ECONOMIST IMPACT

World Ocean Outlook 2023

Building on the ocean momentum

Contents

Acknowledgments

The World Ocean Outlook 2023 is a report written by Economist Impact's World Ocean Initiative. The report focuses on solutions and opportunities for action to address the three planetary crises: climate change, biodiversity loss and pollution. It highlights how building a sustainable ocean economy can facilitate solutions to these three crises in 2023 and beyond. We will touch upon key global events, predict trends across industries and sectors, and look at exciting initiatives in those spaces during 2023. Several mini "case studies" highlight specific initiatives and projects that are already doing innovative work and have clear plans for 2023.

The report is based on extensive desk research, data analysis and a series of in-depth expert interviews. We would like to thank the following experts (in alphabetical order) for their time and insight:

- **Chip Cunliffe**, programme and risk director, Ocean Risk and Resilience Action Alliance
- **Boze Hancock**, senior marine habitat restoration scientist, The Nature Conservancy
- **Dorothée Herr**, senior associate at NatureFinance, and former manager of Ocean and Climate Change, International Union for Conservation of Nature
- **Phil McCabe**, Pacific regional lead on deep-sea mining, Deep Sea Conservation Coalition
- **Lance Morgan**, president and CEO, Marine Conservation Institute
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Abbreviations

ADB	Asian Development Bank
AI	Artificial intelligence
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CDR	Carbon dioxide removal
COP	Conference of the Parties
FAO	UN Food and Agriculture Organisation
GDP	Gross domestic product
GHG	Greenhouse gas
GMA	Global Mangrove Alliance
GW	Gigawatt
IEA	International Energy Agency
IMO	International Maritime Organisation
IRFF	Insurance & Risk Finance Facility
ISA	International Seabed Authority
IUCN	International Union for Conservation of Nature
IUU	Illegal, unreported and unregulated [fishing]
LNG	Liquefied natural gas
MPA	Marine Protected Area
MSC	Marine Stewardship Council
NDC	Nationally Determined Contribution
OECD	Organisation for Economic Co-operation and Development
ORRAA	Ocean Risk and Resilience Action Alliance
SCIFF	Sea Change Impact Financing Facility
SDG	Sustainable Development Goal
SIDS	Small island developing states
TNC	The Nature Conservancy
UNEP-FI	UN Environment Programme Finance Initiative
WTO	World Trade Organisation
WWF	World Wide Fund for Nature

Foreword

The ocean faces an unprecedented combination of challenges from the three interconnected planetary crises: climate change, biodiversity loss and pollution. News feeds are rife with painfully familiar images such as storm surges, coral bleaching or marine animals entangled in plastic bags. In the short term, unfortunately, these crises are bound to get worse before subsiding.

However, there is hope. We at the World Ocean Initiative are optimistic that the tide can be turned: 2023 is a year full of promise that we can achieve major progress on reversing some of these destructive trends, and putting the ocean on a path to regeneration.

On climate change, there will be a continued recognition that the ocean holds enormous potential to address the climate crisis, with new opportunities for sustainable aquaculture, ocean-based renewable energy and carbon-capture schemes, as well as an acceleration in the decarbonisation of shipping.

On biodiversity loss, huge momentum is building following the agreement of a new global framework at the biodiversity COP in Montreal at the end of 2022. While the 30x30 goal for ocean protection may currently feel out of sight, there is now a real chance for political momentum to accelerate agreement on a high seas treaty.

On pollution, there is an unprecedented level of scrutiny and awareness of the plastic pollution crisis. This year we are anticipating a further impulse that will ensure the adoption in 2024 of a global treaty to address plastic

pollution. At the World Ocean Initiative, and our sister initiative Back to Blue, we have continuously argued that chemical pollution has been neglected and needs to be at the top of the agenda. Making this "invisible wave" more prominent on decision-makers' radar will continue to be one of our priorities throughout 2023.

Blue finance will hold the key to unlocking many of these opportunities for building a sustainable ocean economy. From sovereign blue bonds and blended finance to impact funds and the promise of high-quality blue-carbon credits, the blue-finance space continues to evolve and develop steadily. We are passionate about this opportunity, which features prominently on the agenda of our World Ocean Summit in Lisbon at the end of February/beginning of March.

We look forward to convening key ocean stakeholders during 2023 to imagine a sustainable ocean economy and inspire innovative ocean solutions.

Martin Koehring
Head, World Ocean Initiative
Economist Impact

Executive summary

The blue economy was valued at an estimated US$2.5trn annually before the outbreak of covid-19, equivalent to the gross domestic product (GDP) of the world's eighth-largest economy. But the health of the ocean—and therefore the rest of the planet—hangs in the balance. Climate change, pollution, resource extraction and other destructive human activities are harming marine ecosystems and their ability to sequester CO2 emissions and produce oxygen, as well as to sustain ocean industries such as food production.

In 2022 we saw some major wins for marine health which should go some way to halting its decline. These include the World Trade Organisation's (WTO) agreement to ban some harmful fishing subsidies—although more progress is needed in 2023—and the UN Environment Assembly's decision to negotiate a treaty to ban plastic pollution. Negotiators came close to agreeing on a high seas treaty to give legal protections for international waters, and we are hopeful that this will be achieved in 2023.

And although the world is not on track to meet Sustainable Development Goal 14 (SDG 14)—to conserve and use the ocean for sustainable development—many solutions exist to create a sustainable blue economy. In 2022 we saw exciting new initiatives, alliances, tools and innovations launched in every blue sector. Importantly, the finance sector is increasingly engaged in ocean health and recognising its longer-term impacts on investments on land and sea.

We expect progress in 2023 in shaping a robust plastic pollution treaty, and for the WTO ban on harmful fishing subsidies to come into force and be extended to apply to overfishing and overcapacity. A tougher decarbonisation target for shipping is also set to be adopted in 2023. Increased ambition will be needed in countries' proposals for establishing Marine Protected Areas (MPAs), and in channelling funding for MPAs to developing countries. An important decision is likely over whether to allow deep-sea mining to begin in international waters. And, most importantly of all, greater ambition will be needed in curbing greenhouse-gas (GHG) emissions. But all multilateral talks are set against the backdrop of Russia's invasion of Ukraine, the subsequent energy crisis for many parts of the world, and growing tensions between China and the US.

Weakening economic growth and shifts in international trade will continue in 2023 to impact blue sectors including fisheries, aquaculture and shipping. The rising costs of

inputs, fuel and energy have pushed up prices of fisheries and aquaculture products. Shipping faces slowing demand. It also faces possible changes after the covid-19 pandemic exposed weaknesses around supply chains being reliant on distant suppliers.

The energy crisis could accelerate ocean renewable energies, especially offshore wind production.

Climate change

- Important progress has been made to help stem destruction of marine ecosystems, and this must continue in 2023. Most importantly, we must also see increased global ambition to curb GHG emissions.
- Warming waters and acidification could hurt aquaculture and fisheries, especially in poorer coastal regions. Cooler regions may see an increase in landings.
- Quality blue-carbon-credit projects, such as restoring mangroves and other ecosystems, are likely to grow in 2023 to meet huge demand.

Biodiversity loss

- Progress in protection and restoration of marine biodiversity has been encouraging. It includes exciting initiatives, innovations and new technologies, as well as growing political will. But a lot more work and finance are needed.
- UN talks to agree on a treaty to protect the biodiversity in the world's international waters will continue in 2023. Without this agreement, the 30x30 goal to protect the ocean will be impossible to achieve.
- In 2023 there will be continued tensions over whether the International Seabed Authority will allow deep-sea mining to begin in international waters. Mining company Metals Co is set to apply for a licence to begin mining in the second half of 2023.

Pollution

- Governments, consumers and industry are increasingly working to build a circular plastic economy that will help stem the flow of plastic waste entering the ocean.
- But major investments and rapid progress in scaling solutions are needed throughout the plastics supply chain.

- UN talks will continue in 2023 to forge an international, legally binding treaty by 2024 to end plastic pollution.
- Other forms of chemical pollutants need more attention, including international regulations and increased awareness of their impacts on marine biodiversity.

Sustainable ocean economy

- A new wave of investment in a sustainable blue economy is emerging. Growing interest and investment in ocean activities—including in aquaculture, renewable energy and tourism—needs careful oversight to ensure growth is sustainable and does not damage marine ecosystems.
- Some shipping companies and ports are shifting to green fuels, but the sector needs a regulatory framework—as well as progress in green-fuel development and delivery—to accelerate decarbonisation.
- Marine energies are a vital part of meeting global renewable-energy needs. Offshore wind capacity is accelerating, but tidal stream energy and wave energy need policies and regulatory frameworks, and a large volume of projects, to scale.
- Expected growth in demand for aquatic foods will be met mainly by expansion in aquaculture. Wild fisheries are expected to continue recovering slowly, but more finance is needed to support their recovery.
- Both aquaculture and fisheries will face growing challenges from climate change, especially in warmer regions.
- Progress is needed to share the benefits of a sustainable ocean economy equally between men and women.

Introduction

This report focuses on solutions and opportunities for action to address the main challenges impacting the blue economy, and ocean health in general. It is divided into four chapters, aligned with the four pillars of Economist Impact's World Ocean Initiative.[1] The first three address the main and interlinking challenges of climate change, biodiversity loss and pollution. The final section focuses on sectors in the ocean economy. All sections touch on key global events, predict trends across industries and sectors, and look at exciting initiatives in those spaces.

A look back at 2022

In 2022 key meetings cumulatively shifted the dial on several major issues affecting the ocean, including plastic pollution and unsustainable fisheries practices:

One Ocean Summit, February - Delegates made commitments to do more to protect biodiversity and ocean resources[2]

UN Environment Assembly, March - The assembly agreed to start negotiating a plastic pollution treaty by 2024.

World Ocean Summit, March - Global experts discussed the potential of the ocean to contribute to global climate and sustainability goals.

World Trade Organisation, June - Delegates reached an agreement to partially ban harmful fisheries subsidies.

UN Ocean Conference, June/July - Delegates agreed to scale science-based and innovative actions to improve ocean health.

UN high seas treaty negotiations, August - Delegates did not reach agreement. Talks to continue in 2023.

[1] https://impact.economist.com/ocean
[2] https://www.oneplanetsummit.fr/sites/default/files/2022-03/BREST-COMMITMENTS-FOR-THE-OCEANS.pdf

World Ocean Tech and Innovation Summit, October - Ocean innovators, financiers and business leaders came together in Halifax, Canada, to discuss how to power the next phase in blue growth.

G20 meeting in Bali, November - Leaders declared their commitment to limit global warming to 1.5 degrees Celsius, and to accelerate the phasing down of coal use.

27th session of the Conference of the Parties (COP27) to the UNFCCC, November - Delegates agreed a new Loss and Damage Fund to help vulnerable states with extreme weather events, and slow onset events like rising temperatures and ocean acidification. The main benefactors are expected to be small island developing states.

World Ocean Summit Asia-Pacific, November - Regional experts came together to discuss challenges and opportunities for building a sustainable ocean economy in the region.

UN Biodiversity Conference (COP15), December - Delegates agreed to the Kunming-Montreal Global Biodiversity Framework. This includes targets to restore 30% of degraded ecosystems on land and sea by 2030, and conserve and manage 30% of areas (terrestrial, inland water, and coastal and marine) by 2030.[3]

Meetings to watch in 2023

Fifth Session of high seas treaty talks resumes February 20th - March 3rd, New York[4]

World Ocean Summit & Expo, February 27th - March 1st, Lisbon[5]

Our Ocean, March 2nd-3rd, Panama[6]

UN World Water Conference, March 22nd-24th, New York[7]

28th session of the Conference of the Parties (COP28) to the UNFCCC, November 30th - December 12th, Dubai[8]

International Seabed Authority, meetings throughout 2023[9]

Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) to progress MPA implementation—dates to be confirmed[10]

[3] https://impact.economist.com/ocean/biodiversity-ecosystems-and-resources/cop15-dispatch-will-the-new-global-biodiversity-deal-save-the-ocean
[4] https://www.un.org/bbnj/
[5] https://events.economist.com/world-ocean-summit/
[6] https://ouroceanpanama2023.gob.pa/
[7] https://sdgs.un.org/conferences/water2023
[8] https://sdg.iisd.org/events/2022-un-climate-change-conference-unfccc-cop-28/
[9] https://isa.org.jm/sessions/28th-session-2023
[10] https://www.ccamlr.org/en/meetings

Chapter I. Climate change

Climate risk/ocean risk

The world relies on a healthy ocean to produce oxygen and food, and to mitigate climate change and boost resilience to its impacts. But the ocean's ability to protect the planet from the worst impacts of global warming is being dented by a combination of climate change, pollution and other destructive human activities.

Climate change is also impacting the future of tourism, aquaculture and fisheries in some parts of the world, and the coastal communities that rely on them. Coastal and island populations face increasing threats from rising sea levels, flooding and coastal erosion caused by worsening storms. In many cases the poorest countries and communities are most impacted.

Financial markets could bring forward risk recognition in affected regions, which could trigger capital reallocation and asset repricing. Losses from flooding in Florida, for example, could devalue exposed homes by US$30bn-80bn by 2050.[11]

In Ho Chi Minh City, direct infrastructure asset damage from a 100-year flood could more than double by 2050, while knock-on costs to the economy could rise from US$100m-400m to between US$1.5bn and US$8.5bn.[12]

2023 must see increased global ambition to curb emissions, and implementation of commitments already made, else the world risks permanently damaging the ocean. Existing pledges, even if fully implemented, would result in a 2.4-2.6°C rise by the end of the century. Policies currently in place point to a 2.8°C rise. The world must cut emissions by an additional 45% by 2030 to avoid global catastrophe.[13]

Governments, industry, the financial sector and others are increasingly waking up to the links between ocean health and climate change, and the impact of ocean health on the sustainability of many sectors. In 2022 key multilateral decisions were taken that will help stop the downward spiral in ocean health. These include the start of talks for a UN treaty to ban plastic pollution, and a partial ban by the World Trade Organisation (WTO) on harmful fishing subsidies. Many of the people we interviewed for this report are confident that this momentum will continue in 2023.

[11] https://www.mckinsey.com/capabilities/sustainability/our-insights/climate-risk-and-response-physical-hazards-and-socioeconomic-impacts
[12] Ibid.
[13] https://www.unep.org/resources/emissions-gap-report-2022

Using the ocean to absorb CO2

New technologies are being developed to use the ocean to help absorb excess emissions from the atmosphere. Carbon dioxide removal (CDR) technologies have mainly focused on land, but are increasingly being researched for the ocean, where competition for space is less. It is a fast-growing field,[14] with about 58 companies working in it.[15] The most promising technologies include ways to reduce the water's acidity by adding powdered lime to the ocean (ocean liming), or by reacting seawater with alkaline minerals in desalination plants before releasing the alkaline solution back into the ocean (electrochemical ocean alkalinity enhancement).[16] What is not yet clear is how these technologies may impact the health of ocean ecosystems, with conservationists warning that these must be fully researched before decisions about the technologies' wide applications are taken, says Dorothée Herr, senior associate at NatureFinance and former manager of Ocean and Climate Change at the International Union for Conservation of Nature (IUCN).

Other technologies include laying engineered coral reefs on the seabed to help absorb excess CO2 from the atmosphere. One company in this field says the world's need to absorb carbon from the atmosphere is so urgent that 2,500 engineered reefs, each measuring 4 square kilometres, will need to be planted on the seabed in the next decade.[17]

The ocean's biodiversity absorbs huge amounts of CO2 from the atmosphere. Conserving and restoring nature-based solutions—including mangroves and seagrass meadows—are a vital part of mitigating climate change. (See sections on Blue Carbon and on Biodiversity below.)

[14] https://ebcd.org/wp-content/uploads/2022/05/Ocean-based-CDR-policy-challenges.pdf
[15] https://ebcd.org/wp-content/uploads/2022/05/David-Keller-PDF-Presentation.pdf
[16] https://www.oceannets.eu/contents/uploads/2022/10/CDRmareOceanNETs_policybrief_final.pdf
[17] https://www.newscientist.com/article/2332268-start-up-plans-2500-artificial-coral-reefs-to-fight-climate-change/

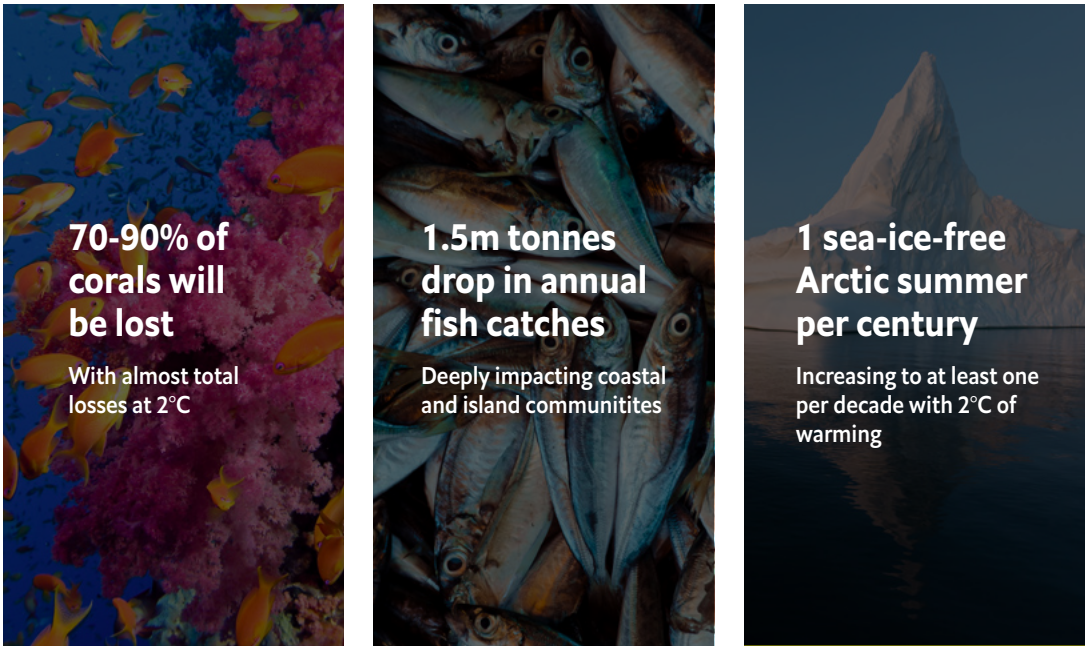
Warming waters and acidification

Carbon pollution is changing the ocean's chemistry, slowing its ability to absorb CO2, making it more acidic, harming shellfish, coral reefs and other marine life we depend on. The ocean has absorbed about 29% of global CO2 emissions since the end of the preindustrial era.[18]

Estimates of future carbon-dioxide levels, based on business-as-usual emission scenarios, indicate that by the end of this century the surface waters of the ocean could have a pH around 7.8. The last time the ocean pH was this low was during the middle Miocene, 14m-17m years ago. The Earth was several degrees warmer and a major extinction event was occurring.

The ocean is also warming fast—the rate of ocean warming has more than doubled since 1993.[19] The ocean has absorbed more than 90% of the excess heat from human-caused global warming,[20] and ocean temperatures could increase by 1-4°C by 2100.[21] This warming will increasingly force some fish to migrate to cooler waters.[22] This may increase fish landings in cooler waters, but in warmer waters falling fish catches could affect the livelihoods of 650m-800m people.[23] Atlantic mackerel, for example, have already moved northward as sea temperatures rise.[24]

Figure 1: In a world in which global warming exceeds 1.5°C
Compared with pre-industrial levels



Source: Intergovernmental Panel on Climate Change (IPCC)

[18] https://www.ucsusa.org/resources/co2-and-ocean-acidification#:~:text=The%20rising%20concentration%20of%20carbon,the%20detriment%20of%20marine%20ecosystems
[19] https://www.un.org/en/conferences/ocean2022/facts-figures
[20] Ibid.
[21] https://www.msc.org/what-we-are-doing/oceans-at-risk/climate-change-and-fishing
[22] https://nca2018.globalchange.gov/chapter/9/
[23] https://www.mckinsey.com/capabilities/sustainability/our-insights/climate-risk-and-response-physical-hazards-and-socioeconomic-impacts
[24] https://www.msc.org/what-we-are-doing/oceans-at-risk/climate-change-and-fishing

Resilience and adaptation

The only way to stop CO2 pollution from irreparably destroying ocean health is to curb greenhouse-gas emissions.

In the meantime, marine ecosystems could be made more resilient to climate-change impacts if they are protected from other stressors like pollution, overfishing and destruction of marine habitats from coastal construction and from boats, for example. Some marine plants, including seagrasses, can help buffer local acidification, but need protections.[25]

Important steps were taken in 2022 to reduce these stressors, including a WTO decision to curb harmful fishing subsidies and the start of UN talks for a plastic pollution treaty, and we expect momentum to continue in 2023 (see chapters II and III).

The costs of adapting to climate impacts are likely to be enormous. The US alone will have to spend more than US$400bn over the next 20 years to defend coastal communities from sea-level rise, according to one estimate.[26] This may represent just 10-15% of the total adaptation costs that local and state governments in the US will have to finance.[27]

US government entities are increasingly filing lawsuits against oil and gas companies to seek compensation for climate-adaptation costs, such as sea walls.[28] Because sea-level rise is easily attributable to global warming, most of these suits have been filed by coastal cities, counties and states.[29]

Nature-based solutions, including mangroves, seagrass meadows and coral reefs, can protect coastlines from the impacts of storms, and are cheaper than building a sea wall. They are also some of the ecosystems most vulnerable to destructive human activities.[30]

"Nature-based solutions are rising up the agenda and being seen as a critical pathway to reducing risk and building resilience for coastal people," says Chip Cunliffe, programme and risk director at the Ocean Risk and Resilience Action Alliance (ORRAA), and former biodiversity director at AXA XL.

Shipping decarbonisation

The shipping industry's shift to low-emissions fuels is gathering momentum. Talks in 2023 will be vital in overhauling industry models. If the International Maritime Organisation (IMO) agrees on a new target of reaching net zero by 2050, this will give certainty to the whole industry's course of action.[31]

The shipping sector produces about 2% of global energy-related CO2 emissions.[32] Shipping transports over 80% of the volume of international trade in goods,[33] so other sectors cannot reach net-zero emissions targets unless shipping also decarbonises.

The IMO currently has a target to curb emissions by at least 50% by 2050 compared with 2008.[34,35] The UN body is discussing proposals to raise its ambitions to put it in line with the Paris agreement, with a decision expected in 2023.

[25] https://cordis.europa.eu/article/id/421523-seagrass-revealing-impact-of-climate-change-on-marine-environments
[26] https://climatecosts2040.org/files/ClimateCosts2040_Report.pdf
[27] Ibid.
[28] Ibid.
[29] https://www.americanbar.org/groups/environment_energy_resources/publications/trends/2021-2022/january-february-2022/climate-litigation-rising/
[30] https://impact.economist.com/ocean/ocean-and-climate/blue-carbon-seagrasses-and-mangroves-can-suck-carbon-from-the-air
[31] https://impact.economist.com/ocean/biodiversity-ecosystems-and-resources/decarbonisation-of-shipping-the-challenges-of-getting-into-action
[32] https://www.iea.org/reports/international-shipping
[33] https://unctad.org/meeting/launch-review-maritime-transport-2022
[34] https://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx
[35] https://impact.economist.com/ocean/ocean-and-climate/how-the-shipping-sector-is-decarbonising

The shipping industry is urging the IMO to establish regulatory infrastructure and mechanisms that will make the process of decarbonising economically fair to companies that want to reduce their emissions and switch to higher-cost green fuels.

Regulators are looking at ways to support the industry's shift to green fuels. Options include applying tariffs, cap-and-trade and securing capital investment.

A widespread global demand for green fuels and green technology is key to facilitate market upscaling and accelerate the adoption of tech solutions in the sector, according to Andreas Nordseth, director-general of the Danish Maritime Authority.[36]

In the meantime, some ports and major shipping companies are already planning for net-zero targets. The Maritime and Port Authority of Singapore, for example, has mapped out how to decarbonise its ports by 2050. This includes multi-fuel bunkering, with transitionary fuels like liquefied natural gas (LNG) and biofuels already available in the Port of Singapore.[37]

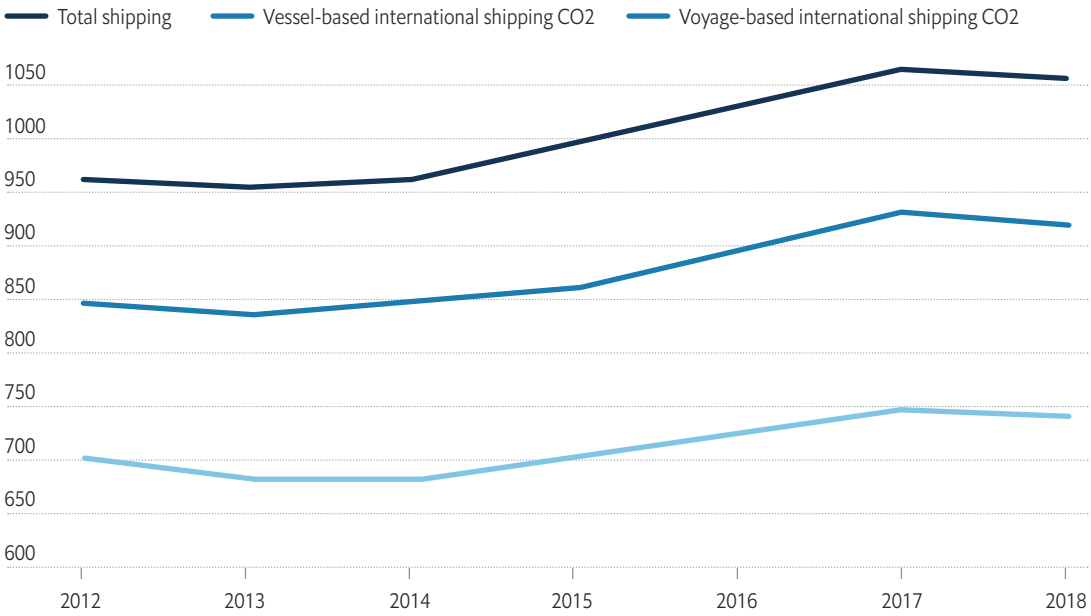
The Global Centre for Maritime Decarbonisation[38] is helping to develop standards and supply chains for greener fuels like methanol and ammonia.[39]

Two of the world's largest bunkering ports—Singapore and Rotterdam—are creating the world's longest green corridor, aiming to have the first sustainable vessels sailing on the route by 2027. The two ports, which signed a memorandum of understanding in 2022, are collaborating with a coalition of shippers, fuel suppliers and other companies on potential solutions to challenges in using alternative fuels.[40] They hope the Green and Digital Corridor project will raise investment confidence, attract green financing, and kickstart joint bunkering pilots and trials for the use of low- and zero-carbon fuels along the route.[41]

In the meantime projects and trials are under way to develop low-emissions fuels for shipping. Hydrogen and ammonia dominate, according

[36] https://impact.economist.com/ocean/biodiversity-ecosystems-and-resources/decarbonisation-of-shipping-the-challenges-of-getting-into-action
[37] https://www.mpa.gov.sg/media-centre/details/keynote-address-by-ce-mpa-quah-ley-hoon-nautical-institute-conference-2022-1-september-2022
[38] https://www.gcformd.org/
[39] https://www.mpa.gov.sg/media-centre/details/keynote-address-by-ce-mpa-quah-ley-hoon-nautical-institute-conference-2022-1-september-2022
[40] https://www.mpa.gov.sg/media-centre/details/maritime-and-port-authority-of-singapore-and-port-of-rotterdam-to-establish-world-s-longest-green-and-digital-corridor-for-efficient-and-sustainable-shipping
[41] Ibid.

Figure 2: Total international shipping CO2 emissions (2012-18)
Million tonnes



Source: Fourth IMO GHG study

to a Global Maritime Forum survey of zero-emissions projects in progress in 2021 and early 2022. Of the more than 200 projects surveyed, 45 focused on hydrogen technologies and another 40 on ammonia. They covered ship technology, fuel production, and bunkering and infrastructure projects.[42]

Ship owners are investing in vessels designed to run on alternative fuels, including LNG and methanol, or be ready for hydrogen or ammonia. In the first half of 2022 these alternative fuels comprised 61% of newbuild orders, according to Clarksons Research. The majority are designed to run on LNG, but 66 were for ammonia-ready and three for hydrogen-ready vessels. In 2021 31.7% of newbuild tonnage ordered was for alternative-fuel-capable vessels, Clarksons Research shows.[43]

Deep Dive: banking on blue carbon

Coastal ecosystems like mangrove forests, tidal marshes and seagrass meadows capture and store CO2 from the atmosphere. They can sequester two to four times more carbon than terrestrial forests.[44] They are also some of the most threatened ecosystems on Earth.

Projects that restore these ecosystems can generate "credits" based on the tonnes of carbon captured and stored, which can then be sold to businesses interested in offsetting some of the emissions they generate. Global demand for carbon credits is set to increase 15-fold from 2020 levels, to be worth around US$50bn by 2030.[45]

[42] https://www.globalmaritimeforum.org/content/2022/03/Mapping-of-zero-emission-pilots-and-demonstration-projects_third-edition.pdf
[43] https://www.rivieramm.com/news-content-hub/green-wave-61-of-newbuilds-ordered-will-burn-alternative-fuels-71876?utm_source=newsletter&utm_medium=email&utm_campaign=Marine%20Propulsion%20%26%20Auxiliary%20Machinery%20Newsletter
[44] https://ioc.unesco.org/our-work/blue-carbon
[45] https://impact.economist.com/ocean/ocean-health/are-blue-carbon-markets-becoming-mainstream

There are currently too few suitable projects to meet the rising demand for high-quality blue carbon credits. But as blue carbon is integrated into climate-mitigation strategies via new trading platforms, government climate action plans (called Nationally Determined Contributions or NDCs)[46] and the Natural Capital Protocol for the Ocean,[47] quality projects are likely to grow.

A framework of High-Quality Blue Carbon Principles and Guidance[48] was launched at COP27 to ensure that blue-carbon credits are optimised for nature and local communities as well as mitigating climate change. This will provide "guardrails" for the development and purchasing of high-quality blue-carbon projects and credits so investors can see that they are fair, equitable and credible, says Mr Cunliffe of ORRAA.

In 2022 the Sea Change Impact Financing Facility (SCIFF)[49] was launched to drive at least US$1bn of private investment into coastal and ocean ecosystems by 2030, a springboard from which to mobilise at least US$2.5bn of broader finance capital. SCIFF creates an investment ecosystem for sustainable initiatives, and for developing them at speed and at scale.

Mangrove restoration projects are the most studied in this field. The Delta Blue Carbon Project[50] is a massive project in Pakistan's Indus Delta. Scientists in 2022 developed a new global model and map of mangrove restoration potential. Indonesia has the largest potential restoration area. Other countries with large areas include Mexico, Australia and Myanmar.[51]

Indonesia has the world's largest potential restoration area at national level. In 2022 a US$419m restoration project was launched to support the government's National Mangrove Rehabilitation programme to rehabilitate 600,000 hectares of mangroves by 2024. The project will help Indonesia meet its NDC emissions-reduction target, and mitigate the impacts of climate change.[52]

The scaling of mangrove habitat restoration is being driven by demand from the carbon-credit market more than demand for shoreline protection, even though mangroves are critical in shoreline protection, says Boze Hancock, senior marine habitat restoration scientist at The Nature Conservancy (TNC).

Work to demonstrate the carbon-credit potential of seagrass beds is also progressing. A project is taking place in the US's Virginia Coast Reserve. Seagrass meadows absorb carbon up to 35 times faster than tropical rainforests, according to the World Wide Fund for Nature (WWF).[53] They only cover 0.2% of the sea floor, but absorb 10% of the ocean's carbon each year. Their ecosystem carbon-capture services have been valued at US$2.3trn. They are also home for a wide variety of marine life[54] and help improve water quality. Seagrass habitats also locally buffer ocean acidification.[56]

The United Nations Education, Scientific and Cultural Organisation (UNESCO) is exploring using carbon credits to help fund conservation for 21 World Heritage sites recognised for their blue-carbon ecosystems.

[46] https://www.un.org/en/climatechange/all-about-ndcs
[47] https://impact.economist.com/ocean/ocean-health/valuing-natural-coastal-infrastructure
[48] https://www3.weforum.org/docs/WEF_HC_Blue_Carbon_2022.pdf
[49] https://oceanriskalliance.org/resource/sciff/#:~:text=The%20Sea%20Change%20Impact%20Financing,bn%20of%20broader%20finance%20capital.
[50] https://deltabluecarbon.com/
[51] https://www.mangrovealliance.org/wp-content/uploads/2022/09/The-State-of-the-Worlds-Mangroves-Report_2022.pdf
[52] https://www.worldbank.org/en/news/press-release/2022/06/07/new-project-will-support-large-scale-mangrove-conservation-and-restoration-in-indonesia
[53] https://www.wwf.org.uk/what-we-do/planting-hope-how-seagrass-can-tackle-climate-change
[54] https://cordis.europa.eu/article/id/421523-seagrass-revealing-impact-of-climate-change-on-marine-environments
[55] Ibid.
[56] https://unesdoc.unesco.org/ark:/48223/pf0000375565

Kenyan mangroves

An exciting case study is the Mikoko Pamoja project in Kenya, one of the recent winners of the UpLink Blue Carbon Challenge[57] and featured in the World Ocean Initiative's Ocean Protectors series, supported by Blancpain.[58] It is a pro-poor, pro-nature and pro-climate mangrove restoration intervention, geared at providing benefits for biodiversity, socioeconomic empowerment and mitigating climate change. Annually, 2,500 tonnes of carbon dioxide equivalent (CO2eq) are sequestered, generating income of approximately US$30,000. Certified by Plan Vivo, 65% of the proceeds are reinvested in the community. Revenue is channelled into local community development in water, sanitation, education and further ecosystem conservation.

For projects like this to work there need to be strong systems for designing, registering and validating blue-carbon projects.[59]

Deep dive: small island developing states

Small island developing states (SIDS)—or, more appropriately, large ocean states—are among the least responsible for climate change, but are likely to suffer most from its adverse effects, including on tourism (often the largest sector), agriculture, fresh-water supply, food security and land availability.[60] In some cases they will become uninhabitable.[61]

The majority are increasingly affected by extreme weather events—tropical storms, cyclones and hurricanes—as well as droughts and flooding.[62] The frequency of extreme water-level events in small islands is projected to double by 2050, according to a 2017 study published in *Nature*.[63]

[57] https://impact.economist.com/ocean/ocean-and-climate/12-organisations-delivering-on-the-promise-of-blue-carbon
[58] https://impact.economist.com/ocean/ocean-health/mangroves-how-they-help-the-ocean
[59] https://impact.economist.com/ocean/ocean-health/how-to-scale-up-blue-carbon-projects
[60] Ibid.
[61] https://unfccc.int/resource/docs/publications/cc_sids.pdf
[62] Ibid.
[63] https://www.nature.com/articles/s41598-017-01362-7

Severe erosion on the islands of Hetaheta and Sogomou in the northern Solomon Islands has led to 62% and 55% island loss, respectively, over the 20th century.

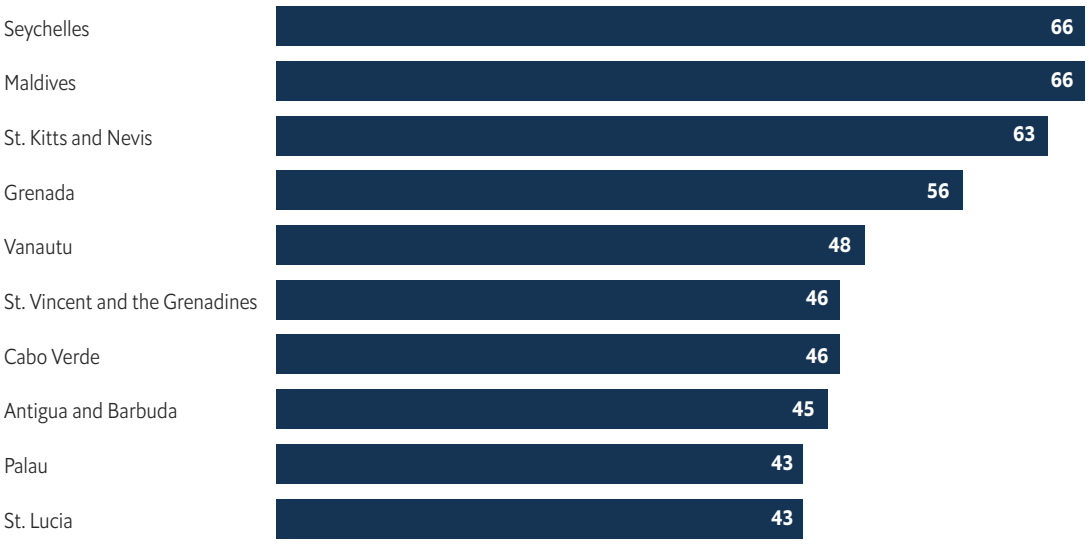
Several low-lying Pacific Islands in the Solomon Islands and Micronesia have been lost to rising sea levels. Severe erosion on the islands of Hetaheta and Sogomou in the northern Solomon Islands has led to 62% and 55% island loss, respectively, over the 20th century.[64]

The UN estimates that the economic risks of climate change for SIDS will be higher than the global average, with projected average annual losses (AAL) by 2030 between 0.75% and 6.5% of gross domestic product (GDP) for Pacific SIDS, compared with the global average of 0.5%.[65]

Delegates at COP27 agreed on a new Loss and Damage Fund to help developing countries that are particularly vulnerable to climate disasters including extreme weather events and rising sea levels. However, the delegates did not decide where the money will come from and which countries will benefit, the UN Environment Programme (UNEP) says.[66]

Many SIDS want to convert to renewable energy, and have set goals to become carbon-neutral or carbon-negative.[67] Many SIDS highlighted in their NDCs their need for human, technological and financial support to achieve their mitigation goals.[68]

Figure 3: The ten small island developing states most dependent on tourism
(Tourism, % of GDP)



Source: United Nations Conference on Trade and Development (UNCTAD)

[64] https://www.annualreviews.org/doi/10.1146/annurev-environ-012320-083355#:~:text=Current%20Impacts%20of%20Climate%20Change,levels%20and%20associated%20land%20loss
[65] https://sdgs.un.org/sites/default/files/publications/2189SIDS-IN-NUMBERS-CLIMATE-CHANGE-EDITION_2015.pdf (exact figures are cited in https://www.annualreviews.org/doi/10.1146/annurev-environ-012320-083355#:~:text=Current%20Impacts%20of%20Climate%20Change,levels%20and%20associated%20land%20loss)
[66] https://www.unep.org/news-and-stories/story/cop27-ends-announcement-historic-loss-and-damage-fund
[67] https://www.annualreviews.org/doi/10.1146/annurev-environ-012320-083355#:~:text=Current%20Impacts%20of%20Climate%20Change,levels%20and%20associated%20land%20loss
[68] Ibid.

Key takeaways:

- Ocean health—and its ability to mitigate CO2 emissions—is damaged by climate change, pollution and other destructive human activities.
- In 2022 some key multilateral decisions were taken to help stop the downward spiral in ocean health. Many are confident this momentum will continue in 2023.
- 2023 must see increased global ambition to curb emissions, and implementation of commitments already made.
- Climate change will impact tourism, aquaculture and fisheries, and the livelihoods and food security in many coastal communities.
- There are too few suitable projects to meet the rising demand for high-quality blue-carbon credits. But quality projects—restoring mangroves and other ecosystems—are set to grow.
- The shipping industry's shift to low-emission fuels is gathering momentum.
- New marine technologies to sequester CO2 are growing, but must be rigorously assessed for their environmental impact before scaling.

Chapter II. Biodiversity loss

The ocean's natural capital is valued at US$24trn, according to the World Wide Fund for Nature (WWF). Yet human activity is causing rapid deterioration of ocean biodiversity. One of the key aspects of protecting marine biodiversity is recognising its contribution to the blue economy—including fisheries, tourism and food security—and in protecting coasts from storm damage. Another major contribution is marine ecosystems' ability to mitigate climate change by acting as a carbon sink and absorbing excess temperatures (see Chapter I).

Advances are being made in quantifying both of these in increasing detail.

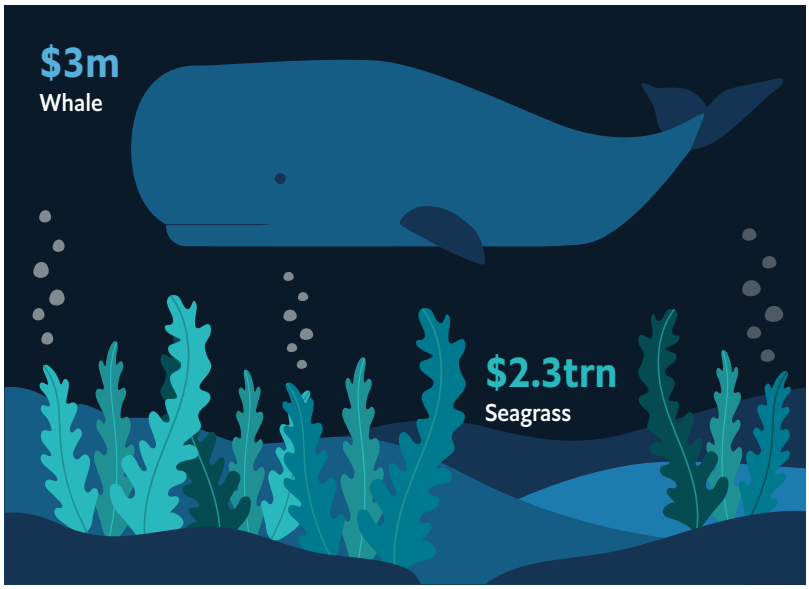
Economic models on large-scale restoration projects are becoming more detailed, and should help attract more investment. For example, detailed financial analysis of a large-scale oyster-bed restoration project in Chesapeake Bay in the US estimates it will create more than 300 jobs and a return of US$23m a year in additional fish and seafood alone.[69] That is an annual return of 50% on investment, says Boze Hancock, senior marine habitat restoration scientist at The Nature Conservancy (TNC).[70]

Another large-scale shellfish restoration project currently taking place in Australia[71] will provide a second detailed economic analysis, probably in 2023. "The logic of the return on investment for marine habitat restoration is fairly straightforward to describe, but quantifying that is just starting," explains Mr Hancock.

Mangroves are the most efficient carbon capture and storage systems on the planet. They also prevent more than US$65bn in property damage from storms, and their restoration could result in at least 25bn more commercial marine fish and shellfish, according to the Global Mangrove Alliance (GMA).[72] The good news is that mangrove loss is declining and global awareness of their importance is strengthening, the GMA says.[73]

[69] https://www.fisheries.noaa.gov/feature-story/more-oysters-good-chesapeake-bay-good-people
[70] https://www.nature.org/en-us/about-us/who-we-are/our-people/dr-boze-hancock/
[71] https://www.natureaustralia.org.au/what-we-do/our-priorities/oceans/ocean-stories/restoring-shellfish-reefs/
[72] https://oceanwealth.org/the-state-of-the-worlds-mangroves-2022/
[73] Ibid.

Figure 4: Carbon-sequestration value



Source: https://impact.economist.com/ocean/sustainable-ocean-economy/lessons-from-world-oceans-day-2022-a-revitalised-ocean-economy

The UN Climate Change High Level Champions and the GMA aim to unlock public, private and philanthropic finance at scale for conservation and restoration of mangrove ecosystems. By 2030 their goal is to halt mangrove loss, restore half of mangrove ecosystems, and increase their protection.[74]

Seagrass meadows are also highly efficient at absorbing carbon. Their ecosystem carbon-capture services have been valued at US$2.3trn.[75] They are also home for a wide variety of marine life and help improve water quality.[76] Seagrass habitats also locally buffer ocean acidification.[77]

Marine Protected Areas

Marine Protected Areas (MPAs) are effective ways to protect and restore marine biodiversity, support sustainable fisheries for the future[78] and enhance carbon sequestration.

A major initiative in this field aims to establish MPAs in 30% of the ocean by 2030.[79,80] More than 100 countries[81] have joined the High Ambition Coalition for Nature and People[82] as part of this 30x30 initiative. And, as a result of the Fifteenth meeting of the Conference of the Parties to the Convention on Biological Diversity (COP15) held in Montreal in December 2022, 30x30 is now an agreed target of the Global Biodiversity Framework.

Only 2.9% of the ocean is fully or highly protected from fishing impacts.[83] And even these areas could theoretically be open to future oil and gas exploration, says Lance Morgan, president and chief executive officer of Marine Conservation Institute, which tracks MPAs.[84]

Nearly 10% of the ocean has some level of MPA protection. However, momentum in establishing MPAs has slowed after a good run of large areas being protected, especially in the US and UK, which have large overseas territories with little activity in them, says Mr Morgan.[85]

Two countries—Palau and the UK—have passed the 30% mark, although there are reports that more than 90% of Britain's offshore MPAs were bottom-trawled and dredged in 2021.[86]

[74] https://www.mangrovealliance.org/wp-content/uploads/2022/09/The-State-of-the-Worlds-Mangroves-Report_2022.pdf
[75] https://impact.economist.com/ocean/sustainable-ocean-economy/lessons-from-world-oceans-day-2022-a-revitalised-ocean-economy
[76] https://cordis.europa.eu/article/id/421523-seagrass-revealing-impact-of-climate-change-on-marine-environments
[77] Ibid.
[78] https://www.science.org/doi/10.1126/science.abn0098
[79] https://www.hacfornatureandpeople.org/home
[80] https://marine-conservation.org/30x30/
[81] https://www.campaignfornature.org/more-than-100-countries-commit-to-protect-at-least-30-of-land-and-oceans-by-2030
[82] https://www.hacfornatureandpeople.org/more-than-100-countries-now-formally-support-the-global-target-to-protect-at-least-30-of-the-planet-by-2030
[83] https://mpatlas.org/zones?status=Shp
[84] https://marine-conservation.org/mpatlas/
[85] Ibid.
[86] https://www.theguardian.com/environment/2022/may/31/fishing-industry-still-bulldozing-seabed-in-90-of-uk-marine-protected-areas

Colombia stepped up at the 2022 UN Ocean Conference[87] with proposals to meet the 30% target.[88] The US is close to 30%.

"We're moving at this with an energy that's still pretty high. It's just slow going ... because these areas are contested by fishing and other interests," explains Mr Morgan.

Marine conservation can significantly enhance carbon sequestration, coastal protection, biodiversity, and fishers' catch and income, but some of these benefits are only achieved in fully or highly protected areas.[89] Achieving the 30x30 target will require "a lot more ambition" in on-the-ground work to find and designate new MPAs, working with local communities to ensure they benefit, and political will, says Mr Morgan. It will also need a high seas treaty to protect international waters, without which it will be impossible to protect much of the ocean.

Momentum to establish three new MPAs in the Southern Ocean—one of the world's least-touched ecosystems[90]—has slowed. In November 2022 Russia and China vetoed proposals for the sixth year in a row at a meeting of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR).[91]

Mr Morgan says major upcoming meetings to watch include UN negotiations to finalise the treaty to conserve biodiversity on the high seas, currently underway, and a CCAMLR meeting in June 2023 in Chile to further examine MPA implementation in the waters surrounding Antarctica.[92] The Our Ocean Conference hosted by Panama in March 2023[93] is likely to see more countries present MPA commitments. MPAs will also be prominently on the agenda at the World Ocean Summit in Lisbon in late February and early March.[94]

Funding solutions

Participants at the fifth International Marine Protected Areas Congress (IMPAC5) in Vancouver in February 2023 welcomed so-called "other effective area-based conservation measures" (OECMs) as a tool for establishing conservation structures alongside MPAs.[95] It may cost between US$5bn and US$19bn to establish MPAs in 30% of the world's ocean, says Peter Thomson, the UN Secretary-General's Special Envoy for the Ocean.[96]

[87] https://www.un.org/en/conferences/ocean2022/participate/logistics
[88] https://missionblue.org/2022/06/colombia-expands-mpa-at-malpelo-island-hope-spot-reaching-30x30-goals/
[89] https://www.cell.com/one-earth/fulltext/S2590-3322(22)00480-8?_returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS2590332222004808%3Fshowall%3Dtrue
[90] https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2020/10/the-need-for-a-network-of-marine-protected-areas-in-the-southern-ocean
[91] https://news.mongabay.com/2022/11/negotiations-to-conserve-antarctic-ocean-end-in-stalemate-on-many-issues/
[92] https://www.ccamlr.org/en/news/2022/meeting-antarctic-experts-comes-close
[93] https://ouroceanpanama2023.gob.pa/
[94] https://events.economist.com/world-ocean-summit/
[95] https://sdg.iisd.org/news/impac5-recognizes-role-of-other-area-based-measures-in-protecting-ocean/
[96] https://impact.economist.com/ocean/ocean-health/how-to-pay-for-the-protection-of-marine-environments

Mr Thomson has insisted that new flows of funding, especially to developing countries, will be required if 30x30 is to succeed. He has proposed a distance-neutral toll on international shipping that is applied to all ships over a certain size . He has also called for a redirection of government monies spent on harmful fisheries subsidies—which the World Trade Organisation (WTO) partly banned in June 2022[97]—into the establishment and governance of MPAs.[98,99]

"You can't expect developing countries to carry the financial burdens of MPAs on behalf of the industrialised North," says Mr Thomson.

Other ideas include the establishment of a well-governed compliance market for blue carbon, and generating income from tourism (both physical and virtual) and from blue-carbon credits. The creation of blue-carbon credits for MPAs relies on detailed research on the amount of carbon they capture, and this remains work in progress.

MPA initiatives

California has 124 MPAs, spanning the entire California coastline and ecologically designed to form a network. A ten-yearly review of the system is being carried out and will be made available in 2023.[100] It is mainly funded with state government funds.

In 2021, four Latin American countries announced plans to create a vast MPA in the Pacific, linking protected waters of Ecuador, Colombia, Panama and Costa Rica to protect migrating species.[101] This will help safeguard the Eastern Tropical Marine Corridor established by the same four countries nearly 20 years ago. Such international collaboration—which expanded this year to include the US[102] and a multi-sector coalition bringing US$150m in funding[103]—helps with protection from foreign industrial fishing fleets, and other threats.[104]

Coral reefs

Coral reefs absorb CO2, protect coastlines from storms and erosion, and act as nurseries for fish. About 25% of marine life depends on coral reefs. More than 1bn people depend on coral reefs for their livelihoods and food, together worth more than US$2.7trn annually. And they help protect over 600m people from coastal flooding.[105] They are also an important source of income from tourism—coral-reef tourism generates more than US$36bn in economic revenue[106] each year, according to Sustainable Travel International.

Despite their critical importance, their protection and restoration is severely underfunded.[107]

Climate change, pollution[108] and other impacts are killing them. Without fast action, up to 90% of them will be lost by 2050.[109]

The cost of reduced tourism alone due to coral bleaching could be US$12bn annually.[110]

The Caribbean has lost more than half of its live coral in the past 50 years, according to TNC.[111]

[97] https://www.wto.org/english/tratop_e/rulesneg_e/fish_e/fish_e.htm
[98] https://www.pewtrusts.org/en/research-and-analysis/articles/2020/06/08/governments-should-act-to-end-harmful-fishing-subsidies
[99] https://www.wto.org/english/thewto_e/minist_e/mc12_e/briefing_notes_e/bffish_e.htm
[100] https://healthebay.org/the-future-of-california-mpas-insights-from-the-experts/
[101] https://www.theguardian.com/environment/2021/nov/02/four-latin-american-countries-join-protected-marine-reserves-to-create-mega-mpa
[102] https://cl.usembassy.gov/mou-in-support-of-the-eastern-tropical-pacific-marine-corridor-cmar/
[103] https://sdgs.un.org/partnerships/connect-protect-eastern-tropical-pacific-coalition-commitment
[104] https://www.thegef.org/newsroom/news/broad-coalition-announces-support-conserving-eastern-tropical-pacific
[105] https://irff.undp.org/blog/coral-reef-insurance-protection-necessary-and-possible
[106] https://sustainabletravel.org/our-work/oceans-reefs/
[107] https://irff.undp.org/blog/coral-reef-insurance-protection-necessary-and-possible
[108] https://www.science.org/doi/10.1126/science.aar3320
[109] https://irff.undp.org/blog/coral-reef-insurance-protection-necessary-and-possible
[110] https://www.un.org/en/conferences/ocean2022/facts-figures
[111] https://www.nature.org/en-us/newsroom/caribbean-guidelines-coral-reef-tourism/

Figure 5: Value of coral reefs

Source: National Oceanic and Atmospheric Administration

Solutions and opportunities for action

Monitoring the state of the world's coral reefs has accelerated in recent years. The first[112] detailed global atlas[113] of coral reefs was completed in 2021. This was expanded in 2022 to include a platform—REEF THREATS[114]—that links changes in water quality and temperature to coral reefs and coral bleaching.

Scientists are developing genetically engineered coral that are more resilient to rising sea temperatures.[115]

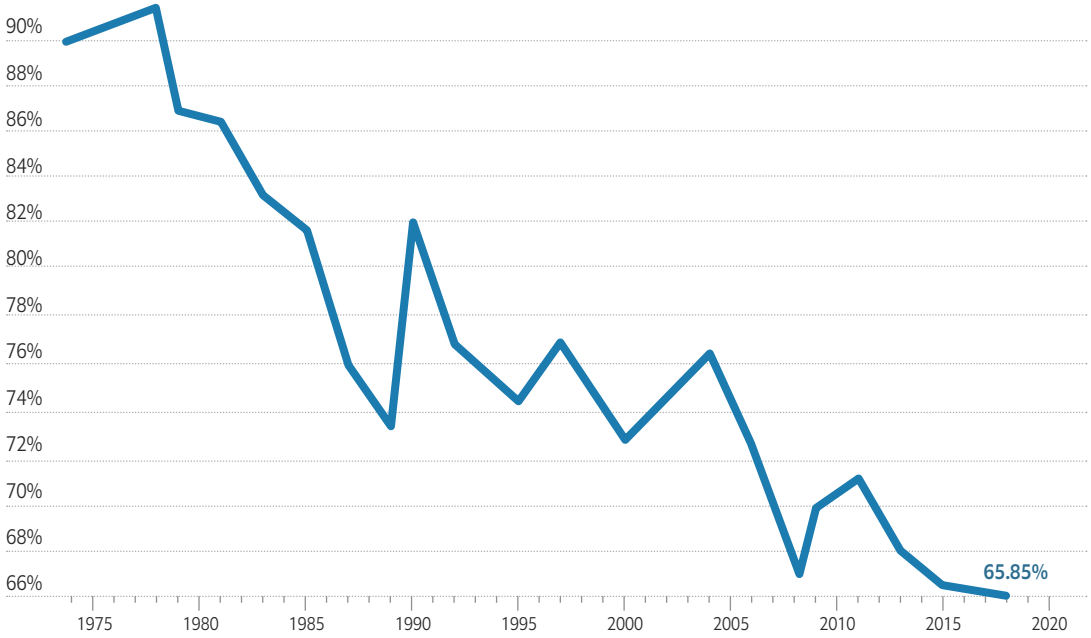
UNDP's Insurance & Risk Finance Facility (IRFF) is working with partners to develop a nature-based insurance solution. Parametric insurance solutions for coral reefs (which pay policyholders according to the magnitude of a disaster rather than the magnitude of the losses) can offer timely payouts for clean-up and restoration after a disaster. The IRFF is also exploring finances for regular reef maintenance and investing in risk reduction, as well as paying for small uninsured losses. In addition, it is looking at buying insurance for larger and insurable risks faced by reefs, and alternative risk-transfer instruments. The IRFF will receive the payout from claims, which will be used to pay for reef restoration.[116]

Preventing pollution and waste from entering the ocean is vital to protect coral reefs. (See Pollution.) This includes sediment run-off from land that smothers corals.[117]

Initiatives include the Global Tourism Plastics Initiative,[118] led by the UN Environment Programme[119] and the World Tourism Organisation, in collaboration with the Ellen MacArthur Foundation.[120]

[112] https://www.smithsonianmag.com/smart-news/see-first-map-worlds-coral-reefs-180978676/
[113] https://www.allencoralatlas.org/
[114] https://www.allencoralatlas.org/blog/atlas-launches-reef-threats/
[115] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8782467/
[116] https://irff.undp.org/blog/coral-reef-insurance-protection-necessary-and-possible
[117] https://www.allencoralatlas.org/blog/atlas-launches-reef-threats/
[118] https://www.oneplanetnetwork.org/programmes/sustainable-tourism/global-tourism-plastics-initiative
[119] https://www.unep.org/news-and-stories/story/tourism-tackle-plastic-pollution-new-commitment
[120] https://www.ellenmacarthurfoundation.org/

Figure 6: Global proportion of fish stocks within biologically sustainable levels
(%, 1974-2017)



Source: Food and Agriculture Organisation

Fisheries regulation and subsidies

Overexploited fish stocks are at risk of collapsing in many parts of the world. Just 64.6% of fish stocks were sustainably fished in 2019—1.2 % lower than in 2017,[121] and a drop from 90% in 1974.[122]

Such unsustainable fishing has resulted in the loss of US$88.9bn in ocean benefits every year, and left around 20% of marine species at risk of extinction.[123]

Rebuilding overfished stocks could increase fisheries production by 16.5m tonnes and help improve the food security, economic growth and well-being of coastal communities.[124]

The year 2022 saw progress towards curbing illegal, unreported and unregulated (IUU) fishing, which should go some way to helping fish stocks recover. However, there has been limited progress on overfishing, and the WTO needs to make more progress on this in 2023.

After two decades of talks, the WTO finally banned some harmful fisheries subsidies which support the fishing of overfished stocks. One estimate says these subsidies total more than US$22bn a year globally.[125]

The ban ends support for IUU fishing, support for fishing overfished stocks and support for fishing on unregulated high seas.[126] However, it does not end subsidies that can lead to overcapacity and

[121] https://www.fao.org/3/cc0461en/online/sofia/2022/key-messages.html
[122] https://www.wto.org/english/thewto_e/minist_e/mc12_e/briefing_notes_e/bffish_e.htm
[123] https://www.msc.org/media-centre/news-opinion/news/2022/10/26/msc-launches-new-global-standard-for-sustainable-fishing
[124] https://www.fao.org/3/cc0461en/online/sofia/2022/key-messages.html
[125] https://www.pewtrusts.org/en/research-and-analysis/articles/2020/06/08/governments-should-act-to-end-harmful-fishing-subsidies
[126] https://www.wto.org/english/thewto_e/minist_e/mc12_e/briefing_notes_e/bffish_e.htm

overfishing. The Organisation for Economic Co-operation and Development (OECD) says these subsidies, which include support for fuel and for fishing vessels,[127] are the most damaging because they encourage overfishing.[128]

The WTO agreement was reached in June 2022[129] and will enter into force once two-thirds of the WTO's members accept its legal instrument.[130,131] The UN's Mr Thomson says that given the right degree of priority by Member States, this should be achievable by the end of 2023.

The year 2022 also saw the number of countries backing the UN Food and Agriculture Organisation's Agreement on Port State Measures (PSMA)[132] grow to 100 (or 60% of the world's port states). The binding international agreement denies port access and use to foreign vessels engaging in or supporting IUU fishing.[133]

Insurance companies are also important in combating IUU fishing, and the Ocean Risk and Resilience Action Alliance (ORRAA), Global Fishing Watch, and TMT are developing a new tool, Vessel Viewer,[134] to help. Vessel Viewer was launched for pilot testing in September 2022.[135] It gathers data to help insurers better assess whether vessels are at risk of engaging in IUU fishing. Without insurance, IUU vessels become more costly to operate, so cutting off access to insurance is a key lever to deterring illegal fishing. Keeping IUU fishing vessels off their books can also help insurers avoid costly claims and exposure to potential legal and reputational liabilities.[136] Vessel Viewer is being piloted by at least 15 insurance companies, with the goal to roll it out in the second half of 2023.

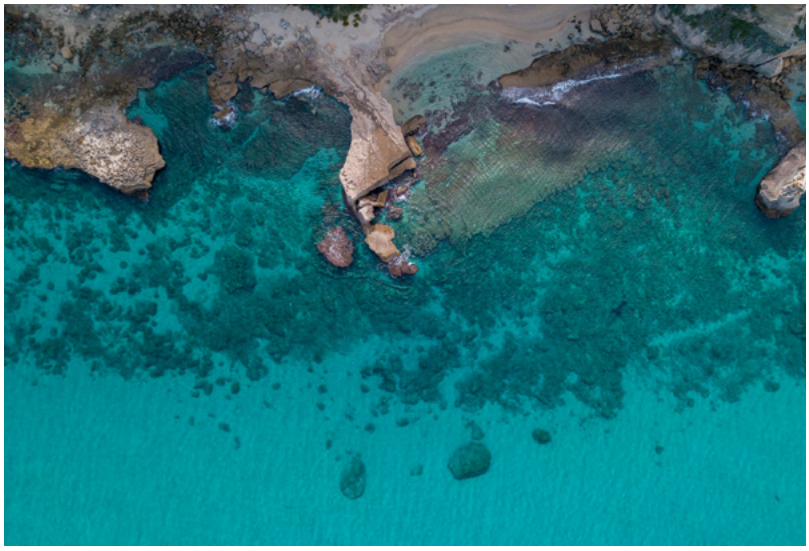
Certification of sustainable fisheries[137] increases the value of fish by giving consumers a guarantee that the fish was sustainably sourced, as well as boosting fish stocks of the future. About 15% of the wild marine harvest comes from fisheries certified to the Marine Stewardship Council (MSC) Fisheries Standard. The MSC aims to increase this to a third of the world's wild seafood catch by 2030. In 2022 it released a new global standard for sustainable fishing, after a four-year review of marine science and fisheries best practice. The new standard includes stronger requirements to protect fish stocks and ecosystems.[138]

[127] https://www.oecd.org/agriculture/government-subsidies-overfishing/
[128] https://www.oecd-ilibrary.org/agriculture-and-food/relative-effects-of-fisheries-support-policies_bd9b0dc3-en
[129] https://www.wto.org/english/tratop_e/rulesneg_e/fish_e/fish_e.htm
[130] https://www.wto.org/english/tratop_e/rulesneg_e/fish_e/agreement_fisheries_subsidies_e.htm
[131] https://www.wto.org/english/thewto_e/minist_e/mc12_e/briefing_notes_e/bffish_e.htm
[132] https://www.fao.org/port-state-measures/en/
[133] http://www.fao.org/iuu-fishing/en
[134] https://oceanriskalliance.org/project/insuring-against-iuu-fishing/
[135] https://oceanriskalliance.org/news/closing-the-net-on-illegal-fishers/
[136] Ibid.
[137] https://fisheries.msc.org/en/fisheries/
[138] https://www.msc.org/media-centre/news-opinion/news/2022/10/26/msc-launches-new-global-standard-for-sustainable-fishing

The high seas

International waters comprise about two-thirds of the ocean.[139] They hold some of the largest reservoirs of biodiversity[140] and contain microorganisms that produce almost half of the world's oxygen supply.[141] They also sequester excess carbon dioxide. In 2014 the Global Ocean Commission estimated the economic value of removing this carbon from the atmosphere at US$74bn-222bn a year.[142]

But only 1.2% of international waters[143] are protected. UN talks to agree on a high seas treaty to protect their biodiversity came close to success in 2022, and hopes are high they will succeed in 2023.[144]



Deep dive: deep-sea mining

Technological advances in deep-sea mining and increasing global demand[145] for metals and rare-earth elements could make deep-sea mining economically viable. This poses new risks to the health of the high seas.[146] Some researchers have warned that minerals extraction "will have irreversible consequences that could lead to the loss of habitats, species and ecosystems services".[147]

The International Seabed Authority (ISA)[148] is mandated under the UN Convention on the Law of the Sea (UNCLOS) to manage all mineral-related activities in the international seabed area. It has granted 15-year contracts to 21 contractors[149] to explore for minerals.

The authority is under pressure to finalise regulations governing deep-sea mining, including environmental monitoring and compliance, after the Pacific nation of Nauru in 2021 triggered an obscure provision of UNCLOS known as the "two-year rule" that compels the ISA to finalise rules and regulations within two years so that Nauru and its contractor can submit an application to begin mining at the expiry of the 2 year period, July 9th 2023.[150] Nauru is a sponsoring state for Nauru Ocean Resources Inc (NORI), a wholly-owned subsidiary of The Metals Company (Metals Co) that will carry out the mining.

[139] https://www.pewtrusts.org/en/research-and-analysis/reports/2020/03/a-path-to-creating-the-first-generation-of-high-seas-protected-areas
[140] https://mpa.highseasalliance.org/
[141] https://www.pewtrusts.org/en/research-and-analysis/reports/2020/03/a-path-to-creating-the-first-generation-of-high-seas-protected-areas
[142] https://www.some.ox.ac.uk/wp-content/uploads/2016/03/GOC_report_2015.July_2.pdf
[143] https://highseasdialogues.org/about/
[144] https://highseasdialogues.org/programme/
[145] https://www.science.org/doi/10.1126/science.aac6647
[146] https://www.pewtrusts.org/en/research-and-analysis/reports/2020/03/a-path-to-creating-the-first-generation-of-high-seas-protected-areas
[147] https://www.frontiersin.org/articles/10.3389/fmars.2018.00480/full
[148] https://www.isa.org.jm/
[149] https://www.isa.org.jm/index.php/minerals/exploration-areas
[150] https://www.reuters.com/business/environment/pacific-island-nauru-sets-two-year-deadline-deep-sea-mining-rules-2021-06-29/

In September 2022 the ISA's secretary-general gave Metals Co permission to start test-mining[151] a small area of seabed. The process lacked transparency and was highly controversial, says Phil McCabe, Pacific regional lead on deep-sea mining at the Deep Sea Conservation Coalition. The company says it expects to apply for a licence to begin mining in the second half of 2023.[152]

But a growing number of ISA member states, including France,[153,154] want to stop[155] or pause the move towards mining, in order to protect ecosystems. An Alliance of Countries Calling for a Deep-Sea Mining Moratorium was launched by Palau at the 2022 UN Ocean Conference.[156]

Member states have until July 2023 to find a way to ensure a licence is only issued with the agreement of ISA states, explains Mr McCabe. The next ISA meeting is scheduled for March 2023. "Very few members of the ISA Council are happy for the licence to be granted", because of the risks to the environment, says Mr McCabe.

Key takeaways:

- Progress in protection and restoration of marine biodiversity has been encouraging. It includes exciting initiatives, innovations and new technologies as well as growing political will. But a lot more work and finance are needed.
- The WTO has banned some harmful fisheries subsidies which support the fishing of overfished stocks. The ban ends support for IUU fishing, support for fishing overfished stocks and support for fishing on unregulated high seas. However, it does not end subsidies that can lead to overcapacity and overfishing.
- UN talks to agree on a treaty to protect the biodiversity in the world's international waters will continue in 2023. Without this agreement, the 30x30 goal to protect the ocean will be impossible to achieve.
- In 2023, there will be continued tensions over whether the International Seabed Authority will allow deep-sea mining to begin in international waters. Mining company Metals Co is set to apply for a licence to begin mining in the second half of 2023.

[151] https://www.isa.org.jm/news/isa-legal-and-technical-commission-concludes-its-review-environmental-impact-statement
[152] https://metals.co/nori/
[153] https://www.theguardian.com/environment/2022/jul/01/stop-deep-sea-mining-says-macron-in-call-for-new-laws-to-protect-ecosystems
[154] https://www.eco-business.com/news/narratives-on-deep-sea-mining-clash-at-cop27/
[155] https://www.reuters.com/business/environment/frances-macron-says-deep-sea-mining-must-not-go-ahead-2022-06-30/
[156] https://sdgs.un.org/events/launch-alliance-countries-deep-sea-mining-moratorium-47193

Chapter III. Pollution

Pollution, combined with increasing resource extraction, is destroying some blue ecosystems faster than climate change.[157]

Although plastic constitutes only 12% of waste generated, it makes up 80% of waste found in the ocean, with the remaining consisting of chemicals, pesticides and other materials.[158]

Progress in curbing plastic waste is accelerating as governments, consumers and industry increasingly embrace circular practices to help stem the flow of plastic waste entering the ocean. Solutions and major investments are needed throughout the plastics supply chain. Awareness of other forms of chemical pollutants is lagging behind.

Plastics[159]

About 11m metric tonnes of plastic waste enter the ocean every year, and without radical changes, this could nearly triple by 2040.[160]

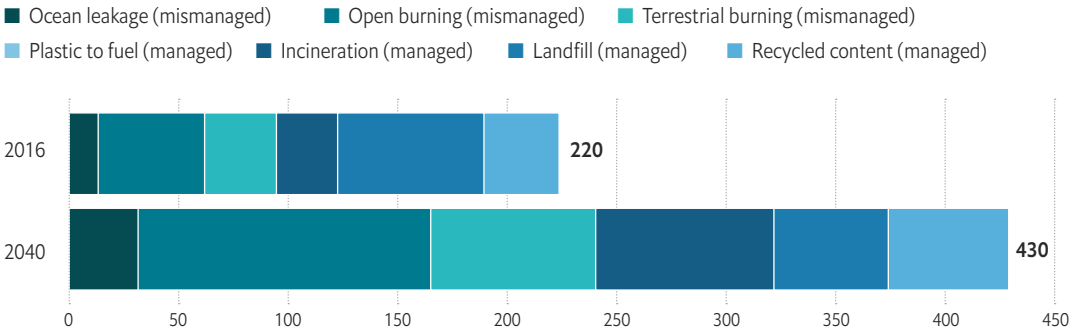
Plastics kill about 100,000 marine animals a year. Research suggests that microplastics affect the ability of marine microorganisms to absorb carbon dioxide and release oxygen, and the ability of plankton organisms to grow, reproduce and capture carbon. A plastic-choked and warming ocean will create a negative feedback loop where plant and animal life suffer, less carbon dioxide is absorbed and our ability to rein in climate change is further hampered.

The Organisation for Economic Co-operation and Development (OECD) predicts that plastics use will nearly triple by 2060 from 2019 levels, driven by economic and population growth. The largest increase will occur in sub-Saharan Africa and Asia, where waste collection and recycling systems are often weak.[161] The cost of preventing plastics from leaking into the ocean is much lower than the cost of inaction, according to the OECD, which studied 38 member countries, including 10 major plastic-waste emitters in Asia and Africa.[162]

Policymakers made a major step towards curbing plastic waste in March 2022, when the UN Environment Assembly agreed to forge a treaty

[157] https://www.allencoralatlas.org/blog/atlas-launches-reef-threats/
[158] https://impact.economist.com/ocean/rethinking-plastics/breathing-life-into-plastic-waste/
[159] https://www.weforum.org/agenda/2022/01/plastic-pollution-climate-change-solution/
[160] https://www.pewtrusts.org/-/media/assets/2020/07/breakingtheplasticwave_report.pdf
[161] https://read.oecd-ilibrary.org/view/?ref=1143_1143481-88j1bxuktr&title=Global-Plastics-Outlook-Policy-Scenarios-to-2060-Policy-Highlights
[162] https://www.oecd-ilibrary.org/environment/the-cost-of-preventing-ocean-plastic-pollution_5c41963b-en

Figure 7: Volume of managed and mismanaged plastic waste under a business-as-usual scenario
(Million metric tonnes, 2016 and 2040)



Source: Food and Agriculture Organisation

by 2024 on curbing plastic pollution.[163] The UN Environment Programme's executive director, Inger Andersen, called it "the most important international multilateral environmental deal" since the Paris climate accord.[164]

Extended Producer Responsibility schemes for plastic packaging are being rolled out in several countries, including India.[165] These make it the responsibility of producers, importers and brand-owners to ensure processing of their plastic packaging waste through recycling, re-use or end-of-life disposal. Plastic packaging is the largest segment of the plastics industry (comprising 44% of the plastics market in 2021).[166] It is also the largest source of plastic waste, responsible for almost half of the global total, according to Our World in Data.[167]

One of the most important steps in curbing waste is to reduce plastic use, and many governments have banned single-use plastics such as straws and bags. These include Caribbean countries which rely heavily on coral reef tourism,[168] and whose reefs are being harmed by plastics.

Governments, consumers and industry are now resolved to act on plastic pollution, so robust research is needed to verify the efficacy of solutions, says Richard Thompson,[169] professor of marine biology and director of the Marine Institute at the University of Plymouth.

Circular and regenerative practices

Finding waste collection and recycling solutions and shifting to a circular plastics economy could cut the volume of plastics entering the ocean by 80% each year, according to the Ellen MacArthur Foundation. It could also generate annual savings of US$200bn, reduce greenhouse-gas emissions by 25% and create 700,000 net additional jobs by 2040.[170]

To achieve a circular economy, all plastics need to be reused or recycled.

[163] https://www.unep.org/news-and-stories/story/what-you-need-know-about-plastic-pollution-resolution
[164] https://www.unep.org/news-and-stories/speech/leap-forward-environmental-action
[165] https://eprplastic.cpcb.gov.in/#/plastic/home
[166] https://plasticseurope.org/knowledge-hub/plastics-the-facts-2022/
[167] https://ourworldindata.org/plastic-pollution#how-much-of-ocean-plastics-come-from-land-and-marine-sources
[168] https://www.sknis.gov.kn/2021/04/26/twelve-caribbean-countries-have-since-banned-single-use-plastics/
[169] https://www.plymouth.ac.uk/staff/richard-thompson
[170] https://ellenmacarthurfoundation.org/topics/plastics/overview

Currently only 16% of plastics are collected and recycled globally[171] (in the EU the figure is 32.5%[172]). The rest goes to landfill or is incinerated, including plastics which are designed to be recycled. Much of it ends up in rivers and the ocean, especially in countries with poor waste collection and processing systems.

Most plastics for the packaging market (the single largest segment in the plastics industry) can be made recyclable. But the converter industry—that turns resins into plastic products—must adapt its factories to handle the new plastic resins. This will take a few years, but by 2025 the plastics sector should be producing more recyclable products, according to Marco ten Bruggencate, a commercial vice-president for packaging and specialty plastics at Dow.[173]

Systemic change is needed along the plastics supply chain, so that plastics are designed with waste-management systems in mind. There is little point designing something to be biodegradable or recyclable if there are no waste systems in place to handle it. One difficulty is that every country, and often different municipalities within the same country, handle recycling differently, which makes it hard to get economies of scale, explains Mr Thompson.

Expert Market Research says the value of the global recycled plastics market was US$37.5bn in 2020, and could grow to US$53.5bn by 2026.[174]

The EU has introduced regulations to help create a market for recycled plastics, and demands that all plastic packaging must be reusable or recyclable by 2030.[175] European plastics producers are backing EU plans to make plastic packaging comprise 30% recycled material.[176] The use of recycled plastics in new products rose 20% in the EU between 2020 and 2021. Recycled content in plastic products is now almost 10%.[177]

Globally, the plastics industry is acting to curb waste, with some producers starting to invest in recycling. "They're buying recycling operations because they recognise they need to be driving a circular economy," says Justin Wood, vice-president and head of Europe, Middle East & Africa at the Alliance to End Plastic Waste.[178] "Rather than continuing to rely on using virgin oil as a feedstock, they want to increasingly

[171] https://www.mckinsey.com/industries/chemicals/our-insights/no-time-to-waste-what-plastics-recycling-could-offer
[172] https://www.europarl.europa.eu/news/en/headlines/society/20181212STO21610/plastic-waste-and-recycling-in-the-eu-facts-and-figures
[173] https://www.wired.co.uk/article/plastic-waste-packaging
[174] https://www.expertmarketresearch.com/reports/recycled-plastics-market
[175] https://ec.europa.eu/commission/presscorner/detail/sv/MEMO_18_6
[176] https://legacy.plasticseurope.org/en/newsroom/news/european-plastics-producers-call-mandatory-eu-recycled-content-target-plastics-packaging-30-2030
[177] https://plasticseurope.org/media/backgrounder-plastics-the-facts-2022/
[178] https://endplasticwaste.org/en/about#justin_wood

add recycled plastic to feed their refineries. The awareness is rising and the investments are growing," says Mr Wood.

Plastics producers are also investing heavily in chemical recycling.[179] This is a relatively new technology that breaks down some plastics that cannot be mechanically recycled. It will likely be a key part of the circular plastics economy because even plastics that are mechanically recycled gradually lose some of their properties. These can be restored through chemical recycling. However, it is a relatively expensive process whose impact on the environment is not yet fully understood, according to the European Environment Agency.[180]

Empowering consumers to recycle plastics is also vital to boosting recycling rates. A 2021 global survey of consumers by Economist Impact found that 67% were recycling plastic waste. But ongoing education is needed to ensure that consumers follow recycling best practice: in the same study, 37% said they lacked knowledge about plastic recycling in their area.[181]

CASE STUDY

Creating waste processing in Malang, Indonesia[182]

In 2022, the Alliance to End Plastic Waste, the Malang Regency and the Co-ordinating Ministry for Maritime and Investment Affairs (CMMIA) launched an initiative to create a waste collection and management system for 2.6m people. It aims to be fully operational in 2025.

The Bersih Indonesia project aims to develop an effective, scalable, and commercially viable waste management system in Indonesia to support the nation's goal to be plastic pollution-free by 2040—an ambition that requires collaboration across the public, private, and people sectors.

Bersih Indonesia aims to divert more than 50,000 tonnes of plastic waste annually, representing a recycling rate of more than 60%.

CASE STUDY

HolyGrail 2.0[183]

The Ellen MacArthur Foundation has developed an invisible digital watermark which can be embedded in product labels. Waste-processing centres can use optical technology to detect the watermark, which identifies the plastic type, to improve sorting and recycling rates for packaging. Once it has been tested in commercial sorting and recycling facilities under normal operating conditions, the HolyGrail 2.0 Initiative will release a final public report analysing the technical and economic viability of the technology.[184]

[179] https://plasticseurope.org/media/european-plastics-manufacturers-plan-7-2-billion-euros-of-investment-in-chemical-recycling-3/
[180] https://www.eea.europa.eu/publications/plastics-the-circular-economy-and
[181] https://impact.economist.com/ocean/sustainable-ocean-economy/the-economist-intelligence-unit-surveyed-more-than-1-000-global-executives
[182] https://endplasticwaste.org/en/news/end-to-end-waste-management-system-in-malang-regency
[183] https://www.digitalwatermarks.eu/
[184] Ibid. (see Timeline Phase 3)

Chemicals

Back to Blue's landmark report in 2022, "The Invisible Wave",[185] put the spotlight on a wide range of chemical pollutants endangering marine life. Whereas the momentum to tackle plastic pollution is well underway, it is just beginning for other chemical pollutants. Raising awareness about the issue will be critical in creating a systemic and co-ordinated global response.

Chemical pollution has reached dangerous levels, and chemical production and pollution are outpacing the global capacity for monitoring and assessment, and are beyond the limit for safe management.[186] These chemicals threaten the marine ecosystems which provide services worth trillions of dollars every year.[187]

Chemicals production is forecast to grow by almost 60% by 2050.[188] More than 350,000 chemicals and mixtures of chemicals have been registered for production and use. The identities of many are publicly unknown because they are claimed as confidential (more than 50,000) or ambiguously described (up to 70,000).[189] They include nutrients, heavy metals, persistent organic pollutants, sewage and many others.

Some of the world's poorest countries are used as a dumping ground for older electronic and electrical products and hazardous chemicals, but often lack the capacity to effectively manage the waste.[190] In the past decade 80% of global electrical and electronic waste went to China, India, Pakistan, Vietnam and the Philippines, where it was commonly shredded and burnt. A lot is also illegally dumped across borders.[191]

Innovative practices in aquaculture, land-based agriculture and nature-based solutions for absorbing pollutants before they reach the ocean are already helping to reduce marine chemical pollution. If deployed at scale they could have a major impact.[192]

Regulations

There is no comprehensive international law to tackle marine chemical pollution. Existing laws are fragmentary and run up against laws covering trade and intellectual property, for example, whose goals are often at odds with protecting the marine environment.

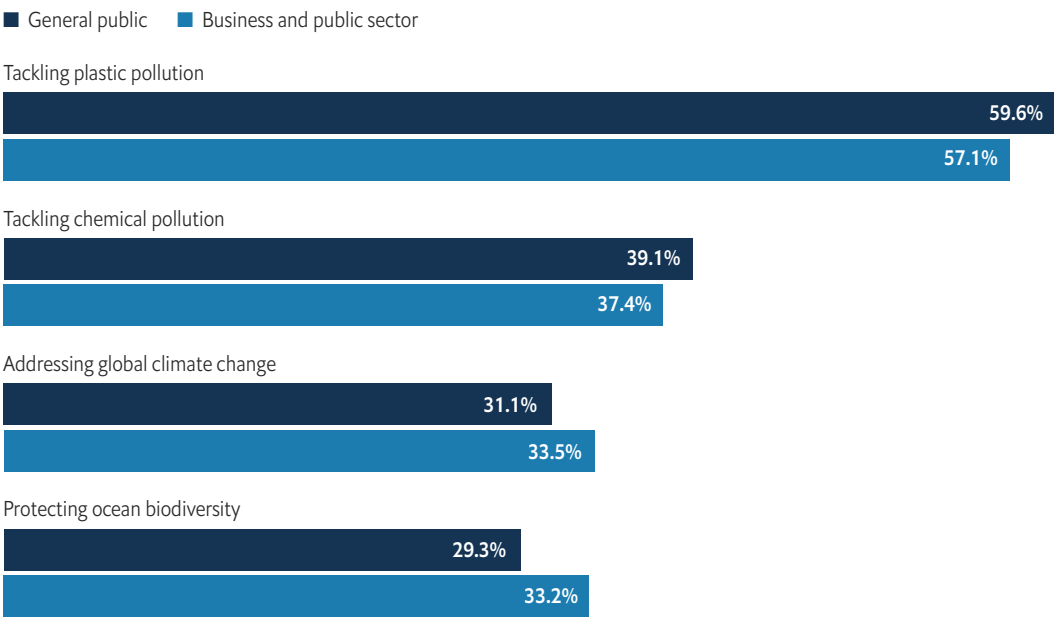
Many countries have established individual regulatory frameworks for chemicals, including an inventory of chemicals manufactured in, imported into, and/or used in the respective state.[193] Europe's Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) legislation takes an unusual step in putting the burden of proof on companies to show their products are not harmful.[194]

But because of the global prevalence of chemical pollution, governments need to work together to scale down production of plastics and chemicals that could have serious health impacts.

Discussions are ongoing to create a global framework or instrument for the sound management of chemicals and waste.

[185] https://backtoblueinitiative.com/the-invisible-wave-getting-to-zero-chemical-pollution-exec-summ/
[186] https://pubs.acs.org/doi/10.1021/acs.est.1c04158
[187] https://backtoblueinitiative.com/the-invisible-wave-getting-to-zero-chemical-pollution-exec-summ/
[188] Ibid.
[189] https://pubs.acs.org/doi/10.1021/acs.est.9b06379
[190] https://sdg.iisd.org/news/africa-identifies-chemicals-and-waste-management-priorities-beyond-2020/
[191] https://backtoblueinitiative.com/the-invisible-wave-getting-to-zero-chemical-pollution-exec-summ/
[192] Ibid.
[193] https://pubs.acs.org/doi/10.1021/acs.est.9b06379
[194] https://backtoblueinitiative.com/the-invisible-wave-getting-to-zero-chemical-pollution-exec-summ/

Figure 8: What are your top priorities for restoring ocean health?
(% respondents)



Source: Economist Impact survey as part of the Back to Blue initiative

Strategic Approach to International Chemicals Management (SAICM)[195] delegates met in 2022[196] to discuss recommendations to be discussed and possibly adopted by the fifth session of the International Conference on Chemicals Management (ICCM5) in September 2023.[197]

Industry solutions

Chemical companies need to collaborate to tackle marine chemical pollution, so that individual businesses do not face first-mover disadvantage. Several collaborative initiatives exist that include marine chemical pollution, and these may provide a template for a broad-based chemicals industry alliance. These include ReSource Plastic, Operation Clean Sweep, the Ship Recycling Transparency Initiative and the Getting to Zero Coalition.[198]

Source-to-sea

Eighty percent of marine pollution originates on land.[199] So taking a holistic approach to the management of land, fresh water, coastal and marine ecosystems is an important step to stop pollutants entering the ocean. These ecosystems are traditionally regulated and managed separately, but there is a push for a source-to-sea approach that works across sectors and administrative boundaries.[200]

[195] http://www.saicm.org/Home/tabid/5410/language/en-GB/Default.aspx
[196] https://sdg.iisd.org/commentary/policy-briefs/addressing-industry-involvement-in-the-funding-of-sound-management-of-chemicals-and-waste/
[197] https://sdg.iisd.org/events/international-conference-on-chemicals-management-iccm5/
[198] https://backtoblueinitiative.com/the-invisible-wave-getting-to-zero-chemical-pollution-exec-summ/
[199] https://oceanservice.noaa.gov/facts/pollution.html#:~:text=Much%20of%20this%20runoff%20flows,as%20a%20result%20of%20runoff
[200] https://cap-net.org/source2sea/

The solution for preventing plastic pollution from reaching the ocean lies in both source-to-sea management and circular-economy approaches working together.[201]

Understanding where pollution originates is key to formulating good policies to tackle it. Many initiatives are trying to fill the gap. One is the CounterMEASURE project, which is using technologies like geographic information systems (GIS), machine learning and drones to identify sources and pathways of plastic pollution in the Mekong and Ganges rivers.[202] Rivers transport millions of tonnes of plastics into the ocean every year. Some 95% comes from ten rivers, eight of which are in Asia—including the Mekong and the Ganges.[203]

Source-to-sea featured at the 2022 World Water Week as an important step towards global water sustainability. However, the freshwater community still struggles to connect with other communities—the ocean did not feature prominently on the agenda.[204] The UN World Water Conference in March 2023 needs to focus on source-to-sea management to connect freshwater and ocean.

Deep dive: ship recycling

Every year more than a thousand ships are scrapped to extract valuable resources such as steel, iron and aluminium. Along with environmental benefits from the circularity of this process, shipbreaking holds immense potential for economic development through job creation and raw-material supply.[205]

Most of the work is done in South Asian and West African countries with weak environmental

[201] https://siwi.org/publications/source-to-sea-framework-for-marine-litter-prevention/
[202] https://www.cms.int/en/project/countermeasure-ii-project
[203] Ibid.
[204] https://impact.economist.com/sustainability/ecosystems-resources/world-water-week-2022-five-key-takeaways
[205] https://theconversation.com/how-to-recycle-a-huge-ship-safely-and-sustainably-143519

regulations.[206] Toxic waste created in the shipbreaking process releases contaminants like asbestos, carcinogens, liquid metals and ozone-depleting substances into surrounding ecosystems.[207] From oil spills to pollution, coastal communities can also be devastated by non-regulated and dangerous practices.[208] The industry also often exploits migrant labour, leading to occupational illness, injury, disease and even fatalities stemming from unsafe operations.[209,210]

Regulatory frameworks include the International Maritime Organisation's (IMO) convention to encourage eco-friendly recycling of ships,[211] and the EU Ship Recycling Regulation for responsible shipbreaking for EU flag-bearing vessels.[212] The Basel Convention attempts to govern the trans-boundary movement of hazardous wastes, like end-of-life vessels, but ship owners often circumvent the requirement by claiming the vessel's voyage to the scrapping site is an operational trip.[213]

That said, solutions do exist to mitigate the risks that shipbreaking poses. These include mechanical cutting and safety equipment, and decontamination of vessels prior to their arrival at the shipyard. Other interventions include stronger and more comprehensive labour laws, regular environmental-impact assessments, and lower insurance premiums for green vessels.[214]

Sustainable changes are imminent within the ship-recycling industry. Presently, Bangladesh dismantles half of the world's discarded ships, which adds an estimate of US$2bn to the nation's economy.[215] However, as part of the country's commitments to meet the UN Sustainable Development Goal (SDG) 14 (Life under Water), the Bangladeshi government has announced new actions aimed at ensuring safe ship recycling by 2023. Setting a new and ambitious target, the authorities have mandated that ship-recycling yards will be required to provide a Ship Recycling Plan, to detail how each individual ship will be recycled. For other countries struggling to manage the negative externalities of ship recycling, Bangladesh's model may provide an incentive and example to support effective solutions in this space.[216]

Deep dive: ocean health is human health

According to sources, 24% of global deaths are linked to the environment. After the onset of the covid-19 pandemic, the prevalence of more extreme weather events, including water scarcity, further spotlights the intertwined well-being of people and planet.[217] A healthy ocean offers abundant and safe seafood, and high-quality "blue" environments enhance human well-being, combat obesity, and offer support for mental-health issues.[218]

The volume of plastic material in rivers and lakes is set to increase from 109m tonnes in 2019 to 348m tonnes in 2060, while plastics leaking into the ocean are expected to rise from 30m tonnes

[206] https://shipbreakingplatform.org/our-work/the-problem/
[207] https://theconversation.com/how-to-recycle-a-huge-ship-safely-and-sustainably-143519
[208] Ibid.
[209] Ibid.
[210] https://www.ilo.org/safework/areasofwork/hazardous-work/WCMS_110335/lang--en/index.htm#main-content
[211] Ibid.
[212] https://ec.europa.eu/environment/pdf/waste/ships/Ship%20recycling%20leaflet%20updated.pdf
[213] https://www.chemistryworld.com/features/the-toxic-tide-of-ship-breaking/4015158.article
[214] Ibid.
[215] https://thefinancialexpress.com.bd/views/shipbreaking-a-potential-growth-driver-1644942704
[216] https://sdgs.un.org/partnerships/government-bangladesh-announces-new-actions-aimed-ensuring-safe-ship-recycling-2023
[217] https://www.who.int/news/item/04-04-2022-health-and-the-environment
[218] Ibid.

in 2019 to 145m tonnes in 2060.[219] And as the waters become more polluted and overexploited, human as well as ocean health is impacted. Vulnerable peoples suffer disproportionately: Arctic communities are regularly exposed to pollutant build-up, and the security of coastal societies' health, food and livelihood is at risk as fish stocks collapse.[220] Direct health risks also arise from exposure to pollutants and toxic substances, including through eating seafood. More than 250m cases of respiratory and gastroenterological illness annually are tied to swimming in polluted waters.[221]

Scientists and the medical community need to address the growing link between ocean degradation and impacts on human health.[222] And given the codependency on health outcomes shared by humans and the ocean, it is necessary to redefine interaction with marine systems. The Decade of Ocean Science for Sustainable Development (2021-30) framework focuses attention on this complex relationship, as does SDG 14 to conserve and protect marine biodiversity.[223]

There is far more to be done to synthesise global partnerships and cross-sector collaborations to preserve water resources. The EU-funded Seas, Oceans & Public Health in Europe (SOPHIE) Project highlights three areas where co-operation is necessary:

1. Sustainable seafood for healthy people
2. Biodiversity, biotechnology and medicine
3. Blue spaces, tourism and well-being

In 2022 Norway and Rwanda initiated the High Ambition Coalition to End Plastic Pollution, composed of a group of countries working to establish protocols to end plastic pollution, thus curbing the enormous plastic leakage expected to enter water bodies by 2060. This commitment extends to creating a circular economy for plastics to prevent chemicals arising from plastics from impacting ecosystems and human health. Exemplifying current efforts in ocean waste management, the coalition highlights the ability of diverse entities to come together for a common purpose and build mutually beneficial road maps for solution implementation.[224]

Researchers have stated that a multi-stakeholder approach, prioritising the involvement of communities with deep dependencies on the ocean, can generate positive change. Phasing out plastics, adopting renewable power, restocking fisheries, and designating Marine Protected Areas (MPAs) are some approaches that restore the ocean while supporting healthy generations to come.[225]

[219] https://www.weforum.org/agenda/2022/09/roadmap-to-end-plastic-pollution-by-2040/
[220] Ibid.
[221] https://www.medicalnewstoday.com/articles/human-health-intricately-linked-to-ocean-health-says-report
[222] Ibid.
[223] https://besjournals.onlinelibrary.wiley.com/doi/full/10.1002/pan3.10038
[224] https://www.weforum.org/agenda/2022/09/roadmap-to-end-plastic-pollution-by-2040/
[225] https://www.medicalnewstoday.com/articles/human-health-intricately-linked-to-ocean-health-says-report

Key takeaways:

- Progress in curbing plastic waste is accelerating, with governments, consumers and industry increasingly embracing circular practices that will help stem the flow of plastic waste entering the ocean.
- But major investments and rapid progress in scaling solutions are needed throughout the plastics supply chain.
- The UN Environment Assembly's decision in 2022 to begin negotiations for a treaty on plastic pollution is a major step to push these along.
- Awareness of other forms of chemical pollutants is lagging behind. Comprehensive international regulations to tackle these are urgently needed.
- Source-to-sea management is a key part of preventing marine pollution which is gaining traction slowly.

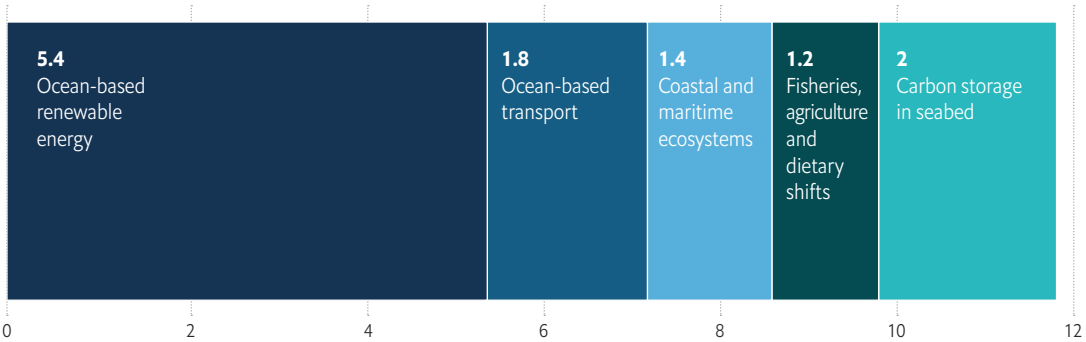
Chapter IV. Sustainable ocean economy

A new wave of investment in a sustainable blue economy is emerging. Establishing a sustainable blue economy will ensure the future viability of the ocean and the blue economy's fisheries, aquaculture and tourism sectors and coastal communities.

A healthy and sustainable blue ocean economy will also have a major impact on climate mitigation. The High Level Panel for a Sustainable Ocean Economy estimates that ocean-based solutions could contribute 20% of all greenhouse-gas (GHG) emission reductions required.

Maritime Spatial Planning (MSP)—a policy framework for mediating between human activities and managing their impact on the marine environment—is a key pillar of the sustainable blue economy. As more sectors engage with the ocean and compete for space, it ensures coherence and exposes synergies and trade-offs among ocean uses, embedding strategic foresight into decisions about the use of the ocean.[226]

Figure 9: Maximum annual emissions reductions of five ocean-based climate action areas by 2050
(Maximum GtCO2e)



Source: High Level Panel for a Sustainable Ocean Economy
Note: Maximum annual emissions reductions to stay under a 1.5°C change relative to pre-industrial levels

[226] https://op.europa.eu/en/publication-detail/-/publication/156eecbd-d7eb-11ec-a95f-01aa75ed71a1

International shipping is one of the world's most polluting industries, making up about 2% of global energy-related CO2 emissions.

Shipping

The shipping sector is facing many changes and challenges. The covid-19 pandemic exposed labour shortages and infrastructure needs, and highlighted the need for supply chains to become more resilient, responsive and agile. This has led to calls to reduce heavy reliance on distant suppliers, with some predicting an acceleration in reshoring and nearshoring, resulting in deep reconfiguration of supply chains.[227]

Weakening economic growth has caused freight rates in container shipping to drop.[228] The medium-term outlook for maritime trade is subject to mounting risks and uncertainties. In 2022 the UN Conference on Trade and Development (UNCTAD) predicted that annual growth in maritime trade between 2023 and 2027 will drop to 2.1%, compared with a 3.3% average over the past three decades.[229]

Another major shift in the industry is a push to decarbonise. International shipping is one of the world's most polluting industries, and it comprises about 2% of global energy-related CO2 emissions.[230] If its governing body—the International Maritime Organisation (IMO)—decides in 2023 to set a net-zero target for 2050, this will likely accelerate a mass shift to more sustainable energy sources (see chapter I).

Energy

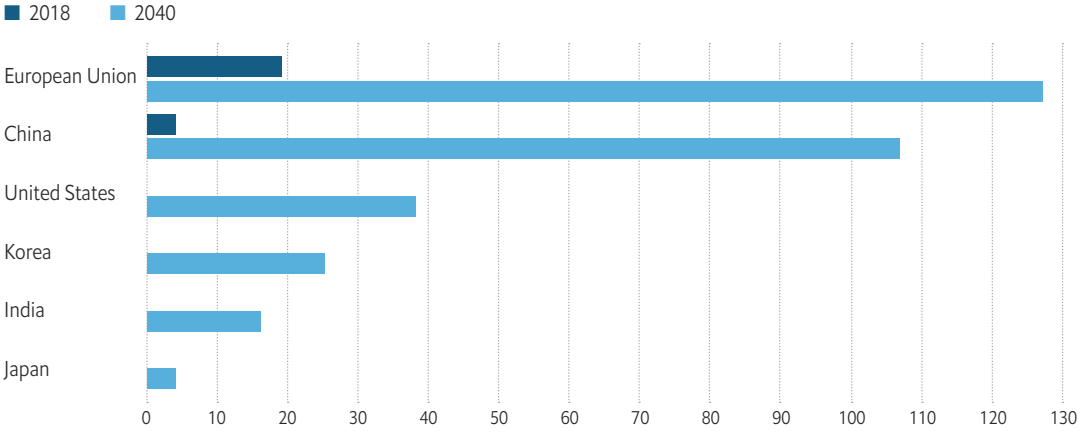
Power generated at sea has enormous potential to help decarbonise the world's energy systems, but the sector needs to scale fast. The technologies that generate energy at sea—such as offshore wind and solar farms, and wave and tidal energy—are at different stages of maturity.

Offshore wind is the most advanced and is set to expand rapidly in some parts of the world. If fully exploited, the world's best close-to-shore wind sites could provide almost 36,000 terawatt hours of electricity per year—close to the global electricity demand projected for 2040.[231] Government policies will continue to be critical in determining its future trajectory.[232]

A Global Offshore Wind Alliance (GOWA) of governments, private-sector and other stakeholders was launched in November 2022 to help accelerate global offshore wind capacity to at least 380 gigawatts (GW) by 2030.

[227] https://unctad.org/system/files/official-document/rmt2021_en_0.pdf
[228] https://www.reuters.com/business/autos-transportation/shipping-firm-maersk-picks-vincent-clerc-new-ceo-2022-12-12/
[229] https://unctad.org/rmt2022
[230] https://www.iea.org/reports/international-shipping
[231] https://www.iea.org/fuels-and-technologies/wind
[232] Ibid.

Figure 10: Installed offshore wind capacity in 2018 and 2040
Gigawatt, Stated Policies Scenario



Source: International Energy Agency

In May 2022, the International Energy Agency (IEA) forecast that offshore wind capacity additions will double in 2022 compared with 2020, mainly because of growth in China and the EU. (This is lower than in 2021, when new installations increased almost six-fold compared with 2020.[233]) The IEA expects China to overtake the EU and UK as a global leader in offshore capacity by the end of 2022.[234]

Offshore capacity could reach almost 120GW by 2026, with large-scale projects to be commissioned in France, Taiwan, South Korea, Vietnam, Japan and the US.[235]

Renewables, including wind, are the default option for capacity additions in the power sector in almost all countries, and they dominate current investments.[236] And the current global energy crisis means governments are accelerating clean-energy transitions. The new focus on energy security, especially in the EU, is "triggering an unprecedented policy momentum" towards accelerating renewables, according to the IEA. Wind is one of the renewables with the potential to reduce the EU's dependence on Russia's natural gas in 2023, the IEA says.[237]

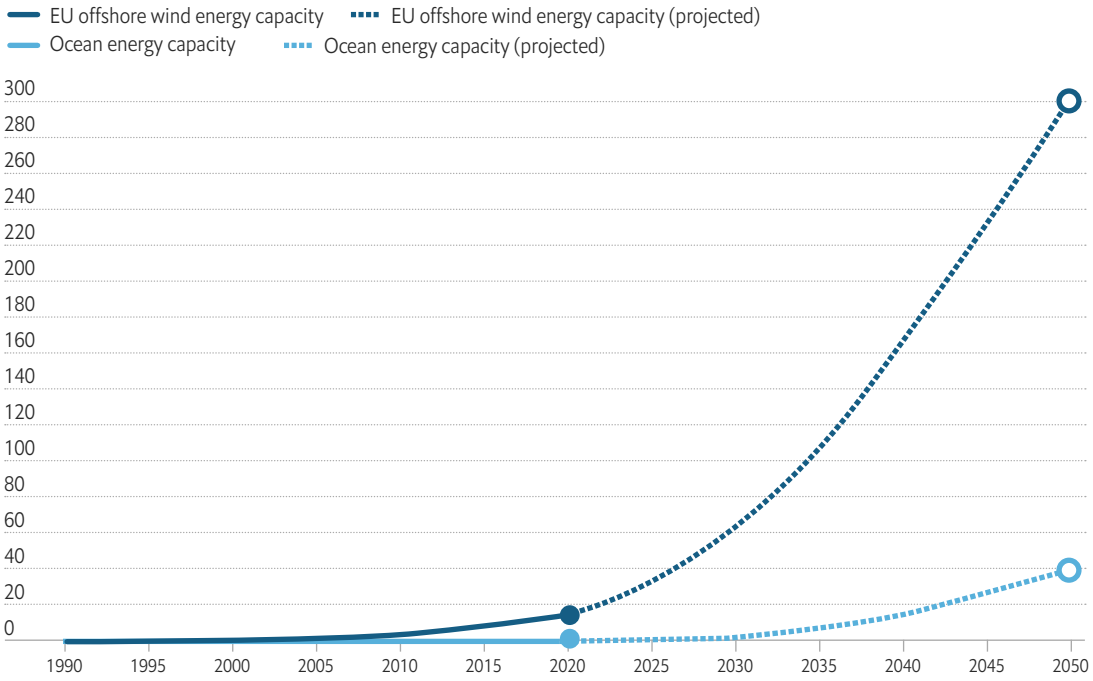
Tidal-stream energy and wave energy are at an early stage of development compared with offshore wind, but they could have an important role to play in offering predictability for energy portfolios. These ocean energy sources also have the potential to boost industries and remote coastal economies through job creation.

The annual energy potential of waves off the coasts of the US is estimated to be the equivalent of about 64% of US electricity generation in 2021.[238]

The west coasts of the US and Europe, and the coasts of Japan and New Zealand, have potential sites for harnessing wave energy.[239] Australia, China and Korea are also looking at wave energy.[240]

[233] https://www.iea.org/reports/renewable-energy-market-update-may-2022/renewable-electricity
[234] Ibid.
[235] https://www.iea.org/reports/renewables-2021/renewable-electricity?mode=market&region=World&publication=2021&product=Total
[236] https://www.irena.org/publications/2022/Mar/World-Energy-Transitions-Outlook-2022
[237] https://www.iea.org/reports/renewable-energy-market-update-may-2022
[238] https://www.eia.gov/energyexplained/hydropower/wave-power.php
[239] Ibid.
[240] https://www.weforum.org/agenda/2022/03/wave-energy-ocean-electricity-renewables/

Figure 11: European Union offshore wind and ocean energy (tidal and wave) capacity
(Gigawatts, 1991-2050)



Source: European Commission

The market for wave and tidal energy needs a co-ordinated, coherent effort to get to scale and get the cost trajectory down. That requires policies and regulatory frameworks informed by market interest, and a large volume of projects to boost competition in the supply chain, which will lower the costs.[241]

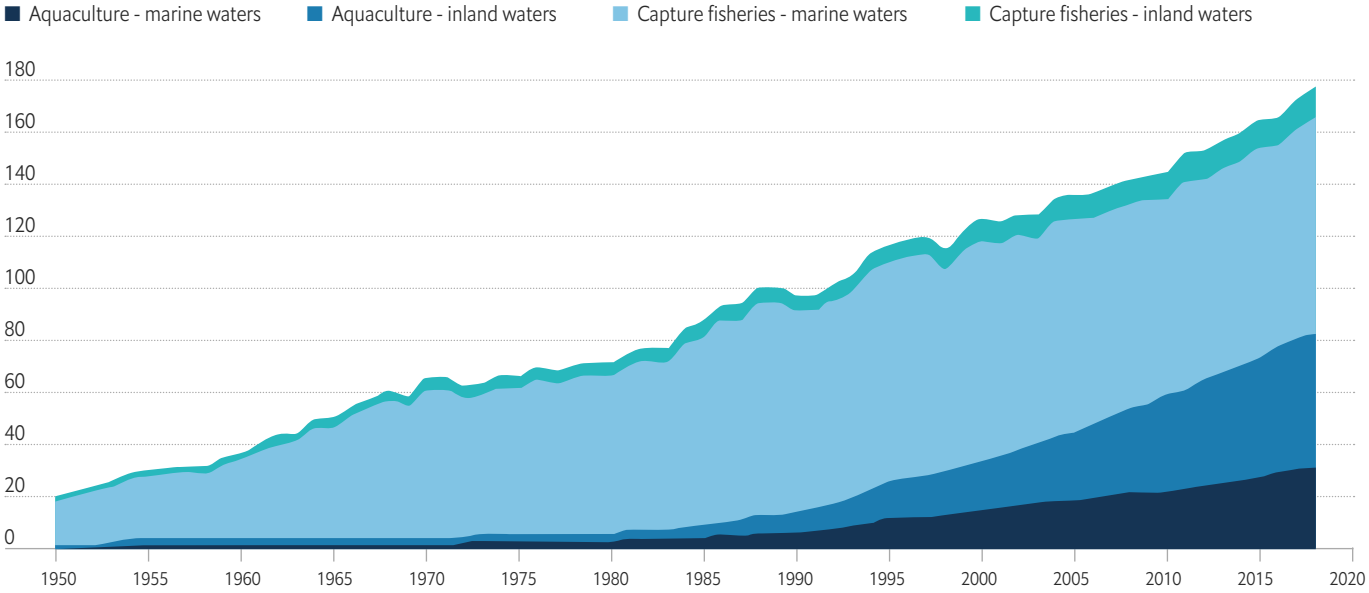
Innovative, large-scale deployments which use integrated design and systems thinking are hitting the water. These include ways to combine energy production with coastal protection, and ways to use the same space to produce solar and wind energy.[242]

Global demand for green hydrogen will also boost offshore wind investment. Assurance and risk management experts DNV predict that by 2050, some 46% of hydrogen will be produced by off-grid capacities led by offshore wind.[243]

In 2022 French developer Lhyfe inaugurated the world's first offshore hydrogen production facility. The platform is powered by an offshore wind turbine.[244] And hydrogen-producing offshore wind turbines are being developed, which include incorporating electrolysers in existing turbines.[245] Because ocean-energy sites are closed to fishing and to sea traffic, evidence shows that they can have a "marine-reserve effect", as some species shelter under and around the structures, hiding from predators, and feeding and reproducing undisturbed.[246]

[241] https://impact.economist.com/ocean/ocean-and-climate/energy-at-sea-the-future-of-blue-power
[242] https://impact.economist.com/ocean/sustainable-ocean-economy/tapping-the-oceans-large-renewable-energy-sources
[243] https://www.dnv.com/energy-transition-outlook/download.html?utm_source=Google&utm_medium=Search&utm_campaign=eto22&gclid=EAIaIQobChMIpMKK-tyF_AIVV5nVCh36lwClEAAYASAAEgLIVvD_BwE
[244] https://www.offshorewind.biz/2022/09/22/worlds-first-offshore-green-hydrogen-production-platform-launched-in-france/
[245] https://www.offshorewind.biz/2022/10/11/hydrogen-producing-offshore-wind-turbine-project-progressing-towards-permit-application/
[246] https://impact.economist.com/ocean/ocean-and-climate/ocean-energy-an-important-ally-in-the-fight-against-climate-change

Figure 12: World capture fisheries and aquaculture production
(million tonnes, 1950-2018)



Source: Food and Agriculture Organisation
Note: Excludes aquatic mammals, crocodiles, alligators and caimans, seaweeds and other aquatic plants

The foundations of ocean-energy devices offer an ideal home for many fish, crayfish and molluscs, just as sunken shipwrecks and offshore wind turbines help to boost biodiversity in their vicinity.[247] Research is being carried out into the feasibility of using offshore wind-farm infrastructure in the North Sea to create shellfish beds. The idea is also being looked at by regulators, industry and conservation organisations in Australia and the US, says Boze Hancock, senior marine habitat restoration scientist at The Nature Conservancy (TNC).

As ocean energy grows in scale, making sure these innovative technologies respect their habitat should be a top priority for project developers, adds Mr Hancock.

Fisheries and aquaculture

Global demand for aquatic foods will rise from 20.5kg per capita in 2019 to 21.4kg per capita in 2030, says the UN Food and Agriculture Organisation (FAO). This growing demand will be driven by rising incomes, urbanisation, improvements in post-harvest practices and changes in dietary trends.[248]

However, the Ukraine conflict could have major impacts on the fisheries and aquaculture sector by continuing to pose risks to trade relations among the US, Europe, China, Russia and the rest of the world.[249] Soaring prices of energy and inputs, including feed for aquaculture, have pushed up the prices of fisheries and aquaculture products, says FAO.[250]

[247] Ibid.
[248] https://www.fao.org/3/cc0463en/cc0463en.pdf
[249] https://www.fao.org/3/cc0461en/online/sofia/2022/fisheries-and-aquaculture-projections.html
[250] Ibid.

Total fisheries and aquaculture production reached a record 214m tonnes in 2020, largely due to the growth of aquaculture in Asia. About 58.5m people were employed in the primary sector, and about 600m livelihoods depend at least partially on fisheries and aquaculture. The international trade of fisheries and aquaculture products generated US$151bn in 2020.[251]

Improved fisheries management, investment in sustainable aquaculture and protection of key habitats could help restore the productivity of the ocean and generate benefits worth billions of dollars in developing countries, while ensuring future growth, food security and jobs for coastal communities.

Fisheries

About 35% of fish stocks are not sustainably fished, putting the future of many fisheries at risk.[252] However, fish stocks in countries and regions with strong fisheries-protection policies are recovering and will continue to do so. FAO predicts world capture fisheries will increase 6% in total from 2020,[253] to reach 96m tonnes in 2030.[254] FAO says this increase will be the result of improved resource management, underfished resources, and reduced discards, waste and losses.[255]

In the meantime, governments, supply chains, retailers and customers will need to find ways to share the costs of helping fish stocks recover.

Countries (especially China and European countries) have been reducing their fleet sizes. The total number of fishing vessels in 2020 was 4.1m, a 10% drop since 2015. Asia had about two-thirds of the global fishing fleet.[256]

More than 15m people work full-time on board fishing vessels.[257] Human-rights abuses on board ships, including forced labour, are hard to monitor, especially as ships can stay far out at sea for months, even years. Satellite tracking tools and other technologies are being used to try and monitor labour abuses as well as illegal fishing.[258]

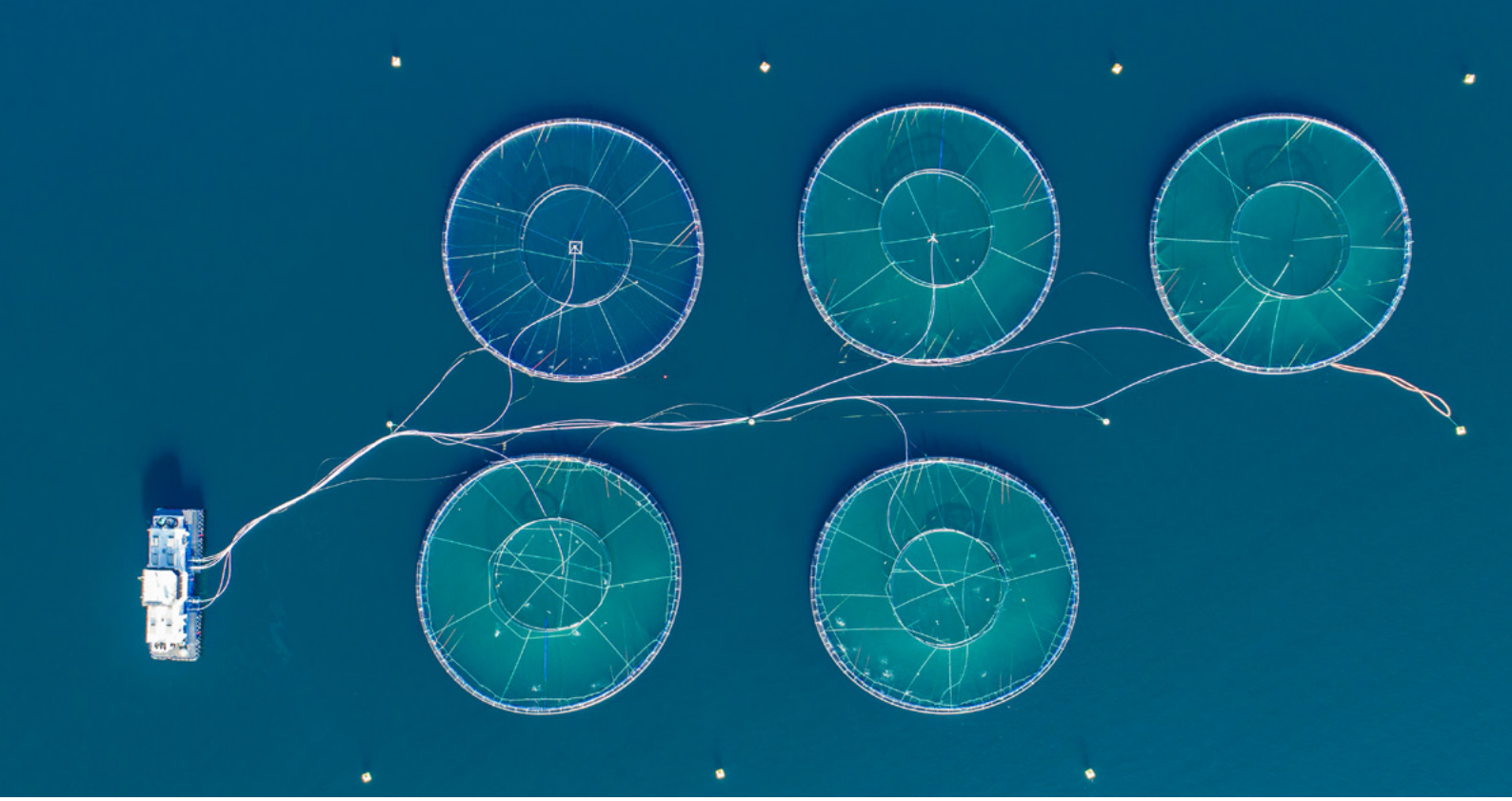
Global warming is likely to force some fish populations to migrate to cooler waters. As a result, low-income communities in the tropical south—including Brazil, India and Thailand—may suffer losses, and northern countries like Greenland, Norway and Canada could experience about a 30-70% increase in their fish landing.[259] Fisheries that include climate impacts in their management can reduce the impacts of carbon pollution and increase the value of marine resources.[260]

Aquaculture

Aquaculture has great potential to feed the world's growing population. Global aquaculture production reached a record US$281.5bn in 2020, driven by expansion in Chile, China and Norway. Asia produced 91.6% of the total.[261]

But the rapidly expanding sector has often grown at the expense of the environment, according to FAO.[262] Over the next decade aquaculture must expand sustainably to

[251] https://www.fao.org/3/cc0463en/cc0463en.pdf
[252] https://www.wto.org/english/thewto_e/minist_e/mc12_e/briefing_notes_e/bffish_e.htm
[253] https://www.fao.org/documents/card/en/c/cc0461en
[254] https://www.fao.org/3/cc0463en/cc0463en.pdf
[255] Ibid.
[256] Ibid.
[257] https://www.ilo.org/global/industries-and-sectors/shipping-ports-fisheries-inland-waterways/fisheries/lang--en/index.htm
[258] https://www.ilo.org/wcmsp5/groups/public/---ed_norm/---ipec/documents/publication/wcms_856925.pdf
[259] https://assets.ey.com/content/dam/ey-sites/ey-com/en_no/noindex/ey-report-the-norwegian-aquaculture-analysis-2021.pdf
[260] https://nca2018.globalchange.gov/chapter/9/
[261] https://www.fao.org/3/cc0463en/cc0463en.pdf
[262] Ibid.



satisfy the gap in global demand for aquatic foods, especially in food-deficit regions, while generating new or securing existing sources of income and employment. This requires updating aquaculture governance by fostering improved planning, legal and institutional frameworks and policies, according to FAO.[263]

Aquaculture faces challenges from climate change, especially in South-East Asia. Warming waters could increase pathogens and harmful algal and jellyfish blooms, and reduce the number of production sites. Water acidification damages many marine species, and has already resulted in significant losses in the oyster industry in the Pacific Northwest.[264]

Consumers, regulators and financial lenders are likely to increase pressure on aquaculture (and wild fisheries) to be more sustainable and transparent. The sector may also face requirements for curbing pollution, life-cycle climate impacts—including feed and transport—and impacts on local biodiversity, and improving animal welfare.[265]

One way to reduce both the threat to wild fish stocks and environmental pollution is to use onshore fully closed recirculating aquaculture systems. These keep farmed fish entirely separate from wild ecosystems, and could be installed in regions with limited access to fresh fish. They rely on precision management. Innovators are developing artificial intelligence (AI) and software to improve their efficiency, including in energy and water use.[266]

Advanced satellite technologies and analytics could also enable aquaculture farms to expand and run more efficiently in remote locations with minimal on-site supervision.

At the same time, small-scale producers in developing countries—who produce the bulk of aquaculture—will need transfer of more basic technology from Western companies to avoid overusing chemicals, especially as warming waters will increase disease outbreaks.

Innovation in developing new feeds continues, which could replace soya and wild fish with more sustainable options like insect feed.

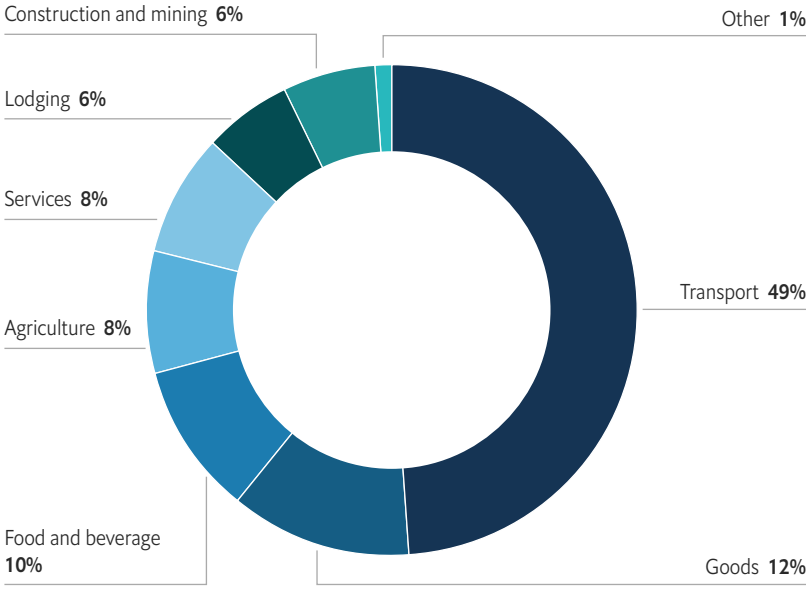
Seaweed is a young but growing sector of aquaculture, with companies developing its uses in fertilisers, animal feed and food for people.[267]

[263] https://www.fao.org/3/cc0461en/online/sofia/2022/transforming-aquatic-based-food.html
[264] https://assets.ey.com/content/dam/ey-sites/ey-com/en_no/noindex/ey-report-the-norwegian-aquaculture-analysis-2021.pdf
[265] Ibid.
[266] https://www.cleantech.com/aquaculture-innovation-trends-and-challenges/
[267] Ibid.

Tourism

Tourism is one of the world's fastest-growing sectors, accounting for 10% of global gross domestic product (GDP) and 10% of jobs.[268] Some 80% of tourism takes place in coastal areas.[269] Coastal and marine tourism supports more than 6.5m jobs—second only to industrial fishing among ocean-based industries. With anticipated global growth rates of more than 3.5%, coastal and marine tourism is projected to be the largest value-adding segment of the ocean economy by 2030, at 26%, the World Bank said in 2017.[270]

Figure 13: Carbon footprint of global tourism by activity
(%, 2018)



Source: Nature Climate Change

However this growth needs to be sustainable. Holidays account for about 8% of global GHG emissions.[271] Under a business-as-usual scenario, by 2050 tourism's energy consumption will increase by 154%, water consumption by 152%, solid-waste disposal by 251%, and GHG emissions by 131%, according to the UN Environment Programme.[272] This is a path the world cannot afford to take.

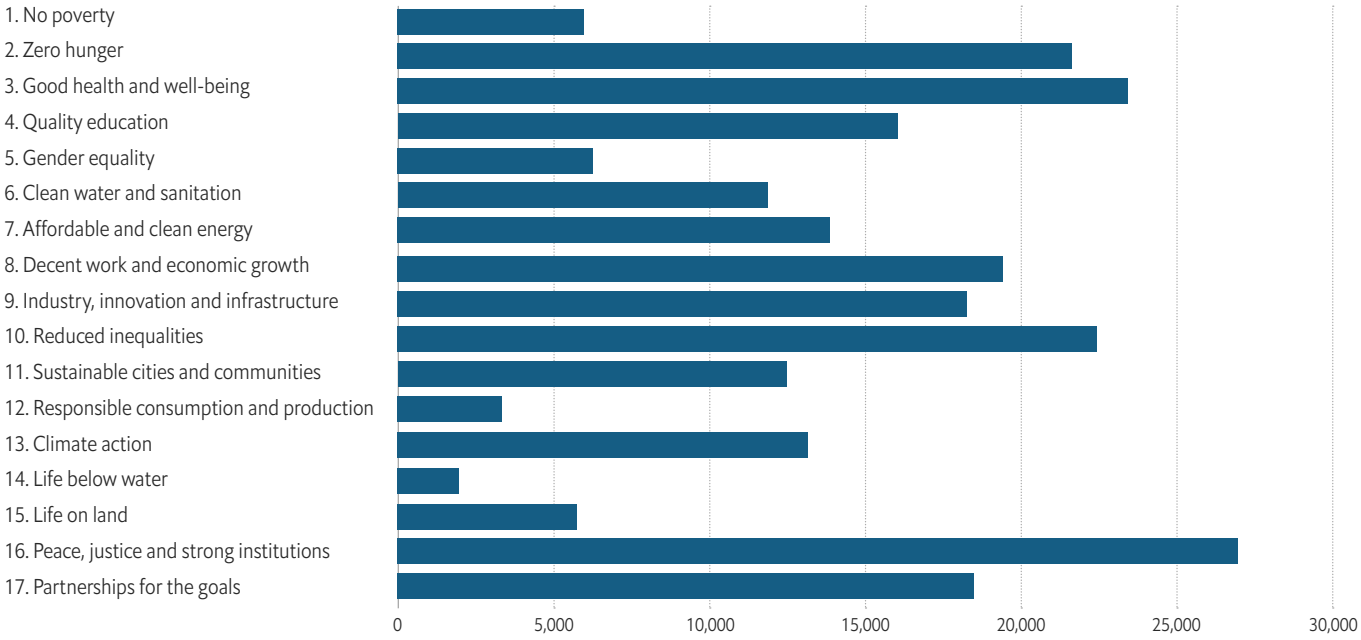
There is growing action in parts of the tourism industry to help sustain the natural environments that attract tourists, but this needs to increase. Several non-legally binding initiatives support the mainstreaming of sustainable tourism, such as the One Planet Sustainable Tourism Programme under the UN World Tourism Organisation (UNWTO); the Global Tourism Plastics Initiative; the Glasgow Declaration on Climate Action in Tourism made at COP26; the High Level Panel for a Sustainable Ocean Economy (the Ocean Panel); and the Tourism Action Coalition.

Blue finance

Prior to the covid-19 pandemic, the value-added generated by ocean-based industries was expected to reach US$3trn in 2030, double that of 2010, according to the Organisation for Economic Co-operation and Development (OECD).[273] The financial sector is waking up to the opportunities that a healthy ocean can provide. It has a critical role to play in pivoting the global economic system towards rebuilding ocean prosperity, restoring biodiversity and regenerating ocean health.[274]

[268] https://www.unep.org/explore-topics/resource-efficiency/what-we-do/responsible-industry/tourism#:~:text=In%20a%20'business%2Das%2D,in%20the%2021st%20century
[269] https://www.wri.org/events/2021/5/building-sustainable-coastal-and-marine-tourism-economy
[270] https://blogs.worldbank.org/voices/Sustainable-Tourism-Can-Drive-the-Blue-Economy
[271] https://sustainabletravel.org/issues/carbon-footprint-tourism/
[272] https://www.unep.org/explore-topics/resource-efficiency/what-we-do/responsible-industry/tourism#:~:text=In%20a%20'business%2Das%2D,in%20the%2021st%20century.
[273] https://www.oecd.org/ocean/OECD-work-in-support-of-a-sustainable-ocean.pdf
[274] https://blogs.worldbank.org/climatechange/blue-finance-how-can-innovative-wave-finance-blue-economy

Figure 14: ODA financial flows for the SDGs
From the top 25 donors (2019, US$m)



Source: OECD

Sustainable Development Goal (SDG) 14 is the least funded out of all 17 SDGs. About US$174.52bn per year is needed to implement SDG14 until 2030 for the health of our ocean, according to one estimate.[275] Encouragingly, investment in a sustainable blue economy is growing. "Everybody seems to want a slice of ocean action these days … People are starting to realise that, if we don't stop the decline in the ocean's health, we're in trouble. It's time to double down on our moves to conserve and sustainably use the ocean's resources," says Peter Thomson, the UN Secretary-General's Special Envoy for the Ocean.

Products are proliferating, a sign that asset managers are seeing demand from their clients, and investors will engage more as funds get bigger and longer track records are established, writes Ted Janulis, founder and principal of Investable Oceans.[276] The growing acknowledgement of significant links between the ocean and broader climate challenges will also help bring existing climate investors to the table, says Mr Janulis.[277]

Some exciting financial products and projects include TNC and Swiss Re's "Coral Reef Insurance" supporting the restoration of parts of the Mesoamerican Reef, says Dennis Fritsch head of the UN's Sustainable Blue Economy Finance Initiative, part of the UN Environment Programme Finance Initiative (UNEP-FI).[278]

UNEP-FI has published a guide on ocean pollution and coastal resilience[279] to help financial institutions break the pollution cycle and take sustainable decisions when financing coastal infrastructure projects.

[275] https://www.sciencedirect.com/science/article/abs/pii/S0308597X19305111
[276] https://www.weforum.org/agenda/2022/09/sustainable-ocean-investing-goes-mainstream/
[277] Ibid.
[278] https://impact.economist.com/ocean/sustainable-ocean-economy/is-private-finance-ready-for-an-ocean-super-year
[279] https://www.unepfi.org/publications/diving-deep/

Blue bonds and blue loans, which are innovative instruments that earmark funds exclusively for ocean-friendly projects and protecting critical clean water resources, are seeing a surge in interest.

They include the Asian Development Bank's (ADB) Blue Bond, a mangrove bond, and the expansion of the Blue Bonds for Conservation Programme to include Belize.

Blue bonds are key to growing the ocean economy—which has the potential to grow from US$1.5trn in 2010 to US$3trn in 2030.[280] But demand is outstripping supply. One roadblock to the market is the lack of a globally standardised way to issue a blue bond, says Mr Fritsch of UNEP-FI.[281]

A practitioner's guide for bonds to try and address this roadblock will be published in 2023 by UNEP-FI, the International Capital Markets Association (ICMA), the International Finance Corporation (IFC), the ADB and United Nations Global Compact.[282]

The blue-carbon market is growing, but its huge potential is not yet fully tapped. (See *Climate Change*.)

Blue innovation and technology

A vast field of blue technologies exists which could help develop marine resources in a sustainable way. Many of these were explored at Economist Impact's World Ocean Tech and Innovation Summit in October 2022.[283]

They include technologies for fisheries, such as developments in underwater image recognition, autonomous underwater vehicles, analytics, and light and laser technology which improve our abilities to navigate the seas. AI and satellites are helping to track fishing patterns and improve predictive fishing, and new track and trace technologies are coming onstream to help curb overfishing. Global Fishing Watch tracks and makes freely available data on fishing activity in near real-time. These technologies can help combat Illegal, unreported and unregulated (IUU) fishing, especially when combined with greater understanding of fish behaviour, good fisheries management and an improved ability to collect, analyse and curate vast amounts of data.

Applications for new technologies are also accelerating to help monitor the ocean's health. For example, the Ocean Observatories Initiative uses sensor systems to record the ocean's physical, chemical, geological and biological properties. Satellites collect 250m square kilometres of imagery a day across the planet.[284]

New ship technologies could help the shipping sector decarbonise. These include intelligent optimisation systems, autonomous ships and energy-efficient vessels.

Technologies are being developed and piloted for ocean-energy projects, including offshore wind turbines that incorporate hydrogen production, and developments in wave and tidal energy technologies.

Some marine conservationists are concerned about the likely negative impacts of carbon dioxide removal (CDR) technologies being researched for the ocean, says Dorothée Herr, senior associate at NatureFinance and former manager of Ocean and Climate Change at the International Union for Conservation of Nature

[280] https://impact.economist.com/ocean/sustainable-ocean-economy/a-breakthrough-for-blue-bonds-at-the-un-ocean-conference
[281] Ibid.
[282] https://www.unepfi.org/themes/ecosystems/unep-fi-joins-international-coalition-to-develop-guidance-on-blue-bonds/
[283] https://events.economist.com/world-ocean-tech/
[284] https://impact.economist.com/ocean/sustainable-ocean-economy/how-to-shift-the-ocean-narrative-for-a-sustainable-blue-economy

(IUCN). These include ways to reduce the water's acidity by adding powdered lime to the ocean, or by reacting seawater with alkaline minerals in desalination plants before releasing the alkaline solution back into the ocean.[285]

Other innovations and technologies include coral which are genetically modified to resist climate impacts and which are being used to restore damaged coral reefs.

Other new technologies include precision and satellite technologies for aquaculture, and digital twin technologies for monitoring parts of the ocean.

Deep dive: generating gender equality and social equity

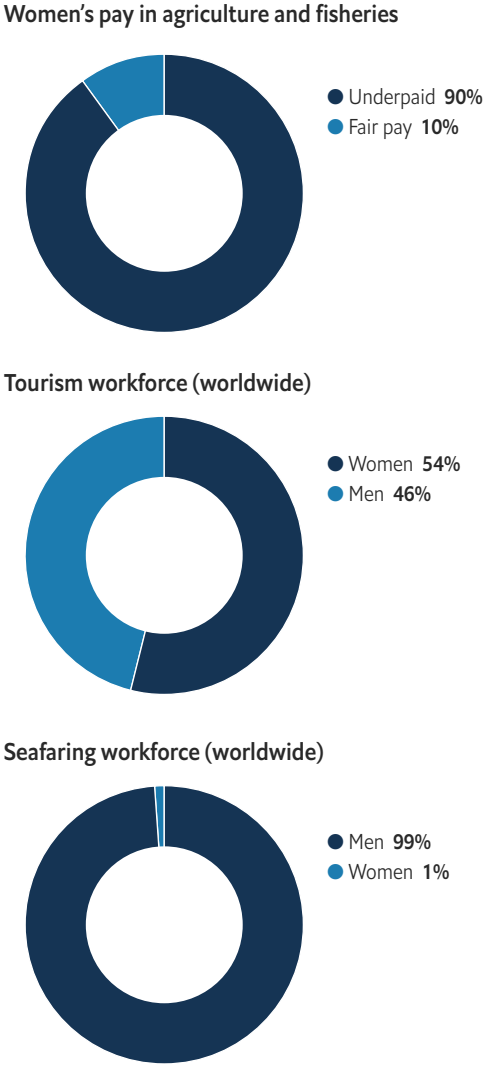
Redistributing blue benefits

Unlocking the true potential of the ocean requires understanding disenfranchised communities. Historically, gainful ocean interactions have involved non-Indigenous communities, and primarily men. According to research, this skew extends to ethnicities, classes, ages and abilities.[286]

Women comprise 50% of the total ocean labour force but face systemic inequalities. They receive lower wages than male counterparts for the same work and are often segregated into low-skilled roles. Absent from decision-making positions in the industry, women are largely unable to benefit equally from the opportunities that the maritime sector provides.[287]

With respect to ocean conservation, studies have found that frequently used management models fail to accurately consider local needs and requirements. This oversight is said to result in mass displacement, violence, disempowerment, human-rights abuses, widening of economic inequities and increased poverty. A lack of local and native participation in marine-protection planning and practices has been noted to be a fundamental obstacle in generating social equity.[288]

Figure 15: Women and the ocean



Source: UNCTAD, IMO, Harper et al. 2013, UNWTO

[285] https://www.oceannets.eu/contents/uploads/2022/10/CDRmareOceanNETs_policybrief_final.pdf
[286] https://www.frontiersin.org/articles/10.3389/fmars.2021.711538/full
[287] https://www.un.org/en/desa/promoting-gender-equality-%E2%80%98crucial-contribution%E2%80%99-effort-restore-protect-our
[288] https://www.frontiersin.org/articles/10.3389/fmars.2021.711538/full

In support of fairness in ocean management, the UN General Assembly has identified 2021-30 as the Ocean Science Decade for Sustainable Development. The framework is designed to encourage equal representation of men and women in ocean science and policy to mobilise a just distribution of value from the global blue economy. To ensure that the framework is on track to meet these goals, it will undergo its first formal review of progress and emerging scientific issues in 2023, before updating the Decade Action Framework.[289] By reinventing ocean governance patterns, the ocean economy will be better poised to deliver more favourable human development outcomes.[290]

However, decision-making within marine conservation requires significant overhaul. Frameworks of ocean planning necessitate recognition of diverse perspectives, inclusive governance procedures, fair distribution of benefits, local communities within management, and an appreciation of the indigenous environment.[291]

According to the World Resources Institute, the following measures can advance ocean equity:[292]

1. Intergovernmental negotiations should consider the perspectives of marginalised communities in developing ocean solutions.
2. More research on drivers of ocean inequity can inform inclusive ocean-policy agendas.
3. A global treaty should be established to enforce capacity-building and equitable sharing of benefits of marine genetic resources.
4. Key stakeholders, especially marginalised peoples, should be involved in the development and implementation of integrated ocean planning.
5. Rights-based policies should be developed in the ocean economy.

Deep dive: ocean literacy and building blue skills

Legacy through literacy

The demand for an ocean-literate society stems from an immediate need for individuals to understand and appreciate the influence they have on the ocean and that the ocean has on them. The Ocean Literacy Principles describe this codependency through the following seven principles:[293]

1. The Earth has one big ocean with many features.
2. The ocean and life in the ocean shape the features of Earth.
3. The ocean is a major influence on weather and climate.
4. The ocean made the Earth habitable.
5. The ocean supports a great diversity of life and ecosystems.
6. The ocean and humans are inextricably interconnected.
7. The ocean is largely unexplored.

Founded upon these principles, the ocean-literacy movement has developed a framework to bring ocean sciences into school curricula in an effort to educate conscious citizens.

[289] https://www.oceandecade.org/wp-content/uploads/2021/09/337521-Ocean%20Decade%20Implementation%20Plan:%20Summary
[290] https://www.un.org/en/desa/promoting-gender-equality-%E2%80%98crucial-contribution%E2%80%99-effort-restore-protect-our
[291] https://www.frontiersin.org/articles/10.3389/fmars.2021.711538/full
[292] https://www.wri.org/insights/5-ways-build-equitable-ocean-economy
[293] https://www.frontiersin.org/articles/10.3389/fmars.2019.00646/full

The movement also informs maritime-policy and civil-society organisations. Examples of projects such as the ERASMUS+ Blueprint for a Sector Skills Alliance in the maritime technologies, MATES and the COLUMBUS project, are active programmes that work to build channels for knowledge transfer within and among maritime sectors to improve knowledge of ocean systems.

The impacts of ocean literacy are diverse and far-reaching, as activism influences politicians and responsible companies evolve business models. Media, including TV and movies, have helped increase understanding and appreciation for marine elements and provisions.

However, there are persistent obstacles barring comprehensive ocean education and knowledge in the marine research space. These include insufficient awareness, inaccessible data, technical jargon and stakeholders continuing to operate in silos. Strategies and projects to enhance ocean literacy are rarely implemented systematically. To navigate these difficulties, experts suggest that complementary approaches, such as the ones proposed by MATES, should be further explored.

As ocean literacy continues to bring different communities of marine stakeholders together, ideas, innovations and initiatives to engage and educate youth are present and future imperatives. For instance, in 2022 the UN Sciences Organisation launched a bold programme to employ forensic environmental DNA testing to map species across delicate ocean ecosystems. The programme enlists interested pupils in local schools, equipping them with the training to meaningfully participate and foster interest in marine conservation.[294] Furthermore, the Intergovernmental Oceanographic Commission (IOC) has identified students to be active agents of change, developing resources to enhance social and emotional learning objectives in alignment with ocean protection. As international communities apply new ways to skill teachers, revise curriculums and deliver accessible marine information, discussions on global platforms, such as the Ocean Decade Forum, will become increasingly impactful.[295]

[294] https://www.unesco.org/en/articles/cop15-schoolchildren-help-unesco-accelerate-tracking-ocean-species
[295] https://news.un.org/en/story/2022/06/1120652

Key takeaways:

- A new wave of investment in a sustainable blue economy is emerging.
- The shipping sector is facing many changes and challenges, and the medium-term outlook for maritime trade is subject to mounting risks and uncertainties. Its annual growth could slow in the next few years.
- The IMO is under pressure to set in 2023 a net-zero target for 2050. The sector needs a fair regulatory framework—as well as progress in green-fuel development and delivery—to accelerate decarbonisation.
- Offshore wind capacity could reach almost 120GW by 2026, with large-scale projects to be commissioned in France, Taiwan, South Korea, Vietnam, Japan and the US.
- The energy crisis means many governments are accelerating clean-energy transitions, including wind.
- Tidal-stream energy and wave energy are at an early stage of development. In order to scale they need policies and regulatory frameworks informed by market interest, and a large volume of projects.
- Innovative, large-scale deployments which use integrated design and systems-thinking are hitting the water.
- As ocean energy grows in scale, making sure these innovative technologies respect their habitat should be a top priority for project developers.
- Demand for aquatic foods is projected to rise by 2030, driven by rising incomes, urbanisation, improvements in post-harvest practices and changes in dietary trends.
- However, both aquaculture and fisheries face major challenges from climate change, geopolitical tensions and macroeconomic instability.
- Aquaculture must expand sustainably to satisfy the gap in global demand for aquatic foods.
- Consumers, regulators and financial lenders will continue to increase pressure on aquaculture and fisheries to be more sustainable and transparent.
- Coastal and marine tourism is set to be the largest value-adding segment of the ocean economy by 2030. But growth must be sustainable.
- The financial sector is critical in pivoting the global economic system towards rebuilding ocean prosperity, restoring biodiversity and regenerating ocean health. The sector is waking up to the opportunities and benefits of a sustainable blue economy.
- Women comprise 50% of the total ocean labour force, but face systemic inequalities.
- Ocean conservation projects frequently fail to accurately consider local needs and requirements.
- By combining information and encouraging innovation through skill development and uptake, the ocean-literacy movement is poised to generate economic opportunities while reinventing the maritime sector.

Conclusion

After decades of uphill work by scientists, negotiators and conservationists, the needs of the ocean—and people's dependence on it—are finally getting some of the attention they urgently require. SDG14 is one of the most underfunded of the 17 Sustainable Development Goals, yet now governments, finance sectors, private corporations and others increasingly want to support a transition to a sustainable blue economy.

Greater understanding of the environmental and financial benefits of a healthy ocean led to some important advances in 2022. These include a decision to negotiate an internationally binding treaty to end plastic pollution, progress in curbing harmful fishing subsidies, and an agreement to protect 30% of the Earth, including land and sea.

Negotiations will continue in 2023 on plastic pollution, fishing subsidies and a treaty to protect international waters. The International Maritime Organisation is set to make a decision about whether to set more ambitious targets to decarbonise shipping. And the International Seabed Authority will decide whether to allow deep-sea mining to begin.

New guidelines for blue bonds will be published in 2023 which could help boost investment in a sustainable blue economy. The results of research into returns on investment in marine conservation in Australia may be available in 2023, helping to make the case for scaling investment.

A lot of major pilots and research and development projects will continue in 2023, including in alternative fuels for shipping, wave and tidal energy, and in offshore hydrogen production.

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