ENVIRONMENT AT A GLANCE INDICATORS

Sustainable ocean economy

Context

Issues at stake

The ocean may be a new economic frontier (OECD, 2016) but foremost it is a shared global resource. Ocean-related industries in many countries have expanded with insufficient consideration for the environment, risking the natural resources and essential marine ecosystem services on which economies and the well-being of people depend.

The **health of marine ecosystems** is a key issue. Marine biodiversity sustains life in the ocean and life on land; marine biodiversity, composed of species, ecosystems and genetic diversity, provides critical ecosystem services like food and oxygen production and carbon sequestration. Biodiversity loss reduces the ability of marine ecosystems to provide these services and their capacity to recover from climatic or biogeochemical changes (Worm et al., 2006). The most important pressures on marine biodiversity are resource over-exploitation, pollution, habitat disturbance, climate change and invasive alien species (Halpern et al., 2017; OECD 2017a).

Closely linked is the **well-being of people and the resilience of coastal communities to risks**. Sea level rise, extreme weather events, over-extraction of marine resources, over-tourism, and air and water pollution from ocean industries and land-based sources can threaten the health, infrastructure and livelihoods of coastal populations.

It is also necessary to monitor progress in improving the **environmental and resource productivity** of the ocean economy; that is, are we becoming more efficient in using ocean resources? What are the key dependencies of our economies on ocean resource utilisation?

We need to better understand how households, industries and governments are responding to these challenges. For example, achieving environmental objectives cost-efficiently will require considerable innovation, a key driver of productivity gains and economic growth that may create new business opportunities and markets. Monitoring and highlighting **economic opportunities** like those created through innovation and investment directed at ocean sustainability can help motivate and accelerate the necessary changes.

How are policy-makers responding to these challenges? **Policy responses** take many different forms (in part because pressures on ocean ecosystems vary locally and regionally). For example, the designation of marine protected areas can help conserve and restore habitats and species and ensure that marine and coastal ecosystems continue to provide storm and erosion protection, carbon storage, fish, and recreation and tourism opportunities.

Taxes, subsidies and other policy instruments provide important market signals that can influence the behaviour of producers and consumers. They can help incorporate environmental costs and benefits into the decisions of households and businesses, by changing the price of a product or service. They can be a cost-effective way to achieve environmental goals, such as limiting air emissions from maritime shipping, reducing discharges of contaminated water from vessels, encouraging sustainable management of marine resources, and reducing noise from transport and energy installations that can harm marine ecosystems.

Some government measures may also be harmful for the marine environment and economically wasteful. For example, policies supporting offshore oil & gas extraction and the consumption of fossil fuels in marine transport; or policies encouraging unsustainable fishing undermine climate and biodiversity policy goals and increase the overall cost of the necessary transition, such as delineated in the Nationally Determined Contributions (NDCs).

Policy challenges

- Ensure the effective conservation and sustainable use of marine biodiversity, for example, by strengthening the degree of protection of species, habitats and ecosystems, sustainably managing fish stocks and resource extraction, eliminating illegal and unregulated fishing, and reforming environmentally harmful subsidies. See the Environment at a Glance: Biodiversity chapter for more information.
- Strengthen international and regional co-operation to protect the marine environment (e.g. pursue the ratification and implementation of international agreements on the prevention of marine pollution such as the 1996 Protocol to the London Dumping Convention as well as the Anti-fouling Systems and Ballast Water Conventions) and improve capacity to respond to incidents involving pollution by oil and hazardous and noxious substances.
- Accelerate ocean economy decarbonisation: Implement national and international low-carbon strategies and further decouple greenhouse gas (GHG) emissions from economic growth, increase the share of renewable sources in the energy supply (in which marine renewable energy plays a role), reduce energy intensity by adopting energy-efficient technologies in manufacturing, transportation and consumer appliances, and phase-out support for fossil fuels. See the Environment at a Glance: Climate chapter for more information.
- Adapt coastal communities to the risks from rising sea levels, extreme weather events and other natural hazards (and technological accidents triggered by natural hazards). As appropriate for local contexts, countries should engage with those directly at risk, adopt long-term plans for coastal areas which take future changes into account, implement maritime spatial planning in coherence with coastal zone management, and protect existing coastal ecosystems that can serve as natural buffers.
- Ensure material resources and waste are well managed, for example, by enacting pro-circular economy policies, improving resource efficiency (e.g. efforts to reduce single-use plastics or to promote environmentally sound ship breaking and recycling), and integrating policies on water, materials, product and chemicals management to address the issue of microplastics, marine plastic litter and other pollutants of concern (e.g. nitrogen). See the Environment at a Glance: Waste chapter for more information.
- Encourage innovation and mobilise private finance at the scale needed to support these challenges, notably through public (co-)financing that avoids crowding out private efforts and suitably designed policy instruments that provide stringent, flexible and predictable signals to innovators and investors (e.g. OECD, 2011). Removing barriers to market entry and exit is also key.

Ocean-relevant policies cover a wide range of economic sectors and environmental domains. In order for them to be effective, it is essential that they are aligned with other environmental and climate policy priorities and coherent with economic and sectoral policies (e.g. through the use of market-based instruments, such as carbon pricing, and implementing environmental fiscal reforms). It is also important to systematically review the opportunities and threats to marine ecosystems posed by policy measures in other sectors (e.g. fisheries, agriculture, transport, tourism) and to integrate the sustainable use of resources and conservation of ecosystem services into tools such as strategic environmental assessments.

Sustainable ocean economy

Measuring progress and performance

Reliable, timely and internationally harmonised data on the state of marine ecosystems and pressures thereon, and the benefits generated for human well-being, are required to support policy-making directed at a sustainable ocean economy. Monitoring the various policy instruments and government measures in place is likewise necessary for policy assessment and to support policy reform.

Progress towards a sustainable ocean economy can be assessed against domestic and international goals and commitments where these exist. All indicators presented here are relevant to Sustainable Development Goal 14:

Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

This page includes selected sustainable-ocean-related indicators published by the OECD and partner organisations; however, environmental and economic ocean data are immature compared to the terrestrial domain, and considerable data collection and integration challenges remain in order to comprehensively monitor progress towards a sustainable ocean economy. In particular, there is a need to fill data gaps related to measuring and monitoring the status of marine ecosystem services and to strengthen their valuation to identify priorities and address potential trade-offs.

Indicator groups

This work draws inspiration from the OECD *Green Growth indicators* framework (OECD, 2017b), which was developed to improve our understanding of issues at the interface of the environment and the economy in an integrated manner. The following main indicator groups are presented:

- Natural capital of the ocean
- The environmental dimension of well-being and resilience
- Environmental and resource productivity
- Economic opportunities from pursuing ocean sustainability
- Policy responses directed at ocean sustainabilitySocio-economic context

Natural capital of the ocean

Key messages

- Marine biodiversity is in a perilous state. Many ecosystems (particularly coral ecosystems) and species are threatened and populations are declining. Practically all indicators give cause for alarm.
- Coastal ecosystems are under increased pressure from urbanisation with OECD coastal areas at least twice as developed than inland areas.
- Continued degradation of ocean natural capital poses a threat to global ecosystem stability and already has perceptible repercussions on human well-being and prospects for sustainable development.
- Regularly assessing the status of individual fish stocks is essential to sustainable fisheries management. Latest available figures show that 18% of assessed fish stocks reported to the OECD Review of Fisheries 2022 fall below sustainability standards and in these cases countries should build these stocks back for example by encouraging fisheries manager review their current management action. Increasing the number and frequency of stock assessments is important for maintaining the natural capital of the ocean.

Main trends and recent developments

Many **marine fish species are threatened** in countries covered by OECD data, and other state and trend indicators of global marine biodiversity show cause for concern and are often dire. For example, the

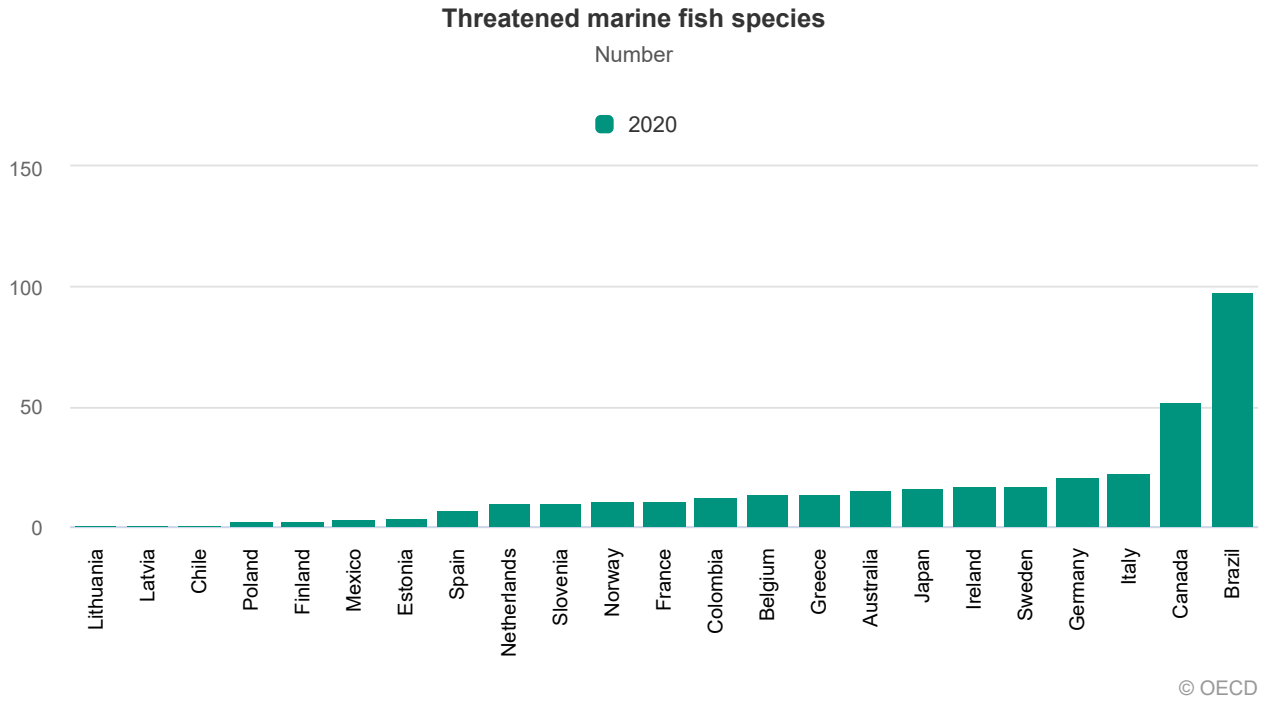
average population size of marine birds, mammals, reptiles and fish monitored by the Living Planet Index approximately halved since 1970 (WWF, 2015); the IUCN Red List Index which tracks aggregate extinction risk for taxa that have been adequately assessed shows the prospects for corals worsening rapidly (Carpenter et al., 2008); and the IUCN Red List database of threatened species lists close to 9% of marine animals and plants with a risk of extinction. For example, 14% of the fishes and 30% of corals are threatened, i.e. critically endangered, endangered or vulnerable (IUCN, 2022).

Coastal areas in the OECD are considerably more built-up than other areas and remaining unbuilt land in coastal areas is being developed faster than inland. In many countries, coastal areas (within 10 km) are more than twice as built-up on average compared to the country as a whole. Land development, along with agricultural land uses, potentially increases pressures on coastal ecosystems via organic (nutrients like nitrogen and phosphorous), inorganic (e.g. industrial chemicals, pesticides) and debris (e.g. microplastics and plastic litter) water pollution as well as via habitat loss and disturbance.

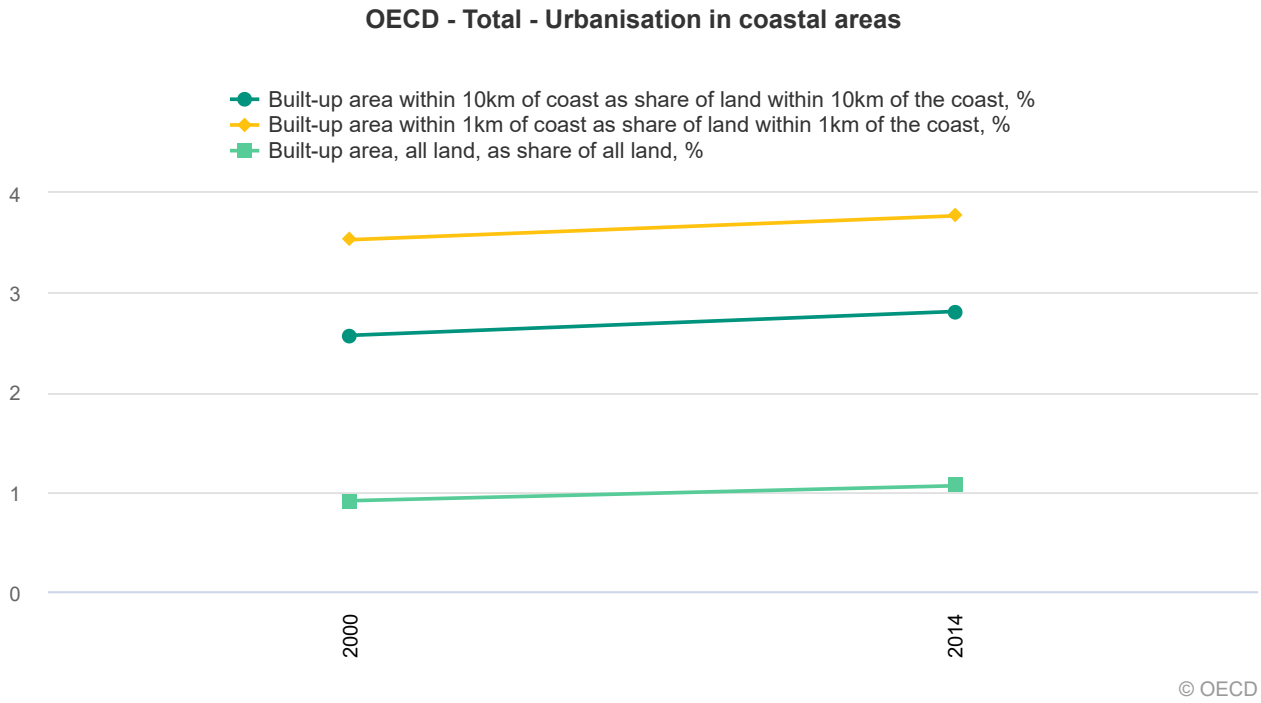
Healthy **fish stocks** are fundamental for maximising sustainable catch, or its value, which itself is key to providing food-security, jobs and incomes in the long-term. Healthy stocks are also vital for maintaining aquatic biodiversity, and the provision of ecosystem services on which several other sectors of the ocean economy rely (OECD, 2022b).

According to the most recent stock assessments undertaken in 32 countries, 64% of assessed stocks are in good health, 18% fall below sustainability standards, and for another 18%, assessments are not conclusive and their health status remains undetermined (OECD, 2022b).

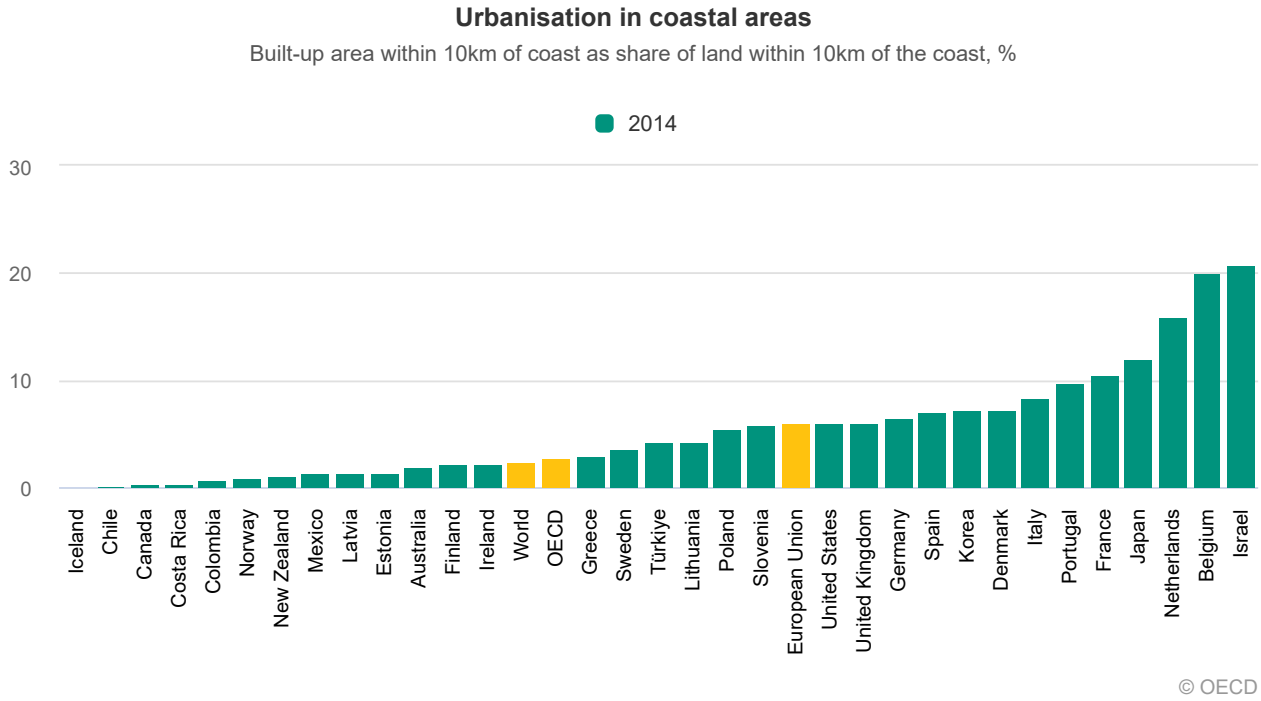
Indicators



Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.

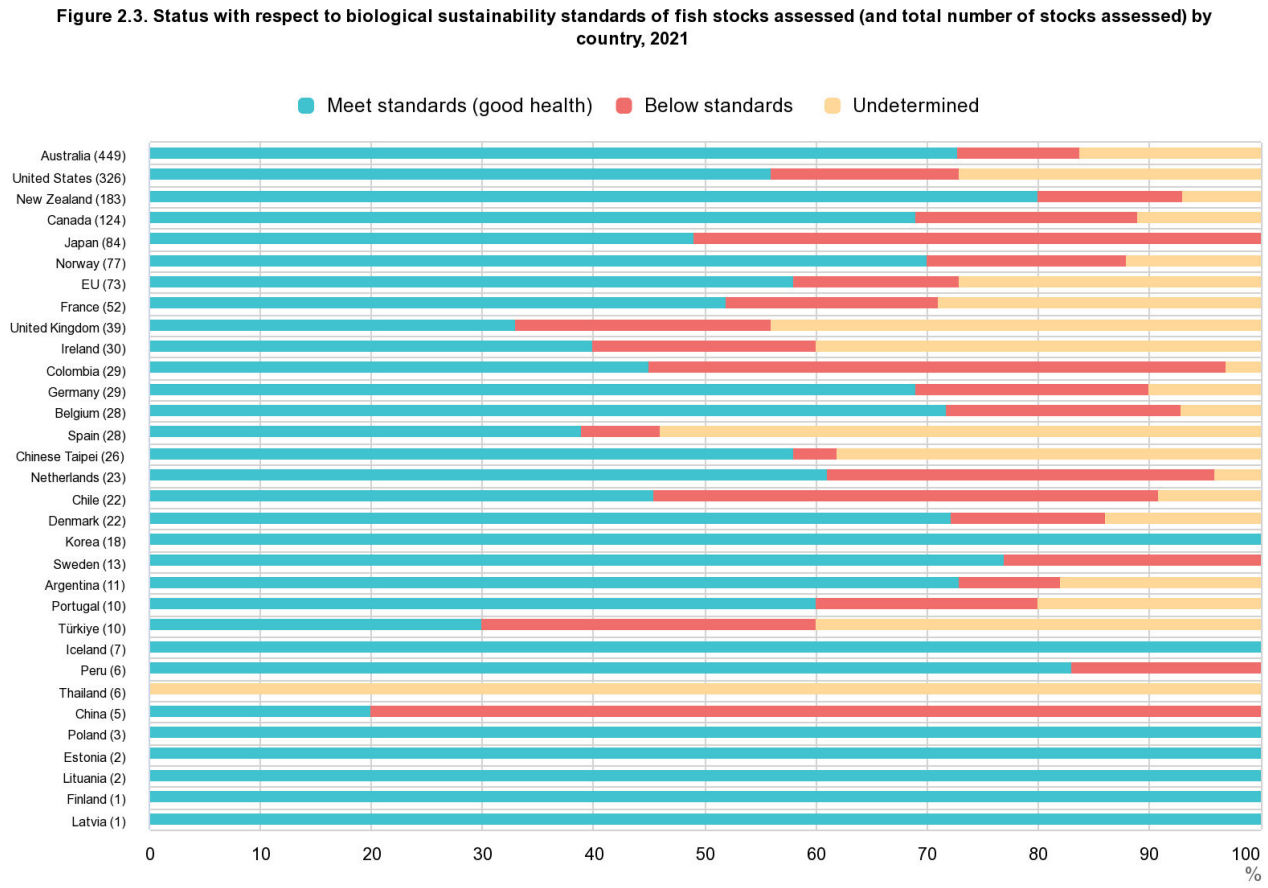


Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.



Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.

Figure 0.4 Reported biological status of all assessed fish stocks: National level



Note: This figure presents the status of assessed stocks as reported to the OECD by individual countries and economies (the total number of which is provided in parentheses). Favourable and unfavourable status refer to the stock's biological situation (signalling a stock was found to be within all limit reference points or outside one or more limit reference point). The status of stocks for which the assessment was not conclusive is reported as undetermined. The degree to which harvested stocks are assessed (and reported upon) was not reported by countries and varies significantly.

Source: OECD (2022), OECD Review of Fisheries 2022, OECD Publishing, Paris, https://doi.org/10.1787/9c3ad238-en

Comparability and interpretation

Threatened species include those listed as vulnerable, endangered and critically endangered. Data on **threatened species** are available with varying degrees of completeness. The number of species known or assessed does not always accurately reflect the number of species in existence, and the definitions that should follow IUCN standards are applied with varying degrees of rigour in countries. Historical data are generally not comparable or not available. For many of the incompletely evaluated species groups, assessment efforts have focused on species that are likely to be threatened; therefore any percentage of threatened species reported for these groups would be heavily biased (that is, the % threatened species would likely be an overestimate). For some countries, data include extinct species. Not all species are monitored, in which case their status is unknown.

For further details, see the metadata in the source database listed below under Data source.

Percentage of fish stocks assessed must be studied carefully as they are dependent on the number of stocks assessed and reported on. Stock assessments are done using biological sustainability standards (i.e. limit reference points, typically defined in terms of biomass or mortality thresholds) and higher management standards (i.e. target reference points, typically aimed at optimising catch value or volume

under sustainability constraints). Stocks in good health are defined as those that meet all assigned sustainability standards. Stocks that fall below sustainability standards are those below one or more limit reference points. Stocks with an undetermined status are those where an assessment was attempted but uncertainty in the results prevented a determination from being made.

Environmental and resource productivity

Key messages

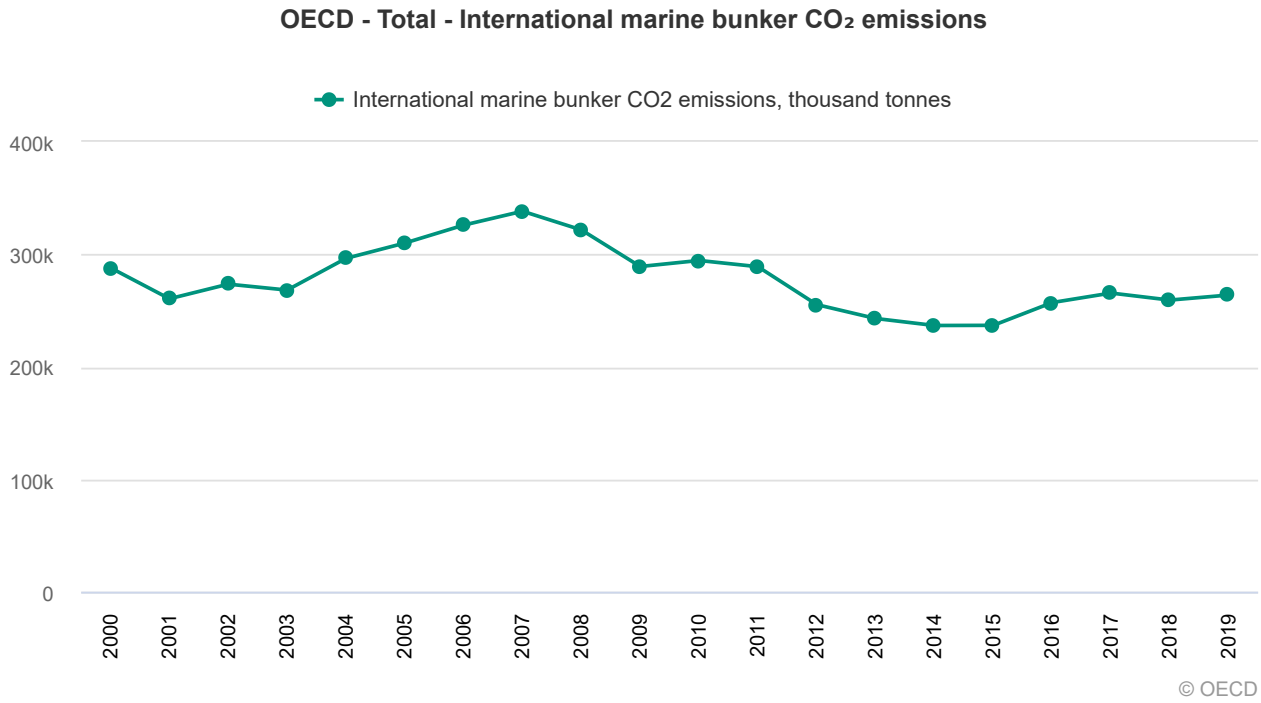
- CO2 emissions from OECD international marine bunkers reached their highest point in 2007 before the Great Financial Crisis and were on a decreasing trend thereafter. They have been increasing again since 2014 to reach a level similar to that observed in the mid-1990s. In 2020, the emissions are close to 225 million tonnes of CO2, their lowest level since 1990 due to the drop in international trade following the coronavirus pandemic.
- OECD international marine bunker CO2 emissions have on average been a little over 2% of the total emissions from domestic fuel combustion plus international aviation and marine bunkers since 1990. The share of CO2 emissions from international marine bunkers over total emissions follows business cycles. They were at their highest in 2007, then decreased until 2014, and started to increase again since then. As is to be expected, emissions from international marine trade are large compared to domestic emissions in transit countries.

Main trends and recent developments

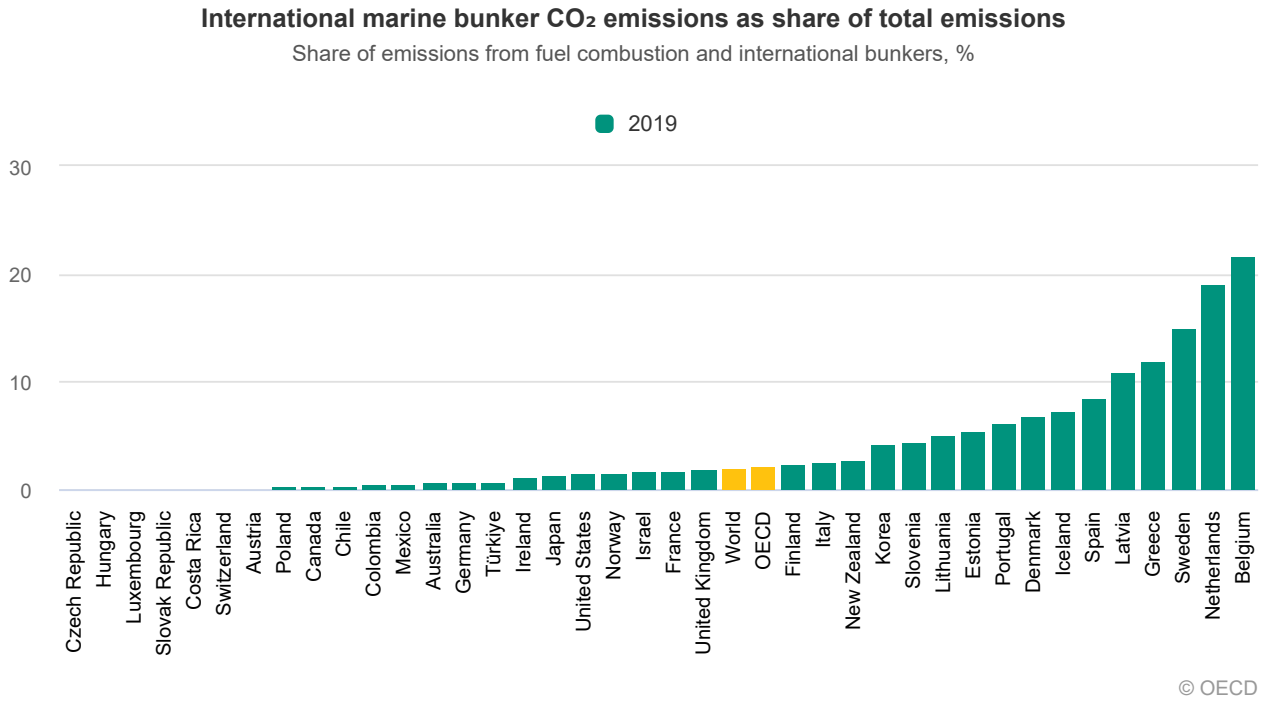
Emissions from international marine bunkers from OECD shipping generally decreased both in level of CO2 emitted and share of total domestic emissions following the Great Financial Crisis until 2014, and increased again since then. The decrease has two main causes: one is the link between international travel and business cycles, the other is driven by long-term efficiency gains. More information is required to fully capture *efficiency changes* in international shipping. Maritime shipping emissions account for a significant share of global greenhouse gas emissions. OECD international marine bunker CO2 emissions are a little over 2% of the total emissions. Total emissions are understood as the sum of domestic emissions coming from fuel, plus international aviation and marine bunkers. Emissions from international marine trade are large compared to domestic emissions in transit countries such as the Netherlands and Belgium. This disconnect between domestic and international emissions highlights the importance of addressing emissions from marine bunkers through cooperative global action.

Measurement challenges exist on air and water emissions from international maritime transport and how they relate to economic performance of the industry, in part due to a lack of established accounting methodologies on how such emissions should be allocated to countries (under the SEEA). There is also a dearth of internationally harmonised data on waste generation, ballast water and brine discharges, oil spills as well as land-based plastic emissions and nutrient loading into the ocean. On-going work (including at the OECD) seeks to address these data gaps, for example using microdata on distance travelled and categories of ships travelling.

Indicators



Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.



Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.

Comparability and interpretation

The total emissions denominator used in the figure above is the sum of emissions from fuel combustion, emissions from international aviation bunkers and emissions from international marine bunkers (allocated to countries based on ports of departure).

Economic opportunities from pursuing ocean sustainability

Key messages

- Public budgets for ocean-related renewable energy research, development and demonstration (RD&D) is strongly fluctuating from one year to another. It remains small in overall RD&D public budgets considering the new frontier that the ocean represents. At USD 200 million in 2021 (half the budget of 2019) , public budgets for ocean-related renewable energy technology research, development and demonstration are a modest share of total energy RD&D budgets in most countries (under 1.5% on average across OECD).
- Technological innovation directed at ocean sustainability is strongly concentrated in a small number of OECD countries that account for almost all relevant inventions, including Korea, the USA and Japan. Such innovation increased four-fold between 2000 and 2010, but it decreased more than two-fold between 2010 and 2019.

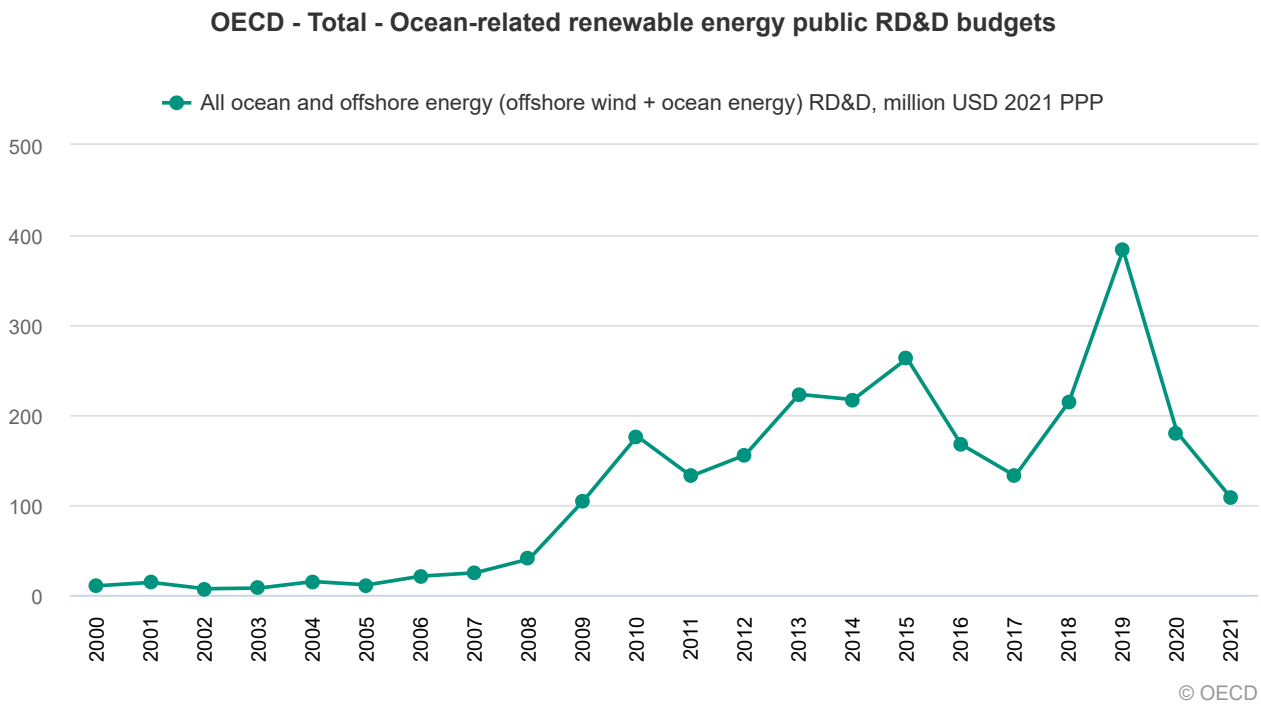
Main trends and recent developments

Ocean-related renewable energy public RD&D spending (including tidal, wave, salinity gradient and offshore wind energy) is small compared to overall RD&D public budgets. Ocean related RD&D has been on an increasing trend both in volume and share since the onset of the Great Financial Crisis in 2007, reflecting the growing importance of the ocean at the global level in addressing climate change. However, this increase stopped in the face of the COVID-19 sanitary crisis. Indeed, it reached its highest point in 2019, when the amount allocated for ocean renewable energy RD&D totalled 398 million USD in OECD economies, representing 2.75% of total public RD&D budget. In 2021, ocean-related RD&D reached 208 million USD, and its share in total public RD&D was at its lowest point in five years at 1.37%, half of that observed in 2019. Ocean RD&D budgets are highly concentrated within a handful of countries. Japan, France, the United Kingdom and the Netherlands are regularly among the top OECD spending countries. Offshore wind energy is the biggest component among the four components studied and has been receiving between a half and close to 90% of total ocean renewable energy RD&D since 2016. These trends indicate governments' growing focus to exploit the ocean energy potential in an effort to reach clean energy targets declared in the Nationally Determined Contributions (NDCs). However, the negative biodiversity impacts of ocean energy are not yet sufficiently taken into account (e.g. marine noise pollution).

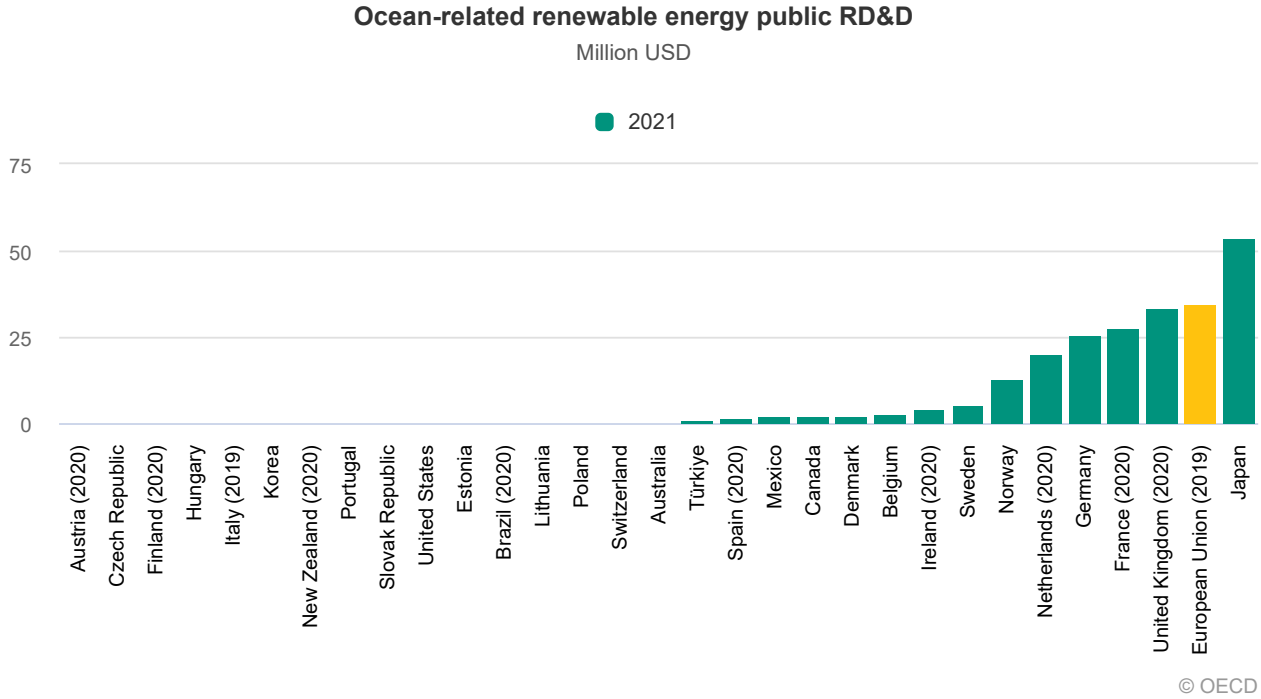
Inventive activity in ocean-related environmental technologies (ENVTECH), measured using patented inventions, has grown over time, but decreased more recently. Following ten years of continuous growth between 2000 and 2010 with a three-fold increase, the last decade saw a reversing trend as the number of patented inventions halved between 2010 and 2019. High-quality inventions were cut by three. Three quarters of ocean ENVTECH inventions originate in OECD countries in 2019 – especially in the United States, Korea and Japan, followed by a number of European countries. The technology domains contributing the most to patent applications are ocean renewable energy generation and climate change mitigation and adaption in aquaculture and aquafarming. The latter technology domain has been more stable in terms of patent applications. On the contrary, innovation directed at ocean pollution abatement has decreased the strongest. For a handful of countries, development of ocean-related technologies represents an increasing share of overall inventive output, reflecting a high degree of specialisation. In

2019, this share is 7.3% in Norway, 4.5% in Iceland, 3% in Chile, 1.8% in New Zealand and 1.5% in Denmark, well above the OECD average of 0.3%.

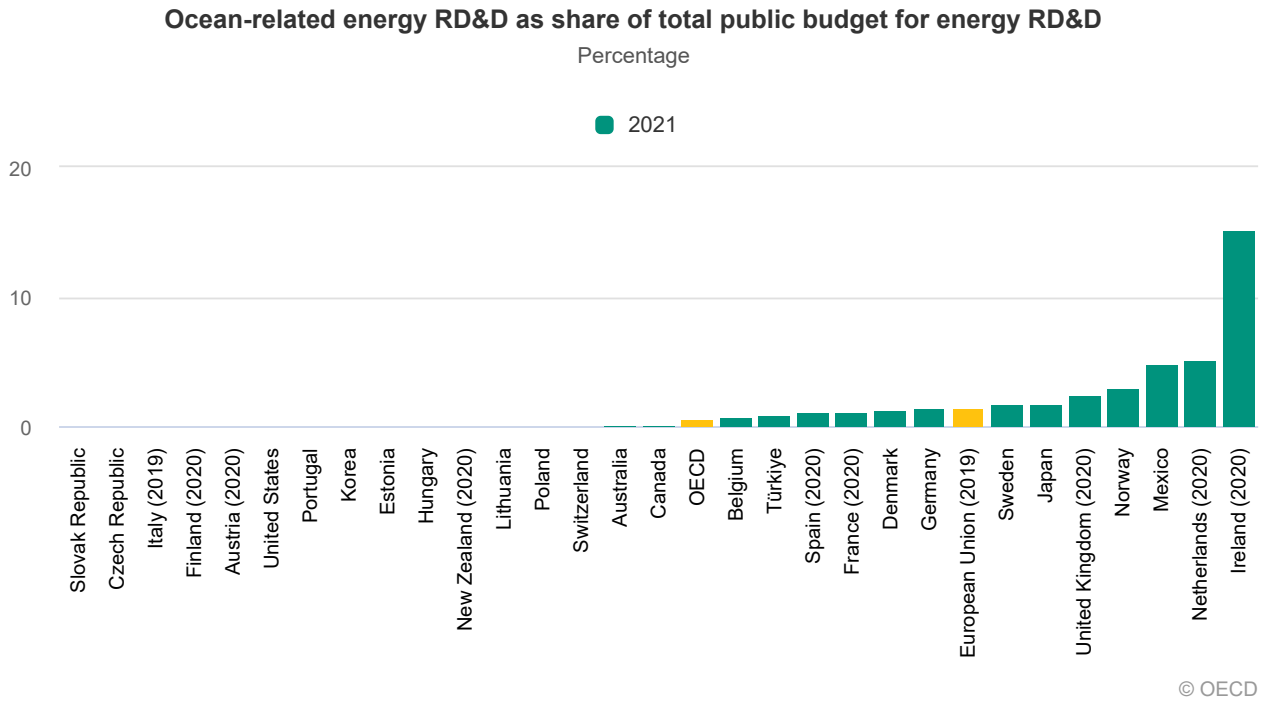
Indicators



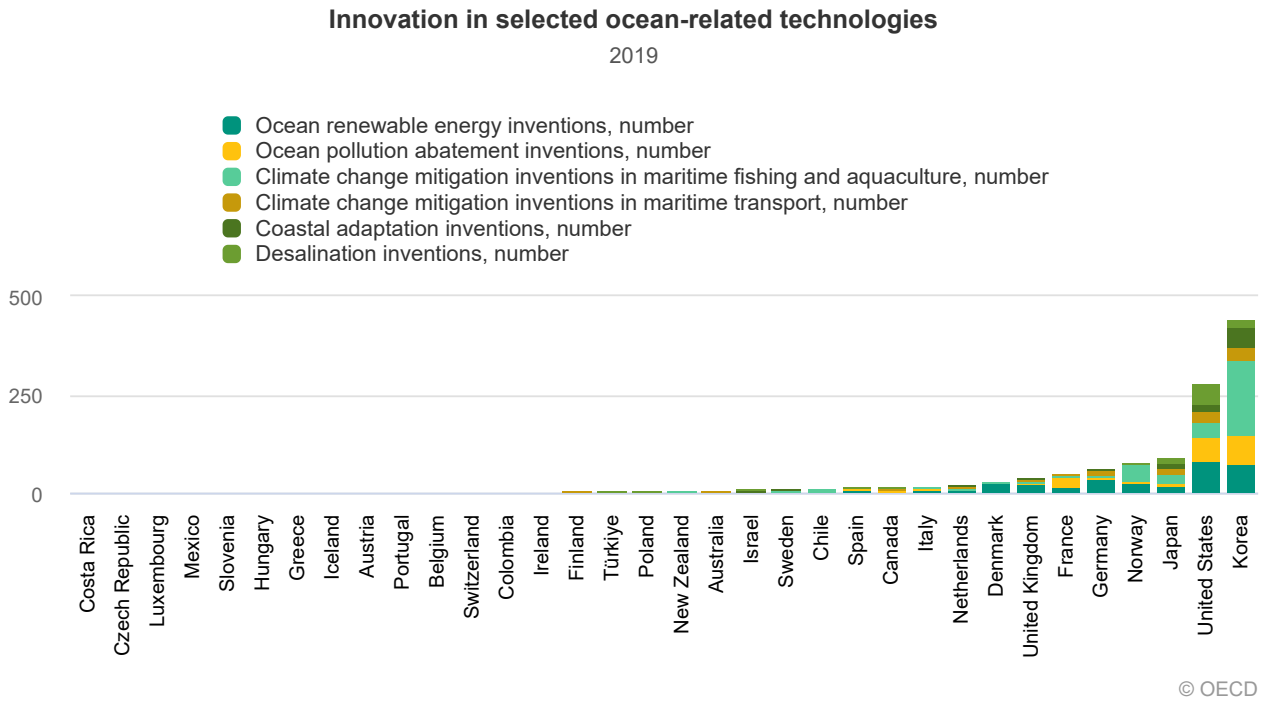
Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.



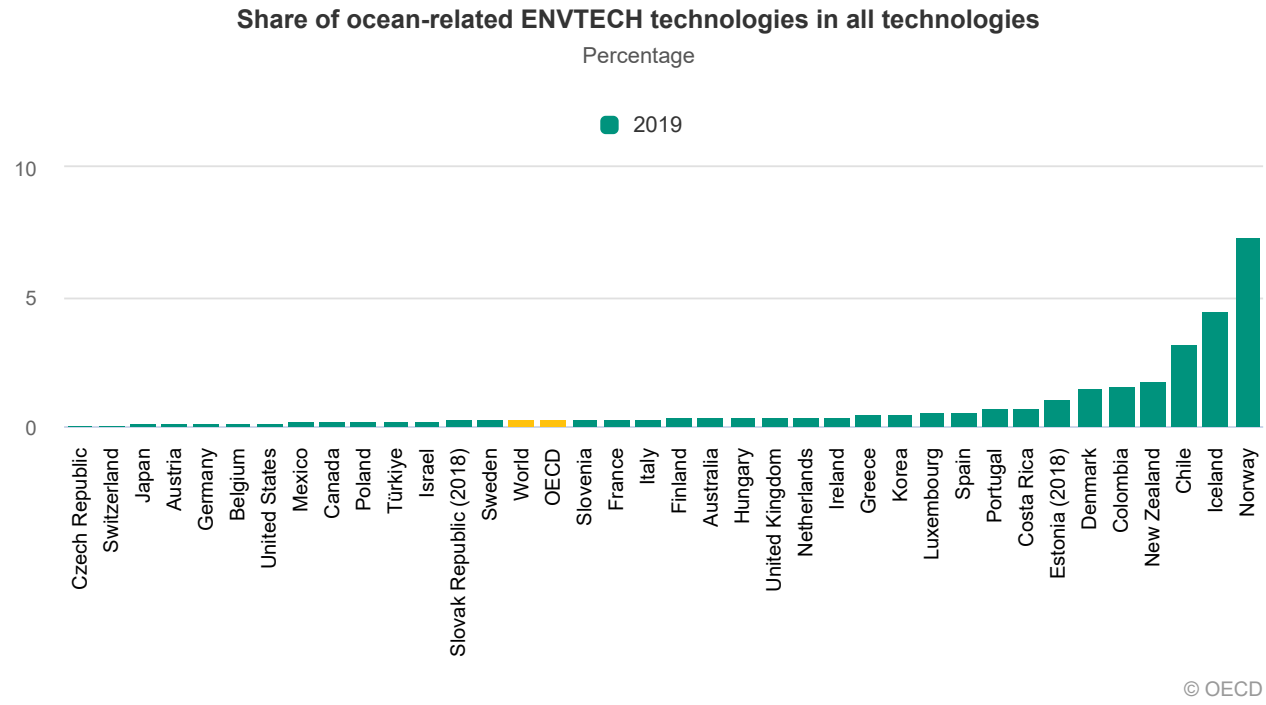
Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.



Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.



Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.



Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.

Comparability and interpretation

The decrease in reported public funding for ocean-related renewable energy RD&D following 2015 may reflect data quality issues, as official RD&D data for the United States is absent post-2015 and is estimated by the IEA as '0' for the period 2015-2019. Prior to this period, the United States accounted for a large share of the OECD ocean-related renewable energy RD&D budget. European Union refers to the budget under Horizon-2020 and not to the sum of national budgets of member states.

Policy responses directed at ocean sustainability

Key messages

- Marine protected areas (MPAs) have consistently expanded in recent years and now cover 22% of OECD exclusive economic zones (EEZ).
- Economic instruments directed at ocean sustainability exist in most countries and most often take the form of taxes. Around 156 ocean-related environmental policy instruments have been identified in OECD countries.
- Revenue from environmentally related taxes in the ocean economy is a small share of total environmentally related tax revenues (0.6%) in OECD countries. It has been slightly declining in the last decade compared it its highest level observed in 2008 (0.7%).
- Fossil fuel support measures in the ocean economy are common and in place in most countries. The 120 measures identified primarily benefit fossil fuel consumers except for some major fossil-fuel producing countries where they mainly benefit producers.
- Illegal, unreported and unregulated (IUU) fishing is a serious threat to fisheries and fisheries-dependent communities that impairs the development of a sustainable ocean economy. Overall, the up-take of best practices is highest for port state measures (the average indicator scores 0.83 for all respondents) and for vessel registration and authorisation to operate in the EEZ (average scores are 0.81 for both). At the

other end of the spectrum, market measures are the least widely used across respondents (with an average score of 0.64).

Main trends and recent developments

Since the year 2000, OECD countries overall have considerably expanded **marine protected area networks**; 22% of OECD marine area (exclusive economic zone) are designated protected in 2022 and most countries have some system in place (however, establishing effective management plans for MPAs and allocating adequate resources to implement them remains challenging). Protected areas explicitly designated with IUCN management categories Ia, Ib, II, or III (approximately 'marine reserves' insofar that commercial fishing or other extractive activities are generally restricted) are less frequently used, accounting for a mere 5.5% of OECD EEZ (however, their adoption by the United States and Australia accounts for virtually all of this; in most countries they are rarely used). Marine coastal areas are about as likely to be protected as non-coastal areas: 23% of OECD and 18% of world marine areas within 10km of the coast are designated protected. However, protection for the immediate shore is greater– close to 30% of OECD land area within 1km of the coast is protected (compared to around 16% for OECD terrestrial areas generally). Marine protected areas are rarely established on the high seas; only 0.5% of the global ocean beyond national jurisdiction is designated protected.

The number of countries with **economic (market-based) instruments targeted at ocean sustainability** has increased notably over time. By 2021, 70 countries had introduced ocean-related instruments, up from 53 in 1994 (according to data reported to OECD PINE database). Among these, **taxes** are the most common instrument type (both across countries and over time). More than 51 countries have introduced ocean-related taxes (such as taxes on fisheries, maritime transportation or marine pollution) and more taxes have been introduced every year than any other instrument type. Even though most ocean-related instruments are taxes, the share of **tradable permit systems** is highest in the ocean domain (more than in any other environmental domain). Ocean-related tradable permit systems include, for example, individual fishing quotas (Australia, Estonia, Iceland, Canada, the United Kingdom and the United States), transferable vessel quotas (Spain) and territorial user rights (Mexico and Chile).

Ocean-related **fees and charges** have been introduced in at least 42 countries, with examples such as entrance fees to national parks, fees on fishing licenses, charges on sewage discharge into the ocean (e.g. in the Great Barrier Reef area in Australia) and various non-compliance fines. **Environmentally motivated subsidies** relevant for the ocean have been reported in at least 19 countries. Examples include feed-in tariffs for offshore wind, tide and wave power generation (Argentina, Canada, Denmark, France, Korea, the United Kingdom) and conservation grants to preserve marine biodiversity (Sweden).

In the OECD area, **ocean-sustainability-related taxes raised USD 5.0 billion in 2021,** a level which has remained broadly stable since 2000 (despite the growing number of such taxes implemented). The share of ocean-related tax revenue in total Environmentally Related Tax Revenue (ERTR) is decreasing, from 0.68% in 2000 to 0.62% in 2021. Pollution and transport dominate the tax base, accounting for 36% each of ocean-related tax revenue in 2021. Revenue from taxes on ocean resources (e.g. fishing taxes) raise 12% of ocean ERTR, while energy taxes (e.g. fuel for maritime transport) raise 16% of ocean-related revenue.

A large number of **ocean-related fossil fuel support measures** are in effect with over 120 measures identified in 31 countries (of the 51 countries covering the OECD, G20 and European Union Eastern Partnership economies). Fossil-fuel producing countries (e.g., Brazil, Norway, the United Kingdom, and the United States) mostly support offshore extraction and general services via measures such as preferential tax treatment for entities with offshore oil & gas extraction; research and exploration activities; port infrastructure upgrades for increased fossil fuel trade capacity; and capacity building on decommissioning activities. Other countries that are mainly consumers of fossil fuels tend to divide their ocean-related

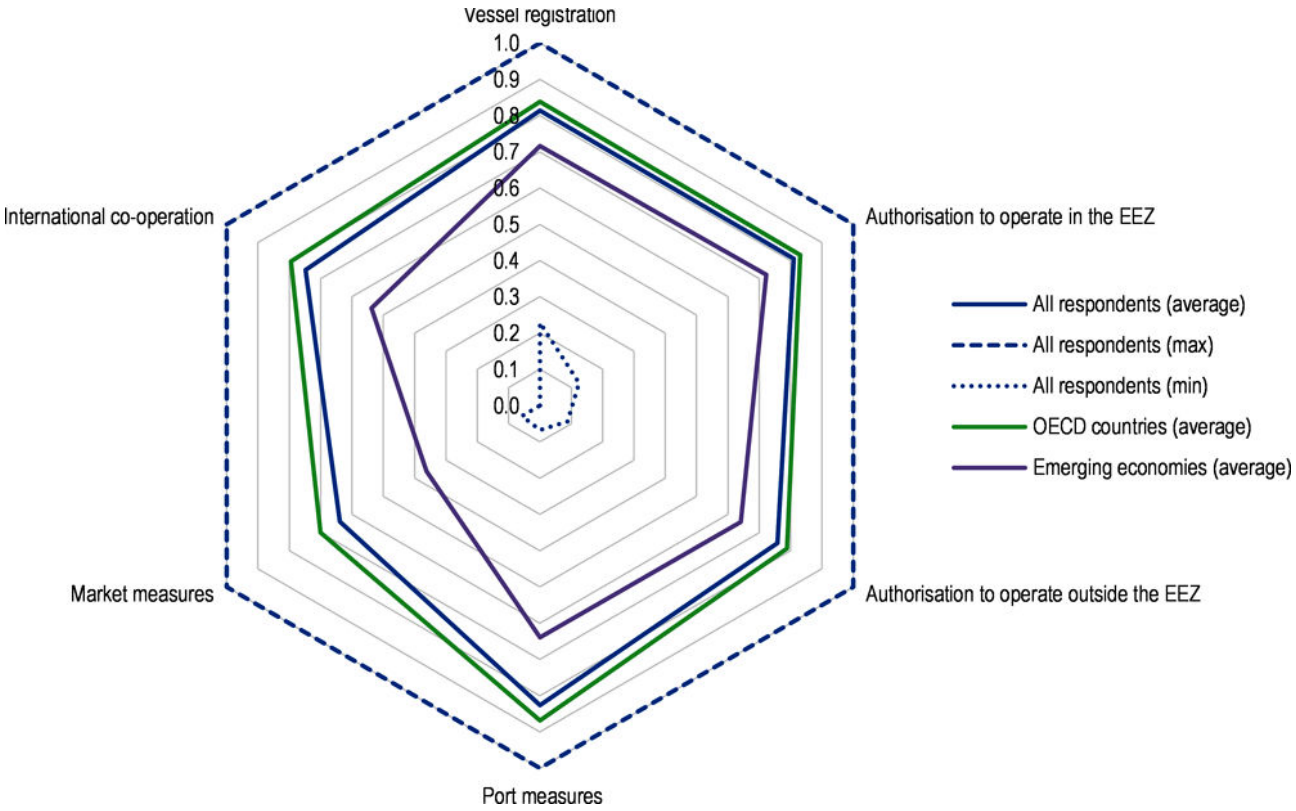
support between the fisheries & aquaculture and the transportation sectors (e.g. via preferential tax rates on fuels used in fisheries & aquaculture or in maritime transport).

Illegal, unreported and unregulated (IUU) fishing is a serious threat to fisheries and fisheries-dependent communities that impairs the development of a sustainable ocean economy. The pressure on fish stocks resulting from IUU fishing harms law-abiding fishers by creating unfair competition, reducing their profitability and employment opportunities throughout the value chain. It can also affect revenues from other activities that depend on fish resources, such as tourism activities related to recreational fishing or marine wildlife watching. When replacing legal activities, IUU fishing also deprives countries of the associated fiscal revenues. This is why, this indicator has to be studied in the context of the other indicators gathered in the Sustainable Ocean Economy database. More information about the results, the regulation in place and policy solutions can be found in (OECD, 2020c).

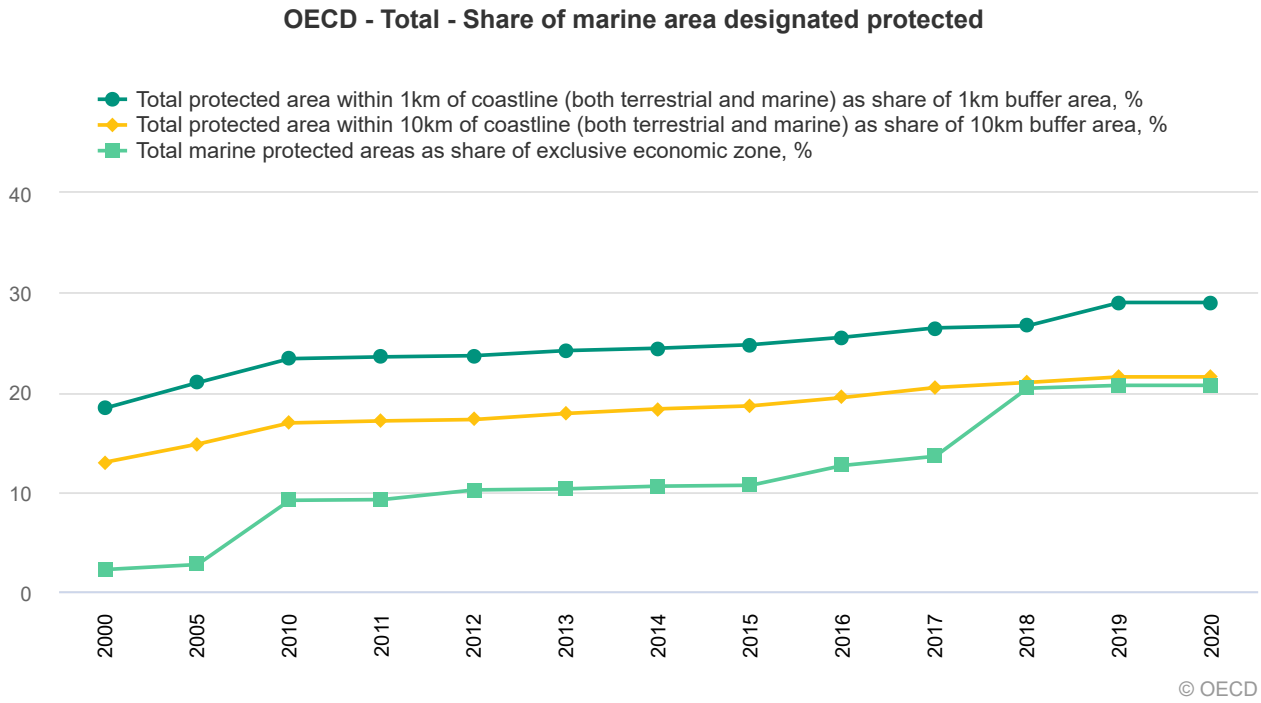
Indicators

Figure 0.12 Uptake of best policies and practices against illegal, unreported and unregulated fishing, 2018

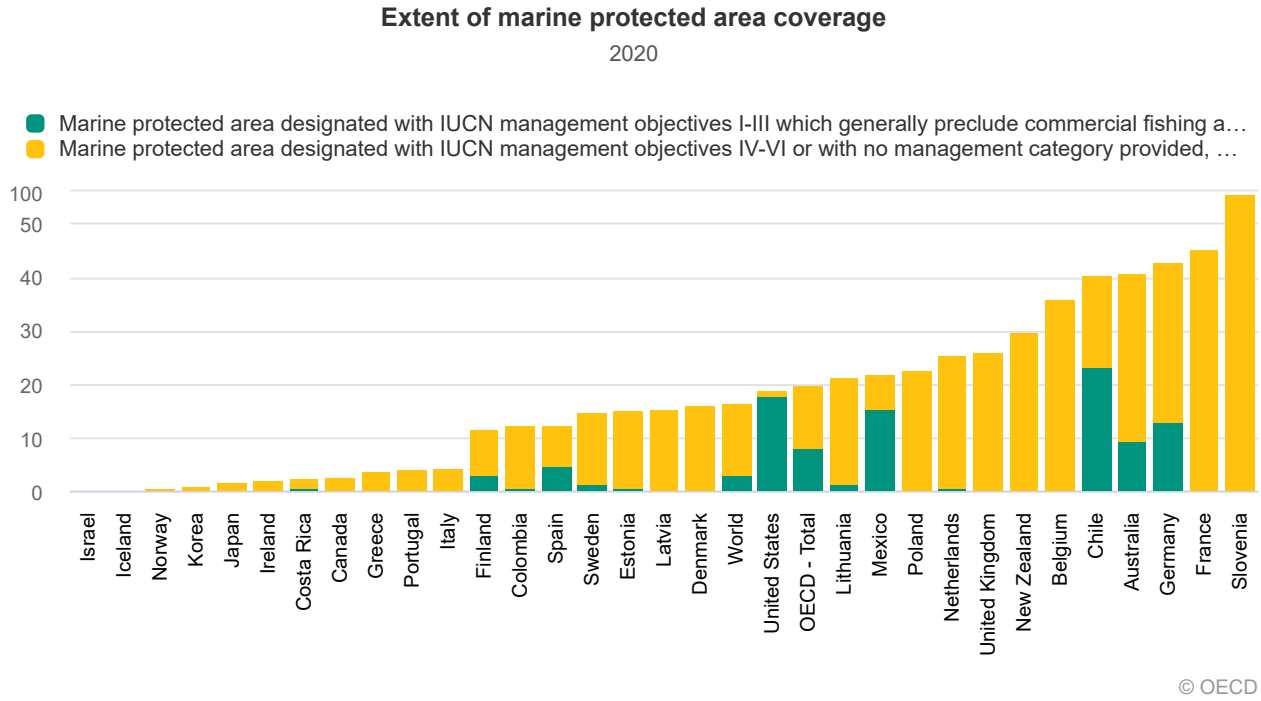
Indicator scores range between 0 and 1, with increasing scores indicating higher levels of adoption and implementation of the measures covered by each indicator



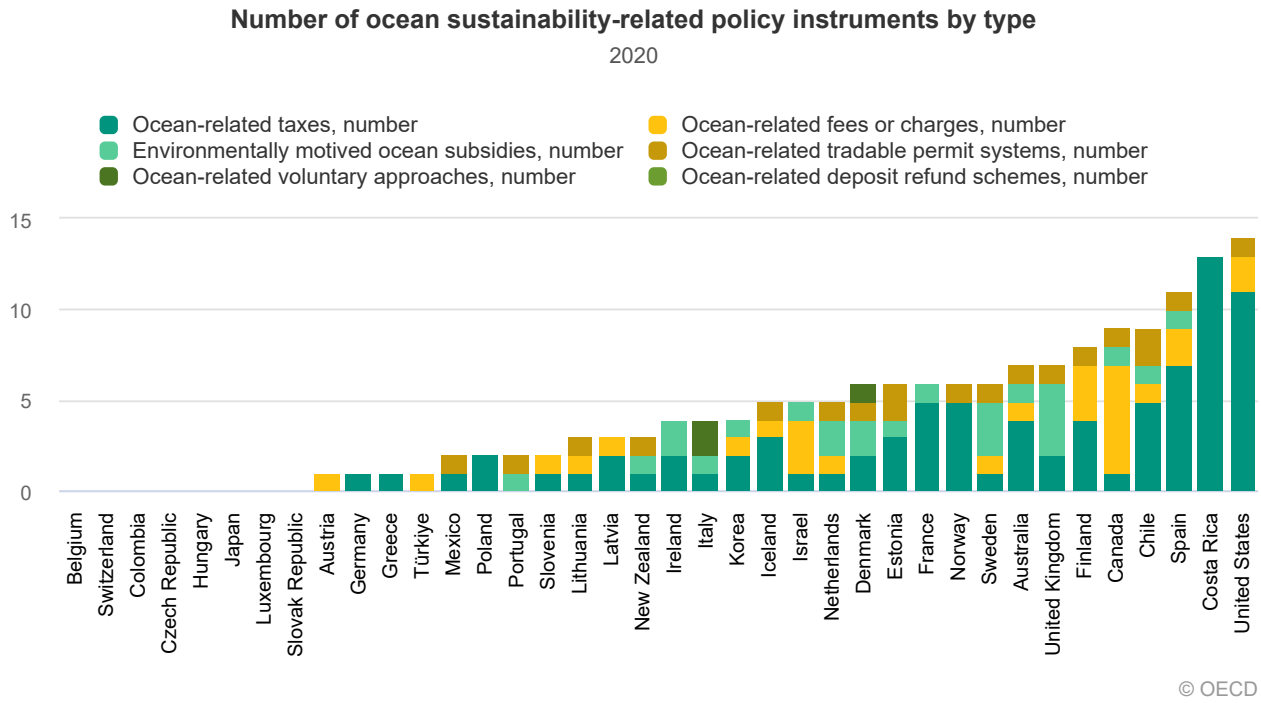
Source: OECD (2020), OECD Review of Fisheries 2020, OECD Publishing, Paris, https://doi.org/10.1787/7946bc8a-en.



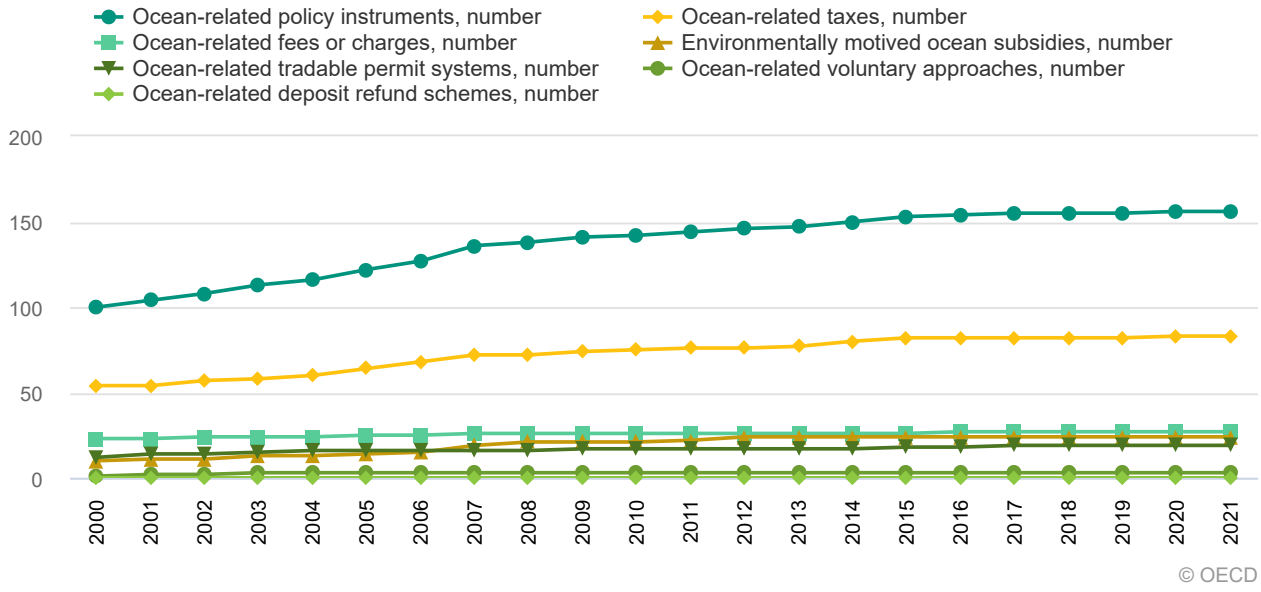
Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.



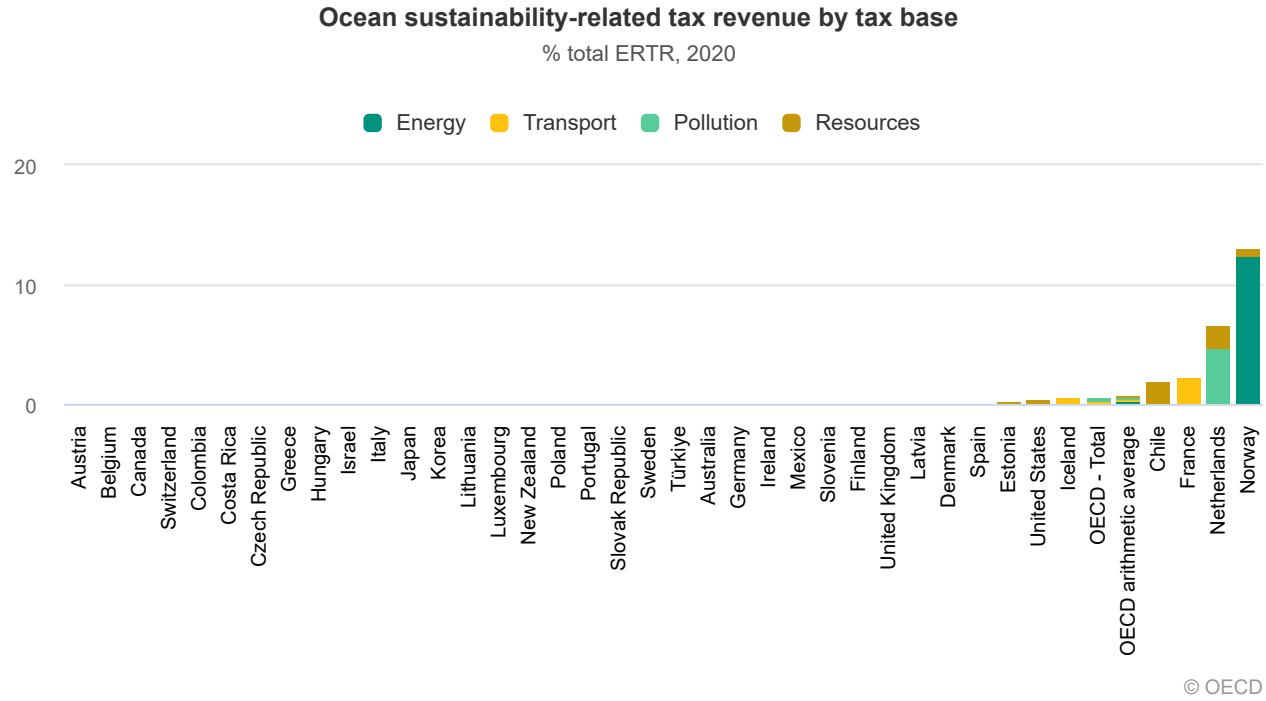
Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.



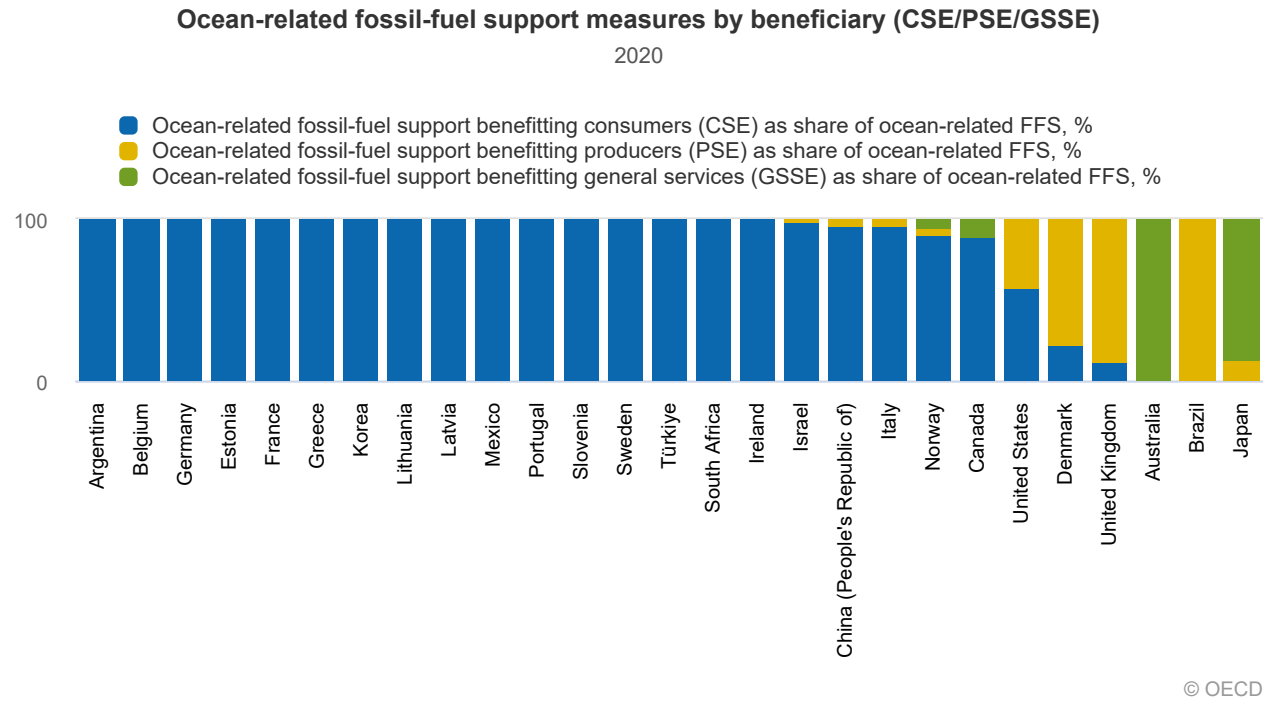
Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.



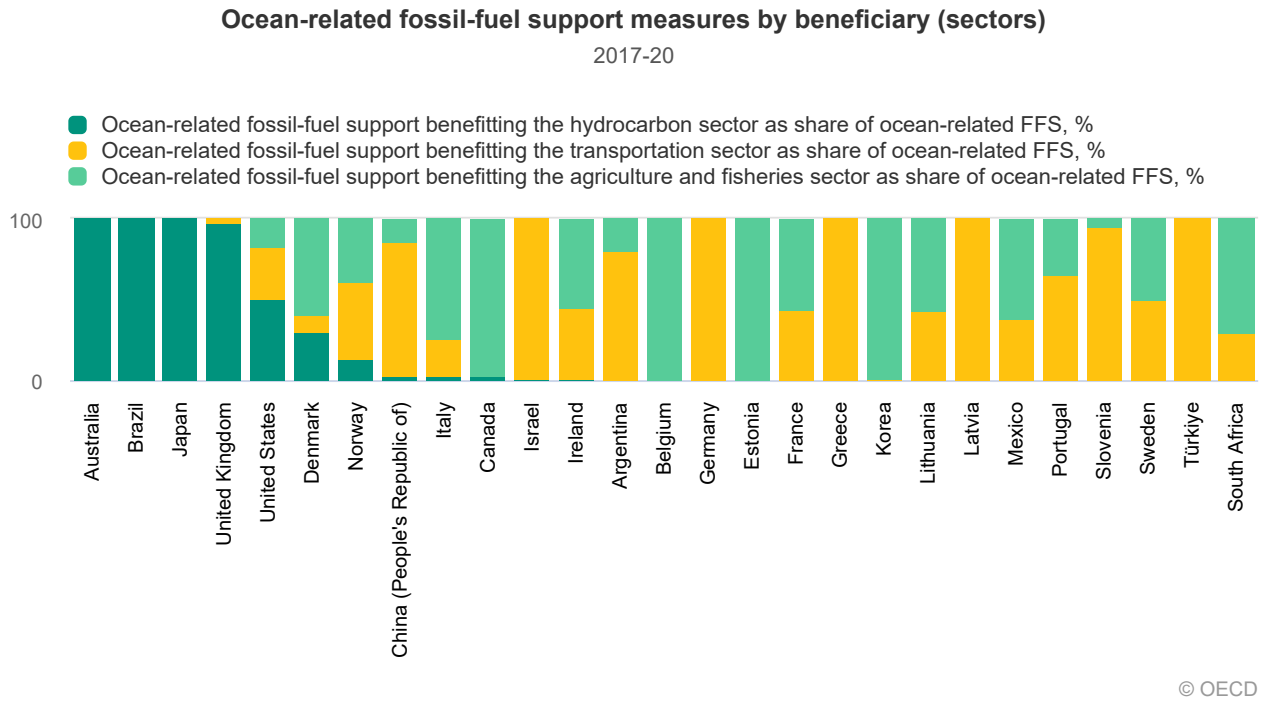
Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.



Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.



Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.



Source: OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://doi.org/10.1787/4c44ff65-en.

Comparability and interpretation

Protection designation does not guarantee that the area in question is effectively managed or appropriately located; and empirical studies of the effectiveness of marine protected areas in conserving biodiversity show mixed results (e.g. Dureuil et al., 2018). On a more technical level, the UNEP-WCMC's World Database of Protected Areas (WDPA) relies on regular submissions of data from countries and other data providers; therefore, where these have not been provided the database is incomplete or outdated. Furthermore, protected area attribute fields (such as the management category) can be missing or incomplete so these measures are not perfectly reliable. Some designated marine protected areas target only a narrow range of species (or even just a single species) through (e.g.) proscription of a particular fishing technique, but without any special restrictions on other high-impact activities that may harm biodiversity and are therefore only marginally more protected than other areas.

Care should be taken when interpreting the economic instrument counts. The existence of an instrument does not guarantee its enforcement; moreover, the level of stringency might not be adequate for the desired environmental outcome and the pattern of instrument types recorded in the OECD Policy Instruments for the Environment (PINE) database may not be representative of all existing instruments.

The indicators on environmentally related taxes should not be used to assess the "environmental friendliness" of the tax systems. For such analysis, additional information, describing the economic and taxation structure of each country, is required. Moreover, a number of environmentally related taxes can have important environmental impacts, even if they raise little (or no) revenue. In addition, revenue from fees and charges, and from royalties related to resource management, is not included.

The proportion of benefitting fossil fuel support (FFS) consumption sectors is calculated using the median of ocean-related FFS measures with active fund disbursements in 2018-2021. These disbursements (targeting specific known fuels) are allocated to sectors using country-level sectoral energy consumption data from the IEA's *World Energy Balances*.

The data on illegal, unreported and unregulated (IUU) fishing are based on a survey conducted by the OECD in 2019. The answers from 33 countries and 26 OECD members were received and compiled. The analysis is limited to the results of the survey. Individual country results should thus be interpreted cautiously. More information, comparison between countries and over time can be found in (OECD, 2020c). The survey includes questions covering six indicators. The choice of these indicators follow the methodology used in Hutniczak, Delpeuch and Leroy (2019).

The environmental dimension of well-being and resilience

Forthcoming in Q4 2023

Socio-economic context

Key messages

- Physical volumes of OECD marine landings (fish catches) have declined in 2020 by more than 20% since the 2000s and by 36% since 1995. The volume caught has stabilized since 2012. The current unit price value of the catches remained broadly stable between 2000 and 2020 going up from 1.32 to 1.45 real 2015 USD/tonne.
- OECD marine aquaculture production increased in volume two-fold between 1995 and 2020. The current unit price increased by close to 40%.
- Employment in the fishing sector in the OECD continuously decreased between 1995 and 2020, on average by 1.5% every year. On the contrary, employment in the aquaculture sector increased over the same period of time, on average by 1.2% every year. Employment in the processing sector has remained steady in levels.
- The number of OECD fishing vessels of all sizes have declined by 1.2% on average every year. The unit weight per vessels (average gross tonnage) increased slightly especially since 2007. It increased by 14% between 2007 and 20218 from 7.4 to 8.2 tonnes per vessel.
- The value of exports and imports have increased on average by 3% year on year between 1995 and 2020. Most of the exports are directed towards other OECD countries. The EU and the USA remain the world's major importers of fish, while Asia the main exporter (OECD/FAO (2021)).
- **Maritime transport dominates freight activity with more than 70% of all tonne-kilometres (**ITF, 2021). The other modes of freight by order of importance are road and rail. In the OECD, coastal shipping freight decreased by a little over 1% every year between 2000 and 2021. However, the People Republic of China's (hereafter, China) average yearly growth rate of 7% over the same period of time is leading the growth of the sector. Marine container transport in OECD has increased consistently and is now more than twice as large in tonnage and container number than in the early 2000s. In 2021, a year after the start of COVID-19, the number of containers and the tonnage were back to their pre-pandemic levels.
- Sea passenger tourism receipts (tourism "exports") as a share of total tourism receipts spiked in the follow-up of the pandemic. They are a small part of inbound tourism spending except for Estonia, Finland, and Denmark where they represent respectively 15%, 7%,and 4% in 2021. Equivalent expenditures (tourism "imports") stagnated on the period 2000-19 and surged in 2020.
- About a quarter of the overall OECD population lives within 10km of the coast. This is of particular concern considering the projected global mean sea level rise expected to reach between 0.43m to 0.84m by 2100 relative to 1986-2005 (IPCC, 2019). Population living within 10km of the coast as a share of total population is particularly high in Iceland (95%), Norway (75%), Denmark (67%), New Zealand (66%), Greece (63%), Australia (59%), Estonia (53%) and Portugal (53%) [2015 figures]. Several non-OECD

economies are even more threatened by the sea level rise such as Kuwait, Qatar, Brunei, Guyana, Panama and Belize.

Main trends and recent developments

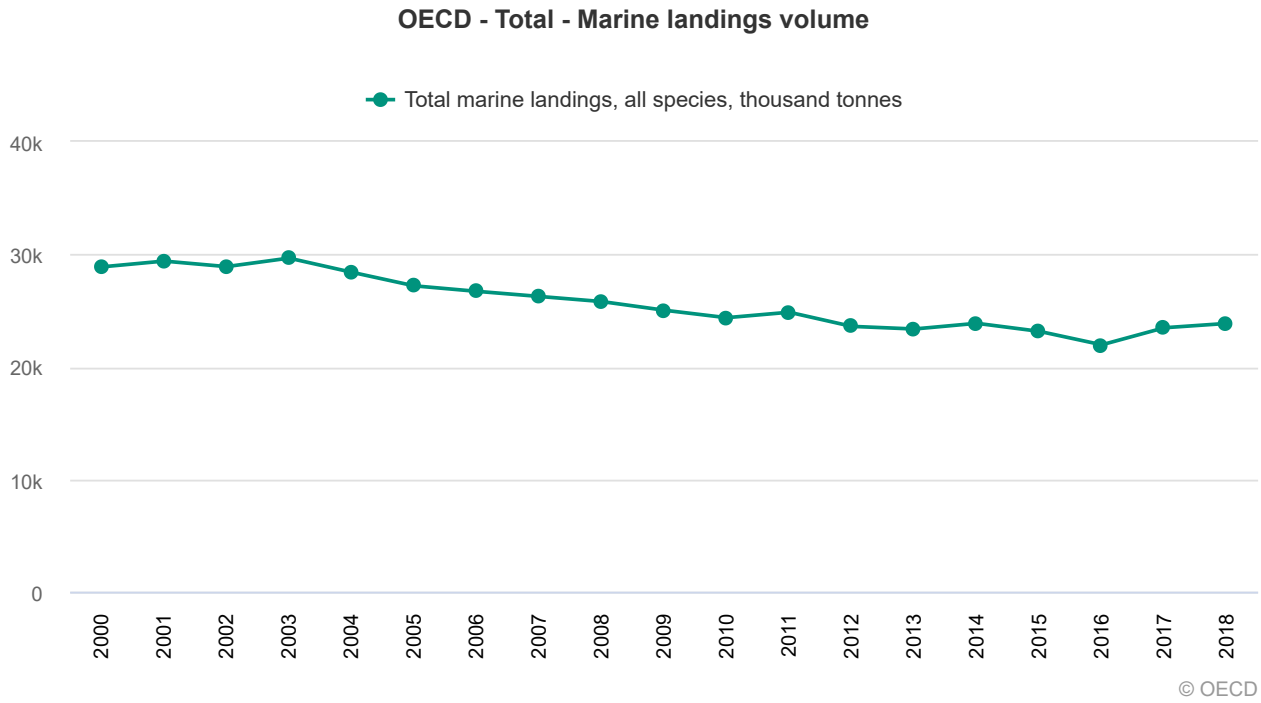
Based on the currently available data, several notable trends are observed. OECD aquaculture production has doubled in volume and tripled in real value since 1995. However, studying the impact of OECD countries on the ocean is not sufficient. Non-OECD countries also have significant impacts on ocean resources, in particular China which is the world's largest producer in both the capture fisheries and the aquaculture sectors. In 2020, China's aquaculture production was 4.6 times that of all the OECD countries combined. Likewise, although OECD fishing fleet per tonnage decreased continuously since 1995, China's fishing fleet tonnage increased over the same period of time and was in 2020 almost twice that of all OECD combined. Another remarkable trend is the consistent increase in marine trade, which reached 239 million containers handled by OECD ports in 2021, more than doubling the number of the early 2000s, and recovering its pre-pandemic levels. This is equivalent to seven twenty-foot equivalent units (TEUs) every second in OECD ports in 2021, compared to two TEUs every second in the early 1990s (reflecting economic growth and an increase in global trade generally).

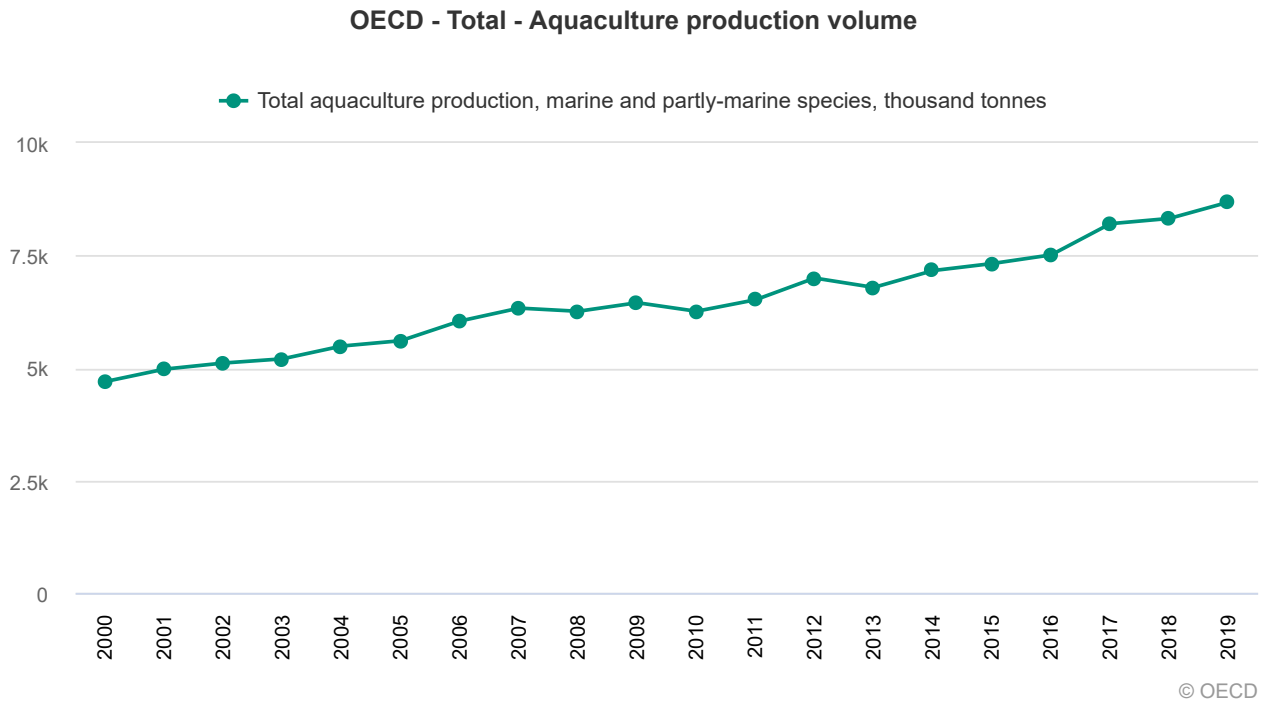
Box 1. Measurement challenges

This section presents contextual indicators such as population living in coastal areas, factor inputs of selected ocean industries (labour, energy, produced capital) and their output (revenue, value added). However, major information gaps persist, notably concerning internationally harmonised economic and environmental statistics on ocean industries, e.g., value added, employment but also energy consumption, air and water emissions, and use of other marine ecosystem services by industries such as coastal and marine tourism, offshore energy, maritime transport or port activities. Collection and availability of data on fisheries management and its sustainability is not well distributed geographically. Some regions have very good data available, while for others the information is very poor in this regard. Such information is needed to draw a more complete picture of the ocean economy and its sustainability. The OECD and its international partners have been active in this area (e.g. OECD, 2016) and work is on-going on developing ocean economic accounts consistent with the System of National Accounts (SNA) as well as on developing ocean environmental accounts consistent with the System of Environmental-Economic Accounting (SEEA).

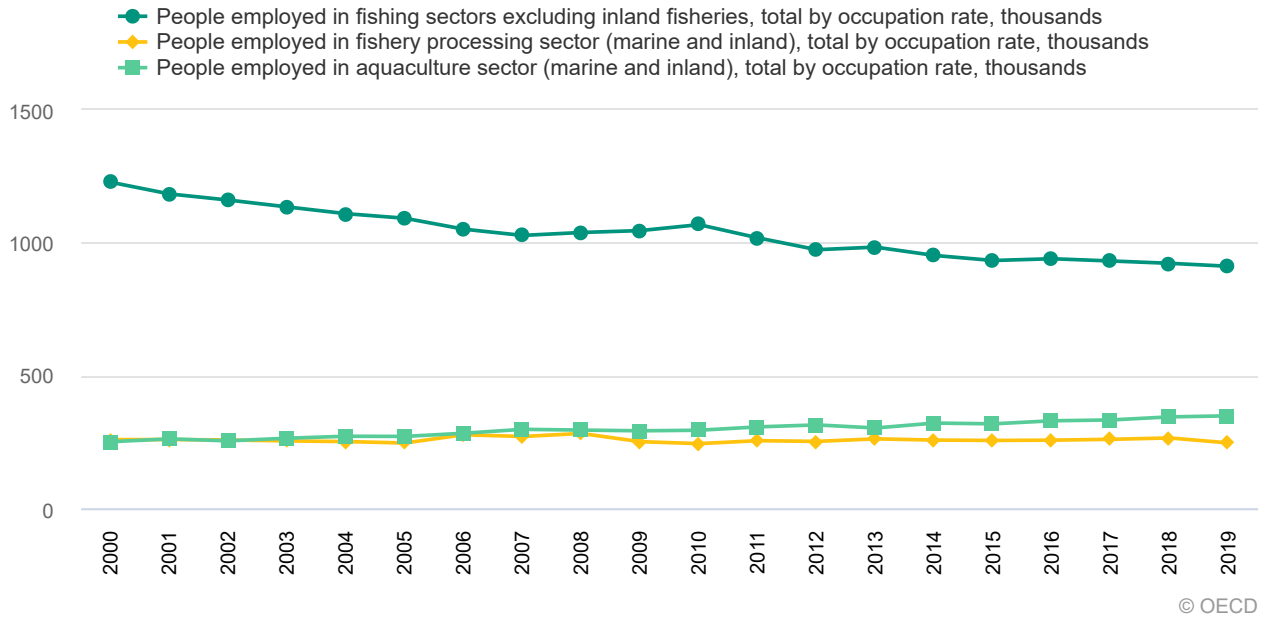
In the meantime, ocean industries remain only partially covered in the OECD database. Data on selected ocean-related activities is presented, where available, noting that often little or no harmonised data on the sustainability aspects of these sectors can be currently identified and presented. Addressing these information gaps is important so that the sustainability of these sectors and industries can be assessed. As accounting methodologies are developed and internationally harmonised data become available, more data and indicators will be included under the various thematic headings above.

Indicators

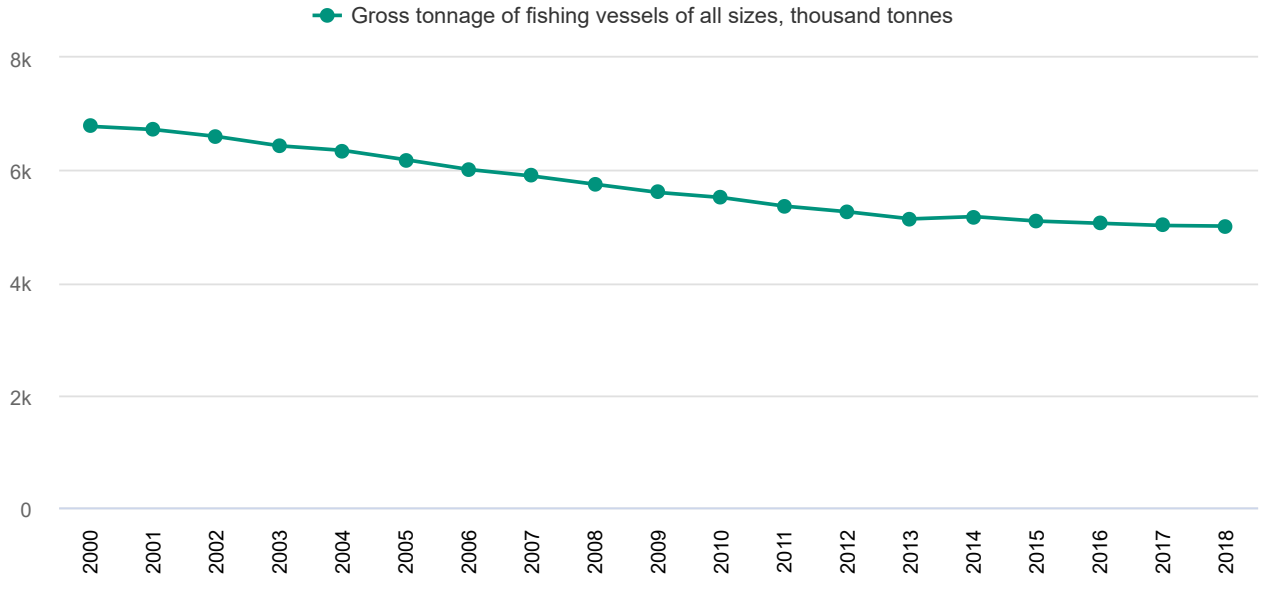

OECD - Total - Marine landings volume
Total marine landings, all species, thousand tonnes
40k
30k
20k
10k
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
© OECD

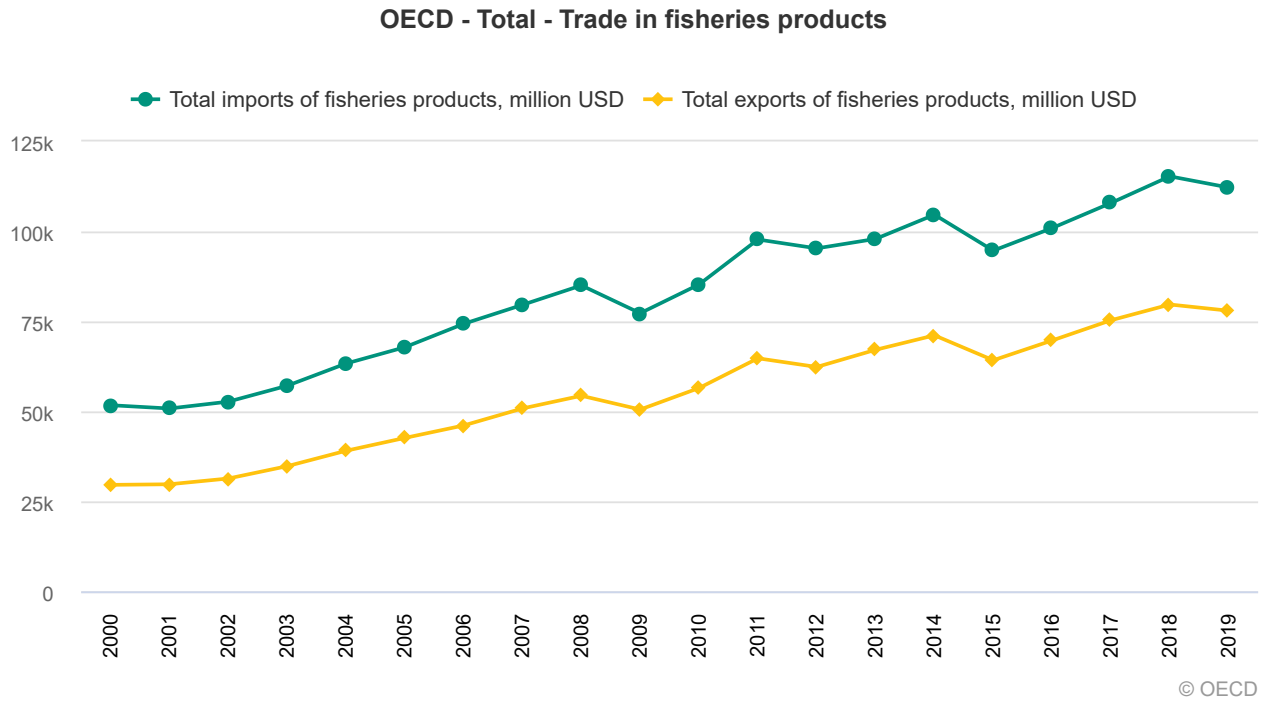

OECD - Total - Aquaculture production volume
Total aquaculture production, marine and partly-marine species, thousand tonnes
10k
7.5k
5k
2.5k
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
© OECD

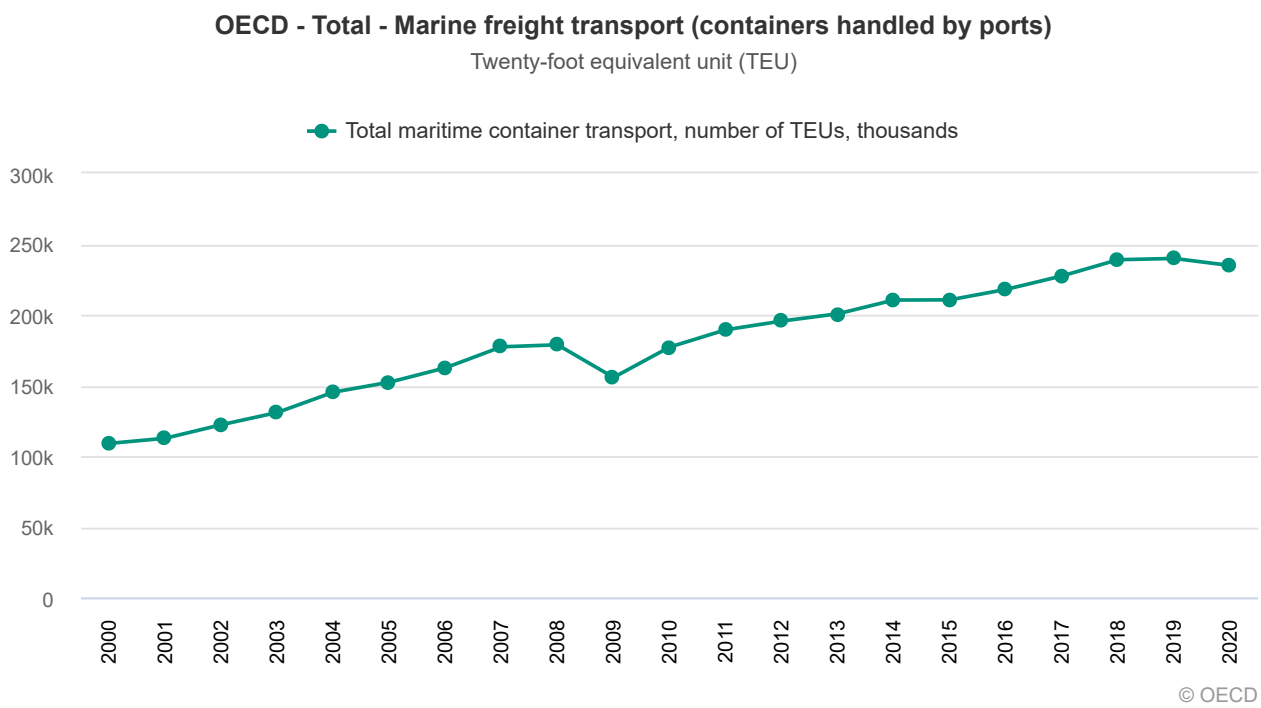
OECD - Total - Employment in fishing and aquaculture

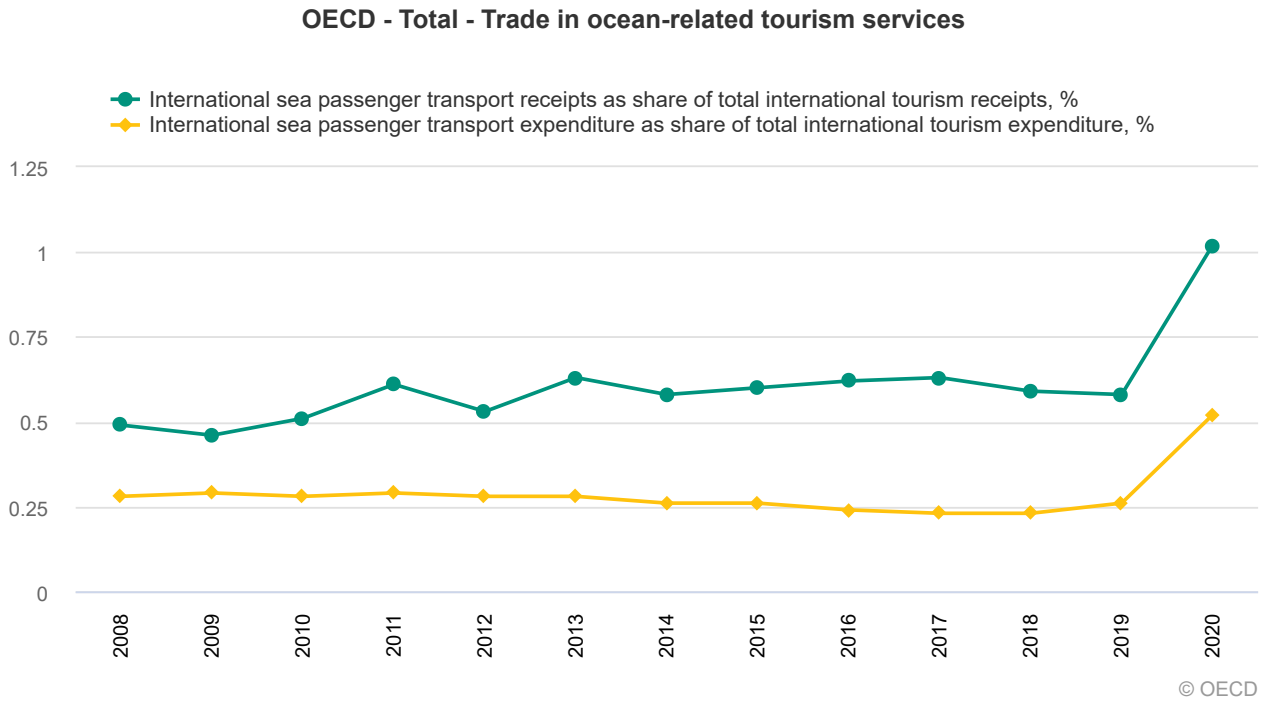


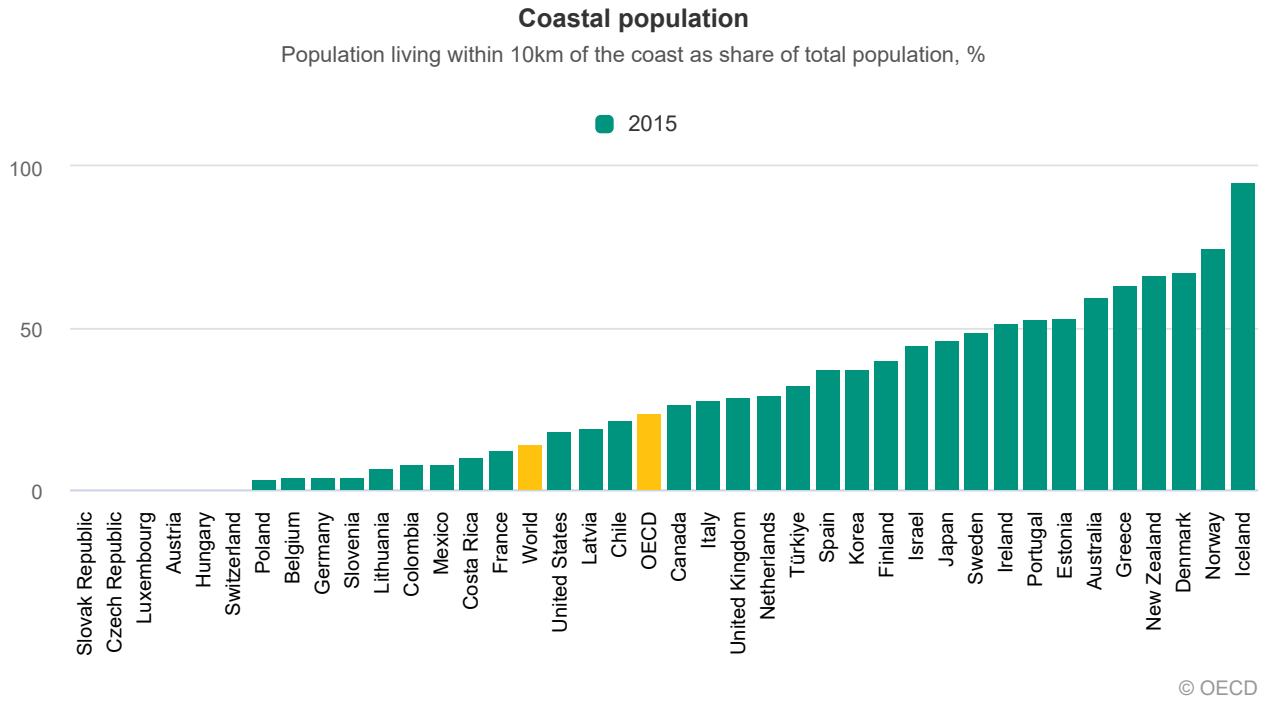
OECD - Total - Fishing fleet











Comparability and interpretation

These observations cover OECD member countries for which data are available; global trends may differ. The reported OECD aggregates do not generally cover *all* members (either because of incomplete data or because the indicator does not apply (e.g. landlocked countries). In general, around 30 of 37 OECD members are included (depending on topic and year) with the exception of tourism receipts and revenues where data is only available for around 20 OECD members. For indicators on flows, aggregated values

include flows between member countries. When calculating aggregates where country-data-years are missing, missing values are interpolated where possible or else back-and-forward filled using the closest valid value. Sometimes this involves filling data several years from the nearest value so some caution in interpreting the OECD value is warranted. Refer to the OECD *Sustainable Ocean Economy Database* metadata for comprehensive information.

Marine freight measures freight passing through ports therefore for each departure is there is also at least one corresponding arrival elsewhere. Consequently, individual freight items will often be counted more than once.

Exports (imports) for the OECD as a whole is the sum of exports (imports) of all OECD member countries. As such, exports (imports) between OECD countries are counted as non-zero. The statistic does not inform on the relative autonomy of OECD as an entity with regards to the rest of the world.

Glossary

Aquaculture production: Aquaculture is the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated.

Fish, crustaceans, molluscs, and all other aquatic organisms are classified according to the FAO International Standard Statistical Classification of Aquatic Animals and Plants (ISSCAAP). In this dataset, only species considered to be marine or partly marine are selected. The included species list can be found in the ocean database metadata.

Built-up area: "Built-up" is defined as the presence of buildings (roofed structures). Coastal area is defined as the area within 1km or within 10km of the coast.

Employment in fishing: Commercial, industrial and subsistence fishers, operating in freshwater, brackish water, and marine waters in economically inspired efforts to catch and land any of the great variety of aquatic animals and plants and also people working on fish farms, hatcheries, processing, and employed in shellfish culture operations.

Fishing fleet: Vessels engaged in catching operations only.

Fishing stocks: A fish stock is considered assessed when management objectives were set and stock status was recently quantitatively assessed with respect to the associated reference points.

Illegal, Unreported and Unregulated (IUU) fishing: the "International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU)" describes IUU fishing as follows:

- Illegal fishing refers to activities conducted in a country's Exclusive Economic Zone (EEZ) in contravention of its laws and regulations as well as to fishing in international waters in violation of that country's flag state law and regulations related to its obligations under the international treaties and regional fisheries management organisations (RFMO) convention arrangements to which it is party;

- Unreported fishing refers to fishing activities that have not been reported, or have been misreported, to the relevant national authority or RFMO, in contravention of the laws, regulations and reporting procedures of that country or organisation. This can occur both within EEZs and on the high seas (Areas beyond national jurisdiction - ABNJ);

- Unregulated fishing refers to fishing activities in areas or of fish stocks where there are no national, regional or international conservation or management measures applicable to a particular fishery or fishing vessel. Unregulated fishing can occur in an unmanaged fishery within an EEZ or on the high seas by

vessels without nationality, or by vessels flying the flag of a country that is not a party to international conventions or a relevant RFMO

International marine bunker CO2 emissions: International marine bunkers contains emissions from fuels burned by ships of all flags that are engaged in international navigation. The international navigation may take place at sea, on inland lakes and waterways, and in coastal waters. Consumption by ships engaged in domestic navigation is excluded. The domestic/international split is determined on the basis of port of departure and port of arrival, and not by the flag or nationality of the ship. Consumption by fishing vessels and by military forces is also excluded.

Marine freight transport: Containers are a special box to carry freight, strengthened and stackable and allowing horizontal or vertical transfers. Swap bodies are excluded.

Coastal shipping or short sea shipping is the movement of cargo by sea between ports situated within a relatively narrow geographical area. Included in such movements would be ferry and feeder traffic. For Europe, short sea shipping would consist of the movement of cargo by sea between ports situated in Europe as well as between ports in Europe and ports situated in non-European countries having a coastline on the enclosed seas bordering Europe.

Marine landings: Fish, crustaceans, molluscs and other aquatic invertebrates (and animals), residues and seaweeds on a landed weight basis, i.e. the mass (or weight) of a product at the time of landing, regardless of the state in which is landed (i.e. whole, gutted, filleted, meal, etc.). Data cover all industrial, artisanal and subsistence fisheries, excluding aquaculture.

Ocean and offshore energy public RD&D budgets: Energy RD&D covers basic and applied research, experimental development, and demonstration related to the production, storage, transportation, distribution and use of all forms of energy. Shown here are data for the following ocean-related renewable energy sectors:

Offshore wind RD&D activities which focus on the performance and the reliability of these technologies.

Ocean energy, including technologies that harness the physical properties of the ocean to generate electricity from tidal energy, wave energy, and salinity gradient power. RD&D activities for this sector includes the design and development of equipment and turbine technology, as well as the research on the effect on marine life of ocean energy.

Ocean-sustainability-related inventions: The number of inventions (simple patent families) developed by a country's inventors, independent of the jurisdictions where a patent application has been registered (i.e. all known patent families worldwide are considered). Patents in ocean-related ENVTECH technologies represent only a small portion of overall patenting activity. Therefore, prior to data retrieval from a worldwide patent database, a search strategy is used to identify the relevant patent documents using common patent classification systems. For more details, see the metadata to the OECD *Sustainable Ocean Economy Database*.

Ocean-sustainability-related policy instruments: Policy instruments such as taxes, fees and charges, tradable permits, environmentally motivated subsidies, deposit refund schemes and voluntary approaches directed at ocean sustainability. Examples include taxes on fishing, taxes on maritime transport, import duties on vessels, fees on access to marine reserve parks, fishing licenses, coastal protection subsidies, subsidies for offshore wind electricity generation, individual transferable quotas for fisheries, etc.

Data are extracted from the OECD Policy Instruments for the Environment (PINE) database (http://oe.cd/pine). The PINE database, contains quantitative and qualitative information on over 3500 policy instruments in 110 countries worldwide. Policy instruments are tagged into 13 environmental domains that represent

the focal issues (environmental externalities). Instruments can have both a direct and an indirect effect on several environmental domains; however, only the domain to which the instrument has a direct effect is considered. Ocean sustainability is the most recent domain added to the database. For more details, see the metadata to the OECD *Sustainable Ocean Economy Database*

Ocean- sustainability-related tax revenue: Revenue raised from taxes and auctioning of tradable permits directed at ocean sustainability. These include specific taxes on i) energy products for maritime transport purposes; ii) maritime vessels and transport infrastructure (e.g. one-off or recurrent taxes on ownerships and use of boats); iii) ocean pollution (e.g. discharges into the ocean); and iv) ocean-resource extraction (e.g. fishing taxes, revenue from auctioning of individual transferable quotas for fisheries).

The information on taxes and the associated tax revenue is extracted from the OECD Policy Instruments for the Environment (PINE) database (http://oe.cd/pine). The PINE database, contains quantitative and qualitative information on over 3500 policy instruments in 110 countries worldwide. Policy instruments are tagged into 13 environmental domains that represent the focal issues (environmental externalities). Instruments can have both a direct and an indirect effect on several environmental domains; however, only the domain to which the instrument has a direct effect is considered. Ocean sustainability is the most recent domain added to the database. For more details, see the metadata to the OECD *Sustainable Ocean Economy Database.*

Ocean-related fossil fuel support measures: Direct budgetary support and tax expenditures supporting the production or consumption of fossil fuels. Following the OECD's PSE-CSE framework the measures benefitting fossil fuel producers are classified as the Producer Support Estimate (PSE) while those that benefit individual fossil fuel consumers are classified under the Consumer Support Estimate (CSE). A third category, the General Services Support Estimate (GSSE), is assigned for measures that do not currently increase fossil fuel production and consumption but may do so in the future.

The OECD Inventory of Fossil Fuel Support Measures (http://oe.cd/fossil-fuels) identifies the type of fossil fuels benefitted by each measure and presents a breakdown of the amount of support by assigning fuel type tags. In cases where this breakdown is not available in official government sources, the OECD performs data transformation procedure to allocate support to individual fuel tags according to the relative value of production or consumption as calculated from the IEA's World Energy Balances database. Note that measures can benefit more than one type of fossil fuel at the same time and can thus receive multiple fuel tags in this respect. For example, a measure granting lower sales tax rates for road transport fuels will receive multiple fuel tags such as motor gasoline, diesel, LPG and natural gas.

Building on this methodology, an additional binary tag is developed for ocean-related government support for fossil fuels. This tagging strategy is detailed in the metadata to the OECD *Sustainable Ocean Economy Database*.

Protected area: Area of land or sea especially dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources, and managed through legal or other effective means. The data refer to the World Conservation Union (IUCN) management categories I-VI. National classifications may differ. The data cover areas under the management categories:

- I (strict nature reserves and wilderness areas),
- II (national parks),
- III (natural monument or feature)
- IV (habitat or species management area),
- V (protected landscape or seascape) and

- VI (protected area with sustainable use of natural resources).

Areas nationally/internationally designated without any IUCN category assigned are also included. This category includes regional and international designations such as the European Natura 2000 network.

In general, under the 1982 UN Convention on the Law of the Sea the EEZ of a country extends 200 nautical miles from the coastline, or to the mid-point between coastlines where the EEZ of different countries would otherwise overlap. Coastal area is here defined as the area within 1km or within 10km of the coast, including the terrestrial shoreline.

Threatened species: The number of threatened species compared to the number of known or assessed species. "Threatened" refers to the categories of "endangered", "critically endangered" and "vulnerable" species (i.e. species in danger of extinction and species soon likely to be in danger of extinction), as defined by the IUCN.

Tourism receipts and expenditure – sea passengers: Passenger services cover the transport of people. This category covers all services provided in the international transport of non-residents by resident carriers (credit or international passenger transport receipts) (similar to exports) and that of residents by non-resident carriers (debit or international passenger transport expenditure) (similar to imports). Passenger services include fares and other expenditure related to the carriage of passengers, any taxes levied on passenger services, and fares that are a part of package tours, cruise fares, rentals, charters, and leases of vessels, aircraft, coaches, or other commercial vehicles with crews for the carriage of passengers.

Trade in fisheries products: Fishery products entering (imports) or leaving (exports) an economic territory. Goods simply being transported through a country (goods in transit) or temporarily admitted or withdrawn (except for goods for inward or outward processing) do not add to or subtract from the stock of material resources of a country and are not included in the international merchandise trade statistics. Fisheries products are classified according to the International Merchandise Trade Statistics, Concepts and Definitions manual.

Data source

The immediate source of all data presented here is the OECD *Sustainable Ocean Economy Database*, a synthetic database that brings relevant datasets from across the OECD and partner organisations together in a single place:

OECD, "Sustainable Ocean Economy", *OECD Environment Statistics* (database), https://stats.oecd.org/index.aspx?datasetcode=OCEAN

Original sources include:

- International Energy Agency (IEA): *CO2 Emissions from Fuel Combustion*, *Detailed Country RD&D Budgets*
- International Transport Forum (ITF): *Freight Transport*
- OECD *Environment Statistics* (Biodiversity, Land cover change, Protected areas, Environmentally related tax revenue, Innovation in environment-related technologies).
- OECD *Fisheries Statistics* (Fish stocks, Illegal, unreported and unregulated fishing, Marine landings, Production from aquaculture, Employment in fisheries, Fishing fleet, Trade in products)
- OECD *Green Growth Indicators*
- OECD *International Trade in Services Statistics*
- OECD *Inventory of Support Measures for Fossil Fuels*
- OECD *Policy Instruments for the Environment (PINE) Database*.

References and further reading

Bahri, T. et al. (eds.) (2021), "Adaptive management of fisheries in response to climate change", *FAO Fisheries and Aquaculture Technical Paper*, No. 667, Food and Agriculture Organization, Rome, https://doi.org/10.4060/cb3095en.

Barbier, E. (2017), "Marine ecosystem services", Current Biology, Vol. 27/11, pp. R507-R510, https://doi.org/10.1016/j.cub.2017.03.020.

Carpenter, K.E. et al. (2008), "One-third of reef-building corals face elevated extinction risk from climate change and local impacts", *Science*, Vol. 321/5888, http://doi.org/10.1126/science.1159196.

Costello, C. et al. (2016), "Global fishery prospects under contrasting management regimes", Proceedings of the National Academy of Sciences, Vol. 113/18, pp. 5125-5129, https://doi.org/10.1073/pnas.1520420113.

Dureuil, M. et al. (2018), "Elevated trawling inside protected areas undermines conservation outcomes in a global fishing hot spot", *Science*, Vol. 362/6421, https://doi.org/10.1126/science.aau0561.

Halpern, B.S. et al. (2017), "Drivers and implications of change in global ocean health over the past five years", *PloS one*, Vol. 12/7, https://doi.org/10.1371/journal.pone.0178267.

Haščič, I. and M. Migotto (2015), "Measuring environmental innovation using patent data", *OECD Environment Working Papers*, No. 89, OECD Publishing, Paris, https://doi.org/10.1787/5js009kf48xw-en.

Hilborn, R. et al. (2020), "Effective fisheries management instrumental in improving fish stock status", Proceedings of the National Academy of Sciences, Vol. 117/4, pp. 2218-2224, https://doi.org/10.1073/pnas.1909726116.

Hutniczak, B., C. Delpeuch and A. Leroy (2019), "Closing Gaps in National Regulations Against IUU Fishing", *OECD Food, Agriculture and Fisheries Papers*, No. 120, OECD Publishing, Paris, https://dx.doi.org/10.1787/9b86ba08-en.

IEA (2018), *Energy Technology RD&D Budgets 2018: Overview*, IEA, Paris, www.iea.org/statistics/rdd.

ITF (2019), *ITF Transport Outlook 2019*, OECD Publishing, Paris, https://doi.org/10.1787/transp_outlook-en-2019-en.

IUCN (2022), *The IUCN Red List of Threatened Species*, Version 2022-2, www.iucnredlist.org. Accessed on [18 May 2023]

Oppenheimer, M., B.C. Glavovic , J. Hinkel, R. van de Wal, A.K. Magnan, A. Abd-Elgawad, R. Cai, M. Cifuentes-Jara, R.M. DeConto, T. Ghosh, J. Hay, F. Isla, B. Marzeion, B. Meyssignac, and Z. Sebesvari, 2019: Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities. In: *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 321-445. https://doi.org/10.1017/9781009157964.006.

OECD/FAO (2021), OECD-FAO Agricultural Outlook 2021-2030, OECD Publishing, Paris, https://doi.org/10.1787/19428846-en.

OECD, *Environment Statistics* (database), https://doi.org/10.1787/env-data-en.

OECD (2022), OECD Tourism Trends and Policies 2022, OECD Publishing, Paris, https://doi.org/10.1787/a8dd3019-en

OECD (2022b), OECD Review of Fisheries 2022, OECD Publishing, Paris, https://doi.org/10.1787/9c3ad238-en.

OECD (2020), *Policy Instruments for the Environment (PINE)* database, December 2019 edition, www.oecd.org/environment/indicators-modelling-outlooks/policy-instrument-database.

OECD (2019), *Inventory of Fossil Fuel Support Measures,* www.oecd.org/fossil-fuels.

OECD (2019), *Responding to Rising Seas: OECD Country Approaches to Tackling Coastal Risks*, OECD Publishing, Paris. https://doi.org/10.1787/9789264312487-en.

OECD (2019), *Rethinking Innovation for a Sustainable Ocean Economy*, OECD Publishing, Paris, https://doi.org/10.1787/9789264311053-en.

OECD (2019), *Revenue Statistics 2019*, OECD Publishing, Paris, https://doi.org/10.1787/0bbc27da-en.

OECD (2018), *OECD Companion to the Inventory of Support Measures for Fossil Fuels 2018*, OECD Publishing, Paris, https://doi.org/10.1787/9789264286061-en.

OECD (2017a), *Marine Protected Areas: Economics, Management and Effective Policy Mixes*, OECD Publishing, Paris, https://doi.org/10.1787/9789264276208-en.

OECD (2017b), *Green Growth Indicators 2017*, OECD Green Growth Studies, OECD Publishing, Paris, https://doi.org/10.1787/9789264268586-en.

OECD (2017c), *OECD Review of Fisheries: Policies and Summary Statistics 2017*, OECD Publishing, Paris, https://doi.org/10.1787/rev_fish_stat_en-2017-en.

OECD (2016), *The Ocean Economy in 2030*, OECD Publishing, Paris, https://doi.org/10.1787/9789264251724-en.

OECD (2011), *Invention and Transfer of Environmental Technologies*, OECD Studies on Environmental Innovation, OECD Publishing, Paris, https://doi.org/10.1787/9789264115620-en.

Worm, B. et al. (2006), Impacts of biodiversity loss on ocean ecosystem services. *Science*, Vol. 314/5800, http://doi.org/10.1126/science.1132294.

WWF (2015), *Living Blue Planet Report. Species, habitats and human well-being*, Tanzer, J. et al. (eds), WWF, Gland, Switzerland, www.wwf.or.jp/activities/data/20150831LBPT.pdf.

