ONE OCEAN

FOUNDATION

BUSINESS FOR OCEAN SUSTAINABILITY

FIRST EDITION – FOCUS ON MEDITERRANEAN SEA

SDA Bocconi School of Management | Sustainability Lab

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CONTENTS

FOREWORD

The ocean seems an infinite resource. The reality is profoundly different: growing scientific evidence shows that the health of the sea is strongly at risk and that marine ecosystems are already subject to extreme stress due to over-exploitation of natural resources, reduction of biodiversity, acidification and pollution. This is a serious and complex problem, since the conservation of the ocean is fundamental for our health and well-being.

The ocean and the sea are a source of natural resources and eco-system services. They provide us with several irreplaceable benefits such as harvestable goods (e.g. fish, shellfish, seaweed), regulating services (e.g. atmospheric heat absorption and redistribution, climate regulation), supporting services (e.g. oxygen generation 2.5 times greater than that of the Amazon rainforest), as well as cultural services (e.g. recreational, aesthetic, and spiritual benefits), and they are crucial to address many of the global challenges of the coming decades, such as food security, climate change and clean energy generation. Therefore, the conservation of marine and coastal ecosystems is part of the UN Agenda 2030 directly addressed in Sustainable Development Goal (SDG) 14, Life below water, but it is also linked to the other SDGs.

The value of the “ocean economy” is comparable to the GDP of countries such as UK or Italy. The sectors involved include consolidated industrial activities and services such as maritime and coastal tourism, commercial fishing and fish processing, industrial aquaculture, shipbuilding and ship maintenance, offshore oil and gas extraction, port activities, shipping and maritime trade. Moreover, emerging sectors, such as the exploitation of renewable energy (e.g. generated by waves, tides, algae, offshore wind), industrial aquaculture in open marine environments, or the use of marine biodiversity, yet to be mapped, for medical-pharmaceutical purposes, are destined to assume greater importance in the near future. Some of these sectors have experienced exponential growth in the last decade.

This environmental and economic wealth is threatened by direct and indirect pressures exerted by production and consumption activities. Indeed, scientific research suggests that the pressures generated by land-based industries exceed those directly operating on the ocean. This means that the possibility of increasing the sustainability of marine and coastal ecosystems depends to a large extent on the involvement and engagement of many different sectors and stakeholders. But more specifically, it depends on the engagement of industries that - only apparently - seem to have a minor impact on the health of our seas. This is about building awareness, diffusing knowledge, and identifying possible solutions with regard to the protection of the ocean, similarly to the global efforts deployed to tackle climate change over the last two decades.

In fact, the mission of the One Ocean Foundation is to accelerate solutions to ocean issues by inspiring leaders, promoting the sustainable blue economy and enhancing knowledge through ocean literacy. I would like to personally express my gratitude to our partners, CSIC, McKinsey & Company and SDA Bocconi School of Management who assisted us all the way from the initial definitions of this study through to the execution.

This publication comes at an important time. We will give you insights into the current business understanding of ocean risks and challenges and we will provide a first overview of the many technologies and organizational innovations that can be leveraged to reduce the pressures we are exerting on the seas and the marine environment.

We decided to focus this research on the Mediterranean Sea and on companies operating mainly in this sensitive social-ecological area: due to its unique biodiversity, natural resources, restricted communication with the open ocean, high anthropization and industrialization of its coasts, in fact, the Mediterranean Sea is even more vulnerable to external pressures than other marine ecosystems. We believe that this is the first step to take in order to start creating awareness and engaging business organizations and other relevant stakeholders on these issues. In the years to come, we aim to extend the project on a global level and stimulate further debate on the ocean challenges. The journey has just begun.

Princess Zahra Aga Khan

One Ocean Foundation

President

EXECUTIVE SUMMARY

This report offers a new perspective on relation between the sustainability of the ocean and the economy, with a novel focus on business organizations' awareness, strategies and innovative practices. It extends the traditional boundaries of analysis in order to include not only the direct, but also the indirect pressures on marine and coastal ecosystems, highlighting the contribution that innovation, both technological and organizational, can bring to the development of more sustainable production and consumption models.

The Mediterranean region is home to some of the world's oldest cultures and it has been traditionally recognized as a crossroad of marine routes, biota and civilizations. At the same time, it delivers significant economic benefits, with estimated annual revenues of €386 billion, €205 billion of Gross Value Added, and 4.8 million jobs. Preserving the health of marine and coastal ecosystems is paramount. Human activities exert both direct and indirect pressures on the Mediterranean Sea.

Companies are on average aware of 35% of their industry's potential pressures on marine and coastal ecosystems. The most acknowledged issues are those targeted by extensive campaigns and social movements (e.g. marine litter and, by extension, contaminants), while awareness of indirect pressures or less "mainstream" problems (e.g. over-exploitation of marine resources or effects on biodiversity) is more limited.

To ensure marine sustainability, it is necessary the unlocking of awareness and activation. On average, companies deploy mitigating activities on the large majority of the pressures that they acknowledge. The analysis suggests that it is first of all necessary to unlock "awareness", thus ensuring that companies are aware of the actual pressures produced by their industries or by their specific activities on marine and coastal ecosystems. A second key element is unlocking the related "actions". Through this second unlocking, companies acknowledging the existence of some form of pressure on marine ecosystems, respond with specific actions (e.g. adoption of sustainable technologies, or participation in multi-stakeholder initiatives) to eliminate or reduce these pressures.

According to our analysis, 34% of the companies in our sample are simultaneously aware and active, and we call these companies "sustainability leaders". Their attention to marine sustainability is mainly driven by ethical and strategic motivations. On average, sustainability leaders recognize 72% of their pressures on marine and coastal ecosystems and are active on 78% of the relevant pressures. Sustainability leaders can be found in most industries, thus representing a case for hope.

Technological and organizational innovation represent the key “actions” to address the challenges of the Oceans. Indeed, several clusters of technologies appear relevant for this purpose: cleaner sources of energy, new materials, and digital, automation, monitoring & control technologies.

Organizational initiatives – such as voluntary sustainability standards, codes of conduct and self-regulation; assessment and measurement initiatives; knowledge platforms and partnerships – complement technological innovation, as they contribute to creating more favorable conditions for developing, sharing, and adopting new and more sustainable solutions.

The possibility of changing course, preventing or at least mitigating the pressures on marine and coastal ecosystems is real, and business is expected to play a fundamental role in the transition to an economy where ocean and non-ocean-based activities operate in balance with the long-term capacity of the marine environment to regenerate, safeguarding the potential for usage and activities by current and future generations.

However, awareness is not widespread in all sectors and among all companies (awareness unlocking), and there are cases in which the attention to the issues is not followed by coherent business responses (activation unlocking).

We believe that unlocking these two aspects is key for a journey towards ocean sustainability. In order to do so, it is paramount to raise business awareness, and to incorporate protection of the seas and marine ecosystems as a part of the corporate sustainability agenda.

OBJECTIVES OF THE REPORT

This report offers a new perspective on the analysis of the relationships between the sustainability of the ocean and the economy, with a novel focus on business organizations' awareness, strategies and innovative practices. It also provides insights into the possibility of developing and diffusing innovative technologies suitable to address the many, complex and multi-dimensional challenges posed by the safeguard of marine and coastal ecosystems.

The perimeter of the study is represented by the Mediterranean Sea. For this reason, the majority of the information and data collected refers to organizations operating in this geographic area. At the same time, the business practices examined help to understand the main trends occurring at a global level.

In particular, this report responds to three main objectives.

First, it aims at investigating what companies are doing to address the many challenges facing marine ecosystems. Up until now, studies have been mainly focused on the ecological status of the ocean and of the seas, or on measuring the monetary value of the ocean economy. Building on these studies, this report adopts the perspective of business, investigating the level of awareness of companies regarding the pressures exerted on marine and coastal ecosystems, and analyzing the responses developed in order to address these pressures. For the purpose of this report, we consider as "pressure" any action that makes a change to the state of the natural environment, whether adverse or beneficial, wholly or partially resulting from the activity of an organization, or the utilization of products or services.[1]

Second, it extends the traditional boundaries of analysis in order to include not only the direct, but also the indirect pressures determined by production and consumption activities. Until now, research on ocean sustainability was mainly focused on investigating the pressures generated by the activities that take place in the ocean and the seas. These industrial sectors have been categorized under the concept of "blue economy", and several studies have attempted to monetize the size of these businesses and the value associated to marine natural capital. Nevertheless, scientists have drawn the attention to the fact that the pressures exerted by land-based industries and activities (e.g. GHG emissions, marine litter and pollution, contaminants, etc.) far outweigh those of ocean-related sectors. The goal to identify medium and long-term solutions that can contribute to safeguarding the health of the ocean requires us to extend the boundaries of our analysis. This implies to consider also those actors that generate indirect pressures on the seas and marine ecosystems (e.g. agro-food, textile, chemical).

1 Cooper P. (2013), Socio-ecological accounting: DPSWR, a modified DPSIR framework, and its application to marine ecosystems, Ecological Economics 94 (2013) 106–115

Consequently, ocean sustainability emerges when both in-land and marine-based economic activities operate in balance with the long-term capacity of marine and coastal ecosystems to support these activities, while remaining resilient and healthy.

Third, it highlights the contribution that innovation, both technological and organizational, can bring to the development of more sustainable production and consumption models, aimed at positively affecting the health of marine ecosystems. The possibility of combining economic growth and the safeguard of seas and coastal environments depends on the ability to promote new technological and organizational solutions. This report provides a first overview of the current and future technological trends (e.g. clean energy, new materials, digital, automation, monitoring & control technologies, as well as cross-cutting solutions), both in terms of new processes and products that industries and companies are exploring in order to face the challenges of the environmental status if the ocean.

METHODOLOGY

This report is based on primary and secondary data and information, collected, analyzed and elaborated through qualitative and quantitative research methods. An extensive analysis was conducted to assess the value of the Mediterranean Sea from the social, economic and environmental perspectives. This was done by gathering and elaborating data and information from multiple sources (academic research, government reports and practitioner-based literature). In order to identify the most significant direct and indirect pressures exerted by industrial sectors – both ocean and non-ocean related – on marine and coastal ecosystems, this report builds on existing institutional frameworks, and scientific knowledge. The ocean pressures have been analyzed in connection to the 11 Good Environmental Status (GES) descriptors defined by the EU Marine Strategy Framework Directive. The evaluation of the direct and indirect pressures exerted by industries on the 11 GES was assessed through a thorough scientific review involving a panel of 34 scientific experts.

After designing our research, an extensive panel of companies, business associations, NGOs, and experts were involved, through qualitative interviews and a quantitative online survey. The aim was to gather insights on the awareness of companies regarding the pressures exerted by their industries on marine and coastal ecosystems, and on the initiatives adopted to mitigate them.

In terms of economic dimension, the sample (both qualitative and quantitative) represents companies with a total turnover of almost € 1 trillion, with companies headquartered in Italy accounting for 15% of the Italian GDP.

CHAPTER 1 – HIGH STAKES ON THE MEDITERRANEAN SEA

The Mediterranean Sea is one of the most valuable environments in the world and a crucial economic pillar for its region

The Mediterranean region is home to some of the world's oldest cultures and it has been traditionally recognized as a crossroad of marine routes, biota and civilizations. The total population of the Mediterranean countries, spanning across three continents, is approximately 500 million, expected to grow to around 530 million by 2025. One-third of the Mediterranean population is concentrated along its coastal regions, mainly in the southern countries.[2]

It also represents an international biodiversity hotspot with many unique species and natural resources: even though it covers only less than 1% of the world's ocean, it hosts approximately 17,000 species, including temperate, cosmopolitan, subtropical, Atlantic and indo-pacific taxa, representing 4-18% of the world's marine biodiversity, and 17% of the known marine mammals.[3]

The Mediterranean Sea also delivers significant economic benefits, with estimated annual revenues of € 386 billion, € 205 € billion of Gross Value Added, and 4.8 million jobs (9% and 3% of world oceans, respectively).[4] The Mediterranean is also the world's leading tourism destination, with more than 330 million tourists per year, mainly concentrated in the summer season. Due to its geographical position, the Mediterranean Sea is one of the world's busiest shipping routes with about one-third of the world's total merchant shipping crossing the sea each year.[5]

Preserving this environmental and social-economic wealth is paramount

Preserving the health of marine and coastal ecosystems is paramount due to the many irreplaceable benefits provided by the sea, as well as the fact that a healthy marine environment is a habitat in which businesses can develop and thrive.Human activities exert pressures on the Mediterranean Sea. In recent decades, the degradation of marine and coastal ecosystems has quickly accelerated. The Intergovernmental Panel on Climate Change (IPCC) identified the Mediterranean as one of the most responsive areas to climate change (hotspots) due to high concentration of urban settlements and economic activities in the coastal areas, endemic water shortage, and dependence on climate-sensitive agriculture. The recent Statement of the World Meteorological Organization (WMO) on the State of the Global Climate in 2018 reported exceptionally high ocean and land temperatures over the past years, and a rise record in sea level, with a warming trend expected to con-

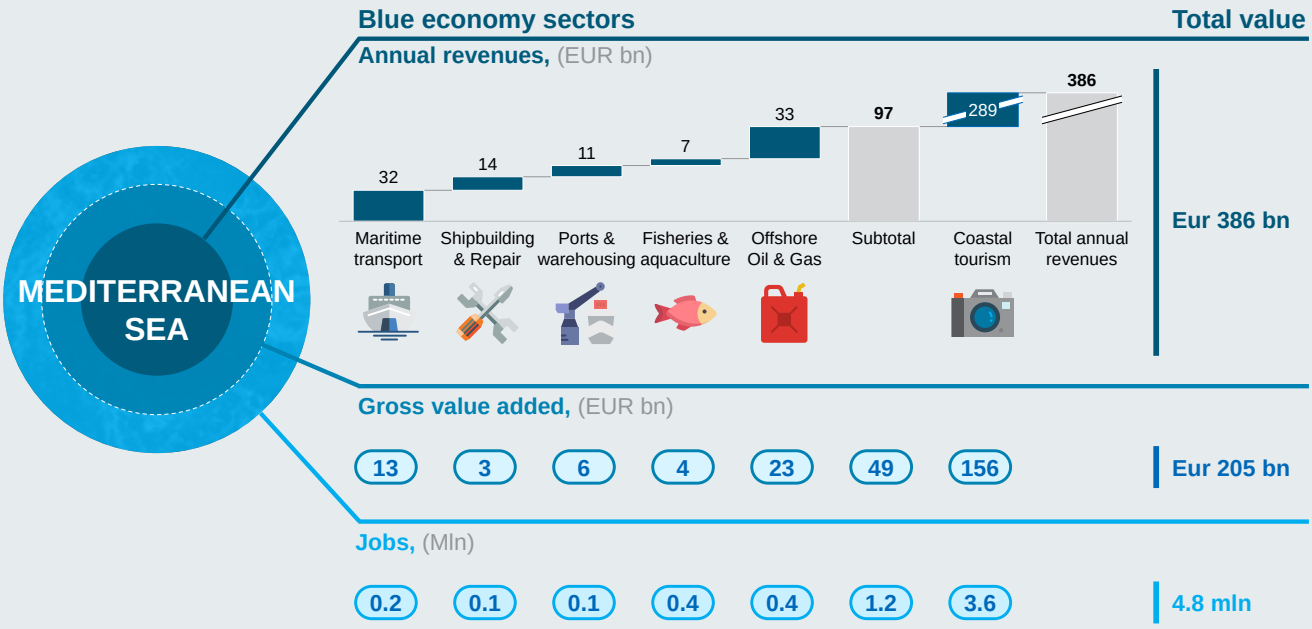
2 UNEP/MAP (2012). State of the Mediterranean Marine and Coastal Environment

3 Coll M, Piroddi C, Steenbeek J, Kaschner K, Ben Rais Lasram F, Aguzzi J, et al. (2010) The Biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats. PLoS ONE 5(8): e11842. https://doi.org/10.1371/journal.pone.0011842

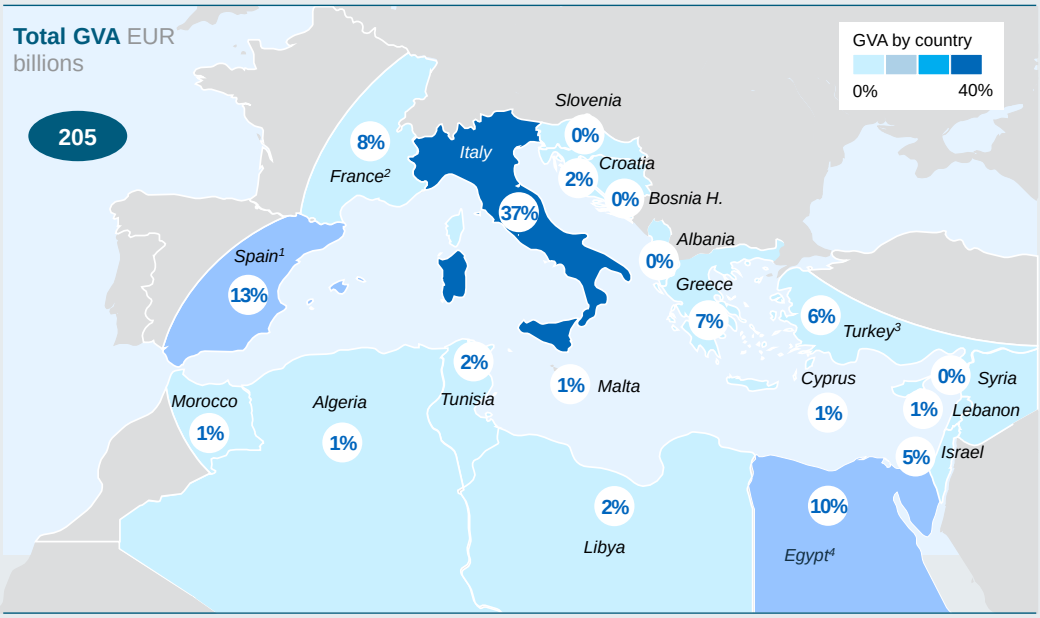
4 FAO, Eurostat Database, Rystad Energy Database, WTTC, IHS Markit, press research, McKinsey & Company analytic support

5 European Environmental Agency (EEA) https://www.eea.europa.eu/soer-2015/countries/mediterranean

FIGURE 1 – ECONOMIC VALUE OF THE MEDITERRANEAN SEA



Mediterranean Sea economy GVA distribution by country



Italy accounts for ~37% of gross value added generated by blue economy activities in the Mediterranean Sea, followed by Spain (13%) and Egypt (10%)

1 Spain: share of Mediterranean Sea coastline equals to 30%
2 France: share of Mediterranean Sea coastline equals to 40%
3 Turkey share of Mediterranean Sea coastline equals to 70%,
4 Egypt share of Mediterranean Sea coastline equals to 45%
4 Morocco share of Mediterranean Sea coastline equals to 30%

tinue.[6] The IPCC predicts a decrease in annual precipitations, an increase in extreme waves and marine heatwaves events, and a temperature rise of 2–3 °C in the Mediterranean region by 2050, and of 3–5 °C by 2100, with a sea-level rise of 0.1–0.3 meters by 2050 and of 0.1–0.9 meters by 2100, with relevant and likely even more severe effects on the southern regions. [7] [8]

Overfishing is widely acknowledged as the greatest single threat to biodiversity, marine wildlife and habitats. The Food and Agriculture Organization (FAO) reports that more than 60% of the world's fish stocks are now fully fished, overfished or depleted. Among the 16 major statistical areas, the Mediterranean and Black Sea have the highest percentage (62%) of unsustainable fishing stocks, followed by the Southeast Pacific (61%) and Southwest Atlantic (59%).[9] In any case, overfishing is only one of many threats weighing on the Mediterranean Sea: temperature stress, reduction in underwater light levels and the invasion of tropical species will endanger this area and the region will experience severe habitat losses by 2050 and species extinctions by 2100. At the same time, the Mediterranean Sea will lose part of its carbon sequestration potential.[10]

DETERIORATION OF MEDITERRANEAN ECOSYSTEM CAN HAVE SIGNIFICANT ECONOMIC AND SOCIAL CONSEQUENCES

Growth in population and in activities will drive additional and accelerating pressures on the marine and coastal environment. Negative consequences do not only impact on habitats and biodiversity, but also on economic activities based on ecosystem services (e.g. fisheries, agriculture, etc.). Consequences are expected to affect coastal or ocean related industries, but also other sectors, such as agriculture, infrastructures and services such as energy, transportation, and utilities. The consequences of the deterioration of the Mediterranean ecosystems could be significant from the economic and social point of view: the EU estimates a cost of almost € 11 billion per year as a result of marine pollution in sectors such as fishing, aquaculture and tourism. It is also expected that the negative effects of climate change in the form of coastal flooding will reach values between € 12 and € 40 billion per year by 2050, and that it will directly or indirectly affect the lives of over 700,000 citizens.[11]

6 WMO (2019), WMO Statement on the State of the Global Climate in 2018
7 IPCC (2013), Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York
8 IPCC (2019), Special Report on the Ocean and Cryosphere in a Changing Climate [H.- O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, M. Nicolai, A. Okem, J. Petzold, B. Rama, N. Weyer (eds.)]
9 FAO (2018), The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals. Rome.
10 IPCC (2019), Special Report on the Ocean and Cryosphere in a Changing Climate [H.- O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, M. Nicolai, A. Okem, J. Petzold, B. Rama, N. Weyer (eds.)]
11 European Commission (2019), The EU Blue Economy Report. 2019, Publications Office of the EU

THE MEDITERRANEAN ACTION PLAN (MAP) AND THE MARINE STRATEGY FRAMEWORK DIRECTIVE

In 1974, the United Nations Environmental Programme (UNEP) established its Regional Seas Programme to coordinate activities aimed at the protection of the marine environment using a regional approach. The Mediterranean Action Plan (MAP) was the first UNEP initiative to be developed under the program and became the model for other seas across the globe. MAP was approved in 1975 being a coherent legal and institutional framework for cooperation. It was soon followed by the Barcelona Convention and seven protocols addressing issues relevant to the conservation and sustainable use of marine and coastal resources. The UNEP/MAP - Barcelona Convention constituted the first and foremost Governance Framework for the Mediterranean.

Recently, two initiatives have been launched to deal with marine ecosystem integrity while enabling its sustainable use:

- the Marine Strategy Framework Directive (MSFD) under the Integrated Maritime Policy for European Union Member States with the basic goal to reach - in 2020 “or as soon as possible” - a Good Environmental Status (GES) of European marine waters
- the Ecosystem Approach strategy (ECAP) for all the Mediterranean countries under the UNEP/MAP framework

Both instruments adopt the Ecosystem Approach (EA) as the fundamental strategic pillar and are aimed to produce a synergistic approach aimed at: a) restoring the structure and the function of marine and coastal ecosystems; b) reducing pollution and; c) preventing, reducing and managing the vulnerability of the sea and the coasts to risk. The Ecosystem Approach (EA) is a strategy focused on understanding the relationship between human society and its activities and the ecosystems that support these activities, and how this can inform management decisions.

Significant changes need to be made today to respond to pressures and aim to restore a Good Environmental Status (GES) for the sea, specifically defined by the EU through 11 key descriptors.

The Environmental Governance of the Mediterranean Sea under the EA strategy and the MAP architecture is the main goal for the coming decades responding to the central objective to achieve Good Environmental Status (GES) for its waters and ecosystems. In particular, GES refers to *“the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations*”.[12]

12 European Commission (2018), Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)

11 Good Environmental Status descriptors

GES is defined through indicators related to 11 descriptors. As pointed out in the Commission Decision 2010/477/EU, the criteria for the achievement of GES are the starting point for the development of coherent approaches in the preparatory stages of marine strategies, including the determination of characteristics of GES and the establishment of a comprehensive set of environmental targets, to be developed in a coherent and coordinated manner in the framework of regional cooperation.

FIGURE 2 – 11 GES DESCRIPTORS

Biodiversity	Descriptor 1: Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with
Non-indigenous species	Descriptor 2: Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem
Commercial fish and shellfish	Descriptor 3: Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock
Food webs	Descriptor 4: All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity
Eutrophication	Descriptor 5: Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom water
Sea-floor integrity	Descriptor 6: Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected
Hydrographical conditions	Descriptor 7: Permanent alteration of hydrological conditions (i.e. physical parameters of seawater: temperature, salinity, depth, currents, waves, turbulence, turbidity) does not affect marine ecosystems
Contaminants	Descriptor 8: Concentrations of contaminants are at levels not giving rise to pollution effects
Contaminants in seafood	Descriptor 9: Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards
Marine litter	Descriptor 10: Properties and quantities of marine litter do not cause harm to the coastal and marine environment
Energy incl. underwater noise	Descriptor 11: Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment

Although GES has only been introduced as a mandatory requirement for European Union coastal states, this approach can be applied to all Mediterranean coastal states. Achieving GES is the key target of the environmental marine policy in Europe and should be considered the desired vision for the future of its marine waters.

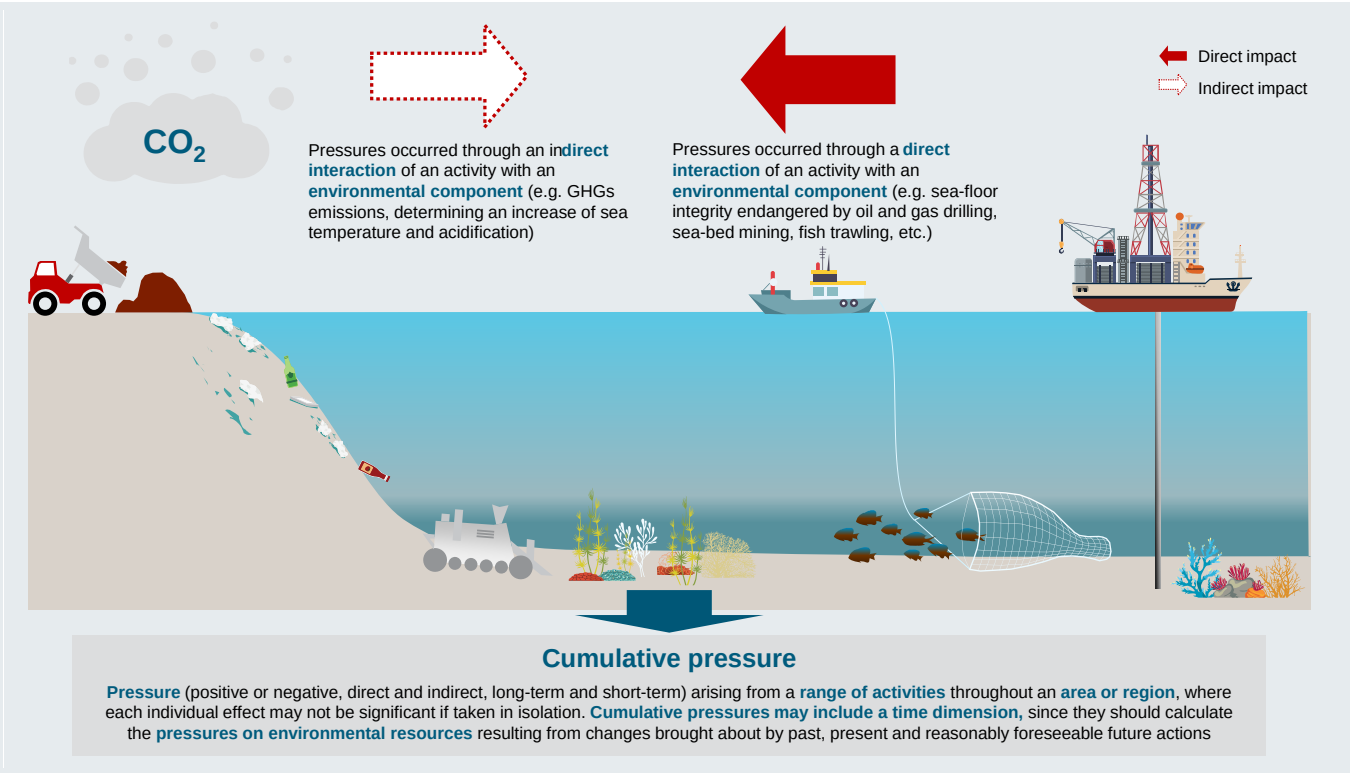
Direct and indirect pressures are exerted on marine ecosystems

Direct and indirect pressures from business and consumption activities have consequences on marine ecosystems. Pressures occur through a direct interaction with an environmental component: seafloor integrity, for example, is endangered by oil and gas drilling, trawler fishing, grounding and anchoring, while contaminants in sea waters and in seafood enter the marine ecosystem in the form of hydrocarbons leaks, biocides and anti-fouling, coagulants, or anti-foaming directly discharged or spilled into the sea.

On the other hand, indirect pressures can be observed through an indirect interaction with an environmental component: pollution and contaminants, including heavy metals or plastics and microplastics, indirectly reach the sea through land-based sources of discharge such as wastewaters, dumping grounds, fluvial run-offs, or atmospheric deposition.

These pressures can be observed at different spatial scales: at micro (i.e. with a local area of impact, such as a site, a bay, a gulf), meso (i.e. a regional area, such as a region, or a basin) or macro (i.e. the whole ocean, or the atmosphere). In addition, direct and indirect pressures include cumulative effects, since the pressures on environmental resources may result from changes determined by past, present and future actions, as well as from their interactions. The Table 1 below reports the results of the extensive literature review carried out for this project, highlighting not only the main direct pressures, but also the indirect pressures exerted on the 11 GES descriptors.

FIGURE 3 – DIRECT AND INDIRECT PRESSURES



Source: Authors' elaboration

TABLE 1 - MAIN SOURCES OF DIRECT AND INDIRECT PRESSURES ON 11 GES DESCRIPTORS

GES description	Main sources of direct pressure	Main soruces of indirect pressure
Biodiversity	Multiple and cumulative pressures on biodiversity derive from over-exploitation of natural species, introduction of non-indigenous species, eutrophication, seafloor destruction or alteration, changes in hydrographical conditions, pollution, climate change	Multiple and cumulative pressures on biodiversity derive from land-based sources of pollution, dumping grounds, fluvial run-offs. Major land-based pressures to biodiversity are exerted by inorganic pollution, fertilizers, pesticides[13]
Non-indigenous species	Natural invasion through waterways (also due to global warming and Sea Surface Temperature increase), transportation by ships, intentional or unintentional introduction by aquaculture, including commercial species, bait, aquarium trade	250 bn pieces of marine litter (including plastics and microplastics) floating in the Mediterranean Sea are expected to be potential carriers for alien and invasive species[14]
Commercial fish and shellfish	Over-exploitation, by-catch, direct and indirect impacts from fishing gears and trawler fishing, pollution, contaminants and marine litter in sea waters are the main pressures on commercial fish and shellfish. Overfishing is the greatest single threat	
Food webs	Overfishing, eutrophication, modification of hydrographical conditions, introduction of non-indigenous species, pollutants and marine litter, and alteration of marine habitats can impact food webs and nutrient chains	Chemical and nutrients run-offs from rivers and land-based activities (e.g. agriculture), as well as pollution and contaminants from industrial activities can exert pressure on marine ecosystems (flora and fauna) and alter marine food webs and nutrient chains
Eutrophication	Excessive emission of nutrients through coastal wastewater treatment plants, discharges from aquaculture, ships and vessels, and tourism facilities. The largest emissions of organic matter in coastal areas originate from urban/domestic and industrial wastewaters entering marine environments through direct discharges[15]	Organic and inorganic nutrients run-offs from rivers or from farming of animals, manure and fertilizers cause eutrophication of coastal areas
Seafloor integrity	Trawler fishing causes severe alterations of the shallow (e.g. sea grass meadows) and deep-water ecosystems, reducing the number of species and the available habitats. Drilling, seabed exploitation, dredging, grounding and anchoring exert additional significant threats to benthic and shallow water ecosystems[16]	High-density marine litter accumulation on seafloor (continental shelves, canyons and deep-sea-environments) is highly reported in the Mediterranean Sea, with plastic as the main marine litter component[17]
Hydrographical conditions	Local and regional direct sources of pressure relate to sediment resuspension, and to altered conditions in localized hotspots (salinity, acidity, temperature)	GHG emissions from industrial, agriculture and household activities influencing climate change and determining sea temperature rise, higher water acidity, decrease of oxygen
Contaminants	Hydrocarbons leaks and spills, biocides and anti-fouling, coagulants, anti-foaming agents, and heavy metals are all present in Mediterranean waters	Land-based sources of pollution such as wastewaters, discharge points and dumping grounds, fluvial run-offs, atmospheric deposition
Contaminants in seafood	Contaminants in sea waters, and especially heavy metals that cannot be degraded, represent a serious threat for marine species as well as for human consumption	Land-based sources of pollution, including contaminants and heavy metals, reach the sea through fluvial run-offs and atmospheric deposition and can contribute to seafood contamination. Recently discovered seafood contaminants regard microplastics
Marine litter	Plastic, wood, metal, clothing, and paper waste originating from coastal household and municipal disposal, tourism facilities, pleasure craft and commercial vessels, are the main sources of marine litter and pollution. Plastic is by far the most common type of litter	Plastic, wood, metal, clothing, paper run-offs from rivers and land-based production and consumption activities
Energy incl. underwater noise	Energy, heat, noise, and vibrations introduced and/or discharged in water from exploration and exploitation activities, commercial transportation and pleasure crafts exert an increasing pressure on the aquatic ecosystems	

Source: Authors' elaboration

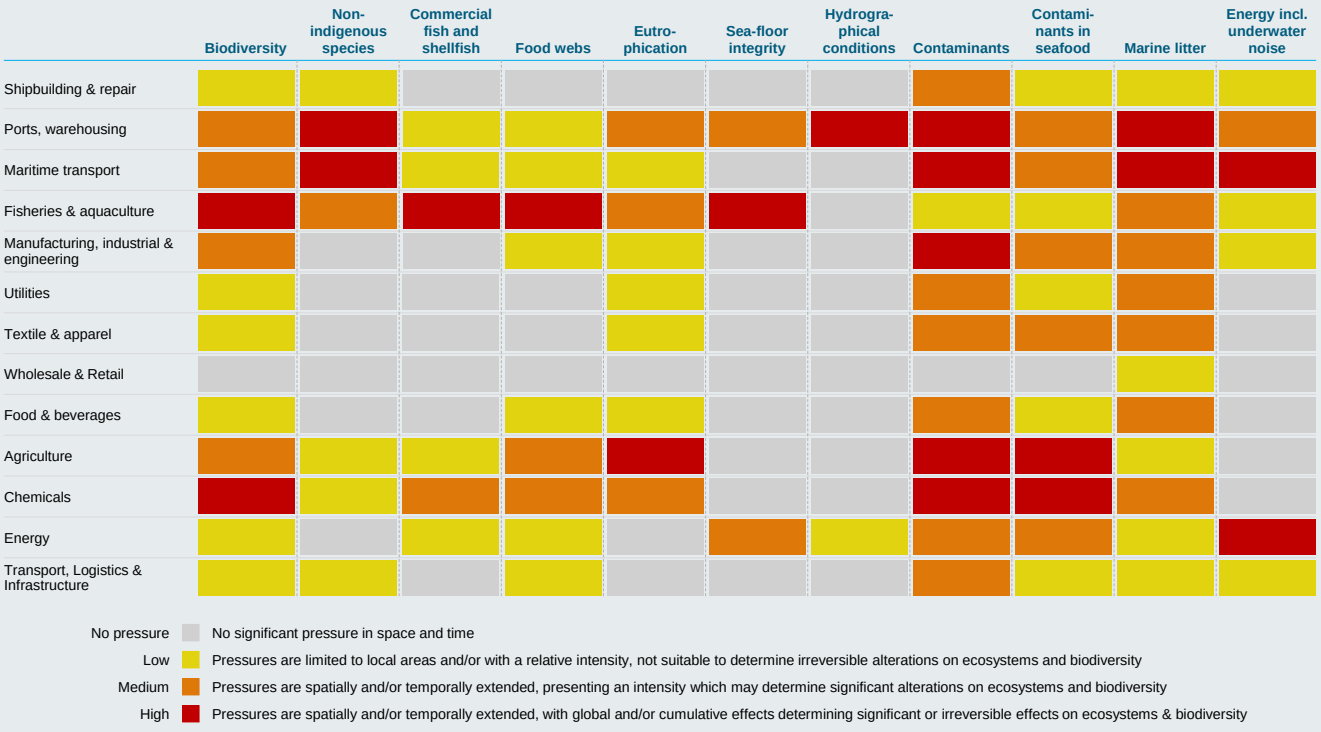
13 WWF Mediterranean, Randone, M. (2016), MedTrends Project: Blue Growth Trends in the Adriatic Sea - the challenge of environmental protection
14 UNEP/MAP (2012), State of the Mediterranean Marine and Coastal Environment
15 UNEP/MAP (2012), State of the Mediterranean Marine and Coastal Environment
16 UNEP/MAP (2012), State of the Mediterranean Marine and Coastal Environment
17 UNEP/MAP (2018), 2017 Mediterranean Quality Status Report

According to an independent scientific review carried out for this project, all industries, directly or indirectly interacting with the ocean/seas, can potentially exercise negative pressures on most of the 11 GES descriptors. The most significant pressures appear to be those related to: the introduction of contaminants, including their presence in seafood, and litter in marine ecosystems; the effects on marine biodiversity, including the depletion of fish stocks and the alteration of food webs; and the eutrophication of waters, and its consequences on biodiversity conservation.

Ocean or coastal based industries (e.g. fisheries, marine transportation, ports & warehousing) have long been recognized for their “direct” pressures on marine ecosystems. However, indirect pressures from other sectors (e.g. chemicals, agriculture, energy) cannot be neglected and require adequate business responses.

MAIN DIRECT AND INDIRECT PRESSURES ON MARINE ENVIRONMENT ARE THE ONES RELATED TO THE INTRODUCTION OF CONTAMINANTS, MARINE LITTER AND THE EFFECTS ON MARINE BIODIVERSITY

FIGURE 4 – REVIEW OF NEGATIVE DIRECT&INDIRECT PRESSURES OF VARIOUS SECTORS



Source: Experts scientific review, total no. = 34

Several studies suggest that the pressures exerted by land-based activities exceed those of direct ocean industries:

- **80% of plastic pollution is of land-based origin**. It is estimated that due to mismanaged processes, such as littering or dumping in uncontrolled landfills, one-third of plastic waste eventually enters the natural environment as land, freshwater or marine pollution[18], and that 80% of plastic pollution in marine ecosystems is of land-based origin.[19]

  Studies carried out on the main types of beach marine litter report plastic, glass, paper, metal, polystyrene, cloth, rubber, fishing-related items, munitions, wood, smoking-related items, sanitary waste, and other unidentified items, with cigarette butts, plastic and glass beverage bottles, food wrappers, plastic and metal bottle caps, straws/stirrers, plastic bags and lids being the top items found on Mediterranean beaches. Plastics are the predominant type, accounting for over 80% of the recorded marine litter.[20]

  Plastic is also the main component of floating and seafloor marine litter. The Mediterranean Sea is heavily impacted by floating litter items, with concentrations comparable to the 5 sub-tropical gyres, while densities on the seafloor seem to range from 0 to over 7,700 items per km^2. Human activities are the primary sources of the increased abundance of marine litter in the Mediterranean Sea.[21]

  Recent studies focusing on marine litter in the size of microplastics or nanoplastics[22], reveal that the main types found in the Mediterranean Sea are hard plastics, fibers, and nylon[23], deriving, to a large extent, from different land-based industrial and consumption sources. Primary microplastics include industrial scrubbers, plastic powders used in molding, micro-beads adopted in cosmetic formulations, virgin resin pellets used by the plastic manufacturing industry, and plastic nanoparticles from a variety of other industrial processes. Secondary microplastics result from the fragmentation of larger plastic items, during the use of products such as textiles (e.g. fibers released into wastewater effluents due to washing of clothes), paint degradation and tires abrasion, or once the plastic items have been disposed of in the environment.[24]

18 WWF and Dalberg (2019), Solving Plastic Pollution through accountability
19 Ocean Conservancy & McKinsey McKinsey Center for Business and Environment (2015), Stemming the Tide: Land-Based Strategies for a Plastic-Free Ocean
20 UNEP/MAP (2018), 2017 Mediterranean Quality Status Report https://www.medqsr.org/sites/default/files/inline-files/2017MedQSR_Online_0.pdf
21 UNEP/MAP (2018), 2017 Mediterranean Quality Status Report https://www.medqsr.org/sites/default/files/inline-files/2017MedQSR_Online_0.pdf
22 Primary microplastics, produced originally at microscopic size, or secondary microplastics, fragments from originally larger plastic items
23 UNEP/MAP (2018), 2017 Mediterranean Quality Status Report https://www.medqsr.org/sites/default/files/inline-files/2017MedQSR_Online_0.pdf
24 GESAMP (2015), Sources, fate and effects of microplastics in the marine environment: a global assessment (Kershaw, P. J., ed.). (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection)

- **The vast majority of GHG emissions contributing to climate change, and thus sea temperature rise, water acidification, and decrease of oxygen in the water, are land-based**. Global CO_2 emissions increased in 2017, reaching a record of 53.5 $GtCO_2e$, a growth of 0.7 $GtCO_2e$ compared with 2016.[25] In terms of sector contribution, energy supply accounts for 29% of total GHG emissions, followed by transport (19%) and industry (19%), residential and commercial (11%), and agriculture (11%).[26]
- **Contaminants also enter the marine environment through wastewaters, discharge points and dumping grounds, or atmospheric deposition**. Water releases are mostly related to the fertilizer industry, metal industry, wastewater treatment plants, energy and chemical sector. Eutrophication of local and regional coastal marine ecosystems derives mostly from organic and inorganic chemicals and nutrients run-offs from rivers and/or from farming of animals, animal manure and fertilizers.

25 UNEP (2018). The Emissions Gap Report 2018
26 EEA https://www.eea.europa.eu/data-and-maps/daviz/change-of-co2-eq-emissions-2#tab-dashboard-01

CHAPTER 2 – UNLOCKING AWARENESS AND ACTIVATION TO ENSURE MARINE SUSTAINABILITY

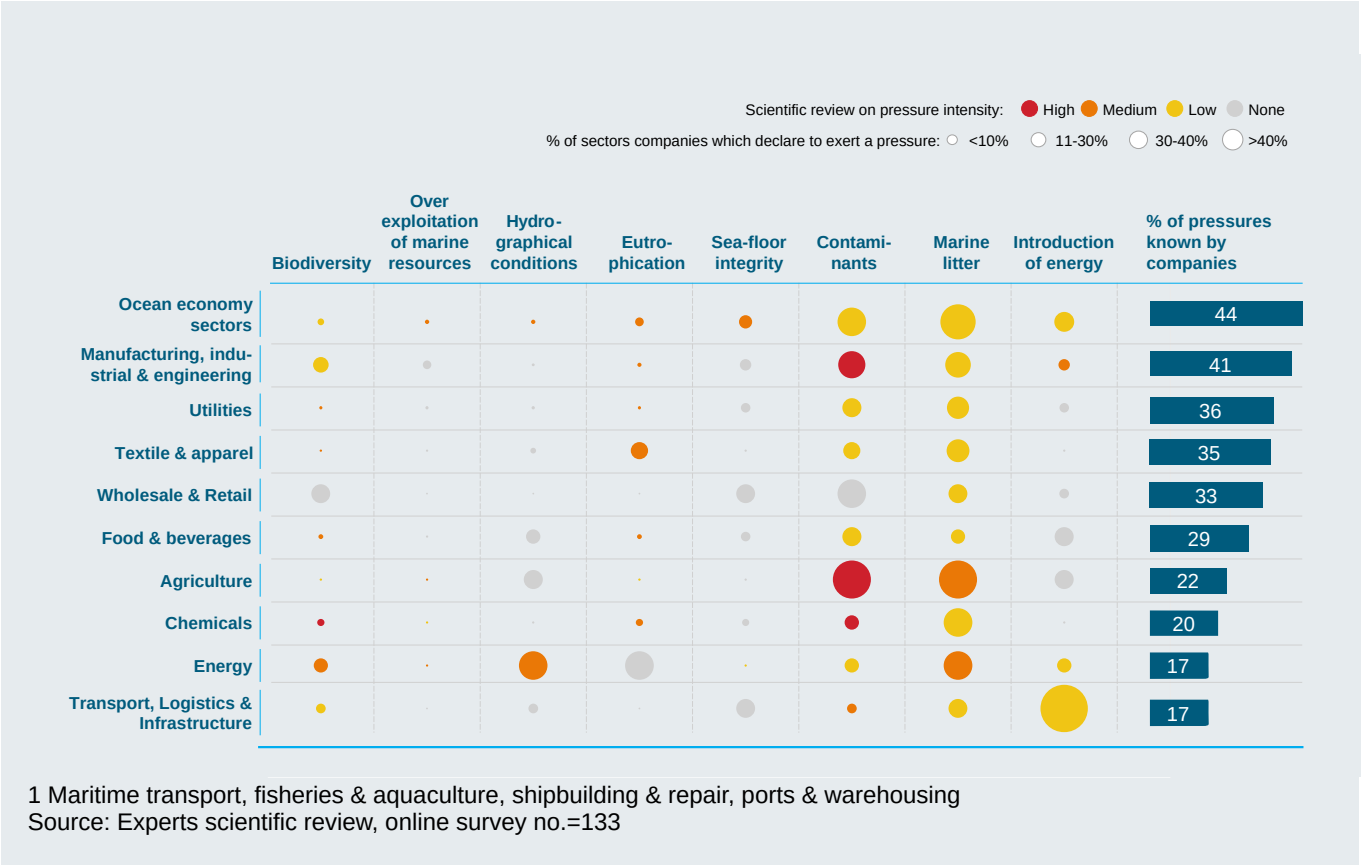
Companies' awareness of their negative pressures on coastal and marine ecosystems is higher with regard to pressures targeted by extensive campaigns and social movements. On the contrary, awareness of indirect pressures or on less "mainstream" issues is more limited, and often accompanied by misinterpretation

COMPANIES ARE AWARE OF 35% OF THEIR INDUSTRY'S PRESSURES ON GES DESCRIPTORS AND DEPLOY MITIGATING ACTIVITIES FOR 74% OF THE PRESSURES THAT THEY ACKNOWLEDGE

We define companies as being "aware" of the negative pressures directly and indirectly exerted by their activities on marine and coastal ecosystems when their level of acknowledgment matches the opinion of ocean science experts. According to our analysis, companies are on average aware of 35% of their industry's potential pressures on selected GES descriptors. The most recognized issues regard pressures targeted by extensive campaigns and social movements, such as marine litter and, by extension, contaminants: all sectors, to different degrees, are aware of the pressures, directly or indirectly exerted on these two descriptors.

On the contrary, awareness on pressures generated on less "publicized" issues, such as over-exploitation of marine resources, effects on biodiversity, or eutrophication, is more limited.

FIGURE 5 – COMPANIES' AWARENESS OF THE NEGATIVE PRESSURES THAT THEIR INDUSTRIES CAN POTENTIALLY EXERCISE ON SELECTED GES DESCRIPTORS - OCEAN SECTORS VS. OTHER SECTORS

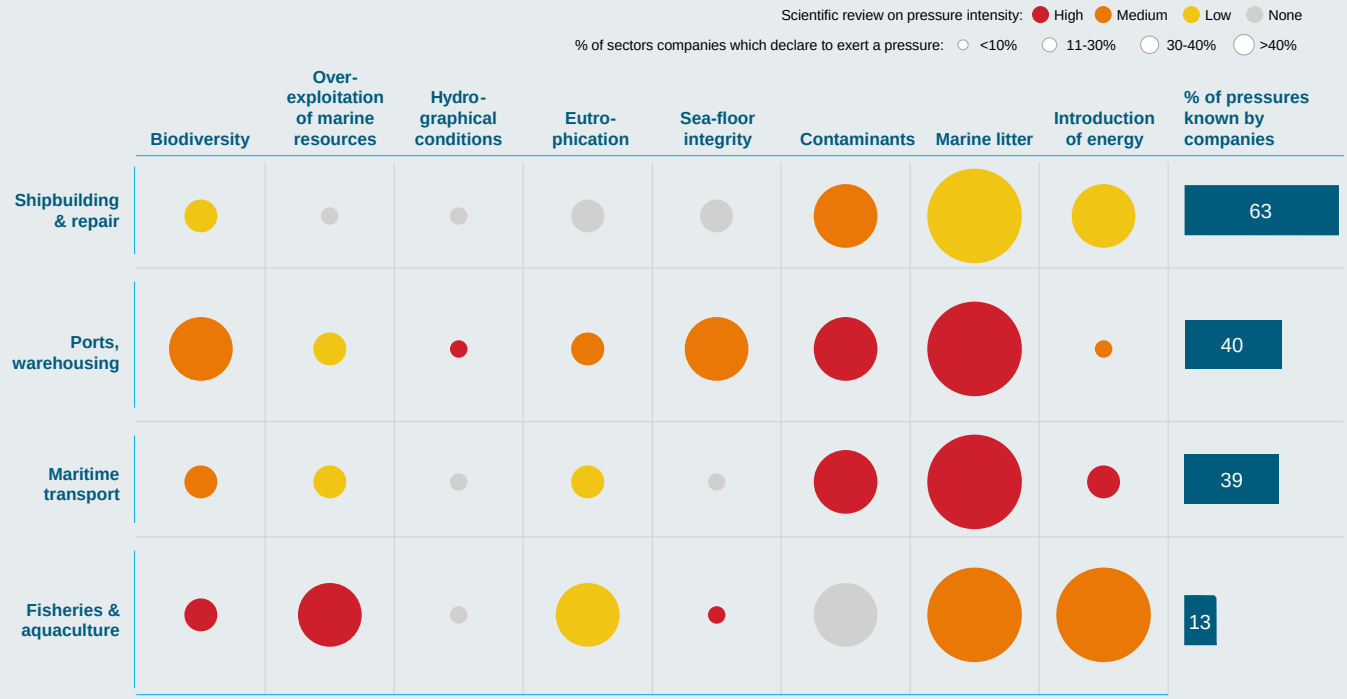


1 Maritime transport, fisheries & aquaculture, shipbuilding & repair, ports & warehousing
Source: Experts scientific review, online survey no.=133

When we look at industries, ocean sectors perform better than the others on awareness. This is also due to the fact that these industries have a direct interaction with the marine environment, and are - probably - more used to dealing with the pressures exerted on the seas and coastal ecosystems. On average, ocean sector companies are aware of 44% of their pressures, with shipbuilding & repair being the most aware. Moreover, ocean sectors also seem more aware than others of the pressures produced on less well-known GES descriptors, such as biodiversity and over-exploitation of marine resources.

Several pressures are not properly identified by respondents. Within the ocean sectors, for example, none of the companies belonging to ports & warehousing recognizes the pressures on hydrographical conditions (e.g. changes in depth, currents, waves, or turbidity of waters and coastal environment), while the fisheries and aquaculture companies involved are unaware of the pressures potentially or actually exerted on sea-floor integrity by their industry (e.g. determined by trawler fishing). Outside the ocean sectors, none of the agriculture companies acknowledges the pressures on eutrophication, while being the most aware of the consequences determined by their industry in terms of marine litter and contaminants, presumably misinterpreting these different types of issues (eutrophication vs. marine litter and contaminants).

FIGURE 6 – COMPANIES' AWARENESS OF THE NEGATIVE PRESSURES THAT THEIR INDUSTRIES CAN POTENTIALLY EXERCISE ON SELECTED GES DESCRIPTORS - OCEAN SECTORS



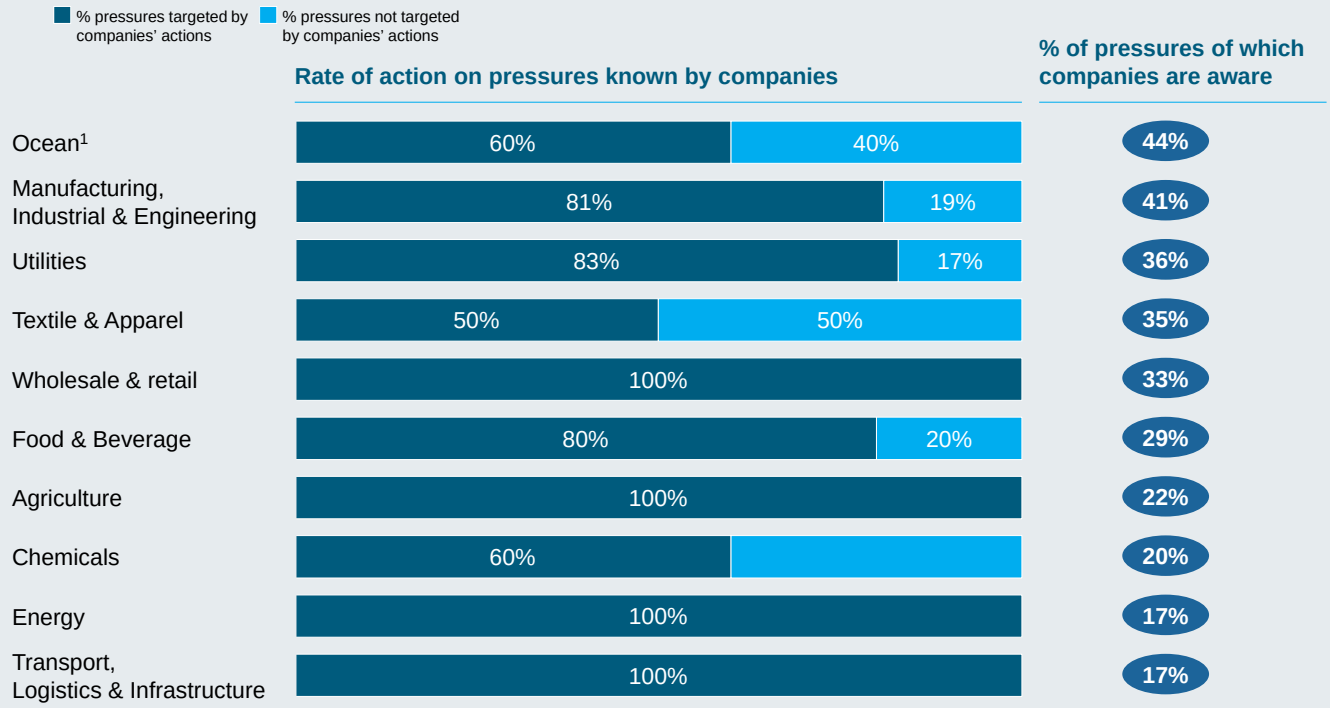
Source: Experts scientific review, online survey no.=133

On the other hand, there are cases in which companies report pressures not considered significant by ocean scientists and experts: 50% of the energy companies report exerting pressures on eutrophication, and 1 out of 3 in the food & beverage and agriculture industries claims to be responsible for the introduction of energy into marine ecosystems (e.g. light, electricity, heat, noise, electromagnetic radiation, radio waves or vibrations), presumably linking this issue to the increased sea temperature determined by climate change.

On average, companies deploy mitigating activities for 74% of the pressures that they acknowledge

Considering the pressures that companies are aware of, on average respondents report to implementing mitigation activities in 74% of the cases. Although in almost 3 out of 4 cases awareness corresponds to action, there are still cases in which awareness does not imply response, demonstrating another type of misalignment: a gap between being aware of an environmental problem and responding through specific initiatives.

FIGURE 7 – RATE OF ACTION ON PRESSURES ACKNOWLEDGED BY COMPANIES



1 Includes: Fisheries & Aquaculture, Maritime transport, ports & warehousing, shipbuilding & repair
Source: online survey no.=133

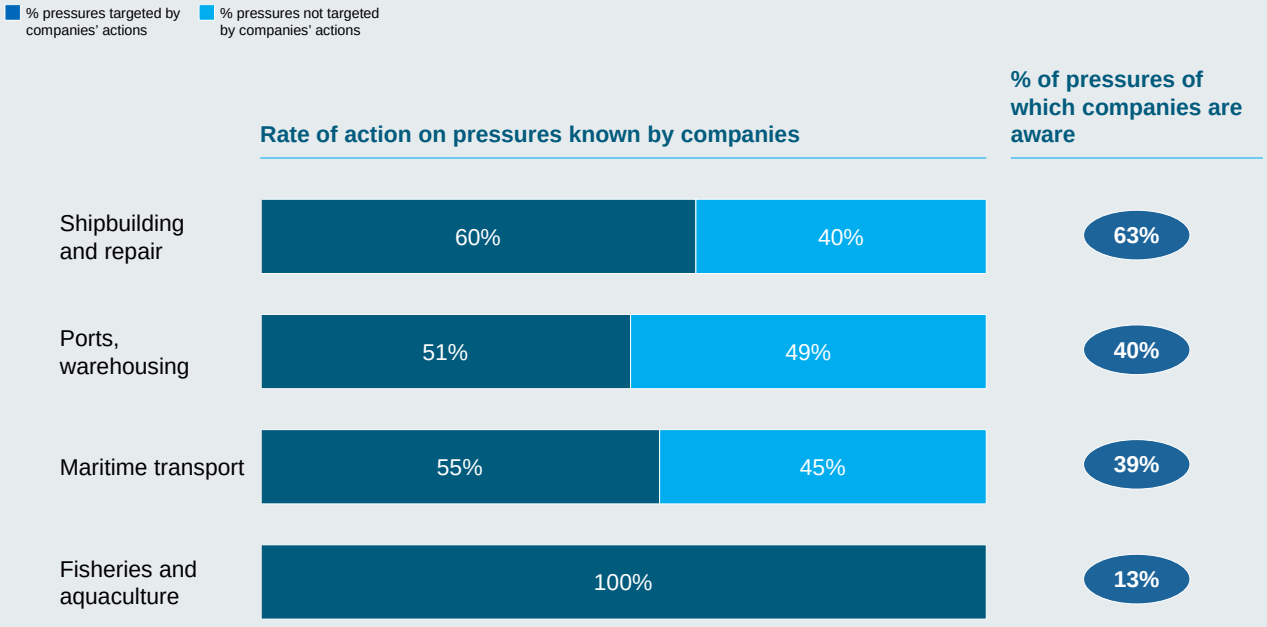
Unlocking “awareness” and “activation” allows us to understand the main pressures on marine and coastal ecosystems and to develop coherent responses to relevant pressures

The analysis suggests that besides unlocking “awareness”, thus ensuring that companies are aware of the actual pressures produced by their industries or by their specific activities on marine and coastal ecosystems, a second key element is unlocking the related “actions”. Through this second unlocking, companies acknowledging the existence of some form of pressure on marine ecosystems, respond with specific actions (e.g. adoption of sustainable technologies, or participation in multi-stakeholder initiatives) to eliminate or reduce these pressures.

34% OF THE COMPANIES ARE AT THE SAME TIME AWARE AND ACTIVE, WHILE 44% ARE NEITHER AWARE NOR ACTIVE

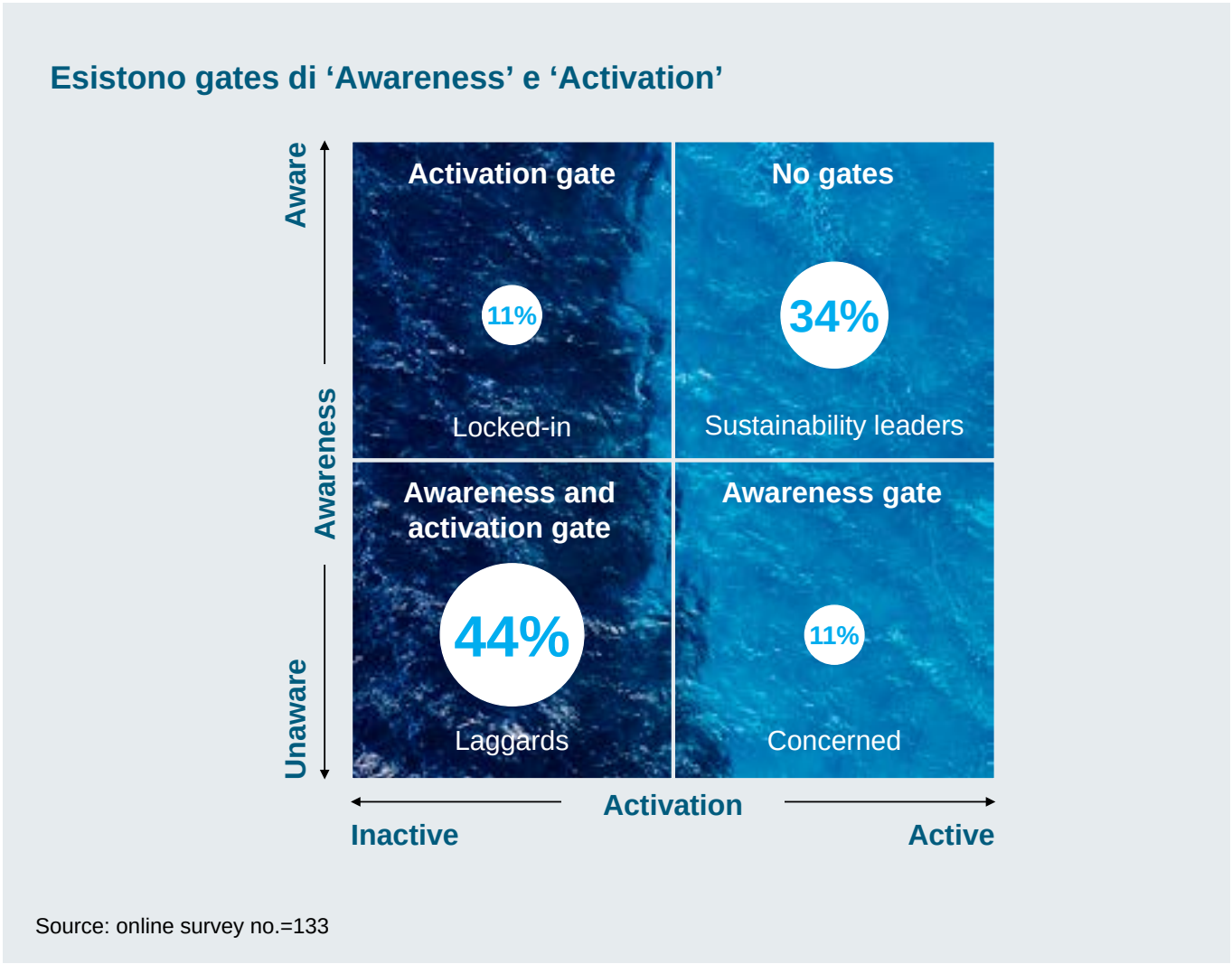
Awareness and/or activation “gates” are found in most sectors. An example of awareness misalignment regards GHG emissions: several companies, from different sectors, are not aware of the linkages between GHG emissions and hydrographical conditions (i.e. GHG emissions influencing climate change and determining sea temperature rise, higher water acidity, decrease of oxygen). This implies that when they act on this specific issue (e.g. implementing solutions for GHG emissions reduction), they are not aware of doing something that has positive indirect consequences on the marine environment.

FIGURE 8 - RATE OF ACTION ON PRESSURES KNOWN BY COMPANIES - OCEAN SECTORS



Source: online survey no.=133

FIGURE 9 - DISTRIBUTION OF COMPANIES ACCORDING TO AWARENESS AND ACTIVATION (% OF COMPANIES)



Source: online survey no.=133

Another example, related to the activation gate, concerns the textile and apparel sector and microfibers: awareness about microfibers dispersion in marine ecosystems is growing, and an increasing number of players are working to research solutions to prevent or limit this problem. Unfortunately, as of today, growing awareness does not correspond to credible and effective responses, due to the fact that further R&D is required to develop commercially viable technological solutions, capable of tackling this challenge.

According to our analysis, 34% of the companies in our sample are simultaneously aware and active (sustainability leaders), while 44% are not aware, and not active (laggards). The remaining 22% is equally divided between aware but inactive (locked-in), and unaware but active (concerned).

In order to tackle the problem of ocean and marine ecosystem sustainability, it is necessary to unlock both awareness and activation. Indeed, unlocking activation could be more difficult than increasing awareness, and might require more time. On the one hand, awareness can be tackled through stimulating a large-scale debate on the ocean protection that engages busi-

ness organizations, industrial associations, governmental agencies, and civil society. On the other hand, the possibility of activating responses depends on organizational changes, on the availability of efficient and viable technological solutions, as well as on other types of constraints (e.g. operational, economic, financial, and institutional impediments) that “lock-in” companies and prevent them from acting.

CHAPTER 3 – THE CASE FOR HOPE: SUSTAINABILITY LEADERS EXIST

Sustainability leaders are more aware and active than other companies, and their attention to marine sustainability is mainly driven by ethical and strategic motivations.

SUSTAINABILITY LEADERS RECOGNIZE 72% OF THEIR PRESSURES ON MARINE AND COASTAL ECOSYSTEMS AND ARE ACTIVE ON 78%

On average, sustainability leaders recognize 72% of their pressures on marine and coastal ecosystems and are active on 78% of the relevant pressures. Although representing 1/3 of the sample, sustainability leaders can be found in most industries, both ocean (e.g. maritime transport, ports & warehousing, shipbuilding & repair) and non-ocean related sectors (e.g. energy, utilities, transport, logistics & infrastructure, textile & apparel, chemicals, food & beverage, manufacturing, industrial & engineering, wholesale & retail).

According to our analysis[27], 4 main drivers are spurring sustainability leaders to act in order to mitigate their pressures on marine and coastal ecosystems:

1. **Moral imperative**. Sustainability leaders are 1.2 times more likely to align their strategies with the company's missions and ethical values than other companies. This means that values, beliefs and principles linked to sustainability translate into specific activities aimed at identifying and mapping the pressures on marine ecosystems, and drive the development of cleaner solutions.
2. **Growth opportunities and awareness of dependence on ecosystem services**. Sustainability leaders declare themselves as 1.9 times more inclined than other companies to capture new growth opportunities, such as developing more sustainable use of marine resources, as well as new products or materials. Several companies, in particular those belonging to industries that depend heavily on ecosystem services – such as fishing and agriculture as well as food processing – have matured greater awareness of the significant consequences of production and consumption pressures on natural ecosystems. Driven by this attention, they have started to implement initiatives and programs to address some of the problems that derive from their activities. For example, they have adopted voluntary sustainability standards, or promoted knowledge platforms and partnerships aimed at introducing enhanced and more sustainable production practices (e.g. sustainable fishing, precision agriculture) in their activities. Moreover, in the perspective of the circular economy companies belonging to this cluster mentioned the opportunities linked to sustainable production processes, such as recovering biogas (e.g. methane) from bacterial breakdown of agricultural waste or water treatment facilities, and turning it into energy.

27 Interviews with a panel of >50 leading players from different sectors (including large companies and multinationals, startups, business associations), and NGOs; questionnaires total no. = 133

3. **Market demand.** Incisive campaigns, social movements and market demand have contributed to increasing the focus on the pressures on natural ecosystems. Campaigns related to climate change and ocean litter have been particularly effective. The case of plastic waste is worth mentioning, because of the speed with which this issue has become mainstream, which is unprecedented. Inactivity has become increasingly dangerous for companies, exposing laggards to reputational risk and boycotts from consumers. Regarding market demand, sustainability leaders are 1.9 times more likely than other companies to consider customers' expectations as one of the key drivers prompting ocean mitigation initiatives.
4. **Institutional pressure and regulation.** Finally, although the least significant reason, institutional pressure and regulation nevertheless represent one of the drivers that require a response from companies. Interestingly, sustainability leaders seem less predisposed than other companies to considering regulatory requirements as one of the reasons to address sustainability, confirming their superior attitude in considering sustainability as part of the company's strategic orientation.

FIGURE 10 - TOP REASONS TO ADDRESS SUSTAINABILITY – SUSTAINABILITY LEADERS VS. OTHERS

Source: online survey no.=133

INSTITUTIONAL PRESSURE AND REGULATION INFLUENCING THE ADOPTION OF MEASURES AIMED AT MITIGATING THE PRESSURES ON MARINE AND COASTAL ECOSYSTEMS

The Paris Agreement and the efforts to reduce GHG emissions

The objective to reduce GHG emissions and the transition to a low carbon economy, are reshaping the strategies of several industries. In particular, the energy sector is among the most impacted. At the UNFCCC (United Nations Framework Convention on Climate Change) XXI climate conference (COP21) held in December 2015 in Paris, 195 countries adopted the Paris Agreement, the global climate deal aimed at defining a global action plan to avoid the most dangerous consequences of climate change by limiting global warming to well below 2 °C above pre-industrial levels, and pursuing efforts to limit it to 1.5 °C. The Paris Agreement requires all Parties to adopt their best efforts through nationally determined contributions (NDCs), and to regularly report on their emissions, and on their implementation efforts.

The EU's nationally determined contribution, within the 2030 climate and energy framework strategy, is to reduce GHG emissions by at least 40% by 2030 compared to 1990, leveraging renewable sources of energy (at least 32% of share by 2030), and improving energy efficiency (at least 32.5% improvement). The targets for renewables and energy efficiency were revised upwards at the end of 2018.

The new EU Directive on single use plastics and fishing gear

On June 5th 2019 the new EU Directive 2019/904 on single use plastics and fishing gear, introducing a series of measures regarding the top 10 single-use plastics found on European beaches, as well as fishing gear, was definitively approved by the European Parliament and Council. Member States have two years (i.e. until July 3rd 2021) to transpose the Directive into national law.

The measures introduced, ranging from market restriction, to consumption reduction, separate collection, product design, extended producer responsibility (EPR), labelling, and awareness raising, depend on whether viable alternatives and separate collection and recycling streams exist or not.

The Directive is aimed at reducing marine litter and it intends to ban selected single-use products made of plastic, for which alternatives exist on the market (e.g. cotton bud sticks, cutlery, plates, straws, stirrers, sticks for balloons, cups, polystyrene food and beverage containers). Moreover, it extends producer's responsibility, asking producers to cover the cost of clean-up for products such as tobacco filters and fishing gear, and establishes a separate collection target for plastic bottles, with design requirements and the target of incorporating recycled plastic in PET and in all plastic bottles.

As regards fishing gear, three main measures are introduced: a) according to EPR, fishing gear producers will cover the costs of waste

management of gear delivered to port reception facilities; b) awareness initiatives will be implemented regarding the available re-use systems and waste management options, as well as the negative impacts of inappropriate disposal of gear; c) Member States are required to set national minimum annual collection rates for waste fishing gear for recycling, and to monitor fishing gear placed on the market, as well as waste fishing gear collected, with a view to the establishment of binding quantitative EU-wide collection targets.

Expected benefits of the introduction of these measures related to fishing gear are a decrease of 2,600 tons each year in the amount of fishing gear left at sea, which would generate between €2 million and €7 million in economic benefits for the fishing, port and tourism industries[28].

Maritime sector-specific regulation and restrictions

The International Maritime Organization (IMO) has established more stringent limits on pollutant emissions (SOx, NOx, PM) in ECAs (Emission Control Areas) and extra ECAs, with additional restrictions effective from 1 January 2020. In April 2018, the IMO's Marine Environment Protection Committee (MEPC) adopted an initial strategy on the reduction of GHG emissions from international shipping, with the objective to reduce them by at least 50% by 2050 compared to 2008. Additional IMO regulations relate to worldwide, legally binding energy-efficiency measures, setting a series of baselines for the amount of fuel that each type of ship burns for a certain cargo capacity, or the Ballast Water Management (BWM) Convention, requiring that ships submit ballast waters, embarked during each voyage, to mechanical, physical, chemical, or biological treatment processes.[29]

Sustainability leaders are more active than other companies in addressing the identified pressures

When we look at the focus of the efforts deployed to mitigate the pressures on marine and coastal ecosystems, sustainability leaders are 3.6 times more likely than other companies to address contaminants issues, and almost 3 times more responsive to tackling marine litter. In addition, they are also more active in targeting all the other issues (e.g. biodiversity, introduction of energy in the sea, over-exploitation of marine resources) than less aware companies.

Beyond the distinctive features previously examined, sustainability leaders reveal other specific characteristics. They appear, in fact, more concerned about their business responsibilities, and more likely to adopt technological innovation and to develop organizational initiatives.

SUSTAINABILITY LEADERS ARE 3.6 TIMES MORE LIKELY THAN OTHER COMPANIES TO ADDRESS CONTAMINANTS ISSUES, AND 3 TIMES MORE RESPONSIVE TO TACKLING MARINE LITTER

28 http://www.europarl.europa.eu/RegData/etudes/BRIE/2018/625115/EPRS_BRI(2018)625115_EN.pdf

29 IMO (2004), Final Act of the International Conference on Ballast Water Management for ships, BWM/CONF/37 and International Convention for the Control and Management of Ships' Ballast Water and Sediments, BWM/CONF/36. The Ballast Water Management Convention, aimed at stopping the spread of potentially invasive aquatic species in ships' ballast water has entered into force on September 8th 2017

FIGURE 11 - FOCUS OF EFFORTS RELATED TO SELECTED GES DESCRIPTORS – SUSTAINABILITY LEADERS VS. OTHERS

Source: online survey no.=133

Sustainability leaders, in fact, engage employees and customers almost 2 times more than less aware companies, for example by involving employees in specific education and awareness-raising initiatives, or marketing sustainability related attributes of products and services, encouraging customers to adopt more sustainable behaviors.

They are more likely to sustainably manage their value chains, by interacting with suppliers and/or distributors on ocean-related issues, selecting certified supply chain partners, adopting sustainability performance standards, or building traceability of materials.

In terms of partnerships, sustainability leaders reveal a superior attitude in establishing collaborations with relevant stakeholders, such as industry peers and business associations, research centers, NGOs and civil society groups for awareness-raising initiatives, such as, for example, days dedicated to beach and coastal clean-ups.

FIGURE 12 - TOP ACTIVITIES UNDERTAKEN TO MITIGATE PRESSURES ON GES – SUSTAINABILITY LEADERS VS. OTHERS

Source: online survey no.=133

Sustainability leaders also report a better attitude towards process and product innovation, aimed at reducing their pressures on marine and coastal ecosystems

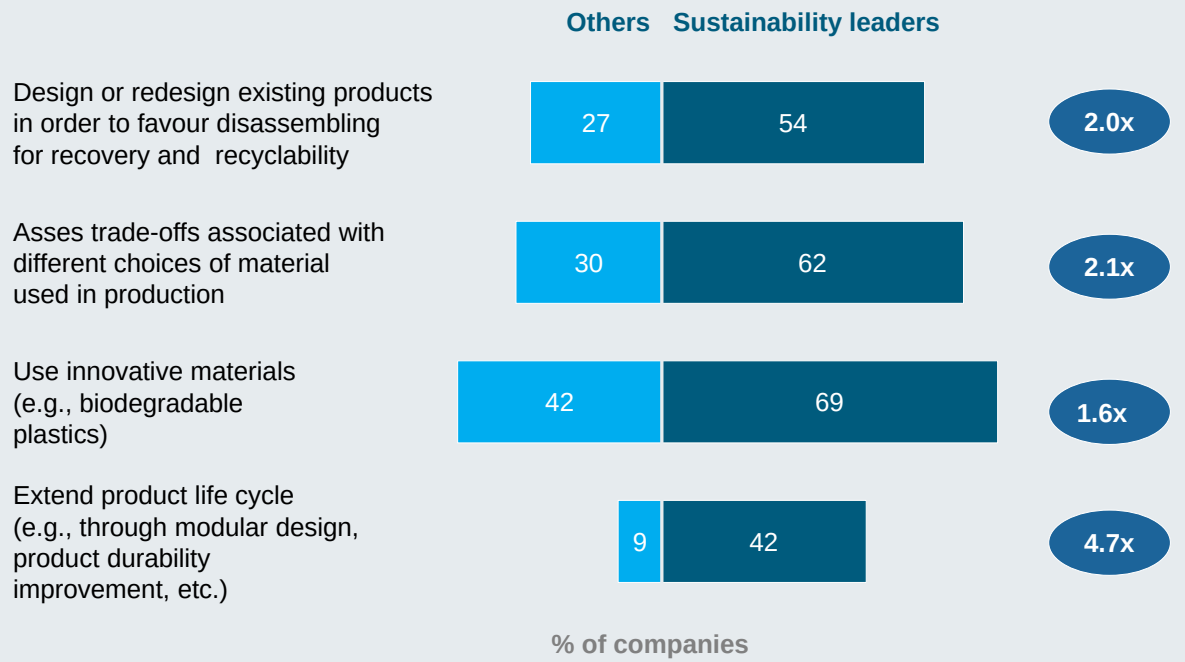
As regards process innovation, sustainability leaders and other companies are relatively close when it comes to considering improvements in the area of energy efficiency devoted to reducing GHG emissions (81% vs. 84%), while the gap widens for other initiatives, such as the implementation of improved waste and wastewater management, adoption of circular economy models or models inspired by industrial symbiosis.

In terms of product innovation, sustainability leaders are approximately 2 times more likely than other companies to assess trade-offs associated with choices of different materials and to design or redesign products to favor disassembling for recovery or recycling, while they are more than 4.5 times more likely to develop initiatives that aim at extending the life cycles of their products.

FIGURE 13 - MAIN PROCESS INNOVATION INITIATIVES TO REDUCE MARINE AND COASTAL PRESSURES – SUSTAINABILITY LEADERS VS. OTHERS

Source: online survey no.=133

FIGURE 14 - MAIN PRODUCT INNOVATION INITIATIVES TO REDUCE MARINE AND COASTAL PRESSURES – SUSTAINABILITY LEADERS VS. OTHERS



Source: online survey no.=133

LEADING COMPANIES IN THE FINANCIAL SERVICES AND MEDIA AND COMMUNICATIONS SECTORS HAVE STARTED TO INTEGRATE SUSTAINABILITY-RELATED ISSUES IN THEIR CORE ACTIVITIES

The sample of interviewed companies and survey respondents involved in this study also included leading companies from the financial and media and communications sectors. While adopting the necessary measures to mitigate the pressures originated by their facilities and "office" activities (mostly related to energy consumption and efficiency, sustainable procurement, and recycling policies), the importance of these players is closely related to their capacity to raise other actors' level of attention and commitment to the protection of marine and coastal ecosystems, influencing their behaviors.

Companies concerned with sustainability within the **financial services** sector, for example, are increasingly developing investment policies that include the assessment of portfolio companies' performance on environmental, social and governance (ESG) issues, with specific initiatives directly focused on climate change and ocean conservation. Recently, some of the world's largest pension funds and insurers launched the Net-Zero Asset Owner Alliance initiative supported by UNEP FI, committing themselves to transitioning their investment portfolios to net-zero GHG emissions by 2050, consistent with a maximum temperature rise of 1.5 °C above pre-industrial temperatures. The Alliance, which represents more than USD 2 trillion, was initiated by Allianz, Caisse des Dépôts, La Caisse de Dépôt et Placement du Québec (CDPQ), Folksam Group, PensionDanmark and Swiss Re at the beginning of 2019. Since then, Alecta, AMF, CalPERS, Nordea Life and Pension, Storebrand, and Zurich have joined as founding members.

Again in 2017, the European Commission, WWF, the Prince of Wales' International Sustainability Unit and the European Investment Bank (EIB) developed the Sustainable Blue Economy Finance Principles to raise awareness about the role that investors can play in developing innovative solutions that can mitigate the pressures on marine and coastal ecosystems. UNEP FI is hosting the platform, aimed at bringing together financial organizations, scientists, companies and civil society to raise awareness, share practices and develop tools to support the adoption of the principles. Several financial institutions and stakeholders have already endorsed the Sustainable Blue Economy Principles, including Boston Common Asset Management, The Nature Conservancy, Rockefeller Asset Management, SKY – Ocean Rescue Fund.

With regard to the **media and communication** sector, leading companies in sustainability are contributing to disseminating knowledge about ocean-related pressures and the threats endangering marine and coastal ecosystems, through the development of extensive campaigns, dedicated information and content, events, sponsorships and partnership initiatives. As regards partnerships with industry peers, leading companies in the sector launched the Responsible Media Forum in 2001, a knowledge platform aimed at supporting their members in identifying the main sustainability-related challenges facing the industry, and taking action to engage relevant stakeholders.

INCREASING AWARENESS AND SUSTAINABLE INITIATIVES ARE EMERGING FROM LEADING TOURISM COMPANIES

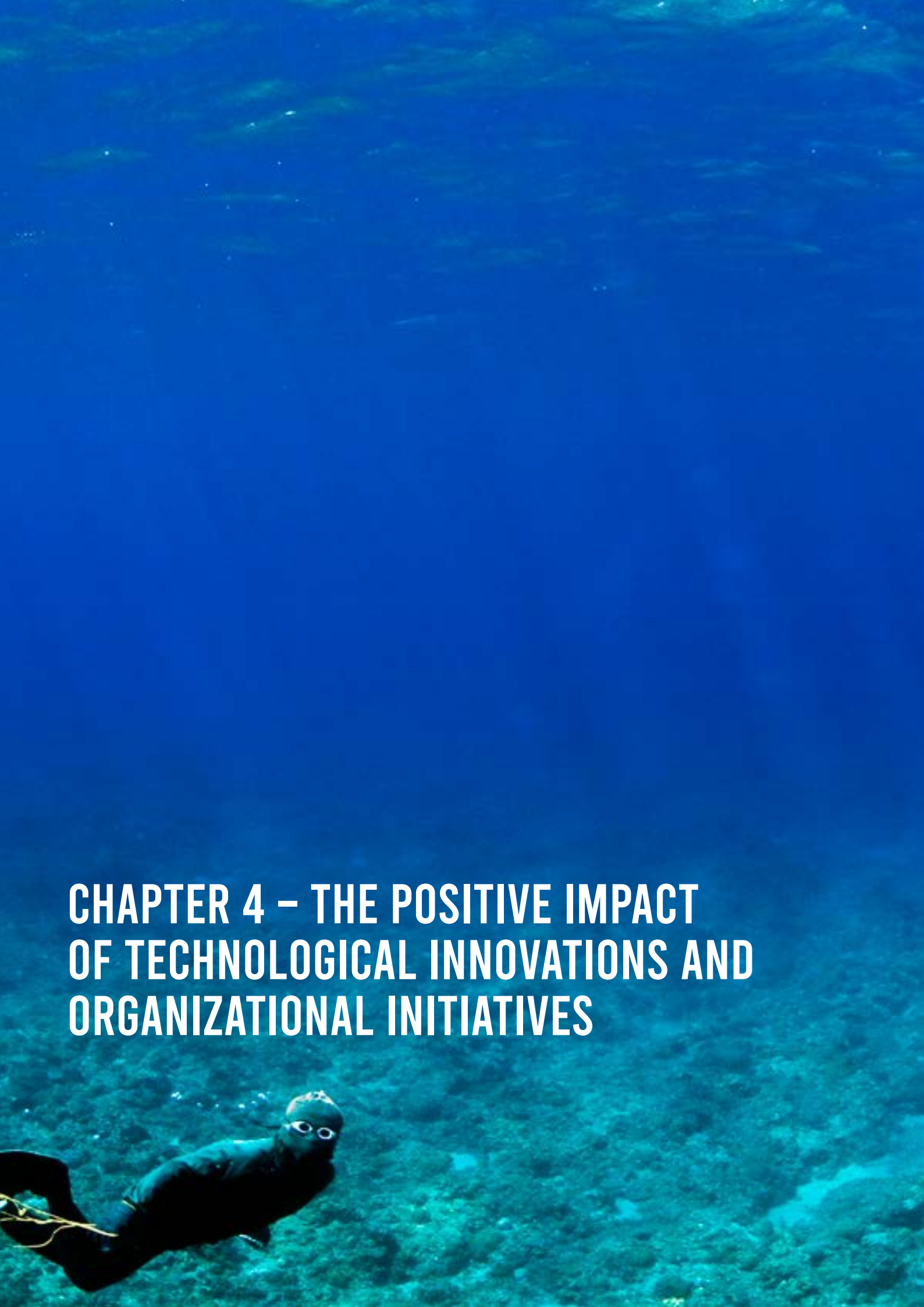
The Mediterranean is the world's leading tourism destination, with more than 330 million tourists per year, representing ~30% of total world arrivals, mainly concentrated in the summer season, with a forecast of ~500 million arrivals by 2030.[30] Due to the high volumes of tourist visits, their concentration in limited time periods, and the fact that tourism activities take place mainly in areas characterized by great natural value, the pressures generated by this sector can have considerable consequences for marine and coastal ecosystems. Indeed, due to the heterogeneous nature of tourism activities (e.g. restaurants, hotels and tourist resorts, cruise tourism, pleasure and recreational boating) significant pressures are exerted on a wide range of GES descriptors, such as over-exploitation of commercial fish and shellfish (e.g. due to the necessity to supply restaurants and tourist facilities), with effects on food webs and biodiversity. Marine litter and pollution are generated by tourism activities, while anchoring and grounding from cruises and recreational boating can have consequences for seafloor integrity and benthic ecosystems, especially in Marine Protected Areas (MPAs). Additional pressures come from the noise generated by powerful combustion engines, and contamination can occur from oil leakages, as well as from mismanagement of wastewaters (dark, grey, ballast waters) and anti-fouling paints.

Leading players in the tourism sector are increasingly grasping the necessity of addressing sustainability issues in order to preserve the natural environment on which their activities depend heavily. According to the companies involved in the project, activities aimed at mitigating the pressures on marine and coastal ecosystems range from the development of more sustainable practices aimed at reducing waste (e.g. reducing use of single-use-plastics items), while increasing the capacity of intercepting and correctly disposing of waste (e.g. separate waste collection, recycling), also adopting a circular approach when it comes to considering certain categories of "streams", such as food surpluses and unconsumed meals (e.g. establishing partnerships with local NGOs and charities for the distribution of leftovers). Additional initiatives relate to the responsible use of natural resources (e.g. water, energy), and the development of awareness and information campaigns targeting customers and employees, aimed at promoting more sustainable practices (e.g. related to waste management and separate collection, resource preservation, correct behaviors to be adopted in natural ecosystems).

The companies involved in this study operating on a multinational scale state that they address each of these aspects according to local specificities, environmental characteristics, institutional and regulatory frameworks, and quality standards. This requires global strategies to be designed according to local features, collaborating and developing partnerships with local communities, as well as exchanging best practices.

30 UNWTO (2011), Tourism Towards 2030 / Global Overview - Advance edition presented at UNWTO 19th General Assembly, and UNWTO (2019), International Tourism Highlights 2019 Edition

CHAPTER 4 – THE POSITIVE IMPACT OF TECHNOLOGICAL INNOVATIONS AND ORGANIZATIONAL INITIATIVES



Technological innovation has a prominent role in addressing the sustainability of marine and coastal ecosystems

Several clusters of technologies have been identified with regard to ocean challenges. Some of these solutions are at the early stage of their technological cycle, and need further R&D activity in order to become fully viable. Other technologies are almost ready to scale up, while we have found more mature solutions that can easily be adopted by the market. Amongst the different types of technological innovation analyzed, the following 3 major clusters can bring the greatest benefits.

3 TECHNOLOGICAL CLUSTERS CAN BRING THE GREATEST BENEFITS: CLEANER SOURCES OF ENERGY, NEW MATERIALS, DIGITAL, AUTOMATION, MONITORING & CONTROL TECHNOLOGIES

1. **Cleaner sources of energy** are key to reducing the pressures on oceans and seas, in terms of contribution to climate change, which has consequences for the hydrographical conditions of waters in the form of increased temperature, acidification (i.e. the increase of water acidity due to higher concentrations of CO_2 dissolved in the ocean and seas), and reduction of oxygen levels. The transition to a carbon-neutral economy requires the development and the adoption of multiple – and complementary – technologies. Companies involved in the project showcased a number of initiatives.

   The energy sector is leading the way through massive investments in "traditional" (e.g. solar, wind, hydropower, geothermal), and "emerging" (e.g. wave and tidal energy) renewable energy sources. Some of these renewables are increasingly exploiting the opportunities provided by marine environments, such as offshore wind, waves and tides. The transition to primary sources of electricity from renewables, and the growth of extensive electrification, is probably the most realistic pathway to decarbonization, although this transition needs to be supported by additional technological advancements, for example in the field of energy storage. As of today, batteries still have low energy density, and their weight makes them ill-suited for a number of applications, including long-distance shipping, while electrification of short sea shipping may be an option, provided that the power-to-weight ratio makes it more feasible.

   While we wait for the most advanced technologies to become available, bridging solutions for both pollution and carbon intensity reduction are currently being implemented. In the maritime transport and shipbuilding sectors, the adoption of cleaner sources of energy replacing Heavy Fuel Oil (HFO) or Marine Gas Oil (MGO), such as Liquid Natural Gas (LNG), occasionally blended with biomethane, is considered the short-medium term solution to address both pollution and GHG emissions, while hybrid engines and full electric propulsion systems are expected to play a more relevant role in the future. Importantly, when adopted in ocean and sea environments, cleaner sources of energy

(e.g. LNG, biofuels, electricity) also contribute to reducing the risk of contamination, leakages, and spills.

Innovative solutions dealing with cleaner energy supply are being implemented or tested by port authorities. The Ports Authority of Genoa has implemented Onshore Power Supply (OPS) facilities connected to the local electricity grid, aimed at providing berthed cruise ships, cargo ships and ferries with the power required for loading, unloading, heating, lighting and other onboard activities, avoiding the need to generate this power onboard through auxiliary engines emitting CO_2, air pollutants, and low frequency noise, propagating over long distances in the marine environment. The Port of Valencia is testing the possibility of using Hydrogen Fuel Cells to power heavy-duty port and logistics equipment, as well as supplying hydrogen in port facilities.

Other promising advancements in the field of cleaner energy, although not yet at scale, regard the processing of advanced biofuels (e.g. from waste processing, hydrogen from water hydrolysis using electricity from renewables), or R&D on advanced fuel cells. Further innovations, such as the direct conversion of CO_2 into fuels and other materials (e.g. Carbon Capture Utilization and Storage - CCUS) are expected to become more viable in the future. All these options are technically available at various scales, but their large-scale deployment may be hindered by operational, economic, financial, and institutional constraints due to the characteristics and contexts of specific sectors and applications.

EMERGING RENEWABLE OCEAN ENERGY SOURCES

Wave, tidal and other renewable ocean sources of energy are emerging, and starting to reach viability for commercial purposes. Ocean Energy Europe, the European industry association, estimates that 100 GW of wave and tidal energy capacity will be installed in Europe by 2050, out of a worldwide capacity of 340 GW, meeting 10% of the European electricity demand and creating 400,000 jobs along the supply chain.

Different technologies are being developed, each with specific electricity production patterns: wave energy converters generate energy from the movement of waves, tidal stream or range turbines derive electricity respectively from the flow of the currents, or the difference in sea level between low and high tides. Other technologies, such as Ocean Thermal Energy Conversion (OTEC), exploit the difference of temperature between warm ocean surface waters and colder deep waters, while salinity gradient technology uses Reverse Electro Dialysis (RED) or osmosis to generate electricity from the different salinity between freshwater and saltwater.

In order to overcome operational conditions in different contexts, such as calmer seas in the Mediterranean, the industry is testing a wide range of solutions: smaller wave converters or tidal turbines for slower currents or near-shore areas, as well as devices that can be attached to harbor docks, dams, bridges and other existing infrastructure.

Energy companies, as well as startups interviewed for the project, are heavily investing in these technologies,whose potential will fully unfold in the coming years.

2. **New materials**. Marine litter and plastic pollution are probably the ocean-related sustainability issues that have received the most attention from the media, social movements and consumers in recent years – radically increasing business awareness. This is particularly the case for certain types of plastic packaging such as bottles, bags, pots, foam boxes and trays. Many of the companies involved in this project, belonging to different sectors (e.g. wholesale & retail, food & beverage), address this issue by fostering the design of solutions aimed at the reduction of plastics usage, increasing the percentage of recycled and non-virgin materials, and experimenting with substitution of new solutions, such as bio-based plastics derived from vegetal feedstocks, as well as biodegradable bioplastics.[31]

   As of today, extensive use of these bioplastics materials in a number of applications has not been possible due to their mechanical and thermal properties. New and less harmful alternatives to plastics are being researched from natural materials, such as algae and fungi, or synthesized in laboratories using advanced chemical or genetic engineering processes (e.g. chemically engineered starch and other hemicellulosic materials, genetically modified yeast), with the addition of bio-additives and bio-resins to improve the requirements of these alternative materials. Green chemistry, biotech and nanotechnology are expected to provide additional responses that prevent pollution or the introduction of destructive materials into the environment, investigating ways to mimic nature and to grow new solutions for more sustainable products.

   Outside of plastic substitutes, new materials are also being developed and tested in ocean-related sectors, such as maritime transport, and shipbuilding & repair. More sustainable anti-fouling solutions, for example, represented by marine biocides without heavy metals (e.g. cuprous oxide) are being tested. They present the benefits of boost-

31 According to European Bioplastics, the European industry association, a plastic material is defined as a bioplastic if it is either bio-based (i.e., derived from vegetal feedstocks such as corn, sugarcane, or cellulose), biodegradable (i.e., the material is convertible into natural substances such as water, CO_2, and compost, by microorganisms existing in the environment without artificial additives), or presents both properties. The characteristics of biodegradability depends on the chemical structure of the material, and not on the vegetal feedstock used to produce it, hence 100% bio-based plastics may be non-biodegradable (e.g. bio-based PE, PP, or PET), while 100% fossil derived plastics can biodegrade (e.g. PBAT). Plastics that are both bio-based and biodegradable are PLA, PHA or PBS. https://www.european-bioplastics.org/

ing hard-fouling protection and significantly reducing heavy metals in marine environments, while improving fuel savings due to better ship hull performance.

Further advancements in the field of new materials for enhanced battery storage are being researched to improve the energy density of accumulators, in order to extend the range of applications of electricity to sectors where these solutions cannot currently be employed.

NEW, ADVANCED AND MORE SUSTAINABLE MATERIALS AIMED AT PROVIDING RESPONSES TO SEVERAL OF THE PRESSURES EXERTED ON MARINE ECOSYSTEMS ARE BEING RESEARCHED, DEVELOPED AND MADE AVAILABLE BY HIGH-TECH STARTUPS INVOLVED IN THIS RESEARCH PROJECT

Some of the most interesting examples relate to:

a. Nanoengineered graphene-based membranes for recovery of oil spills and wastewater treatment, able to adsorb contaminants faster, and more efficiently than conventional solutions. These solutions are useful both in the case of oil spills and close to offshore extraction sites (e.g. adsorbent barriers and pillows), or for the treatment of contaminated wastewaters – offering the advantage that the hydrocarbons absorbed can be recovered and reused.

b. Seaweed-based technologies to replace single-use plastics with edible bioplastics, offering the advantage, including compared with more “traditional” biomaterials requiring industrial composting facilities for the complete degradation, of faster and natural break down (i.e. in a matter of weeks), even if they accidentally end up in marine environments.

c. Plastic-free water bottles, made of a sustainably derived patented biomaterial (inner casing) and recycled biodegradable materials (recycled paper for the external coating and label, recycled steel for the metal capping system), which take less than a year, instead of a few centuries, to degrade if accidentally dropped in natural environments.

d. Advanced recycling technology for polylaminate packaging (i.e. made of a plastic film coupled with a metal film) such as cartons for drinks and packaging for liquid foods, bags for oily products, packaging for candy, “non-compostable” capsules for hot drinks, that otherwise end up in incinerators or landfills. Both in terms of costs and characteristics (e.g. processing and molding, possibility of being colored), the recycled plastic is competitive with virgin material.

3. **Digital, automation, monitoring & control technologies.** Digital, automation, monitoring & control technologies can greatly contribute to addressing the pressures exerted on the natural environment, including marine and coastal ecosystems. When applied to **fishing and aquaculture**, these technologies can significantly improve the level of sustainability of these sectors, reducing the direct pressures on at least 4 out of 11 GES descriptors (i.e. commercial fish and shellfish, food webs, biodiversity, seafloor integrity), with benefits that extend along the supply chain (e.g. food industry and retail companies demanding sustainable fishing certificates from their suppliers).

   From a technological standpoint, reported practices include high-tech fishing gear and trawl nets designed to selectively catch specific species, reduce by-catch and prevent seabed alteration and/or abrasion, or wild fishery monitoring leveraging video and acoustic technologies, such as underwater video cameras, trawl sonars and echo sounders, to identify the type, species, quantity and size of fish, with the benefit of making the capture more selective, and efficient. More advanced aquaculture techniques (e.g. sensors for monitoring the status of farmed species, in order to design the most appropriate feeding patterns) are also available in the aquaculture sector.

   Similarly, the application of modern digital, automation, monitoring & control technologies to traditional farming enables the development of **precision agriculture**, leading to important progress in agricultural practices, with a significant positive effect on at least 3 out of 11 GES descriptors (eutrophication, food webs, contaminants). Fertilizers are, in fact, a relevant issue threatening marine biodiversity, causing eutrophication and polluting the sea. Evidences regarding the improvements made possible by the adoption of precision agriculture techniques are striking. The systematic development of agronomic studies on crop resistance, selection, appropriateness to soil characteristics (e.g. terrain composition, organic matter content, moisture levels) and spatial orientation (topography), coupled with advanced monitoring and operational devices (e.g. sensors, drones, satellite-assisted unmanned vehicles) and data analysis (e.g. predictive models), allow the preservation of resources, while maintaining the output. If adopted at large scale, these practices can significantly reduce pressures on the sea: companies experimenting with these techniques reported using -50% fertilizers, -50% energy and -20% water in a span of 10 years. Additional improvements can be achieved from **more sustainable livestock breeding**. The adoption of advanced and already available livestock breeding techniques have the potential to significantly reduce specific GHG emissions (i.e. per unit of animal bred). Such techniques regard the improvement in feed and nutrition (e.g. improving forage quality, dietary substitutes, and precision feeding), animal genetics and health, manure management (e.g. collection and storage facility, temperature and aeration of manure, capturing biogas from

anaerobic process). Precision feeding, combining genetics with customized and balanced feeding programs, has been shown to increase productivity and reduce the intensity of CH_4 emissions (15-20%) and nitrogen excretion (20-30%). Additional ways of mitigating pressures from the livestock supply chain arise in the areas of energy management, transportation, feed production and processing, and food waste management.[32]

Digital, automation, monitoring & control technologies, assisted by big data analysis, artificial intelligence and predictive modelling, are becoming almost ubiquitous: smart metering for energy consumption in the energy and utility sectors, satellite-assisted solutions for more efficient route planning in marine transport and shipping, autonomous underwater vehicles for seafloor inspections, restoration and recovery, port authorities implementing control and decision support systems aimed at monitoring environmental pollutants generated by ships, ferries, cargos, and vehicles.

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EXAMPLES OF DIGITAL, AUTOMATION, MONITORING & CONTROL TECHNOLOGIES DEVELOPED BY STARTUPS FOR SUSTAINABLE FISHING AND PRECISION AGRICULTURE

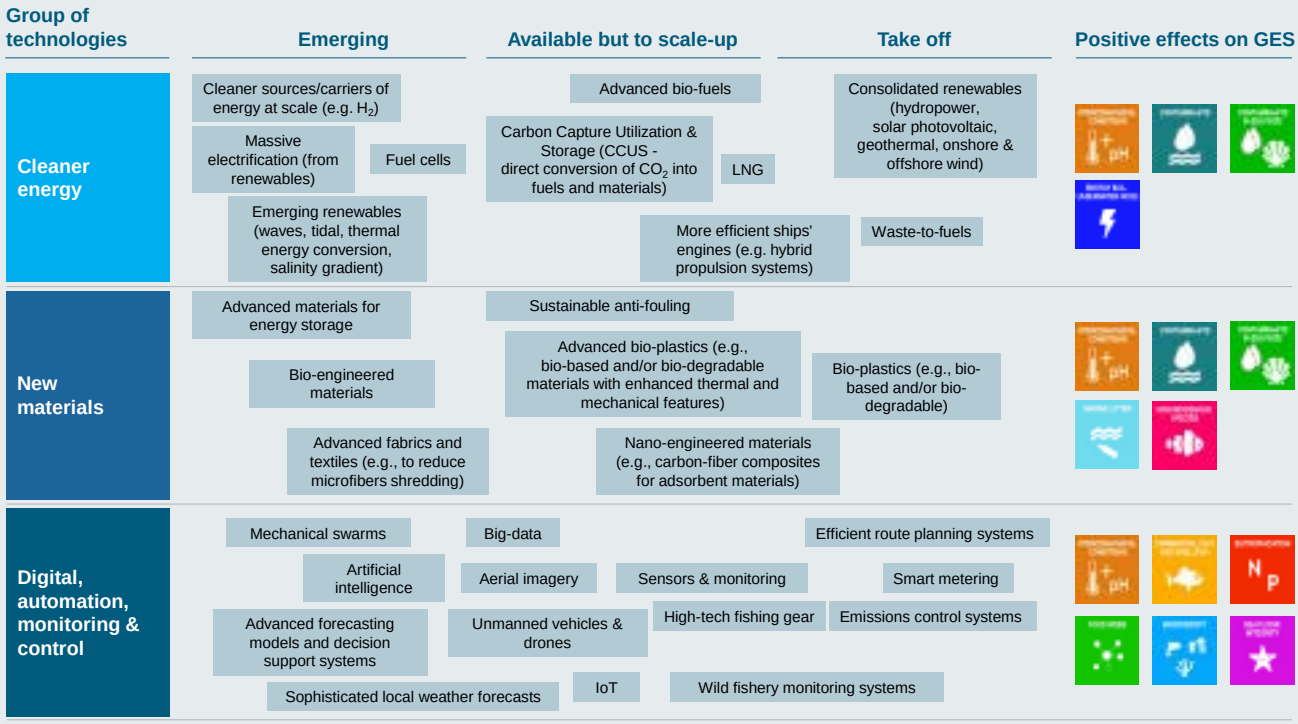
Among the startups interviewed in the project, interesting examples of digital, automation, monitoring & control technologies for sustainable fishing and precision agriculture have emerged:

a. Innovative technologies adopting Light Emitting Diode (LED) devices to improve the selectivity of commercial fishing practices, leveraging the use of light to segregate fish of different ages and species are being marketed. These solutions are aimed at reducing by-catch by up to 90% and attracting target species, including fish with the desired maturity. Further advancements are being developed in the area of sensors that can monitor sea variables and provide ocean data to alert and predict eutrophication, as well as the preservation of seafloor integrity.

b. Digital, automation, monitoring & control technologies (e.g. sensors and smart-metering devices to monitor temperature, air humidity, soil moisture, rainfall and leaf wetness, Internet-of-Things, data analysis and predictive modeling, solar powered electric actuators) have been integrated to provide smart irrigation systems, aimed at reducing water consumption by 30% along with the energy to power irrigation systems. Based on the data collected in the field and on the weather forecast, customizable algorithms suggest timing to irrigate, and the necessary quantity of water.

32 Global Research Alliance on Agricultural Greenhouse Gases (GRA) and Sustainable Agriculture Initiative (SAI) Platform (2014), Reducing greenhouse gas emissions from livestock: Best practice and emerging options

FIGURE 15 - MAIN GROUPS OF TECHNOLOGICAL INNOVATION THAT CAN BRING MAJOR BENEFITS TO MARINE AND COASTAL SUSTAINABILITY



Source: Authors' elaboration

CROSS-CUTTING SOLUTIONS ARE EMERGING FOR CONTAMINANTS, POLLUTION, WASTE CLEAN-UP AND TREATMENT IN THE MARINE ENVIRONMENT

Cross-cutting solutions are emerging for contaminants, pollution, waste clean-up and treatment in the marine environment

Several cross-cutting solutions that build on digital, automation, monitoring and control technologies, as well as on new materials, in order to target contaminants, pollution, waste clean-up and treatment in marine environment have been recorded:

a. Following the entry in force of the IMO BWM Convention, ballast water treatment systems have been developed to provide solutions to remove, render harmless, or avoid the uptake or discharge of harmful aquatic organisms and pathogens. These solutions involve several technologies (e.g. ultrasound, UV, filtration systems using advanced engineered materials) and are available for new ships, as well as for already existing vessels (retrofit), or for ports facilities, when ballast water treatment cannot be performed on board.

b. Off shore oil and gas companies have developed technologies to minimize ordinary leakages, and repair spills, in order to avoid or promptly

limit the consequences of major contaminations. Advanced solutions include, for example, the rapid intervention equipment designed and engineered for a consortium of oil companies, consisting of a rapid intervention platform that can be deployed by air or sea within 24/48 hours, and enables the operation during the spill of a submarine well when direct vertical access is not possible (e.g. an accident similar to that of the Deepwater Horizon platform in the Gulf of Mexico), installing containment valves that allow the shaft to be sealed temporarily and spills to be halted.

c. Several clean-up initiatives to collect floating marine litter, as well as to prevent litter from rivers reaching the sea, are being tested at various scales. In northern Italy, a 4-month pilot test conducted in 2018 on the Po river by the Italian National Consortium for the Collection and Recycling of Plastic packages and other partners, consisting in the installation of floating barriers, intercepted ~300 kg of waste, of which ~93 kg of plastic, mainly represented by PE (polyethylene) coming from drums with a capacity greater than 25 liters, and agriculture or industrial packaging.[33]

Organizational initiatives complement technological innovation. Companies seem to be focusing on solutions aimed at raising awareness, building knowledge, and favoring engagement and transparency along their value chains

Organizational initiatives complement technological innovation, as they contribute to creating more favorable conditions for developing, sharing, and adopting new and more adequate solutions to address the main ocean challenges. Among the different organizational initiatives reported by the companies involved in the study, 3 main groups have been identified:

1. **Voluntary sustainability standards, codes of conduct and self-regulation**. In order to address the complex challenges facing the health of marine and coastal ecosystems, several initiatives have been developed, in the form of voluntary standards, codes of conduct or sector-specific self-regulation. These initiatives aim at voluntarily establishing requirements, as well as practices of good behavior, with the objective of mitigating several pressures directly or indirectly exerted on the marine environment. The development and the adoption of standards for the sustainable management of fisheries and aquaculture have been reported by food & beverage companies, as well as fisheries and aquaculture sectors. These standards define specific requirements that companies must meet in order to claim that their fish and seafood come from well-managed and sustainable sources. The

33 http://www.corepla.it/news/conclusa-con-successo-la-prima-sperimentazione-di-raccolta-dei-rifiuti-sul-po-combattere-il-mar#

most comprehensive standards are consistent with the guidelines and codes published by the FAO on responsible fishing, ecological labeling and certification of aquaculture.[34] The Global Sustainable Seafood Initiative (GSSI), a not for profit organization representing the seafood value chain, companies, NGOs, governments and international organizations, including the FAO, promotes sector-wide collaboration and provides formal recognition of seafood certification schemes that successfully complete a benchmark process, based on FAO guidelines.[35]

Similarly, in the agriculture sector, the Sustainable Agriculture Initiative (SAI) Platform[36] established in 2002 as a collaborative, pre-competitive network for the food and drink industry, is aimed at investigating common solutions to environmental and social challenges facing the sector, and accelerating the adoption of more sustainable agricultural practices, which could also indirectly benefit marine and coastal ecosystems (e.g. reduction in GHG emissions, decrease in the use of fertilizers and nutrients potentially causing eutrophication of the marine environment). The SAI Platform has developed the Farm Sustainability Assessment (FSA) scheme, aimed at providing farmers with a tool to assess the sustainability of their agriculture practices. Companies involved in the project declared to have adopted the FSA assessment along their supply chain, involving suppliers and farmers in order to build and spread knowledge about more sustainable farming techniques and technologies.

In the marine coastal and tourism sector, one of the world's best-recognized voluntary eco-labels awarded to beaches, marinas, and sustainable boating tourism operators is represented by the Blue Flag, requiring stringent environmental, safety, educational and accessibility criteria to be met and maintained.

Additional voluntary initiatives, in the form of codes of conduct and guidelines have been recorded in sectors related to recreational and competitive boating (e.g. Sailors for the Sea Clean Regattas Program, World Sailing Guidance for Sailing Venues and Green Event Guidance, Royal Yachting Association & British Marine Green Guide for Sailing Clubs). In 2017 the Yacht Club Costa Smeralda (YCCS) developed the Charta Smeralda, an ethical code aimed at sharing principles and raising awareness among individuals, stakeholders and communities about the urgency need to act in order to address and start solving the issues facing marine ecosystems. The Charta Smeralda has so far been signed by more than 7,000 individuals and organizations, including 80 Yacht Clubs, and sailing classes.

2. **Assessment and measurement**. Several companies involved in this research report that they are working on the assessment and

34 http://www.fao.org/fishery/code/en
35 https://www.ourgssi.org/
36 https://saiplatform.org/

measurement of the pressures generated by their activities on the natural environment. Companies in the food & beverage sector, for example, have adopted Life-cycle assessment (LCA) methodologies to assess the life-cycle footprint of their products (e.g. in terms of natural resources, including water and energy use, land occupation, and emission intensity), with the aim of developing scientific knowledge able to support the design of more sustainable products and processes. The World Port Climate Initiative (WPCI), promoted by the International Association of Ports and Harbors (IAPH), published the Guidance Document on Carbon Foot-printing in 2010, a reference guide to promote GHG emissions inventories within the sector.[37] More in general, internationally recognized assessment, measurement and disclosure platforms, in particular related to GHG emissions (e.g. the Carbon Disclosure Project), have been referenced by the companies involved in the project, from different sectors (e.g. energy, utilities, food & beverage, shipbuilding & repair), as a way to measure and to communicate internally and externally the efforts to mitigate some of their pressures.

3. **Knowledge platforms and partnerships**. Several respondents have mentioned the development of - or the participation in - knowledge platforms and the importance of partnerships. As regards the food processing industry, in 2009 leading companies, concerned about the future of one of their main natural resources, tuna, promoted the International Seafood Sustainability Foundation (ISSF)[38] together with scientists and environmental NGOs. The ISSF is a not for profit organization whose mission is to undertake and to facilitate science-based initiatives for the long-term conservation and the sustainable use of global tuna stocks, reducing by-catch and promoting the health of the tuna ecosystem. In this way, competitors in the final market decided to join forces and to collaborate for one common overarching interest, advocating for improved fishery management, promoting sound scientific research investigating the maximum sustainable yields of tuna stocks, while committing to conservation measures aimed at improving the long-term health of global tuna fisheries.

   Similarly, in 2008 a group of ocean sectors companies, concerned about the health of the marine environment, established the World Ocean Council (WOC), a not for profit, cross-sector organization aimed at advancing the industry leadership and collaboration for sustainable ocean development, science and stewardship advancement. Since then, the WOC has launched several leading platforms and initiatives (e.g. the annual Sustainable Ocean Summit event, support of the UN 2030 Agenda Sustainable Development Goals, the ocean investment platform, aimed at raising awareness on investment opportunities in

37 http://wpci.iaphworldports.org/carbon-footprinting/
38 https://iss-foundation.org/

responsible economic ocean development) and focused programs (e.g. participation in ocean policy and governance negotiations, including the UN Biodiversity in Areas Beyond National Jurisdiction treaty[39], the promotion of collaboration initiatives to develop cross-sectoral science-based research programs to address operational environmental issues, such as biofouling and invasive species, port reception facilities, introduction of noise in marine ecosystems). Recent emerging issues addressed by WOC relate to marine ecosystem services, ocean acidification, and enhancing ocean uptake of CO_2.

In order to combine technological innovation and organizational solutions, ocean sustainability calls for collaboration among companies and stakeholders

OCEAN SUSTAINABILITY CALLS FOR COLLABORATION AMONG COMPANIES AND STAKEHOLDERS

Many solutions to sustainability challenges can benefit from the development of innovation networks linking the different business organizations and stakeholders. Collaboration is a key enabler both for identifying technological solutions capable of addressing ocean issues, and fostering the adoption and diffusion of cleaner technologies. Some examples may help to clarify the concept:

a. Microfibers reaching the ocean are currently very difficult to intercept, even through the most advanced wastewater treatment systems. The textile & apparel industry is progressively acknowledging this issue, but, apart from solutions with limited effectiveness (e.g. adoption of "bags" to intercept larger microfibers when clothes or fabrics are washed), the technology to solve this problem is currently still lagging. Efforts in this field will require the involvement of all the players along the supply chain through collaborative platforms: suppliers developing more sustainable fabrics and textiles (e.g. possibly biodegradable), fashion & apparel companies investing in new materials, appliances companies developing more advanced filters for industrial and household washing machines, consumers investing in both advanced clothes and appliances.

b. Similarly, Tire Wear and Road Particles (TWRP) generated from the abrasion of tires during use on roads, is gaining increasing attention for the dispersion of materials in the form of microplastics in aquatic environments. Relevant industry players are proactively working in order to promote a system-based and collaborative approach to investigate the issue, and to co-design mitigation options to reduce TWRP. Since several factors influence the production of c (e.g. driving style, road surface, road curves and topology, tire design, vehicle characteristics, weather conditions), mitigation solutions also need to involve all the relevant stakeholders, such as tire manufacturers, road makers,

39 After a long-lasting and still ongoing negotiation process, a new global international legally binding instrument under the United Nations Convention on the Law of Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ) is expected by 2020.

vehicle producers, and drivers.

c. The large-scale adoption of LNG as a cleaner source of energy in the transportation sector (both marine and land-based) involves the development of an innovative infrastructure network and investment in transportation, storage, regasification and terminal facilities, while shipping and logistics companies need to update their fleets in order to use the new fuel.

d. Ensuring sustainable fishing requires not only more advanced and less impacting technologies and techniques, but also precision in stock assessment and reliability in fishery modelling, collection or access to up-to-date statistics (e.g. fish catches, broken down by species, area and periods of catch), policies and regulations about catch limits, as well as the respect of spawning and reproduction periods.

e. The replacement of traditional plastic products with compostable bioplastics is often the result of choices made by the manufacturing industry, food & beverage companies and large-scale retailers. These decisions are usually not coordinated with utility companies, waste management facilities and regulation authorities. The separate collection of bioplastic materials with different characteristics within the compostable organic waste circuit, in fact, introduces several criticalities: users don't easily understand the type of plastic (e.g. recyclable or recycled plastic mixed with compostable plastic), while the different characteristics of bioplastic products (e.g. thickness and shape, flexible vs. rigid materials) and traditional organic waste, require different composting conditions (e.g. time, temperature and humidity). In order to avoid lowering the quality of separated waste collection, greater coordination between producers and disposal services management authorities, as well as end users' awareness initiatives are required.

CONCLUSIONS – IT IS POSSIBLE TO CHANGE COURSE

The possibility of changing the course, preventing or at least mitigating the pressures on marine and coastal ecosystems is real, and business is expected to play a fundamental role in the transition to an economy where ocean and non-ocean-based activities operate in balance with the long-term capacity of the marine environment to regenerate, safeguarding the potential for uses and activities by current and future generations.

Sustainability leaders exist; they acknowledge the majority of the pressures generated by their activities, and act in order to mitigate their pressures. However, awareness is not widespread in all sectors or among all companies. Moreover, there are cases in which acknowledgement of the issues is not followed by coherent responses aimed at mitigating the pressures companies exert.

Two types of unlocking actions appear desirable:

a. Companies need to become fully aware of pressures considered relevant by scientific experts, while, on the contrary, in several cases they consider other pressures to be relevant that are judged not significant according to the scientific review. We call this "**awareness unlocking**".

b. On the other hand, businesses need to act to address these pressures, providing coherent responses in order to eliminate or to reduce them, what we call "**activation unlocking**"

We believe unlocking these two aspects is key for a journey towards ocean sustainability. In order to reach these objectives, it is paramount to increase the business focus on ocean challenges, and to incorporate the protection of the seas and marine ecosystems as a part of the corporate sustainability agenda. Moreover, actions are required to favor the fast development and adoption of innovative technologies and organizational solutions that can help reduce the pressure on the health of the ocean.

We have identified several actions that can help to facilitate unlocking awareness and/or activation. Some of these actions are intended to focus on the level of corporate consideration of ocean issues, others to foster the response in order to reduce or mitigate the pressures on the marine environment.

1. **Companies need to increase consideration of their interdependence with the marine environment and eco-services, and are expected to build knowledge about the multi-scale nature of ocean pressures.**

   Overall, some efforts to raise awareness on ocean and sea conservation have been made in recent years by international agencies

and civil society. The introduction of SDG14 Life Below water within the UN 2030 Agenda on Sustainable Development represented an important step to focus attention on these issues. Nonetheless, most companies have not included protection of the marine environment in their agenda. Business organizations and multi-stakeholder platforms can play an important role in promoting awareness campaigns on specific underexposed ocean issues such as eutrophication, seafloor integrity, introduction of sound and noise in aquatic ecosystems. Moreover, they can contribute by helping companies to build knowledge about the links between industrial activities (processes, products and supply chains) and the ocean and on coastal ecosystems. Similarly, they can help increase understanding of the business risks related to mismanagement of this issue.

Furthermore, involving and raising awareness among civil society and individuals is key for the development of a common and shared awareness of ocean issues, and for the dissemination of more sustainable consumer behaviors aimed at the preservation of marine and coastal ecosystems.

2. **Transparency and disclosure about actions aimed at protecting the seas and marine ecosystems are envisaged**

   New initiatives aiming at promoting the disclosure of data and information on business pressures on marine and coastal ecosystems could favor both the increase of awareness and strategic responses. On the one hand, a process of standardization of metrics and indicators for measuring and assessing ocean pressures and the development of specific guidelines would be useful. On the other hand, similarly to the initiatives developed to tackle climate change, water security, and forest degradation, new instruments that can support the reporting of pressures on the ocean and business mitigation initiatives are expected to match the growing needs of transparency and disclosure of many stakeholders (e.g. NGOs and the financial community).

NEW OCEAN SUSTAINABILITY "SCORING" INITIATIVES CAN STIMULATE AND SUPPORT COMPANIES IN ADDRESSING AND MITIGATING THEIR RELEVANT PRESSURES

The development of new initiatives aimed at scoring the performance of companies regarding the sustainability of their ocean-related strategies can stimulate and support businesses in mitigating their relevant direct and indirect pressures. Such initiatives would measure organizations' pressures on marine and coastal ecosystems, gathering data to facilitate the understanding of key performance information for businesses, while providing the interested stakeholders with additional insights to evaluate the ocean-related sustainability profile of companies.

3. **Technological innovations for the protection of the marine environment are expected to reach scale, while additional breakthrough technologies are also developed**

   Accelerating innovation is a cornerstone to address ocean pressures. First, existing technological clusters (cleaner energy, new materials, digital, automation, monitoring & control technologies, and cross-cutting solutions for the preservation of marine ecosystems) are expected to demonstrate their full benefits with regard to protecting the ocean. The broad diffusion of these solutions can be enhanced thanks to policy and economic measures that favor their adoption in different industrial sectors.

   Second, new breakthrough advancements are expected to address still-unanswered problems. This means stimulating and supporting the development of basic and applied scientific research on ocean protection, creating and enhancing the necessary knowledge and competencies. In both cases, leveraging the existing funding opportunities (e.g. structural funds, grants) and identifying new ways of mobilizing public and private resources (e.g. eco-innovation and strategic investments funds; blue bonds, aimed at financing specifically ocean-friendly projects; impact investing, focused on generating a social-environmental impact compatible with a medium-long term economic return) is key. Third, in order to favor the diffusion of cleaner solutions, we envisage the development of mechanisms promoting the growth of start-ups focused on opportunities linked to the ocean protection. This includes, for example, access to incubators and accelerators for rapid scale-up, innovation contests focusing on blue technologies and platforms giving access to financial investors.

4. **A collaborative perspective that involves all the relevant stakeholders (private and public) is fundamental to foster sustainable technologies**

   Innovation systems that involve multiple stakeholders through collaborative dynamics and mobilize adequate technological and organizational resources are required to respond to ocean issues. The complexity of the sustainability challenges requires skills and competencies that often go beyond the boundaries of a single business organization and calls for the development of partnerships among various private and public actors. The development of networks of innovators can help address the major R&D barriers related to cleaner technologies, thanks to knowledge sharing practices and co-operation between research institutions (e.g. universities and research centers) and companies. Moreover, networks favor technology transfer and increase the likelihood that innovative solutions propagate on the market. Addressing the challenges facing the ocean, therefore, calls for the creation of the institutional and organizational context that incentivize partnerships

and knowledge sharing throughout the different stages of technological innovations. One specific measure, that has already proved to be effective with regard to other cleaner solutions, is the creation of innovation hubs and innovation parks, in this case focused on the development of sustainable technologies for the protection of the ocean and marine ecosystems.

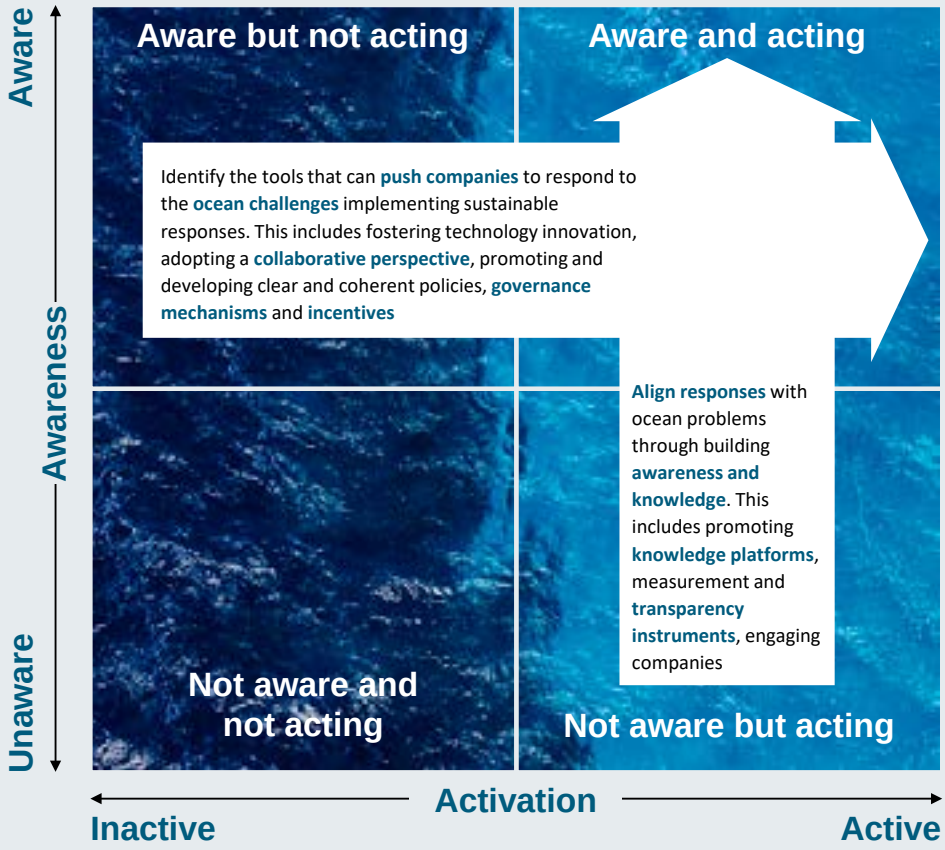
5. **Policy-makers and governments must converge and focus attention on marine environmental issues, promoting and developing clear and coherent policies, governance mechanisms and incentives**

   The governance of the oceans and seas is paramount to addressing the many challenges that we have illustrated in this study. Just as is the case with other environmental problems, governments and policy makers are also fundamental actors as regards marine and coastal protection. We need clear legal frameworks for the conservation and the sustainable use of the marine resources to be enforced (e.g. the new EU Directive on single use plastics and fishing gear). Moreover, regulations are a powerful force to drive sustainable behaviors at the level of organizations and individuals.

   Ocean challenges cover multiple scales, both spatial/geographical and temporal: some of the issues are global (e.g. climate change, marine litter), while others have a more regional or local dimension (e.g. eutrophication, seafloor integrity, contaminants and pollution); some issues have long-term dynamics (e.g. acidification), other can be very short-term (e.g. oil spills). Just as with any other social-ecological problem, such as climate change and biodiversity loss, we need governance that allows different and sometimes contrasting stakes to be aligned.

   We have discussed the importance of supporting technological innovation for sustainable solutions. Policy-makers and governments should provide the institutional framework to favor the development of clean-tech clusters, through the introduction of market-based instruments. Different types of mechanisms can be envisaged to promote ocean conservation: fiscal incentives to push R&D and innovation, public-private funds, environmental taxes, direct subsidies for cleaner technologies. New mechanisms such as payment for ecosystem services are also promising instruments to protect common goods like ocean resources and biodiversity. Finally, non-market-based instruments can also be effective, promoting collaborative efforts among stakeholders and pushing consumers towards green purchasing. This can be the case with eco-labels and other reporting requirements and promotion of disclosure and transparency initiatives.

La possibilità di cambiare rotta è reale



Source: online survey no.=133

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Cargill

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Prysmian Group

SafetyNet Technologies LTD

SAIPEM S.p.A.

Saras S.p.A.

Sky

Snam S.p.A

SOS LOGistica - Associazione per la logistica sostenibile

TELESPAZIO a LEONARDO and THALES company

Tirreno Power S.p.A.

UCINA Confindustria Nautica

Angelo Vasino S.p.A.

WWF Mediterranean

One Ocean Foundation thanks the experts who have contributed to the sectors' direct and indirect pressures review.

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GLOSSARY

Acidification – Reduction in the pH (i.e. increase in acidity) of ocean waters over an extended period of time, caused primarily by the uptake of carbon dioxide (CO2) from the atmosphere

Biofuels – Any fuel (gaseous, liquid, or solid) derived from natural sources such as plants, algae or waste (biomass). Biofuels represent a renewable alternative to fossil fuels

Bioplastic – A plastic material that is either bio-based (i.e., derived from vegetal feedstocks such as corn, sugarcane, or cellulose), biodegradable (i.e., the material is convertible into natural substances such as water, CO2, and compost, by microorganisms existing in the environment without artificial additives), or presents both properties

Blue bond – Financial instrument aimed at financing specifically ocean-friendly projects

Blue economy – Economic sectors whose activities take place in marine and/or coastal environments

Carbon Capture Utilization and Storage (CCUS) – Technologies aimed at capturing carbon dioxide (CO2) from fuel combustion or industrial processes, transporting it via ship or pipeline, and either using it as a resource to create products or services or permanently storing it underground

Contaminant – Substances (i.e. chemical elements and compounds) or groups of substances that are toxic, persistent and liable to bio-accumulate and other substances or groups of substances which give rise to an equivalent level of concern

Ecosystem services – The Millennium Ecosystem Assessment defined ecosystem services as “the benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling”

Eutrophication – The process by which a body of water becomes enriched in dissolved nutrients (such as phosphates) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen

Food web – A system of interlocking and interdependent food chains

Fuel cell – Electrochemical cell that converts the chemical energy of a fuel (e.g. hydrogen) and an oxidizing agent (e.g. oxygen) into electricity through chemical reactions

Greenhouse Gas (GHG) – Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Primary greenhouse gases in the Earth's atmosphere are water vapor (H2O), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4), ozone (O3)

Hydrographical conditions – The physical parameters of seawater, such as temperature, salinity, depth, currents, waves, turbulence, turbidity

Impact investing – Socially responsible investing strategy focused on generating a social-environmental impact compatible with a medium-long term economic return

Liquid Natural Gas – Natural gas (primarily methane) that has been liquefied at atmospheric pressure by reducing its temperature in order to facilitate its safe storage and transport

NGO – Non-governmental organization

Non-indigenous species – Species introduced outside their natural past or present range, which might survive and subsequently reproduce, threatening the biodiversity of an ecosystem

Overfishing – The uncontrolled catch of fish in a water course or in a sea area, destined to irreparably compromise its reproductive capacity

PBAT – Polybutylene adipate terephthalate, a biodegradable type of plastic derived from fossil raw materials

PBS – Polybutylene succinate, a biodegradable type of bio-based plastic

PE – Polyethylene, a non-biodegradable type of plastic

PET – Polyethylene terephthalate, a non-biodegradable type of plastic

PHA – Polyhydroxyalkanoate, a biodegradable type of bio-based plastic

PLA – Polylactic acid, a biodegradable type of bio-based plastic

PP – Polypropylene, a non-biodegradable type of plastic

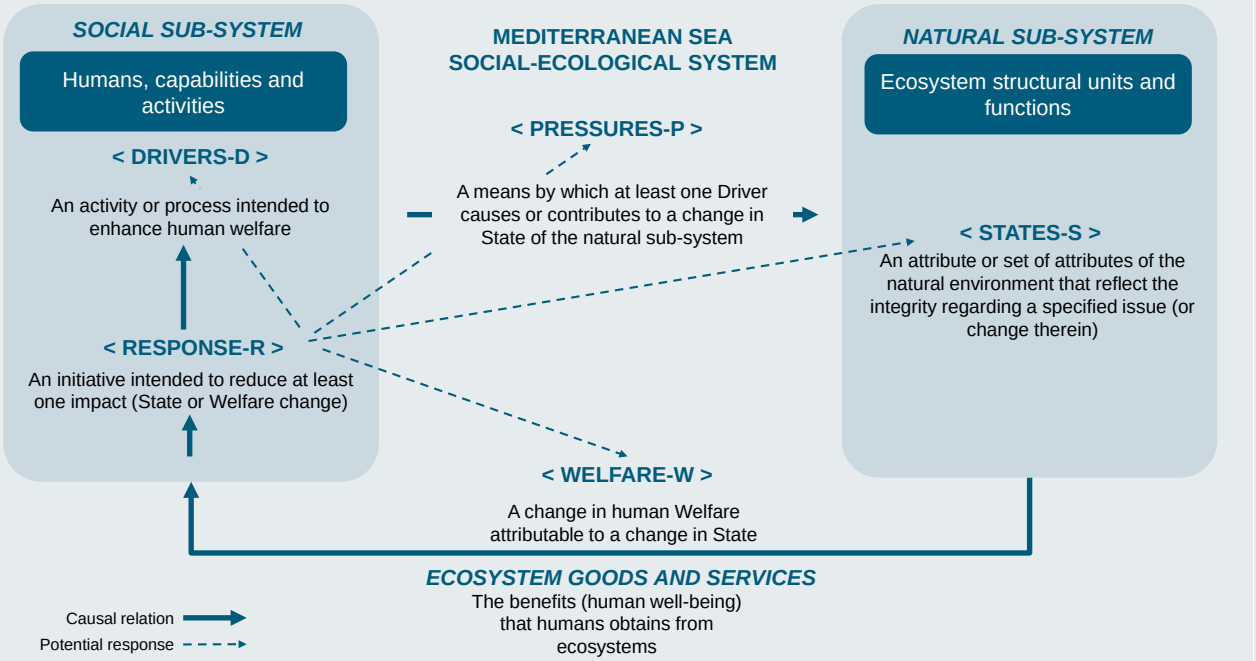
Pressure – Any action that makes a change to the state of the natural environment whether adverse or beneficial, wholly or partially resulting from the activity of an organization, or the utilization of products or services

ANNEX I – A SOCIAL-ECOLOGICAL SYSTEM FRAMEWORK FOR THE ANALYSIS OF THE SUSTAINABILITY OF THE MEDITERRANEAN SEA

A SOCIAL-ECOLOGICAL SYSTEM FRAMEWORK FOR THE ANALYSIS OF THE SUSTAINABILITY OF THE MEDITERRANEAN SEA

2009 Nobel Prize Winner, Elinor Ostrom developed a comprehensive framework in order to analyze social-ecological systems (SES) and represent their dynamics. This framework extends the theory of common-pool resources and collective self-governance, to areas of research that are still evolving. This approach relies heavily on systems ecology and the theory of complexity, and incorporates other aspects from theories relating to the study of resilience, robustness, sustainability, and vulnerability. The SES approach also incorporates societal concerns such as equity, wellbeing and environmental degradation. Recently, Philip Cooper proposed another framework to analyze the relations between social and ecological systems. The Driver-Pressure-State-Welfare-Response (DPSWR) framework. According to this approach, social sub-systems (humans, human capabilities and their activities), are <drivers> of change (D). They put <pressure> (P) on the natural sub-systems, (structural units and functions) that can alter their <states> (S) because of these pressures. This process, in turn, can translate into the degradation of fundamental natural resources used by humans (natural goods and ecosystem services), thus diminishing human <welfare> (W). The acknowledgement of such process of degradation should induce humans to develop adequate <responses> (R), for example policies and innovative solutions, that can address the ecological problems, and help restore SES resilience.

Components (structural and functional) of a social-ecological system, including the accountable framework for the analysis



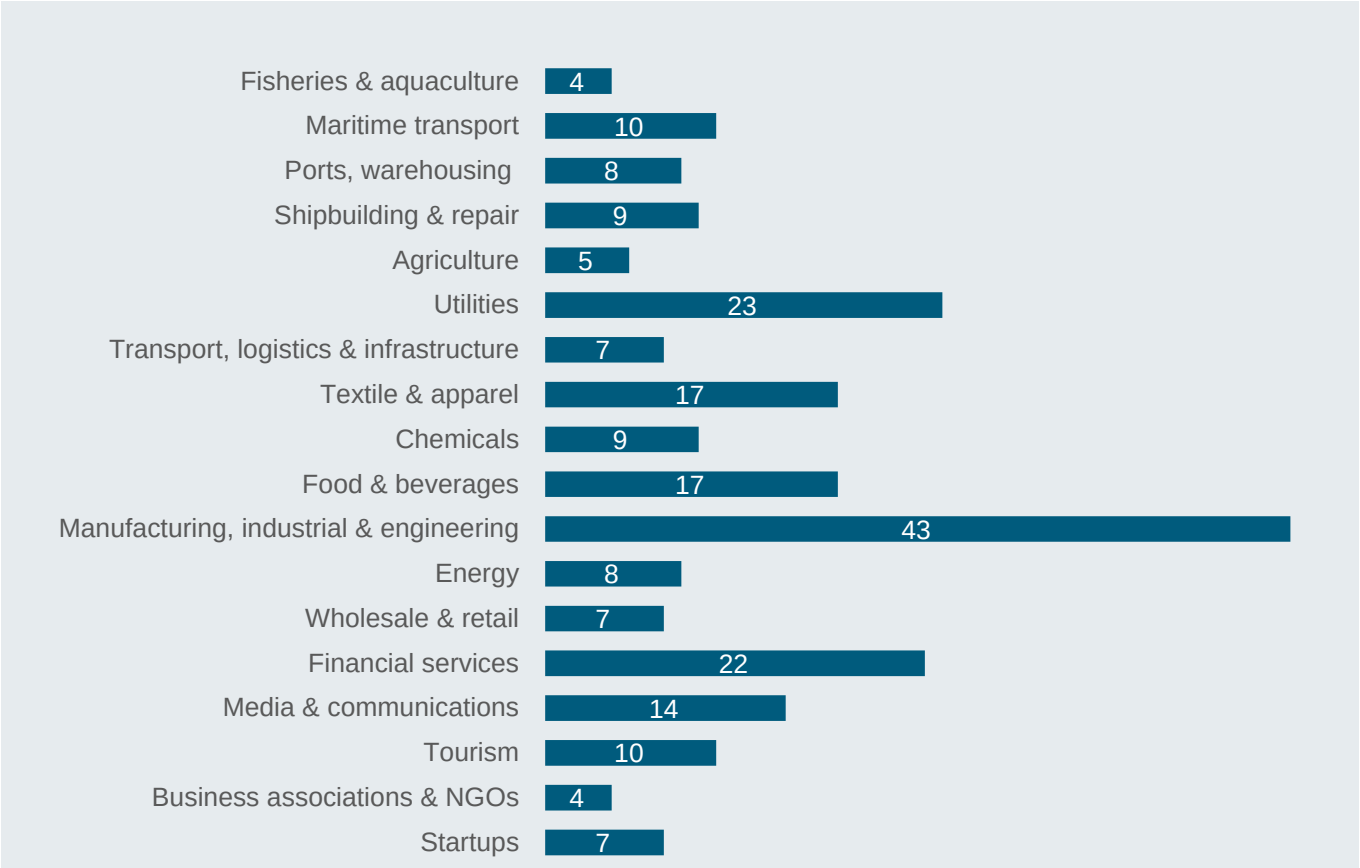
Source: adapted from Cooper P. (2013) and Sardà R. & Pogutz S. (2019)

ANNEX II – DESCRIPTION OF THE SAMPLE

An extensive panel of companies, including startups, business associations, and NGOs were involved in the project, through qualitative interviews and a quantitative online survey.

More than 50 companies, startups, business associations and NGOs were interviewed between March and September 2019. The companies involved were mostly multinationals, from both ocean and non-ocean related sectors, with headquarters or branches in Italy or Spain, while the business associations were mainly European or Italian. The quantitative online survey was administered between June and September 2019. More than 3,000 companies were contacted and more than 200 questionnaires collected: we base our analysis on 170+ valid responses. Due to the specific characteristics of the financial services and media and communication sectors, the 30+ responses coming from these companies were processed to complement qualitative interviews. Qualitative interviews were also adopted to gather insights into

DESCRIPTION OF THE SAMPLE – NUMBER OF OBSERVATIONS BY SECTOR

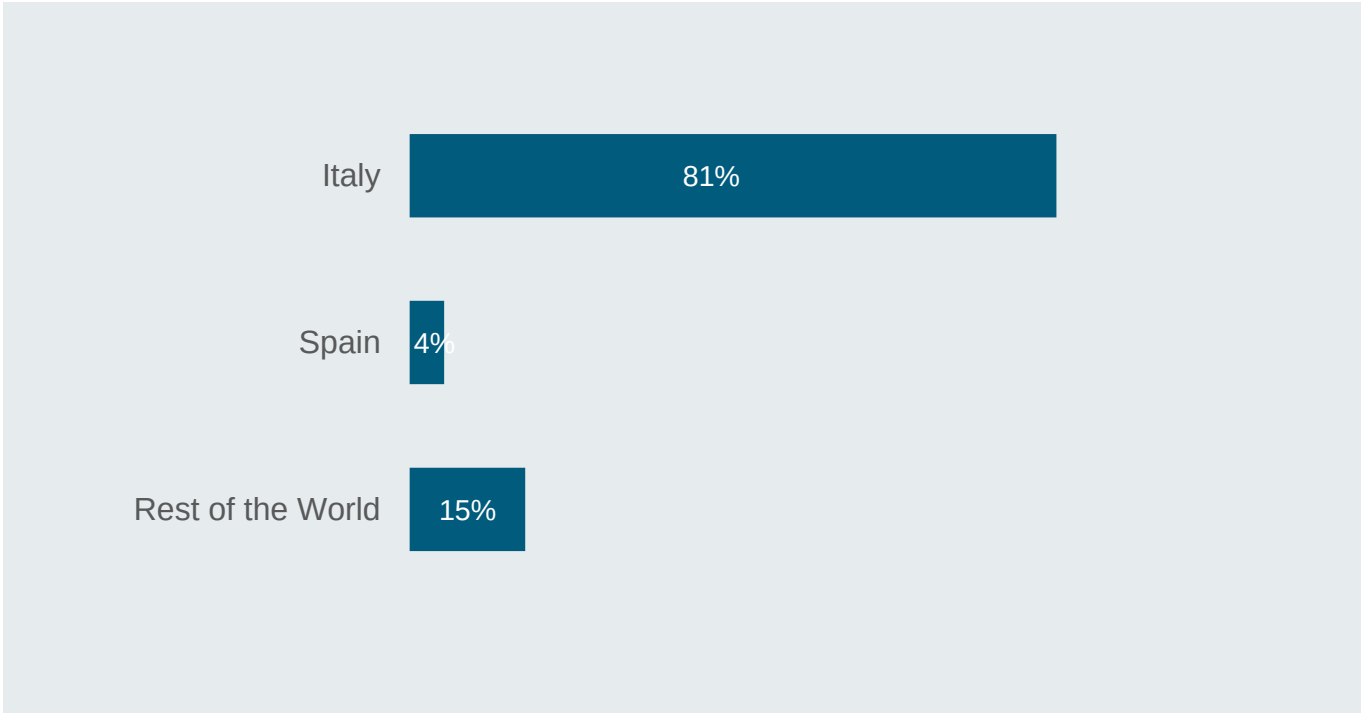


Source: observations total no.=224

the tourism industry, due to the high heterogeneous nature of companies belonging to this “meta-sector” (e.g. restaurants, hotels, tourism agencies, cruise companies, etc.).

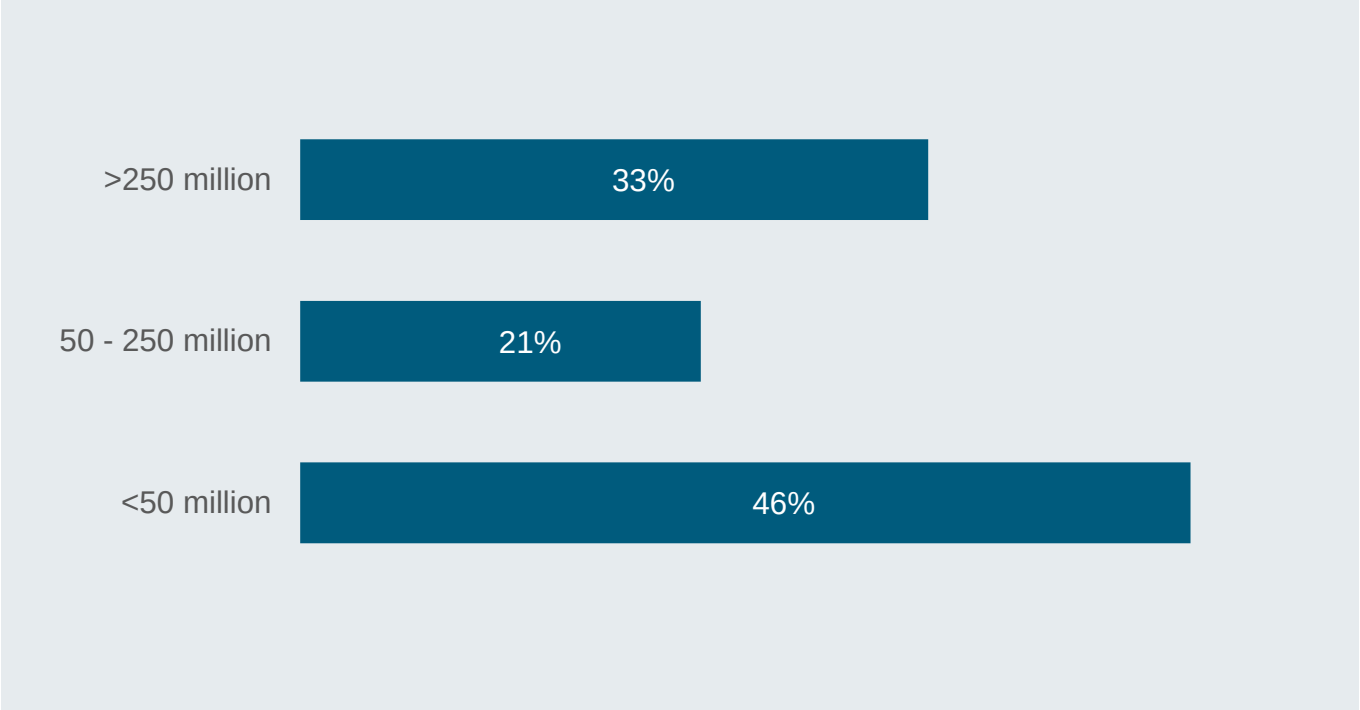
As regards the geographical distribution, 81% of the sample is represented by companies headquartered in Italy, and 4% in Spain. The remaining 15% is represented by companies headquartered in the Rest of the World, with operative branches in Italy.

DESCRIPTION OF THE SAMPLE – GEOGRAPHICAL DISTRIBUTION



In terms of economic dimension, 46% of the companies in the sample (both qualitative interviews and quantitative survey) have a turnover of less than €50 million, 21% between € 50 and € 250 million, and 33% of more than € 250 million. On aggregate, the sample represents companies with a total turnover of almost € 1 trillion, with Italian headquartered companies accounting for 15% of the Italian GDP.

DESCRIPTION OF THE SAMPLE – ECONOMIC DIMENSIONS IN TERMS OF TURNOVER



All the pictures are kindly provided by the photographer
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