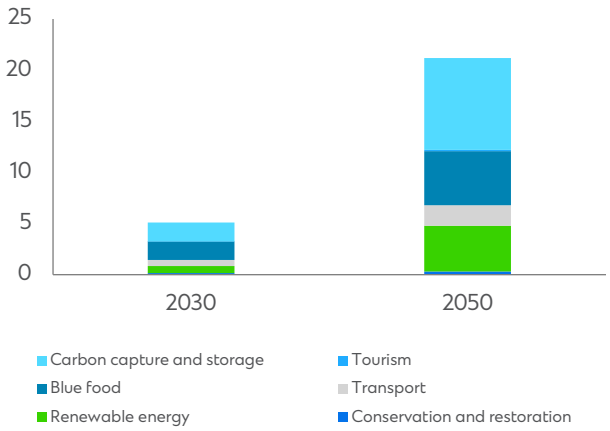
All of the areas of the blue economy mentioned in Figure 3 are made up of broad value chains, suggesting that a wide range of companies and organisations will be impacted if these industries start to benefit from increased demand or investments. We highlight the value chains for some of the key blue economy sectors in Appendix A.

Several studies have assessed what the impact of improving the sustainability of some of the industries listed in Figure 3 might be. Work from the High-Level Panel for the Sustainable Ocean Economy (HLPSOE), for example, suggests that implementing the full range of solutions that are currently available, or that are expected to become operational across six key industries, could help mitigate more than 21 gigatonnes (Gt) of CO_2 equivalent (CO_2e) by 2050. This would represent around 40 per cent of current global greenhouse gas (GHG) emissions (Figure 4).

Adopting sustainability-related solutions across blue-economy-related sectors also has a substantial positive economic impact. Work from Konar et al., 2023 indicates that technological solutions across the key blue economy areas have a benefit-cost ratio, ranging from 3x for conservation and restoration, to more than 12x in case of renewable energy. Their work suggests that creating a sustainable ocean might have a net positive economic benefit of more than USD15 trillion representing around 15 per cent of global GDP (Figure 5).

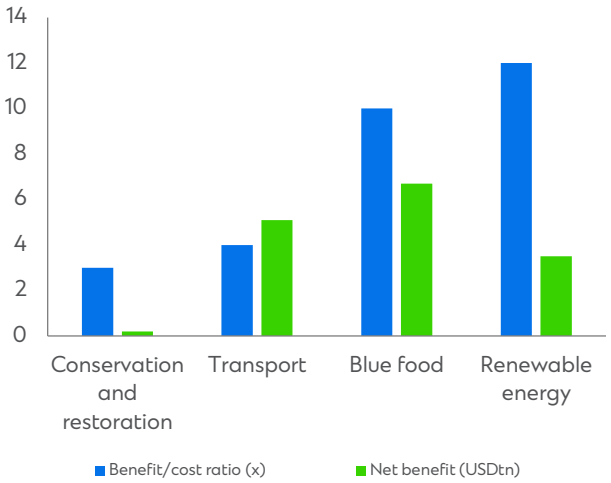
Figure 4: Climate mitigation potential

$GtCO_2e$, from 'ready-to-use' to 'concept stage' solutions



Source: Hoegh-Guldberg, Northrop et al. (2023), Standard Chartered

Figure 5: The blue economy has high economic potential



Source: Konar, Ding et al. (2020), Standard Chartered

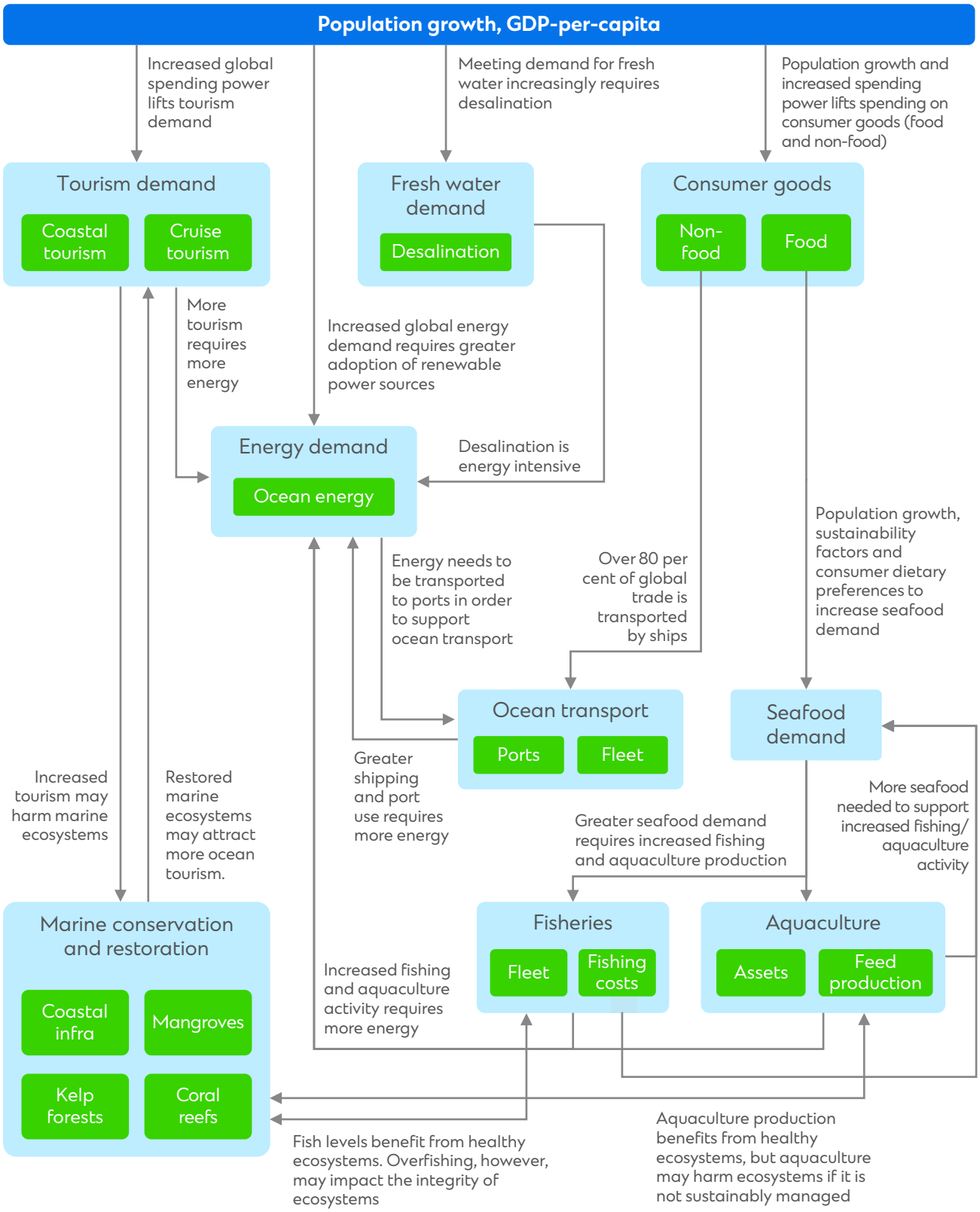
The blue economy requires an integrated approach

This report highlights individual solutions by sector that help improve the sustainability of the world's ocean. Key for policy makers to understand, however, is that the blue economy sectors are interrelated. To illustrate this, we explore one of the potential scenarios related to global population growth, coupled with increased spending power per capita and a potential shift in dietary preferences. These developments may cause demand for seafood to rise, which in turn supports fisheries and aquaculture operations. However, this may negatively impact the sustainability of marine ecosystems if it leads to overfishing. Growing demand for fishery activities also raises demand for energy, which unless a transition to renewables is achieved, will increase carbon emissions. Furthermore, increased energy demand will, in turn, result in increased ocean transport demand as more fuel or energy needs to be shipped back to support fishery and aquaculture business.

Therefore, improving one part of the blue economy will only have maximum positive impact on ocean and environmental sustainability if the other interrelated sectors are addressed at the same time. We outline interrelations between some of the key blue economy sectors in Figure 6.

Figure 6: Impact assessment between key blue economy sectors and exogenous factors

Direction of arrow shows the direction of impact between two variables.



Source: Standard Chartered

Exploring solutions across blue economy's key areas

To improve the ocean's sustainability requires the development, implementation, and adoption of integrated solutions across all industries highlighted in Figure 3. Government policies and frameworks help in this regard, but it is crucial that investment flows into companies developing blue-economy-related solutions increase sufficiently.

This report not only explores solutions that exist within the industries highlighted in Figure 3, but also provides case studies of some of the companies and organisations that are developing these. We note that these case studies highlight only a few of a large and rapidly-growing universe of companies that are developing sustainable ocean-related solutions. These case studies should not be seen as a recommendation or endorsement from Standard Chartered for the companies or organisations mentioned nor do they provide an implicit view on any other companies or organisations active in the blue economy.

To gain a better understanding of blue economy solutions that are being developed we used input from the Ocean Impact Navigator and from The Earthshot Prize and their unique database of more than 4,000 companies and organisations engaged in creating a more sustainable world.

The Earthshot Prize: a short introduction

Founded in 2020 by HRH Prince William to bring optimism and innovation to the mission to repair and protect our planet, The Earthshot Prize is a global environmental platform to discover, spotlight and scale groundbreaking solutions to the world's greatest environmental challenges.

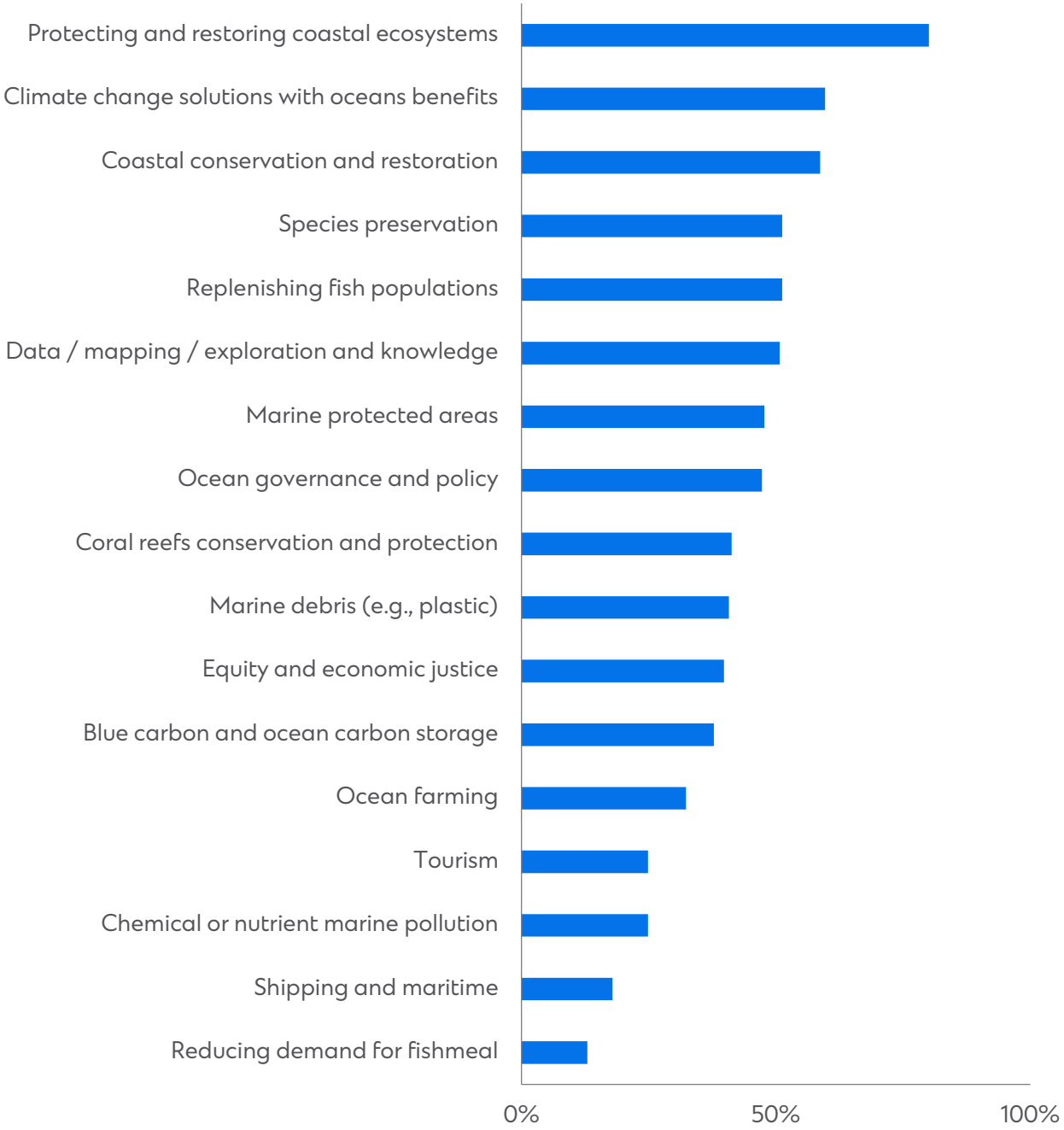
The Earthshot Prize is organised around five Earthshots: Protect and restore nature, clean our air, revive our oceans, build a waste-free world and fix our climate. The aim is to discover, spotlight and help scale innovative solutions that address these Earthshots, Since its launch The Earthshot Prize has engaged with almost 4,000 organisations.

Earthshot and blue economy related solutions

During the past few years, The Earthshot Prize has seen a rapid increase in the number of organisations whose prime focus is to develop solutions that revive our oceans. In 2021, The Earthshot Prize was approached by 62 ocean-focused organisations. This has risen to around 200 this year. The early stage of development of these organisations is highlighted by the fact that less than 30 per cent of them have revenues of more USD1 million per year, while only 15 per cent of these organisations classify themselves as mature. The solutions and services that these companies develop cover a wide range of blue-economy-related end markets, which makes this database a very useful tool to understand how the ocean can be made more sustainable (Figure 7).

Figure 7: Blue economy solutions targeted by The Earthshot Prize nominees

Percentage of 'revive our ocean'-exposed companies that target a blue economy solution



Source: The Earthshot Prize, Standard Chartered

In the remainder of this chapter, we discuss sustainability solutions of some of the key blue economy sectors in more detail. These are: ocean renewables; sustainable shipping; sustainable seafood; pollution and waste prevention; coastal and marine ecosystem protection; restoration and blue carbon. We also include case studies for seven organisations, six of which were selected from The Earthshot Prize database.

Ocean renewables

Developing offshore wind capacity is one of the key ways in which net zero pathways can be achieved and the blue economy made more sustainable. This could mitigate up to 4.5Gt/CO2e per year by 2050 and yield net financial benefits of up to USD6.8 trillion according to the HLPSOE. Offshore wind-related job creation would likely more than offset any decline in traditional offshore oil and gas from the transition, according to Det Norske Veritas (DNV) calculations (see Ocean's Future to 2050). We show the key beneficiaries of ocean renewable growth in Figure 8.

Figure 8: Ocean renewables related solutions

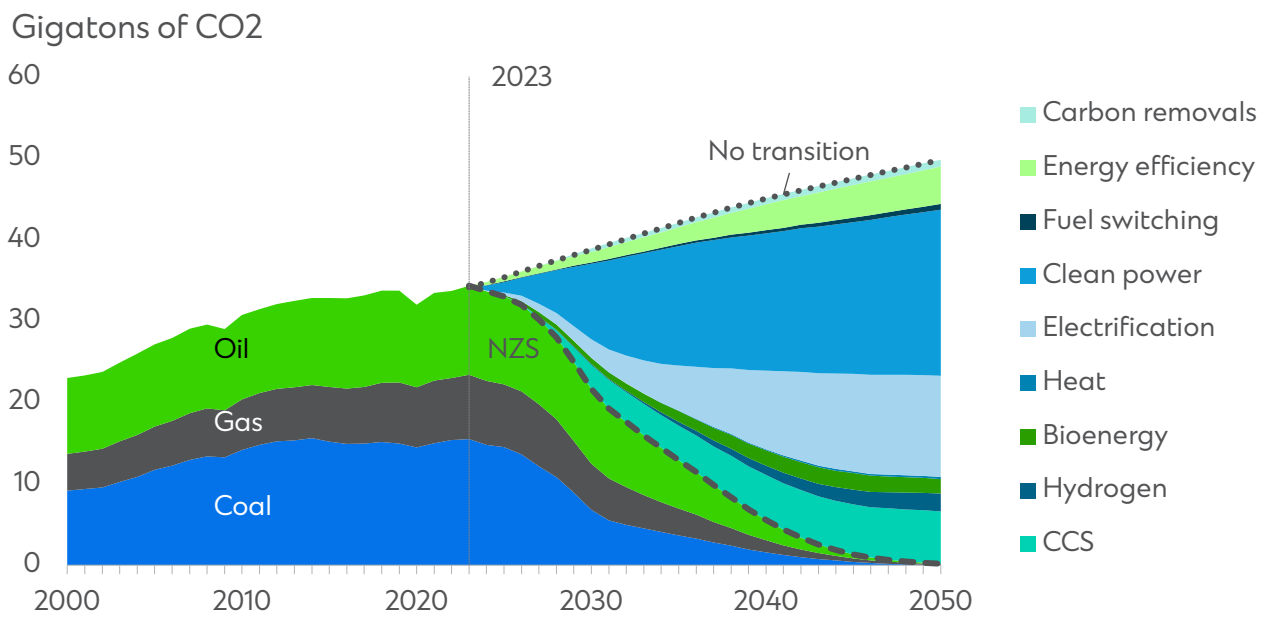
Blue economy sector	Key solutions	
Renewable energy	Cable manufacturers	Offshore wind
	Floating solar	Seaweed based biofuel
	Hydropower turbines	Solar power-based desalination
	Ocean waste to energy	Wave technologies

Source: Earthshot Prize, 1,000 Ocean Startups, Standard Chartered

Why is it relevant?

Reducing greenhouse gas emissions to net zero, in order to minimise the impact of climate change, requires the energy system to move away from fossil-fuel-powered sources towards clean energy sources such as solar and wind. Pathways that aim to achieve this also assume the electrification of the global economy using renewable-energy-powered sources. Bloomberg's most recent net zero calculations indicate that clean power and electrification combined account for almost 70 per cent of the emission reduction needed to get to net zero by 2050 (Figure 9).

Figure 9: Net Zero Scenario (NZS) implied emission profile



Source: BNEF, Standard Chartered

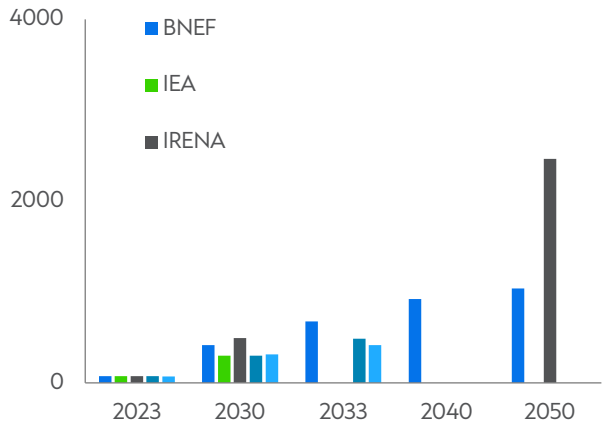
At the United Nation's (UN) COP28 climate change conference in 2023, world leaders agreed to triple renewable energy capacity by 2030. Organisations such as the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA) and Bloomberg (BNEF) estimate that renewable capacity does need to triple to a total of c. 11 terawatts (TW) by 2030 if 1.5°C scenarios are to be met.

The ocean plays a key role in these net zero pathway calculations as it supports the use of a range of renewable energy technologies. This includes offshore wave and tidal energy, wind energy and floating solar photovoltaics (floating PV). Wave and tidal energy and floating PV are technologies that are not yet ready for full scale adoption. However, this is not the case for offshore wind. The HLPSOE notes that the technical potential of offshore wind energy ranges from 1930,000 to 630,000 TWh per year, which is more than twice the electricity needed to meet demand in 2050. This ranges between 50,000 – 90,000 TWh according to Bosch et al. and IRENA.

The growth in offshore wind energy generating capacity needed to support broader net zero pathways is very significant. For example, IRENA estimates that offshore wind capacity needs to increase from 73GW in 2023 to almost 500GW by 2030, implying annual average capacity additions of more than 60GW per year. As context, this is more than 3x the annual capacity achieved during the past few years. Other estimates from organisations such as BNEF and the Global Wind Energy Council are somewhat more moderate, but still expect a 4-6x capacity expansion in offshore wind between 2023 and 2030 (Figure 10). BNEF's calculations show that the annual increase in investment activity related to offshore wind capacity expansion needs to not only rise significantly from recent levels, but also stay at elevated levels of more than 80GW per year during the 2029-2034 period (Figure 11).

Figure 10: Offshore wind capacity estimates

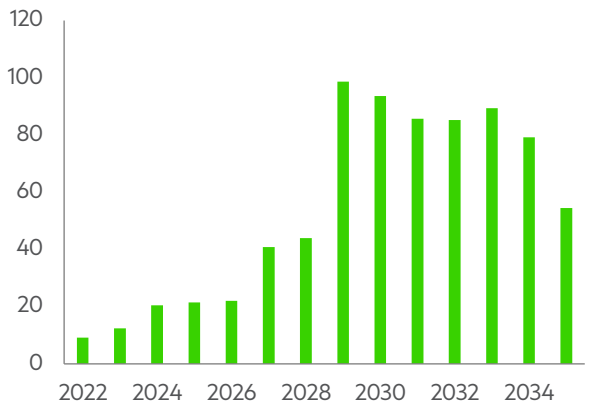
GW



Source:
BNEF, IEA, IRENA, GWEC, WFO, Standard Chartered

Figure 11: Annual offshore wind capacity additions

GW, to meet BNEF net zero pathway implied capacity



Source:
BNEF, Standard Chartered

Despite the agreement reached at COP28, we note that recent analysis from energy thinktank EMBER shows that national wind-related renewable energy targets fall short of a tripling in capacity by 2030. Their analysis shows that the sum of 2030 national wind targets from 70 countries and one region (the European Union, or EU) implies a 2.4x increase from 2022 levels. China is the only country that appears to be on track to almost triple wind capacity from 2022 by 2030. Excluding China, the rest of the countries have targets that on average suggest just a 1.9x increase in wind energy generating capacity by 2030. Furthermore, of the 51 countries with forecast data and national targets, only six expect to meet or exceed their 2030 national target. Among the jurisdictions that show sizeable gaps between their targets and forecast capacity are the US, India, EU, Saudia Arabia, and Indonesia. National and regional investment plans clearly need to be upgraded if wind energy capacity growth is to achieve levels implied by net zero pathway calculations.

Overall wind-related capacity targets are not ambitious enough for most countries, however, the outlook for offshore wind appears more promising. Offshore wind is a relatively new subset of the wind industry. It is reasonably developed in China and Europe but still mainly emerging elsewhere. EMBER's analysis shows that 19 countries have offshore wind targets that show a 2.9x increase in offshore wind capacity in 2030 from 2022 levels. This is broadly aligned with the required overall 3x increase that is needed to stay on track with long term 1.5°C pathway scenarios.

What are the challenges?

Scaling offshore wind energy to levels aligned with net zero requirements is not without its challenges. We highlight the following:

01 **The need for floating:** According to Bosch et al., about 70 per cent of the world's offshore wind potential is in water depths of more than 60m. This is too deep for standard fixed offshore wind turbines, and therefore requires the development of floating wind installations. This technology is more costly.

02 **Supply chain challenges:** During the past few years, the renewable sector has been impacted by supply chain challenges. Political divisions between global trading partners and the conflict between Russia and the Ukraine has not only increased the cost of offshore wind equipment, but also led to supply chain shortfalls. Moving away from a globalised production model to a more regional or polarised production approach may hamper the ability for the offshore wind industry to accelerate investments and growth.

03 **Permitting and licensing procedures:** One of the key challenges faced by the renewable sector in general is the fact that licensing and permitting processes tend to be very slow. As a result, it can take many years before a wind turbine is up and running and starts to generate electricity. In the US, for example, it can take six years before regulatory approval is received.

04 **Cost and revenue structure:** A potential hurdle for offshore wind growth, and indeed one that has impacted licensing and offshore investments during the last two years in the US, relates to unfavourable power purchase agreements. Rising inflation and a related increase in borrowing costs meant that offshore wind developers were not able to generate a profit on the development of a windfarm, given the energy purchase strike price that was agreed as part of the project award. Greater support is needed from governments to ensure that offshore wind projects are sufficiently profitable to generate investor interest.

05 **Grid and infrastructure requirements:** For offshore wind to deliver the electricity implied by climate change scenarios not only requires the development of wind turbines, but, crucially, also sufficient grid infrastructure including cabling. The European Network of Transmission System Operators for Electricity (ENTSO-E) published an assessment earlier this year related to offshore wind related infrastructure investments. This showed that, to meet the EU's offshore wind targets by 2050, would require cEUR400 billion of investments in supporting (i.e., non-turbine) infrastructure.

What are the potential benefits?

Developing ocean renewable energy has several key sustainability benefits. The obvious one relates to the mitigation potential as a switch from emission intense energy sources to ocean-based renewable sources takes place. Estimates for the mitigation potential of ocean-based renewable energy are as high as c. 4.5Gt/CO_2e per year by 2050 (HLPSOE).

Other benefits from developing ocean-based renewable energy include job creation. Estimates by DNV indicate that employment in offshore wind may increase from just 3,000 people in 2018 to 524,000 in 2050. This increase more than offsets the decline that DNV expects to take place in the offshore oil and gas industry, implying that the offshore renewable transition is a net economic benefit.

Another positive side effect may be that offshore renewable farms, especially wind, can be used to help develop seaweed-growing farms.
Developing ocean-based renewable energy facilities may also expand areas free of bottom trawling, which would enhance the quality and biodiversity of seafloor ecosystems.

The total net economic benefit of fully scaling offshore wind energy can be sizeable as shown by work from the HLPOE. They estimate that over the 30-year period of 2020-2050, total net financial benefit from offshore wind energy ranged between USD252 billion and USD6.8 trillion.

Company profile:

Ørsted

Overview

Ørsted is the global leader in offshore wind power and is one of the largest renewable energy companies in the world. The company opened its first offshore wind farm in 1991 and currently has a c. 25 per cent market share of the global offshore wind market excluding China. The development of offshore wind capabilities has transformed the company's financials. In 2007, only 7 per cent of the company's Earnings Before Interest, Taxes, Depreciation and Amortisation (EBITDA) was generated by renewables. Last year, this was 95 per cent on a taxonomy-aligned basis. By September 2024, Ørsted had 17.6GW of installed wind capacity, up from 0.8GW in 2007.

Relevance to the blue economy

Being the largest offshore wind developer and operator in the world, Ørsted is a key company in relation to the blue economy theme of ocean renewables. The company's targets suggest that it expects this business to continue to grow strongly. Ørsted expects to expand its current offshore wind capacity of 9.9GW to 16.5GW by the end of this year and reach 20-22GW of installed capacity by 2030.

Ørsted's relevance to the blue economy goes beyond its business as an offshore wind developer. The company's sustainability targets, for example, include a 2040 deadline for achieving a net zero value chain, and that all new renewable energy projects commissioned must have net positive biodiversity impact by 2030. Ørsted also exclusively deploys green and sustainable long-term financing and was the first energy company to issue a blue bond in June 2023. Ørsted's focus in relation to its blue bond programme is on marine ecosystem restoration and sustainable shipping.

What are the key challenges and opportunities?

Ørsted is positive on the outlook of its core offshore wind business. The company believes that global installed offshore wind capacity, excluding China, needs to increase from c. 35GW in 2023 to well beyond 133GW by 2030 if climate targets are to be reached. Although environmental targets support a positive growth outlook for offshore wind, Ørsted notes that the rapidly declining cost of generating offshore wind-powered electricity has added a financial tailwind to the story. Between 2012 and 2023, the company estimates that the levelized cost of offshore wind electricity has fallen by c. 60 per cent to between EUR60-106 per MWh. In most markets, this is cheaper than the cost of producing electricity with a gas turbine or nuclear power plant.

Ørsted is one of many offshore wind developers that struggled with the economic conditions of 2023. Rising inflation and higher interest rates coupled with supply-chain-related challenges has made the business case for offshore wind more difficult. This has required government flexibility to adjust project agreements and increase agreed power purchase prices to reflect the rise in investing and operating costs. Other challenges the offshore wind industry faces include increasing competition from Chinese wind developers, and growing pressures to develop strategies around the recycling of used wind farm equipment. Despite recent headwinds for the renewables industry, more favourable conditions seem to be emerging through easing supply chain bottle necks and reduced interest rates, as well as political momentum in some markets.

Sustainable shipping

Shipping is to the global economy what the aorta is to human life, as c. 80 per cent of global trade volume is carried by ships. Shipping-related emissions already account for c. 3 per cent of global GHG emissions but these may rise another 50 per cent in a business-as-usual scenario, according to the International Maritime Organisation (IMO). A range of solutions exist that will help make the shipping industry more sustainable. We list the beneficiaries below but note that significant challenges remain to scale these sufficiently. This is especially true for sustainable or low-carbon fuels.

Figure 12: Overview of sustainable shipping solution

Blue economy sector	Key solutions	
Sustainable shipping	Automated ship inspection and cleaning	Hybrid shipping
	Clean fuel solutions (hydrogen, sail, solar)	Navigational optimisation software
	Electric shipping	Sustainable antifouling solutions
	Fleet management software	Sustainable fuel, biofuel

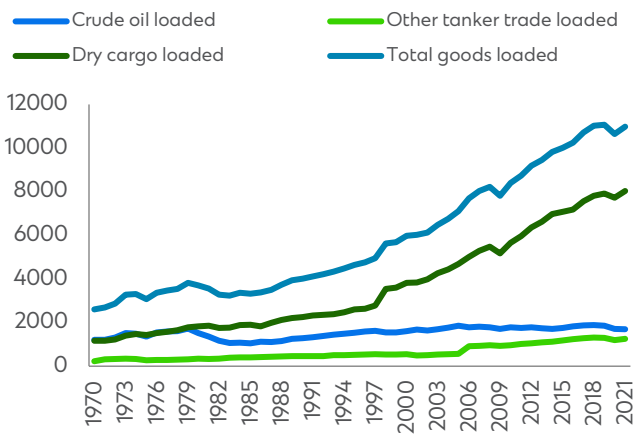
Source: Earthshot Prize, 1,000 Ocean Startups, Standard Chartered

Why is it relevant?

The ocean is one of the prime enablers of global economic growth, considering that c. 80 per cent of global trade volume, and 60 per cent of trade value, is carried by ships. Data from the UN shows that total cargo loaded onto seaborne ships reached almost 11 billion tonnes in 2021, up from 2.6 billion in 1970, implying an annual average growth in seaborne cargo trade of c. 3 per cent (Figure 13). The type of cargo transported by ships has changed over the years. During the 1970s, crude oil represented more than 45 per cent of cargo shipped, while dry cargo (which includes containers) accounted for c. 45 per cent too. Globalisation, and the general increase of purchasing power throughout the developing world during the past few decades, has caused the share of dry goods to increase to more than 70 per cent of seaborne trade in 2021. (Figure 14).

Figure 13: Total seaborne cargo loaded

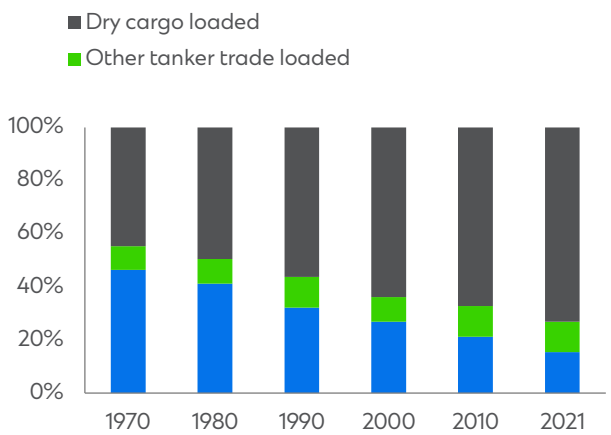
Million metric tonnes



Source: UN, Standard Chartered

Figure 14: Type of cargo loaded

Share of tonnes loaded



Source: UN, Standard Chartered

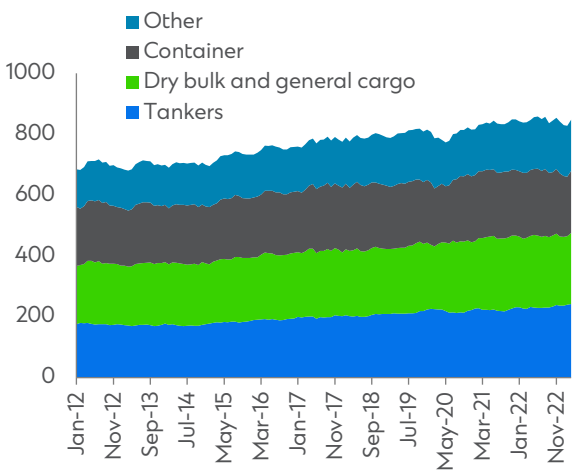
The need to improve the efficiency of sea-based transport is high in our view. The sector's greenhouse gas emissions have increased by c. 25 per cent since the start of 2012 (according to data from the UN and Marine Benchmark) and account for c. 3 per cent of global GHG emissions (Figure 15). Without strong action, shipping emissions will likely increase by up to 50 per cent between 2018 and 2050 in a business-as-usual scenario according to the IMO. To put this in context, calculations from the IEA suggest that shipping emissions need to fall by 15 per cent between 2022 and 2030 in order to be aligned with Paris-agreed net zero pathway calculations.

Some may argue that a full move away from fossil fuel will be a boost to shipping's overall emission profile given that oil tankers will no longer be needed. We see several reasons why this assumption may be too optimistic.

- First, we note that recent growth in bulk carriers and container ships has been much stronger than for oil and gas ships. For example, total dead weight of container ships increased from 63mn tonnes in 2010 to almost 330mn tonnes this year, a rise of more than 400 per cent. This compares to an increase of 135 per cent for oil tankers. In 2000 oil tankers made up 36 per cent of the overall shipping industry capacity. This has dropped to 28 per cent this year (Figure 16).
- Second, the transport of oil may decline over time as the world transitions toward alternatives fuels, however that does not necessarily mean that these ships are no longer needed. A transition towards alternative fuels may increase shipping demand for other products such as hydrogen, ammonia, biofuels or CO_2 as part of carbon capture programs. Oil tankers may, even after refurbishment, still be needed for this.

Figure 15: Shipping related emissions

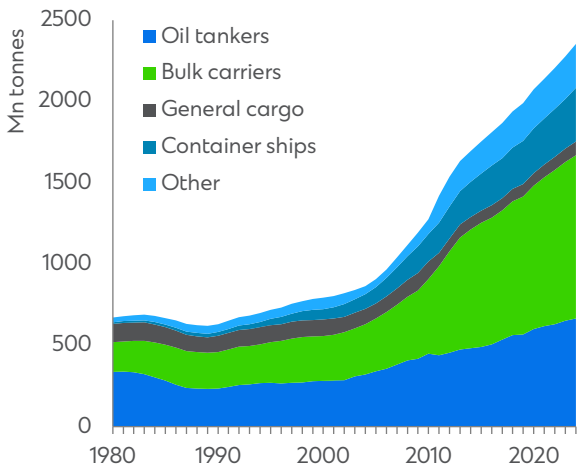
Mn CO_2e



Source: UN, Marine Benchmark, Standard Chartered

Figure 16: Total shipping capacity

Dead weight



Source: UN, Standard Chartered

How can shipping be made more sustainable?

Momentum to decarbonise the shipping industry is increasing as a growing range of solutions are being developed and implemented. We would highlight the following:

- **Regulation and targets.** Regulatory requirements play a crucial part in reducing the carbon intensity of the global shipping industry. Last year, the IMO agreed on a strategy regarding the decarbonisation of the international shipping sector. Medium- and long-term targets include a 20 per cent emission reduction by 2030, 70 per cent by 2040 (relative to 2008), and to reach net zero GHG emissions from international shipping by or around 2050. Other targets adopted by the IMO include an improvement in carbon intensity of international shipping by at least 40 per cent by 2030 compared to 2008. There is also the requirement for zero or near-zero GHG emission technologies and fuels to represent at least 5 per cent (and striving for 10 per cent) of energy used by international shipping by 2030. To ensure that the shipping sector reaches these targets, the IMO has also announced regulatory measures which are expected to enter into force by 2027. We see the IMO's updated targets and regulatory structure as a strong driver to improve the shipping industry's carbon intensity. They will put pressure on the sector's entire value chain to improve performance and develop new technologies and solutions.

  The EU's carbon Emission Trading Scheme (EU ETS) is another regulation-related development that will force the shipping industry into becoming more sustainable. Since January 2024, the EU ETS has been extended to cover CO_2 emissions from ships with a gross tonnage of 5,000 and above. The system covers 50 per cent of emissions from voyages starting or ending outside the EU, and 100 per cent of emissions that occur between two EU ports and when ships are between EU ports. The updated EU ETS has adopted a phase-in period, which means that shipping companies will have to surrender allowances covering 100 per cent of their reported emissions from 2027 onwards.

  The IMO and EU are not the only organisations focused on decarbonising the shipping industry. We highlight other initiatives in Figure 17.

Figure 17: Initiatives focused on decarbonising the shipping industry

Initiative	Members	Purpose
Getting to zero coalition	Over 200 organisations including entities from the maritime, energy, infrastructure and finance sector	Decarbonise maritime shipping and develop and deploy commercially viable deep sea zero emission vessels by 2030 and full decarbonisation by 2050
Mission innovation	Co-led by Denmark, Norway, US, shipping companies and Global maritime forum	Demonstrate commercially viable zero emission ships by 2030 and promote zero emission fuelled vessels
Poseidon principles	35 banks jointly representing c. USD200bn in shipping finance	Voluntary principles by global shipping banks to promote shipping decarbonisation and adopt a framework for disclosing the climate alignment of lending portfolios to the shipping industry
Sea cargo charter	38 charterers and operators	A framework for aligning chartering activities with responsible environmental behaviour and disclosing the climate alignment of global ship chartering activities
Clean energy marine hubs	International chamber of shipping, International association of ports and harbours and the Clean Energy Ministerial	A public-private platform across the energy-maritime value chains to promote green fuels and support the global energy transition

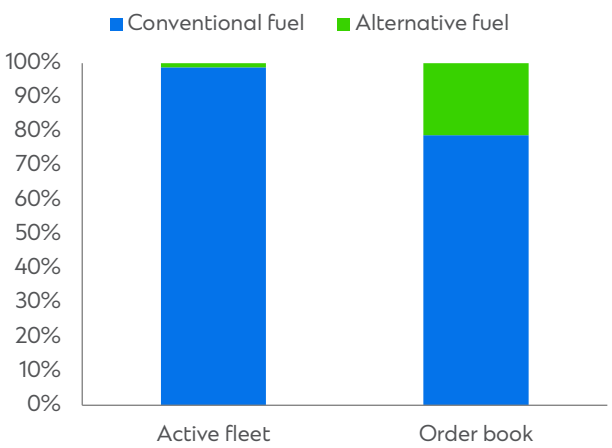
Initiative	Members	Purpose
GreenVoyage2050	Led by IMO and funded by Norway. Focus on selected developing countries.	Cooperation between developing countries and maritime-related international associations and the industry
Zero emission waterborne transport	Horizon Europe, European maritime companies	Provide and demonstrate zero emission solutions for ships before 2030

Source: OECD, Standard Chartered

- **Low carbon fuels.** One of the areas with the biggest potential impact on decarbonising the shipping industry relates to the switch to low- or zero-carbon fuels. The transition towards alternative fuels has barely started at this stage given that in 2022 almost 99 per cent of ships relied solely on traditional emission intense fuel (Figure 18). Furthermore, while 1.2 per cent of ships used alternative fuels, we note that this was mainly driven by liquified natural gas (LNG) and liquified petroleum gas (LPG). There is debate around the benefit that a switch from traditional diesel fuel to LNG might deliver. For example, a study from University Maritime Advisory Services in 2018 related to the EU's plans for switching to LNG in shipping suggested that this might only result in a 6 per cent reduction of GHG emissions by 2050. Future improvement in shipping emission intensity does look promising in our view. Shipping orderbook data from 2022 shows not only an increase in the share of ships that rely on alternative fuels, but also a growing contribution from battery and hybrid technologies and methanol (Figure 19).

Figure 18: Fuel uptake by shipping fleet

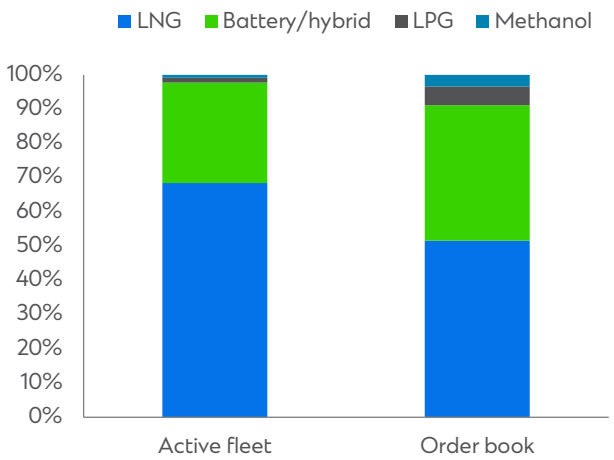
Current fleet versus order book, 2022



Source: UN, Standard Chartered

Figure 19: Breakdown of alternative fuel by type

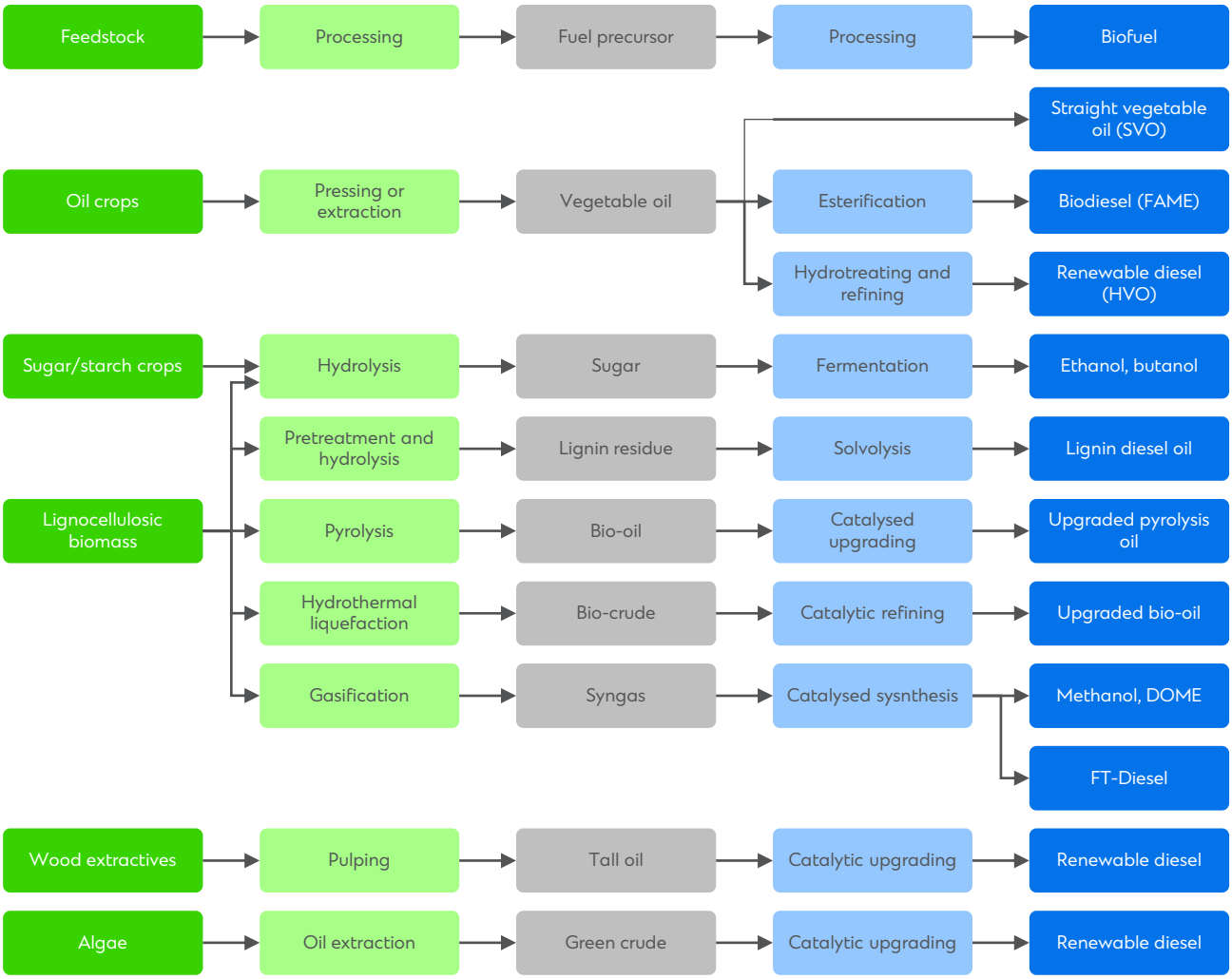
Percentage of total alternative fuel



Source: UN, Standard Chartered

Switching from traditional shipping fuel to LNG or LPG might not have a very significant GHG benefit, however, the case for biofuels is much stronger in our view. Biofuels can be produced using different types of feedstocks, ranging from plant-based sugars, oils, and animal fat to algae and wood extracts. The range of potential biofuels for the marine sector is extensive (Figure 20).

Figure 20: Feedstock conversion routes to marine biofuels



Source: IEA, Standard Chartered

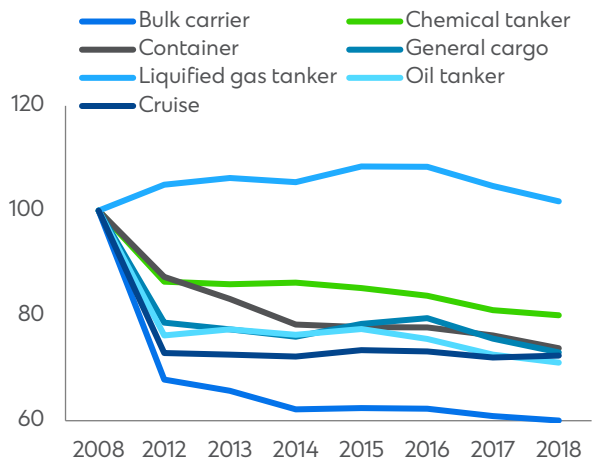
Key determinants for the role that biofuels can play in decarbonising the shipping industry are the availability of sustainable feedstock and the production costs of the biofuel. Work from CE Delft & RH DHV in 2020 (see: Bio scope report) suggest that globally the projected availability of sustainable maritime biofuel ranges from 131-207 exajoule (EJ) in 2050. More recent estimates by DNV put the potential economical supply of biofuel in 2050 at between 500-1300Mtoe per year. They estimate that for the shipping industry to decarbonise by 2050, it would need about 250Mtoe of this biofuel. This would represent consuming 20-50 per cent of global biofuel consumption. The shipping sector would be competing with other sectors – including aviation – who are looking to switch to less emission-intense fuels too, but global biofuel potential appears sufficient to cover total shipping demand in our view.

The challenges faced by the shipping industry in making this transition are not just securing sufficient biofuel, however. There remain questions over the potential environmental and human impact of producing biofuel at scale. For example, using feedstock that might otherwise be used for human consumption would increase food security challenges. There are also potential deforestation challenges associated with increased biofuel production if land needs to be cleared for feedstocks, such as soybeans. Finally, there are questions regarding the environmental impact that the production processes of biofuel feedstock may have. These focus on how the production facilities are powered (e.g., using fossil fuel) and the degree to which fertilisers, pesticides, and freshwater are needed to grow crops for biofuel production.

- **Other zero emission solutions.** The potential solution set that is being developed to decarbonise the shipping industry is rapidly expanding. The Global Maritime Forum published their fifth edition of the "Mapping of Zero Emission Pilots and Demonstration Projects" report in July this year, which showed that the number of zero emission projects had increased to 340. This compares to just 14 in 2018. Some 45 per cent of the identified projects focus on ship technology, with more than 70 per cent of these relating to ammonia and hydrogen power solutions. Fuel production solutions account for 39 per cent of the total, although most of these represent so-called 'concept studies', and are therefore not expected to become operational in the near term. Most of these projects focus on exploring different ways to produce biofuels, such as green methanol or green ammonia. Bunkering and infrastructure-related solutions make up the balance of 24 per cent of all projects. The majority of these are concept studies related to the infrastructure needs associated with the adoption of new fuels. The fact that most of these studies are in concept stage only may reflect the lengthy and complex regulatory hurdles that need to be overcome to implement new fuels such as hydrogen and ammonia.
- **Increase energy efficiency of ships**. Analysis published in 2021 by the IMO indicates that the carbon intensity of international ocean shipping improved by 30 per cent between 2008 and 2018. The key drivers behind this improvement were technical and operational improvements that reduced the amount of fuel consumption per nautical mile. In fact, one of the key drivers has been the efficiency gains achieved through increasing ship sizes. The analysis of Faber et al., 2021 shows that the strongest improvement in general ship emission intensity was achieved before 2012. This suggests that the easy gains have already been achieved, and that annual improvements in emission intensity are likely to be closer to 1-2 per cent currently (Figure 21). One interesting point to make, in relation to the emission intensity of different ships, is that Faber's analysis suggests that tankers carrying liquified gas are 50 per cent less efficient than those carrying oil. This would seem to suggest that a switch from oil to LNG or LPG might actually increase shipping-related emissions, and therefore reduce the net benefit of the lower emission intensity of LNG relative to traditional oil (Figure 22). This observation does not take into consideration the fact that methane leakage is a risk associated with the LNG supply chain.

Figure 21: Improvement in ship emission intensity

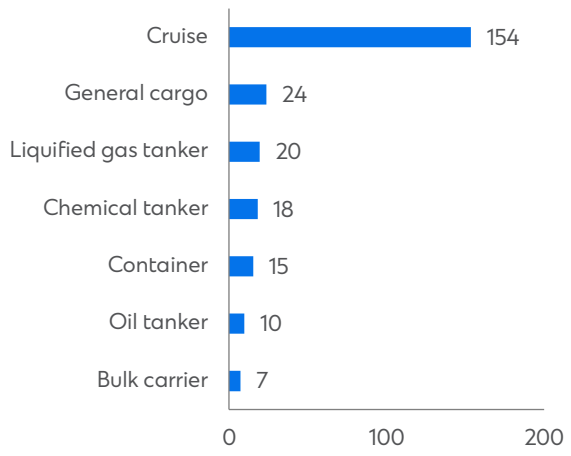
gCO_2/tonne of cargo/nautical mile, 2008=100



Source: Faber et al. (2021), Standard Chartered

Figure 22: Emission intensity of ships

gCO_2/tonne of cargo/nautical mile, 2018



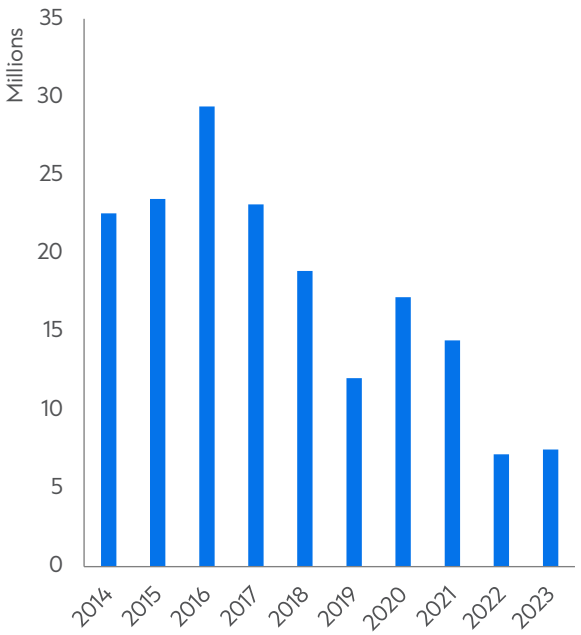
Source: Faber et al. (2021), Standard Chartered

Additional improvements that can still be achieved relate to optimising the logistics of shipping. Maximising ship utilisation, reducing ballast, optimising route selection, shortening distancing and minimising dead times outside of ports can all help to further improve the energy efficiency of shipping. Solutions that reduce a ship's frictional resistance will also help. These include anti-fouling coatings or robots that remove fouling from hulls and propellers.

- **Sails to make a comeback.** Most of the fuel consumption on a ship is driven by its propulsion. With that in mind, we note that a return to using wind power is being investigated by several companies. Work from Lindstad et al., 2022 shows that building more slender ships that are powered with wind-assisted propulsion can reduce GHG emissions by c. 27 per cent even on mid-sized ships. Companies engaged with building ships that incorporate modern sail technologies typically use Flettner rotors for this. These are large, vertical, rotating cylinders that use wind to generate thrust to drive the ship. Using sails would not only reduce the need for fuel to power a ship but would therefore also reduce the load of a ship as less fuel needs to be stored. Storing wind-based power on ships might also become possible if battery technologies continue to improve.
- **Ship recycling.** One final area related to shipping that we believe will become increasingly important relates to ship recycling. Data from the UN indicates that the average age of the current shipping fleet is just over 22 years. This suggests that ship decommissioning, and importantly recycling, will becomes a more relevant topic for the shipping world, given that the lifespan of a typical ship is around 25 years. To put this in context, the Baltic and International Maritime Council estimates that c. 15,000 ships – or more than 10 per cent of the current global fleet – is projected to be recycled. This is in sharp contrast to ship recycling and decommissioning rates that took place during the past 10 years (Figure 23).

Figure 23:
Global ship decommissioning and recycling

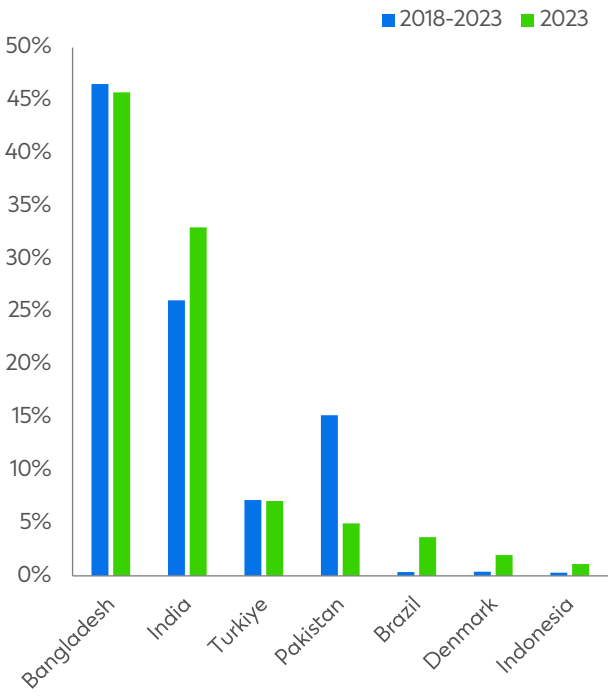
Million of tonnes



Source: UN, Standard Chartered

Figure 24:
Decommissioning market share

Percentage of worldwide decommissioning



Source: UN, Standard Chartered

The current ship decommissioning market is highly concentrated, as almost 85 per cent of global ship decommissioning in 2023 took place in Bangladesh, India, and Pakistan (Figure 24). This market structure may change, however. Concerns over the environmental and worker health and safety in ship decommissioning yards has resulted in growing regulatory changes, including policies adopted by the EU and the IMO's Hong Kong Convention. These changes may allow ship recycling capacity to be developed in other regions.

Ocean tourism – cruises

The ocean and coastal areas are highly linked to tourism. 80 per cent of tourism already takes place in coastal areas, according to the World Resources Institute (WRI). The need to create a sustainable tourism offering is key in relation to safeguarding the ocean: World Bank estimates suggest that coastal and marine tourism is set to grow at an annual rate of more than 3.5 per cent and is likely to be the largest segment of the blue economy by 2030.

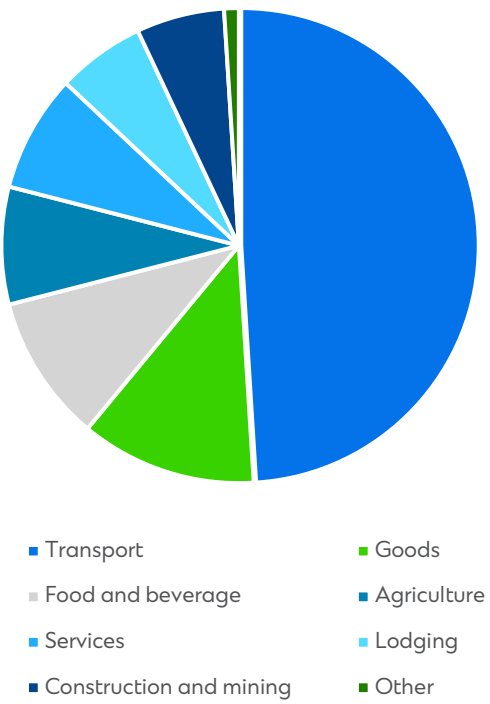
Cruise tourism is one sub-segment of marine tourism that is particularly emission intense. Estimates from Faber et al. (2021) indicated that the global cruise sector generated total emissions of up to 60Mt CO_2e in 2018. Assuming that historical passenger growth rates continue, this implies that total emissions might reach close to 200MT CO_2e by 2050, even if ship fuel efficiency gains continue at the historical annual average of 2 per cent.

Beyond emissions, the cruise sector also impacts the environment in other ways, including waste generation (e.g., wastewater, food and plastic) and risks to marine ecosystems and coastal communities. Cruise line passenger data from Cruise Market Watch underlines the need to address the environmental impact of the cruise industry. Between 2000 and 2019 annual average passenger growth reached 7 per cent, up from 6 per cent achieved between 1990 and 1999. COVID-19 caused the number of cruise line passengers to drop by 88 per cent between 2019 and 2021, however, this has since recovered to an all-time high of almost 29 million in 2023 – 5 per cent above the pre-COVID high of 27.5 million.

One region that is likely to keep cruise line growth high is Asia Pacific, as passengers from this region only accounted for 4 per cent of the total in 2023. Further economic development across emerging markets (EM) is likely to drive cruise line adoption higher across these countries, which puts further pressure on the sustainability of the ocean, coastal regions and broader marine ecosystems in our view. This reinforces the need for an integrated approach to ocean planning, to bring conservation efforts and other blue economy sectors along with tourism growth.

Figure 25:
Carbon footprint of global tourism

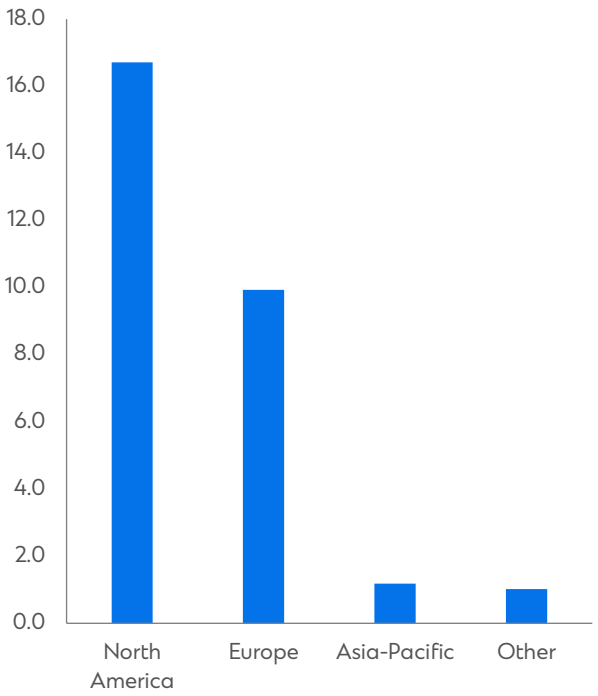
By activity, 2018



Source: Nature Climate Change, Standard Chartered

Figure 26:
Cruise passengers by region

Millions, 2023



Source: Nature Climate Change, Standard Chartered

Company profile:

Bound4blue

Overview

Bound4blue is a Spanish company founded in 2014 that produces wind propulsion systems for ships. The company raised more than EUR22 million last year which will be used to further develop its eSAIL® system and expand its company operations.

Relevance to the blue economy

Bound4blue is exposed to the blue economy theme of sustainable shipping. Its eSAIL® suction sail system is central to the company's strategy to provide zero-emission propulsion solutions in shipping. The system requires minimal maintenance and has a short payback period. Important to note is that when a ship with the eSAIL® system installed goes out of service, the eSAIL® system can be dismantled and used on other ships, thereby extending its useful life.

Wind-assisted propulsion systems use wind to generate low-emission forward thrust. This reduces the amount of thrust needed from the engine of a ship, which therefore lowers fuel consumption and generated emissions. Three main wind systems exist in the market: rigid sail systems, Flettner rotor systems and suction sail systems. Bound4blue's eSAIL® is a suction sail-based system.

Bound4blue case studies with different eSAIL® models suggest that significant fuel savings can be achieved, while pay back periods for the installation of the system are generally less than five years. The overall benefit for the shipping company using eSAIL® is greater than the fuel saving alone. Retrofitting a ship with eSAILs® improves its carbon intensity indicator, the energy efficiency design index, and the energy efficiency existing ship index. This suggests that a ship fitted with an eSAIL® system might meet efficiency requirements without the need to reduce its speed. Furthermore, such ships may also avoid penalties imposed by the EU Emission Trading System and FuelEU program for ships that are not efficient enough. Bound4blue estimates that the value of the combination of avoided penalties with direct fuel savings from the adoption of eSAIL® can comprise almost 23 per cent of traditional fuel costs for ships making a voyage from Europe to North America.

What are the key challenges and opportunities?

Bound4blue believes that its eSAIL® system will benefit substantially from growing demand from ship owners for fuel- and emission-saving shipping technologies. The company expects that its business model will gradually shift as after-sales and service revenues become more relevant.
The company faces several challenges:

1) Wind propulsion technologies are still relatively new, while in the case of Bound4blue, third-party ratification of emission and fuel savings has not yet been published. Market confidence in the technology and impact is, therefore, not fully developed yet.

2) To service the large Asian market effectively may require the company to invest in new production capacity locally.

3) Competitive dynamics are relatively underdeveloped at this stage. This may change when wind propulsion technologies become more established. Other challenges that the company faces include the need for more research and development and managing rapid headcount expansion.

Sustainable seafood: aquaculture and fishing

Growing seafood production in such a way that it is sustainable is one of the biggest challenges associated with the blue economy in our view. The global food system already accounts for up to 34 per cent of global GHG emissions; seafood demand is likely to continue to increase while only 12 per cent of global fish stock is deemed 'underfished' by the FAO. Traditional fishery activities need to become more sustainable, while aquaculture production needs to be scaled aggressively, but only if it's possible to do so in a sustainable manner. Alternative protein is a potential way to limit the growth in demand for traditional fish. We list the key beneficiaries of this theme in the table below (Figure 27).

Figure 27: Overview of solutions that help fishery and aquaculture become more sustainable

Blue economy sector	Key solutions	
Sustainable fishery	Aquaculture solutions	General farm management
	General efficiency software	Monitoring and data analysis
Sustainable food	Alternative feed	Insect based solutions
	Aquaculture infrastructure solutions	Nutrient delivery solutions
	Aquaculture optimisation technologies	Protein alternatives
	Cold storage solutions	Seaweed farming solutions
	Disease treatment	Shrimp farming optimisation
	Feeding optimisation	Water treatment solutions
	Fish health solutions	

Source: Earthshot Prize, 1,000 Ocean Startups, Standard Chartered

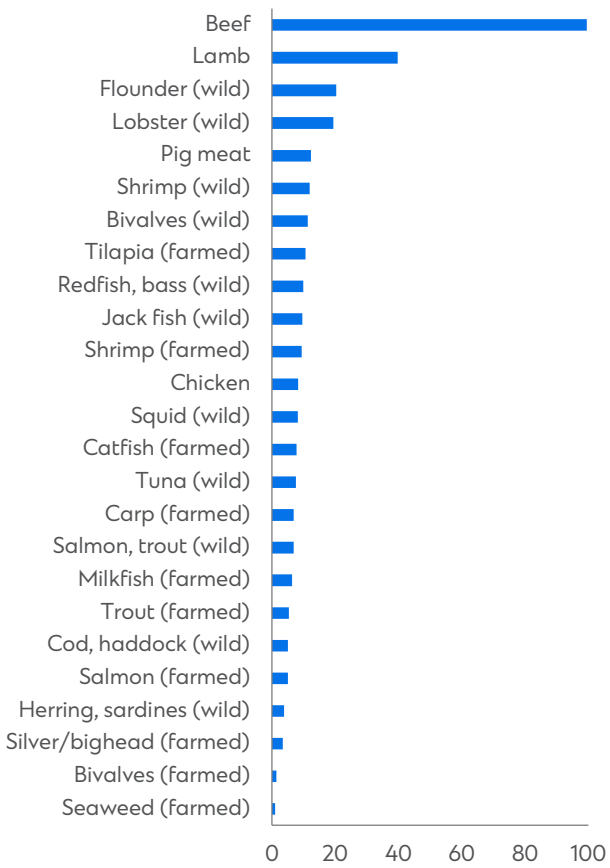
Why the food system needs to change

Estimates from studies such as Poore and Nemecek (2018) and Crippa et al. (2021) suggest that the global food system, from farm to fork, accounts for between 26-34 per cent of the world's GHG emissions. This makes the food system one of the biggest challenges to addressing climate change. However, this challenge is set to grow substantially larger in a business-as-usual scenario.

- The expected increase in the world's population during the next few decades, coupled with the likely further expansion of the middle class across developing countries, will cause food demand to increase substantially. This creates a number of challenges.
- Food system-related emissions will rise significantly, especially if increasing purchasing power across the developing world causes a shift in food consumption towards emission-intense animal meat such as beef and lamb (Figure 28).
- A rise in food demand creates substantial land challenges if dietary habits do not change, given that 45 per cent of the earth's habitable land is already occupied by agriculture. There may simply not be enough land available to grow the increase in food that a rising population and growing spending power would trigger (Figure 29).
- Thirdly, we note that work from Mekonnen and Hoekstra (2012) and the OECD (2012) suggest that the agricultural sector is responsible for c. 70 per cent of freshwater withdrawals. A further increase in agricultural production would put freshwater availability under yet more stress.

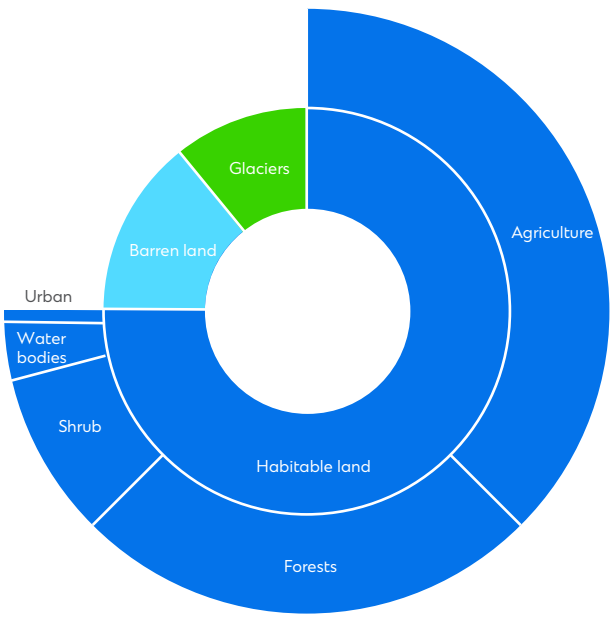
Figure 28:
GHG emission intensity of animal food items

CO_2e/kilogram



Source: Poore and Nemecek (2018), Gephart et al. (2021), Standard Chartered

Figure 29:
45 per cent of the world's habitable land is already used by agriculture



Source: FAO and Poore and Nemecek (2018), Standard Chartered

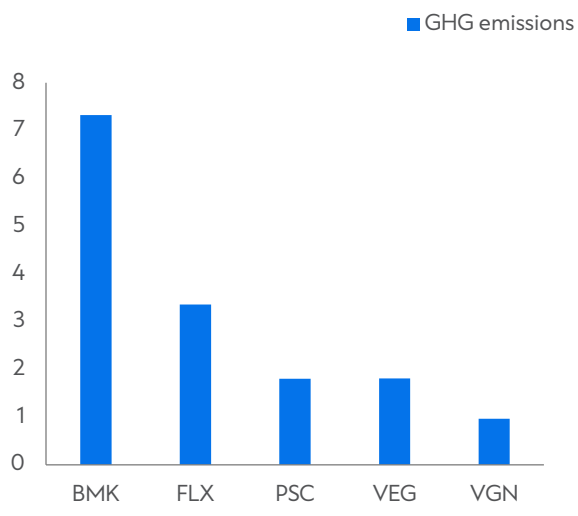
Seafood can help address environmental and health challenges

A sustainable seafood sector would help address several key sustainability issues with the overall food system.

- Shifting consumer diets away from land-based animal protein appears to be one of the most effective ways in which agricultural emissions can be reduced. Work from Poore and Nemecek, for example, showed that almost 100 kilograms of GHG emissions are produced for each kilogram of beef. For lamb, this is almost 40 kilogram while for pigs, this is 12.3 kilogram. Gephart et al. (2021) analysed the emission intensity of a wide range of seafood items and showed that most of these generate less than 10 kilograms of GHG emissions per kilogram of edible weight of seafood (Figure 30).
- Shifting food intake from land-based animal food towards seafood would also allow for agricultural land to become available for other uses. Specifically, this could be used for reforestation and other nature-based solutions that reduce emissions further.
- Growing seafood not only requires minimal land use, but clearly also sharply reduces the need for freshwater when compared to traditional agricultural products.
- Finally, we note that shifting food consumption towards more healthy diets, that have fish as a key ingredient, appears to have not only environmental benefits but also positive health implications. A landmark publication by the EAT-Lancet Commission in 2019 provided evidence that a more balanced reference diet that relied less on red meat did indeed meet both health and environmental requirements. Work from Springmann et al. (2018), meanwhile, provided more quantitative insight into the impact of different diets. Their calculations suggest that switching from a general (or benchmark) diet, to one that is based on fish for protein delivery (pescetarian diet), might cause GHG emissions to fall by 75 per cent. Their calculations also indicated strong health benefits. As such, a dietary switch when adopted globally could avert almost 12 million deaths per year, including averting 4.7 million premature deaths.

Figure 30:
Dietary switches could case emissions to fall

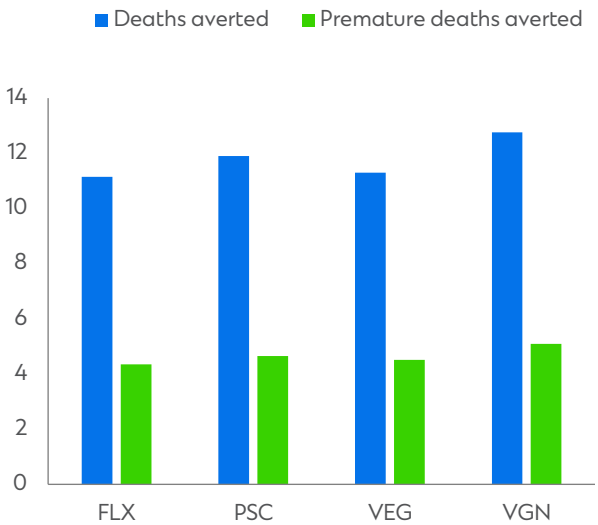
$GtCO_2e/y$



Source: Springmann et al. (2018), Standard Chartered
BMK=benchmark, FLX=flexitarian, PSC=pescetarian, VEG=vegetarian, VGN=vegan

Figure 31:
A pescetarian diet has strong health benefits

Averted deaths by switching from a benchmark diet in millions



Source: Springmann et al. (2018), Standard Chartered
BMK=benchmark, FLX=flexitarian, PSC=pescetarian, VEG=vegetarian, VGN=vegan

Creating a sustainable seafood system is not without challenges

Developing a sustainable ocean food system without doing damage to the sustainability of fish stocks is a major challenge. Data from the FAO suggests that only 11.8 per cent of the total assessed fish stock is deemed 'underfished', while c. 38 per cent of stocks are fished at unsustainable levels. Areas with the lowest percentage of sustainable fishing activity include the Eastern Central Atlantic, Northwest Pacific Mediterranean and Black Sea and the Southeast Pacific.

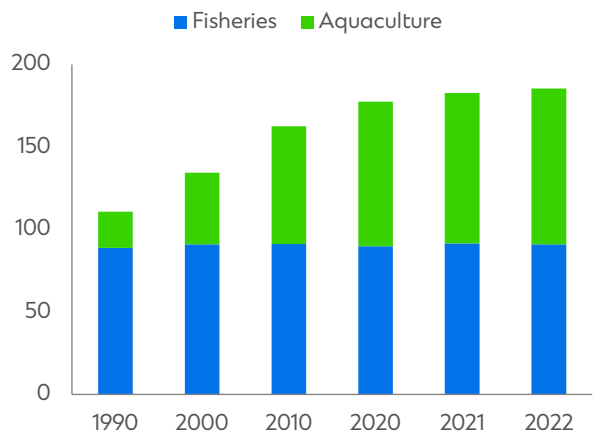
Regulation and monitoring processes appear to have a positive impact on the sustainability of ocean fishing. In their most recent 2024 State of World Fisheries and Aquaculture report, the FAO assesses fish landing activity broken down by region. This seems to suggest that the highest level of sustainable fishing activity appears to take place in regions with full development of fisheries, adequate management and effective fishing regulation. Their analysis of trends by major fish species seems to confirm the relevance of regulation.

Fishing of tuna species that are assessed and monitored by regional fisheries management organisations is now largely done sustainably. Globally, 87 per cent of these monitored tuna stocks are now sustainably fished, while 99 per cent of tuna catch comes from healthy tuna stocks. The recovery of these tuna species has been partly enabled by work from a range of organisations, including the Global Tuna Alliance. This was partly funded by the Walton Family Foundation, the NGO Tuna Forum and the Prince Albert II of Monaco Foundation.

Data and information for the other tuna species, however, is uncertain. This presents a major challenge, considering that tuna fishing accounts for at least 15 per cent of the total global small-scale fisheries catch according to the FAO. Better monitoring and regulation are required to enhance the sustainability of marine and inland fishing activities.

Figure 32:
Aquaculture now bigger than fisheries

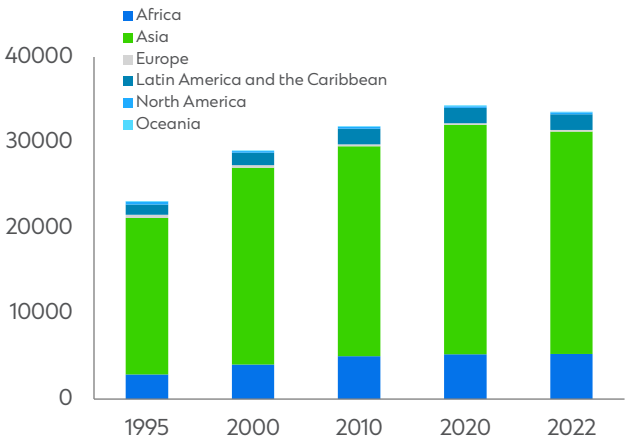
Million tonnes of live weight



Source: FAO, Standard Chartered

Figure 33:
More than 33mn people work in fisheries

Millions



Source: FAO, Standard Chartered

Stricter fishing regulation may improve the sustainability of the ocean's fishing stock, however, there are other consequences that need to be considered too, especially if it is imposed on areas across Asia and Africa. Limiting fishing activity will make it more difficult to meet growing global food demand and creates negative local economic impact. Globally, more than 33 million people were employed across marine and inland fisheries in 2022, a 45 per cent increase from 1995 levels. Global warming may force fish populations to migrate to cooler waters. As a result, this may negatively impact future employment prospects across key areas in Asia, Latin America and Africa, which currently account for well over 90 per cent of total fishery employment.

Solutions exist that help improve the sustainability of fishery and that maintain growth potential. Reducing seafood waste, estimated to account for 35 per cent of fish according to the FAO, and increasing yields from fisheries through precision fishing technologies are two examples of this.

Aquaculture activity set to increase further

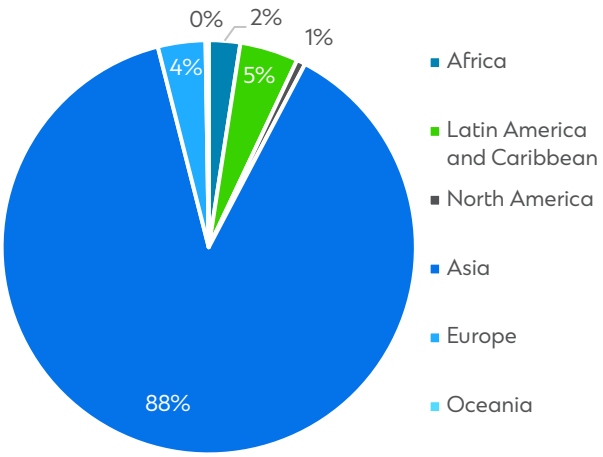
Aquaculture, in contrast to traditional fishing, relies on growing fish in a controlled environment that mimics and optimises conditions necessary for seafood production. One of the key advantages that aquaculture offers over traditional fishing is the ability to control key growth factors including feed, temperature, and water quality. Growing seafood through aquaculture not only helps to improve the ocean's biodiversity, but also plays a role in economic development, job creation and food security.

Aquaculture fish production has rapidly increased during the past few decades. In 2022, global aquaculture production reached 94.4 million tonnes of live weight; 51 per cent of total annual global fish production (Figure 32). Since the 1990s, aquaculture production has increased more than 4x, whereas total fishery capture levels have remained stable at around c90 million tonnes per year. In fact, aquaculture fish production in 2022 was greater than fishery catch for all but one year since 1950. Regional production data (as reported by the FAO) shows that Asia dominates aquaculture with an 88 per cent share of production (Figure 34).

Aquaculture production growth rates have been strong across the world. For example, aquaculture growth since 2000 has been highest in Africa at an annual average rate of 8.3 per cent (Figure 35). Various studies have indicated that meeting future seafood demand in a sustainable manner probably requires a further expansion of aquaculture production. The high growth rates of aquaculture production in Africa and Latin America and the Caribbean suggest that aquaculture might be a longer-term solution to solving food security challenges across those regions.

Figure 34:
Aquaculture animal production by region

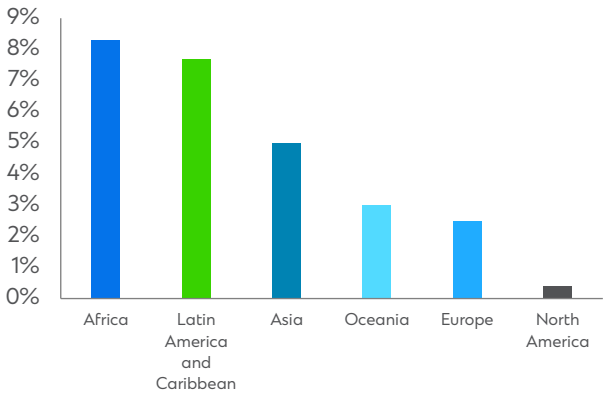
Percentage of 2022 production



Source: FAO, Standard Chartered

Figure 35:
Annual growth rate in aquaculture production

2000-2022, annual average growth



Source: FAO, Standard Chartered

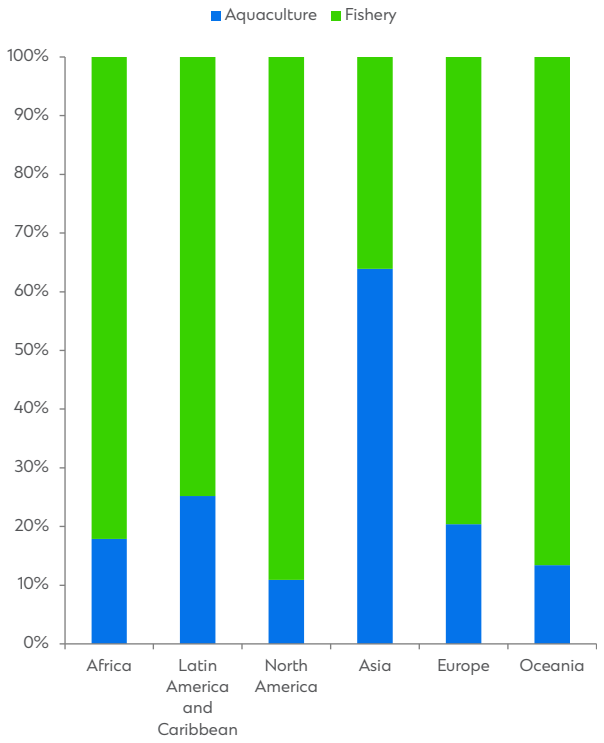
Production not only includes fish, but also algae (seaweed and micro-algae) and shells and pearls. In 2022 algae production levels reached 36.5 million tonnes, while 2.7 million tonnes of shells and pearls were produced. FAO data for algae production provides similar regional dynamics as for aquatic animal production. Growth across Africa has been strong since 2000, at an annual average rate of 6.1 per cent, however, algae production is dominated by Asia which has a 99 per cent share of the global market.

One of the opportunities that policymakers need to focus on is the fact that aquaculture activities remain underdeveloped, especially in many low-income countries. Aquaculture fish production makes up less than 20 per cent of total fish production across Africa and Latin America and the Caribbean. Aquaculture production across Asia, on the other hand, represents more than 60 per cent of total fish production (Figure 36). Data on a country level suggests strong upside for aquaculture across many parts of Asia too (Figure 37). Furthermore, we note that aquaculture is also underdeveloped in Europe and the USA. The regional differences suggest that the aquaculture sector has strong growth potential in our view. If managed well, it would also help meet the growing demand for seafood, support local economic growth, and improve the overall sustainability of the world's fishing market.

Notwithstanding aquaculture's strong growth potential, we highlight that it is not without its challenges. Environmental concerns around water pollution, disease spreading, and habitat destruction have been raised. Health concerns about the widespread use of antibiotics (or microbiomes in general) have also been highlighted. This clearly suggests that aquaculture can only be a sustainable alternative to wild fishing if it is done in a sustainable manner that does not create the above mentioned concerns.

Figure 36: Aquaculture growth potential large outside Asia

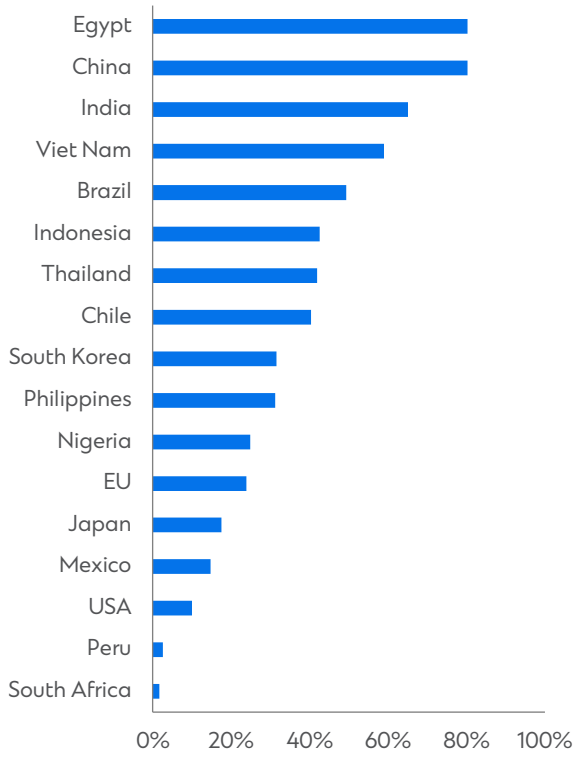
Percentage of fish production by method, 2022



Source: FAO, Standard Chartered

Figure 37: Share of aquaculture for key markets

Aquaculture production as per cent of total fish production, 2022



Source: FAO, Standard Chartered

Solutions that help create a more sustainable seafood economy

We propose that improving the sustainability of the seafood industry can be achieved through the adoption of three drivers:

- We believe that there is a need for stricter regulation and enforcement of fishing regulation. This regulation should not only focus on fishery of wild fish from oceans, rivers, and lakes, but also on the sustainability aspects of aquaculture. Important to point out here, is that stricter regulation should not delay fishing license approval times.
- Technologies and solutions need to be developed and adopted that aim to improve the efficiency or productivity of seafood production. These solutions not only need to result in better combinations of production yields, with fewer inputs and lower environmental impact, but also need to reduce seafood waste.
- Finally, we believe that alternative seafood solutions including cell-based seafood need to be developed, as this may shift some demand away from traditional seafood.

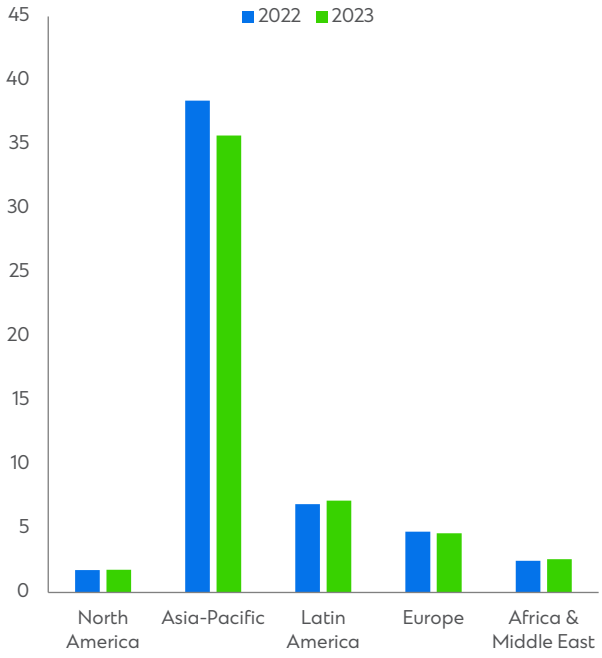
The seafood value chain exists in a number of different markets, each of which are currently developing solutions that potentially enhance the sustainability of the seafood ecosystem. A full analysis of all of them goes beyond the scope of this report – however, we do briefly outline the key aspects for some.

Aquafeed and alternatives

The growth in aquaculture production has been facilitated by an increasing reliance and availability of aquafeed. Total aquafeed tonnage reached 52 million metric tonnes in 2023, which according to the Alltech annual Agri-Feed report was the first year of a decline in aquafeed production. Falling fish prices in China were cited as the main reason for this decline. Aquafeed production is mainly located in Asia-Pacific as it accounts for 69 per cent of the overall market (Figure 38).

Figure 38:
Aquafeed production by region

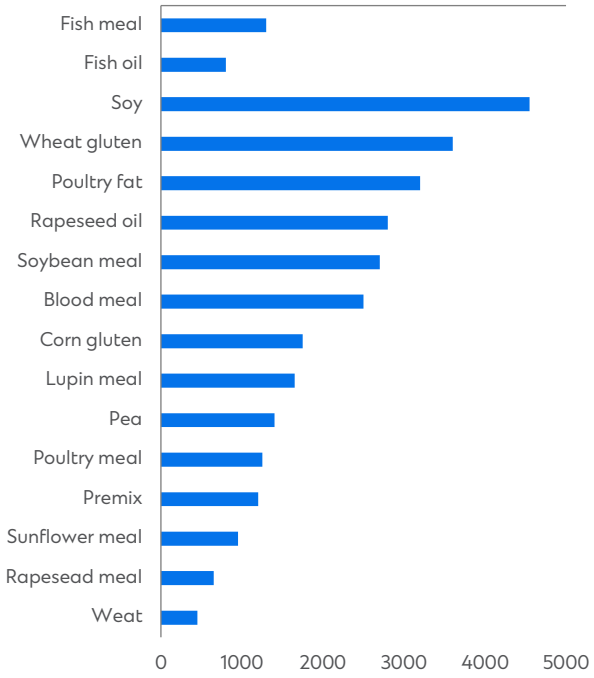
Million metric tonnes



Source: Alltech, Standard Chartered

Figure 39:
Global warming potential of different aquafeed

Kg CO_2e/tonne product



Source: IFFO, Standard Chartered

The traditional components of aquafeed have been fishmeal and fish oil, which are protein-rich byproducts of species such as anchovy, herring, and krill. The growth in aquaculture has increased demand for fishmeal and fish oil to the extent that seven of the world's largest ten fisheries by volume, target fish of which 90 per cent is used to be processed into fishmeal and fish oil, according to the WWF.

The need to expand aquaculture production in a sustainable way has started to create discussions around whether this can be achieved with current aquafeed. Arguments in favour of switching to different forms of aquafeed include the fact that using fish to feed fish is inefficient, and importantly the fact that current aquafeed appears to dominate the life cycle environmental footprint of aquaculture production. Cooney et al. (2021), for example, highlight a range of studies showing that aquafeed is responsible for up to more than 90 per cent of the global warming potential related to rainbow trout production; up to almost 50 per cent in case of white-leg shrimp; and can be as high as 93 per cent in the case of salmon. The same studies also show that aquafeed plays a significant role in cumulative energy demand of these production sites and acidification potential.

Shifting aquafeed production away from fishmeal and fish oil to more plant-based products does not appear to improve the sustainability of aquafeed. Malcorps et al. (2019) show that substituting fishmeal (in the case of shrimp production) could lead to increasing demand for freshwater by up 63 per cent, land by up to 81 per cent and phosphorus by up to 83 per cent. Soy is also used as a fishmeal and fish oil substitute. However, this also has environmental challenges associated with it, including deforestation. More broadly, the Marine Ingredients Association IFFO, highlights analysis showing that most plant-based alternatives to fishmeal and fish oil have a higher global warming potential (Figure 39).

To improve the sustainability of aquafeed and provide sufficient supply to support future aquaculture growth, a number of new alternative aquafeed markets are being developed. Examples are:

01

Single cell solutions: Alternative protein solutions to produce aquafeed have become popular during the past ten years. These include proteins from single-cell organisms such as bacteria, yeast, and microalgae. One of the benefits of producing protein from yeast and bacteria is the fact that feed sources used include methane and carbon dioxide, which enhances their environmental credentials. Single cell proteins have been tested in diets of a range of aquatic species and this has shown that it can make up to c. 40-50 per cent of protein required by Rainbow trout and Atlantic salmon. The key challenge at this stage appears to be access to capital, as production facilities for single cell protein solutions are capital intense.

02

Macro algae – the seaweed revolution: As shown earlier in this section, using land-based plant proteins as substitute for fishmeal may not improve the environmental footprint of aquaculture. This downside may not exist when using seaweed as a protein source. A literary review by Chopin (2019) showed that adding seaweed to aquafeed did not have negative impact on growth rate, weight gain, feeding efficiency or muscle protein. Some studies showed positive impact on growth. Substitution rates of fishmeal with seaweed were assessed to be as high as 50 per cent for some species. In our seaweed report (link: Kelp is on the way) we provide further insight into the outlook for seaweed production and how this may help sustainable targets. Growing seaweed as a potential source for aquafeed would also help the quality of local ecosystems.

03

Insects as source of protein: Finally, we note that an increasing number of companies are developing production capabilities related to using insect protein as a source for aquafeed. Insects that have been used include mealworm, fruit flies, locusts, and the black soldier fly. Work from Belghit et al. (2019) showed the potential whereby a 100 per cent replacement of fish meal with a black soldier fly meal was possible without negative effects on growth performance, feed utilisation or nutrient digestibility. One of the additional positive side effects of using insect protein appears to be that it improves the immune response and modulates the microbiota of fish.

Precision fishing technologies

Improving production yields for both fisheries and aquaculture is a key requirement to improve the sustainability of the seafood system. This also reduces the environmental footprint per unit of fish produced or caught. To achieve this, seafood companies can adopt precision fishing technologies. These not only increase production yields, but importantly can also help to address the fact that current fishing processes are indiscriminate and wasteful. The FAO estimates that c. 10 per cent of fish caught consists of unwanted species or bycatch.

Precision fishing uses data and AI technologies to optimise fishing operations and fishing management. These technologies focus on monitoring of fishing activities, measuring of the oceans and their fish populations, and provide insight into how to respond to changing conditions.

Aquatech for the aquaculture sector

The controlled nature of fish production makes the aquaculture sector ideal for the adoption of automation, robotics, AI, and data technology solutions. It allows farmers to optimise feeding schedules, maximise yields, minimise waste, and, as a result, minimise any potential negative impact of overfeeding on local ecosystems, too. Furthermore, automation of aquaculture production facilities allows for greater scaling potential which in turn increases overall production potential for the sector.

Figure 40: Aquatechnology solutions for fishery and aquaculture

Sub Header	Use cases
Robotics	Feeding, cleaning ponds and nets, injecting vaccines, removing fish.
Drones	Can be used above and below water for extensive monitoring. Especially useful for offshore farms.
Sensor technology	Used to measure full range of datapoints relevant for aquaculture including for water quality, feeding and state of fish, net status and fish movement. Cost benefits are substantial. Feed reduction cost of more than 20 per cent are reported by companies such as eFisheries.
AI/Cloud computing	Using data collected through drones and sensors AI can develop and optimise aquaculture production procedures and algorithms. Cost reduction of 30 per cent or more can be achieved.

Source: Standard Chartered

Alternative protein – cultivated seafood

Creating a more sustainable seafood sector can also be achieved through the development of alternative seafood products. Like in the meat industry, we note that cultivated seafood is an area that is a relatively recent phenomenon but has the potential to attract consumer demand if it can scale sufficiently for its products to become cost competitive. Additional benefits of cultivated seafood production are that it does not have some of the environmental challenges associated with traditional wild fishing or aquaculture, such as nutrient pollution, overcrowding or waste generation (e.g., from discarded fishing nets).

The Good Food Institute, in their most recent annual review, noted that 174 companies worldwide were involved in developing cell-based cultivated meat and seafood in 2023. Corporate interest in developing alternative meat and seafood products has rapidly increased; ten years ago, only 2 companies were active in this field. Typically, small new industries suffer from a lack of capital. While this is likely the case for a section of the alternative meat and seafood sector too, we do note that many of the largest meat and consumer packaged goods companies have exposure to the sector through investments, acquisitions and partnerships. This should (in our view) provide the alternative meat industry with sufficient growth capital if proof of concept can be delivered. Partnerships that are active in the alternative seafood space include those between Umami Bioworks and Triplebar, BlueNalu and Nutreco and Umami Bioworks and Cell AgriTech. Distribution networks between established companies and alternative seafood producers are also being set up. An example is the partnership between BlueNalu, Mitsubishi Corporation, Pulmuone and Thai Union.

Several key challenges will have to be overcome before the alternative seafood market can become a realistic alternative to traditional seafood. First, regulation needs to develop more broadly. Specifically, approval to sell cultivated meat and seafood needs to be given by more countries. At present, only a few – including Singapore and the US – allow the sale of cultivated products. Second, the industry needs to scale, which requires a full development of the entire value chain, including bioreactors and media suppliers. This requires a lot of capital and investments. Finally, we note that consumer appetite for cultivated or cell-based meat and seafood is not a given. Substantial marketing efforts need to be developed to increase consumer willingness to eat alternative meat and seafood. These three factors suggest that alternative seafood is unlikely to become a significant disruptor to the existing seafood market in the short term. However, long term we do not discount the possibility that cultivated seafood may attract an increasing market share and thereby help address food security and increase the sustainability of the overall seafood market.

Company profile:

Wildtype

Overview

Wildtype was founded in 2017 with the aim to produce cultivated seafood. The company has raised c. USD130 million to date and has an operating pilot plant that can produce up to 20,000 kilogrammes of cultivated salmon per year.

Relevance to the blue economy

Wildtype contributes to the sustainability of the blue economy given that its products reduce the need to increase wild fishing and aquaculture in order to meet the growing demand for seafood as the world's population increases and dietary preferences change. Wildtype notes that its products help reduce potential negative health implications from eating traditional seafood, which is often contaminated with micro plastics, antibiotics and can contain high levels of mercury, lead or arsenic. Finally, the company estimates that the carbon intensity of its seafood production at scale will be more than 80 per cent lower than that of traditional seafood production. Wildtype can produce its salmon within 3 weeks with minimal waste which compares very favourably to traditional fishing conditions.

What are the key challenges and opportunities?

Wildtype currently has a prime focus on the US market. The company believes that its growth prospects there are strong given that the US imports c. 80 per cent of its seafood. Other factors highlighted by the company as supportive for its growth outlook include the fact that the cost of traditional salmon has increased c. 4-fold over the past twenty years. Consumer acceptance of Wildtype's salmon product appears promising too, as over a third of consumers participating in blind taste tests prefer Wildtype's salmon over traditional sushi-grade and smoked salmon. Future growth-drivers might include expansion into other markets, most likely Asia, and the potential to license its technology.

In our assessment of alternative (or cultivated) protein products, we have often encountered concerns around the cost. In the case of Wildtype, the company notes that its cost of production has fallen by more than two orders of magnitude since 2019, and now has line of sight to cost parity with premium conventional salmon.

Wildtype faces two key challenges in growing its business beyond its current pilot-stage. The company has not yet completed the FDA's voluntary pre-market consultation process. Wildtype is unlikely to scale production to commercially viable levels until this consultation process is complete. The second challenge that the company faces relates to investment needs associated with scaling production. The associated cost of setting up such a facility may amount to USD100-200 million dollar, according to the company. Wildtype notes that this might be a potential issue given that blue economy financing is too focused on early stage or seed capital projects, and that there is too little finance available to allow companies to scale from early stage to full-scale commercial status. This needs to change in their view to ensure solution providers to grow and help improve the sustainability of the blue economy.

Pollution and waste prevention

Pollution is one of the key sustainability challenges faced by blue ecosystems. Plastic waste in particular needs to be addressed, but chemical and nutrient waste, mostly as a result of agricultural activities, is also a concern. A rapidly growing number of companies are developing solutions that aim to tackle specific pollution and waste issues. We list some of these in the table below.

Figure 41: Overview of solutions to help reduce pollution and waste

Blue economy sector	Key solutions	
Pollution and waste	Algae based solutions	Plastic alternatives
	Biodegradable pads	Plastic and waste recycling solutions
	Biopesticides	Plastic to apparel solutions
	Bioplastics	Reducing chemical spillage solutions
	Bricks from recycled plastic	Reusable packaging
	Circular logistics	Waste collection and processing
	Fishing gear solutions	Waste to protein solutions
	Methane reduction (seaweed)	Water monitoring, filtering and cleaning solutions

Source: Earthshot Prize, 1,000 Ocean Startups, Standard Chartered

Why is it relevant?

Analysis from Pew et al. shows the potential scale of the problem posed by plastic. A business-as-usual scenario suggests:

- That between 2021 and 2040 plastic production will double, plastic leakage into ocean will triple, and that the plastic stock in the ocean will quadruple.
- That plastic pollution will cost businesses USD10 trillion in 2040 while governments face costs of USD670bn.
- That the plastic industry alone will use 19 per cent of the remaining carbon budget associated with a 1.5°C scenario.

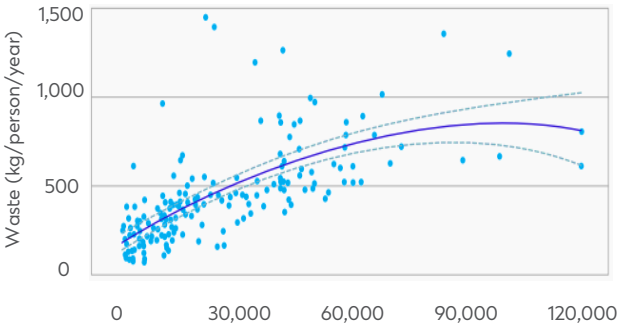
Solutions that reduce plastic pollution

A wide range of solutions exist that will help address plastic pollution in marine ecosystems. We highlight the following:

- **Reducing the growth in new plastic production:** This can be achieved through tighter regulation on plastic usage (e.g., a ban on the use of single-use plastic), recycling of plastic and switching how plastic products are delivered (e.g., allow refilling of bottles and other reusable plastic packaging from dispensers). One of the interesting recycling developments that has strong relevance to the blue economy relates to companies that recycle wasted fishing gear and help convert this into other products. The relevance of addressing this was underlined by estimates from Richardson et al. (2022) and Gilman et al. (2021) who suggest that 56 per cent of fish aggregating devices, 29 per cent of lines, 8.6 per cent of pots and traps and 5.7 per cent of nets are lost annually. Examples of companies that recycle end of life fishing gear, and thereby aim to reduce the environmental and health problem associated with it, include Bureo and Netspa. These companies benefit the blue economy directly through employment, help improve the sustainability of blue ecosystems by collecting wasted fishing gear and help reduce growth in new plastic production as their old fishing gear is used in other products.
- **Switching from plastic packaging to alternatives:** Ready to use solutions include paper-based packaging, however, we note that bioplastics are an interesting future alternative too. Companies that use seaweed to produce bioplastic products are especially impactful as they would help grow a sustainable blue economy and allow consumer product manufacturers to switch away from using traditional plastic at the same time. We analysed the outlook for bioplastic production in more detail in our analysis of seaweed (see: Kelp is on the way) but note here that the key challenge for these companies is to scale sufficiently enough to become more cost competitive with traditional plastic producers.
- **Expanding waste and recycling capacity especially across developing countries:** Economic growth across the developing world, driven partly by a further increase of the global population, means that plastic demand across EM is likely to increase stronger than elsewhere. This could contribute to a broader increase in waste generation there. Analysis from the United Nations Environment Programme (UNEP) in their most recent Global Waste Management Outlook report (2024) shows that waste generation per capita increases as wealth levels rise. Their analysis also suggests that plastic waste makes up just over 10 per cent of total municipal waste. Of particular concern is the level of uncontrolled waste generation which accounts for 38 per cent of global waste, and has the potential to end up in rivers, lakes or ultimately the ocean – and impact marine sustainability. In a business-as-usual scenario, global uncontrolled municipal solid waste may increase 94 per cent to c. 1.6 billion tonnes in 2050 (Figure 43). This scenario implies that in 2050, more than 179 million kg of solid municipal waste will be generated each hour of every day.

Figure 42: Relationship between waste and GDP

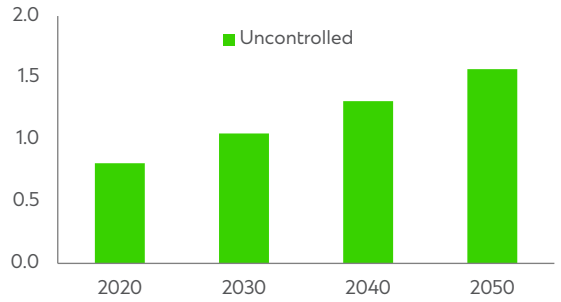
Most recent year available data



Source: FAO, Standard Chartered

Figure 43: Total uncontrolled waste generation

Business as usual scenario (billions of tonnes)

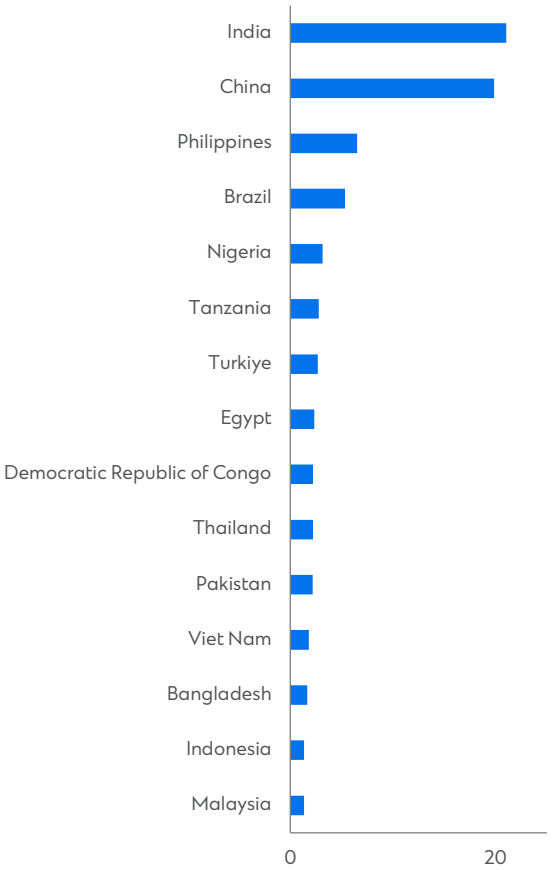


Source: FAO, Standard Chartered

At present, some 2.7 billion people do not have their waste collected, while waste collection rates generally are lowest in Sub-Saharan Africa and Central and South Asia according to data from UNEP (2024). Indeed, all the 15 countries that contribute most to mismanaged plastic waste, and that emit most plastic waste into the ocean are developing countries (Figures 44 and 45).

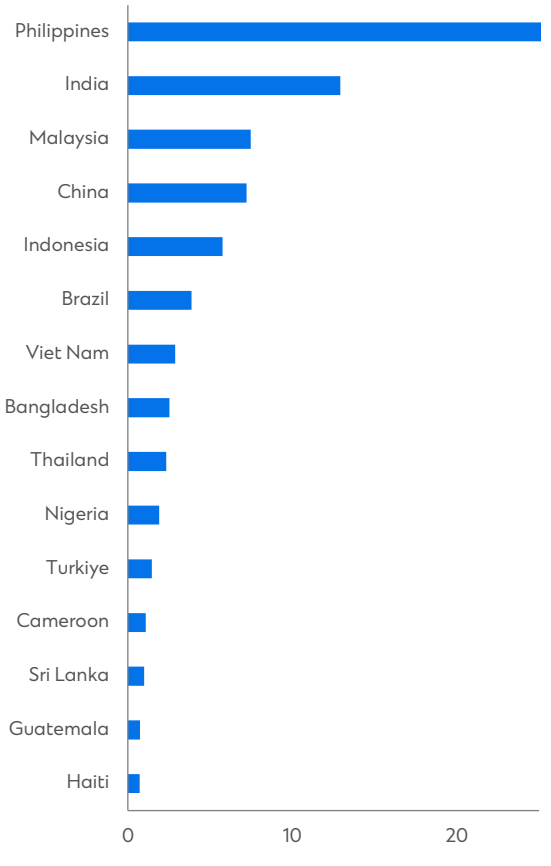
The potential rise in total waste generation especially across emerging markets where recycling is already low, suggest in our view that creating additional waste recycling capacity is crucial. In the absence of this, we expect more waste including plastic to end up in waterways and thereby do further damage to marine ecosystems.

Figure 44: Share of global mismanaged plastic waste, 2019, Countries with highest share



Source: Meijer et al. (2021), Standard Chartered

Figure 45: Share of global plastic waste emitted to the ocean, 2019



Source: Meijer et al. (2021), Standard Chartered

A range of organisations have started to develop solutions aimed at addressing plastic waste. The Clean Currents Coalition, for example, is a global network of local projects aimed at cleaning up the world's rivers across countries in Central America, Africa and Southeast Asia. Since 2021, almost 2.5 million kg of plastic has been collected. Different plastic collection or interceptor devices are used that, in some cases, can remove up to 100 tonnes of waste daily. Technology can be integrated into these solutions to optimise capture-rates and recycling of captured plastic. For example, some solutions use AI to categorise the waste as it moves along conveyors. Data analytics on river pollution, water-flow dynamics and probability modelling can be used to decide where and when to use refuse collection devices.

- **Microplastic-based solutions:** Pew estimates that c. 11 per cent of total plastic entering the ocean comes in the form of microplastics related to the tyre, textile, personal care, and pellet industries. The amount of microplastics that enter the ocean will rise significantly in a business-as-usual scenario given that, on a per capita basis, microplastic emissions are 3.4x higher in high-income countries than in the rest of the world. Microplastic emissions are therefore likely to grow, driven by the expansion of economic growth across the developing world. Reducing microplastic leakage can be achieved at source through changing design and production processes of textiles, change transport intensity and reduced overall plastic production. However, this is unlikely to completely remove microplastic leakage. Companies engaged in capturing microplastics, once released, provide a useful service in this regard.

Company profile:

The Great Bubble Barrier

Overview

The Great Bubble Barrier is a Dutch social enterprise that was founded in 2017 to help address plastic pollution in rivers before it flows into the ocean. The company has developed a technology that uses air bubbles to capture plastic.

Relevance to the blue economy

The Great Bubble Barrier is exposed to the blue economy theme of pollution and waste. To remove plastic from waterways The Great Bubble Barrier has developed a technology that creates a bubble curtain by pumping air through a perforated tube placed on the bottom of a waterway. The upward moving air bubbles create a current which direct plastic to the surface. Placing the perforated tube diagonally across the river ensures that the natural flow of river water will push the plastic to the side and into a catchment system. Once collected, the plastic can be removed and recycled.

The Bubble Barrier not only captures larger pieces of plastic but is also able to catch particles as small as 1 millimetre, as a pilot conducted in Berlin has shown. Key benefits of the Bubble Barrier are that it works non-stop, and that it can be deployed across the entire width of a river. What separates The Great Bubble Barrier's solution from other companies aiming to remove plastic is that its technology does not interfere with fish migration or ship traffic flows. The air bubbles can also have a positive impact on local ecosystems as they increase oxygenation levels and may decrease saltwater intrusion into freshwater environments.

The first Bubble Barrier was installed in Amsterdam in 2019. An 86 per cent catch rate was achieved in pilot programmes and since adoption in Amsterdam, close to 5 tonnes of dry debris has been collected. At present, 4 systems are operational across the Netherlands and Portugal. The company believes that the life expectancy of a Bubble Barrier is at least 10 years. The Bubble Barrier developed by The Great Bubble Barrier is not applicable in all solutions. It is best suited in small to medium sized waterways where no blockages are allowed, and where water flow intensity is not too high. For example, the system will struggle in deep rivers, those with heavy deep ship traffic, or in rivers with frequent dredging activity.

What are the key challenges and opportunities?

The Great Bubble Barrier is positive about its growth potential and is likely to expand into more jurisdictions. Feasibility studies are ongoing in Thailand, the USA and UK. The company currently relies on public funding for its projects, however, co-funding with private investors may develop, which could help capture growth potential.

Legislation does not currently define plastic as a water polluter. This, according to the company, is one of its key challenges as local and national governments may therefore not see removing plastic from waterways as a priority. This hampers both approval processes and securing sufficient funding. Internal challenges for the company include optimising its operational structure and deciding the most efficient method to scale its impact and technology

Nutrient and chemical spillage is a problem too

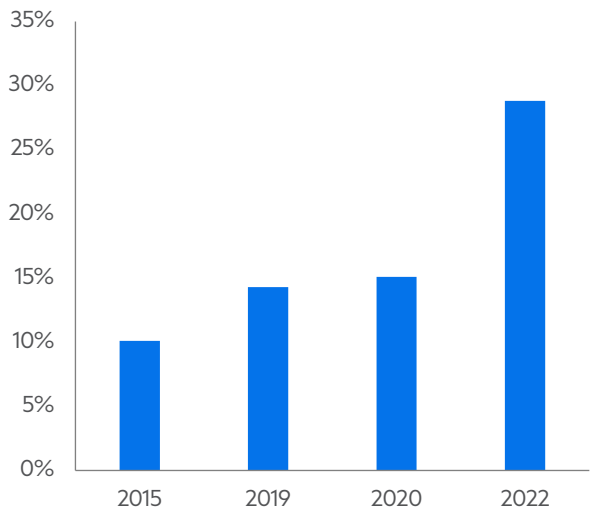
Marine ecosystems are impacted not only by solid waste and plastic but also by chemical leakage into rivers, lakes, and oceans. Nutrient pollution is a key problem, especially nitrogen and phosphorus leakage. Sources for this include agriculture (e.g., mismanagement of manure and overuse of fertilisers), domestic (e.g., fertiliser use, pest waste or certain soaps and detergents) and wastewater (e.g., not properly functioning sewer and septic systems).

Too much nutrient-rich chemicals pose a significant problem for the ocean and waterways. They can trigger algal blooms, which in turn can lead to deoxygenation when bacteria consume oxygen in order to break down the algae. Nutrient or chemical spillage is a global phenomenon. Data from the Environmental Protection Agency (EPA) in the USA, for example, suggests that all 50 states are impacted by nutrient pollution, and that c. 15,000 water bodies in the US have been identified with nutrient-related problems. Solutions to help address nutrient and chemical spillage include the following.

- **Prevention:** poorly managed usage of agricultural chemicals such as fertilisers is a key driver of nutrient spillage into waterways. This can be addressed through precision farming technologies that optimise the use of fertilisers and reduces their impact on soil and water ways. The quality of sewage and sceptic systems in general is deemed to be low, either because of a lack of maintenance spending in developed countries, or an absence of these systems across developing countries. Improving these systems would be a clear help. To minimise the cost impact, national and local governments could use automation and sensor technologies to help identify problem areas in a sewage system.
- **Chemical and nutrient alternatives:** Reducing demand for traditional chemicals or nutrients would be an obvious solution to their potential environmental impact on marine ecosystems. This can be achieved through improving soil quality to reduce the need for fertiliser. Adding biochar to agricultural soil would help in this regard. Fertiliser alternatives would be another example. A range of companies produce seaweed-based fertiliser alternatives that have a much better environmental footprint than chemical fertilizers. Beyond fertilisers, we note that the concept of 'green chemistry' is gaining momentum (Figure 46). Green chemistry products already make up c. 30 per cent of consumer-packaged goods sold, while almost half of new product launches in 2021 incorporated green chemistry (Figure 47).

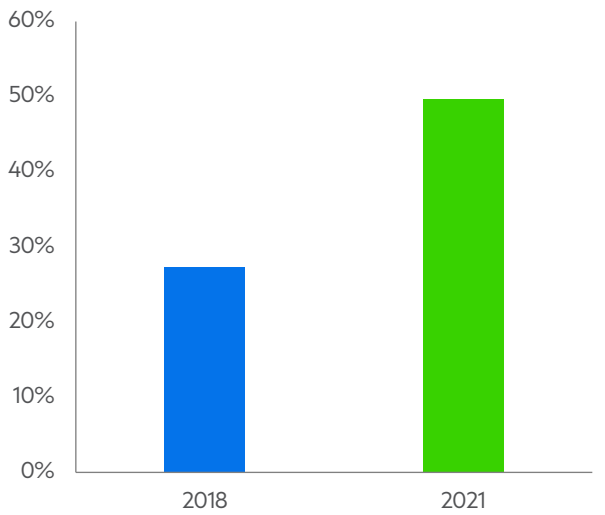
Figure 46: Green chemistry share of total sales

USD share of sales



Source: Change Chemistry, NYU Stern Center for Sustainable Business, Standard Chartered

Figure 47: Sustainable new products as per cent of total new products



Source: Change Chemistry, NYU Stern Center for Sustainable Business, Standard Chartered

Company profile:

Bureo

Overview

Bureo is a US company that was founded in 2013 with the aim to recycle end-of-life fishing nets that are sourced directly from fisheries. Today, Bureo sources nets from 43 different fishing communities across 9 countries, while headcount has grown to more than 40 employees.

Relevance to the blue economy

Bureo is exposed to the blue economy theme of pollution and waste. It collects end-of-life fishing nets from fisheries, which is recycled into NetPlus® nylon yarn. This recycled nylon can be woven into a wide range of fabrics such as shorts, vests, jackets, and hoodies. Fishing nets made from high-density polyethylene (HDPE) and nylon are recycled and used in the production of hard goods such as performance skateboards, frames for sunglasses, board games and surf fins and hat brims.

Bureo's business not only addresses potential plastic waste but has broader environmental benefits too. The company's lifecycle analysis comparing NetPlus Nylon 6 with Virgin Nylon 6 suggests that NetPlus Nylon 6 has a 20 per cent lower GHG footprint, reduces water consumption by 70 per cent, fossil fuel use by 67 per cent and reduces energy consumption by 68 per cent.

Bureo currently works with more than 25 brands that have adopted NetPlus material into their product lines. These include Patagonia, Costa Sunglasses, Quicksilver and Trek. Over 3.9 million products made with NetPlus material were sold in 2023. The company is actively engaging with new potential buyers to expand the number of brands that buy its products. The most recent example of this is Bureo's entry in the UK via outdoor specialist Finisterre.

In the areas where Bureo works, it engages with local communities to help drive impact. Recycling end-of-life fishing nets allows the company to direct funding to help projects set up by local environmental non-profit organisations. These include wastewater treatment facilities in Peru, the establishment of hydroponic gardens in Chile, or the installation of plastic collection systems to trap waste in rivers in Mexico.

What are the key challenges and opportunities?

Bureo believes that it has strong growth potential. It expects to recycle c. 1500 tonnes of fishing nets this year, however, this still only represents less than 0.3 per cent of total global annual fishing net waste. Recycled nylon makes up less than 2 per cent of annual nylon consumption which also implies strong growth potential according to Bureo.

Securing sufficient quality feedstock, organising the logistical part of its production process and establishing longer term offtake agreements with buyers are some of Bureo's main challenges as it starts to recycle ever more fishing nets. The company notes that it remains challenging to strike contracts with larger apparel companies given that its recycled nylon is somewhat more expensive than virgin nylon. However, Bureo expects to benefit from the impact of plastic-related legislation and a shift in consumer preferences in favour of circular and recycling production methods.

Coastal and marine ecosystem protection and restoration

The ocean cannot become sustainable unless existing marine eco-systems are protected and restored where needed. Most of the other solution areas discussed in this report rely heavily on private capital involvement. This is different for the restoration of ocean areas. Governments have committed themselves to the Global Biodiversity Framework's '30x30' commitment to conserve 30% of terrestrial, inland water, coastal and marine areas by 2030. However, we see insufficient funding and operational progress to suggest that the Kunming-Montreal targets will be achieved. Solutions that need greater support in this regard are active in the fields listed in the table below. We see blended finance and debt-for-nature swaps as key tools to unlock greater funding for conservation and restoration efforts, especially across the developing world.

Figure 48: Activities that help restore and protect marine ecosystems

Blue economy sector	Key solutions	
Restoration and conservation	Blue carbon credit-driven approach	Seaweed-driven conservation efforts
	Coral reef restoration solutions	Urchin-driven conservation
	Mangrove restoration solutions	Wave barrier technology-focused
	Monitoring technologies for conservation	Wetland-focused conservation

Source: Earthshot Prize, 1,000 Ocean Startups, Standard Chartered

Why is it relevant?

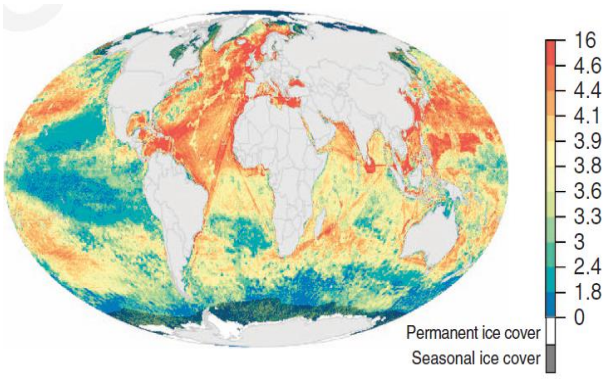
71 per cent of the Earth's surface is covered by oceans and consists of various coastal and marine ecosystems such as mangroves, seagrass beds, coral reefs, and kelp forests. Yet, it is estimated that 97 per cent of the ocean is affected by multiple human stressors, many of which are associated with climate change, commercial fishing, and shipping (Halpern et al. (2015). The cumulative impact of these human stressors is particularly significant in the Atlantic Ocean and in the West Pacific Ocean (Figure 49).

The need to restore wetlands is high, as various estimates show a significant decline in the area of mangrove habitats since 1990 (Figure 50). The 2021 Global Mangrove Alliance update states that in many countries more than 80 per cent of small-scale fishers rely on mangroves, while they are estimated to prevent more than USD65 billion to property damages annually, reduce flood risk to some 15 million people per year and store the carbon equivalent to over 21 gigatonnes of CO_2. A further decline in mangroves would put all these factors at more risk.

The restoration and conservation of marine ecosystems will improve not only the ocean's carbon sequestration potential, but also lead to indirect economic and social benefits. The focus is mainly on coastal wetlands such as mangroves and seagrass, however, we expect this to widen in the future to include kelp forests and other seaweeds as their carbon storage characteristics become better understood.

Figure 49: Cumulative human impact on marine ecosystems

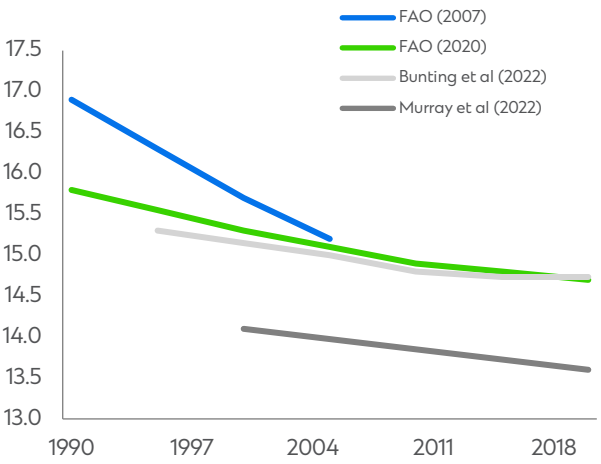
Impact score out of 19 anthropogenic stressors



Source: Halpern et al., 2015

Figure 50: Global mangrove habitat estimates

Hectare million



Source: FAO, Bunting et al., Murray et al., Standard Chartered

Coastal and marine ecosystem conservation and restoration

Coastal and marine ecosystem conservation generally refers to the sustainable management of coastal and marine ecosystems to ensure the continued provision of ecosystem services, and derivation of benefits for the next generations. Conservation may involve the protection of marine ecosystems or the regulation of human activity within or near the ecosystems.

Coastal and marine ecosystem restoration can entail active restoration, which involves various human interventions that are targeted at improving the ecosystem beyond natural processes or rates. There is also passive restoration, which involves the reliance on natural ecological processes to recover a given ecosystem. An example of active restoration in marine ecosystems is coral re-planting. An example of passive restoration in a similar context could be the prevention of any human activity to ensure no further impacts on the existing coral reef ecosystem, allowing it to naturally regrow. A range of efforts exist that aim to conserve and restore coastal and marine ecosystems. We highlight a few of the more prominent ones here.

International policies and agreements

- **UN SDG 14:** Targetsrelating to SDG 14 revolve around the reduction of marine pollution of all kinds; the sustainable management and protection of coastal and marine ecosystems through ecosystem-based approaches; and the conservation of coastal and marine areas.
- **The UNFCCC Paris Agreement** encouraged the inclusion of conservation and restoration of blue carbon ecosystems in countries' Nationally Determined Contributions (NDCs), recognising the potential as both a climate mitigation and adaptation solution.
- **UN Convention on the Law of the Sea (UNCLOS) and the High Seas Treaty:** Adopted in 1982, UNCLOS establishes rules governing the use of oceans and their resources and designates waters within 200 nautical miles (370km) of a country's baseline (typically the low-water line of a coastal state) to be Exclusive Economic Zones (EEZs) of the coastal states. Within EEZs, coastal states enjoy sovereign rights to the fish and other resources in these waters, but do not have sovereignty over the waters.

Adopted in 2023, the UN High Seas Treaty seeks to conserve and ensure the sustainable use of the marine environment beyond the national boundaries (the "high seas"). It provides the legal framework and process for establishing marine protected areas in waters beyond national jurisdiction. It also provides standards and guidelines for conducting environmental impact assessments, and the fair and equitable sharing of benefits, as well as enabling capacity building and technology transfers.

National policies and activities

Various governments have also developed national restoration and conservation policies with the aim to strengthen their local marine ecosystems. These typically evolve around the management of fisheries and marine protected areas within the country's EEZ. Examples of national policies and activities include:

- Australia's Commonwealth Marine Reserves Network, which manages 60 Australian Marine Parks that span more than 4.3 million km^2 (or approximately 40 per cent) of Australia's oceans.
- Indonesia's Sustainable Oceans Program, which aims to help Indonesia's transition to a blue economy by supporting sustainable fisheries and coastal livelihoods, building healthy coastal and marine ecosystems, and reducing marine pollution to increase the economic, social, and environmental benefits derived from healthy coastal and marine ecosystems.
- UK's Blue Belt Programme, which assists UK Overseas Territories in creating and maintaining healthy and productive marine ecosystems.
- USA's Marine Protection, Research and Sanctuaries Act, also known as the Ocean Dumping Act, prohibits the dumping of material into the ocean that would unreasonably degrade or endanger human health, welfare, or amenities or the marine environment, ecological systems, or economic potentialities.

Conservation and restoration are not without their challenges

Despite international programmes and national efforts to conserve and protect marine and ocean ecosystems, we find that progress to date has been slow. National waters represent 39 per cent of the ocean, however, protected national waters account for less than 8 per cent of total marine protected areas. Furthermore, less than 1 per cent of protected marine areas are found within the high seas.

The lack of progress can, in our view, be linked to the complexities of managing and protecting marine areas within the high seas. These challenges include: a lack of clear jurisdiction, the existence of various international and regional agreements and bodies that further fragment governance, limited enforcement and monitoring capacity in the high seas, and the trade-offs between protecting national ocean resources versus dedicating resources to the high seas. While the High Seas Treaty may help to address the governance and jurisdiction aspects of protecting the high seas, challenges around enforcement and dedicated resources to the protection of the high seas remain largely unresolved.

Furthermore, with the nature of oceans being liquid and interconnected by currents, impacts are not limited to the geographies they first occur in. For example, a pollutive impact in one location can easily spread across large distances with the very same currents that moderate coastal temperatures and carry nutrients. Similarly, with dependencies on fishing stocks, migratory fish species may be decimated by overfishing in one region, yet instead create scarcity in another region that is also dependent on the species.

As such, effective and meaningful coastal and marine ecosystem conservation and restoration requires concerted international support to ensure that the efforts of countries are sustained, and to ensure that sufficient resources are channelled towards the protection of areas that are not within national jurisdictions.

Conservation and restoration funding remains too low

One of the major challenges associated with coastal and marine ecosystem conservation and restoration is the fact that funding has been too low. To achieve the targets of UN SDG 14 by 2030, a 2020 study estimated that a total of around USD175 billion is required each year. Of the USD175 billion, USD34.1 billion is required for protecting and restoring ecosystems, to the extent of reducing the rate of loss of natural habitats and minimising anthropogenic pressures on ecosystems (see: Johansen and Vestvik (2020). With an estimated USD25 billion committed annually for SDG 14, this leaves a financing gap of USD150 billion each year.

As we outline elsewhere in this report, we see blended finance and debt-for-sustainability swaps as tools that might help unlock greater levels of funding that could be deployed to conserve and restore marine ecosystems. These tools are especially relevant for developing countries, as these typically suffer from a relative lack of access to cheaper financing. Attracting financing for conservation and restoration activities requires an understanding of their economic benefits, as this provides investors with greater insight into the potential for managed marine areas to repay debt financing.

Company profile:

Regenerative AquaForestry Technologies (RAFT)

Overview

RAFT is a company that has developed a regenerative seawater-based aquaculture solution that helps address poverty, biodiversity loss, ecological degradation and food and water scarcity. The company is currently focused on projects in Texas and Mexico but is also talking to potential partners across Middle East and Africa.

Relevance to the blue economy

RAFT has identified 15 million hectares globally where it can provide its Regenerative Seawater Agroforestry (RSA) solution. The company has focused on shrimp farming for its RSA solution until now. Shrimp aquaculture farming is worth c. USD40 billion per year but is associated with mangrove deforestation and pollution of marine ecosystems. An RSA approach towards shrimp farming does not have these negative environmental externalities, but rather eliminates pollution, facilitates mangrove and marine restoration, and provides a sustainable source of crucial food-security products without the use of freshwater.

The RSA approach uses effluent from shrimp aquaculture production to help grow mangrove-based agroecologies. These in turn help grow the aquaculture feed that is then used in its shrimp farming operations. This approach helps sequester carbon, reduce the need for external feed and fertiliser, provides work for local communities and improve local biodiversity conditions. The RSA-based approach can also be helpful in reducing freshwater challenges. For example, the company notes that its system could grow to produce 100 per cent of the fodder needs for the Middle East and East Africa. This means that local dairy companies do not have to rely on imported fodder sources, which often require substantial amounts of
fresh water.

Regenerative seawater agroforestry can help restore depleted fish levels. This in turn will support incomes for small scale fisheries and in so doing help strengthen economic conditions of coastal communities. Overall, the company believes that its RSA solutions help address 13 of the 17 SDGs.

What are the key challenges and opportunities?

One of the biggest challenges faced by the company is attracting sufficient funding to establish its own farm and show the impact of RSA at scale. The company notes that this is difficult because the related investment needs are substantial, while institutional investors, in particular, want to see prove of concept first before committing. This creates a classic 'chicken and egg' problem for the company.
To be more effective in raising required funding, RAFT was created out of Regenerative Resources which also included blue carbon activities. Splitting these two activities into separate companies reduces the overall complexity of the investment case and should allow RAFT to more effectively target potential investors.

Longer term the company believes that licensing of its regenerative aquaculture technology to other aquaculture farms provides strong growth and impact potential.

Blue carbon

Net zero pathway calculations by institutes such as The Intergovernmental Panel on Climate Change (IPCC) and the IEA, suggest that carbon capture and storage solutions will be needed to reduce emissions to net zero. Ocean-based carbon storage is increasingly seen as one of the solutions that might help achieve this. With the rise of nature-based solutions, "blue carbon" has become increasingly popular in recent years. In this section, we cover what blue carbon entails; why it is increasingly relevant; developments in the blue carbon space; and future headwinds and trends emerging in blue carbon. Some solutions developed by companies in this area are listed in Figure 51.

Figure 51: Overview of activities associated with blue carbon

Blue economy sector	Key solutions	
Blue carbon	Biochar production from seaweed	Ocean alkalinity enhancement
	Micro algae-based carbon capture	Seaweed-based carbon capture

Source: Earthshot Prize, 1,000 Ocean Startups, Standard Chartered

About blue carbon

First coined in 2009 to raise awareness of the degradation of marine and coastal ecosystems, the original definitions of "blue carbon" referred to the biological carbon captured by marine living organisms within marine ecosystems, which was estimated to be 55 per cent of all biological carbon (Lovelock and Duarte (2019). In two seminal documents that brought blue carbon to the fore, the UNEP-published "Blue Carbon: The Role of Healthy Oceans in Binding Carbon" and the IUCN-led "The Management of Natural Coastal Carbon Sinks", the importance of sustainably managing coastal and marine ecosystems was highlighted.

While the core driver of the "blue carbon" concept had always been to conserve and restore the blue carbon ecosystems – mangroves, seagrass beds and salt marshes – the discourse around blue carbon was mainly focused on its climate mitigation potential. Aptly dubbed "nature's ingenuity for carbon capture and storage", attention around these coastal and marine ecosystems grew, with research & policy developments focused on quantifying the carbon stocks, sequestration rates and mitigation potential of the blue carbon ecosystems (Nelleman et al. (2009). By 2016, several countries had incorporated coastal wetlands into their mitigation efforts as part of their nationally determined contributions (Lovelock & Duarte, 2019).

In the 2020s, the discourse around blue carbon shifted. IPCC's Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC), published in 2021, had noted the mitigation potential of restoring blue carbon ecosystems to be only around 0.5 per cent of annual global emissions (0.5-2.1 $GtCO_2/yr$). This mitigation potential is small in comparison to that of restoring forests, which was estimated to be between 0.5-10 $GtCO_2/yr$. Despite its low mitigation potential from restoration, the SROCC report highlighted the importance of protecting and managing these ecosystems to reduce the emissions that are generated from their degradation. In fact, while these blue carbon ecosystems absorb approximately 12 per cent of human-caused CO_2 emissions, storing up to 5 times more carbon per area than tropical forests, blue carbon ecosystems are still being threatened (Wood and Ashford (2023). Based on estimates, at least 50 per cent of salt marshes, 29 per cent of seagrass meadows and 35 per cent of mangroves have been degraded or lost since the mid-twentieth century (Wood and Ashford (2023). As the ecosystems are degraded, they are not only unable to absorb as much carbon dioxide as before, but they will also release their stored carbon into the atmosphere.

The SROCC report also recognised the protection and management of these ecosystems to enable "multiple benefits, such as providing storm protection, improving water quality, and benefitting biodiversity and fisheries" (IPCC, 2019). For example, World Bank's Changing Wealth of Nations 2021 Report estimated that mangrove ecosystems protected USD24 billion of productive assets from flooding in 2018 (World Bank, 2023). In the face of ecosystem degradation, such benefits, also known as ecosystem services, will be reduced, and this may result in significant ripple effects throughout the economy.

Thus, the refreshed argument for blue ecosystems focused on conserving existing blue carbon ecosystems for their adaptation and socio-economic benefits to retain existing carbon stores and continue existing sequestration levels.

State of play on blue carbon

Today, blue carbon is still popular as a concept, particularly gaining traction along with the rise of nature-based solutions. This has been exemplified by the inclusion of blue carbon within various countries' NDCs, some of which have incorporated blue carbon within their numerical targets such as Australia and the USA. While others, such as Angola, Bahamas, Bangladesh, Suriname, and Sri Lanka, have not yet done so and instead may include particular blue carbon ecosystems such as mangroves in their mitigation measures. Japan has also been exploring blue carbon to be included in their GHG accounting, though the measures are focused on seaweed and seagrass.

Figure 51: Blue carbon ecosystems around the world

Source: United Nations, Standard Chartered

Beyond national policies, the past few years have seen different blue carbon initiatives come to life, along with various guidance for implementing blue carbon solutions. Notable initiatives include:

- The High-Level Panel for a Sustainable Ocean Economy is a group of 18 world leaders that are working to promote a sustainable ocean economy in which effective protection, sustainable production and equitable prosperity go hand-in-hand. To guide the implementation of blue carbon as a nature-based solution for climate and sustainable development, the panel commissioned the "Blue Carbon Handbook" (Murray, et al.., 2023).
- The Blue Carbon Initiative, convened by Conservation International, UNESCO, and IUCN, brings together governments, researchers, and NGOs to protect and restore coastal ecosystems through the promotion and development of scientific knowledge about these ecosystems. The Blue Carbon Initiative has published guidance on methods for assessing carbon stocks and emission factors in these blue carbon ecosystems (The Blue Carbon Initiative, 2014).
- Several organisations including the Ocean Risk and Resilience Action Alliance (ORRAA), Conservation International (CI), World Economic Forum (WEF), and The Nature Conservancy (TNC) have also come together to publish the "High-Quality Blue Carbon Principles and Guidance" (2022) to instil confidence and drive momentum around blue carbon project development and investments.

Blue carbon has also been incorporated in well-known carbon credits standards such as Verra's Methodology for Tidal Wetland and Seagrass Restoration and Gold Standard's Blue Carbon and Freshwater Wetlands Activity Requirements.

There are also many case studies around blue carbon ecosystem maintenance and restoration and the unlocking of finance through blue carbon credits. One of which is the Delta Blue Carbon Project in Pakistan, which sold its credits on the Climate Impact X (CIX) platform, a joint venture between Standard Chartered, DBS, Singapore Exchange (SGX) and Temasek Holdings. The Delta Blue Carbon project involves the restoration of 350,000 hectares of degraded tidal wetlands in the Indus Delta Area in the Sindh Province, Pakistan. The project is expected to sequester 142 million tonnes of CO_2e over its 60-year lifespan and will also contribute to biodiversity conservation and supporting local livelihoods. In 2022, the project's credits received overwhelming interest – in one auction of 250,000 tonnes of credits, 30 per cent of volume had bid at USD35 per tonne and above, compared to the credit's sold price of USD27.80 per tonne.

The potential of blue carbon

The potential of blue carbon may be viewed from several angles:

- The blue carbon credits realisable from restoration of blue carbon ecosystems, which was discussed in the earlier sections of this paper. These realised carbon credits may be sold or used for the purposes of meeting climate ambitions. Blue carbon credits cost between USD13 – 35 per tonne of CO_2e. In UNESCO's "Custodians of the globe's blue carbon assets report", blue carbon was recognised as a potential revenue stream to finance the conservation of blue carbon ecosystems, at least in part (UNESCO, 2020).
- The blue carbon stock and continued sequestration that may be retained through the sustainable management and protection of blue carbon ecosystems. Research suggests that the conservation of existing mangroves, seagrass meadows, and salt marshes could avoid emissions of about 304 Tg CO_2e (304 million metric tonnes of CO_2e) per year (Macreadie et al., (2021). The same paper also estimates a global stock of between 8,970 to 32,650 Tg C across 185 million hectares of blue carbon ecosystems. While there is not yet a credit mechanism created for such blue carbon stocks, there has been increasing chatter around the idea of rewarding the conservation of largely untouched ecosystems that may not be at risk of degradation.
- The adaptation and socioeconomic benefits realisable from the conservation and/or restoration of blue carbon ecosystems. For example, a study in Cuba on the role of corals and mangroves in protecting coastal assets, found that mangroves helped to reduce the number of people affected by flooding by 35 per cent and reduced infrastructure damage by 34 per cent (Gautreau and Correa (2023). To quantify these benefits, the value of blue carbon ecosystems globally has been estimated to be over USD190 billion per year, based on a social cost of carbon methodology (Bertram et al. (2021). Another estimate puts the value of mangroves' ability to reduce costs associated with climate impacts – such as flooding, erosion, and storm surges – at USD65 billion per year (Mangrove Alliance (2022)).

Blue Carbon Challenges & Headwinds

However, several challenges still stand in the way of achieving the fully unlocked potential of the blue carbon ecosystems.

From a pure blue carbon perspective, there has been widespread recognition that the monitoring, verification and reporting methodologies for blue carbon are still in development (World Bank, 2023). This is further complicated by the large variation in literature around the carbon burial rates, with a supposed 600-fold difference in salt marshes, 76-fold difference for seagrasses and 19-fold difference for mangroves (Europe Marine Board, 2023). Within the offset debate, there have also been allegations that countries and companies are utilising the blue carbon offsets to continue their harms against nature. In one case in China, defendants found guilty of using prohibited fishing gear during the closed season has used carbon credits to partially compensate their fines for damaging the ecosystem (Xia 2024).

On the conservation of blue carbon ecosystems for improved climate adaptation and resilience, the challenges are more institutional in nature, requiring concerted efforts and stakeholder management across local communities, conservation agents, investors, local and national governments (UNFCCC, n.d.). Among the stakeholders, there is also the need to communicate the costs and benefits of the conservation of blue carbon ecosystems clearly to ensure local and national support for conservation efforts (European Environment Agency, 2023). This coordination and agreement between stakeholders may also help to ensure the permanence of such conservation projects and reduce the likelihood of other new non-conservation-related projects (such as infrastructure projects) from affecting the ecosystems under conservation (World Bank, 2023). To unlock the value of the conservation of blue carbon, ecosystems may require the insurance sector to play a key role.

Company profile:

Seawater Solutions

Overview

Seawater Solutions is a UK-based company founded in 2017 that uses nature-based solutions to restore coastlines. The company develops coastal wetlands, including mangrove forests and saltmarshes. Seawater Solutions integrates regenerative agricultural practices into its coastal restoration efforts.

Relevance to the blue economy

Seawater Solutions is exposed to the blue economy themes of habitat restoration and conservation and blue carbon. The company's approach to coastal restoration creates ecosystems that allow for the development of carbon negative products and ingredients including animal feed and cosmetics. Key activities for the company are:

Coastal wetland restoration: Saltmarshes provide excellent agricultural conditions that Seawater Solutions aims to unlock. The company uses an agriculture approach based on growing halophytes, which turn salinized land into high-value biomass. Halophytes have high nutritional value as they contain unsaturated oil (30 per cent) and proteins (40 per cent). This is used to produce biodiesel, alternative animal feed and nutraceuticals. Halophytes can capture and store c. 400 tonnes CO_2 per hectare over their lifetime, generate crop yields of 40 tonnes per hectare per year, reduce flooding and erosion, and support climate and economic resilience according to the company. The company is working on a pipeline of projects of which the one in Ghana is the largest at this stage, with a projected scale of more than 5,300 hectares. Seawater Solutions aims to scale its operations to more than 100,000 hectares of converted land by 2028.

Carbon credit generation: Seawater Solutions is integrating carbon credit strategies into its efforts to revitalise degraded mangrove forests. The Keta Lagoon, the largest wetland in Ghana, functions as the key pilot for this. More than 50 per cent of mangrove cover in the Keta Ramsar Area has been lost with more than 60 per cent of the lagoon becoming unsuitable for aquatic life. The project currently covers more than 2,200 ha which over a 40-year period could remove c. 1 million tonnes of CO_2. Seawater Solutions believes that almost 10,000 hectares of the Keta Lagoon is eligible for restoration. An integrated carbon credit and mangrove restoration project offers a range of environmental and social benefits. Blue and coastal carbon credits also benefit from having prices that are c. 3x that of forest-based carbon credits.

Salt-affected regeneration: The company's activities also focus on creating blue ecosystems on salt-affected land, such as saline farmland. Seawater Solutions develops these projects in South Asia and East Africa.

What are the key challenges and opportunities?

The need to improve the sustainability of the world's coastal systems and switch to more sustainable sources of fuel, animal feed and cosmetic and nutraceuticals is high if long term sustainability targets are to be met. This suggests that Seawater Solutions' growth potential is strong. However, key challenges remain, including the need for voluntary, nature-based carbon markets to mature and for regulatory and approval processes to become more streamlined. The company also notes that attracting finance for blue economy companies remains very challenging.

Ocean governance is improving

Ocean governance is improving

Investors need to feel confident about the long term outlook for blue economy-related investments before committing capital. Creating predictability of revenues and cash flows requires stable and solid governance and regulation. In this chapter we show that blue economy-related regulation and governance is improving. Increased use of technologies such as drones, sensors, robotics and artificial intelligence drive greater insights into the ocean and its health and help improve the effectiveness of the ocean's governance. This in turn should help direct more capital towards sustainable ocean solutions in our view.

The SDGs as a starting point for a sustainable ocean

In 2015, the United Nations launched its Sustainable Development Goals (SDGs) which included a water-focused goal. SDG 14 is "Life Below Water: conserve and sustainably use the oceans, seas and marine resources for sustainable development". Figure 53 shows the 10 targets associated with SDG 14 and the indicators that the UN uses to measure progress towards these targets.

The UN's SDG Actions Platform registers the voluntary policies, commitments, multi-stakeholder partnerships and other initiatives that support the acceleration of the SDGs. To date more than 8,000 have been registered. Of these, almost 3,100 relate to SDG 14, making "Life below water" the SDG with the highest number of commitments and policies (Figure 53).

Since the launch of the SDGs, the UN has monitored progress achieved per country towards the more than 100 indicators used across all the 17 SDGs, including those linked to SDG 14. As far as SDG 14 is concerned, UN data shows that some progress has been achieved, even though SDG 14 is impacted by more policies and commitments than any other SDG. However, the pace of progress is too slow.

The most recent UN update on SDG progress showed that none of the 193 assessed countries has achieved SDG 14 as yet, while 100 countries face major challenges to achieve the targets in time, and another 39 face significant challenges. On a global scale the progress achieved for SDG 14 lags that of the other SDGs, suggesting that more attention and focus is needed, in our view, if the targets associated with SDG 14 are to be met on time (Figure 55).

A review of the individual indicators used in relation to SDG 14 shows that the slow pace of progress for SDG 14 is not driven by one or two areas, but rather a more general, across the board, lack of improvement (Figure 56).

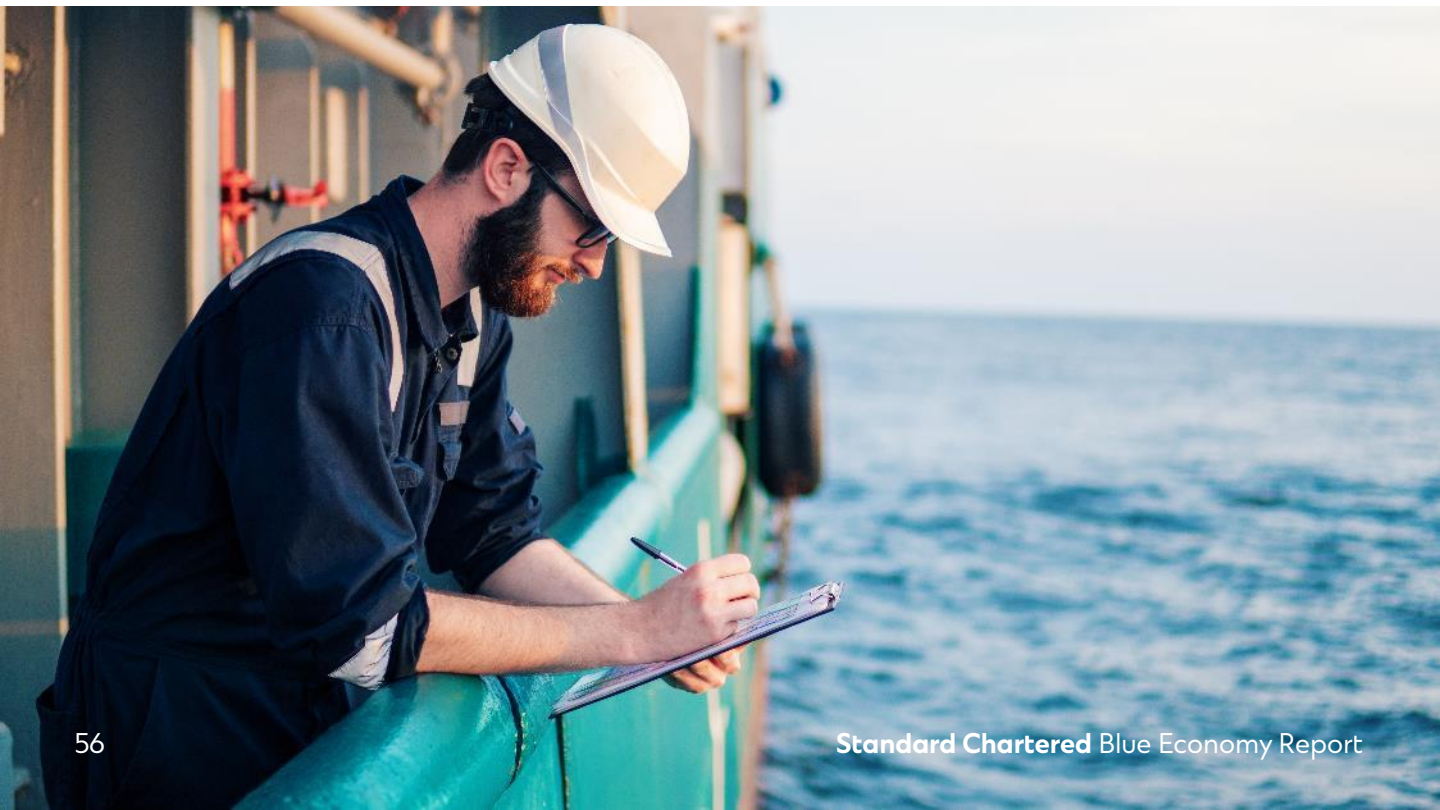
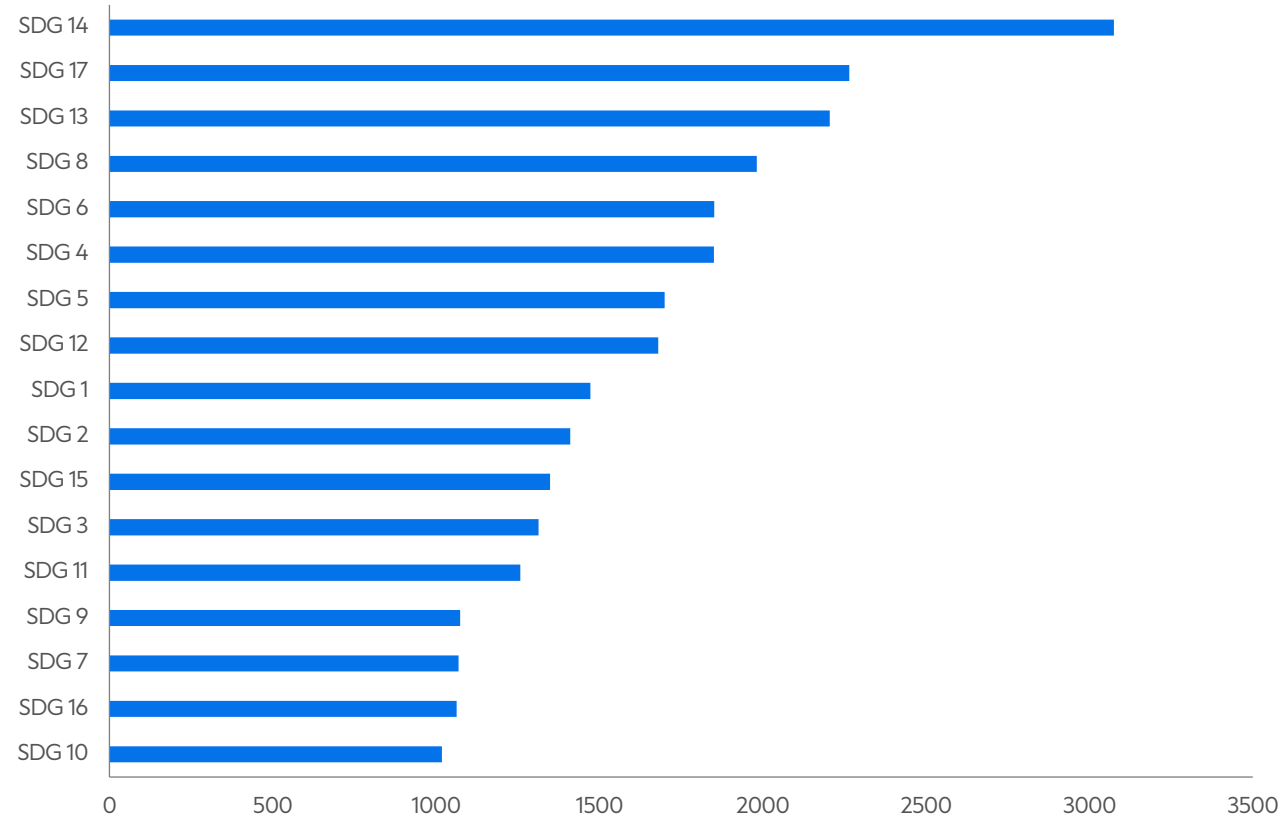


Figure 53: UN SDG 14: Targets and indicators used to measure progress

SDG 14 targets	Description	Indicator used to monitor
14.1 Reduce marine pollution	By 2025 prevent and significantly reduce marine pollution of all kinds including marine debris and nutrient pollution.	• Index of coastal eutrophication • Plastic debris density
14.2 Protect and restore ecosystems	By 2020 sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts and take action for their restoration in order to achieve healthy and protective oceans.	• Number of countries using ecosystem-based approaches to managing marine areas
14.3 Reduce ocean acidification	Minimise and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels.	• Average marine acidity measured at agreed suite of representative sampling stations
14.4 Sustainable fishing	By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics.	• Proportion of fish stocks within biologically sustainable levels
14.5 Conserve coastal and marine areas	By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information.	• Coverage of protected areas in relation to marine areas
14.6 End subsidies contributing to overfishing	By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognising that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation.	• Degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing
14.7 Increase the economic benefits from sustainable use of marine resources	By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism.	• Sustainable fisheries as per cent of GDP in small island developing states, least developed countries and all countries
14.a Increase scientific knowledge, research and technology for ocean health	Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries.	• Proportion of total research budget al.located to research in the field of marine technology
14.b Support small scale fishers	Provide access for small-scale artisanal fishers to marine resources and markets.	• Degree of application of a legal/regulatory/policy/institutional framework which recognises and protects access rights for small-scale fisheries
14.c Implement and enforce international law	Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in the United Nations Convention on the Law of the Sea, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of "The future we want".	• Number of countries making progress in ratifying, accepting and implementing through legal, policy and institutional frameworks, ocean-related instruments that implement international law, as reflected in the United Nations Convention on the Law of the Sea, for the conservation and sustainable use of the oceans and their resources

Source: United Nations, Standard Chartered

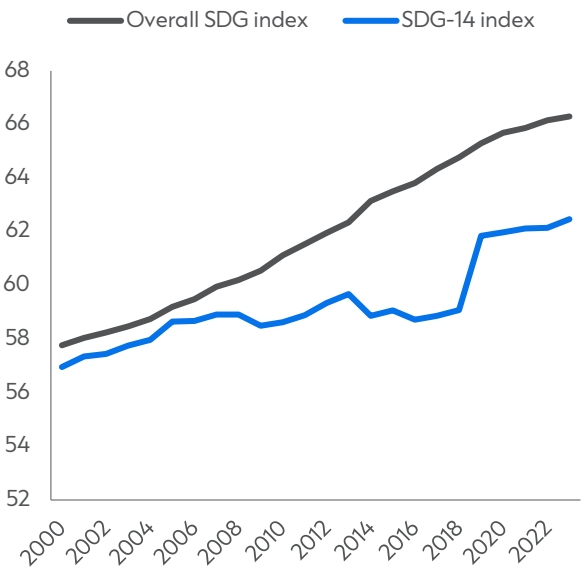
Figure 54: Number of policies and commitments linked to the 17 SDGs



Source: SDG Actions Platform, Standard Chartered

Figure 55: 2024 SDG progress: overall vs SDG

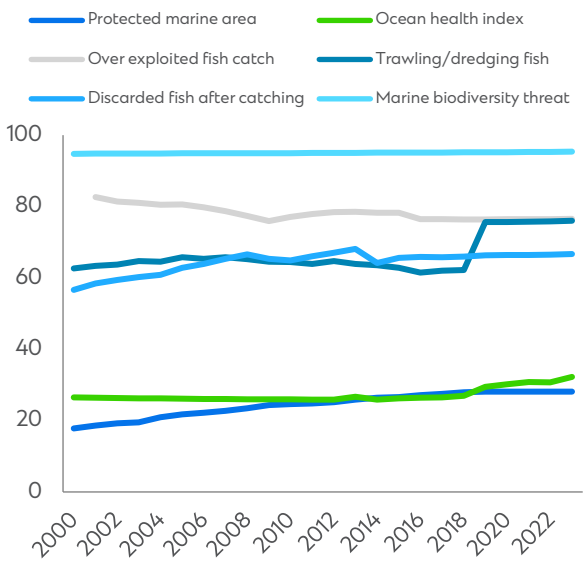
Global index score: 100 is all achieved



Source: Sachs, J.D., Lafortune, G., Fuller, G. (2024), Standard Chartered

Figure 56: Development of key SDG 14 targets by year

Index score: 100 indicates that target is achieved



Source: Sachs, J.D., Lafortune, G., Fuller, G. (2024), Standard Chartered

Recent initiatives to help improve ocean sustainability

More recently a range of water and ocean-related policies have been put in place by various countries, regions, and globally, with the aim to accelerate progress towards a sustainable ocean and address some of the above-mentioned barriers. We see this development as a clear positive for the ocean agenda and believe that it will make achieving long term sustainable blue economy targets more likely.

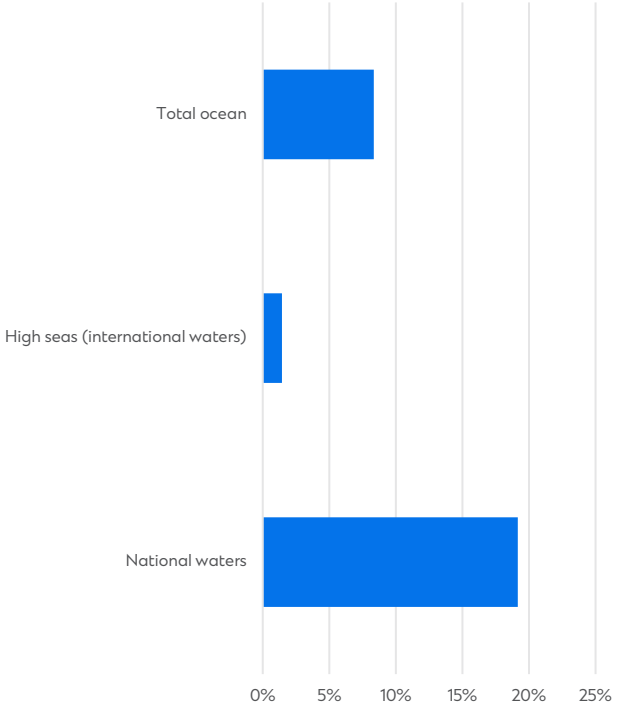
30x30 initiative

In December 2022 at COP15, more than 190 countries adopted the Kunming-Montreal Global Biodiversity Framework. The framework includes 23 targets aimed at reversing habitat and species loss. Target 3 is known as the 30x30 plan and calls for the protection of at least 30 per cent of the planet's land and ocean by 2030. Meeting the 30x30 targets requires countries to rapidly increase the designation and management of marine protected and conserved areas. Currently only 8 per cent of marine areas globally are under some form of protection, while more than 19 per cent of areas within national jurisdictions are currently protected (Figure 57). Regional data suggest that developing countries have been more aggressive to date in designating marine protected areas. Nevertheless, improvement is needed across the board (Figure 58).

While the 30x30 initiative is positive, we note that it leaves 70 per cent of the oceans requiring greater governance too if the entire ocean is to become more sustainable.

Figure 57:
Share of ocean area that is protected

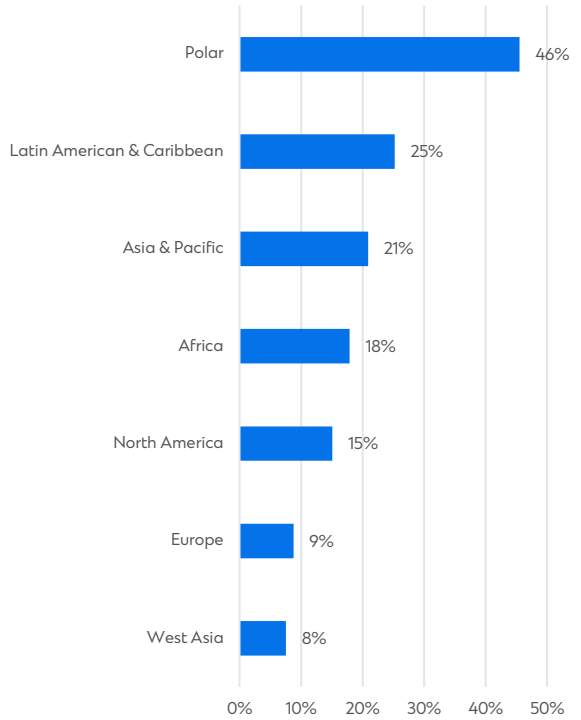
2024



Source: UNEP-WCMC and IUCN, Standard Chartered

Figure 58:
Marine protected area coverage by region

2024



Source: WDPA, Standard Chartered

Global initiatives

A number of more global initiatives have also been established, with the aim to improve the governance of the broader ocean. Two examples of this are:

- **The High Seas Treaty:** In 2023 the 193 UN member states adopted a legally binding agreement on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdictions. This agreement covers approximately two thirds of the planet's oceans. One of the key components of the agreement is the possibility to create marine protected areas in international waters, which in turn supports the efforts to protect 30 per cent of the oceans by 2030.
- **International Seabed Authority (ISA):** The ISA was established under the UN convention on the law of the sea and has 170 members. The organisation controls mineral resource-related activities. It has the mandate to ensure the protection of the marine environment from harmful effects arising from deep-seabed-related activities. Demand for deep-sea mining has rapidly increased during the past few years as the ocean floor is believed to hold significant reserves of minerals such as copper, cobalt, nickel, zinc, and rare earth elements that are needed as part of the energy transition. However, concerns around the ecological impact of deep-sea mining have increased. Several nations have applied for permits to explore deep-sea mining. The ISA has until 2025 to finalise regulations dictating whether, and how, countries can pursue deep-sea mining in international waters.

Broader blue economy initiatives being developed

Following the adoption of the 30x30 plan at COP 15, a range of countries across Europe, the Americas, Africa, the Middle East and Asia have started to develop broader strategies and action plans related to the blue economy (Figures 59-61). We see this as a positive development as it supports the view that awareness of the need to address ocean sustainability is increasing. At the same time, however, we believe that developing countries may struggle to balance the need to enhance ocean sustainability with the need to develop their local economies. This challenge is made harder, in our view, for those developing economies whose GDP is more reliant on ocean exposed sectors such as fishery and tourism.

Figure 59: Overview of blue economy plans for key regions and countries: Europe and the Americas

Region	Plans and targets
European Union	• EU Biodiversity strategy: protect a minimum of 30 per cent of EU's sea area and integrate ecological corridors. At least 25,000 km of free-flowing rivers are restored. • Reduce plastic litter at sea by at least 50 per cent, reduce microplastics release by at least 30 per cent and reduce nutrient loss and the use and risk of chemical pesticides by at least 30 per cent. • Make the blue economy carbon neutral and circular in line with the European Climate Law.
UK	• The UK is the leader of the Global Ocean Alliance and a co-leader of the International Partnership on Marine Protected Areas, Biodiversity and Climate Change. The UK has also announced full membership of the Ocean Risk and Resilience Action Alliance. • UK's Blue Planet Fund of GBP500mn was set up to help developing countries and vulnerable coastal communities adapt to climate change.
USA	• The USA has announced over 100 commitments from 14 agencies and offices worth USD2.6bn. • The National Oceanic and Atmospheric Administration has released a Blue Economic Strategy Plan. • The US Agency for International Development has announced 24 initiatives to help conserve and protect the ocean.

Region	Plans and targets
Mexico	• Mexico has published its Implementation Strategy for a Sustainable Ocean Economy. It complements the National Policy of Seas and Coasts, launched in 2018. • The Strategy establishes the definition of a sustainable ocean economy for Mexico and contains 13 priority actions for achieving this in the country. • Mexico assumed 4 voluntary commitments at the UN Ocean Conference, which included updating its National Policy and formulating a National Action Plan.
Barbados	• Barbados has committed itself to ocean conservation, with a target to protect up to 30 per cent of its marine ecosystems. • The Ministry of Energy and Business is considering having ocean energy technology operational on the island to contribute to the Barbados National Energy Policy target of 100 per cent renewable energy by 2030.
Chile	• Chile explicitly integrates ocean protection in its NDC. Targets include, establishing new protected areas in at least 10 per cent of its under-represented marine ecoregions and protect at least 20 coastal wetlands by 2025 and at least 30 by 2030.

Source: Standard Chartered

Figure 60: Overview of blue economy plans for key regions and countries: Africa and the Middle East

Region	Plans and targets
Ghana	• Member of the Commonwealth Clean Ocean Alliance and Marine Protected Areas Action Groups. • Has developed a comprehensive National Integrated Maritime Strategy. • Committed to sustainably manage 100 per cent of the ocean area under national jurisdiction by 2025.
Nigeria	• Pledged commitment to international legally binding instrument aimed at reducing marine plastic pollution. • Commitment to join and implement the UN Water Convention treaty.
Kenya	• Go Blue initiative launched in 2021 which aims to protect Kenya's coastal ecosystems while creating environmentally sustainable jobs, coastal tourism and small-scale fishing. • Nairobi statement on Advancing Blue Economy Bank of 2018 included pledges to address overfishing, aquaculture and preserving endangered organisms.
South Africa	• The government's commitments to the ocean economy includes Operation Phakisa, an Oceans Economy programme which brings different representatives of the coastal sectors in the region together to plan economic potential of South Africa's oceans. • The Phakisa operation aims to boost GDP by R177 billion by 2033 from ocean sectors.
Saudi Arabia	• Member of the Global Ocean Alliance. • The National Centre for Wildlife is developing a national strategy for the Sustainable Use of Coastal and Marine Areas which should be completed in 2025.
UAE	• The first Middle Eastern country to join the Global Ocean Alliance and has established 16 marine protected areas. • Enacted laws banning disposal of waste and oil sludge into the ocean by the hundreds of tankers operating in the region. • Launched various programmes including the UAE's Sustainable Fisheries Programme to help develop sustainable fishing.
Oman	• Oman's Tanfeedh or national program for enhancing economic diversification is a key part of the country's 2040 targets. It focuses among others on sustainable fishing, the protection of biodiversity and sustainable marine mining.

Source: Standard Chartered

Figure 61: Overview of blue economy plans for key regions and countries: Asia

Region	Plans and targets
Bangladesh	• Establishment of Blue Economy Cell. • International and national workshops and consultation on the blue economy. • Two phases of Safe and Environmentally Sound Ship Recycling in Bangladesh project (SENSREC).
China	• Published Outline of the National Ocean Economic Development Plan. • 14th Five Year Plan to include major focus on building a modern ocean industrial system. • China's blue economy includes: Blue Economic Belt, Blue Economic Zone and Blue Economic Circle.
India	• Draft National Policy for the Blue Economy published in 2021. Focus areas fishing, tourism and shipping. • Sustainable fishing scheme launched in 2020. • Government launched the Deep Ocean Mission in 2021 for exploring deep-sea mining and conservation of deep-sea biodiversity • The Maritime India Vision 2030 was launched in 2021. Focus is to expedite growth in the marine sector with a focus on establishing a sustainable and environmentally friendly maritime industry.
Indonesia	• Blue Economy Plan with the Spectrum Solutions Group. • IndoBlue concept. • Blue Economy Development Framework 2021. • Development of a Blue Economy Road Map in conjunction with international partners.
Malaysia	• Incorporated SDG 14 into the 11th and 12th Malaysia Plan. • Malaysia developed Roadmap Towards Single Use Plastics 2018-2030.
Maldives	• Implementation of coastal protection projects to preserve wetlands and marine ecosystems. • Sewerage Treatment Plan with support from the World Bank. • Building climate smart and resilient islands to strengthen implementation of NDC. • Developed master plan for Sustainable Fisheries in Maldives.
Thailand	• Department of Fisheries developed a Fisheries and Management Plan. • Port, Safety, Health and Environmental Management programs launched at Bangkok and Laem Chabang ports. • Developed National State of Oceans and Coasts report sponsored by the UN.
Viet Nam	• Strategy for sustainable developed of Viet Nam's marine economy 2030. • UN prepared Blue Economy Scenarios for Viet Nam in partnership with Viet Nam Administration of Seas and Islands.

Source: United Nations, Standard Chartered

Blue economy action groups to drive sectoral change

In the past few years, a number of platforms or collectives have been developed with the aim to drive marine or ocean sustainability from an industry or sector perspective. We show a few of these in Figure 62 but note that this list is not exhaustive. It is also worth highlighting the UN's Sustainable Blue Finance Initiative, which supports the financial community in providing guidance and frameworks to increase SDG 14 aligned investments, underwriting and lending. These platforms provide a vehicle for bottom-up engagement, and in doing so, complement the more top-down programs highlighted so far in this chapter. We do note that these agreements and programs are voluntary in nature, which creates a level of uncertainty around the likelihood that included long term targets will indeed be achieved.

Nature based reporting requirements provides yet more support

The final development that may help drive investments towards sustainable ocean solutions relates to corporate reporting standards. Recently, the Taskforce for Nature-related Financial Disclosures (TNFD) published their set of final recommendations. This (in our view) may help financial investors, when engaging with companies, to provide disclosure around their exposure to, and strategies around, ocean-related activities. This, in turn, should help drive investor engagement with companies to improve their nature-related risk profile and help improve ocean sustainability.

Figure 62: Selection of initiatives focused on promoting sustainable ocean business

Initiative	Description	Examples of measures taken
Association of responsible Krill fishers (ARK)	Established in 2012, ARK brings together companies engaged in Antarctic krill fishing.	Established four voluntary restricted zones to protect critical habitat for krill-dependent predators.
Global salmon initiative (GSI)	Established in 2013, the GSI aims to promote sustainable salmon production while minimising its carbon footprint.	GSI consists of 14 members representing c. 40 per cent of the global farmed salmon market. Reduction in average use of antibiotics since 2013: 75 per cent. Aquaculture Stewardship Council certification reached 64 per cent of members in 2023.
Ocean Renewable Energy Action Coalition (OREAC)	Launched in 2020, OREAC has a focus on sustainable development of ocean-based renewable energy and mitigating the effect of climate change.	OREAC aims to have 1,400GW of offshore wind generated capacity by 2050. Oceans would then supply c10 per cent of global electricity.
Seafood Business for Ocean Stewardship (SeaBOS)	Launched in 2016, SeaBOS is a science-business initiative including some of the world's largest seafood companies that represent over 10 per cent of global seafood production and have combined turnover of more than USD30bn.	Goals agreed between the participating seafood companies focus on reducing modern slavery, protection of endangered species, reducing antibiotics use, address climate change and reduce plastic pollution.
Sustainable Shipping Initiative (SSI)	Established in 2011, the SSI aims to improve the sustainability of the shipping industry across social, environmental and economic dimensions.	The SSI has developed a roadmap to a sustainable shipping industry with a focus on ocean sustainability, safeguarding communities, labor rights and achieving net zero by 2050.
World Ocean Council (WOC)	Established in 2008, the WOC is a cross-sectoral industry group focused on achieving ocean stewardship and 'corporate ocean responsibility'.	The WOC has established regional ocean councils, an ocean investment platform, sustainable ocean summits and programs focused on policy and governance, marine spatial planning, environmental issues and the application of technological solutions.

Source: Virdin et al., data from initiatives' websites, Standard Chartered

As part of TNFD disclosure reporting, investors should get insight into an organisation's governance of nature-related dependencies, how these are impacted, and the risk and opportunities that these provide. In addition, organisations adopting the TNFD need to disclose the impact of nature-related dependencies on the organisation's business model, strategy, and financial planning. Importantly, these organisations will also have to outline the processes that they use to identify, assess, prioritise, and monitor nature-related risks. Finally, investors will be provided with a set of key metrics and targets used by reporting organisations which can be used for benchmarking and drive more meaningful discussions between organisations and their investors.

In addition to the general TNFD reporting requirement, the taskforce has also launched more specific guidance for eight sectors. Among these are Aquaculture and Food and Agriculture, both sectors with a heavy exposure to water and oceans.

We see the development of TNFD as a positive, however, we want to highlight that it is unlikely to lead to material changes in the short term. Some of the key shortcomings that need to be addressed before TNFD can have a meaningful impact on ocean-related matters concern the general lack and quality of data. Ocean data is generally of poor quality or non-existent, and well behind terrestrial data. This makes meaningful disclosures by corporates challenging in the short term. Related to this, the TNFD have argued that the private sector must focus first on addressing the most material impacts and dependencies. Limited ocean data may cause companies to perceive ocean risk as not material which impact disclosure.

Barriers that make a sustainable ocean more challenging

Despite the increased level of governance in relation to the blue economy, we note that several barriers remain that if addressed would further speed up progress towards a sustainable ocean. These barriers include:

- **Institutional inefficiencies:** International ocean management involves more than 570 bilateral or multilateral agreements according to the UN. These agreements are also administered by a range of different institutions with different mandates and authorities. The governance of the ocean is therefore very complex.
- **Lack of integration:** As highlighted previously, the blue economy covers a range of sectors and geographies. Communication and coordination between sectors or geographies, however, is not common. This is likely to result in sub-optimal blue economy strategies in our view. Developing integrated solutions covering multiple blue economy sectors would address this challenge.
- **Incumbent economic structures:** Developing a fully sustainable ocean economy is likely to impact employment across incumbent sectors including fishery. This in turn may have negative indirect economic consequences for coastal communities too. Work from the UN indicates that up to c. 20 million fishing jobs globally might be at risk from a full introduction of sustainable ocean policies. Potential job risk to local communities, and uncertainty regarding redeployment potential for affected individuals, may act as a barrier for the adoption of blue economy strategies. The solutions as highlighted in this report have positive job implications. Further analysis into the economic multiplier effects of these solutions should help address fears related to job losses among incumbent sectors in our view.
- **Cost of capital considerations:** Early-stage technologies tend to have higher cost of capital than established ones. In addition, developing economies tend to have a higher cost of capital than wealthier nations. These two factors impact the investment environment related to sustainable ocean solutions for emerging economies. Elsewhere in this report we show that the range of finance solutions that focus on the blue economy is growing and that there is greater involvement from different types of investors. We believe that these development should make it easier for organisations across the developing world to get access to blue-economy-related funding.

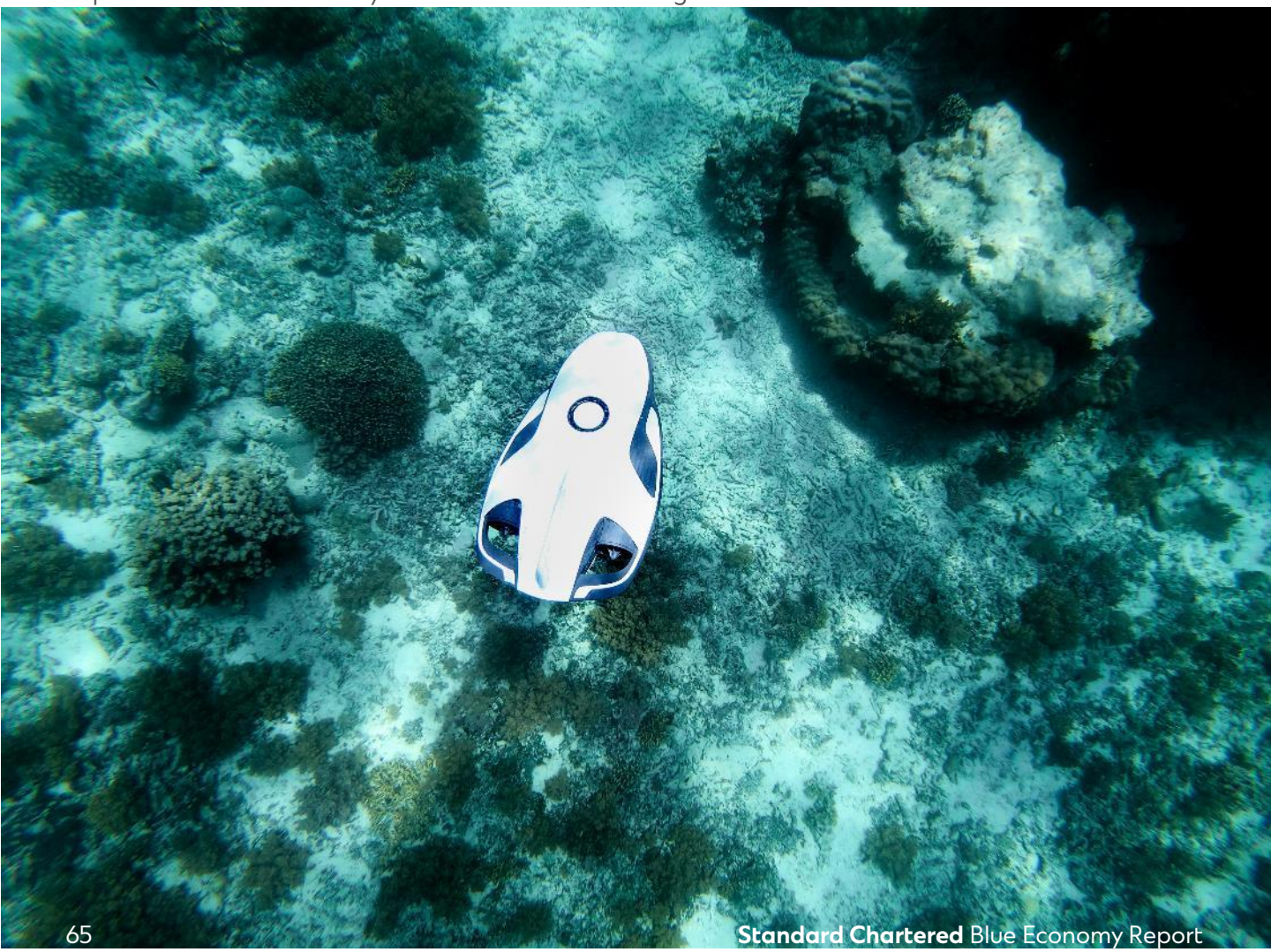
Technology aids ocean understanding and governance

A lack of data has in our view been one of the key challenges faced by policy makers and investors when trying to decide on new legislation or investments in the blue economy. Improving data analytical capabilities including the use of drones, artificial intelligence, robotics and automation is rapidly addressing these challenges in our view. It improves our understanding of the ocean and importantly allows for much improved, more locally designed, targets and solutions to be developed and deployed.

Conservation and restoration to benefit from improved data capabilities

Performing an economic valuation of the conservation and restoration of marine areas that incorporates the interrelated nature of the relevant blue economy sectors is not standard. However, without understanding the overall economic potential of sustainable ocean areas, governments will find it much more difficult to determine which areas to designate for conservation and restoration, or what the optimal strategy for managing these areas is. In the absence of a proper understanding of the economic benefits of marine areas, it will also be more difficult to attract financing from investors for projects related to these areas. We believe that integrating an economic valuation of marine areas into a Marine Spatial Plan (MSP) would help address these challenges. Greater data availability helps with this process.

Frameworks for Marine Spatial Planning have been set forth since the IOC-UNESCO guide on MSP was published in 2009. The MSP process is designed to incorporate input from all relevant stakeholders and identifies biodiversity protection zones and other zones for different activities, and results in a plan for managing marine areas. To develop MSPs effectively requires substantial insight into all, inter-related, aspects of the blue economy for the areas under investigation.



Blue finance: growing across all asset classes

Blue finance: growing across all asset classes

This report provides an overview of the opportunities that can help make the ocean sustainable. Ensuring that these opportunities materialise relies not only on political will to enact tighter regulation or a step-change in technological innovation by the private sector. Important too is the need for sufficient capital to become available, so that investment requirements associated with broader sustainability goals and innovation related research and development are met. This chapter shows that blue finance investments have plenty of positive momentum supporting our positive view on the growth outlook for blue economy investments going forward.

A sustainable ocean requires substantial investments...

The overall investment requirements associated with the blue economy are substantial. For example, to achieve SDG 14 requires USD175 billion per year until 2030, according to estimates from Johansen et al. (2020). However, SDG 14 related funding has been substantially lower than what is required. A World Economic Forum report on SDG 14 financing in 2022 noted that a total of only USD10 billion had been allocated to SDG 14 projects between 2015-2019. Johansen and Vestvik (2020) estimated that the current funding gap for SDG 14 is close to USD150 billion. This implies a cumulative funding gap until 2030 of at least USD900 billion.

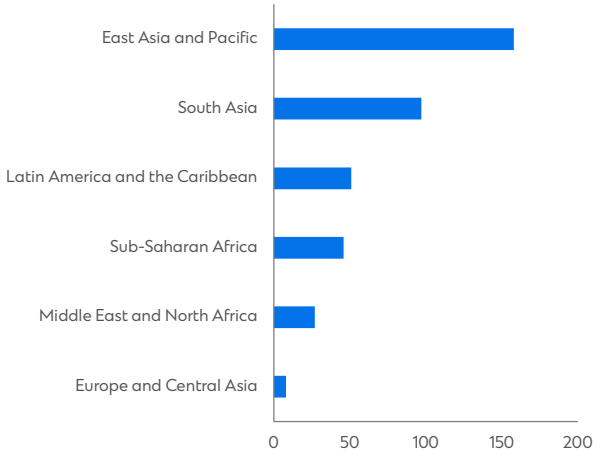
The lack of investments towards achieving the SDGs suggests, in our view, that longer-term climate change mitigation targets have become more challenging. This implies that adapting to climate change may become a necessity, which also increases the need for adaptation-associated investments. The UN's latest Adaptation Finance Gap report provides an overview of adaptation-related investment requirements and the gap between these and actual adaptation spending levels. Their analysis indicates that central costs of adaptation are approximately USD240 billion per year until 2030.

Important from a blue economy perspective, we note that adaptation costs for river flood protection and infrastructure and coastal protection are among the highest. Annual costs of coastal adaption for developing countries range from USD56 billion to almost USD80 billion, depending on emission scenarios. These estimates do not incorporate the so-called residual cost of adaptation, which relates to residual damage after adaptation. These costs according to the UN, would be several hundred billion US dollars per year. Adaptation costs associated with the impact of climate change on fisheries, aquaculture and marine resources are estimated at USD4.8 billion per year until 2030. Adaptation cost associated with flood protection are estimated at USD54 billion per year for developing countries.

The UN estimates that total adaptation-related financing needs for all developing countries are USD387 billion per year (Figure 63). These estimates cover different sectors, most of which have some link to a sustainable blue economy. Just taking the UN's estimates related to water and coastal and marine resources, suggests adaptation financing needs of almost USD100 billion per year – or a cumulative adaptation funding need of USD600 billion until 2030. Developing countries across Asia and Sub-Saharan Africa account for c. 80 per cent of this, which raises questions as to their ability to fund these investments without external help (Figure 64).

Figure 63:
Adaptation finance needs for developing countries

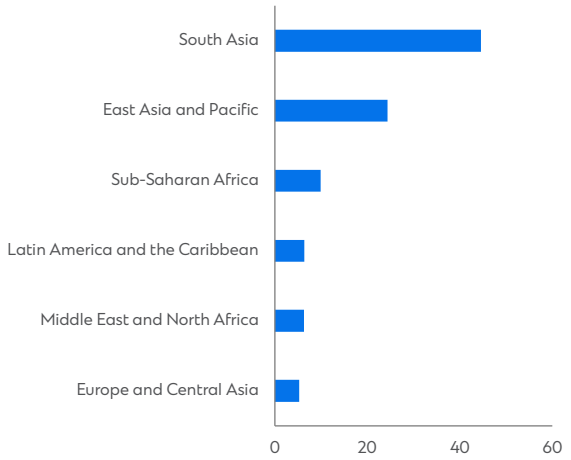
USD billion per year until 2030 (median estimate)



Source: UN, Standard Chartered

Figure 64:
Water, coastal and marine resources related adaptation finance needs for developing regions

USD billion per year until 2030 (median estimate)

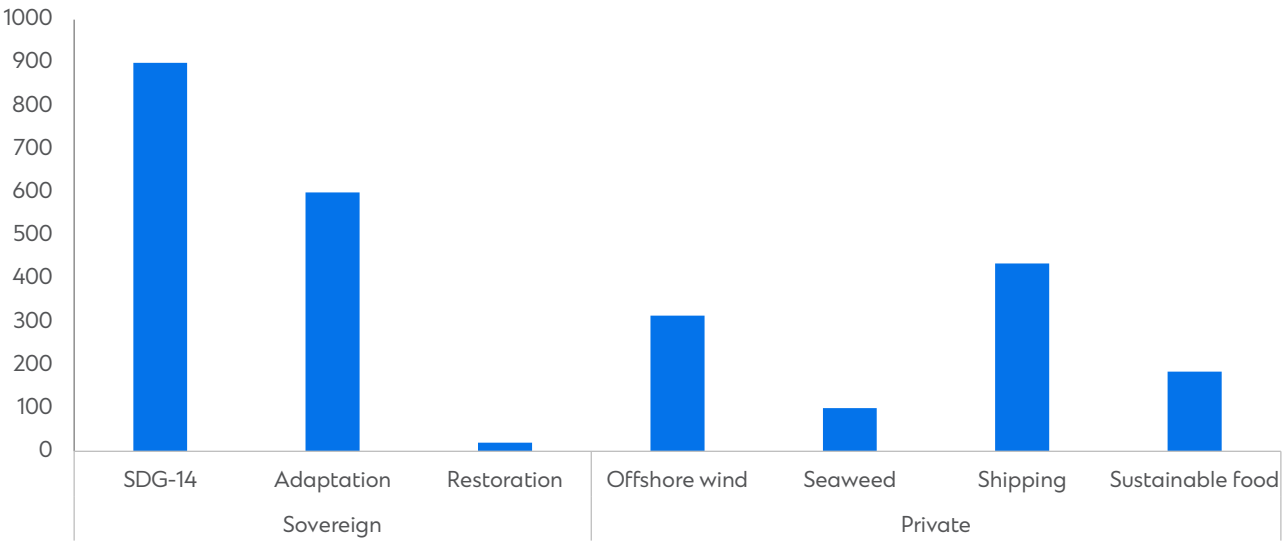


Source: UN, Standard Chartered

To provide one indication of the overall financing requirements, we reviewed estimates from various sources for some of the key blue-economy-related end markets. This shows that total financing needs until 2030 are as high as USD2.5 trillion (Figure 65). The investment needs associated with these sectors are split between activities for which sovereign or governmental funding is required, and those that reside more with the private sector. We estimate that sovereign blue economy financing needs are likely to be around USD1.5 trillion until 2030 as we believe that SDG 14, coastal adaption, and restoration targets will unlikely be achieved without significant sovereign involvement. The private sector is looking at investment needs of c. USD1 trillion based on estimates for the offshore wind, shipping, sustainable food, and seaweed related markets.

Figure 65: Investment requirements associated with blue economy targets

USD billion until 2030



Source: UN, Standard Chartered

...but the value of these investments is large

In this report we show that the environmental consequences of an unsustainable blue economy are very substantial. The investments needed to improve the sustainability of the blue economy are large, however, the value of well-functioning water or ocean-related ecosystems is substantially greater. Earlier in this report we showed an overview of largely socio-economic benefits that the blue economy can provide (Figure 10). However, a sustainable ocean also provides a range of non-market benefits that carry value to the global economy. Examples of non-market benefits provided by freshwater, coastal and marine ecosystems include the provision of food, raw materials, water purification, carbon capture and biodiversity.

A wide range of estimates for the value of these services have been produced across the years (Figure 66). Last year, the WWF published a study in which they estimated that the total value of freshwater was equivalent to c. 60 per cent of global GDP. The value of direct benefits of freshwater to households, agriculture and industry alone were estimated at USD7.5 trillion per year, however, the indirect benefits were substantially larger at an estimated USD50 trillion per year. This included USD12 trillion of value associated with healthy freshwater ecosystems and well-managed water resources, as these contribute to climate adaption and disaster risk reduction. In 2019, the WWF published a report estimating that the value created and supported by the oceans, seas and coasts was USD24 trillion.

What these estimates confirm is our view that investing requirements associated with creating a sustainable blue economy pay for themselves multiple times over, given the value (financial and non-financial) provided by the ocean.

Figure 66: Value estimates for non-market benefits of the blue economy

Ecosystem	Estimated value	Comment
Freshwater		
Rivers, streams, lakes, aquifers, inland wetlands	USD58 trillion	60 per cent of GDP
Peatlands	USD17.5 trillion	For 2011
Mangroves	USD2.7 trillion	For 2011
Coastal		
Salt marshes	USD1.1 trillion	For 2011
Estuaries	USD1.9 trillion	For 2011
Marine		
Oceans, seas and coasts	USD24 trillion	
Seagrass	USD1.9 trillion/year	
Coral reefs	USD172 billion/year	
Oyster reefs	USD5,500-99,000/hectare/year	
Kelp forests	USD500 billion/year	

Source: OECD, Davidson et al. (2019), WWF (2019), WWF (2023), Waycott et al. (2009), Grabowski et al. (2012), Eger et al. (2023), Standard Chartered

Unlocking blue finance to meet investment needs

Each of the end markets associated with the blue economy has different risk and return characteristics. Therefore, meeting the associated investment requirements requires the ability to provide and scale financing options that are best tailored for a specific sector. The range of financial options available to support the development of blue economy projects has grown. In addition to public and private equity and debt financing, the blue economy can attract venture capital, loans, grants, or philanthropic finance. Some of the most recent financial instruments include debt-for-nature swaps and the development of carbon credits.

We assessed which financing solution might be best suited for a given blue economy sector. To do this, we reviewed how sustainable solutions for a blue economy sector are impacted by issues that tend to restrict access to finance. These issues are the degree to which regulation supports demand for blue economy solutions; the predictability around the financial outlook for blue economy solutions; the extent to which these solutions can be sufficiently scaled; and finally, the maturity of the solutions provided for a sector. A high degree of regulatory support, high predictability, high scalability, and mature nature of the solution offered suggest, in our view, that private investor demand through debt or equity is likely. Solutions that do not have this level of support, on the other hand, are likely to need much greater support from public funding, grants, or philanthropy.

Figure 67: Ranking approach for blue economy sectors

Ranking factor	Ranking consideration	Score of 1	Score of 5
Regulation	Degree to which regulation and support assists the outlook for a sector	Low	High
Predictability	Current degree of confidence in financial outlook for the blue economy sector	Low	High
Scalability	Extend to which economies of scale can be achieved quickly to support further growth	Low	High
Maturity	Degree to which solution is developed and proven	Early stage	Mature

Source: Standard Chartered

We scored eight different blue economy solution areas on the four issues highlighted in Figure 67. We show our assessment of the degree of support that each of the ranking factors provide across these areas in Figure 68. We recognise that this is not an exact science and is our qualitative interpretation. Nevertheless, it allows us to rank the sectors on overall support or risk. We believe technology solutions, renewable energy and sustainable shipping solutions appear to have the lowest relative risk profile. Uncertainty around the outlook of projects appears greatest for those associated with blue carbon and restoration and conservation.

Different sustainable finance strategies cater for different types of products. Some investment approaches such as philanthropy or grants may attach more weight to non-financial considerations or returns than finance instruments such as listed equity or public bonds. Venture capital or angel investment funds may approach the blue economy with a greater acceptance of longer payback periods than other types of investment vehicles. We mapped what we think are the most natural finance vehicles for the blue economy to the respective sectors based on our relative risk acceptance

We do point out that each of the blue economy sectors is made up of a number of different sub-sectors. It is therefore likely that the combinations highlighted in Figure 69 might not be applicable to each of the sub-sectors for a given blue economy sector.

Figure 68: Confidence assessment in outlook for blue economy sector

Blue economy sector	Regulation	Predictability	Scalability	Maturity	Total
Seatech	2	4	5	4	15
Renewable energy	4	3	4	3	14
Sustainable shipping	4	4	3	3	14
Aquaculture	3	2	5	3	13
Pollution/waste	4	2	4	2	12
Sustainable fishing	3	2	3	3	11
Restoration/conservation	4	1	2	3	10
Blue carbon	2	1	2	1	8

Source: Standard Chartered

Figure 69: Matching the applicability of finance vehicles to blue economy sectors

Blue economy sector	Philan-thropy	Debt for climate swaps	Blended finance	Grants	Environ-mental credit schemes	Blue loans	Venture capital	Private equity	Blue bonds	Public equity funds
Seatech	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Renewable energy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sustainable shipping	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Aquaculture	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pollution/ waste	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sustainable fishing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Restoration/ conservation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Blue carbon	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Source: Standard Chartered

Our assessment of the various blue economy sectors suggests that funding blue carbon and restoration and conservation projects most likely requires financing using philanthropy, grants, debt-for-sustainability swaps, blended finance, and carbon credit schemes. To scale funding for these projects sufficiently also requires significant sovereign engagement in our view.

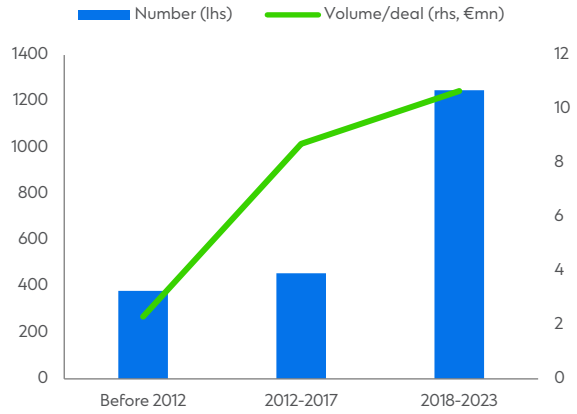
The public market on the other hand is likely to be more interested in technology, renewable energy, and sustainable shipping related solutions. Governmental involvement here should probably focus most on setting investment-supportive regulatory frameworks.

Figure 69 is our current assessment of the funding of the blue economy. Our view will change as the solutions available per sector mature, and importantly as regulatory pressure for a sustainable ocean tightens. In the remainder of this chapter, we will review recent developments of some of the key blue economy finance strategies in more detail.

Equity investments are growing

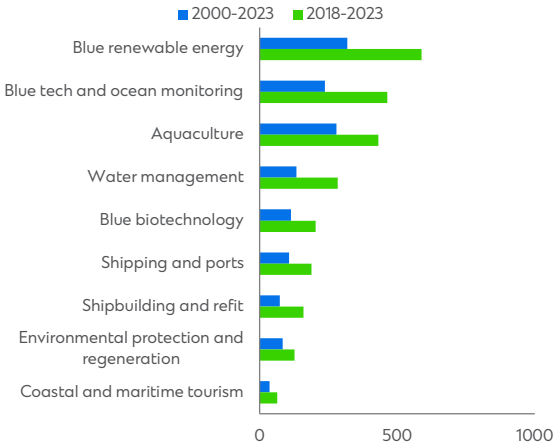
We believe that equity investor interest in the blue economy is starting to accelerate. Data for the EU suggest that the total number of blue economy deals has picked up substantially since 2018; that the average value per deal has started to increase; and that momentum is positive across all blue-economy-related sectors (Figure 70). Data from BlueInvest (an EU initiative aimed at supporting the development of sustainable solutions for the blue economy) suggests that the blue economy sectors with the highest number of deals per year since 2018 are blue renewable energy, aquaculture and fisheries, and blue tech and ocean monitoring (Figure 71).

Figure 70:
The blue economy is experiencing an increase in deals and value per deal



Source: Blue invest, Standard Chartered

Figure 71:
Deal flow is increasing across all blue economy sectors (number of deals per sector)



Source: Blue invest, Standard Chartered

Blue economy deal flow analysis from the EU suggests that only 2 per cent of all deals between 2012 and 2023 consisted of company IPOs, while c. 50 per cent consisted of early-stage funding of companies, including seed capital, angel investments and series A-related deals. With that in mind, we believe that a wide range of investment strategies are likely needed to unlock the investments required for creating a more sustainable blue economy. Beyond more traditional equity investments, we see a role for sustainable debt including blue bonds, SDG bonds and sustainability-linked loans and bonds, blended finance, as well as debt-for-nature swaps and carbon credit schemes.

Growth in private equity investments towards the blue economy

The technologies and solutions that can help make the blue economy more sustainable are often being developed and introduced by early stage and smaller companies. Due to their stage of development, these companies tend to be private. Growing the market for sustainable blue economy solutions therefore requires engagement from private market-focused investment vehicles. This is starting to happen as indicated by data collected by BlueInvest. In their most recent update, they list c. 30 blue economy focused private market funds with total target fund size of c. USD6 billion. Momentum of private investment is rising given that the majority were launched during the past five years. Ocean renewable energy, water management, biotechnology, shipping and ports and aquaculture are the most preferred blue-economy-related themes for private market investors according to BlueInvest (Figure 72).

Blue economy focused investors have shown significant willingness to work together and help accelerate investment flows towards the blue economy. One example of this is '1,000 Ocean Startups', a coalition of incubators, accelerators, and venture capital firms. Its objective is to scale at least 1,000 startups by the end of this decade to restore ocean health and achieve SDG 14. To date more than 300 startups from 50 different countries have already been supported. Most of these are in the US and Europe but Asia and African companies feature too (Figure 73).

Investor profile:

Ocean 14 Capital

Overview

Ocean 14 Capital Limited is based in London and is an investment adviser to one of the leading private equity growth funds in the blue economy. The company was established by the founders of the Blue Marine Foundation, Vedra Partners and Pontos Aqua who combined have over 65 years of investment, impact and industry experience.

How does the fund aim to assist the blue economy?

Ocean 14 Capital is very positive about the outlook for the blue economy and believes that it can expand at twice the rate of the overall global economy between now and 2030. The ocean can provide five times more food than it does today and two-thirds of animal protein required to feed the global population by 2050.

The strategy of the Ocean 14 Capital Fund I SCSp (the Fund) is to focus on food security and marine ecosystems as it believes that these areas have the largest impact outcome for the SDG 14 goals. Within food security, the Fund invests in solutions focused on sustainable aquaculture, alternatives to fish protein and sustainable fisheries. Within marine ecosystems, the Fund targets two verticals: circular plastics and marine flora/seaweed.

The Fund's focus is on late-stage and growth opportunities. Other funds in the blue economy typically concentrate on seeding and incubation or larger buy-out or exit opportunities. Following its first close of EUR80 million in December 2021, the Fund reached its final close of EUR201 million in March this year. The current portfolio has 16 holdings including Novelplast, Aquaexchange, Sofar Ocean, Bureo, The Kingfish Company and SyAqua..

How has the outlook for the blue economy changed?

In our conversation with Ocean 14 Capital Limited, the company noted that several more recent developments have improved the outlook for the blue economy. First the company notes that regulation is tightening for several key sectors which forces them to change behaviour. Examples include shipping, fishing and plastic-related regulation. Another positive development according to Ocean 14 Capital Limited is the fact that the finance community is starting to pay more attention to the ocean and the solutions that can make it more sustainable. The company believes that this process will only continue as more data regarding the ocean and solutions becomes available.

How relevant is the blue economy to developing economies?

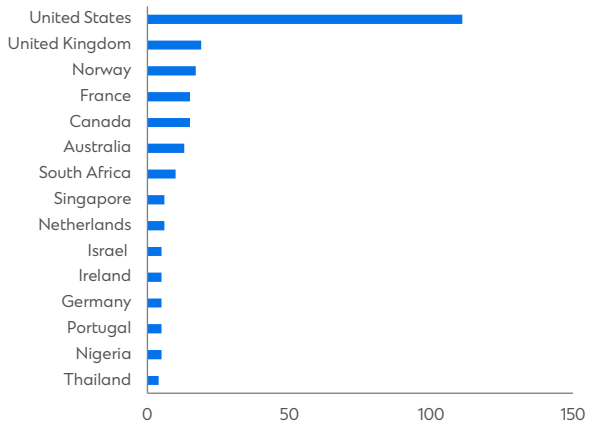
Creating a sustainable ocean provides very substantial benefits to developing economies according to Ocean 14 Capital Limited. Job creation across blue economy sectors such as aquaculture will be strong while the outlook for existing industries with a heavy EM focus such as fisheries and seaweed farming benefit from a more sustainable ocean too. Food security and climate resilience are especially relevant topics to the global south. The Fund's focus on themes of food security and marine ecosystems directly address these topics.

What other changes are needed to make the ocean more sustainable?

Ocean 14 Capital Limited believes that well-functioning voluntary carbon markets are essential to help achieve long-term climate change targets. Although it recognises that the voluntary carbon market is currently immature, Ocean 14 Capital Limited does expect this to change and believes that carbon credit investing will become much more significant during the next five years.

Figure 72:
Startups supported by 1,000 Ocean Startups

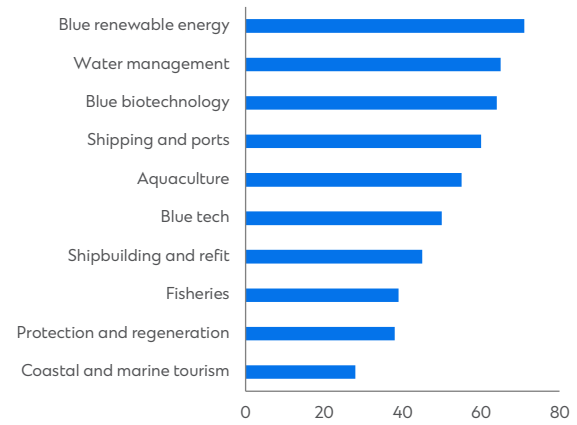
Number of companies



Source: 1,000 Ocean Startups, Standard Chartered

Figure 73:
Preference among blue economy sectors

Percentage of private market ocean-focused funds



Source: BlueInvest, Standard Chartered

One of the blue economy areas that has seen strong interest during the past year or two is the aquaculture and alternative seafood segment. Data from Aquablurb, the aquaculture-focused newsletter, suggest that 87 transactions took place in this sector in 2023, with combined global funding of USD2.2 billion. Some of the largest funding that took place included a USD200 million raising by eFishery in Indonesia and USD104 million raising by FreshtoHome in India. Interestingly, we note that funding by companies in Asia-Pacific and Africa accounted for c. 55 per cent of total funding, more than that raised by those located in North America and Europe combined.

The public equity market is mainly an indirect supporter at present

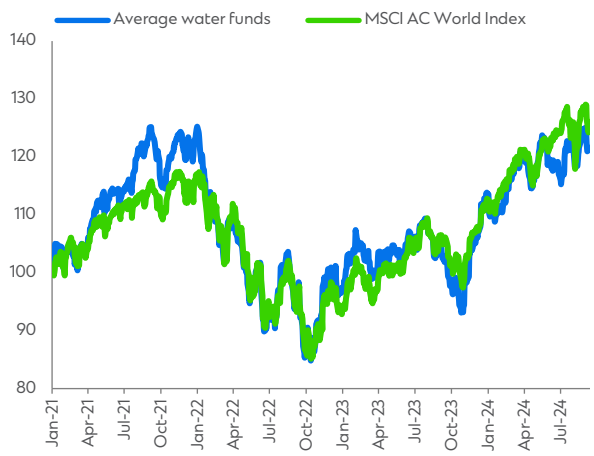
During the past few years, the mutual fund industry has also become more engaged with water-related investing. On an industry level, we highlight the emergence of the Valuing Water Finance Initiative which is a collective of currently more than 100 institutional investors with c. USD17 trillion in assets under management. The aim of the initiative is to engage with large companies from four water-intensive industries (apparel, food, beverage and high-tech) and act on water as a financial risk to drive necessary change to better protect water systems.

Broader public equity market investments in the theme of water are also developing. Our analysis of open-ended equity funds listed on Bloomberg showed that 85 currently exist that have a water focus. These funds manage a combined USD45 billion of assets. Our return analysis suggests that the largest water funds generated returns since the end of 2020 that were very much in line with that of the MSCI AC World Index (Figure 74). We find this supportive for the blue carbon investment theme, considering that these water funds have a narrower stock focus than the MSCI AC World Index, and that their returns are net of management fees (which are not included in the benchmark MSCI AC World Index). The relative returns posted by these funds, coupled with growing awareness among investors regarding blue-economy-related investment requirements, should be two supportive factors for further growth of the water related public investment universe.

The fund universe that might potentially be interested in gaining exposure to blue-economy-related companies is broader than water-specific funds alone in our view. More general sustainability and ESG funds are also natural investors given the relevance of the blue economy to the wider sustainable agenda. Our analysis of assets under management for c. 3900 ESG funds suggest that the broader active ESG fund space currently manages c. USD3.5 trillion in assets (Figure 75). We recognise that these portfolios are diversified and cover many different sustainability-related themes, however, it does indicate strong potential for investments in blue-economy-related companies in our view.

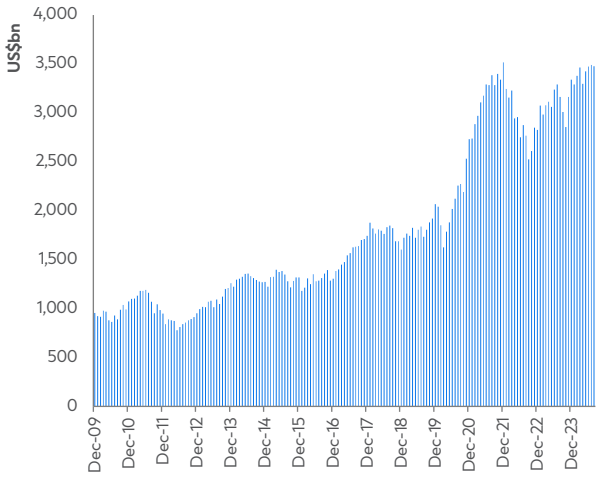
Figure 74: Performance of key water funds vs MSCI AC World index

Rebased to Dec-31 2020 at 100



Source: Bloomberg, Standard Chartered

Figure 75: ESG equity fund universe has total assets under management of c. USD3.5 trillion

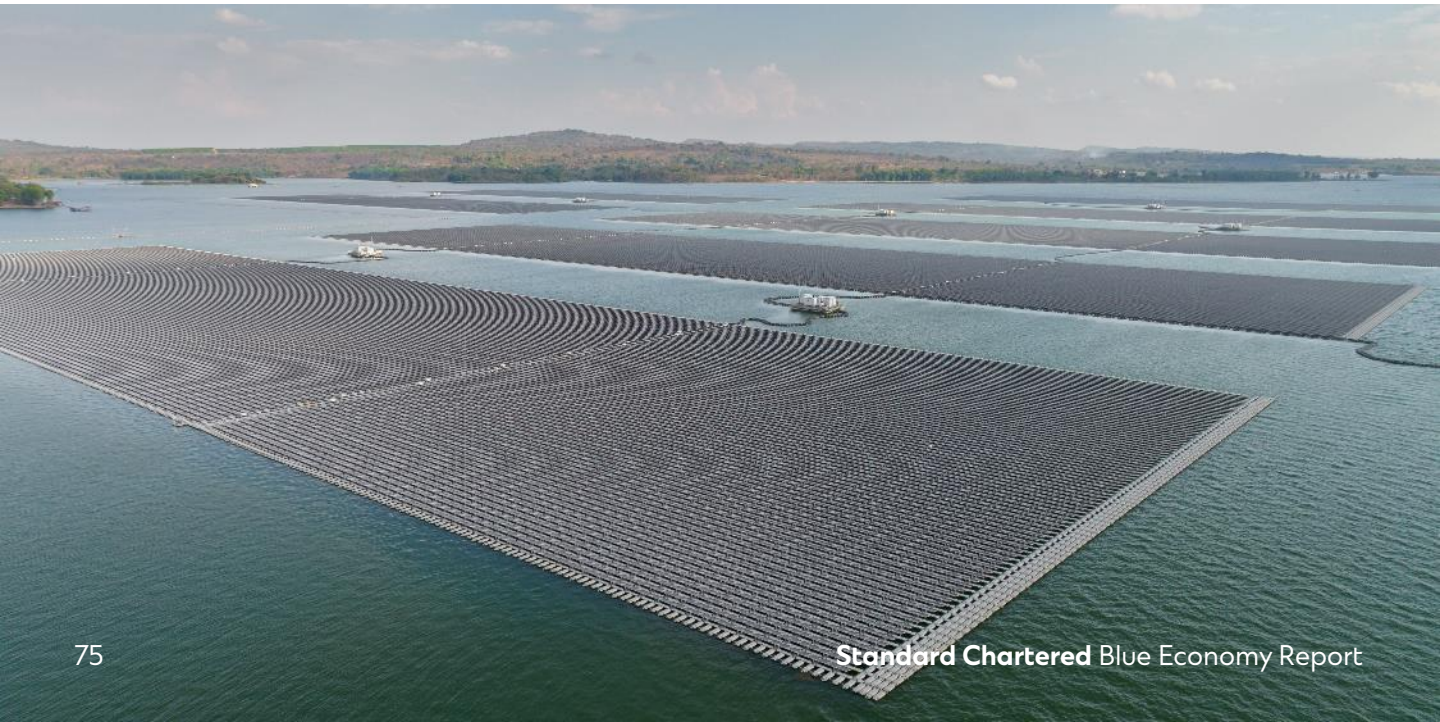


Source: Bloomberg, Standard Chartered

While the growing level of engagement from the mutual fund industry with the theme of water or the blue economy is positive, we would note that this is only likely to indirectly help grow the emerging array of blue economy solutions at this stage. The reason for this is that the mutual fund industry is predominantly exposed to publicly listed companies. In Appendix B we highlight the top 50 companies by market capitalisation that water funds currently have exposure to.

The publicly listed companies as shown in Appendix B do not tend to be those that are developing the new solutions as highlighted earlier in this report, and that we included in our blue economy landscape (see Appendix C). Greater engagement from the mutual fund industry with the listed water exposed companies that they have invested in can increase pressure on these companies to develop exposure to emerging blue economy solutions, including using merger and acquisition (M&A) activity. This in turn, might provide emerging blue economy companies with the necessary capital to scale their business more quickly.

The growth and size of the sustainability-focused mutual fund industry provides a strong long-term level of support to organisations across the blue economy in our view. It suggests that as blue economy solution providers mature and grow they will have sufficient access to public capital too to help fund further expansion.



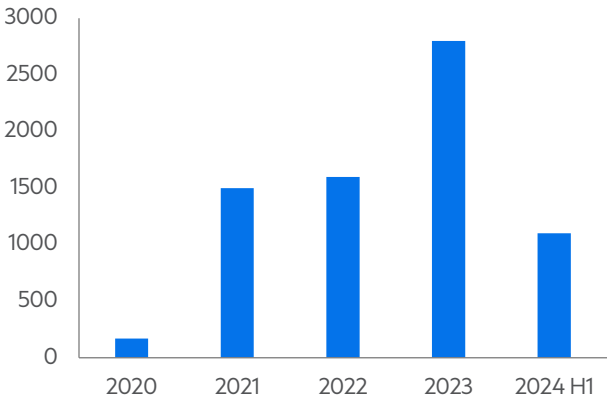
Blue debt financing is growing too

Funding sustainability projects and companies through debt has been a growing phenomenon over the past ten years. At the end of the first half of this year, total outstanding sustainable debt had reached USD4.7 trillion while the balance of sustainable loans had grown to USD1.9 trillion.

We have shown that the financing requirements associated with creating a sustainable blue economy are very substantial, and that not all the related sectors can rely on equity funding for required investments at this stage. Sustainable debt finance in the form of bonds and loans is needed to help bridge the financing gap.

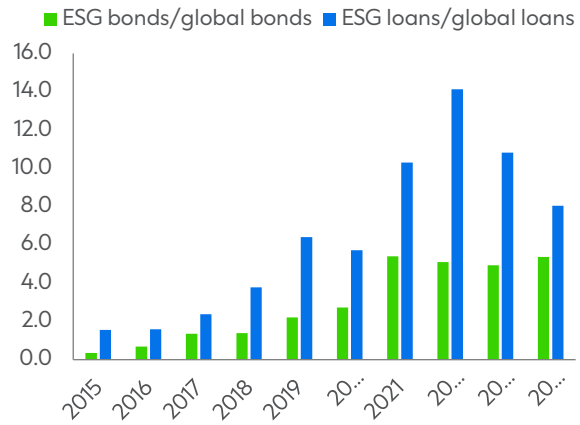
Figure 76:
Issuance of blue bonds

USD million



Source: Bloomberg, Standard Chartered

Figure 77:
ESG bonds and loan issuance as share of the total bond and loan market



Source: IIF, Standard Chartered

Blue finance principles to help unlock financing

During the past few years there has been growing interest in debt financing with a blue economy focus. This has resulted in the creation of so-called blue bonds and blue loans. Recent issuance activity of blue bonds has started to increase and reached USD2.8 billion in 2023 according to Bloomberg, up from USD1.6 billion in 2022. Environmental Finance put last year's issuance of blue bonds at a record USD4 billion and notes that during the first half of 2024, more than USD1.6 billion of blue bonds were issued. Sustainable loan issuance has increased too. Data also from Environmental Finance, indicates that USD1.4 billion in blue loans were issued in 2023, more than double the issuance of 2022.

To help unlock greater blue debt financing, issuance guidelines around blue bonds and loans have been developed during the past few years. In 2018, 14 principles were issued as the first global guiding framework to finance the sustainable blue economy. The principles were developed by the European Commission, WWF, the World Resources Institute and European Investment Bank.

Blue bonds are Use of Proceed facilities, meaning that their proceeds are tied to finance specific blue projects. These projects are governed under the relevant principles of the Loan Market Association and the International Capital Markets Association. Blue projects that are eligible under these principles are those related to Water supply, Water sanitation, Ocean-friendly and Water-friendly products, Ocean-friendly chemicals and Plastic related sectors, Fisheries, Aquaculture and seafood value chain, Marine ecosystem restoration, Sustainable tourism services, Offshore renewable energy production and Sustainable shipping and Port logistics sectors.

The development of these guidelines helps to create a more transparent and efficient market for blue-economy-related debt instruments. This in turn should help unlock greater issuance of these instruments.

Factors that limit investing in the blue economy

Despite the very sizeable investment requirements and value propositions associated with the blue economy, we note that equity and debt-related sustainable finance flows remain low. Our conversations with organisations active in the blue economy provided a clear picture of some of the challenges that have until now limited the amount of capital that was deployed to the blue economy. Some of these include:

- **Relative lack of regulation or support:** To assess blue economy projects and decide whether they are attractive propositions, investors want predictability of future income streams. This requires strong, stable, and supportive regulation, the enforcement of regulation, and in some cases financial support programmes. Progress on this front is being made as we show elsewhere in this report. Greater involvement from public and private bodies in the blue economy will only help address this concern in our view.
- **Financial risk of borrowers too high:** Certain sectors of the blue economy are made up of companies or organisations that have low margins or profitability and volatile and low revenues. Seafood production, especially through fisheries, is an example of this. Traditional bank lending becomes more difficult for these types of organisations. In addition, sponsorship programmes offered by governments or regional development banks aimed at developing blue economy sectors, may not be flexible enough to support individual companies that are too small in terms of revenues or profits.
- **Lack of ability to achieve economies of scale:** Some blue economy projects may have strong impact potential but cannot be scaled. Examples of this would include single seaweed farmers or smaller restoration and conservation projects. To help address this issue, software solutions are being developed with the aim to aggregate buying and selling of products by small scale producers such as seaweed farmers of fisheries. This improves their profitability and growth potential.
- **Technologies or solutions are unproven:** A range of potential solutions to make the blue economy more sustainable are still in relatively early stages of development. This increases the uncertainty over the financial outlook of the companies involved, which in turn makes it more difficult to attract traditional financing. While early-stage companies may find it difficult to attract traditional bank financing we note that in case of the blue economy there is strong growth in the range of angle and venture capital investors. These are willing to engage with early-stage companies which should in turn help ease the funding challenge.
- **Sustainable finance opportunities are too small**: Financial institutions and asset managers have indicated a desire to become more engaged with blue bonds and blue loans. One of the key challenges that they face, however, is a lack of liquidity in the blue bond and blue loan market. Blue bonds tend to be relatively small, which makes it challenging to attract a wide enough number of investors and especially the larger institutions. We believe that this is mainly a timing issue that should gradually reduce over time as more companies and public bodies issue blue debt.

Debt-for-sustainability swaps to unlock blue economy funds

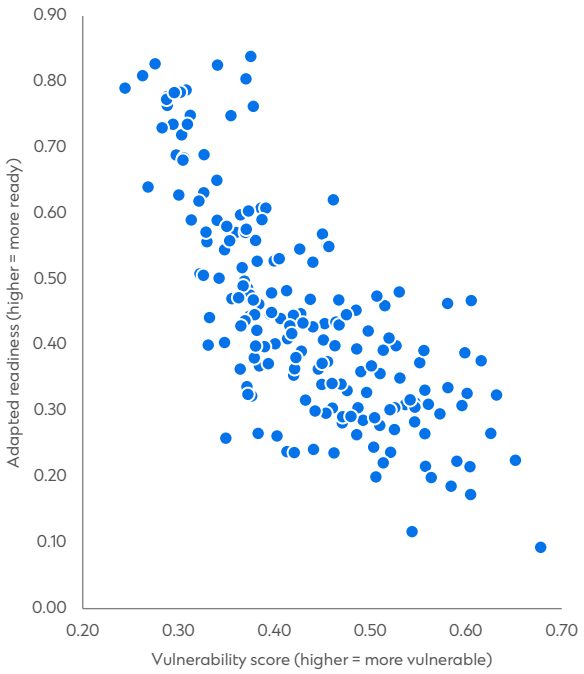
Emerging markets face a 'triple crisis' of high debt burdens, ever-increasing costs of dealing with the worst effects of climate change, and critical nature and biodiversity loss. We believe debt-for-sustainability is one tool that can be deployed to support sovereigns to address all three challenges at once, by unlocking vital fiscal space towards addressing social, nature and climate-related needs.

Emerging markets are most at risk from climate change

IMF data clearly shows that countries with increased vulnerability to climate disruptions tend to be less prepared to leverage private and public sector investment for adaptive actions (Figure 78). In addition to the almost 200 countries assessed by the IMF for climate risk, those with the highest perceived climate risk are all located across emerging markets (Figure 79).

Figure 78:
Climate vulnerability and adaptation readiness

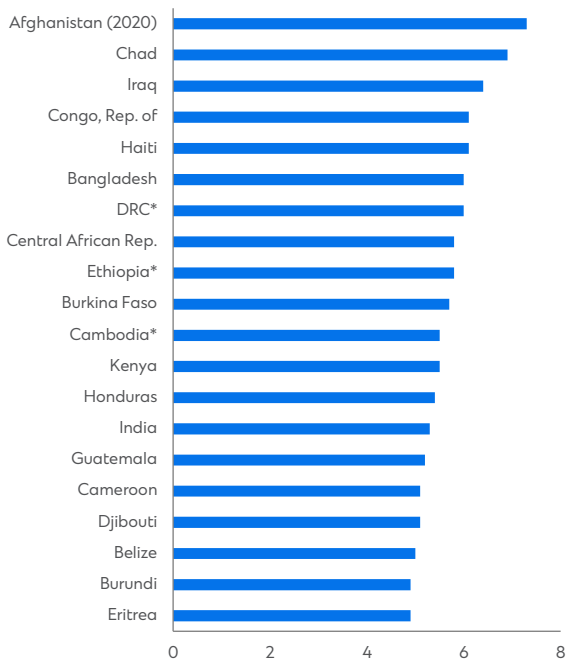
2021



Source: IMF, Standard Chartered

Figure 79:
Countries with the highest climate driven risk

2022

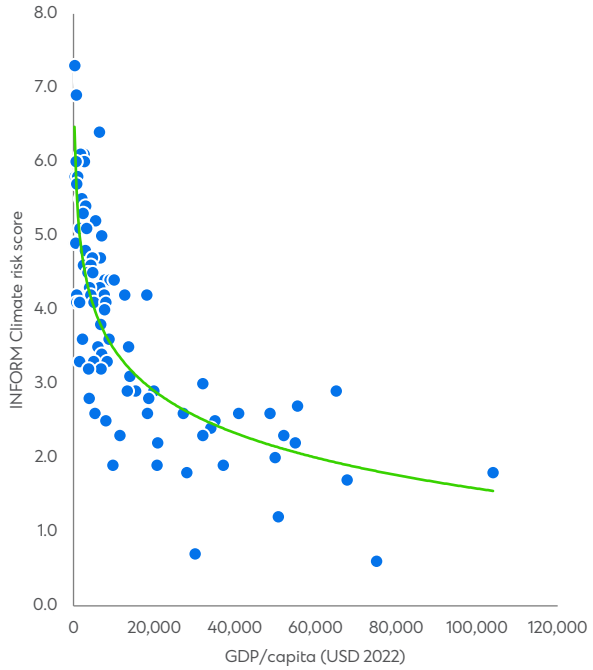


Source: IMF, Standard Chartered

Comparing a country's risk from climate change to the most recent measure of GDP-per-capita clearly shows that emerging markets, on average, face the greatest risk from climate change.

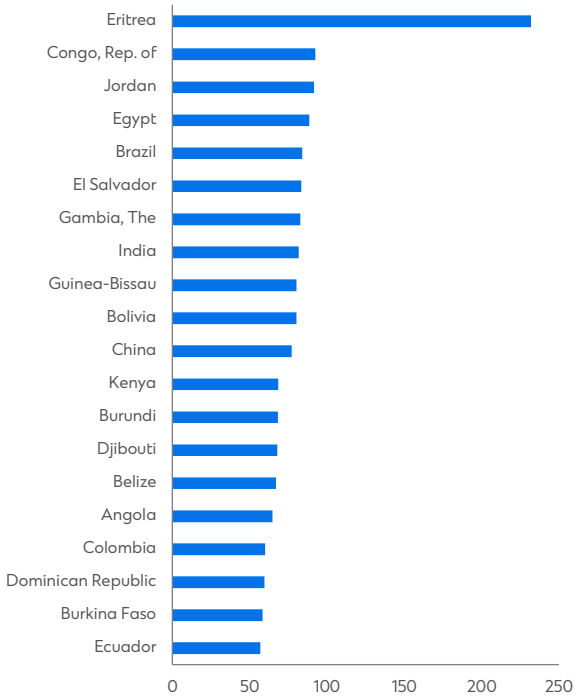
The ability for a country to deal with climate change adaptation and mitigation depends on its financial situation among others. We reviewed debt levels for the 43 countries that face above average risk from climate change, as measured by the IMF Climate driven INFORM index. Emerging markets tend to have lower gross debt-to-GDP levels than developed nations, however this is not true for all. Of the countries with the highest climate risk exposure, we show those that also have the highest level of gross debt-to-GDP according to data from the World Bank (Figure 80).

Figure 80:
Climate risk highest for countries with lower GDP-per-capita



Source: IMF, World Bank, Standard Chartered

Figure 81:
Countries with the highest ratio of gross debt-to-GDP and above average climate risk score



Source: IMF, World Bank, Standard Chartered

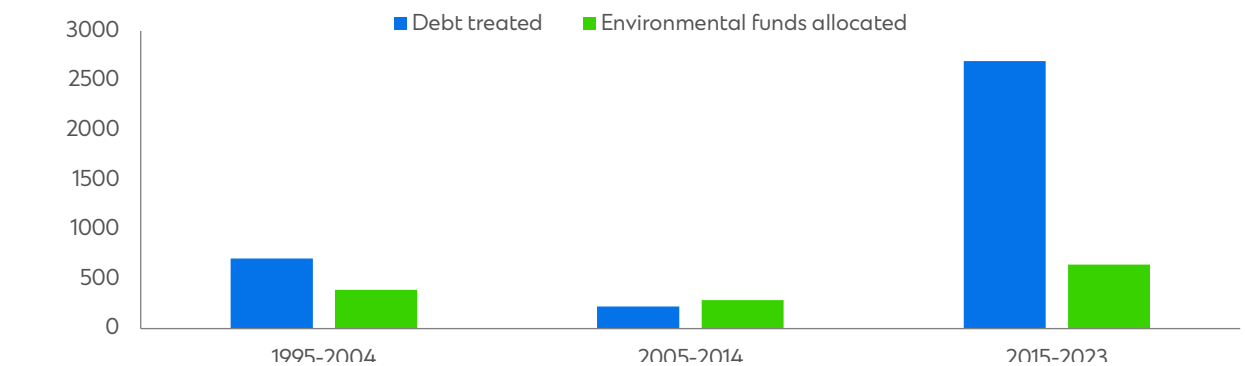
Debt-for-sustainability swaps might just be a good way for countries that have more challenged financial conditions to deal with raising finance to use for climate change adaptation and mitigation efforts.

Debt-for-sustainability swaps are becoming more popular

Debt-for-sustainability swaps are not a recent phenomenon as they have been used since the late 1980s. Annual average volumes of debt restructured in this way, however, have been relatively low at c. USD50 million per annum between 1995 and 2015. We note that more recent debt-for-nature transactions show a sharp increase in the amount of restructured debt. Belize in 2021 agreed to restructure more than USD550 million as part of a debt-for-sustainability swap. Last year saw deals from Ecuador and Gabon that involved total debt of more than USD2 billion (Figure 82).

Figure 82: Volume of debt involved in climate swaps is increasing

USD million



Source: African Development Bank, Standard Chartered

An increase in the face value of the debt that is restructured as part of a debt-for-sustainability swap also lifts the amount of funding that will become available for environmental conservation projects. The Ecuadorian deal, for example, provides USD450 million in environmental funds, while the Belize and Gabon swaps provide almost USD340 million for conservation purposes.

World Bank Debt for Development Swap framework

In July 2024, the World Bank published a framework for Debt for Development Swaps with the aim to optimise the decision-making process on when, where, and how to use debt swaps. According to the World Bank, debt swaps are most suitable for countries at moderate or high risk of debt distress with a sustainable outlook, but that face shorter term liquidity pressures. Debt swaps would not be appropriate tools for countries with unsustainable debt levels or that require comprehensive debt restructuring, according to the World Bank analysis. These countries would benefit more from debt reduction and a fully funded macroeconomic adjustment program.

An important feature in the World Bank's proposed framework is the fact that it proposes a more flexible approach to spending commitments. Rather than ringfencing resources generated via debt swaps, the World Bank's proposal would advocate for a more flexible earmarking of spending. It also believes that greater impact can be achieved if debt swaps rely more on country systems and institutions.

The framework as proposed by the World Bank may help address some of the challenges that the debt swap market has faced until now. For example, it may speed up negotiations among stakeholders, especially if there is greater buy-in from the involved country.

The potential improvements that the World Bank's framework can generate may help increase debt swap activity further during the next few years, however, this may not be sufficient. The key reason for this is that debt swaps, until now, have only involved relatively small fractions of a country's total external debt. The improvement in fiscal room created by the swap has therefore typically not been big enough to provide countries with the money needed to cover their climate mitigation and adaptation needs.

Valuing nature to trigger sovereign blue funding

In the chapter on ocean governance, we argued that a proper valuation of the overall economic benefits for the conservation and restoration of marine areas is not common, and that this hampers progress towards a sustainable ocean. The inability to outline the economic benefits of sustainable marine areas severely limits the potential to raise funding for the restoration and conservation of these areas.

We believe that governments have a greater chance to achieve their overall marine or ocean-related sustainability targets if they develop Marine Spatial Plans (MSP) that incorporate an economic valuation of marine areas. This makes it easier to draw-in investments from the private sector, which would reduce the need for sovereign funding – something that is particularly helpful for more indebted nations. When properly designed, these projects could be financed through the issuance of sovereign or private blue bonds, which in turn would help draw in more appetite from the mutual fund industry. Obtaining debt financing for conservation and restoration efforts without a proper economic valuation of these areas will be unlikely in our view, as investors will not know how this financing is to be serviced and repaid.

Valuing sovereign natural capital is an evolving field and is gaining traction with development banks and sovereigns. In 2020, the Gross Ecosystem Product (GEP) was developed by academics from a number of Chinese, American and UK research institutes, and adopted by the UN in 2021 as part of the UN System of Environmental-Economic Accounting (SEEA). It is designed to express the contribution of ecosystems to society in monetary terms. These monetary estimates can then be used for economic policy planning or cost-benefit analysis. GEP has already been implemented for more than 200 projects across China. Various research centres have developed models that incorporate GEP to analyse the impact of policies on economic output and ecosystem conditions. Examples are the MAGNET model from the Joint Research Centre (JRC) and Wageningen Economic Research and InVest developed by Natcap.

To underline the potential for valuing nature, we note that the original GEP analysis from Ouyang et al. (2020) performed on the Qinghai Province in China showed that in 2015, Qinghai's GEP was 185.41 billion Yuan. In other words, the value of the contribution of nature to Qinghai's society was equal to 76 per cent of the value of the province's GDP.

By understanding the true economic benefit derived from marine areas, governments will, in our view, be able to more effectively raise the required funding needed for the conservation and restoration of these areas. We will dive deeper into the topic of valuing nature in future publications.

Blended finance to play a key role for higher risk projects

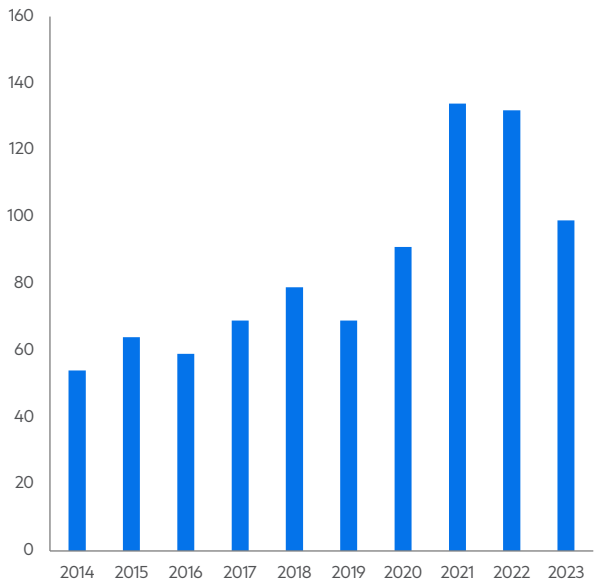
We outlined earlier in this chapter that several of the blue-economy-related solutions carry too much risk when trying to attract traditional funding in the form of early-stage equity investing or loans. One way to improve the ability for these types of projects to attract financing, is by using blended finance where public or philanthropic investors are joined with private investors. Blended finance allows organisations that have different financial or social objectives to achieve them. Concessional capital, guarantees, or risk insurance used by public or philanthropic investors improve the risk-return profile of blended finance projects, which may unlock private capital.

The blended finance market globally is showing signs of growth. The number of deals has steadily increased since 2014 based on data from Convergence. Although the number of blended finance deals declined in 2023 versus the previous year, Convergence does note that these deals represented aggregate value of USD15 billion compared to just USD9 billion in 2022. Average deal size is increasing as c. 40 per cent of blended finance deals in 2023 had a size of USD100 million or more compared to 17 per cent in 2022. Blended finance appears well suited for blue economy challenges considering that transactions have been largely focused on the most underdeveloped areas globally. These are also the regions with the greatest blue economy challenges in our view.

In addition to the increase in deal value, we note that the growing interest in blended finance is also observed through the rise of collaborative or coalition-led blended finance initiatives. These include the Blended Finance for the Energy Transition initiative, the Investment Mobilisation Collaboration Agreement and the launch of the Green Guarantee company.

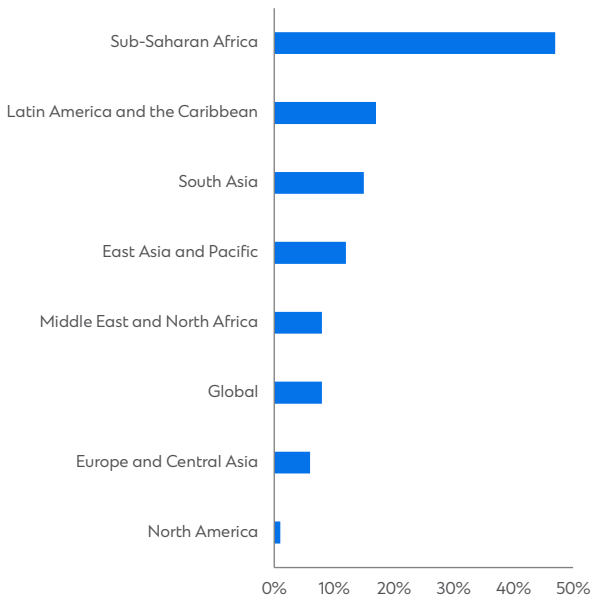
The blue economy provides a good opportunity for blended finance to be applied, and some of Convergence's data supports a positive view of recent developments. For example, fisheries and aquaculture-related blended finance deals are rising relative to other agriculture-related deals – from 4 per cent in 2021 to 15 per cent in 2023. Water and waste management-related blended finance transactions occupied 22 per cent of total infrastructure deals by value for the 2021-2023 period according to Convergence. This was up from 19 per cent for the 2018-2020 period.

Figure 83:
Blended finance deal count



Source: Covergence, Standard Chartered

Figure 84:
Blended finance transactions by region



Source: Covergence, Standard Chartered

The view from blue economy investors

As part of our review of the blue economy, we also wanted to get the insights of some of the theme's investors. With that in mind, we spoke to three of the more high-profile financial investors. Aquaspark, located in the Netherlands, is one of the largest investors in the blue economy and has a focus on aquaculture-related investments. The ReOcean Fund was established through a cooperation between the Prince Albert II of Monaco Foundation and Monaco Asset Management and focuses on five ocean-related verticals. Finally, Ocean 14 Capital is the oldest venture capital fund and the largest impact investor in the blue economy.

All three investors outlined similar positive views on the prospects for the blue economy. They see strong growth potential and believe that the range of solutions and the number of companies engaged with the blue economy continues to increase. In addition, they also note that engagement from the financial sector including banks has started to improve and that governance is indeed becoming a tailwind for a number of key blue economy sectors.

The investors did note that understanding of the ocean and its relevance remains an area that can be improved upon. This would help increase investment flows towards the relevant sectors as investors would better understand the risk-return characteristics of the blue economy. Despite the improving nature of ocean governance, investors do highlight that further tightening of regulation and importantly greater financial commitments towards ocean-based solutions would help increase momentum towards the blue economy further.

Investor profile:

Aqua-Spark

Overview

Aqua-Spark, based in the Netherlands, is one of the world's largest investment funds investing in the global aquaculture industry. Aqua-Spark was founded in 2013 and made its first investment in 2015. The fund currently has 24 holdings while total assets under management is currently c. EU500 million.

How does the fund aim to assist the blue economy?

Aqua-Spark has a sole focus on aquaculture-related investment solutions. Aquaculture offers an alternative to wild catch and helps to create a more sustainable food system.

Aqua-Spark's investment strategy focuses on the entire aquaculture value chain. The fund invests in companies that provide sustainable alternatives for aquafeed (e.g., insects, fungi and microbial proteins), in production and farming operations and technologies that aim to improve the sustainability of aquaculture production across the value chain. The latter includes satellite and monitoring solutions, cultivated or cellular protein alternatives, circular systems, or biotechnology solutions.
Many of Aqua-Spark's initial investments are in early-stage companies. The fund structure enables Aqua-Spark to support these companies through their growth cycle. Most of the fund's current value is in more mature, growth companies.

Sustainable finance: key challenges and opportunities

The fund managers note that the potential universe of investment opportunities for Aqua-Spark is large. When asked about the key challenges for scaling investments in this industry, Aqua-Spark refers to a few specific factors.

- The ocean in general and SDG 14 in particular have been held back by a lack of data and knowledge. Being a relatively new investment space, the blue economy has few examples of the life cycle of its companies, nor track records of investors in this space. Growing awareness of the relevance of a sustainable ocean and the increase in companies aiming to solve its challenges should make scaling investments easier in the future.
- Aquaculture-related investments are often relatively capital and time intensive. Investments in, for instance, an alternative protein factory or an innovative aquaculture production plant can require patient capital. Although competition for this type of deal might be lower than in many other markets and the return potential is good, the required holding period and capital doesn't fit all investors.
- A more immediate concern related to blue economy financing levels is the combination of increased interest rates and more uncertain macro-economic and geopolitical risks. This impacts investor appetite for investment propositions that are at an earlier stage of development.

Despite these challenges, Aqua-Spark notes that due to its funds size of cEUR500 million, they are now experiencing increased interest from institutional investors. This suggests that investor interest in the blue economy is growing, and that capital is available to benefit from a sector where return and impact can go hand-in-hand, according to Aqua-Spark.

Investor profile:

ReOcean Fund

Overview

The ReOcean Fund was set up as a partnership between the Prince Albert II of Monaco Foundation and Monaco Asset Management. The fund exists to support solutions accelerating the transition to a more sustainable blue economy, with a positive impact on biodiversity and climate. It focuses on five verticals addressing the ocean's most pressing challenges and aims to reach EUR100 million in assets under management by June 2025.

How does the fund aim to assist the blue economy?

The ReOcean Fund believes that economic, political and consumer dynamics with the ocean are shifting rapidly and that the ocean represents a real investable asset class with significant opportunity for growth.

After reviewing some 16 different blue-economy-related sectors the ReOcean Fund has identified five that it will focus on most. Through these five verticals the fund focuses on companies that: reduce sources of pollution, transform the way blue food is produced, reduce the impact of global ocean logistics, create a more robust ocean data network, and further the restoration and protection of marine ecosystems. So far, the fund has assessed more than 900 companies, 120 investable opportunities and screened 50 firms within its mandate.

Sustainable finance: key challenges and opportunities

The ReOcean Fund notes that almost 90 per cent of ocean impact funds focus their investments on early-stage ventures. This creates a lack of available financing for companies once they scale beyond their initial growth phase. The ReOcean Fund sees this as an opportunity and therefore aims to allocate 80 per cent of its capital to companies that have moved beyond early-stage venture capital development. This is where the fund feels it has greatest potential to add value.

The ReOcean Fund noticed a shift in momentum towards ocean investing, however, several challenges remain that may impact its success too. Absolute levels of investing and finance into the blue economy remain far too low, partly due to a lack of economic awareness and engagement with the ocean.

Many investors lack knowledge on business opportunities existing in the sustainable blue economy and perceive ocean-related initiatives purely as conservation work. The needed accelerated growth of the blue economy
will be challenging unless finance flows
increase towards a broader array of ocean-related sectors.

Revisiting the ocean's role and challenges

Revisiting the ocean's role and challenges

During the past ten years, numerous studies have been published outlining the challenges faced by the ocean. With that in mind, we decided in this report to start by focusing on the positive and focus on the growing array of solutions that can make the ocean more sustainable. However, we recognise that not all readers might be intimately familiar with the relevance of a sustainable ocean. Therefore, this final chapter outlines the central role played by the ocean in relation to life on earth.

The ocean is integral to the global economy

The ocean supports a range of economic sectors or activities including transport, fishing, tourism and energy. In addition, a high and growing array of countries rely on the ocean for their food and protein intake. To sustain global economic momentum and help economies develop requires a sustainable ocean. Five key factors that support the relevance of a sustainable ocean to the global economy include:

40 per cent of the world's population relies on fish for their protein

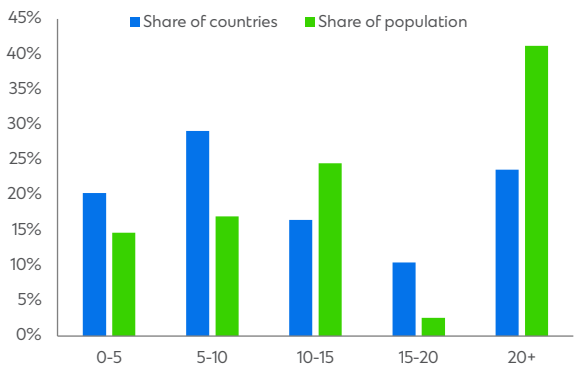
One way to show the relevance of a sustainable ocean is by assessing how much different countries rely on fish for their daily protein intake. Using data from the Food and Agriculture Organization (FAO) online resource (FAOSTAT) on animal and fish protein consumption per capita for 182 countries, we calculate that 43 countries (or 24 per cent of the total) rely on fish for more than 20 per cent of people's daily animal protein consumption. When incorporating World Bank population data, we find that more than 3.2 billion people, or 41 per cent of the world's population in 2021, relied on fish for more than 20 per cent of their daily protein intake (Figure 85).

A range of large Asian and African countries, including Bangladesh, Myanmar, Indonesia, the Democratic Republic of Congo and Uganda, are among those that are most reliant on fish for people's daily animal protein intake (Figure 84). When assessing the relevance of fish intake in relation to people's total daily protein intake we find that fish protein makes up more than 10 per cent of total daily protein intake for more than 15 per cent of the world's population.

The expected expansion of the world's population during the next few decades, coupled with the likely increase in average spending power, especially across emerging markets, is likely to trigger a strong increase in future protein demand. Elsewhere in this report we outline that an increasing share of consumed fish is generated via aquaculture rather than wild catch. We do see strong growth potential for aquaculture as a way to meet future demand for fish consumption. However, unless action is taken, this increased demand will likely also increase wild fishing and thereby put further pressure on the sustainability of the ocean's fish population.

Figure 85: Fish protein intake as a percentage of total animal protein consumption

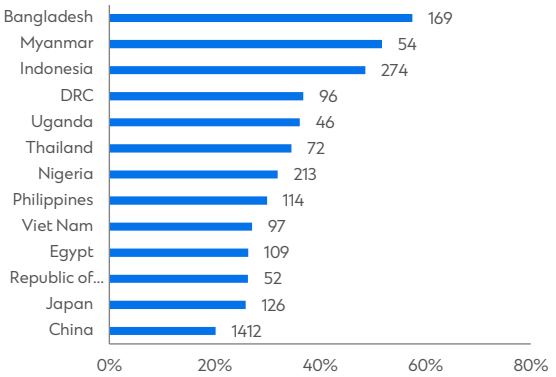
2021 per capita data by country and total population



Source: FAO, World Bank, Standard Chartered

Figure 86: Largest countries with fish protein intake representing more than 20 per cent of total protein consumption

2021, data labels represent population size (m)



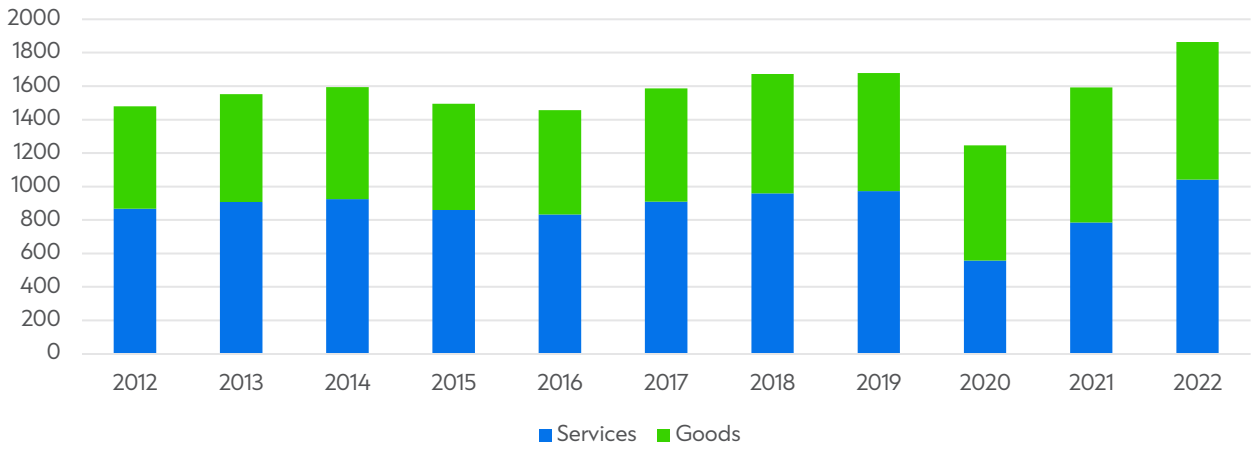
Source: FAO, World Bank, Standard Chartered

The value of ocean-based exports is more than USD1.8 trillion

The ocean fulfils a key role in the global economy not least as an export enabler. Data from UN Trade and Development (Statistics and data | UNCTAD) shows that the export value associated with ocean-related goods and services increased almost 50 per cent from 2020 to an all-time high of more than USD1.8 trillion in 2022 (Figure 87). Total ocean-related exports alone represented c. 2 per cent of global GDP in 2022.

Figure 87: Total export value of ocean-related products and services

USD billion

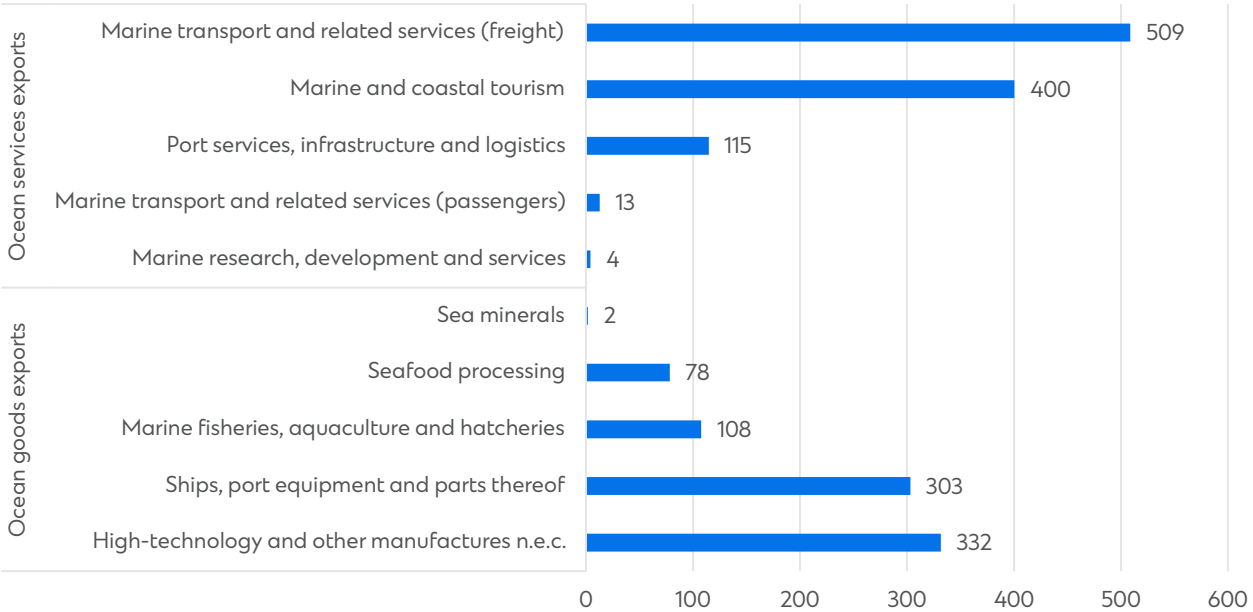


Source: UNCTAD, Standard Chartered

A wide range of ocean-based products and services contribute to the overall export value as shown in Figure 88. However, the most relevant drivers are freight transport (c80 per cent of global trade is transported via shipping), marine tourism (the majority of tourism is ocean-dependent), port and related services and ocean-related technologies. The latter includes renewable energy-related technologies and ocean or marine-based pharmaceutical products (Figure 88).

Figure 88: Export value of ocean-based products and services by sector

USD billion, 2022



Source: UNCTAD, Standard Chartered

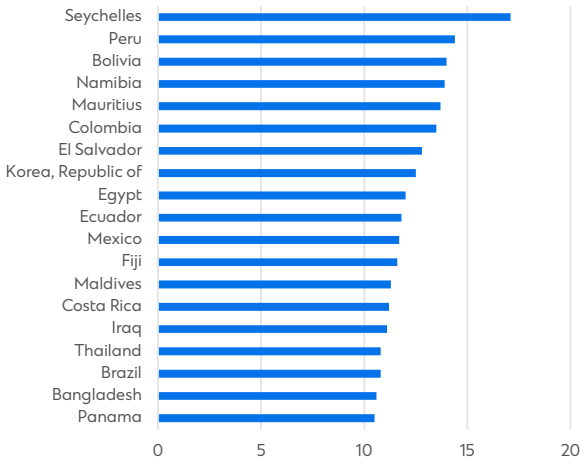
The blue economy generates sizeable employment opportunities

As far as employment is concerned, we note that (excluding tourism) the Organisation for Economic Co-operation and Development (OECD) estimate that the blue economy is responsible for c. 30 million jobs directly (see The Ocean Economy in 2030). Just 7 per cent of these are in Europe and North America, suggesting that a sustainable ocean is of particular relevance to emerging markets (Figure 890).

Ocean tourism is one of the major blue-economy-related sectors, not just in terms of direct revenue spending, but also in terms of overall economic and employment impact. The High Level Panel for a Sustainable Ocean Economy suggested that coastal and marine tourism accounted for c. 50 per cent of all global tourism (Hoegh-Guldberg, Northrop, et al., 2023). Emerging markets in particular require ocean tourism to become sustainable. Data from the International Labour Organisation (ILO) shows that more than 10 per cent of the workforce across almost 20 countries are employed in the tourism industry (Figure 89).

Figure 89: Share of employment in tourism

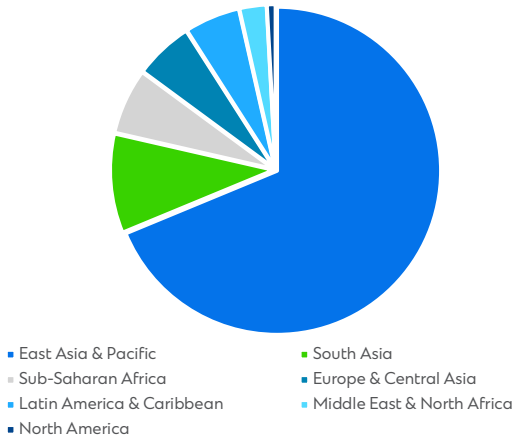
per cent, 2023



Source: ILO, Standard Chartered

Figure 90: Ocean-related employment by region

Excluding tourism, 2015



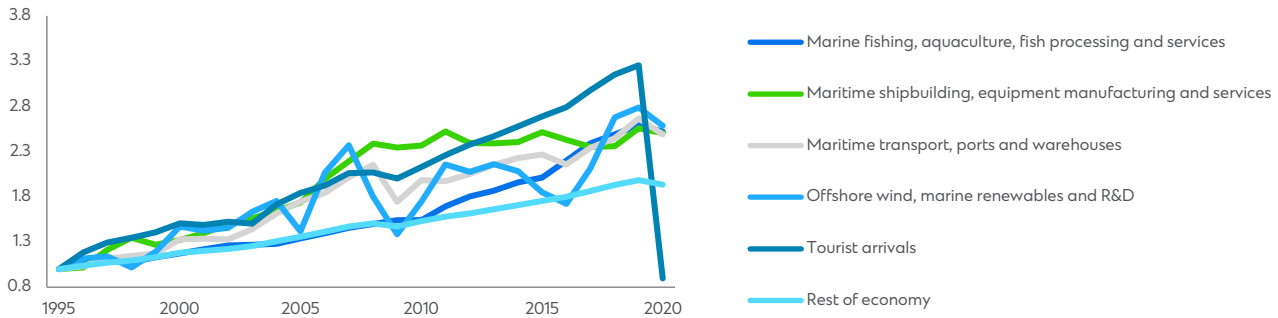
Source: OECD, Standard Chartered

Ocean-exposed sectors outperform the broader economy

Performance analysis of ocean-exposed sectors suggest that the blue economy is not just big, but that it outperforms too. Data from the OECD and UN Tourism on a range of sustainable ocean-related activities dating back to 1995 indicate that these sectors have performed better than the overall economy (Figure 91). We note that the COVID-19 pandemic had a very significant impact on the tourism industry in 2020. Since then, the number of tourist arrivals and related spending has bounced back very strongly as data from the UN and the World Travel and Tourism Council (WTTC) indicates that, in 2023, tourism spending had reached c97 per cent of pre-pandemic levels.

Figure 91: Activity of ocean-related sectors versus the broader economy

Tourism based on arrivals, gross valued added for other sectors



OECD, UN Tourism, Standard Chartered

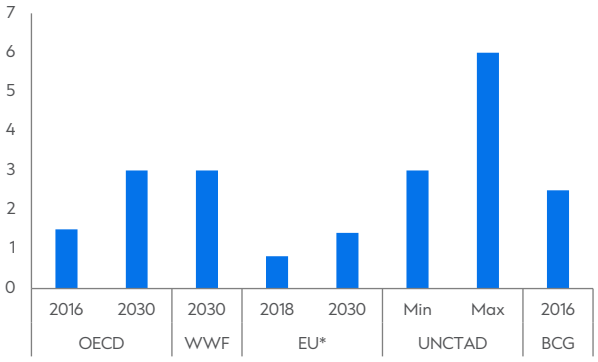
The ocean is the 8th largest economy in the world

Several studies have estimated the overall value of the blue economy. The OECD in 2016 estimated that the sectors included in the blue economy contributed USD1.5 trillion or 2.5 per cent to the global economy, and that this could double by 2030 (The Ocean Economy in 2030). That same year the Boston Consulting Group estimated the value of the blue economy at USD2.5 trillion (BCG). A 2019 report from the WWF estimated that the blue economy could be worth USD3 trillion in 2030 and that it could create up to 40 million new jobs by then. In 2023, the UN published a report in which the value of the world's ocean economy was put at between USD3-6 trillion (see Trade and Environment Review 2023). Work from the EU seems to corroborate these global studies in that it estimated in 2018 that the EU blue economy would be worth c. USD1.4 trillion by 2030 (Figure 92).

To put these various estimates into context, we note that if the blue economy were a country, it would be the 8th largest economy globally – even when we use the 2016 BCG estimate of USD2.5 trillion and compare it to 2023 GDP data for the largest economies globally (Figure 93).

Figure 92: The value of the blue economy is significant

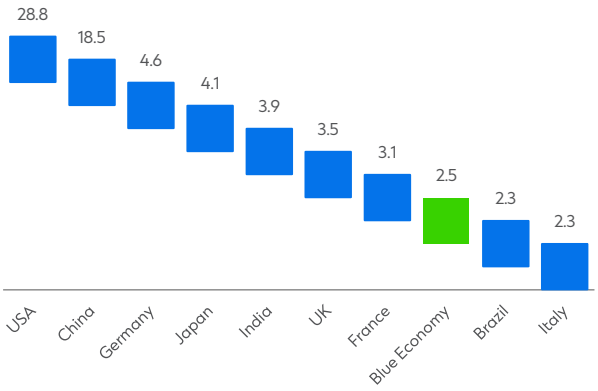
USD trillion



Source: OECD, WWF, EU, UN, Standard Chartered

Figure 93: The blue economy would be the 8th largest economy if it were a country

(USD trillion, 2023)



Source: IMF, Standard Chartered

The sustainability of the ocean is at risk

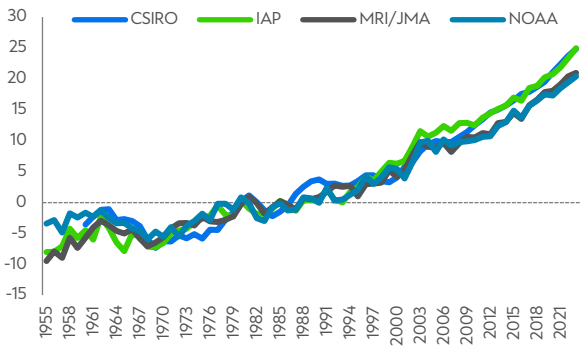
A sustainable ocean is not only needed to support economic development and food production, but also to help mitigate climate change and increase resilience to its impact. However, at present the ocean's health and the blue economy sectors that depend on a healthy ocean are being put at risk by several interconnected factors. We see the following as the ocean's key stress factors. Climate change creates three interrelated developments that put increasing pressure on the ocean's sustainability and therefore its ability to help address climate change. The triple threat faced by the ocean are:

01. The ocean is warming up

IPCC estimates indicate that the ocean has absorbed over 90 per cent of excess heat generated from human-caused global warming (see: IPCC). The heat content that is stored in the world's oceans has started to rapidly increase during the past few decades, which has coincided with an acceleration of the increase in ocean temperatures (Figures 94 and 95)

Figure 94: Ocean heat content in the top 700 meters

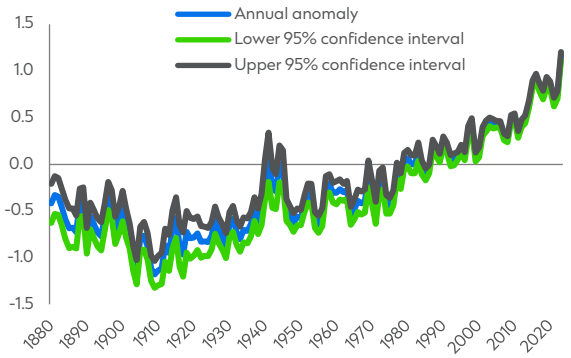
10^22 joules



Source: ILO, Standard Chartered

Figure 95: Average global sea surface temperature

Temperature anomaly (°F)



Source: OECD, Standard Chartered

One of the impacts of the rise in ocean temperatures has been the rise in sea levels and the melting of polar icesheets (Figures 96 and 97).

Higher ocean temperatures disrupt fish migration and marine biodiversity conditions. Increased sea levels and rising temperatures increase flooding risk across a widening range of coastal areas globally. Ultimately, these trends impact the livelihoods of ocean-dependent households. Estimates from McKinsey suggest that up to 800 million people could be affected by falling fish catches in warmer waters (See: Climate risk and response). More than 400 million people globally could be at risk by 2100 from rising sea levels according to a 2021 study from Hooijer and Vernimmen.

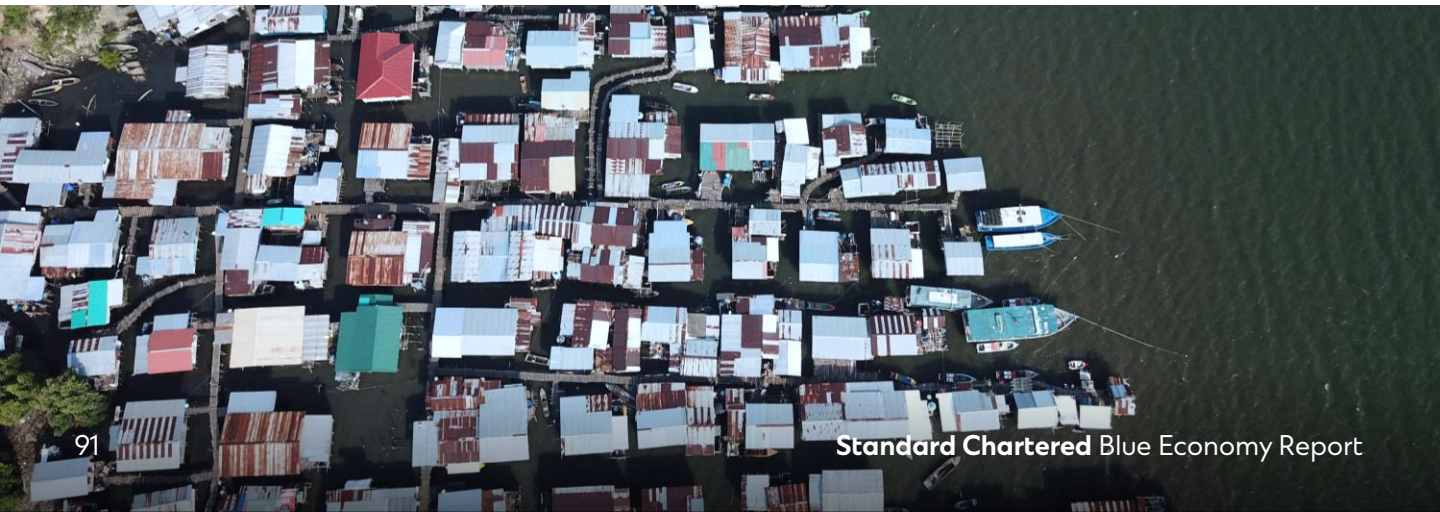
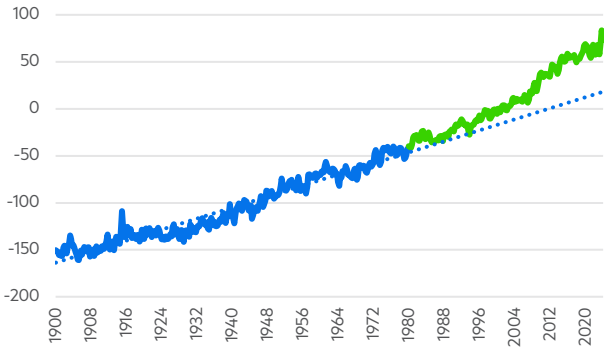


Figure 96:
Acceleration of sea level rises since 1990

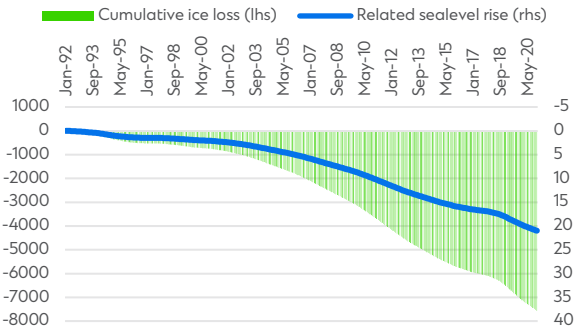
Sea height variation (mm)



Source: NASA, Standard Chartered

Figure 97:
Greenland ice sheet loss and sea level rise

Gt (lhs), mm (rhs)



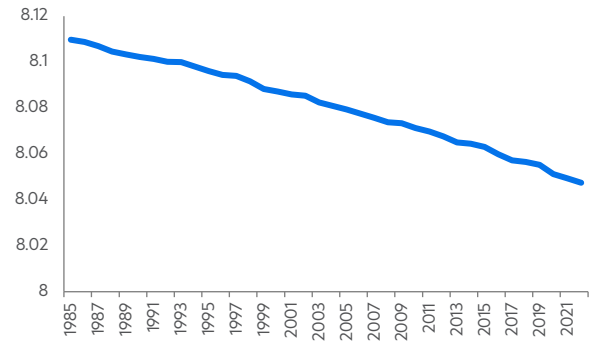
Source: NASA, Standard Chartered

02. The ocean is becoming more acidic

The ocean functions as a very powerful carbon storage sink. A study by the National Oceanic and Atmospheric Administration (NOAA) suggests that c. 30 per cent of global human-caused CO_2 emissions has been absorbed by the oceans (see: Ocean acidification). The carbon storage capability of marine ecosystems including kelp forests, mangroves and seagrass are strong, which helps to reduce CO_2 emissions. However, the steady increase in carbon absorption by the oceans more generally has started to change the ocean's chemistry. Specifically, the ocean is becoming more acidic. Data from various sources including the NOAA and Copernicus show that average oceanic PH levels have been falling since the mid-1980s (Figure 98). Copernicus analysis suggests that the ocean is currently acidifying 10 times faster than at any time in the past 300 million years and that it is c30 per cent more acidic than before the industrial era (New Ocean Monitoring Indicators).

Figure 98:
The ocean is becoming more acidic

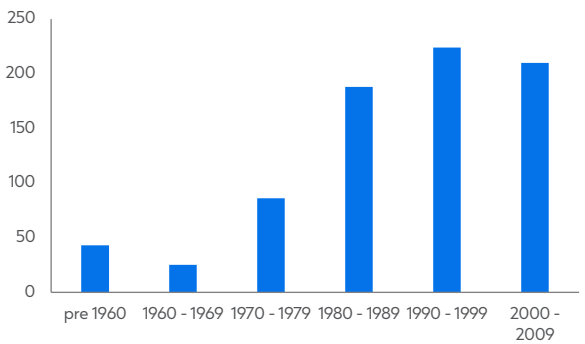
Sea water pH from reprocessed observations



Source: Copernicus, Standard Chartered

Figure 99: Number of coastal areas impacted by eutrophication and/or hypoxia

By decade



Source: WRI, Standard Chartered

A more acidic ocean has a wide range of consequences for the earth's ecosystems. For example, a more acidic ocean impacts the minerals used by a range of marine life including oysters, clams, lobsters, shrimp, and coral reefs, and weakens their shells and skeletons. In addition, harmful algal species bloom faster and produce more toxins in more acidic waters. The combination of this is that seafood supply is likely to come under increased pressure, directly affecting the c. 40 per cent of the world's population that relies on seafood for at least 20 per cent of their daily animal protein intake.

03. Ocean's oxygen generating capacity is under pressure

Oxygen is derived from photosynthesis, and today roughly half of photosynthesis takes place in the ocean while the other half takes place on land. The ocean, therefore, accounts for about 50 per cent of the world's oxygen. As the ocean warms and becomes more acidic, oxygen production comes under pressure.

Contrary to popular belief, a reduction in oxygen generation by the ocean will not directly impact life on land as the ocean is entirely responsible for the oxygen that we breathe (see also Gattuso, Duarte et al., 2021). However, declining oxygen levels in the ocean do impact the sustainability of ocean ecosystems given that most of the oxygen produced by the ocean is consumed by the microbes and animals that live in it. Gattuso, Duarte et al. also suggest that the open ocean has lost up to 3.3 per cent of its oxygen stock in the top 1,000 metres since 1970. They also warn that the number and size of low or oxygen minimum zones are expanding rapidly (Figure 17). Work from Kim et al. (2023) notes that the area across the Pacific, Atlantic and Indian Oceans that have low oxygen levels have expanded by 4.5 million km^2 to a size equivalent to half of Canada. In coastal waters they note that the discharge of nutrients has led to a more than tenfold increase in hypoxic areas compared to pre-1950 levels. These developments have significant biological, ecological, climatic, and economic consequences.

The overall impact and development of the triple threat faced by the world's ocean was outlined in a recent study (Wong et al., 2024). This estimates that up to 20 per cent of the global ocean is now experiencing the impact of these extreme events, and that they reduce 'habitable space' for species in the ocean by up to 75 per cent.

Heating, acidification, and deoxygenation of the ocean generates a positive feedback loop in relation to climate change. Effectively addressing climate change, therefore, needs to include solutions that make the ocean more sustainable.

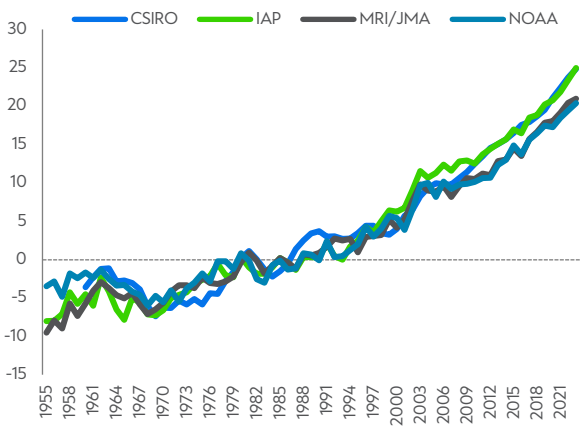
Pollution threatens life below water and on land

The integrity and quality of the world's blue ecosystems are not only threatened by the triple threat as described above, but also by the growing challenge of pollution that is discharged into them. Plastic makes up 80 per cent of total waste found in the ocean, even though it makes up just 12 per cent of total waste generation, according to the Economist.

Plastic production has increased very rapidly from c. 2 million tonnes in 2005 to c. 450 million today (Figure 100). Market estimates suggest that unless action is taken, plastic production may increase further to c1.5bn tonnes by 2050. Plastic waste is a growing problem, not least because plastic use in packaging and textiles account for more than 50 per cent of total global plastic use and this has a short, often single-use, lifespan (Figure 101).

Figure 100: Ocean heat content in the top 700 meters

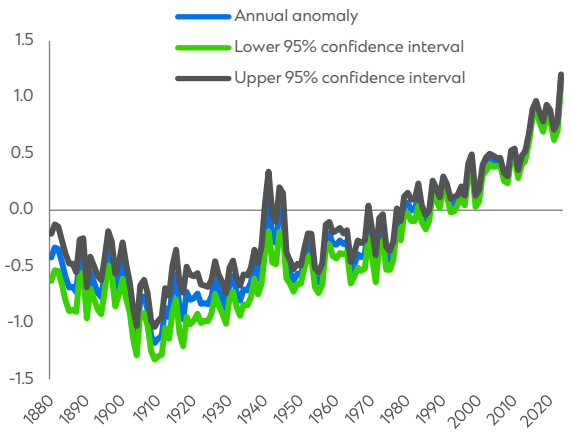
10^22 joules



Source: ILO, Standard Chartered

Figure 101: Average global sea surface temperature

Temperature anomaly (°F)



Source: OECD, Standard Chartered

Despite efforts to address the use of single-use plastic and increase recycling rates of plastic, we note that as recently as 2019 c. 80 per cent of total plastic produced ended up as waste (OECD). The growing balance of plastic waste generation impacts the world's blue ecosystems, given that more than 40 per cent of global waste ends up in the environment. Estimates from the OECD for example, suggest that 22 million tonnes leaked into the environment in 2019. Plastic leakage into marine eco systems (rivers and ultimately the ocean) is a major concern. Estimates regarding how much plastic ends up in the ocean and rivers vary. OECD calculations indicate that 6.1 million tonnes of plastic ended up in aquatic environments in 2019. Work from the Pew Trust in cooperation with multiple academic centres, on the other hand, suggest that more 11 million tonnes of plastic waste ended up in the ocean in 2016. Whereas Borelle et al., 2020 put estimates for plastic leakage into aquatic ecosystems at between 19-23 million tonnes. To put this in context, the Pew estimate of 11 million tonnes implies that more than 1.2 million kilogrammes of plastic ended up in the ocean each hour of each day in 2016.

One area of specific interest in relation to plastic relates to abandoned, lost or discarded fishing gear. Work from the WWF highlights that up to 1 million tonnes of fishing gear ends up in the ocean each year. Recent work from Richardson et al., 2022 puts estimates around the size of this problem: almost 3,000km^2 of gillnets, 75,000km^2 of purse seine nets, almost 740,000km of longline mainlines, and more than 25 million pots and traps are lost to the ocean annually. The impact of this on the ocean is high, as marine debris impacts 66 per cent of marine mammals and 50 per cent of seabirds and sea turtles according to the WWF.

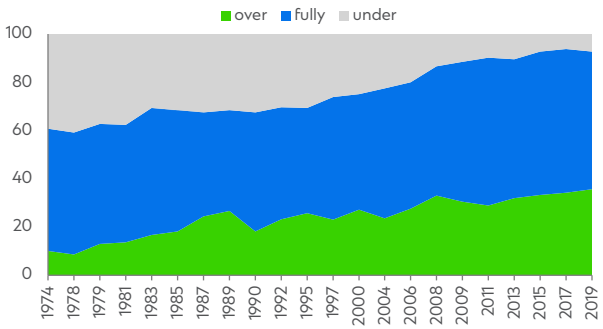
Plastic waste impacts the sustainability of aqua ecosystems in several ways. Microplastics affect the ability of marine microorganisms to absorb carbon dioxide and release oxygen. In addition, it impacts plankton's ability to grow, reproduce and capture carbon. Finally, animals who encounter plastic or ingest it suffer suffocation, entanglement, laceration, infections and internal injuries. Studies including from Gall et al. show that about 900 species have encountered marine debris, and that 17 per cent of the affected species are on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species.

Over-exploitation depresses biodiversity and food security

The final factor that puts the ocean ecosystem and human health at risk relates to overfishing. World seafood production has increased c. 4x since the 1960s to around 200 million tonnes currently based on data from the World Bank (Figure 103). The share of fish caught at sea has steadily declined as aquaculture of fish farming developed. Currently wild catch represents c. 40 per cent of total production, while close to 60 per cent is from aquaculture production. The rapid growth in fish production, however, has put the world's fish population at risk. At present and despite the rapid growth in aquaculture-based seafood production, more than 90 per cent of fish stock is fished at levels that are unsustainable (overfished) or that are maximally sustainable (Figure 102).

Figure 102: Share of overfished stock has reached 35 per cent

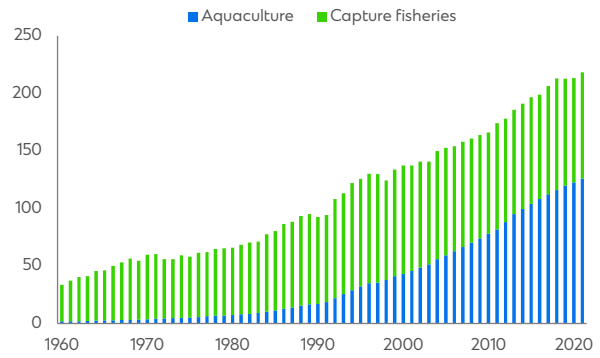
Share of fish stock (overfished, fully fished, underfished)



Source: World Bank, Standard Chartered

Figure 103: Fish production

Million tonnes



Source: World Bank, Standard Chartered

The expected growth in the world's population, and the potential shift in dietary preferences towards fish protein from land-based animal protein, suggest that demand for aquaculture and seafood is likely to increase going forward. Without strong action this is likely to put pressure on the sustainability of the world's fish population. Safeguarding the sustainability of the world's fishing population and seafood production depends on several key factors including:

- **Fishing methods:** There are different fishing methods used across the world. Unintentionally catching fish or marine animals (bycatch) is a particular problem associated with large scale fishing, especially when using bottom trawling. Up to 40 per cent of the ocean's organisms living on the seabed can be lost depending on the type of trawling approach used (Hiddink et al., 2017). Trawling rates across Europe have fallen sharply during the past few decades, but trawling use has grown rapidly across the developing world, especially in China, India and Indonesia. Closer control of fishing methods, including a reduction of trawling and expansion of aquaculture-based fish production, are needed to maintain marine sustainability.

- **Fish feed:** Farmed fisheries rely on fishmeal and fish oil to grow their fish population. Fishmeal and fish oil can be produced from whole fish, fish trimmings or other fish by products. Soybean can be another ingredient, although this may have unwanted indirect consequences as increased soybean production has been associated with increased deforestation. The potential growth in demand for seafood creates challenges for fish feed. For example, relying on fishmeal may reduce the amount of fish that would otherwise be available for human consumption. Work from Kok et al., 2020 showed that the fishing industry has become more efficient in fishmeal use during the past few decades, however, each kilogram of fish produced for human consumption still requires c0.25kilogram of fish feed on average. Data from the FAO supports the greater efficiency argument made by Kok et al. as it suggests that the share of fish production used for fishmeal and fish oil has declined from 35 per cent in 1994 to 22 per cent in 2022. To meet the expected increase in demand for seafood, we believe that a diversification away from traditional fishmeal and fish oil is to be preferred.

  Other fish feed issues that need to be addressed if seafood production is to scale further in a sustainable way, include the need to reduce the share of waste fish feed as this can lead to nutrition leakage into the ecosystem. Increasing seafood production may intensify the usage of antimicrobials, including antibiotics, in fish feed. This in turn may increase the risk of antibiotic resistance among humans. A reduction in the use of antimicrobials in fish feed would lower this risk.

- **Aquatic food loss and waste:** In 2011 the FAO estimated that c. 35 per cent of worldwide seafood production was either lost or wasted each year. This is a particular issue for emerging markets, as they typically lack adequate infrastructure, services and know-how for fish handling and preservation.

Ocean stress factors impact blue economy sectors too

It is important to note that the stress factors highlighted in this chapter not only impact the ocean's health, but also the blue economy sectors that depend on a healthy ocean. For example, warming waters push fish to colder waters which leads to a redistribution of fish and protein, which in turn impacts local fishing industries. The loss of coral reefs and increased levels of pollution are likely to negatively impact local tourism activities. Elsewhere in this report, we explore the risks and opportunities for various blue economy sectors in more detail.

Appendix

Appendix A: Blue economy value chains

Figure 104: Values for key blue economy sectors with exposed sub-sectors or markets

Stages of the value chain of key blue economy sectors

Aquaculture

Inputs	Harvesting	Transport	Processing	Customers
Aquafeed	Fish	Shipping	Slaughtering	Retail
Eggs	Aquatic plants	Ports	Filling	Hotel/Rest.
Seedlings	Molluscs	Land transport	Packaging	End consumers
Disease battling	Crustaceans		Storage	
Fish welfare				

Fisheries

Inputs	Fishing	Landing	Processing	Customers
Fishing gear	Commercial fishing	End consumers	Slaughtering	Whole salers
Equipment for fishing vessels	Subsistence fishing	Shipping and ports	Filling	Retail
Shipbuilding and refits	Recreational fishing		Packaging	End consumers
	Fishing services		Storage	

Blue renewable energy

Inputs	Manufacturing	Services	Production	Storage/ distribution
Materials	Wind turbines	Project development	Offshore wind	Grid-connection
Metals	Solar panels	Geotechnical services	Wave, tidal	Off-grid (batteries)
Copper	Cables	Construction installation	Floating solar	Blue fuel
Fibres	Connectors	Financial services	Geothermal gradient	
Components	Foundations		Salinity gradient	

Blue technology

Inputs	Data collection	Data analysis	Data usage	End users
Instruments	In situ	Preparation	Modelling	Maritime surveillance
Infrastructure	Field operations	Processing and analysis	Prediction	Blue economy sectors
Installation and deployment		Quality analysis		External stakeholders
		Storage		

Source: BlueInvest, Standard Chartered

Figure 104: Values for key blue economy sectors with exposed sub-sectors or markets (Cont.)

Stages of the value chain of key blue economy sectors

Marine conservation and restoration

Inputs	Conservation requirements	Impacted sectors	Beneficiaries
Construction equipment and tools	Blue technology	All blue economy sectors	Current and future population
Building structures	Ocean monitoring	Wider economic growth	Organisations
Natural resources	Biodiversity monitoring		
	Pollution removal		
	Regulation, legislation		

Shipbuilding and refits

Inputs	Construction	Products	Customers	Post construction
Materials	Design	Tankers	Shipping and ports	Testing and inspection
Mechanical engineering	Project management	Specialised vessels	Fisheries	Certification
Infrastructure equipment, machines	Assembly & integration	Container ships	Aquaculture	Refit & maintenance
Software, systems and robotics		Passenger ships	Renewable energy	Recycling
		Fishing vessels	Coastal and marine tourism	
		Bulk carriers	Ocean observation	

Water management

Inputs	Water decontamination	Water supply	Customers	Sewage, waste
Infrastructure Equipment	Decontamination: • Oil spills and gas leaks • Water hazards (chemicals)	Water collection	Residential	Sewage grid, canals
		Desalination	Industrial and others	Sewage treatment
		Purification		Waste collection
		Distribution		Waste treatment

Source: BlueInvest, Standard Chartered

Appendix B: Listed water exposed companies

Figure 105: Largest 40 listed water-exposed companies by market capitalisation owned by mutual water funds

Company	Sub industry	Market capitalisation (USDmn)
Thermo fisher scientific	Life Sciences Tools & Services	234,603
Danaher	Life Sciences Tools & Services	199,352
Waste management	Environmental & Facilities Services	83,602
Parker hannifin	Industrial Machinery & Supplies	76,743
Ecolab	Specialty Chemicals	72,045
Republic services	Environmental & Facilities Services	64,497
Roper technologies	Application Software	59,662
Sika	Specialty Chemicals	51,439
Waste connections	Environmental & Facilities Services	47,884
Agilent technologies	Life Sciences Tools & Services	39,740
Ferguson enterprises	Trading Companies & Distribution	39,709
Ingersoll-rand	Industrial Machinery & Supplies	36,693
Novonesis	Specialty Chemicals	32,625
Xylem	Industrial Machinery & Supplies	32,254
Haier smart home	Household Appliances	31,338
Mettler-toledo	Life Sciences Tools & Services	29,756
American water works	Water Utilities	29,052
Veralto	Environmental & Facilities Services	27,172
Dover	Industrial Machinery & Supplies	25,673
Veolia environnement	Multi-Utilities	25,072
Geberit	Building Products	22,834
WSP global	Construction & Engineering	21,412
Waters	Life Sciences Tools & Services	19,509
Alfa laval	Industrial Machinery & Supplies	19,042
Avantor	Life Sciences Tools & Services	18,492
Sartorius	Life Sciences Tools & Services	18,216
Masco	Building Products	17,687
Bentley systems	Application Software	16,399
Kubota	Agricultural & Farm Machinery	16,083
Pentair	Industrial Machinery & Supplies	15,383
Idex	Industrial Machinery & Supplies	15,344
GFL environmental	Environmental & Facilities Services	15,112
Pool	Distributors	13,715
Aecom	Construction & Engineering	13,194
Clean harbors	Environmental & Facilities Ser	13,186
Halma	Electronic Equipment & Instruments	13,159
Tetra tech	Environmental & Facilities Services	12,473
CIA saneamento basico	Water Utilities	11,955
Smith (a.o.)	Building Products	11,916
Advanced drainage systems	Building Products	11,506
Severn trent	Water Utilities	10,820

Source: Bloomberg, Standard Chartered

Appendix C: Blue economy exposed companies

Figure 106: Blue carbon to Pollution and waste sectors

Blue economy sector	Company	Solution focus
Blue Carbon	Carbon Capture	Biochar production from seaweed
	Skyology	Converts mining waste and CO_2 into ocean alkalinity
	Brilliant Planet	Micro algae-based carbon capture
	Planetary	Ocean alkalinity enhancement
	SOS Carbon	Seaweed-based carbon capture (sargassum)
Pollution and waste	Algaeing	Algae based inks and dyes for textiles
	Algaeba	Algae killer
	Clean Earth Rovers	Autonomous vessels
	Happy Pads	Biodegradable pads
	Saathi Pads	Biodegradable pads
	Plant Biodefenders	Biopesticide producer
	Nohbo	Bioplastic
	Notpla	Bioplastic
	Sway	Bioplastic
	Arena Recycling Industry	Bricks from recycled plastic
	Dispatch Goods	Circular logistics
	Clean Marine Group	Collecting and processing general waste
	Aquammodate	Filtering
	Ashored	Fishing gear focus
	Bureo	Fishing gear focus
	Safety Net Technologies	Fishing gear focus
	Sub Sea Sonics	Fishing gear focus
	Sustainable Seas Technology	Fishing gear focus
	SeaForest	Methane reduction (seaweed)
	Symbrosia	Methane reduction (seaweed)
	NovFeed	Organic waste into alternative protein
	ANB Sensors	pH sensors
	900 Care	Plastic alternative
	Better Packaging Co	Plastic alternative
	Biotic	Plastic alternative
	Cruz Foam	Plastic alternative
	Full Cycle	Plastic alternative
	Great Wrap	Plastic alternative
	Mango Materials	Plastic alternative
	Okeanos	Plastic alternative
	Pleasant State	Plastic alternative
	Usefull	Plastic alternative
	Vericool	Plastic alternative
	Bantam Materials	Plastic recycling
	CIRT (Can I Recover This?)	Plastic recycling
	GIVO	Plastic recycling
	Great Bubble Barrier	Plastic recycling
	Ichthion	Plastic recycling
	Marea Verde	Plastic recycling
	Muuse	Plastic recycling
	Novoloop	Plastic recycling
	Oceanworks	Plastic recycling
	Plastic Fischer	Plastic recycling

Source: The Earthshot Prize, 1000 Ocean Start Ups, Standard Chartered

Figure 107: Pollution and waste to Restoration and conservation

Blue economy sector	Company	Solution focus
Pollution and waste	Plastics for Change	Plastic recycling
	Pluvi	Plastic recycling
	rePurpose	Plastic recycling
	River Recycle	Plastic recycling
	Seabin	Plastic recycling
	Seven Clean Seas	Plastic recycling
	Tontoton	Plastic recycling
	Full Circle Biotechnology	Recapturing waste nutrient streams
	Kind Designs	Recycled plastic to apparel
	Pinovo	Reduced chemical spillage solutions
	PlanetCare	Reusable microfiber filter
	BIBAK	Reusable packaging
	Returnity	Reusable packaging
	B'ZEOS	Seaweed based packaging
	LOLIWARE	Seaweed based resins
	Planet Protector Packaging	Thermal protection to reduce seafood waste
	ecoSPEARS	UV treatment technology for water
	EcoAct Tanzania	Waste recycling Tanzania
	Watch Tower Robotics	Water infrastructure sensoring
	Moleaer	Water purification
	Nuvoe	Water purification and bottle cleaner solution
Renewable energy	Furukawa Electric	Cable manufacturer
	LS Cable & System	Cable manufacturer
	Nexans	Cable manufacturer
	NKT	Cable manufacturer
	Prysmian	Cable manufacturer
	ZTT International	Cable manufacturer
	SolarDuck	Floating solar
	Turbulent Hydro	Hydropower turbines
	Doosan Enerbility	Offshore wind
	Envision Energy	Offshore wind
	GE Renewable Energy	Offshore wind
	Mingyang Smart Energy	Offshore wind
	Orsted	Offshore wind
	Shanghai Electric Wind Power	Offshore wind
	Siemens Gamesa	Offshore wind
	Vestas	Offshore wind
	Xinjiang Goldwind	Offshore wind
	SeaH4	Seaweed based biofuel
	Desolenator	Solar thermal desalination
	Enexor	Waste to energy
	CalWave	Wave technologies
	E-Wave Technologies	Wave technologies
	Gazelle Wind Power	Wave technologies
	GKinetic	Wave technologies
	Mocean Energy	Wave technologies
	WITT Energy Solutions	Wave technologies
Restoration and conservation	Association for Coastal Ecosystem Services	Blue carbon credit-driven approach
	Sea Ranger Service	Conservation-focused technologies
	ARC Marine	Coral reef restoration solutions
	Archireef	Coral reef restoration solutions
	Coastruction	Coral reef restoration solutions
	Coral Maker	Coral reef restoration solutions
	Coral Vita	Coral reef restoration solutions
	Ocean Rescue Alliance	Coral reef restoration solutions

Source: The Earthshot Prize, 1000 Ocean Start Ups, Standard Chartered

Figure 108: Restoration and conservation to Seatech

Blue economy sector	Company	Solution focus
Restoration and conservation	Tēnaka	Coral reef restoration solutions
	Inversa	Leather alternative used for fashion industry
	NS2	Monitoring technologies for conservation
	Smartfin	Monitoring technologies for conservation
	Carbonwave	Seaweed-driven conservation efforts
	Grogenics	Seaweed-driven conservation efforts
	Thalasso	Seaweed-driven conservation efforts
	Natrx	Technological support
	Urchinomics	Urchin-driven conservation
	Regenerative Resources Global	Uses aquaculture effluent
	Reefy	Wave barrier technology-focused
	Seawater Solutions	Wetland-focused conservation
Seatech	Ace Aquatec	Aquaculture technologies
	Ecto	Aquaculture technologies
	eFishery	Aquaculture technologies
	Blue Trace	General efficiency software
	Mabel Systems	General efficiency software
	JET Engineering Services	Mobile and radio connectivity
	UnseenLabs	Mobile and radio connectivity
	Current Lab	Modelling and data analysis
	Distant Imagery	Modelling and data analysis
	H20k Innovations	Modelling and data analysis
	ACUA Ocean	Monitoring technologies
	Advanced Navigation	Monitoring technologies
	Aquaai Corporation	Monitoring technologies
	Aquaconnect	Monitoring technologies
	ATLAN Space	Monitoring technologies
	BeeX	Monitoring technologies
	Berkeley Marine Robotics	Monitoring technologies
	Blue Lion Labs	Monitoring technologies
	Blue Ocean Gear	Monitoring technologies
	Hohonu	Monitoring technologies
	HydroNet	Monitoring technologies
	HydroSurv	Monitoring technologies
	Innomar	Monitoring technologies
	Jaia Robotics	Monitoring technologies
	Liquid Robotics	Monitoring technologies
	Marimetrics	Monitoring technologies
	NatureMetrics	Monitoring technologies
	Ocean Data Network	Monitoring technologies
	Ocean Diagnostics	Monitoring technologies
	Oceanways	Monitoring technologies
	Open Ocean Robotics	Monitoring technologies
	Planblue	Monitoring technologies
	SaNoor Technologies	Monitoring technologies
	Sea Proven	Monitoring technologies
	SeaDeep	Monitoring technologies
	SeaTrac	Monitoring technologies
	Seatrec	Monitoring technologies
	Sipremo	Monitoring technologies
	SkyTruth	Monitoring technologies
	Stone Aerospace	Monitoring technologies
	Stream Ocean	Monitoring technologies
	Sunfish	Monitoring technologies
	Terradepth	Monitoring technologies

Source: The Earthshot Prize, 1000 Ocean Start Ups, Standard Chartered

Figure 109: Seatech to Sustainable food

Blue economy sector	Company	Solution focus
Seatech	Undersee	Monitoring technologies
	WaveAerospace	Monitoring technologies
	Whale Seeker	Monitoring technologies
	WIPSEA	Monitoring technologies
	WSense	Monitoring technologies
	Swedish Algae Factory	Using algae for general (non-food) products such as solar efficiency
Sustainable fishing	Fisherpiscicultura	Aquaculture solutions
	GenetiRate	Aquaculture solutions
	Abalobi	General efficiency software
	Remora	General efficiency software
	Kumbatia Seafood	General farm management
	Fishency	Monitoring and data analysis
	FlyWire	Monitoring and data analysis
	Pelagic Data Systems	Monitoring and data analysis
Sustainable food	CFEED	Alternative feed
	Kinnva	Alternative feed
	MiAlgae	Alternative feed
	Molofeed	Alternative feed
	nextProtein	Alternative feed
	Rare Earth Global	Alternative feed
	Beta Hatch	Alternative feed (insect)
	Inseco	Alternative feed (insect)
	Ittinsect	Alternative feed (insect)
	Protix	Alternative feed (insect)
	AKUA	Alternative protein
	Avant	Alternative protein
	BlueNalu	Alternative protein
	Calysta	Alternative protein
	Current Foods	Alternative protein
	Energaia	Alternative protein
	Finless Foods	Alternative protein
	Hooked	Alternative protein
	Koralo Foods	Alternative protein
	Microharvest	Alternative protein
	microTERRA	Alternative protein
	Motif FoodWorks	Alternative protein
	Shiok Meats	Alternative protein
	Umami Meats	Alternative protein
	Wild Type	Alternative protein
	Chicoa Fish Farm	Aquaculture, Africa
	Matorka	Aquaculture, Arctic char farming
	Oceanfarmr	Aquaculture, general farm management solutions
	Wittaya	Aquaculture, general farm management solutions
	IctioBiotic	Aquaculture, improving fish health
	BiOceanOr	Aquaculture, monitoring and data analysis
	CageEye	Aquaculture, monitoring and data analysis
	Manolin	Aquaculture, monitoring and data analysis
	OnDeck Fisheries AI	Aquaculture, monitoring and data analysis
	OptoScale	Aquaculture, monitoring and data analysis
	Radmantis	Aquaculture, monitoring and data analysis
	Reel Data	Aquaculture, monitoring and data analysis
	BioFeyn	Aquaculture, nutrient delivery solution
	Impact-9	Aquaculture, offshore equipment
	Noray Seafood	Aquaculture, shrimp farming
	Aqua Development	Aquaculture, shrimp production optimisation

Source: The Earthshot Prize, 1000 Ocean Start Ups, Standard Chartered

Figure 110: Sustainable food to Sustainable shipping

Blue economy sector	Company	Solution focus
Sustainable food	Jala	Aquaculture, shrimp production optimisation
	Minnowtech	Aquaculture, shrimp production optimisation
	xpertSea	Aquaculture, shrimp production optimisation
	BioFishency	Aquaculture, water treatment solution
	Fortuna Cools	Cold storage solutions
	Eja-iCe	Cold storage, reducing food waste
	Keep IT Cool	Cold storage, reducing food waste
	ViAqua Therapeutics	disease treatment
	ExciPlex	Feeding optimisation
	FeedVax	Feeding optimisation
	Secro	General efficiency software
	Umitron	General efficiency software
	Verifik8	General efficiency software
	Seagrown	Infrastructure for seaweed farming
	Ahiflower	Omega-3
	12 Tides	Seaweed
	Atlantic Mariculture	Seaweed
	Australian Seaweed Institute	Seaweed
	Cascadia Seaweed Corp.	Seaweed
	Crop Project	Seaweed
	Kee Farms	Seaweed
	Kelp Blue	Seaweed
	Kuehnle	Seaweed based products
	Ocean Farmers	Seaweed based products
	Ocean Rainforest	Seaweed based products
	OCEANIUM	Seaweed based products
	Ocean's Balance	Seaweed based products
	Oregon Dulse	Seaweed based products
	Origin by Ocean	Seaweed based products
	Pure Ocean Algae	Seaweed based products
	Sea6 Energy	Seaweed based products
	Seadling	Seaweed based products
	SeaForestation Co	Seaweed based products
	SoftSeaweed	Seaweed based products
	Umaro foods	Seaweed based products
	The Seaweed Company	Seaweed focused
	Coast4C	Seaweed, fishnet recycling
	Atlantic Sea Farms	Seaweed, women-run
Sustainable shipping	ECOsubsea	Automated ship inspection and cleaning
	Hullbot	Automated ship inspection and cleaning
	Symbytech	Automated ship inspection and cleaning
	Aloft Systems	Clean fuel solutions (hydrogen, sail, solar)
	Bound4blue	Clean fuel solutions (hydrogen, sail, solar)
	Freepower	Clean fuel solutions (hydrogen, sail, solar)
	Hyrex	Clean fuel solutions (hydrogen, sail, solar)
	Veer	Clean fuel solutions (hydrogen, sail, solar)
	Brim Explorer	Electric shipping
	Evoy	Electric shipping
	Navier	Electric shipping
	Ship Reality	Fleet management software
	Spinergie	Fleet management software
	BlueNav	Hybrid shipping
	Sofar Ocean	Navigational optimisation software
	Zeabuz	Navigational optimisation software
	Finsulate	Sustainable antifouling solutions

Source: The Earthshot Prize, 1000 Ocean Start Ups, Standard Chartered

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