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BLUE ECONOMY AND OFFSHORE WIND

SUPERVISOR
Prof. Aldo Ravazzi Douvan

CANDIDATE
Lodovica Chiorino
273681

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Introduction

The concept of the "Blue Economy" has come to light as a revolutionary strategy for solving the problems associated with managing marine resources and sustainable development. In a time when concern for the environment is growing and sustainable practices are becoming more and more important, the Blue Economy provides a framework that balances economic development with the preservation of maritime environments. The present thesis looks into the different aspects of the Blue Economy, specifically emphasizing offshore wind energy as a fundamental constituent of marine renewable energy sources.

1. Blue economy

1.1. Background, historical evolution, and context of the Blue Economy

In recent decades, the concept of the Blue Economy has gained increasing relevance on the international stage, assuming a central role in discussions regarding sustainable development and the management of marine resources. The Blue Economy represents an innovative and interdisciplinary approach aimed at reconciling economic objectives with the conservation of marine ecosystems, promoting sustainable use of oceanic resources to foster economic growth, improve the living conditions of coastal communities, and preserve the marine environment for future generations.

Throughout history, coastal communities have relied on marine resources for sustenance and trade. Fishing, shipping, and maritime trade were among the earliest forms of economic activity related to the oceans. However, these activities were often exploitative and lacked sustainability measures.

The industrial revolution led to increased exploitation of marine resources, driven by advancements in technology and global demand for commodities such as fish, oil, and minerals. This period saw the rise of large-scale commercial fishing fleets, offshore drilling, and seabed mining, often resulting in overfishing, habitat destruction, and pollution.

In the latter half of the 20th century, growing environmental awareness and concerns about the health of marine ecosystems prompted efforts to conserve and manage ocean resources more sustainably. Initiatives such as marine protected areas, fisheries

management plans, and pollution control measures aimed to address the negative impacts of human activities on the oceans.

The concept of sustainable development gained prominence in the late 20th century, emphasizing the need to balance economic growth with environmental protection and social equity. This paradigm shift influenced approaches to ocean governance and resource management, paving the way for the integration of environmental sustainability principles into economic activities related to the oceans.

Governments, international organizations, and non-governmental actors have increasingly recognized the importance of the Blue Economy and have developed policy frameworks and initiatives to support its implementation. These include the United Nations Sustainable Development Goal 14 (Life Below Water), regional agreements such as the European Union's Blue Growth Strategy, and national Blue Economy strategies adopted by countries worldwide.

Let's begin by clarifying what the Blue Economy entails. To start, it's important to understand that this term encompasses two distinct yet interconnected phenomena:

a) The Blue Economy primarily denotes the range of economic activities situated in or revolving around the oceans and seas.
b) However, Gunter Pauli's work, "The Blue Economy: 10 years, 100 Innovations. 100 million Jobs," introduces another perspective. Here, the Blue Economy is seen as a specialized branch of the green economy, focusing on creating a sustainable economic system through technological innovation.

While both notions strive for increased sustainability, the former emphasizes the significance and central role of oceans and seas.

Let's now refine our understanding of the Blue Economy. It encompasses all efforts and industries associated with oceans, seas, and coastlines, directly operating within the marine environment or its immediate vicinity. Consequently, these activities have a vested interest in conserving and revitalizing this ecosystem.

- According to the World Bank, the Blue Economy embodies "the sustainable utilization of oceanic resources for economic advancement, enhanced livelihoods, and the protection of marine ecosystems."

- Conversely, as per the European Commission, it encompasses "all economic undertakings linked to oceans, seas, and coastlines, spanning various established and emerging sectors."
- Moreover, the Commonwealth of Nations defines it as "an emerging concept advocating improved management of marine resources."

Hence, while the overarching focus of the Blue Economy is well-defined and widely acknowledged, formal definitions may slightly differ[1].

1.2. Importance and Relevance of Studying the Blue Economy

Seen from space, Earth appears as a blue marble: 72% of our planet's surface is indeed covered with water. 97% of the water present on Earth is contained in seas and oceans, the largest of which, the Pacific Ocean, alone occupies over a third of the Earth's surface. It is therefore very clear how beneficial the ocean is for humankind.

Let's look at some numbers:

- 1st PRODUCER OF OXYGEN ON EARTH (50 % of word oxygen vs 21 % by forest) thanks to algae and photosynthesizing plankton.
- 90 % OF WORLD'S TRADED GOODS carried by sea.
- MORE THAN 3 BILLION PEOPLE DEPEND ON THE OCEANS for their main sources of proteins.
- 97% OF THE EARTH'S WATER PROVIDED BY OCEANS vs. only 3 % for freshwater.
- EATING: more than 3 billion people depend on the oceans for their main sources of proteins
- AN OFFSHORE WIND TURBINE CAN GENERATE TWICE as much energy as an onshore one[2].

From our perspective, it may not seem so, but discussing the environment effectively means, first and foremost, talking about these vast expanses of water. Knowing moreover that everything is interconnected. Even concerning negative aspects: we know, for example, that the oceans are polluted by our microplastics, and that humans, decidedly

[1] Casa Engie, 2023, "Blue economy: Perchè è importante per un futuro sostenibile" https://casa.engie.it/magazine/blue-economy/

[2] CPR Invest, 2023, "Because protecting our planet requires a sea change"

terrestrial animals, have unwittingly created that enormous floating garbage patch called the Pacific trash vortex, which according to some estimates, is larger than the United States. And again, we know that global warming caused by anthropogenic greenhouse gases is endangering corals, cetaceans, and many other marine species.
This is why, when speaking of sustainability, it would always be wise to also consider the health of the oceans.

1.3. The Ocean Economy

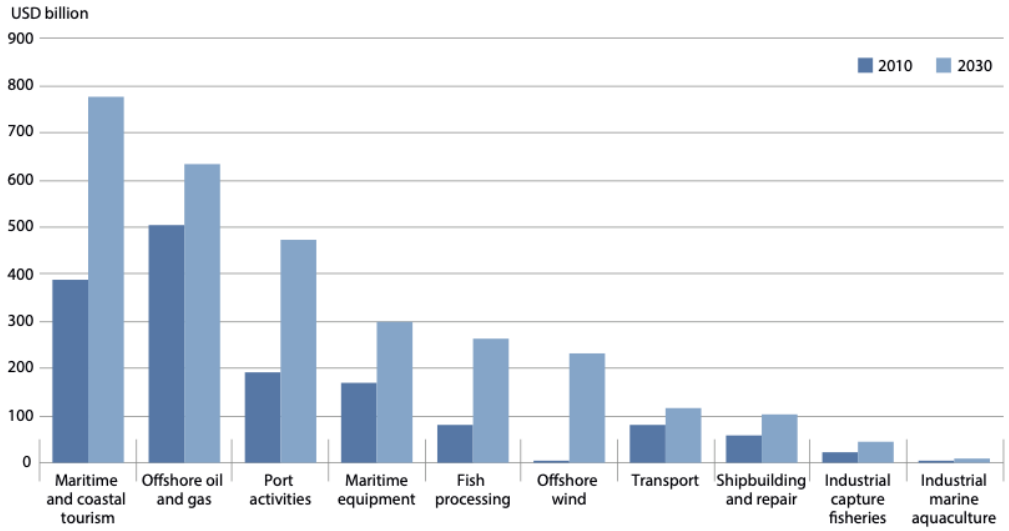
The OECD (Organization for Economic Co-operation and Development) defines the ocean economy as the total economic output generated by industries relying on the ocean, along with the assets, products, and services provided by marine ecosystems. These two components are closely intertwined: many activities within ocean-based industries rely on marine ecosystems, while industrial operations often impact these ecosystems. The connection between businesses that depend on the ocean and the health of marine life, along with the rising dangers to the ocean's well-being, is making people realize that we need to manage the ocean in a more unified way.
Recognizing the economic significance of marine ecosystems could stimulate integrated ocean management to advance sustainability objectives. The need for this is gaining more attention at national and international levels.

Earlier assessments from the OECD forecasted a significant increase in various oceanic economic sectors by 2030 (OECD 2016). Projections indicated that the economic value produced by ocean – related industries worldwide could potentially double in size, escalating from USD 1.5 trillion in 2010 to USD 3 trillion by 2030. Specifically, industries such as marine aquaculture, marine capture fisheries, marine fish processing, offshore wind and port activities were seen as having the capacity to outperform the global economy in terms of growth.
Governments have implemented significant measures in response to COVID-19 pandemic, affecting global trade and transportation. Economic slowdown is expected, with uncertainty challenging strategies for maintaining the ocean economy. However, factors driving growth, such as long-term demand for marine resources, persist. Ensuring

sustainability in decision-making processes remains imperative for policymakers, especially as they consider stimulus strategies.

Implementing comprehensive management approaches, encouraging cooperation between ocean science and industry, and enhancing the collection and distribution of marine data and several measures that could enhance economic growth while promoting the preservation and responsible utilization of marine ecosystems.
Additionally, the ocean presents opportunities for clean energy generation (like Offshore Wind Energy) and other renewable resources that remain largely undeveloped in various regions worldwide, offering prospects for sustainable economic development through targeted investments. Given the challenges of the pandemic, the OECD will persist in examining ocean-based economic activities and their potential future, with a specific focus on the role of science, technology and innovation in sustainable development.

Figure 1: Prior to COVID-19, ocean-based industries' value-added was expected to double by 2030



Source: OECD, "OECD work in support of a sustainable ocean", 2020, p. 2-3

1.4. Ocean and climate change: carbon absorption, rising sea level and rising ocean temperature

The ocean regulates the global climate by mediating temperature and determining rainfall, droughts and floods. The Intergovernmental Panel on Climate Change (IPCC) Synthesis Report on Climate Change (2023) analyses warming and its causes. *"Human activities,*

principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850-1900 in 2011-2020. Global greenhouse gas emissions have continued to increase, with unequal historical and ongoing contributions arising from unsustainable energy use, land use and land-use change, lifestyles and patterns of consumption and production across regions, between and within countries, and among individuals".

- Global surface temperature was 1.09 °C higher in 2011-2020 than 1850-1900 with larger increases over land than over the ocean. Global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years.
- The likely range of total human-caused global surface temperature increase from 1850–1900 to 2010–2019 is 0.8°C to 1.3°C.
- Over this period, it is likely that well-mixed greenhouse gases (GHGs) contributed a warming of 1.0°C to 2.0°C.
- In 2019, atmospheric CO2 concentrations (410 parts per million) were higher than at any time in at least 2 million years, and concentrations of methane (1866 parts per billion) and nitrous oxide (332 parts per billion) were higher than at any time in at least 800,000 years.

"Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred. Human-caused climate change is already affecting many weather and climate extremes in every region across the globe. This has led to widespread adverse impacts and related losses and damages to nature and people. Vulnerable communities who have historically contributed the least to current climate change are disproportionately affected".

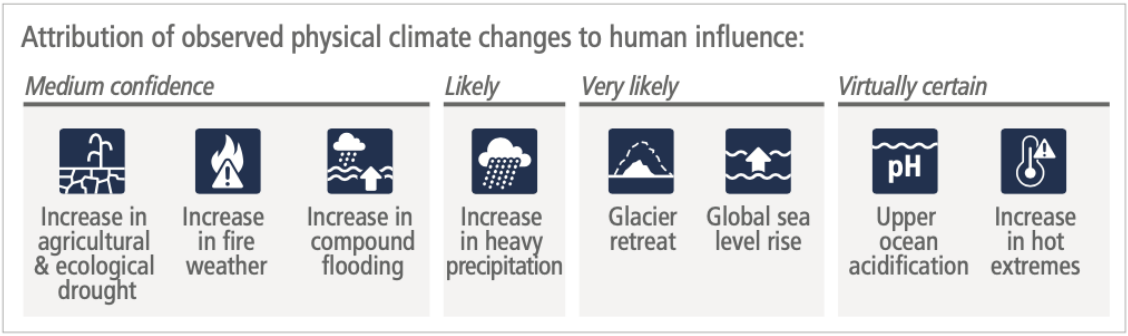
- It is unequivocal that human influence has warmed the atmosphere, ocean and land. Global mean sea level increased by 0.20m between 1901 and 2018.

Human influence was very likely the main driver of these increases since at least 1971. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has further strengthened since AR5. Human influence has likely increased the chance of compound extreme events since the 1950s, including increases in the frequency of concurrent heatwaves and droughts.

- Approximately 3.3 to 3.6 billion people live in contexts that are highly vulnerable to climate change. Human and ecosystem vulnerability are interdependent. Regions and people with considerable development constraints have high vulnerability to climatic hazards. Increasing weather and climate extreme events have exposed millions of people to acute food insecurity and reduced water security, with the largest adverse impacts observed in many locations and/or communities in Africa, Asia, Central and South America, LDCs, Small Islands and the Arctic, and globally for Indigenous Peoples, small-scale food producers and low-income households. Between 2010 and 2020, human mortality from floods, droughts and storms was 15 times higher in highly vulnerable regions, compared to regions with very low vulnerability.
- Climate change has caused substantial damages, and increasingly irreversible losses, in terrestrial, freshwater, cryospheric, and coastal and open ocean ecosystems. Hundreds of local losses of species have been driven by increases in the magnitude of heat extremes with mass mortality events recorded on land and in the ocean. Impacts on some ecosystems are approaching irreversibility such as the impacts of hydrological changes resulting from the retreat of glaciers, or the changes in some mountain and Arctic ecosystems driven by permafrost thaw.
- Climate change has caused widespread adverse impacts and related losses and damages13 to nature and people that are unequally distributed across systems, regions and sectors. Economic damages from climate change have been detected in climate-exposed sectors, such as agriculture, forestry, fishery, energy, and tourism[3].

Figure 2: Impacts are driven by changes in multiple physical climate conditions, which are increasingly attributed to human influence

[3] IPCC, Climate change synthesis report, 2023
https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf



Source: IPCC Climate change 2023 synthesis report, p. 4-7

1.5. UN SDG 14: Life Below Water

The United Nations Sustainable Development Goals (SDGs) are a universal call to action to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity by 2030. Adopted by all United Nations Member States in 2015 as part of the 2030 Agenda for Sustainable Development, the SDGs provide a shared blueprint for peace and prosperity for people and the planet, now and into the future.

Comprising 17 interconnected goals, the SDGs address a wide range of social, economic, and environmental challenges facing the world today. These goals encompass issues such as poverty eradication, health and well-being, quality education, gender equality, clean water and sanitation, affordable and clean energy, decent work and economic growth, sustainable cities and communities, responsible consumption and production, climate action, life below water, life on land, peace, justice, and strong institutions.

The SDGs recognize that achieving sustainable development requires collective action from governments, businesses, civil society, and individuals worldwide. They encourage collaboration, innovation, and partnerships to tackle complex global issues and create a more inclusive, equitable, and sustainable future for all.

Key principles underlying the SDGs include universality, leaving no one behind, and integrating the economic, social, and environmental dimensions of development. Progress towards the SDGs is measured using a set of global indicators, and countries are encouraged to regularly review and report on their progress towards achieving the goals.

Overall, the SDGs represent a shared commitment to building a better world for present and future generations, and they serve as a guiding framework for global development efforts over the next decade and beyond.

SDG 14 specifically focuses on "Life Below Water" and aims to conserve and sustainably use the oceans, seas, and marine resources for sustainable development. Here is a breakdown of the targets under SDG 14 by The Global Goals[4]:

1. Reduce marine pollution: by 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.
2. Protect and restore ecosystems: by 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans.
3. Reduce ocean acidification: minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels.
4. Sustainable fishing: by 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics.
5. Conserve coastal and marine areas: by 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information.
6. End subsidies contributing to overfishing: by 2020, prohibit certain forms of fisheries subsides which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsides, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation.
7. Increase the economic benefits from sustainable use of marine resources: by 2030, increase the economic benefits to small island developing States and least

[4] The Global Goals, https://www.globalgoals.org/goals/14-life-below-water/

developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism.

8. Increase scientific knowledge, research and technology for ocean health: increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries.
9. Support small scale fishers: provide access for small scale artisanal fisheries to marine resources and markets.
10. Implement and enforce international sea law: enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in the United Nations Convention on the Law of the Sea, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of "the future we want".

2. Visible assets and services

2.1. Fisheries and aquaculture

2.1.1. Economic impact and important data

Every day, the nutrition of hundreds of millions of people worldwide is largely dependent on aquaculture and fisheries. Nowadays, almost 60 million people are employed in the aquaculture industry because of the industry's massive expansion, mostly in Asia. In addition, we have some significant data based on FAO's (food and agriculture organization) latest report. First, world population is expected to reach 8.5 billion by 2030. Probably as a consequence of this, annual fish consumption is predicted to exceed 21.2 Kg per capita by 2030. As it is stated in the report, since 1950 the global fisheries and aquaculture production has increased by 820% and in 2019, 92.5 million tons of fish from capture fisheries and 85.3 million tons of fish from aquaculture (aquatic plants not included) were produced[5].

[5] FAO, FAO Fisheries and Aquaculture Division, 2022, p.2
https://www.fao.org/3/cb8609en/cb8609en.pdf#page=16

2.1.2. IUU fishing and OECD policies

Climate change, fishing pressure and pollution from various human activities are causing ocean acidification and declining biodiversity. Global fisheries could generate billions more in benefits if they were better managed. A significant share of the losses due to mismanagement is estimated to be caused by illegal, unreported and unregulated (IUU) fishing.

This term refers to a variety of illicit activities that occur both in national and international waters and affect all sectors of the fisheries industry. It includes every step of the fishing process, from catching to using the fish and it is occasionally connected to organized crime. In the specific:

- ILLEGAL FISHING: fishing without permission or violating the laws of the territorial waters, activities by ships flying the flags of governments that are members of a regional organization for the management of fisheries, but which are acting in opposition to the conservation measures enforced by the organization, which these states have committed to preserve and finally actions that violate international agreements or national laws, especially those made inside regional fisheries management bodies.
- UNREPORTED FISHING: fishing operations that break national restrictions by not reporting them to authorities or by reporting them falsely, fishing activities within areas overseen by a regional fisheries management organization that are either not reported or inaccurately reported, in violation of the organization's established reporting guidelines.
- UNREGULATED FISHING: fishing that goes against the organization's conservation guidelines being done by stateless boats or those from non-member states of the applicable regional fisheries management organization, fishing in areas or for fish stocks when there are no formal conservation or management strategies in place or if fishing is done in a manner that is against international regulations protecting marine resources[6].

[6] FAO, "What is IUU fishing", 2022 https://www.fao.org/iuu-fishing/background/what-is-iuu-fishing/en/

Governments are becoming more conscious of the flaws of the frameworks used to govern fisheries and aquaculture, and that if sustainability and productivity are to be increased, new rules and technologies will be required. Nevertheless, reforming fisheries and aquaculture policies can be challenging because there are many competing interests and because collecting information on marine resources and ecosystems is difficult and expensive.

In order to achieve environmentally friendly fisheries and sustainable aquaculture, the OECD supports governments in establishing effective policies and governance.

Their work fosters communication between authorities in charge of fisheries and aquaculture policies in OECD member countries and beyond, and it adds to a stronger body of evidence supporting policy decisions.

Using the FSE database which tracks fisheries support policies in a uniform and transparent manner across all OECD member countries and significant non-member fishing economies, recent work promotes discussion on government support to the fisheries industry. This database is an invaluable tool for monitoring the UN SDG 14 and providing information during negotiations on fisheries subsidies at the World Trade Organization. Users can also utilize the FSE database as a foundation to explore how fisheries support policies affect ecosystems, resources, employment, and value generation. This allows policymakers to make necessary adjustments to better achieve the objectives that the policies were intended to achieve.

The recent report Relative Effects of Fisheries Support Policies suggests ways to better align the choice of support policies with stated sector objectives while minimizing their impact on resources, according to the new report Relative Effects of Fisheries Support Policies. Research has demonstrated, for instance, that policies aimed at reducing the cost of inputs like fuel or the building and modernization of vessels are among the most likely to lead to overfishing, overcapacity and IUU fishing. In the process they favor large fishers over small producers, resulting in less inclusive outcomes. Of the direct support provided by the 27 OECD nations that participate in the FSE database to individuals or businesses in the fisheries sector in 2017, these programs accounted for 40% of the total.

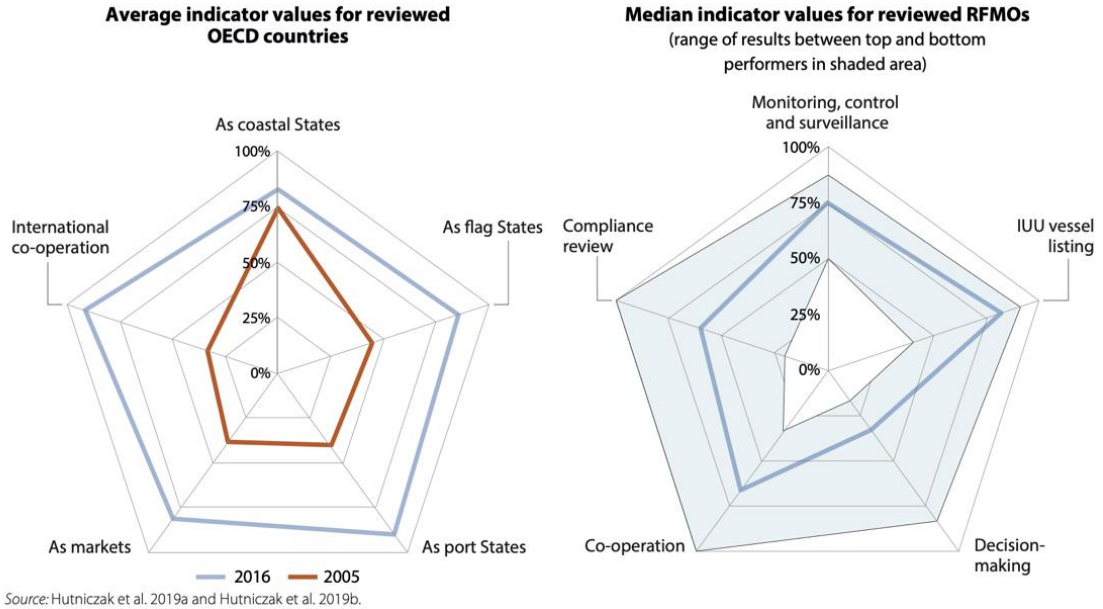
Countries can better address IUU fishing by using the findings of two recent OECD studies, “Closing gaps in national regulations against IUU fishing” and “Intensifying the fight against IUU fishing at the regional level”. The reports examine, using a range of

indicators, how well governments are carrying out their mandates to prevent IUU fishing as well as how well RFMOs (Regional Fisheries Management Organizations) are utilizing best practices to assist their member nations. The findings indicate that there has been a significant improvement in the previous ten years in terms of both enforcing laws and regulating frameworks (as shown in Figure 3), but there are still gaps that require both individual and group attention. RFMOs and nations are given specific advice on how to accomplish this: for example, in a number of nations, laws governing fishing-related activities, such as transshipment of catch between vessels, need to be strengthened to levels comparable to those governing fishing. Additionally, fishermen who break the law should face harsher penalties and lose access to public assistance. In addition, to implementing catch documentation programs that standardize the certification of lawful captures, they should establish severe and open methods for penalizing nations that violate their duties as RFMO members.

The OECD is also focused on facilitating policy reforms in challenging environments, where getting data is challenging and costly.

Governments can discover an effective reform path by enhancing governance, consulting stakeholders, and mobilizing scientific evidence and analysis, as suggested by the OECD report Encouraging policy change for sustainable and resilient fisheries.

Figure 3: OECD countries have shown considerable progress in fighting IUU fishing over the last decade, but gaps remain



Source: Hutniczak et al. 2019a and Hutniczak et al. 2019b.

Source: “OECD work in support of a sustainable ocean”, 2020, p. 21-23

2.2. Maritime Transport and Shipping

2.2.1. Introduction

Almost 90% of traded products are delivered by ship, making ocean shipping the primary form of transportation for international trade. Therefore, the oceans serve as the primary means of transportation for international trade. Both opportunities and challenges accompany this. The OECD is assisting in the planning of a more sustainable and effective maritime transportation system.

Maritime transportation is a component of a broad range of commercial activities that have the potential to generate added economic value. Effective maritime transportation can expand markets by reducing export costs. Costs associated with maritime transportation have dropped in recent decades as a result of container shipping and larger ships. This has contributed to global outsourcing, which has increased global industrial specialization patterns but also contributed to the decline of manufacturing employment in OECD countries. Thus, the growth in marine trade has produced a range of outcomes. Efficiency of the maritime supply chain has increased in many areas, but there is still need to improve the interfaces between the many stakeholders. Digitalization and information exchange amongst public and private parties in the maritime logistics chain may help in reducing inefficiencies and promoting efficient operations. The challenge is to make sure that digitalization is not used as a business strategy by a few powerful players to lock in customers and reduce competition[7].

2.2.2. New policy challenges

Ocean shipping is a component of a wider maritime cluster. The shipping business requires ports, terminals, and logistics services in addition to purchasing ships, which supports the shipbuilding sector. Such marine clusters are significant sources of economic value added, jobs, and know how in port-cities. This expertise may be necessary for developing new ocean-based initiatives like offshore energy production.

The main problem for policy makers is ensuring that policy assistance for the shipping sector yields more economic advantages rather than just enabling a “race to the bottom”

[7] “OECD work in support of a sustainable ocean”, 2020, p. 24-26

among flag states competing to attract shipping corporations through tax breaks, subsidies, or looser regulations.

Increased market concentration and ever larger ships are two examples of how developments in maritime transportation have an impact on public infrastructures like ports, which are under the jurisdiction of public bodies and governments.

Maritime transportation contributes to pollution as well as wealth. About 30% of all NOx emissions worldwide are caused by global shipping. This is a significant portion of air pollutants. In coastal locations, these pollutants have been connected to thousands of preventable deaths. The International Maritime Organizations (IMO) and its member governments announced a plan in 2018 to reduce greenhouse gas emissions from shipping. This plan calls for both absolute and relative emission reduction goals, one of which is to cut shipping emissions from 2008 levels by at least 50% by 2050. To achieve a global agreement on the actions needed to meet these targets, a great deal of work will be required.

The 2018 ITF report provides potential mitigation options that include various combinations of technical and operational solutions, such as more energy-efficient ship designs and reduced ship speeds, as well as the usage of renewable energy sources like wind and hydrogen. Global rules are generally necessary for the successful implementation of such measures, but national policies and framework conditions can also be used by states to encourage the reduction of GHG emissions from shipping.

Additional environmental effects of shipping include the reduction of biodiversity caused by ship ballast water and the disturbance of marine life by noise pollution.

Global policy initiatives have recently concentrated on managing ballast water and the emissions of greenhouse gases and sulfur from ships.

A global cap on the amount of sulfur in ship fuel has been implemented in 2020 as part of a significant global regulation on sulfur emissions from shipping. In its 2016 report "Reducing Sulphur Emissions from Ships: The Impact of International Regulation" ITF offered suggestions for the application and enforcement of this rule. There is room for increased effort in the areas of NOx and PM emissions[8].

[8] "OECD work in support of a sustainable ocean", 2020, p. 24-26

2.3. Coastal and Marine Tourism

2.3.1. Introduction

Coastal and marine tourism represents at least 50 percent of total global tourism. For the majority of small islands developing states and certain coastal states, tourism is the main source of income, and its ability to draw tourists is strongly influenced by the condition of the coastal and marine ecosystems. This indicates that the industry is very susceptible to risks including pollution, climate change, and biodiversity loss.

The foundation of a sustainable ocean economy is a healthy ocean. Through the stimulation of new and high-quality economic opportunities for local communities, the restoration and strengthening of the resilience of the ecosystems in which they operate, and the revitalization of culture and heritage, a sustainable, regenerative, and resilient coastal and marine tourism sector can deliver protection, production and prosperity[9].

2.3.2. Ocean Panel Action Agenda

In December 2020, the High-Level Panel for a Sustainable Ocean Economy (Ocean Panel) launched its ocean action agenda, the "Transformations for a Sustainable Ocean Economy: A Vision for Protection, Production and Prosperity".

The main goal is that coastal and ocean-based tourism must be "sustainable, resilient, addresses climate change, reduces pollution, supports ecosystems regeneration and biodiversity conservation, and invests in local jobs and communities" by 2030.

In order to accomplish this goal, the following areas must be discussed:

- Invest in sustainable tourism that regenerates the ecosystems on which it depends, builds the resilience of coastal communities and Indigenous Peoples, reduces inequality through promoting equal opportunity and equitable distribution of benefits and addresses climate change and pollution (for example: Palau is the first country in the world to change its immigration laws to ensure environmental protection whereby upon entry, visitors must sign a passport pledge that they will act in a culturally and environmentally responsible way for the duration of their trip).

[9] High Level Panel, Sustainable coastal and marine tourism, 2020
https://oceanpanel.org/opportunity/sustainable-coastal-marine-tourism/

- Implement sustainable tourism management strategies that advance environmental, social and economic priorities and enable monitoring and transparent reporting with the full participation of coastal communities and Indigenous Peoples (for example: Maya Ka'an is the first low-impact and sustainable destination brand in Quintana Roo, Mexico. The initiative aims to minimize the impact of tourism on the environment and diversify the tourism industry for the benefit of local communities with ecotourism, rural tourism and adventure tourism activities linked to Mayan communities).
- Implement mechanisms to increase the reinvestment of tourism revenue into local and Indigenous communities to build capacity and skills for increasing local employment in tourism, diversify economic opportunities and increase resources for coastal and marine restoration and protection (for example: In Japan, Ama tourism is keeping traditional knowledge alive. Ama, meaning sea women, free dive to collect abalone, sea snails and other small shore creatures as well as harvest seaweed. The practice appears in ancient literature and is a part of the history of the area, Shima, in the Mie prefecture. The availability of tours changes with the diving season in order to observe changes to the environment and ensure they do not cause harm. The tourism experience provides a source of supplementary income to the coastal communities but also preserves and continues local knowledge and skills for future generations.
- Accelerate financial incentives for including nature-based solutions in sustainable tourism infrastructure (for example: the UK Government through the G7 Legacy Project for Nature Recovery, aims to over five years deliver for people, nature and climate and contribute to the 30x30 target. This includes transforming the tourism sector in Cornwall through the recovery of blue carbon habitats, improving water quality and creating once-scarce habitats such as wetlands, while creating 'green' jobs that involve the local community in nature's recovery)
- Invest in sewerage and wastewater infrastructure for coastal and marine tourism to improve the health of coastal communities and reduce the impacts on coastal and marine ecosystems (for example: Atout France, the France Tourism Development Agency, established a new system for awarding hotels that commit fully to sustainable actions. The new system contains mandatory criteria such as

water-saving and waste management measures as well as waste sorting systems for guests).

But still, the task does not end here. For instance, by minimizing plastic waste and eliminating harmful and superfluous plastics, the tourism industry may play a significant role in promoting the responsible use of plastics. In addition to the five main actions, the Ocean Panel countries are carrying out an extensive range of projects and programs that demonstrate the diversity of activities taking place based on their particular circumstances and national contexts. An example, in spring 2022, Canada introduced new non-mandatory environmental measures that strengthen discharge requirements for cruise ships operating in waters under Canadian jurisdiction. The measures were developed and implemented in full collaboration with the industry and aim to help restore marine habitats[10].

2.3.3. The Blue Generation Conference

The Blue Generation Conference, organized by the Blue Generation Project, took place in Brussels on 5th July 2023. The goal of this initiative is to inspire and motivate youth to pursue careers in the Blue Economy in order to promote the preservation and sustainable growth of Europe's maritime and coastal regions. It focuses on increasing awareness, developing youth's abilities, and providing opportunities.

Among the established sectors of the Blue Economy, coastal tourism keeps generating the largest share of employment and GVA in the EU Blue Economy.

It is critical to acquire pertinent blue skills in order to support a healthy coastal tourism sector and other blue economy industries. In keeping with the European Year of Skills, which emphasizes providing individuals with the necessary skills for high quality employment and fostering the sustainable expansion of business, the EU4Ocean Coalition, which is an organization that connects projects and people to contribute to

[10] High Level Panel, "Advancing action towards sustainable coastal and marine tourism", 2020 https://oceanpanel.org/wp-content/uploads/2023/03/WRI_Tourism_Booklet_Web_v3-1.pdf

ocean literacy and the sustainable management of the ocean, has made improving ocean literacy skills the subject of its 2023 Challenge of the Year[11].

2.4. Marine Energy

2.4.1. Introduction

The energy carried by ocean waves, tides, salinity and temperature variations is known as marine energy or marine power. It is also occasionally referred to as ocean energy, ocean power, or marine and hydrokinetic energy. Kinetic energy, or energy in motion, is created by the flow of water in the oceans across the world. A portion of this energy can be used to create electricity for use in factories, vehicles and residences.

Marine energy is currently a huge, almost untapped energy reserve with inexhaustible potential. If the power of the seas and oceans could be fully harnessed, it would cover the entire energy consumption forecast by the IEA (International Energy Agency) already by 2035. A potential that, however, clashes with the current limits in terms of cost and replicability of the necessary technologies.

Ocean and seas have only just started to play a part in the renewable energy arena. According to the IRENA (International Renewable Energy Agency) 2019 report, marine energy has an installed capacity of 500 MW, which is still significantly less than what its "big sisters" can do. However the sea has very high potential. The IEA's Ocean Energy System 2014 and Ocean Energy Europe 2016 predict that by 2050, marine energy will mostly reach Europe, reaching a capacity of 100 GW in the Old Continent, able to meet 10% of the continent's electricity consumption and creating an estimated 40.000 new jobs[12].

2.4.2. Tidal, wave and OTEC technologies

Ocean energy technologies are often classified according to the energy generating resource. The most extensively established technology worldwide are tidal stream and weave energy converters, with exception of tidal range, which is only useful in specific

[11] European Commission, "Developing skills for the blue economy", 2023 https://maritime-forum.ec.europa.eu/contents/map-week-developing-skills-blue-economy-coastal-tourism_en

[12] Enel Green Power, "Energia marina" https://www.enelgreenpower.com/it/learning-hub/energie-rinnovabili/energia-marina

areas. Over longer time horizons, other ocean energy technologies that capture energy from temperature changes (such ocean thermal energy conversion, or OTEC) or salinity differences might become more and more significant.

Of all ocean energy methods, tidal energy has the lowest potential for producing electricity theoretically (roughly 1200 TWh annually). This is because only a few dozen countries are truly able to utilize this resource, which makes it location specific. It's interesting to note that the current cumulative global installed capacity for ocean energy technologies is dominated by tidal range, a subcategory of tidal technology. At the moment, tidal range accounts for 98% of installed capacity worldwide, mostly due to two sizable installations: a 240 MW plant established in France and a 254 MW plant completed in the Republic of Korea.
There are different types of tidal energy technologies: horizontal or vertical axis turbine, barrage, tidal kite and even Archimedes screw in which a tidal stream passes through the spiral of a helical-shaped device. The device starts to turn, and the rotation is converted into energy.

Wave energy has a theoretical potential of 29,500 TWh annually and is primarily found in deep water (> 40 meters) and latitudes between 30 and 60 degrees. Unlike other technologies like wind energy, wave energy technologies have not experienced a convergence towards a single design. We have: oscillating water column, overtopping device, attenuator which consists of multiple connected segments or a single long and flexible part that extracts energy from waves by following the parallel motion of the waves. We than have point absorber, bulge wave and rotating mass where heaving and swaying in the waves cause a weight to rotate within this device. This rotation drives an electric generator.
Wave energy is currently only being used in demonstration and pilot projects because it is less technologically ready than tidal energy. As a result, only about 2.5 MW are installed worldwide. But just like tidal turbines, wave energy devices are growing in size and power output very quickly, and new installations of about 100 MW can be anticipated in the upcoming years.

Finally, the temperature differential between the ocean's surface and deeper layers is the basis of OTEC (Ocean Thermal Energy Conversion) creation. Using cycles with heat exchangers and turbines, energy can be produced at areas where this difference is approximately 20 degrees Celsius. With 44,000 TWh annually, OTEC has the highest worldwide technical potential of all ocean energy sources. Although the technology is still in the research and development stage (R&D), 100 kW demonstration plants in Hawaii and Japan have shown promising results. A 1 MW plant is being installed by the Republic of Korea in Kiribati, in the Pacific Ocean.

The difference in salt content between two fluids can be used to produce energy by reverse electrodialysis or pressure retarded osmosis. Because the quantity of energy created is related to the difference in salt content, riverbeds where freshwater flows into the sea are suitable for this. With only 1650 TWh annually, this technology has the least potential of all ocean energy options due to geographic restrictions. Only one of these plants was producing power in the Netherlands as of 2020, but numerous nations are actively studying the technology and gathering data through small-scale testing[13].

2.4.3. Intro to offshore wind and floating solar photovoltaic (PV)

Other ocean related technologies include offshore wind. Through the use of turbines anchored in the water or mounted on floating platforms, offshore wind energy captures wind across seas to produce electricity. Higher wind speeds and close proximity to coastal towns are two benefits of this renewable energy source that improve efficiency and lower transmission costs. But this is a subject I will deal with later.

On the other hand, floating solar photovoltaic (PV) is a new technology that has the potential to grow quickly. In fact, the total installed capacity worldwide in 2018 was 1.1 GW. Due to the fact that the cost of water's surface is typically less than that of the land, there is a growing demand for floating solar PV, particularly on islands and other land constrained areas. Asia comprises China, Japan and the Republic of Korea, home to three of the top 10 plants in the world. Specifically, a 2.7 GW floating solar facility in the Yellow Sea has been announced by the Republic of Korea. India, Singapore; Thailand

[13] IRENA, "Offshore renewable energy", 2020

and Vietnam are among the other Asian nations aggressively pursuing the development of floating solar projects.

Most activity on floating PV at present relates to freshwater artificial reservoirs. Islands such as Seychelles are also interested in this application, and an offshore floating PV plant on seawater also recently began operation in the North Sea[14].

2.5. Coral reefs, Marine biotechnology and Telecoms

Coral reefs are stunning, but that doesn't take away their significance. At least 25% of all marine life depends on coral reefs, which make up less than 1% of the ocean floor.

They are essential to maintaining the complex network of biodiversity on Earth and are crucial to the wellbeing and functionality of our planet.

More than 100 nations and territories have coral reefs, which provide ecosystem services worth up to $9.9 trillion a year and sustain the lives of one billion people who depend on them. This sum accounts for the production of sustainable food, means of subsistence and revenue, defense against storm surges, therapeutic benefits, and important cultural legacy. For many of the world's most climate-vulnerable countries, coral reefs are vital to their security, resilience, and ability to adjust to changing climate conditions.

The existence of these vital ecosystems is in danger because of the climate crisis and human caused hazards including destructive fishing and tourism, agricultural runoff, sewage pollution, and plastic pollution, even though they are fundamental to ocean health and climate resilience. An area greater than the Great Barrier Reef has been a 14% loss in coral on reefs worldwide since 2009, and current forecasts indicate that 90% of the world's remaining coral reefs might gone by 2050.

Large-scale, immediate action is required to preserve, maintain, and restore coral reef ecosystems, which have major positive social, economic, and environmental effects. The expected yearly expenditure to achieve SDG 14 is 174.5 billion $; nevertheless, worldwide financing is severely insufficient. According to international experts, seven times as little money is currently being allocated for coral reef protection as is required.

In order to boost biodiversity and climate resilience, the Kunming-Montreal Global Biodiversity Framework (GBF) and Sharm El-Sheik Adaptation Agenda ask for more

[14] IRENA, "Offshore renewable energy", 2020

finance from both the public and commercial sectors. In response, the UN High-Level Climate Champions (HLCC), the Global Fund for Coral Reefs (GFCR), and the International Coral Reef Initiative (ICRI) introduced the Coral Reef Breakthrough. The program, which is a component of the ICRI's Plan of Action 2021-2024, is to safeguard 125.000 km^2 of tropical coral reefs by 2030 for the benefit of more than 500 million people. The GFCR aims to finance Blue Economy initiatives that promote the resilience and regeneration of reefs using blended finance[15].

Marine biotechnology, also known as blue bioeconomy and blue biotechnology, look at groups of marine organisms that until now often have been ignored for commercial exploitation. The blue bioeconomy uses aquatic biomass-algae, invertebrates, and microorganisms- to make a variety of goods, including food, medicine, and bio-packaging. Blue biotechnology is the application of science to aquatic species for products, services, and information. While the Europeans blue bioeconomy is growing quickly, there are regional differences in this industry. Via the Blue Bioeconomy Forum, the European Commission works with stakeholders to promote innovative goods throughout the EU and provide fair opportunities. By strengthening business settings, increasing consumer awareness of algae-based goods, and enhancing governance, the EU's algae initiative offers 23 initiatives to develop a strong algae sector. A very flexible resource, algae have potential applications in many different industries, they provide environmentally favorable substitutes, such as substituting fish oil in animal feed and lowering methane emissions in cattle diets, and have uses in pharmaceuticals, such as antiviral drugs and wound healing. Seaweed farming can help sequester carbon while enhancing ocean environments and supplying food. Algae have potential use in textiles, detergents, building, and soil enhancement. They also contribute to biofuel, biofertilizers, bio packaging, and cosmetics. The goal of EU investments in the blue bioeconomy is to create jobs and sustainable growth in coastal regions and other areas[16].

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[15] World Economic Forum, "The world has lost 14% of its coral reefs since 2009. Investing in a blue economy gives us a shot at saving the rest", 2023 https://www.weforum.org/agenda/2023/11/coralreef-breakthrough-blue-economy/#:~:text=Sustainable%20blue%20economy&text=Investing%20in%20coral%20involves%20interventions,communities'%20resilience%20to%20climate%20impacts

[16] European Commission, "Blue bioeconomy and blue biotechnology" https://oceans-and-fisheries.ec.europa.eu/ocean/blue-economy/blue-bioeconomy-and-blue-biotechnology_en#:~:text=This%20includes%20microorganisms%20(microalgae%2C%20bacteria,packaging%2C%20clothes%20and%20much%20more

Telecommunications describe the use of digital technologies to assist and improve the management and operations of the Blue Economy. The Blue Economy itself is centered on the health of the ocean ecosystem, enhanced livelihoods, and the sustainable utilization of ocean resources for economic growth. How telecommunications fit into this is as follows:

- Maritime connectivity refers to the provision of dependable internet and communication services to enhance efficiency, safety, and navigation in maritime operations such as offshore energy, shipping and fishing.
- Marine data collection is monitoring ocean health, climate and resources real time through the use of telecommunications and sensors.
- Smart ports and shipping: making use of telecommunications to create logistics and smart port infrastructure that improves shipping and port operations efficiency.
- Underwater communications: advancing technology such as acoustic communication to send data underwater, an essential function for scientific study, underwater vehicles, and submarines.
- Telemedicine: improving health and safety on ships and offshore platforms by offering medical services to maritime personnel via remote consultations.
- Remote monitoring: keeping an eye on and keeping track of maritime protected zones to stop illicit activity and make sure sustainable practices are followed.

3. Offshore wind

3.1. History and development

The term “offshore wind energy” describes the practice of producing power with wind turbines situated in bodies of water, typically oceans.

This type of energy has an interesting history, moving forward from experimental beginnings to becoming a significant part of worldwide portfolios of renewable energy.

1991 saw the installation of the world’s first offshore wind farm in Denmark, close to the island of Vinderby. With only 11 turbines, this innovative project was quite small but it opened the path for later advancements and demonstrated that offshore wind was a feasible idea.

In terms of offshore wind energy development, Europe has led the way. Denmark, the United Kingdom, Germany, and the Netherlands were among the nations that invested in offshore wind development as soon as they saw its potential. A number of larger farms were up and running by the early 2000s, demonstrating notable improvements in capacity and technology.

Turbine sizes have expanded considerably over the last 20 years. Early 1990s turbines could only generate a few hundred kilowatts, but by the present day, turbines can generate 14–15 MW each, which is sufficient to power thousands of households.

The introduction of floating turbines is one of the most exciting advances in offshore wind technology. With the use of this technology, wind farms can be located in deep oceans, where the winds are even more powerful and steady. Off the coast of Scotland, the first floating wind farm in the world, started operating in 2017.

With a 1.2 GW overall capacity, the Hornsea Project One in the UK is one of the biggest offshore wind farms. It is a component of a bigger project that has the potential to power millions of households over a surface area of 400 square kilometers.

Figure 4: Hornsea Project One, the world's largest offshore wind farm

Source: Azocleantech, 2019

According to predictions made by the International Energy Agency (IEA), the offshore wind power sector might expand to trillion-dollar levels by 2040, a growth of more than

15 times. It is anticipated that this expansion will be fueled by ongoing technical developments, encouraging governmental regulations, and growing urgency around the world to address climate change.

3.2. Pros and Cons

According to AGI (American Geosciences Institute)[17] the main advantages of offshore wind farms are:

- The wind speed offshore is generally higher than the wind speed on land. A turbine operating in a 15 mph wind can produce twice as much energy as one operating in a 12 mph wind. Greater energy generation is possible offshore due to faster wind speeds.
- Offshore wind speeds tend to be steadier than on land. A steadier supply of wind means a more reliable source of energy.
- Many large cities are located near coasts. Offshore wind farms can be constructed relatively close to these high demand areas, reducing the need for extensive and expensive transmission infrastructure.
- Offshore farms contribute to the fight against climate change and reduce dependency on fossil fuels by producing no greenhouse emissions or air pollution while operating. Instead, they generate power from wind.
- Oceans provide the perfect location to build wind farms in terms of scale and openness. More wind farms being built means more clean, sustainable energy can be produced.

On the other hand, the disadvantages are:

- Compared to onshore farms, offshore wind farms have substantially higher initial construction costs. This involves more costly maintenance and operating requirements, specialized ships for installation, and tougher materials to endure harsh maritime conditions. For example it is very hard to build robust and secure wind farms in water deeper than around 60 meters, or over half a football field's length.

[17] AGI, "What are the advantages and disadvantages of offshore wind farms?", https://www.americangeosciences.org/critical-issues/faq/what-are-advantages-and-disadvantages-offshore-wind-farms

- Aquatic habitats can sustain harm from the installation of turbines. Drilling into the ocean floor has the potential to contaminate areas with garbage and ruin natural habitats. Additionally, sound pollution from turbines harms the health of marine life. Aquatic creatures that are exposed to noise pollution may become confused and more susceptible to predators.
- The final disadvantages of offshore wind farms is surface – level biodiversity loss. In America, turbines cause about 538,000 bird deaths annually.
- Decommissioning offshore wind turbines may have long term environmental effects that are still unclear, and removing massive structures from the water can be difficult and expensive.

3.3. How does it work

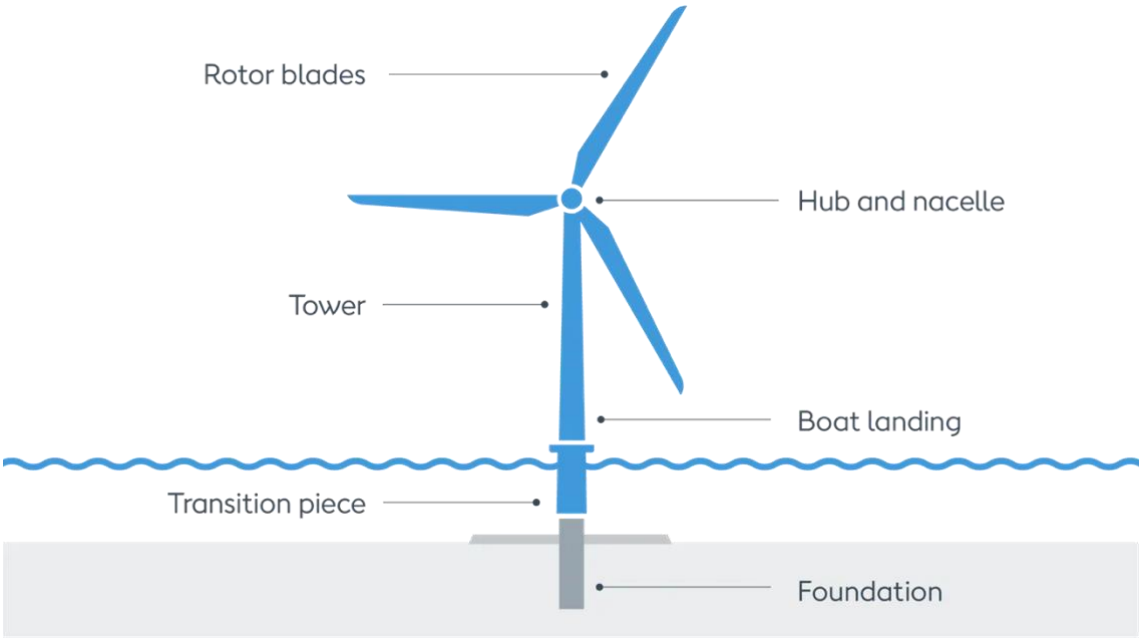
Different wind turbines operate almost identically. As an example, Ørsted, a renowned Danish multinational electricity producer, seems a best practice[18].

Tying conductive wire around a set of magnets can produce electricity. How to accomplish that rotation is the key question.

Fossil fuels such as coal, gas and oil are used in typical power plants to heat water. This process creates high pressure steam, which powers a turbine and an electrical generator. Unfortunately, this also produces carbon dioxide and other harmful emissions, as well as relying on finite resources that need to be constantly extracted from underground and transported to the power station. The clean, organic, and ultimately limitless power of the wind powers a wind turbine's rotation.

[18] Ørsted, "How do offshore wind turbines work?", https://us.orsted.com/renewable-energy-solutions/offshore-wind/what-is-offshore-wind-power/how-do-offshore-wind-turbines-work

Figure 5: Electromagnetism, the basis

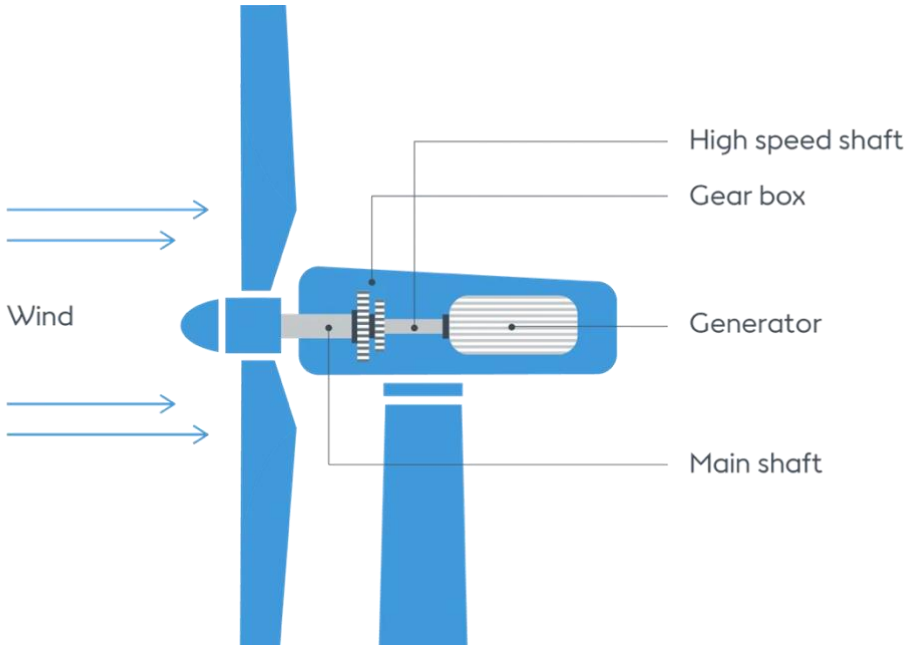


Source: Ørsted, "How do offshore wind turbines work?"

In order to capture wind power, the turbines's top section is oriented towards the wind, its three blades are positioned at an exact angle, and the airflow over them propels the blades into rotation.

The blades' rotation is transferred by a driving shaft, frequently via a gear box, within the nacelle, the non-rotating portion on top of the turbine, to turn magnets inside a coil of wire. This produces an electrical alternating current.

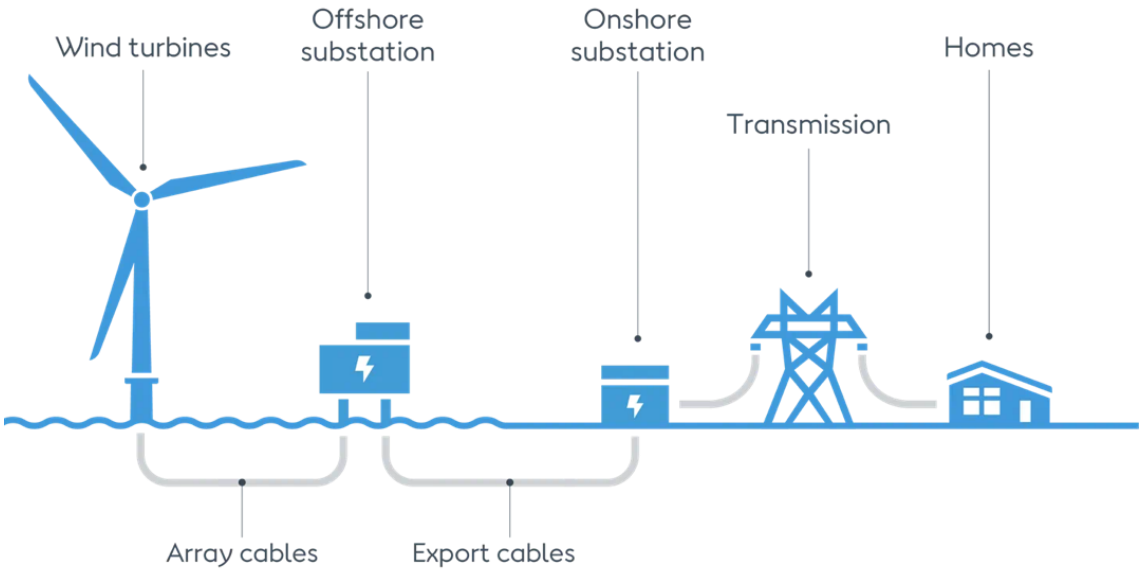
Figure 6: Inside the wind turbine



Source: Ørsted, “How do offshore wind turbines work?”

Each wind turbine sends its power through cables down the tower and under the seabed to an offshore substation. Here the energy is stepped up to a higher voltage ready to send ashore via high voltage cables. Higher voltage means less energy is lost in transmission. On land, another substation adjusts the voltage again so that the electricity can be fed into the grid and distributed via power lines to the homes and business that need it.

Figure 7: Sending the power onshore



Source: Ørsted, "How do offshore wind turbines work?"

A wind farm is expected to be in commercial operation for at least 25 years. When a wind farm eventually reaches the end of its lifespan, it's either decommissioned, life extended, or repowered.

While life extension involves repairing and maintaining the existing wind turbines for further years of service, both decommissioning and repowering mean removing the old turbines.

Repowering involves replacing the old turbines with the latest larger and more efficient models, while decommissioning means completely dismantling the wind farm. At present, up to 95% of Ørsted wind turbines can be recycled, with the lightweight blades proving more challenging.

3.4. Equinor floating turbines

As the first business in the world with a functioning commercial park and another in the final stages of construction, Equinor is a major player in the offshore wind industry with a global presence[19].

[19] Equinor, "Floating wind" https://www.equinor.com/energy/floating-wind

They believe that floating offshore wind is the next big thing in renewable energy, and with scale and industrialization, it can become profitable by 2030.

In a few markets, they are creating partnerships and initiatives and looking for prospects for offshore wind that floats.

But why floating wind?

- First of all, winds are stronger and more consistent further out to sea (close to 80% of the world's offshore wind resource potentials is in waters deeper than 60 meters
- 2.4 billion people live within 100km of the shoreline. Floating offshore wind can deliver major scale power directly to global markets
- Floating wind can potentially power 12 million homes in Europe by 2030. Removing water depth constraints allows them to select the best sites in the world
- Their main goal is that floating wind be competitive with other forms of energy by the year 2030

How do they float?

- In waters that are less than 60 meters deep, the majority of wind turbines nowadays are bottom-fixed or fixed to the seabed.
- The upcoming generation of offshore wind turbines is intended to float farther out to sea, where winds are more intense, but bottom-fixed designs are not viable due to the depth of the water.
- The designs of most offshore wind floaters are recognizable from the oil and gas sector.
- Similar to how a floating oil platform is tied to the seabed, floating wind turbines are secured to it using a number of mooring lines and anchors.
- With the use of sensors and computers, Equinor's unique floating wind turbine motion controller dampens tower movements, eases the load on the moorings, and maximizes energy generation by adjusting the turbine blades on response to wind gusts.

Across all major categories of floating concepts, the following design principles and solutions for floating wind are workable:

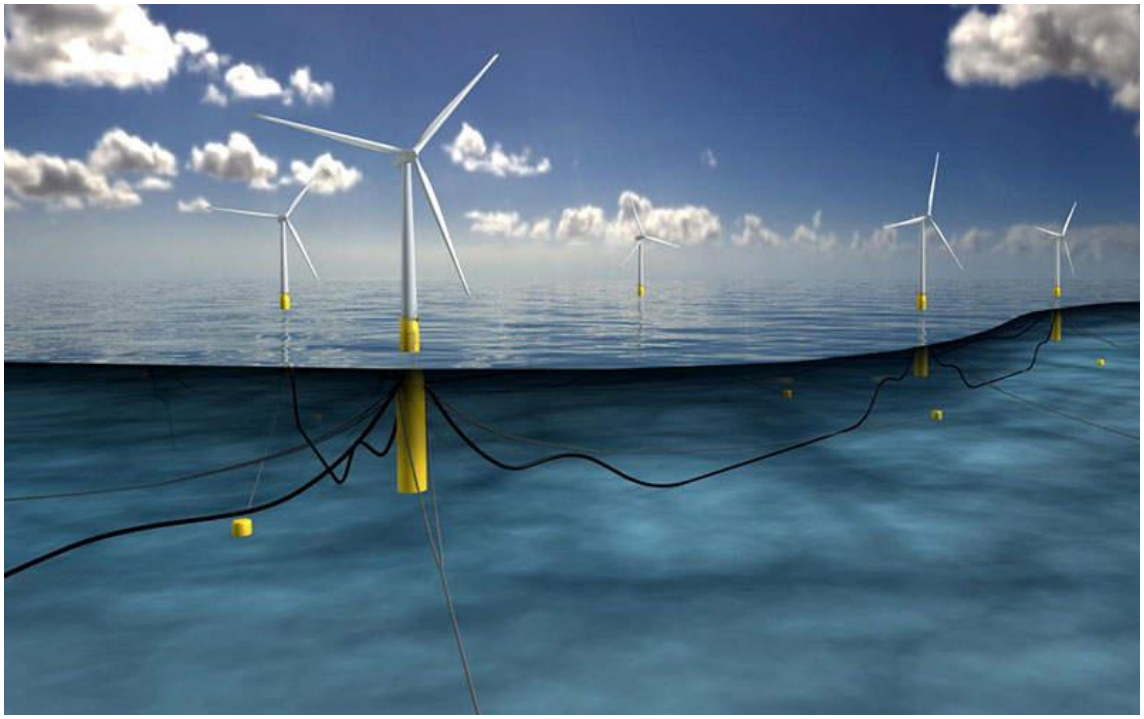
- A proprietary floater motion controller that adds new capabilities and is tailored to semi concepts, all while guaranteeing the stability of the floating wind turbine and producing maximum power output.

- A revolutionary floater substructure based on passive ballast and simple geometric design that complements the Hywind spar and guarantees cost effective units with maximum durability.
- In order to reduce costs and improve chances for local content, we are adding fiber rope into mooring systems in addition to chain options, which will provide safe station maintaining.
- Enhanced dynamic cable solutions and innovative cable layouts that guarantee high power output while lowering investment and maintenance expenses.
- Optimized export solutions, introducing floating and first of its kind seabed substations.

Because Equinor is not limited by technology, it will choose the floating wind concept that best fits its projects. They key factors in choosing a particular design include water depths, the availability of appropriate and reasonably priced fabrication yards and ports, and the capabilities of the local supply chain.

Building on Hywind, Equinor created the semisubmersible Wind Semi, an innovative floating concept wind turbine. The Wind Semi will provide the best stability and power output based on their design ideas and enable the large-scale industrialization of floating wind. It will also permit local assembly and production, promoting the growth of local supply chains.

Figure 8: Early computer rendering of Equinor's 30MW Hywind Scotland project, the world's first floating wind array

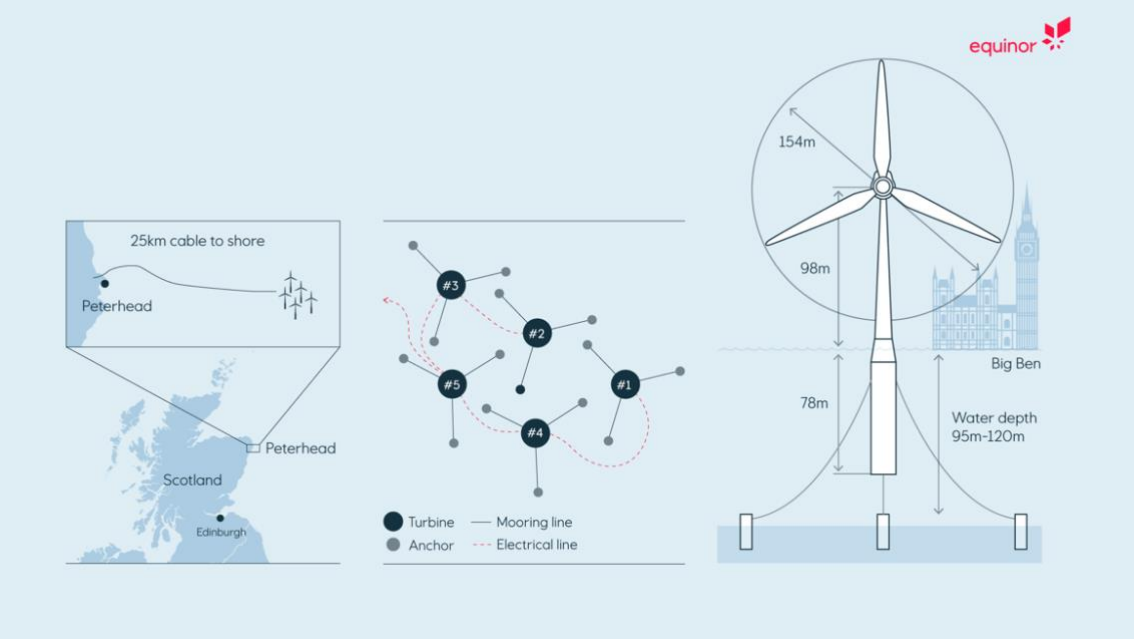


Source: Recharge, "Equinor ties up with Korean groups for 200MW floating play"

This is a representation of Hywind Scotland[20] pilot park, the world's first floating wind farm that has been in operation since 2017. Each year since Hywind Scotland started production the floating wind farm has achieved the highest average capacity factor of all UK offshore windfarms, proving the potential of floating offshore wind farms. The system comprehends 5 turbines, and it covers around 4 square kilometers of ocean. The installed capacity (30 MW) is able to power approximately 35,000 UK houses.

[20] Equinor, "Hywind Scotland" https://www.equinor.com/energy/hywind-scotland

Figure 9: How wind turbines are positioned. Anchored up with three suction anchors each and linked together to send the electricity produced onshore.



Source: Equinor, “Hywind Scotland”

4. Investments opportunities

4.1. Importance of investing in the blue economy

The Blue Economy, which brings trillions of dollars to the global economy every year, is a major force behind job creation and economic growth. Options for job creation are promoted by investing in this industry, especially in coastal and island nations where alternative work options may be scarce.

Environmental sustainability depends on blue economy investments that are made sustainably. Carbon sequestration, climate regulations, and biodiversity all depend on the preservation of marine ecosystems. Long term environmental health is influenced by sustainable practices like ethical fisheries management, marine conservation, and ocean cleanup programs.

Technological advancement and innovation are also supported by the blue economy. Innovation in sustainable aquaculture, renewable ocean energy, and marine biotechnology is propelled by this industry. New goods, services and technology that promote sustainable development are produced as a result of these developments.

Finally, investments in the blue economy improves climate adaptation and resilience. Coastal infrastructure and natural defenses like mangroves and coral reefs are investments that increase resilience against the effects of climate change, such as increasing sea levels and extreme weather. This maintains the economic advantages that come from robust marine ecosystems in addition to safeguarding coastal populations.

4.2. Two types of financial instruments:

4.2.1. ETFs and Funds

ETFs (an acronym for Exchange Traded Funds) are passive funds with low management fees traded on the stock exchange like normal shares. They are characterized by the fact that their sole objective is to faithfully replicate the performance and thus the yield of equity, bond or commodity indices.

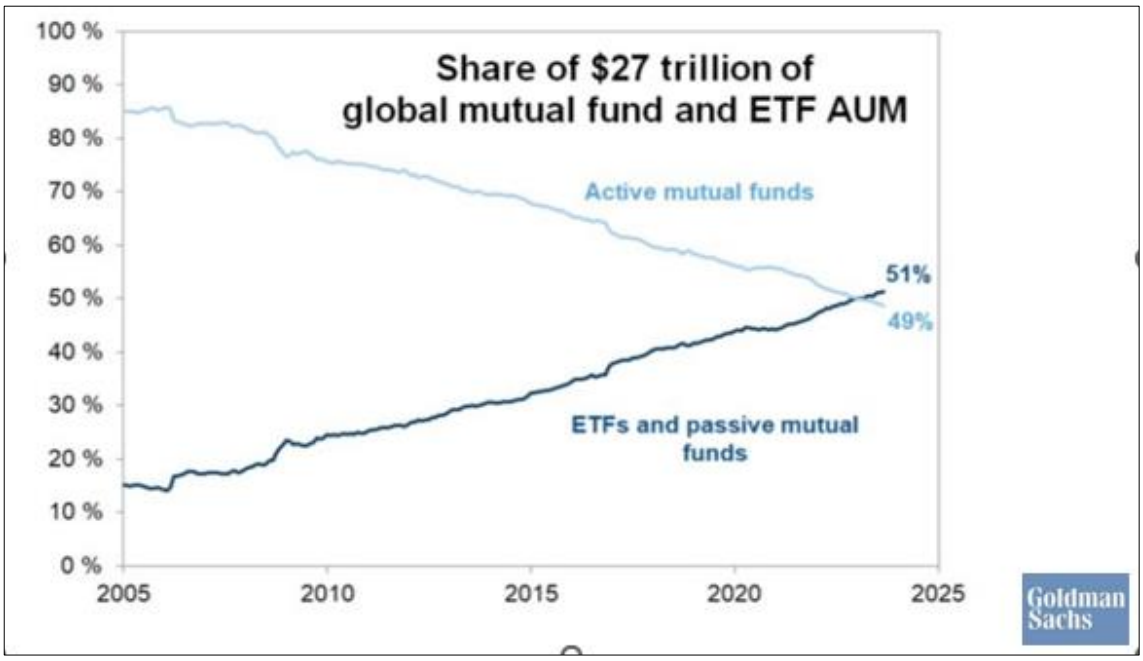
ETFs can be structured to track anything from the price of a commodity to a large and diverse collection of securities.

Originating in the United States in the early 1990s, ETFs became part of the securities available to Italian investors as of September 2002.

Since then, they have achieved growing success, as evidenced by the increase in both trading volumes and assets under management, and by the ever-increasing number of ETFs brought to trading.

During 2023 ETF's aum worldwide have overtaken active funds/SICAVs aum in a sign of continuous success.

Figure 10: Global Passive AUM has now exceeded Global Active AUM for the first time ever in 2023.



Source: Goldman Sachs Investment Research, 2023

ETFs offer investors a means of being exposed to businesses and initiatives that prioritize the sustainable use and preservation of ocean resources within the framework of the blue economy.

At first, I'm going to analyze one of the world's top financial institutions, BNP Paribas[21], which provides a selection of Exchange Traded Funds targeting several industries, including the blue economy.

One such ETF is the "BNP Paribas Easy ECPI Global ESG Blue Economy UCITS ETF". This ETF is designed to track the performance of the ECPI Global ESG Blue Economy Index which includes companies that are active in the sustainable use of ocean resources and contribute to the health of marine ecosystems. The ETF aims to provide investors with exposure to worldwide companies that adhere to environmental, social and governance (ESG) criteria within the blue economy sector and are not materially involved in the armaments, tobacco, thermal coal, or unconventional oil and gas industries.

More specifically, the exclusions regard:

- Producer of Armaments

[21] Simon Smith, ETF Strategy, "BNP Paribas launches 'blue economy' ETF", 2020 https://www.etfstrategy.com/bnp-paribas-launches-blue-economy-etf-74855/

- Producer or wholesale trading of Tobacco Products (> 10% of revenues)
- Extraction of thermal coal and unconventional Oil & Gas (> 10% of revenues)
- Transport of unconventional Oil & Gas
- Extraction of conventional Oil & Gas (< 40% of revenues derives from natural gas extraction or renewable energy sources)

ECPI, a company specializing in customized indexes, assigns corporations to one of five ocean clusters based on which they are considered to be most involved in the sustainable use of ocean resources, selected from this selected list of relevant stocks. The sectors that make up this cluster are:

- coastal livelihood, which deals with eco-tourism and coastal protection;
- energy and resources which includes offshore wind, marine biotech, wave and tidal;
- fish and seafood which includes wild catch fisheries, aquaculture farming, and aquaculture breeding and genetics;
- pollution reduction, which involves recycling and waste management businesses;
- and shipping lanes, which deals with ship equipment and container shipping.

ECPI selects the 50 largest stocks as measured by market capitalization, subject to various constraints. Liquidity constraints include a minimum market capitalization of 500 million € and an average daily traded value over the last six months of at least 3 million € (liquidity filter). The index rebalancing frequency is semi-annually in January and in July to ensure market representation.

The current composition by GICS sector (Global Industry Classification Standard) is strongly biased in favor of businesses in the industrial sector with 64% followed by Utilities (18%), consumer staples (10%), materials (5%) and consumer discretionary (3%).

On the other hand the breakdown by ocean cluster is well balanced between shipping lanes (27%), energy and resources (24%), pollution reduction (23%), fish and seafood (16%) and coastal livelihoods (10%).

The final breakdown by country: the United States contributes 15.5%, followed by Switzerland (10.6%), Japan (9.2%), Great Britain, Denmark and Germany. The fund comes with an expense ratio of 0.3%. Income is capitalized and no dividends are distributed.

The ETF has an ongoing charge of 0.3%.
Examples of ocean clusters include Arcadis NV which is a company that offers consulting and engineering services and it is specialized in coastal protection. We then have Iberdrola SA Spain specialized in offshore wind. Veolia Environment SA that is helping to reduce the flow of pollution discharged into the ocean by acting at source. And finally Alfa Laval specialized in ship equipment.

The other company I want to analyze is Amundi, the largest European asset manager, investing in businesses that are part of the Blue Economy in the CPR Invest Blue Economy Fund[22], managed by CPR Invest, a specialized boutique belonging to Amundi. Businesses engaged in the conservation and sustainable use of marine resources fall under this category. The Fund incorporates Environmental, Social, and Governance (ESG) considerations into its investment process with the goal of outperforming global equity markets over an extended period of time (at least five years).
The Fund invests in foreign stocks that are involved in sustainable marine operations, including marine biotechnology, offshore wind energy, ecotourism, sustainable fisheries, pollution control, and marine transportation.
Top holdings in the fund include Advanced Drainage Systems Inc., Veolia Environment SA, Ecolab Inc., Ingersoll Rand Inc., and Thermo Fisher Scientific Inc.
These firms together account for a significant portion of the portfolio. These businesses are industry leaders in fields like utilities, environmental services, and industrial goods.
The fund is diversified across various regions, with substantial allocations in the United States (35.88%), Eurozone (31.51%), Japan (9.90%), and the United Kingdom (5.98%). Sector-wise, it heavily invests in industrials (50.29%), utilities (13.14%), consumer defensive (8.96%), basic materials (7.18%), and energy (6.88%).
The Fund is based on strict ESG standards; it does not include companies that produce weapons, are engaged in systematic violations of the UN Global Compact or generate a sizeable portion of their revenue from the sale of tobacco, thermal coal, or unconventional oil and gas (just like BNP).
The Fund has an ongoing charge of 1.95% for the share class dedicated to retail investors.

[22] Amundi CPR Invest, “CPR Invest – Blue Economy”, 2023

Through its investments, it hopes to achieve both prosperity and a favorable environmental impact.

Several nations including Austria, Belgium, Finland, France, Italy, Luxembourg, Netherlands, Spain, Sweden and Switzerland are offering the CPR Invest Blue Economy Fund for sale. It is priced in euros and it is registered in Luxembourg.

Figure 11: Performances since launch; 22nd July 2022 till 31st May 2024

Source: Bloomberg

The graph illustrates the positive performances registered by the two instruments over the specified period. CPR Invest Fund shows an increase that adds up to a cumulative growth of +17%, despite having experienced high volatility till summer 2023.

The BNP ETF shows a similar track (both instruments are equity despite having partly different sector and country allocations) but the final performance is lower (+11%).

In conclusion both ETFs have increased during the period, CPR Amundi, despite having a higher cost, performs better. As said it will take at least five years of existence to be able to make a more decisive comparison.

4.2.2. Blue bonds

A relatively new and creative investment option, blue bonds are intended to fund initiatives related to the sustainable use of ocean resources. Though green bonds, which

fund environmentally favorable initiatives, and blue bonds are conceptually similar, blue bonds are targeted primarily at marine and coastal ecosystems.

Governments, development institutions, and private businesses can issue blue bonds to raise money for projects involving the sea and the ocean. The money raised by these bonds will go toward initiatives that support the sustainability and well-being of seas, oceans, and coastal regions.

The sustainable bond market comprises green, blue, social, sustainability, and sustainability linked bonds.

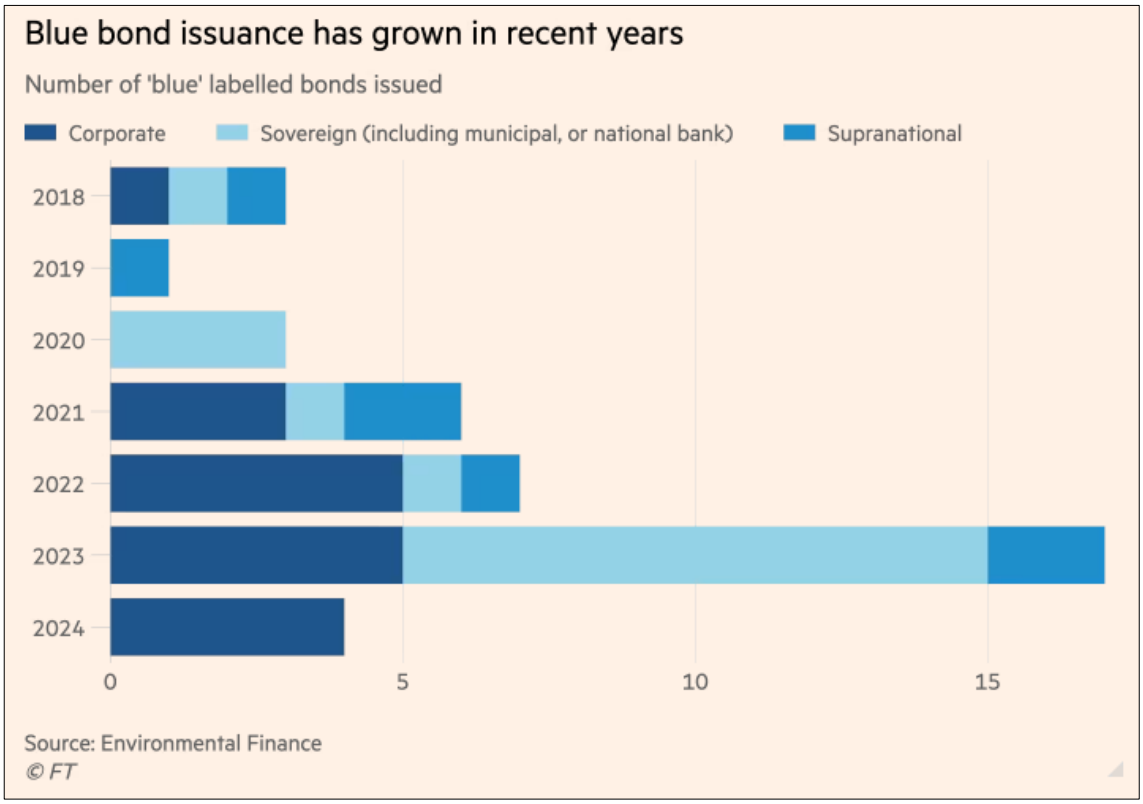
Figure 12: the sustainable debt market, the main type of sustainable debt.

Source: T.RowePrice, “Blue bonds: A growing resource for sustainability financing”, 2023

The market for sustainable bonds has grown rapidly in recent years, topping 1 trillion $ in value annually and expanding to include a wider range of impact themes. Despite this, it is still relatively tiny in comparison to conventional debt markets. In addition, the UN has declared that sustainable initiatives have not received enough funding, projecting that an annual investment of 5-7 trillion $ is required to accomplish the Sustainable Development Goals, highlighting the pressing need for more funding.

Here's a graph of all Blue bonds issued since 2018 and up to April 2024 by the Financial Times showing the very strong 2023 when 17 bonds were launched:

Figure 13: Blue bond issuance



Source: Environmental Finance, Financial Times

In order to close this funding gap, blue bonds might help the sustainable bond market expand faster while also enabling capital flow. Additionally, investors can allocate resources toward SDG aligned projects according to recent industry guidelines. By facilitating investors large-scale capital deployment, asset managers can serve as a driving force for the sustainable development and conservation of limited shared water resources. Additionally, the paper "No Green Without Blue: How Blue Bonds Could Support Climate Goals" (May 2024) goes into further detail about the significance of blue funding for the preservation of marine ecosystems and their capacity to sequester carbon. With rivers and oceans making up more than 70% of the planet's surface, reaching net-zero carbon targets by 2050 will depend on them. However, rising temperatures and chemical shifts in saltwater are reducing their ability to absorb carbon.

I attended a T. Rowe Price[23] online conference where experts talked about how blue bonds could fill the financial gap for water resource management and marine conservation. They stressed that whereas green bonds have established a standard for financing environmental projects, blue bonds are required to address the unique problems that marine habitats face. In addition to promoting biodiversity and lowering pollution, blue bonds projects are essential to maintaining the larger ecological balance required to stave off climate change[24].

Blue bonds, for example, can be used to fund environmentally friendly shipping projects, lowering the maritime industry's carbon footprint which contributes 2.9% of greenhouse gas emissions worldwide. Additionally, they support offshore renewable energy initiatives, which are essential to lowering dependency on fossil fuels. The fact that healthy oceans are essential to the accomplishment of international climate initiatives show how green and blue bonds are linked and that there can be no green without blue.

Among the main initiatives and innovative projects we have the Seychelles Blue Bond[25] which was the very first blue bond launched in October 2018. It raised 15 million $ from international investors, and it was developed by the World Bank and it reached out three main investors: Calvert Impact Capital, Nuveen and US: Headquartered Prudential Financial Inc.

The key objectives of the bond are:

- Promoting sustainable fisheries management to ensure long term economic benefits for the fishing community.
- Implement measures to reduce overfishing and improve fish stock health.
- Marine ecosystems, such as mangroves and coral reefs, should be preserved and restored.
- Protect marine biodiversity by creating marine protected zones (MPAs).
- Strengthen the resilience of coastal communities to climate change impacts.

[23] T.RowePrice, "Blue bonds: A growing resource for sustainability financing", 2023, https://www.troweprice.com/content/dam/iinvestor/resources/insights/pdfs/blue-bonds-a-growing-resource-for-sustainability-financing.pdf

[24] T.RowePrice, "No green without blue: How blue bonds could support climate goals", 2024

[25] The World Bank, "Seychelles launches World's First Sovereign Blue Bond", 2018

- Encourage the use of adaptation techniques to lessen the consequences of extreme weather events and sea level rise.

As regards to the financial structure: the bond is partially guaranteed by the World Bank (5 million $) and supported by a concessional loan from the Global Environment Facility (GEF), which helped to reduce the financing cost.
Grants and loans are provided through the Blue Grants Fund (managed by the Seychelles Conservation and Climate Adaptation Trust SeyCCAT) and Blue Investments Fund (managed by the Development Bank of Seychelles).
Protected Marine Areas: with the help of the bond, MPAs encompassing 30% of the Seychelles' exclusive economic zone (EEZ) have been established, far exceeding international conservation goals.

Management of Fisheries: newly adopted improved fisheries management techniques have resulted in improved stock evaluations and more sustainable harvesting techniques.
Benefits to the Community: increased fish stocks help coastal communities maintain their standard of living and food security.

Local communities can adopt sustainable practices with the support of initiatives aimed at increasing capacity and raising awareness.
A revolutionary development in sustainable finance, the Seychelles Blue Bond shows how creative financial products can raise money for the preservation and sustainable use of marine resources. It emphasizes how crucial cooperation is in addressing global environmental issues and promoting sustainable development between governments, financial institutions, and environmental groups.

Conclusions

Through an in-depth examination of various sectors within the Blue Economy, including fisheries, maritime transport, coastal tourism, and marine energy, this study underscores the significant potential of ocean-based industries to contribute to global sustainability goals.

Developments in this industry, coupled with supportive policy frameworks and financial instruments, have driven substantial growth in the offshore wind sector, positioning it as a key player in the transition to a low-carbon economy.

However, the expansion of offshore wind energy is not without challenges. High initial capital costs, technological constraints related to deep-water installations, and potential environmental impacts on marine life are significant barriers that need to be addressed. Effective policy measures, innovative financial mechanisms such as blue bonds and ETFs, and continuous technological innovation are essential to overcoming these challenges. Collaborative efforts among governments, industry stakeholders, and research institutions are crucial to advancing the offshore wind sector and ensuring its sustainable integration into the Blue Economy.

In conclusion, the Blue Economy offers a viable pathway to achieving sustainable development, with offshore wind energy playing a pivotal role. The transition to a Blue Economy requires a multifaceted approach that includes robust policy frameworks, strategic investments, and innovative technologies. By harnessing the vast potential of the oceans in a sustainable manner, we can drive economic growth, combat climate change, and protect marine ecosystems, ultimately creating a more resilient and prosperous future for all.

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