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INSIGHTS

A SUSTAINABLE BLUE ECONOMY

Rolando Morillo
Equity Analyst and Vice President, Rockefeller & Co.

Mark Spalding
President, The Ocean Foundation

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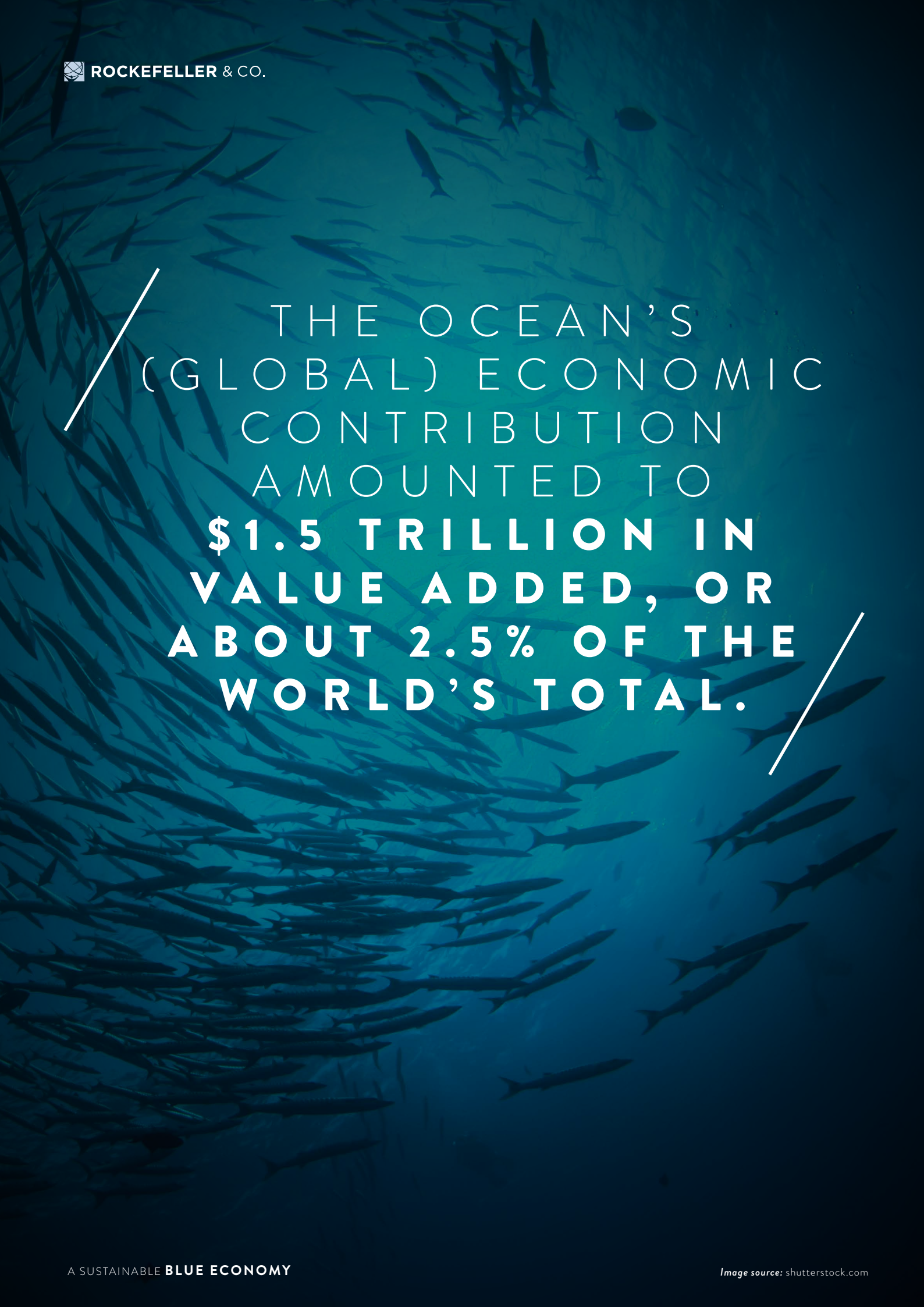


THE OCEAN'S (GLOBAL) ECONOMIC CONTRIBUTION AMOUNTED TO **$1.5 TRILLION IN VALUE ADDED, OR ABOUT 2.5% OF THE WORLD'S TOTAL.**

Image source: shutterstock.com

A Sustainable **Blue Economy**

While the ocean has long been a source of economic livelihood, today this vast resource is under threat. Population growth, urbanization, the rise of the global middle class, and the expansion of global trade are putting increasing stress on marine resources, posing the risk of depletion or irreversible harm.

In recent years, however, global inter-governmental agreements have been reached that address this risk. We believe that compliance with these new measures by ocean-related industries has created a variety of potential investment opportunities. In addition, innovative technologies and business models – including in energy and in water and information – are emerging that seek to minimize and/or remediate environmental damage.

With this confluence of inter-governmental cooperation and technology, unsustainable practices are being shunned. In their place, new practices, business models and industries – a Sustainable Blue Economy – are providing opportunities for investors to capitalize on the ocean's economic potential.

By utilizing capital markets and engaging companies, investors can advocate sustainability and new systematic approaches to not only reduce environmental externalities but also minimize costs, reduce dependence on external commodities, improve profitability and ultimately increase shareholder value. Companies are increasingly realizing that the traditional linear model that is designed for the singular use of natural resources to create disposable consumer, industrial and commercial products is inefficient and unsustainable. A shift to a circular model that is restorative and regenerative by intention and design can be competitive and profitable while simultaneously have a positive impact on the ocean.

The critical role of the ocean in supporting the global economy may be underappreciated. The Organisation for Economic Co-operation and Development (OECD) estimates that, as of 2010, the ocean's economic contribution amounted to USD 1.5 trillion in value added, or about 2.5% of the world's total. Full-time employment directly related to the ocean economy came to about 31 million. By 2030, the value added could double to USD 3 trillion and in a business-as-usual scenario, full-time employment could rise to 40 million.[1]

There are a number of factors driving the world's population toward even deeper dependence on the sea, including population growth, urbanization, trade, middle-class expansion, and technology.

Population Growth

The earth's population continues to grow, and by 2030 it will be larger by 1 billion people, likely creating more demand for marine food sources, sea-based services such as freight and passenger transport, which in turn would require additional ships and marine equipment, as well as more energy.[2]

Urbanization

The United Nations reports that one third of the world's population lived within 100 kilometers of a coastline in 2010 and 40% lived within 150 kilometers. Projections suggest this trend is likely to continue.[3]

Middle-Class Expansion

Of the world's 7 billion people, 2.5 billion live in countries experiencing rapid growth and a burgeoning of the middle class.[4] Growing affluence will likely add pressure to some already stressed resources.[5]

Trade

Growth of the middle class should feed demand for consumer products, which would likely fuel international trade. The OECD forecasts that freight traffic, 90% of which is seaborne, is likely to triple by 2050, adding momentum to the demand for shipping and port services as well as stress on the health of these ocean environs.[6]

Technology

As it has in other industries, information and communications technology promises greater efficiency and productivity in the ocean economy. The automation of riveting, welding, and fish-fileting, for example, has led to the return of industries such as shipbuilding and fish processing to developed countries after a period of outsourcing. In the marine industry, digitalization will encompass sensor networks, connectivity at sea and data analytics in an effort to improve operational efficiencies and reduce maintenance costs for ship operators. [7]

The Ocean Economy **Threatened**

The primary threat to the ocean economy over the long term is the ocean's health, which has deteriorated, and, in the absence of the regulatory changes and technological innovations noted below, could continue to do so. Four primary factors affecting its health are 1) climate change, 2) acidification, 3) pollution, and 4) overfishing.

CLIMATE CHANGE

Carbon emissions resulting from deforestation and the burning of fossil fuels have produced a dramatic effect on the amount of carbon dioxide in the atmosphere. Since the Industrial Revolution, carbon dioxide has risen from 278 parts per million (ppm) to more than 400 ppm.[8] One indication of climate change is the warming of the ocean. The OECD reports that temperatures in the upper 75 meters rose more than 0.1 degree centigrade per decade between 1971 and 2010.[9]

Coral bleaching is one result of warming water temperatures. Warmer water causes corals to expel certain colorful algae, which causes the coral to turn white. In 2017, Australia's Great Barrier Reef experienced an unprecedented second consecutive year of bleaching. Continued bleaching can mean a loss of habitat. Recovery is possible but typically requires 10 years of normal water temperatures. Bleaching in two straight years means that recovery will be delayed, at best.[10]

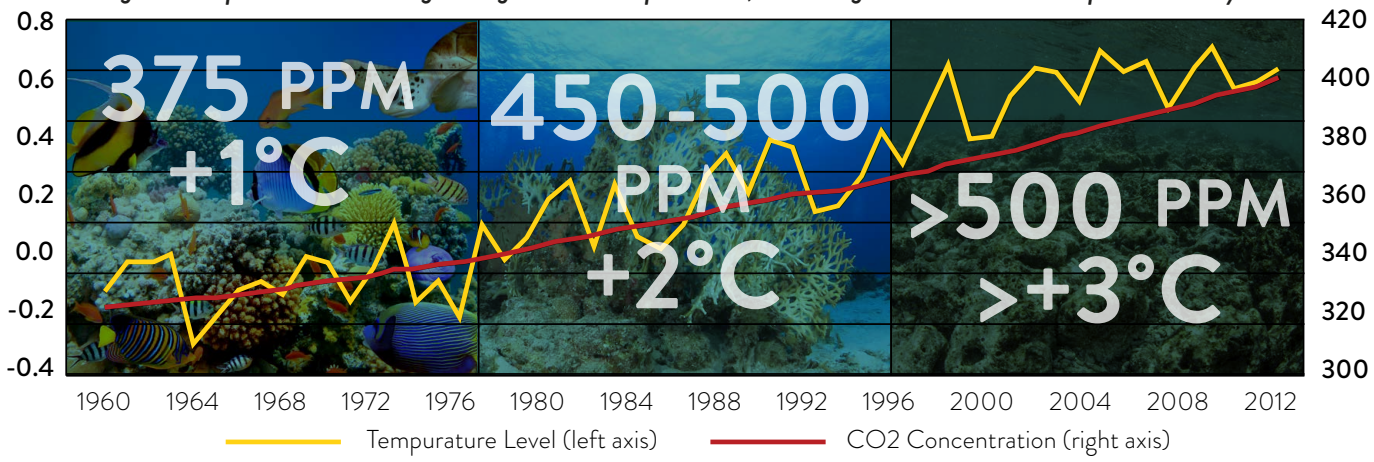
ACIDIFICATION

Because of the constant exchange of gases between the atmosphere and the surface of the ocean, the rise in carbon dioxide in the atmosphere has resulted in a sharp increase in the absorption of carbon dioxide by the ocean. This, in turn, has reduced the pH level, resulting in acidification, which endangers biodiversity by damaging coral reefs and other habitats.

According to one estimate, ocean surface water may now be 30% more acidic than before the Industrial Revolution.[11]

Acidification has put marine ecosystems and the well-being of aquatic life at risk. It reduces the amount of carbonate in the ocean, a compound that some species need to build their skeletons and shells. This can have harmful effects on marine food chains.[12] The effects of acidification are beginning to be felt by humans as well. The shellfish industry in the Pacific Northwest, for example, has suffered serious losses of larval shellfish, which have been unable to form shells due to high ocean acidity. Some shellfish farmers have abandoned the region as a result.[13]

Rising Levels of CO2 Are Leading to Higher Sea Temperatures, Resulting in a Detrimental Impact on Ecosystems



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THE OECD REPORTS THAT TEMPERATURES IN THE UPPER 75 METERS **ROSE MORE THAN 0.1 DEGREE CENTIGRADE PER DECADE BETWEEN 1971 AND 2010.**

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ONE ESTIMATE PUTS THE NUMBER OF PLASTIC FRAGMENTS
AT FIVE TRILLION AND THE WEIGHT AT 250,000 METRIC TONS.
A SUSTAINABLE BLUE ECONOMY
Image source: shutterstock.com

The Ocean Economy **Threatened**

POLLUTION

Nutrient Run-off In addition to climate change, the ocean economy is threatened by pollution from a variety of human activities. Of all the types of pollution, the run-off of nutrients such as phosphorous and nitrogen from land-based sources is perhaps the most damaging. It can produce algal blooms that deplete oxygen levels along coastal areas. Eventually this can result in hypoxic regions, or dead zones. The OECD reports that among the most seriously affected areas are the Baltic Sea, the Adriatic Sea, the Black Sea, the northern Gulf of Mexico and Chesapeake Bay.[14]

Plastics The production of plastic has grown by a factor of 20 over the past 50 years,[15] and plastic debris is becoming an increasing concern. One estimate puts the number of plastic fragments at 5 trillion and the weight at 250,000 metric tons.[16]

Emissions Sulfur and nitrous oxides contribute to climate change and result from burning low-grade fuel oil, which is used by container and passenger ships. While emissions of carbon dioxide from shipping amount to just 2-3% of the global total, emissions of sulfur oxides and nitrous oxides by the shipping industry account for between 17% and 31%, according to the OECD. And while these emissions from land-based sources are declining, those from ocean-going vessels are expected to grow.[17]

Invasive Species Non-native species represent a threat in that they can upset local ecosystems, potentially displacing native species and damaging the livelihood of thousands. Approximately 7,000 species are carried around the world in the ballast water of commercial ships.

Not all non-native species become invasive, and some fail to survive the trip, but those that do can wreak economic damage. The World Wildlife Fund (WWF) estimates the economic losses from non-native species at $50 billion over a five-year period.[18]

OVERFISHING

The UN Food and Agriculture Organization (FAO) estimates that nearly a third of fish stocks are overexploited, or overfished. Fisheries are overexploited when the stock of fish has declined to a level that no longer supports their maximum sustainable yield. In 2013, 31.4% of stocks monitored by the FAO were overexploited, depleted or recovering, 58.1% were fully exploited and just 10.5% were underfished. As a result, fishery production has declined.

The FAO reports that production has been falling since it peaked in 1996.[19]

Research suggests that overfishing harms not only the fisheries themselves but the surrounding ecosystems. Once large, high-value species become fished out, efforts may shift to smaller, lower-value species, a phenomenon known as "fishing down the food web." This can lead to even greater intensity, as the lower market value requires larger catches. And if fishing methods are unsustainable, further damage is possible, according to the OECD. Long-lining and bottom trawling, for example, may harm seabirds, turtles and other species, and alter habitats.[20]

Over 550 marine fish and invertebrate species are on the International Union for Conservation of Nature (IUCN) Red List of threatened species, according to the OECD. In a major region of the eastern Pacific, it is estimated that 12% of species are threatened.[21]

Addressing the Threat: **Inter-Governmental Efforts**

Some governments have recognized the threats represented by climate change, acidification, pollution and overfishing, and have taken steps to address them. Several recent efforts are notable:

THE PARIS AGREEMENT

The Paris Agreement was negotiated by the countries represented at the 21st Conference of the Parties of the UN Framework Convention on Climate Change (COP21 of UNFCCC). COP21 is significant in that for the first time ever countries have signed a single agreement addressing climate change. While the Kyoto Protocol of 1997 involved only a few developed countries, signatories of the Paris Agreement number nearly 200.[22]

Signed in December 2015, the agreement calls for, among other things, limiting the rise in temperatures to within 2 degrees centigrade of pre-industrial levels and attempting to keep them to within 1.5 degrees centigrade. The deal also specifies that greenhouse gas emissions should be limited to levels that can be absorbed naturally, starting sometime between 2050 and 2100.[23]

SUSTAINABLE DEVELOPMENT GOAL 14

Sustainable Development Goal (SDG) 14 is part of a broad set of goals adopted by the United Nations in 2015. In addition to targeting an end to poverty and hunger, and improving health and education, the goals target climate change and protecting the environment, particularly forests and oceans. SDG 14 calls on nations to "conserve and sustainably use the oceans, seas and marine resources for sustainable development."[24]

The goal includes a number of targets, including:

By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution

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

Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels[25]

In addition, SDG 14 supports nine of the 17 SDGs, including, among others, SDG 8 (promote sustained, inclusive and sustainable economic growth), SDG 9 (build resilient infrastructure) and SDG 13 (combat climate change). SDG 14 is therefore critical to future sustainability.

BY 2025, PREVENT AND SIGNIFICANTLY REDUCE MARINE POLLUTION OF ALL KINDS, **IN PARTICULAR FROM LAND-BASED ACTIVITIES...**

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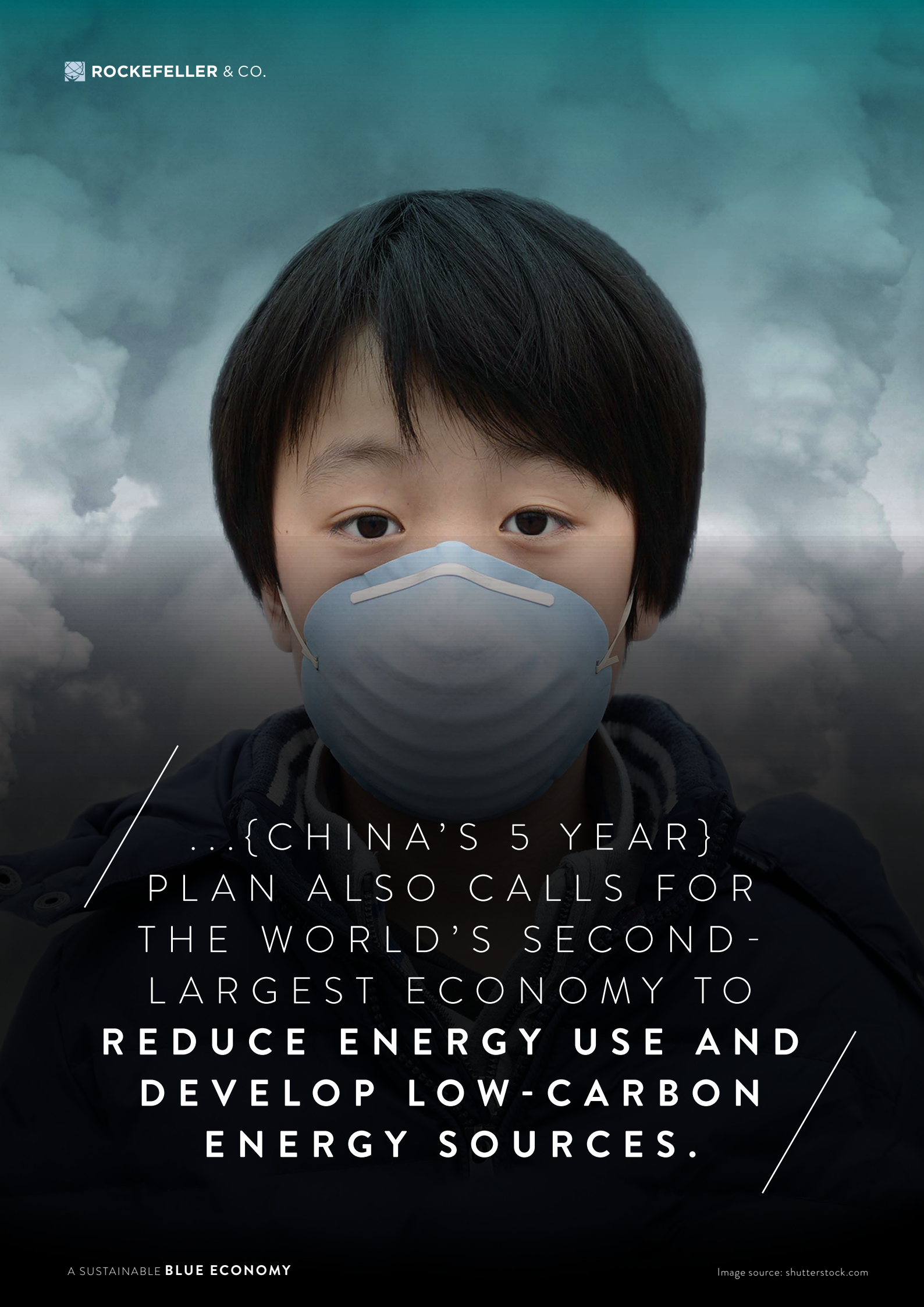

...{CHINA'S 5 YEAR} PLAN ALSO CALLS FOR THE WORLD'S SECOND-LARGEST ECONOMY TO **REDUCE ENERGY USE AND DEVELOP LOW-CARBON ENERGY SOURCES.**

Image source: shutterstock.com

Addressing the Threat: **Inter-Governmental Efforts**

IMO BALLAST WATER CONVENTION

In September 2017, the International Maritime Organization's Ballast Water Convention will take effect,[26] marking a milestone in a multi-year effort to prevent the spread of invasive aquatic species. The agreement requires ships involved in international trade to manage their ballast water to meet certain standards that will prevent the uptake or discharge of organisms that could be harmful to non-native ecosystems. This will require most ships to install on-board systems to treat their ballast water.[27]

EMISSION CONTROL AREAS

Ocean-going ships are subject to standards regarding emissions of sulfur oxides, nitrous oxides, and particulate matter, and these standards have been, or soon will be, tightened. The maximum sulfur content permitted in marine fuels is currently 3.5% (35,000 ppm) but will be reduced to 0.5% (5,000 ppm) in 2020. Ships in designated emission control areas (ECA) are subject to more stringent standards. Currently, ships in ECAs are limited to fuel with 0.1% (1,000 ppm) sulfur, down from 1% in 2015.

Tanker discharging ballast into the harbor. Image source: shutterstock.com

CHINA'S FIVE-YEAR PLAN

Not all efforts are inter-governmental. China announced in 2016 its 13th Five-Year Plan, covering 2016-2020, which includes research and measures to address environmental protection, and involves spending 2.5% of GDP on scientific research by 2020. The plan also calls for the world's second-largest economy to reduce energy use and develop low-carbon energy sources.[28]

The Blue Economy: **Old and New**

While the global economy is expected to expand moderately, some ocean-related industries hold greater potential.[29] Not all of these qualify as part of the Sustainable Blue Economy. A Sustainable Blue Economy excludes industries such as deep-sea oil & gas exploration or commercial fishing, which contribute to climate change or environmental degradation, and are therefore unsustainable.

The Ocean Foundation, a non-profit group intended to support "organizations dedicated to reversing the trend of destruction of ocean environments around the world," distinguishes between the traditional and emerging sectors of the ocean economy. The sustainable Blue Economy cuts across both of these categories. As Mark Spalding of The Ocean Foundation writes,

"Just because something is new [emerging] does not make it blue [sustainable] (e.g., seabed mining plans). And, just because something is part of the traditional economic sector doesn't mean it can't make changes. In fact, 'dirty' ocean industries are changing and evolving with the new understanding that the ocean's ability to handle our extraction and dumping is not infinite." [30]

The critical distinction is not old versus new, but sustainable versus unsustainable, according to Spalding.

TRADITIONAL SECTORS

- OFFSHORE OIL & GAS
- RECREATIONAL AND COMMERCIAL FISHING
- OPEN PEN AQUACULTURE
- SHIPPING
- COASTAL TOURISM
- TELECOMMUNICATIONS

EMERGING SECTORS

- RENEWABLE ENERGY
- SEABED MINING
- REMEDIATION/RESTORATION
- BLUE BIOTECHNOLOGY - BIOMATERIALS, GENETICALLY MODIFIED ORGANISMS
- COSMETICS
- BLUE CARBON- CREDITS FOR CARBON SEQUESTRATION
- BLUE TECHNOLOGY - INFRASTRUCTURE, SENSORS, ENVIRONMENTAL SAFETY, MARINE ROBOTICS, ETC.
- NUTRITION / NUTRACEUTICALS

SOURCE: *The Ocean Foundation*


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A SUSTAINABLE BLUE ECONOMY EXCLUDES INDUSTRIES SUCH AS DEEP-SEA OIL & GAS EXPLORATION OR COMMERCIAL FISHING THAT CONTRIBUTE TO CLIMATE CHANGE OR ENVIRONMENTAL DEGRADATION, AND ARE THEREFORE UNSUSTAINABLE.
Image source: shutterstock.com
A SUSTAINABLE BLUE ECONOMY

Investing: **Opportunities in a Sustainable Blue Economy**

A Sustainable Blue Economy encompasses industries and companies in which ecological and environmental risks are mitigated and reduced. This is accomplished through the application of "circular economy" principles and can be enhanced through innovative technologies.

Climate change, environmental degradation and constraints on natural resources may prompt companies to re-evaluate how resources impact their profitability. Those that adopt sustainable business models may be better able to capture new growth opportunities, capitalize on structural cost advantages and reduce their exposure to environmental risks to their business.

McKinsey & Co. suggests three primary levers of value-creation for resource-related businesses: growth, risk management and return on capital. These levers encompass a variety of tactics including new products and markets, investment/divestment decisions, and the management of a range of regulatory, reputation and operational risks. Investing in the New Blue Economy may not be appropriate for those who are extremely risk averse or have short-term investment horizons. Companies in this investment universe tend to offer products, services and technologies that are proactively confronting environmental and ecosystem challenges.

So, the financial payoff may be realized only over the long term. These companies have relatively smaller market capitalizations and may therefore be more volatile. The following are areas that present some of the more notable opportunities.

SOURCE: *McKinsey Analyses*

Circular Economy
The conventional linear economy relies on an extractive business model that some have summarized as "take, make, and dispose." That model, which relies on a large supply of readily available resources, appears to be reaching its physical limits. In contrast, the circular economy is "a continuous positive development cycle that preserves and enhances natural capital, optimizes resource yields, and minimizes system risks by managing finite stocks and renewable flows."[31]

Companies in the circular economy may incorporate a biological closed-loop model, such as converting waste to energy, for example. Others are focused on technical applications such as "upcycling" plastic debris into other uses, including utilizing marine plastic pollution to create footwear, or recycling discarded fishing nets into carpet tiles. Some large, well-established companies are also increasingly incorporating circular economy principles into their operations with the aim of maximizing resource productivity through both their products and business model design.[32]

Water and Wastewater
These industries can consists of water utilities as well as companies producing technology, equipment and processes necessary for water and wastewater treatment infrastructure. Some water utilities are viewing wastewater as a source of value by developing solutions in energy recovery from organic waste.

A waste-to-energy solution can have the ability to offset operational costs, generate revenue, produce renewable energy and at the same time reduce greenhouse gases while contributing to the restoration of our natural capital. Technologies that can enhance water quality through water reuse and disinfection systems offer sustainable solutions to treat water that can be safely reintroduced back into our bodies of water.

The management of water infrastructure is a major challenge as populations increase, infrastructure decays and available water resources decrease. Solutions that enable water monitoring and measurement such as leak detection and smart meters can enable enhanced productivity and provide a lower cost option in meeting the demands for improved infrastructure. Similarly, water filtration and purification technologies can provide solutions needed to address water scarcity and quality issues. Innovative solutions utilizing existing water technology in aquaponic and aquaculture systems have the potential to provide an ecologically viable alternative to industrial fish farming.

LOW-CARBON ENERGY

Offshore Wind This sector has grown from almost nothing to an installed capacity of 7 gigawatts over the past 20 years, and growth is expected to exceed that of many other sectors.[33]

According to data from WindEurope, cumulative installed capacity has grown from just 0.8 gigawatts in 2006 to more than 12.6 gigawatts in 2016, for a compound annual growth rate of more than 31%.[34] Growth projections put potential capacity at 40-60 gigawatts by 2020 and 400 gigawatts by 2030.[35]

Wave and Tidal Technologies
According to Ocean Energy Systems (OES), an intergovernmental organization, energy sources include waves and swells, tides, and ocean currents. Energy may also be captured from thermal sources and salinity gradients. OES estimates that between 2030 and 2050, wave and tidal energy growth could match that of offshore wind.[37]

Wave and tidal energy could produce significant ripple effects, as equipment used to capture this energy involves extensive supply chains stretching into a number of countries. The OECD reports that supply chains for ocean energy projects in Europe, for example, encompass "tidal turbines, hydro-turbines, steel spare parts" (Austria); "wave power plants and generators" (Germany); "wave power attenuators and overtopping devices" (Denmark).[38]

Ecosystem Services The ocean and coastal development mentioned above will require a wide range of infrastructure. In addition, rising sea levels and storm surges could put populations at risk, requiring investment in defensive infrastructure.

Miami has embarked on its most ambitious anti-flooding project this year, committing an initial tranche of $100 million to raise roads, install industrial pumps and upgrade sewer connections. Boston has commissioned a study to consider building a massive sea wall around Boston Harbor given the potential threat of sea-level rise to 90,000 residents and $80 billion worth of real estate.[39]

The OECD estimates the need at $93 trillion over the next 15 years, assuming a "low-carbon scenario."[40] This industry, which cuts across engineering and consulting firms, includes companies involved in pollution control and remediation, flood management, and coastal erosion prevention.

NEW TECHNOLOGIES

Marine Compliance Technologies With the ratification of the International Maritime Organization's (IMO) Marine Ballast Convention, ocean-going vessels will now be required to manage their ballast water to prevent the spread of invasive species.

A number of companies provide solutions, many of them employing ultraviolet light. More than 60 such systems have been approved.[41]

Emission standards for ocean-going vessels will become more stringent in 2020, and shipping companies would have to reduce their emissions of sulfur and nitrous oxides. Many may choose to meet these standards by employing cleaning systems known as "scrubbers," which reduce sulfur from exhaust gases. A number of providers offer this technology.

Industrial Biotechnology Marine resources hold tremendous potential for the development of innovative products. Applying biotechnology to these resources could unlock this potential and address a wide range of challenges.

The potential applications of marine biotech include genomics of major fish species, algae-based fuels, pharmaceuticals and chemical manufacturing.[42] The OECD estimates that the market for marine biotech products and processes amounted to $2.8 billion in 2010 and that it could grow to $4.8 billion by 2017.[43]

Marine Digitisation/Autonomous Ships Information and communications technology, combined with "big data" analytics, hold the potential to disrupt the shipping industry. Satellite applications, mobile communications, remote sensing, and radar technologies could result in greater automation and data collection, leading to improved maritime management and decision-making.

Similar to the advent of autonomous vehicles, oceangoing autonomous ships are expected to be deployed in the next decade due to their potential for safety, energy efficiency and lower operating cost. These ships are expected to be controlled remotely and could benefit from digital connectivity and intelligence systems. A key advantage for autonomous ships will be the potential larger cargo capacity and lower wind resistance that new ships designs can offer.

Over the next 15 years, the earth's population will expand by one billion, threatening to put greater stress on marine resources. Growing momentum in innovative practices and technologies promises to move the ocean economy away from the extractive, exploitative practices of the past and toward a future that is more sustainable. The New Blue Economy, which treats marine resources as assets to be carefully cultivated, has provided distinct opportunities for investors to capitalize on the vast potential of the ocean while also preserving it for future generations.

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ROCKEFELLER & CO.

INSIGHTS@ROCKCO.COM

NEW YORK, NY
10 Rockefeller Plaza
New York, NY 10020
T. 212-549-5100

WASHINGTON, DC
900 17th Street NW
Washington, DC 20006
T. 202-719-3000

BOSTON, MA
99 High Street, 17th Floor
Boston, MA 02110
T. 617-375-3300

ROCKEFELLER TRUST COMPANY, N.A.
10 Rockefeller Plaza
New York, NY 10020
T. 212-549-5100

THE ROCKEFELLER TRUST COMPANY (DELAWARE)
1201 N. Market Street, Suite 1401
Wilmington, DE 19801
T. 302-498-6000

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