PLASMAR

# Bases para la planificación sostenible de áreas marinas en la Macaronesia

# Macaronesian Blue Growth: current status and future needs.

Fernández-Palacios, Y., C. Andrade, A. Bilbao, G. Carreira, R. Haroun Tabraue, V. Jorge, S. Kaushik, M. Lopes, M. Oliveira, Y. Pérez, P. Sepúlveda & A. Abramic.

UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA

ECOAQUA
www.ecoaqua.eu

PROYECTO COFINANCIADO POR LA UNIÓN EUROPEA
Investigación e Innovación

MAC 2014-2020
Cooperación Territorial

Interreg

www.plasmar.eu

To cite this report:

Fernández-Palacios, Y[1]; C. Andrade[4], A. Bilbao[2], G. Carreira[5], R. Haroun Tabraue[1], V. Jorge[3], S. Kaushik[1], M. Lopes[3], M. Oliveira[3], Y. Pérez[2], P. Sepúlveda[3] & A. Abramic[1]. 2017. **Macaronesian Blue Growth: current status and future needs.** Report prepared as part of PLASMAR Project (co-financed by ERDF as part of POMAC 2014-2020). *70* p. Available at: http://www.plasmar.eu/documentos/

[1]*EcoAqua Institute, University of Las Palmas de Gran Canaria (Canary Islands, Spain).*

[2]*GMR Canarias – Gestión del Medio Rural de Canarias, S.A.U. (Canary Islands, Spain).*

[3]*Secretaria Regional do Ambiente e Recursos Naturais – Direção Regional do Ordenamento do Território e Ambiente (Madeira, Portugal).*

[4]*ARDITI – Agência Regional para o Desenvolvimento da Investigação, Tecnologia e Inovação* (Madeira, Portugal).

[5]*DSBPM-RAM – Direção de Serviços de Biodiversidade e Política do Mar, Direção Regional dos Assuntos do Mar (Azores, Portugal)*

# TABLE OF CONTENTS

**LIST OF FIGURES**

**LIST OF TABLES**

# Summary

The PLASMAR Project, “Setting the basis for sustainable MSP in Macaronesia”, co-financed by ERDF as part of POMAC 2014-2020, aims to define and propose robust scientific methodologies in support of Maritime Spatial Planning and Blue Growth in the Macaronesian Region. PLASMAR not only takes into consideration the biogeographic characteristics of these Atlantic archipelagos, but also searches for a balance between the diverse maritime sectors and the conservation of the natural marine heritage.

This report is the deliverable of PLASMAR Project activity 211a: Finding the balance of Blue Growth Sustainable Development within Ecosystem Approach, within which partners analysed the presence, situation and main forecasted trends of the maritime sectors present in the archipelagos of Madeira, Azores and Canaries. This first project activity intends to identify the present uses of the maritime space (operational maritime activities) and define future needs of the marine space required for these or for new maritime activities to be developed.

The present document was developed following the regional reports (available online in the PLASMAR Project’s webpage: http://www.plasmar.eu/en/documents/) previously prepared by the project partners, as follows:

- The Direção Regional do Ordenamento do Território e Ambiente (DROTA) prepared the report for Madeira (Portugal) with the contributions of the Agência Regional para o Desenvolvimento da Investigação, Tecnologia e Inovação (ARDITI).
- The Direção Regional dos Assuntos do Mar (DRAM) prepared the regional report for the Azores (Portugal), and
- Gestión del Medio Rural de Canarias, S.A.U. (GMR Canarias) prepared the report for the Canary Islands (Spain).

The lead partner, EcoAqua Institute at Las Palmas de Gran Canaria University (Canary Islands, Spain) was in charge of delivering a summary report of the global / European context for each of the maritime sectors and compiling the summaries for each region within this final report. Additional analyses are under preparation and will be produced as scientific papers, in order to disseminate further the knowledge gained.

# I. Context and concepts

The activities that make up the **blue economy** are, according to EASME (2017), those that:

(i) take place in the marine environment,
(ii) use sea resources as an input, and
(iii) are involved in the production of goods or the provision of services that will directly contribute to activities that take place in the marine environment.

This definition of blue economy was developed for policy makers and industry alike, and to serve the purpose of measuring the size of the blue economy and forecast its evolution. It incorporates a geographic criterion (activities occurring in the marine environment) combined with other criteria of process and nature (that result in activities that may also take place on land). This acknowledges the land-sea interaction of the marine sector, which not only takes part within the marine environment but is actually supported by several on-land sectors –seafood processing on land, ports, ship building and maintenance, commerce / trade / transport of people and merchandise, which are all part of the marine economy.

EASME (2017) identified all the economic activities included in the NACE classification[1] that match with the above definition, including them as part of the blue economy and choosing this as the organization structure in order to propose a method for the assessment of the size of each of the maritime activities present in the EU. Table 1 shows the resulting list of groups and sectors, which are further detailed in Annex 1 to incorporate the NACE identification of specific activities, clarifying further the scope and content of the blue economy.

Table 1: List of blue economy groups and sectors (EASME, 2017).

| Group | Sector |
|---|---|
| Living resources | Fisheries and aquaculture |
| | Blue biotechnology |
| Non-living resources | Extraction of aggregates |
| | Extraction of oil and gas |
| | Extraction of salt |
| | Seabed mining |
| | Desalination |
| Shipping | Maritime transport |
| | Ports (including dredging) |
| Shipbuilding | Shipbuilding |
| | Ship repair |
| Renewable energy | Wind energy |
| | Other renewable energy |
| Coastal tourism | Coastal tourism |
| Other | Public sector |

[1] http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Statistical_classification_of_economic_activities_in_the_European_Community_(NACE)

**Blue growth** refers to the capacity of certain blue economy sectors for the creation of jobs and economic value, and the potential for research and development to deliver technology improvements, innovation and finally the needed action for growth within sustainability limits.

Blue Growth is also the name given to the EU long-term strategy to support sustainable growth in the maritime sector and is the response to attaining the goals of the Europe 2020 Strategy. The Communication "Blue Growth opportunities for marine and maritime sustainable growth" (COM/2012/0494 final) and ECORYS (2012) identified five Blue Growth focus areas which could benefit from clear-sighted policymaking, allowing the private sector to play a leading role in helping the blue economy reach its sustainable growth potential:

a. Blue energy
b. Aquaculture
c. Maritime, coastal and cruise tourism
d. Marine mineral resources, and
e. Blue biotechnology.

This list did not intend to be exhaustive, as other value chains may emerge over time as suitable areas for further policy focus, being incorporated to the blue growth sectors.

More recently, the OECD (2016) classified the main maritime activities with regards to their relation to prospects for growth towards 2030, providing a clearer view of the potential of each sector for an improved performance in the short or long term (Table 2):

Table 2: Blue economy towards 2030 (OECD, 2016).

| | |
|---|---|
| **Prospects for modest growth** | • Capture fisheries<br>• Offshore oil & gas extraction in deep water |
| **Prospects for high long-term growth** | • Shipping<br>• Shipbuilding<br>• Offshore wind<br>• Marine aquaculture<br>• Tourism<br>• Surveillance and safety |
| **Long-term potential but not yet at commercial scale** | • Ocean renewable energy<br>• Marine biotechnology<br>• Deep-sea mining<br>• Carbon capture and storage |

# II. Current status and projection of blue economy sectors at the EU level

According to the latest figures produced for the EU as part of the "Study on the establishment of a framework for processing and analysing maritime economic data in Europe" (EASME, 2017), in 2014, the blue economy of the EU26 generated a value addition (direct and indirect) of nearly 215 billion euros and 5,7 million jobs. Direct impact alone is lower and sums a value of nearly 156 billion euros and 3,2 million jobs. It is recognised by the authors that these figures underestimate the real size of the blue economy (due to lack of data for some activities, occasional data gaps or indirect employment underestimation), although the overall picture does not suffer a significant change.

A detailed breakdown by sectors is shown in the following graphs (Figs. 1 and 2), providing an idea of the dimension of the blue economy (excluding the public sector). The overall figures (grouped as shown in Table 1) are presented in Table 3.

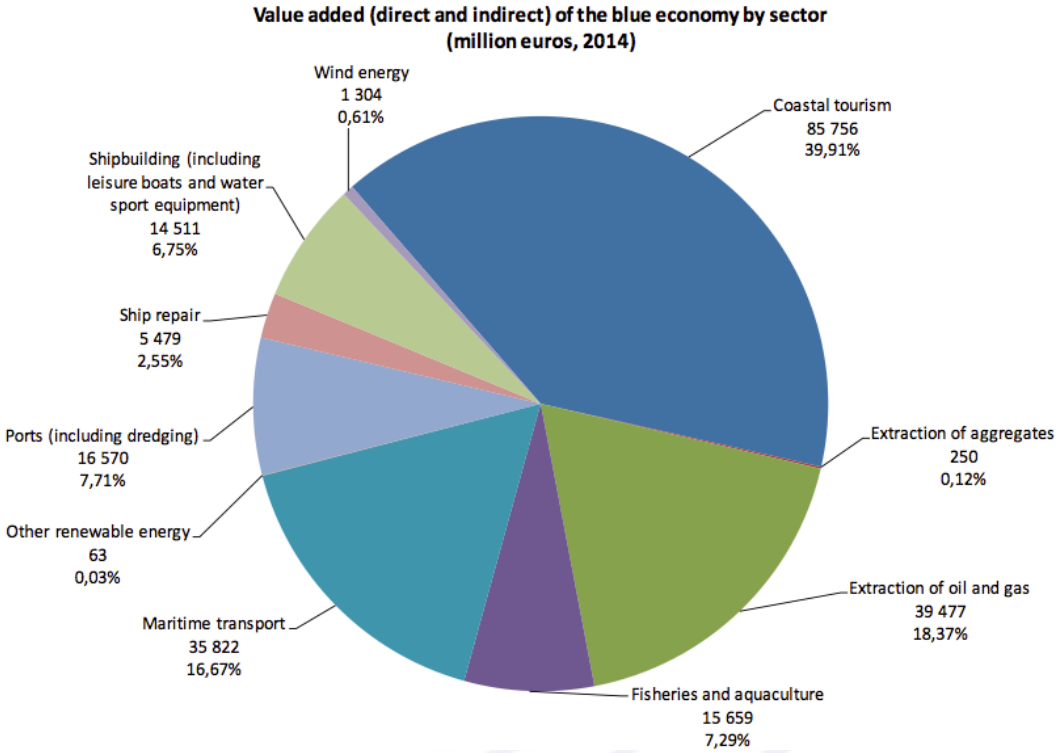



Fig. 1: Value added (direct and indirect) to the blue economy by sector in 2014 for the EU26 (million euros and % of total); (EASME, 2017).

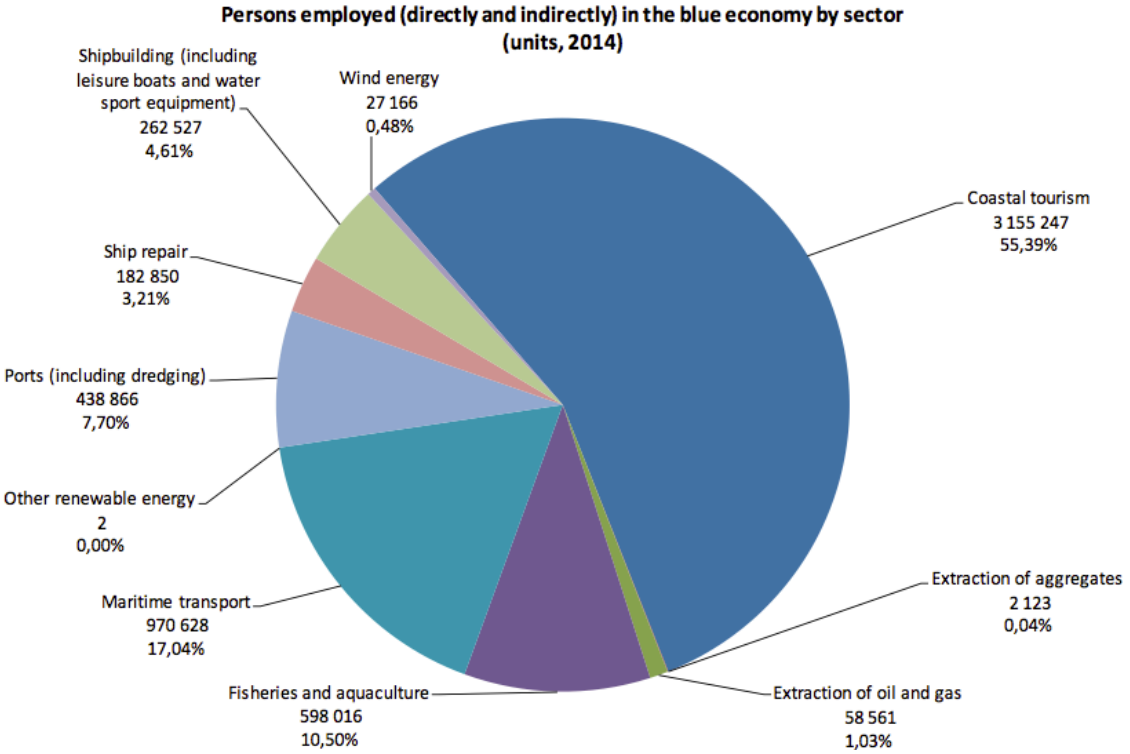



Fig. 2: Persons employed (directly and indirectly) in the blue economy by sector (units and % of total) in 2014 for the EU26; (EASME, 2017).

Table 3: Value of blue economy groups and sectors in 2014 for the EU26 (EASME, 2017).

| Group | Sector | Value added (direct and indirect) (Millions of Euros) | Employment (direct and indirect) (Persons employed) |
|---|---|---|---|
| **Living resources** | Fisheries and aquaculture | 15.659 | 598.016 |
| | Blue biotechnology * | | |
| **Non-living resources** | Extraction of aggregates | 39.727 | 60.683 |
| | Extraction of oil and gas | | |
| | Extraction of salt * | | |
| | Seabed mining * | | |
| | Desalination * | | |
| **Shipping** | Maritime transport | 52.393 | 1.409.494 |
| | Ports (including dredging) | | |
| **Shipbuilding** | Shipbuilding | 19.990 | 445.377 |
| | Ship repair | | |
| **Renewable energy** | Wind energy | 1.367 | 27.168 |
| | Other renewable energy | | |
| **Coastal tourism** | Coastal tourism | 85.756 | 3.155.247 |
| **Other** | Public sector * | | |

* No data available

Some of the most traditional sectors still make up most of the blue economy, such as coastal tourism, which is the largest activity within blue economy followed by maritime transport and extraction of fossil fuel energy (oil and gas).

The following sections present short overviews of the current status and prospects for development of the main maritime sectors (including both blue growth and other blue economy sectors) in a worldwide or European scale:

# 1 Aquaculture

Marine aquaculture is classified by OECD (2016) as an activity with "high long-term growth of business and employment", mainly because the global demand for fish is expected to continue to rise over the next decades, as a consequence of increasing world population, growing purchasing power, and more people entering the middle class. In fact, this sector has continued to grow globally since its beginning in the middle 50s of the last century (Fig. 3a).

According to the Food and Agriculture Organization (FAO, 2014), aquaculture currently accounts for about half of the supply of fish for human consumption. This is the fastest growing agro-industry in the world with the production of food fish from aquaculture growing at about 6.2% per year in between 2000 and 2012. At the European level, the expansion of aquaculture, both for finfish and shellfish, does not follow a similar trend as at the global level, (Fig. 3b), most likely because of costs and complex procedures required for authorization and licensing process, and the competition from extra-EU countries (EC, 2013).

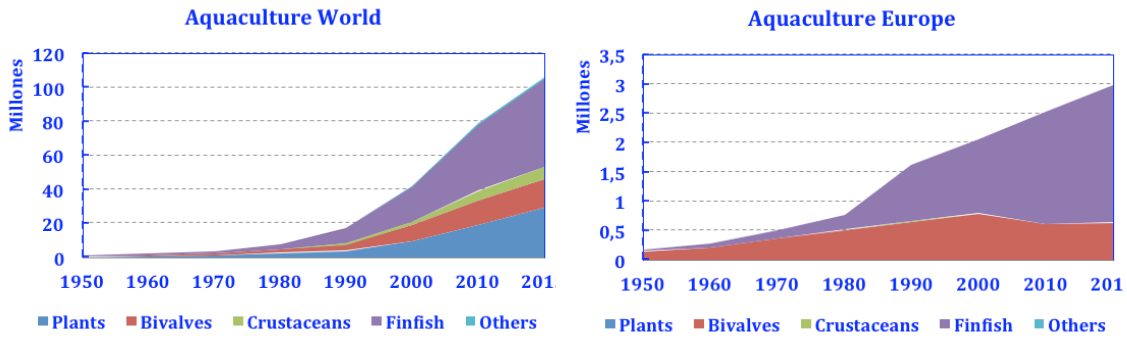



Fig. 3: Aquaculture production by species groups: a) World, b) Europe. Data compiled from: FAO, 2017a.

An in-depth analysis made by OECD (2015) in the report "Green growth in fisheries and aquaculture" observed that in many parts of the world these sectors are at risk and do not reach their full potential. Although prospects for growth of aquaculture are good, improved regulation to deal with environmental externalities and space competition is key to unlocking future growth potential in terms of sustainability.

FAO (2017b) stresses the importance of data needs for blue growth, in order to achieve sustainable aquaculture and fisheries, reduce habitat degradation and preserve biodiversity. In aquaculture, inventories of farming installations can also provide policy-makers with the knowledge to enable effective planning and management.

For the EU, and according to EASME (2017), simplification of administrative procedures, better coordination with competing uses of the sea through Maritime Spatial Planning, together with funding available through the European Maritime Fisheries Fund (EMFF) and Horizon 2020 may give new boost to the sector. Although competition from third countries cannot probably be won based on price only, the extremely high animal health and consumer protection standards in the EU may be received favourably by domestic consumers. In order to reduce the costs associated with farming fish and reduce the competition for space, a possible option is to co-locate mariculture farms with offshore

installations such as wind farms and oil and gas platforms. From a conceptual view point, co-locating different activities is expected to optimise the use of ocean space and make possible to share fixed costs across more industries. Nevertheless, further research and testing through pilot programs are still needed in this field.

Regarding environmental sustainability and ecosystem approach to aquaculture, experience and recommendations are being made available by the publication of key documents by main international organizations (IUCN, 2007, 2009a, 2009b; FAO, 2015 and 2017b; FAO & World Bank, 2015; Science for Environment Policy, 2015).

# 2 Blue biotechnology

Marine or Blue Biotechnology is one of the sub-divisions of biotechnology in general. It has been interpreted as both "the use of marine-origin bioresources for biotechnology purposes" (e.g. marine bioprospecting of sponges or planktonic bacteria and algae) and "the use of biotechnologies in the marine environment" (e.g. in situ bioremediation, genomics in aquaculture or bio-based sensors) (EASME, 2017).

The "Bio-economy 2016 report" (Ronzon *et al.*, 2017) highlights the interlinkages, as possibilities are numerous for synergies with land-based food, feed production and processing, production of bioenergy, chemicals and nutrients in a local and circular bioeconomy perspective. In this way, blue biotechnology has the potential to address major challenges such as sustainable food supply, human health, energy security and environmental remediation, and also is able to provide important services for the planet. The following diagrams give an idea of the broad range of products and services (Fig. 4), and of the specific applications (Fig. 5) that might be included as blue biotechnology.

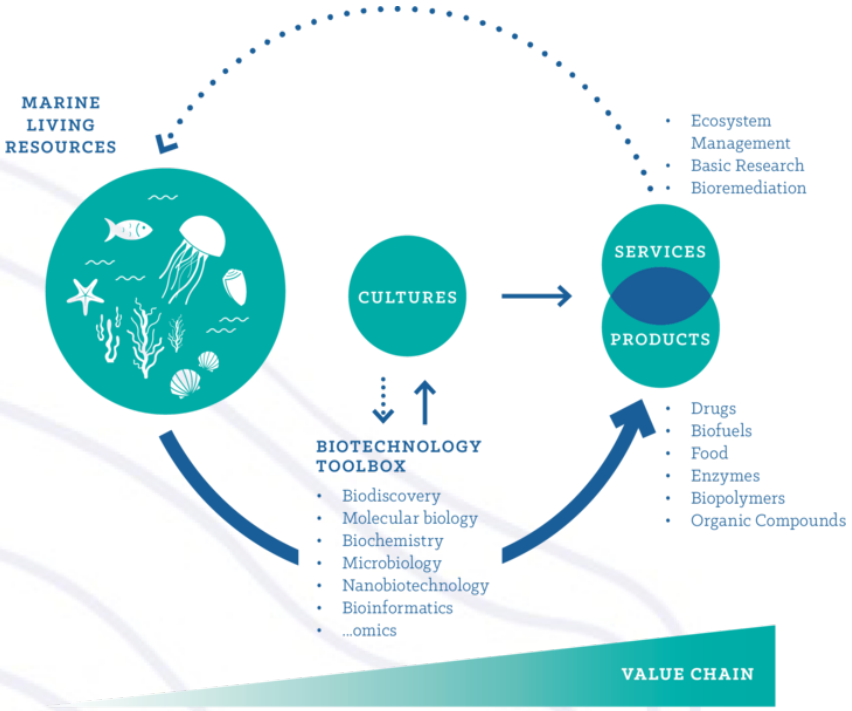



Fig. 4: Examples of products and services developed by technological applications using marine bioresources. Source: http://www.marinebiotech.eu/wiki/Marine_Biotechnology

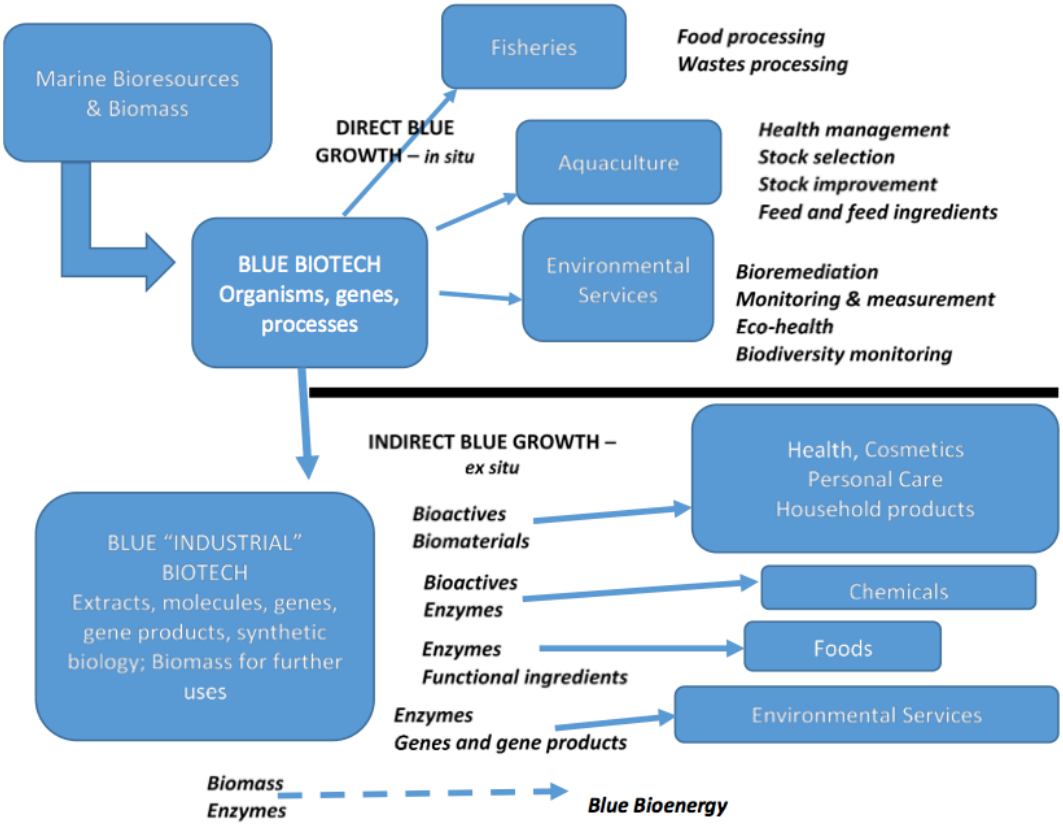



Fig. 5: Blue biotechnology: direct and indirect applications for Blue Growth. (EASME, 2017).

OECD (2016) considers marine biotechnology as an activity with "Long-term potential but not yet at commercial scale", as it is for the moment still mainly a R&D activity. In 2010, it was estimated at around USD 2.8 billion and projected to grow (under conservative assumptions) to around USD 4.6 billion by 2017 (OECD, 2013 and 2017).

EASME (2017) agrees that blue biotechnology is still an emerging area, which describes as "science-rich and cost-heavy, not product-rich and profitable". Dedicated companies tend to be SMEs and even micro-enterprises, and the outputs go into general sectors (chemicals, pharmaceuticals, food, materials, etc.) where the exact origin may go unidentified in data or discussion of inputs and outputs. As conventional indicators do not work well in this context, the authors did not agree on a reliable method to measure the size of blue biotechnology for the EU and, hence, this study does not produce any figures for this activity (as shown in Table 3, above). Nevertheless, it provides a revision of existing estimates of the economic impacts of marine biotechnology. Previous estimates at EU level value the contribution of the sector in 9 million € and 185 jobs, as published in the Blue Growth infographic by the European Commission (http://ec.europa.eu/assets/mare/infographics/). The "Study in Support of Impact Assessment Work on Blue Biotechnology" (DG Maritime Affairs and Fisheries, 2014) calculates the sector`s higher-end revenue generation to be around € 754 million, which with an estimated annual compound growth rate of Blue Biotechnology of 6-8% in 5 years could lead to an annual revenue generation of up to € 1 billion.

# 3 Renewable ocean energy

## 3.1 Wind energy

Procurement and provision of sustainable energy has a key role to play in adaptation and mitigation of adverse effects of climate change, and **wind energy** offers the main contribution. In fact, and according to data for Europe, wind energy (with a total installed capacity of 153.7 GW) now overtakes coal as the second largest form of power generation capacity in Europe (Fig. 6), (WindEurope, 2017a).

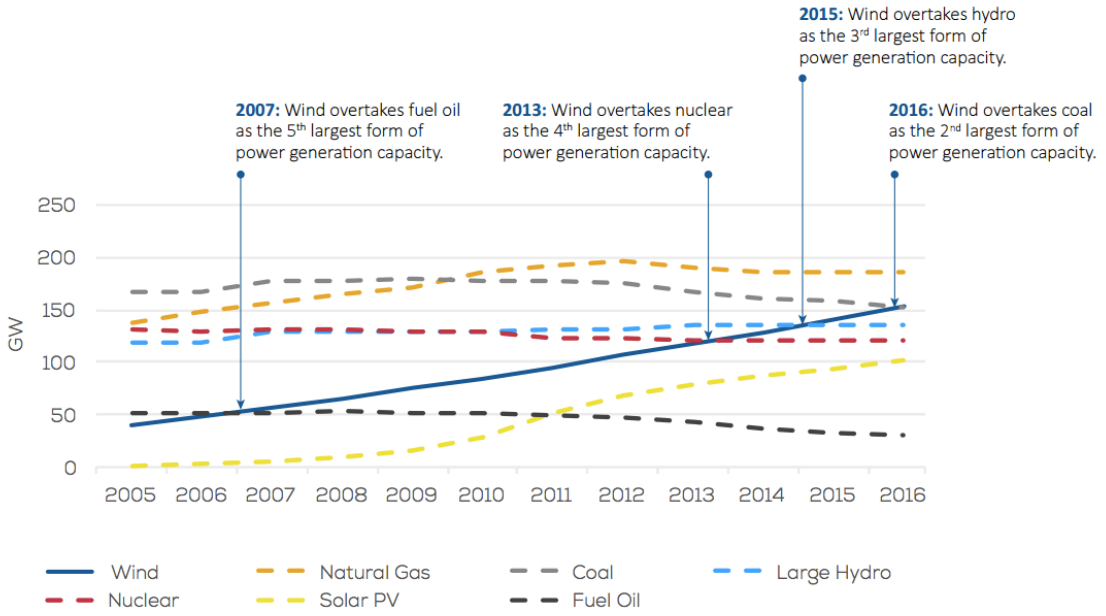



Fig. 6: Cumulative power capacity in the European Union 2005-2016. WindEurope, 2017a.

OECD (2016) classifies **offshore wind** as a sector with "prospects for high long-term growth of business and employment, and grows in presence in the EU, China and North America (Fig. 7). Overall, at the end of 2016, there was 14.384MW of installed offshore wind power capacity in 14 markets around the world (GWEC, 2017) and 88% were located in waters off the coast of Europe.

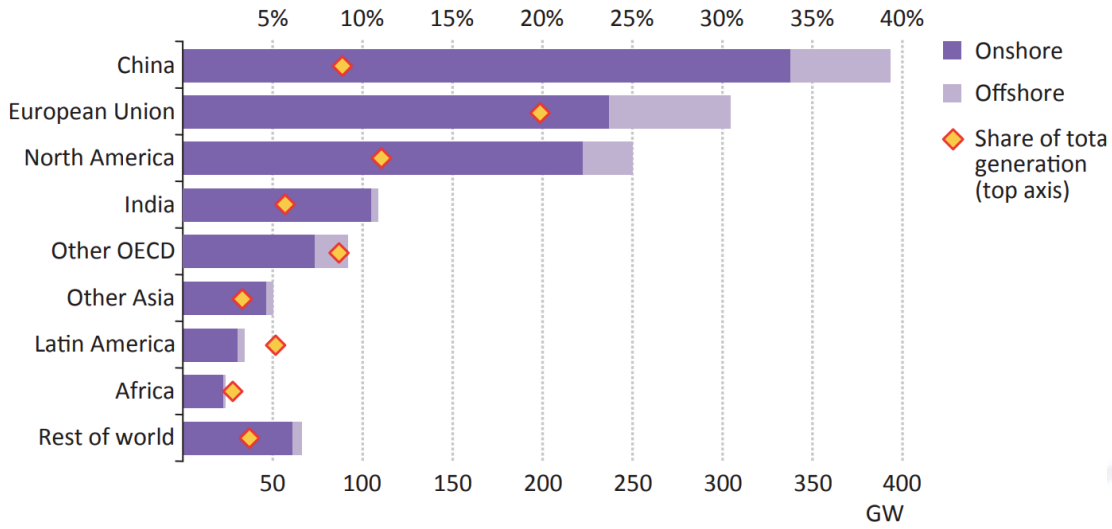



Fig. 7: Installed wind power capacity by type and region in the IEA New Policies Scenario (2040) in GW (bottom axis) and share of total generation in 2040 (top axis). Source: OECD/IEA, 2014.

For the EU, the Commission communication entitled 'Blue Energy: Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond' (COM(2014) 0008), sets out an action plan to support the development of ocean energy.

As shown in Table 4, figures for Europe add a total of 12.631 MW from 3.589 grid-connected wind turbines in 10 countries (WindEurope, 2017b and GWEC, 2017). Projections suggest there is a clear potential for growth worldwide to 40-60 GW by 2020 and a further order of magnitude by 2050 (OECD, 2016) and the same with regards to job creation: data for Europe alone suggests the creation of 170.000 jobs by 2020 and 300.000 jobs by 2030 (OECD, 2016).

Table 4: Number of wind farms with grid-connected turbines, no. of turbines connected and no. of MW grid-connected at the end of 2016 per country. WindEurope, 2017b.

| Country | BE | DE | DK | ES | FI | IE | NL | NO | SE | UK | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of Farms | 6 | 18 | 13 | 1 | 2 | 1 | 6 | 1 | 5 | 28 | 81 |
| No. of turbines connected | 182 | 947 | 517 | 1 | 11 | 7 | 365 | 1 | 86 | 1,472 | 3,589 |
| Capacity Installed | 712 MW | 4,108 MW | 1,271 MW | 5 MW | 32 MW | 25 MW | 1,118 MW | 2 MW | 202 MW | 5,156 MW | 12,631 MW |

For Europe, wind energy investments accounted for 86% of the new clean energy finance in 2016, compared to 67% in 2015 (WindEurope, 2017a, see Table 5). Although the new grid-connected capacity in 2015 was higher than that of 2016, the high number of projects that started construction in the last year will mean an important increase of the figures within the next two years (WindEurope, 2017b).

Table 5: Cumulative and annual offshore wind installations 2006-2016 (MW) in Europe. WindEurope, 2017b.

| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual MW | 93 | 318 | 349 | 614 | 931 | 816 | 1,171 | 1,606 | 1,452 | 3,013 | 1,558 |
| Cumulative MW | 801 | 1,120 | 1,469 | 2,083 | 3,014 | 3,830 | 5,002 | 6,608 | 8,060 | 11,073 | 12,631 |

As stated by TPWind Advisory Council in 2006, "Offshore wind energy is probably ten years behind onshore wind power and only limited development has taken place. But the future potential is almost boundless if further research and development is carried out". In accordance, the following graph (Fig. 8) confirms a clear increase of the installed capacity in the last few years (2009 to 2016) in Europe, showing the breakdown by countries. The very rapid increase in specific countries suggests that the sector still has to be looked with great attention, as it clearly has great potential that can be further exploited.

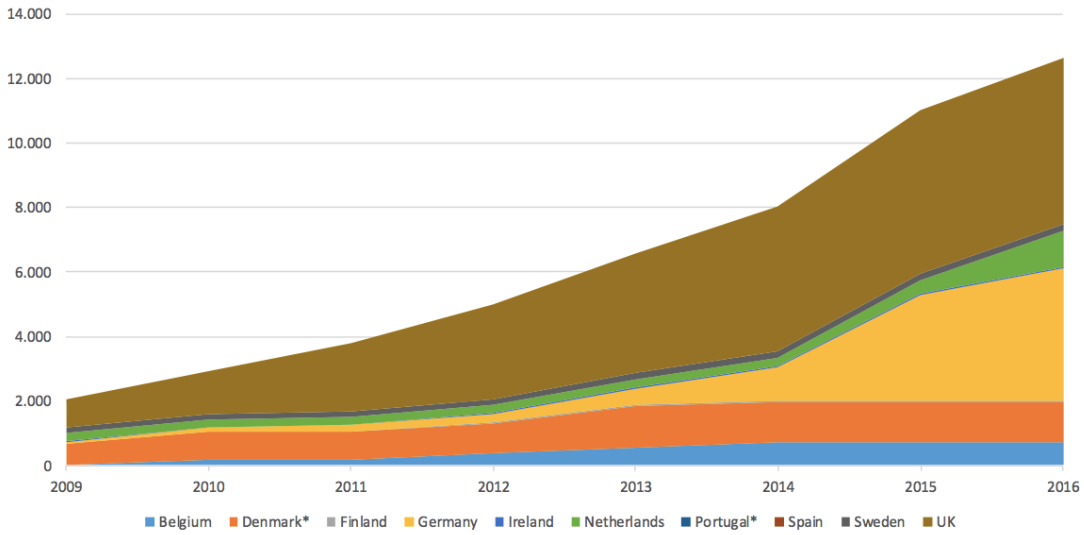



Fig. 8: Offshore wind capacity installed (MW). EASME, 2017. Data source: WindEurope.

However, the number of new projects will fall towards 2019 as European member states complete their National Renewable Energy Action Plans (NREAPs) under the current Renewable Energy Directive which covers the period up to 2020. Similar to 2016, capacity additions will stall in 2020, though a good level of construction activity will still be ongoing. By 2020, total European offshore wind capacity will be 24.6 GW. (WindEurope, 2017b).

A key issue is the distribution of suitable locations, both in terms of geographic area (availability of wind resource) and specific site characteristics (water depth and distance to the coast, environmental description, …). The average water depth of offshore wind farms with grid-connections in 2016 was 29.2 m and the average distance to shore was 43.5 km, although some newly authorised installations and applications submitted move to greater depths that even approach 200m (Fig. 9). The map in Figure 10 shows the distribution of offshore wind farms in the North of Europe, where most of the farms are located to date.

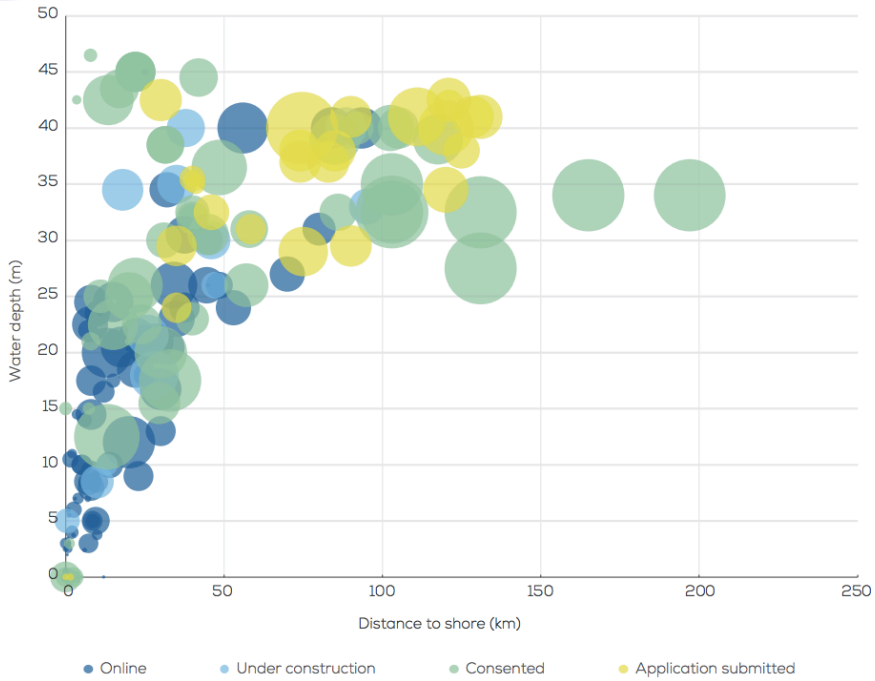



Fig. 9: Location of existing offshore wind farms: average water depth, distance to shore of bottom-fixed. The size of the bubble indicates the overall capacity of the site. WindEurope, 2017b.

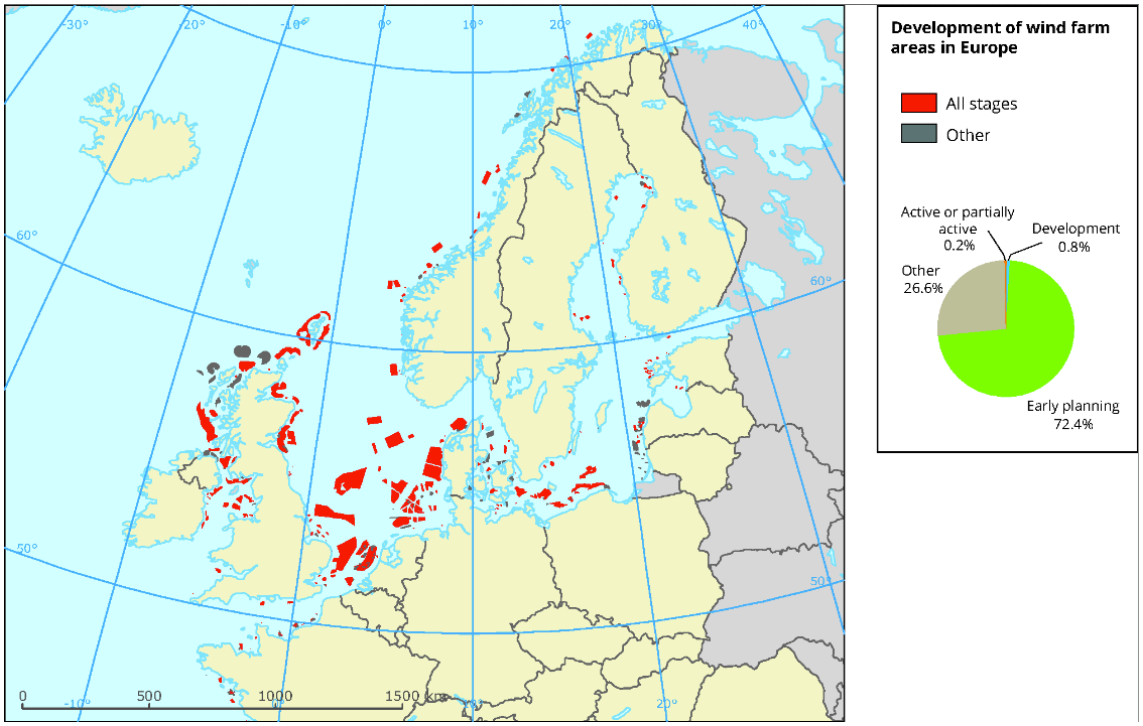



Fig. 10: Development of wind farm areas in Europe. EEA, 2015.

## 3.2 Other than wind

The OECD's report on ocean economy (2016) classifies ocean renewable energy –other than wind– among the activities with significant long-term potential but not operating at commercial scale for some time to come.

As seen before, offshore wind energy is becoming more common, particularly in Northern Europe and prospects for growth are clear. Other forms of marine energy extraction are still experimental, and in most cases, have not yet been developed on a commercial scale. These other forms of marine energy are mainly ocean waves and tides (tidal range and tidal streams), or ocean thermal energy conversion, and also include ocean (permanent) current and osmosis (salinity gradient) energies. According to the Ocean Energy Systems Implementing Agreement (OES), there is potential worldwide to develop 337 GW of wave and tidal energy by 2050, and possibly as much again from ocean thermal energy conversion (OECD, 2016), and points out that employment prospects would increase accordingly (with scenarios that suggest up to 1,2 million jobs worldwide by 2050).

Despite its enormous potential, marine energies face different types of constraints that need attention. According to the Workshop Proceedings "The Assessment of potential and promotion of new generation renewable energy technologies" (European Parliament, 2011): the costs of research and prototype development projects are high, making necessary the availability of funding for this purpose; there is a need for a regulatory framework that ensures the coexistence of the ocean energy installations with other marine economic activities (e.g. seaways); administrative barriers need to be removed, in order to reduce uncertainty of investment in the sector; scientific progress is in order to increase knowledge on potential interactions between ocean energy devices and marine biodiversity (such as collisions, noise, electromagnetic fields). This last issue has been thoroughly addressed (Copping *et al.* 2016) within the 2016 State of the Science Report, which focuses on information and data on the environmental effects of wind and marine renewable energy technologies.

# 4 Mineral resources

The marine mining industry concerns mainly the extraction of aggregates (e.g. sand and gravel) and of mineral deposits, at depths of maximum 500m in the deep-sea.

## 4.1 Extraction of aggregates

Within the non-energy extractive industries, the aggregates sector is by far the largest. The sector includes extraction and dredging of industrial sand, sand for construction, sand for beach nourishment, gravel; breaking and crushing of gravel; quarrying of sand; mining of clays, refractory clays and kaolin. Granular products are used most notably in construction (e.g. sands, stones etc.), manufacture of materials (e.g. clay, gypsum, calcium etc.), manufacture of chemicals, etc. (EASME, 2017). Environmental considerations are critical, both with relation to the exploitation of a finite resource and to the method of extraction.

In the EU, 2,15% of total EU aggregates production corresponded to marine-dredged materials. Between 2008 and 2014, total production of marine aggregates in the EU decreased by 70.4%, from 92 to 54 million tonnes (Source: UPEG, in EASME, 2017). The sector activity is mainly determined by the construction industry trends, although an increasing demand for beach restoration and coastal infrastructures could maintain the sector in the future.

## 4.2 Deep-sea mining

According to OECD (2016), deep-sea mining is an activity with long-term potential but not yet at the commercial scale. The mineral resource potential of the deep sea is considered to be huge, although the size is extremely difficult to assess with accuracy due to the small proportion of seabed already explored to date. All current offshore mining is in shallow water –less than 300m depth– and on continental shelf areas. The activity has potential to expand into deeper waters, although it is highly unlikely that it will extend beyond the continental shelf.

The main types of deposits being explored for their metal contents are: polymetallic sulphides (also known as sea floor massive sulphides), polymetallic nodules and polymetallic (cobalt-rich) crusts. There is also recent interest regarding the high concentrations of rare earth elements (REE) in deep-sea clays although in lower concentrations than those found in land-based ores (OCDE, 2016).

In the last years, the minimisation of the biological impact of the seafloor mining industry in the marine environment has been considered. MIDAS project[2] (2016a, 2016b) undertook research into the nature and scales of the potential impacts of mining. According to Van Dover *et al*. (2017), the cost of impact mitigation could turn deep-sea mining into an unprofitable activity, thus reducing its interest. Nevertheless, the International Seabed Authority[3] is developing regulations for seabed mining which must prevent serious harm (Levin *et al*., 2016).

For the time being, no extraction is undertaken in the EU waters, although there are 9 vessels working on research and exploration (EASME, 2017).

[2] http://www.eu-midas.net/

[3] The International Seabed Authority (ISA) is an autonomous international organization established under the 1982 United Nations Convention on the Law of the Sea (UNCLOS). Through the ISA, States Parties to the Convention shall, in accordance with the regime for the seabed and ocean floor and subsoil thereof beyond the limits of national jurisdiction (the Area) organize and control activities in the Area, particularly with a view to administering the resources.

# 5 Coastal & maritime tourism

Tourism is identified as the largest activity within the blue economy (40% of all value added and 55% of all employment; Table 3); it is also recognised that tourism is not a single economic activity, but it rather encompasses a wide set of activities (accommodation, food and restaurants, transport etc. around it (EASME, 2017).

Although it is a traditional sector, it is also recognised as a blue growth sector and classified by the report "The Ocean Economy in 2030" (OECD, 2016) among the activities with "high long-term growth of business and employment", with tourist travels worldwide expected to increase by 3.3% a year (or 43 million international tourists) from 2010 to 2030, reaching 1.4 billion arrivals by 2020 and 1.8 billion by 2030.

Although international statistics make it difficult to estimate the proportion of marine tourism, it is predicted that it will grow at faster rates than international tourism as a whole. Cruise Market Watch (2017) expected the world market to rise from 21 million in 2013 to over 25,3 million in 2019 (Table 6). The Korean Ministry of Oceans and Fisheries estimates world cruise to rise even more: up to 37 million cruisers in 2020 (approx. 10% increase per annum, according to Lee. H.-J., 2015).

According to Cruise Market Watch (2017) the industry is expanding rapidly internationally. Growth strategies include larger capacity new builds and ship diversification, more local ports, more destinations and new on-board/on-shore activities that match demands of consumers.

Table 6: Source region of total worldwide cruise passengers, showing prospects until 2019. (Cruise Market Watch, 2017).

| Year | North America | Europe | Other | Worldwide Passengers Carried |
|---|---|---|---|---|
| 2015 | 13.037.000 | 5.762.000 | 3.448.000 | 22.247.000 |
| 2016 | 13.211.000 | 5.894.000 | 3.830.000 | 22.935.000 |
| 2017 | 13.655.000 | 6.109.000 | 4.192.000 | 23.956.000 |
| 2018 | 13.890.000 | 6.231.000 | 4.507.000 | 24.627.000 |
| 2019 | 14.127.000 | 6.354.000 | 4.835.000 | 25.316.000 |

According to EASME (2017), the recent growth of coastal tourism in the EU-28 area was of 3% a year (2012-2014). Main increases were registered in The Netherlands, Greece, Latvia and Portugal. The number of bed places in coastal areas remained steady in the same period (+1% a year). Authors noted potential for further growth in Southern Mediterranean countries due to political confusion in Arab countries.

With regard to cruise tourism, there continues to be a clear increasing trend, as the sector has not yet reached its maturity and there is potential for further development (Fig. 11) (EASME, 2017; OECD, 2016).

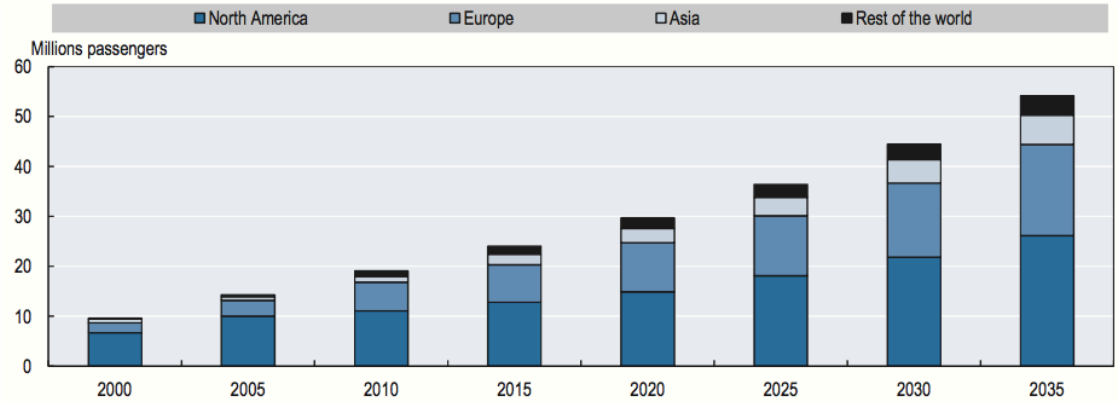



Fig. 11: Projected growth of global cruise tourism to 2035 (OECD, 2016; data from SEA, 2015).

# 6 Fisheries

According to OECD (2016), capture fisheries have been identified as a sector with prospects for modest business and employment growth.

There is no increase of capture fisheries landings since the mid-1990s, staying around 80 million tonnes for marine fish (OECD, 2015; FAO, 2017a). As shown in Fig. 12, the proportion of over-exploited stocks has risen to approximately one third in 2011; fully fished stocks are over 60% while under-fished stocks are just under 10% (FAO, 2016).

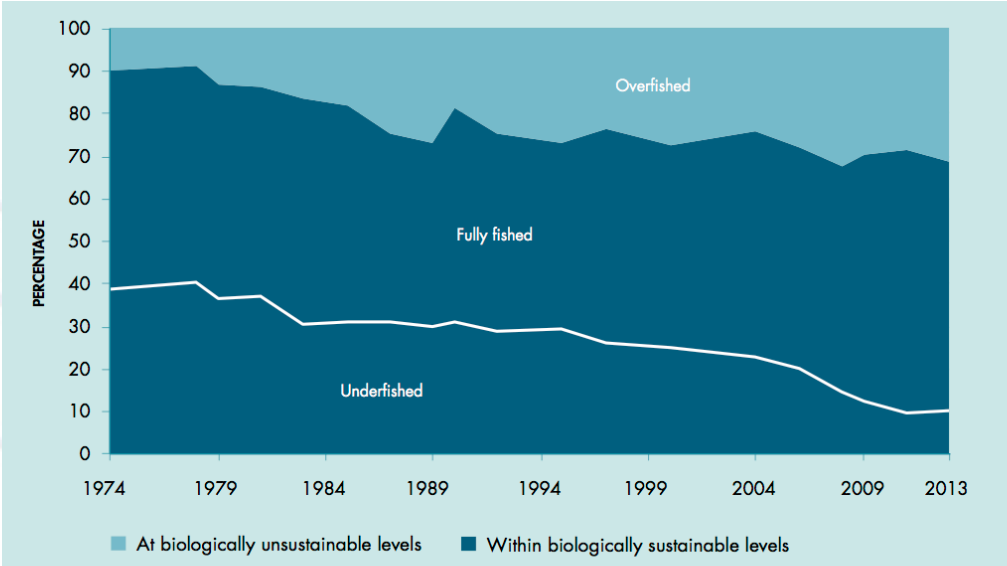



Fig. 12: Relative proportions of the status of capture fisheries over time (1974-2013). Source: FAO (2016).

The past three decades registered a clear rise of aquaculture, in opposition to the decline of capture fisheries. Looking forward, the standstill of total capture fisheries production is expected to continue towards 2030, while aquaculture will continue to grow, increasing the global fish production (OECD, 2016). See Fig. 13.

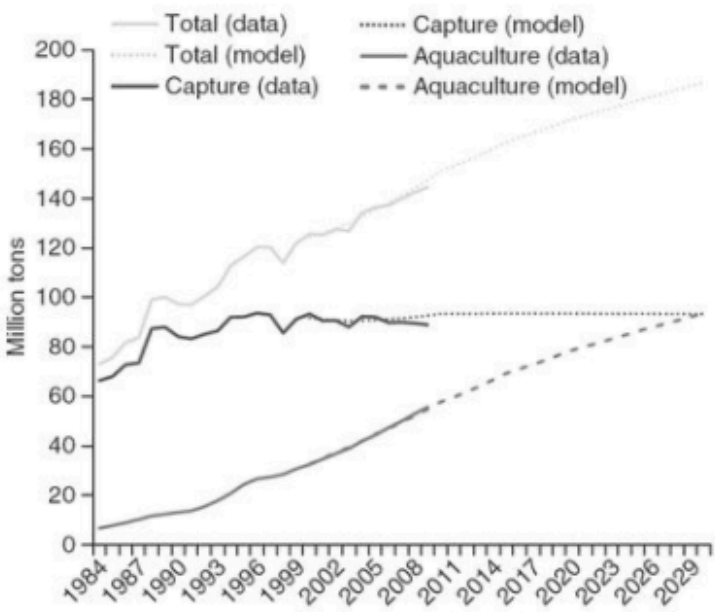



Fig. 13: World Bank (2013; in OECD, 2016).

According to Stobberup *et al*. (2017), European fisheries, on an industrial scale, are the largest employer of the world economy in the oceans. Considering the 5 priority areas of the BG, fishing is only surpassed by tourism in gross value addition (GVA) and employment. In addition, meeting the objectives of the European Common Policy on Sustainable Maximum Yield would significantly increase catches and their potential for economic growth. In the EU, 80-85% of fishing vessels belong to Small Scale Fisheries (SSF) and account for 40% of employment in the fisheries sector. Catches in general are low but usually target local and tourist markets.

In all, although the European fishing fleet operates worldwide, EU catches are taken primarily from the Eastern Atlantic and the Mediterranean. In 2015, 77% of EU-28 catches were made in the North East Atlantic, 8% in the Mediterranean and Black Sea and 5% from the Eastern Central Atlantic (EUROSTAT, 2017).

Data for the EU shows how captures for the EU have decreased since 1990 (Fig. 14b). This is in great part due to the adaptation of the fleet to the available natural resources. Since the 1990s, the EU ceased the promotion of an enlarged fishing fleet and invested public funds in the reduction of the fleet (by 4.000 fishing vessels in the period 2007-2013). At the same time, long term management plans in line with maximum sustainable yield[4] (MSY) objectives have been implemented. In all, there has been a reduction in the pressure of the resource (OECD, 2015). Global data shows a slight increase in the same period (Fig. 14a), reflecting the need for effective implementation of the agreed international rules.

[4] Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions (OECD Glossary of statistical terms: https://stats.oecd.org/glossary/).

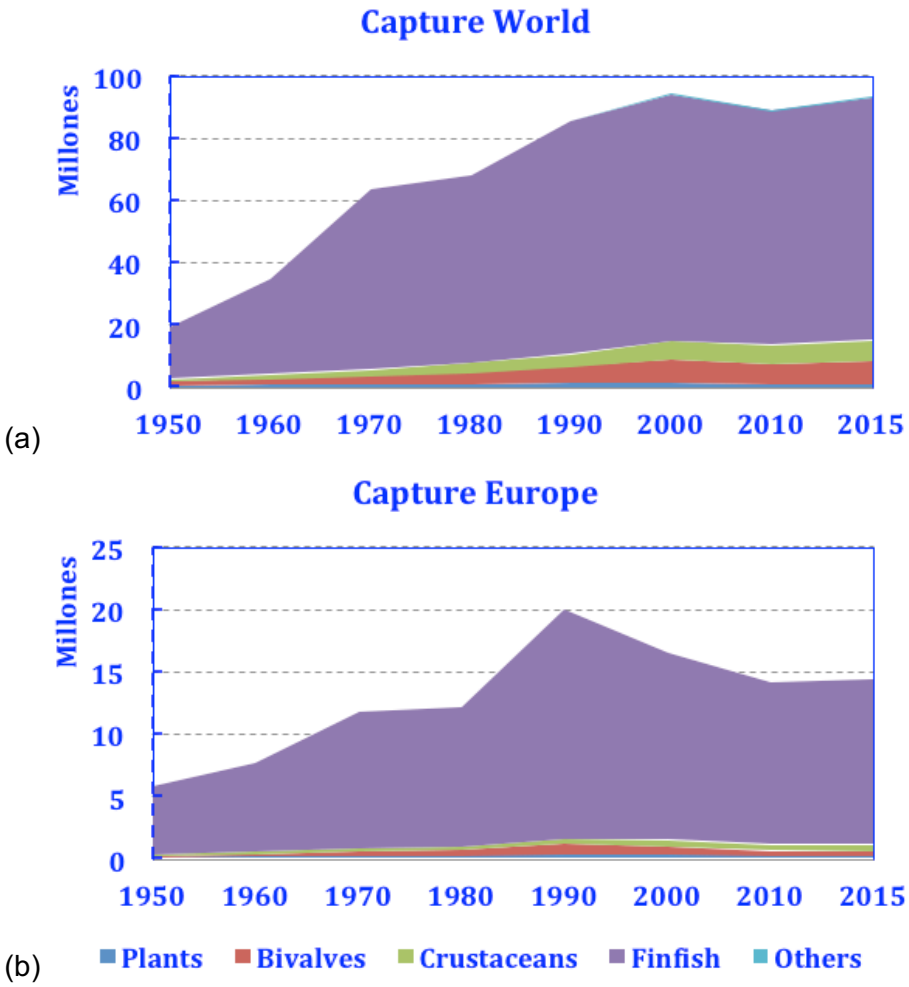



Fig. 14: Total fishing captures both (a) global and for (b) Europe. Source: FAO, 2017a.

In all cases, total catches are recognised as underestimated due to unreliable data on bycatch, discards and illegal, unreported and unregulated (IUU) fishing (World Bank, 2013). To draw the full picture, the reality of IUU (valued in 10-20 billion €/year) must be added to the legally conducted fishing (estimated 55-60 billion €). Thus, IUU contributes to considerable risk of depletion of certain stocks as well as damage to ecosystems (OECD, 2015 & 2016).

In line with the data needs highlighted by FAO (2017b), monitoring the performance of sustainability of fisheries in socioeconomic, environmental and management terms is key to the improvement of people's participation, economic investments and returns, better visibility of small-scale fisheries or identification of potential impacts on biodiversity and, as a result, better management and sustainability of the sector.

# 7 Offshore oil & gas

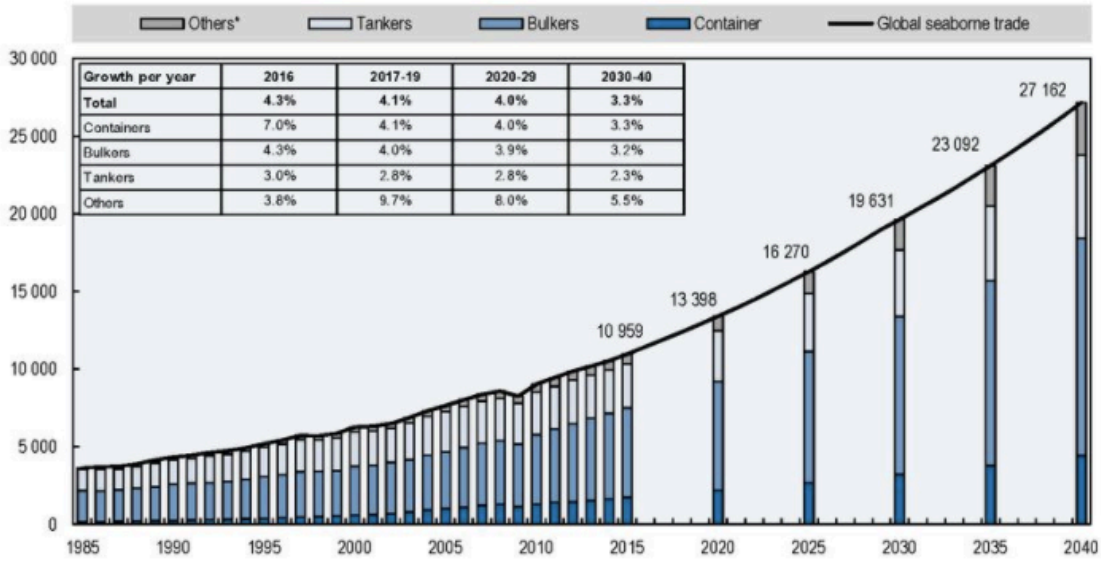
The OECD's report on the ocean economy (2016) classifies both oil and gas extraction among the activities with modest business and growth prospects. Weak market demand, given the increasing efforts to decarbonise the economy in the Western world, as well as concerns about safety and the ocean environment, may hinder the future development of the sector.

In Europe, the oil and gas industries are at a mature stage of development, and it is believed that there is limited growth potential (EASME, 2017).

OECD (2016) considers deep and ultra-deep water offshore oil and gas production as an industry operating at the cutting edge of science and technology. Prediction of the future evolution is complex due to the issues the sector is to face, such as weak market demand and oversupply, decarbonisation policies, or safety and environmental concerns.

# 8 Maritime transport

Shipping is classified by OECD (2016) as a sector with prospects for high long-term growth of business and employment. According to this document, globally, a 1% increase in real GDP corresponds to a 1,1% growth in seaborne trade (measured in tonnes). The following graph (Fig. 15) details the expected growth per periods, both total and for each category.




| Growth per year | 2016 | 2017-19 | 2020-29 | 2030-40 |
|---|---|---|---|---|
| Total | 4.3% | 4.1% | 4.0% | 3.3% |
| Containers | 7.0% | 4.1% | 4.0% | 3.3% |
| Bulkers | 4.3% | 4.0% | 3.9% | 3.2% |
| Tankers | 3.0% | 2.8% | 2.8% | 2.3% |
| Others | 3.8% | 9.7% | 8.0% | 5.5% |

Fig. 15: Seaborne trade projection, 1985-2040 (in million tonnes). The category “Others” includes passenger ro-ro, LNG (Liquefied Natural Gas) and LPG (Liquefied Petroleum Gas), cruise and other seaborne passenger traffic. Source: OECD (2016).

According to EASME (2017), the shipping industry is a significant economic activity for the EU due to the multiple economic benefits. The European-controlled fleet comprises 450 million gross tonnes and 23,000 vessels, which currently represents around 40% of the world’s gross tonnage. The EU fleet has shown a significant increase in terms of capacity of almost 70% during the last five years.

For the EU, and as stated in the “Report on the Blue Growth Strategy Towards more sustainable growth and jobs in the blue economy” (EU Commission, 2017), although the volume of trade has picked up from the low point in 2009, employment has not yet reached its pre-crisis levels. Investment automation in logistics and shipping will increase the competitiveness of shipping against other forms of transport, particularly in short sea-shipping but is unlikely to increase employment.

According to the third IMO GHG study (Smith *et al.*, 2014), maritime transport emits around one billion tonnes of $CO_2$ annually and is responsible for about 2.5% of global GHG emissions. Even more, predictions suggest an increase between 50 - 250% by 2050. In this context, the EU has set specific $CO_2$ reduction targets.

# 9 Shipbuilding & ship repair

The long-term growth predicted for seaborne trade reflects in the sector of shipbuilding (OECD, 2016). This sector can also benefit from strong linkages with the offshore oil and gas industry, offshore wind energy, cruise tourism, aquaculture and fisheries.

Shipbuilding is a complex sector which depends upon a wide range of issues, such as energy consumption and prices, vessel age and ship replacement, changes in trade patterns, etc.

Although in 2013 the sector had produced an oversupply equivalent to one-quarter of the container fleet worldwide, a further growth is expected for the next 20 years even doubling the new build gross tonnage in the period 2015-2030, as shown in Figure 16 (OECD, 2016).

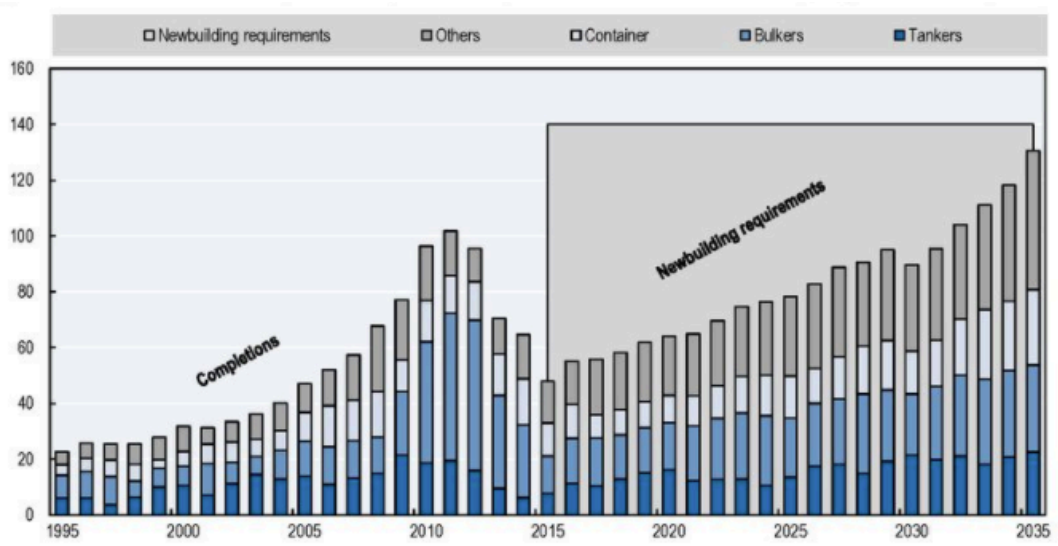



Fig. 16: Past vessel completions (1995-2014) and future new building requirements (2015-2035). Source: OECD (2016).

According to EASME (2017), the European shipbuilding is a dynamic and competitive industry which is important from both an economic and social perspective. It holds a market share of around 6% in terms of tonnage and 35% for marine equipment. Thus, Europe is a major player in the global sector industry, with a total turnover of EUR 60.000 million in 2012.

# III. Overview of the maritime sectors in Madeira Archipelago.

This section presents short overviews of the main maritime sectors (including both blue growth and other blue economy sectors) present in Madeira Region. It has been prepared based on the report by Lopes *et al*. (2017) prepared within PLASMAR Project activity.

*Lopes, M; Sepúlveda, P[2]; Jorge, V[2]; Oliveira, M[2]; Andrade, C[1];* 2017. **Blue Growth – for a better development of the sea – Report from Madeira Archipelago**. *[1]ARDITI – Agência Regional para o Desenvolvimento da Investigação, Tecnologia e Inovação; [2]Secretaria Regional do Ambiente e Recursos Naturais – Direção Regional do Ordenamento do Território e Ambiente.* Report prepared as part of PLASMAR Project (co-financed by ERDF as part of POMAC 2014-2020). 47 p. Available at: http://www.plasmar.eu/documentos/

## 1 Aquaculture

Madeira Archipelago has a significant potential for the development of marine aquaculture. The initial studies from early 1990´s highlighted the oceanic oligotrophic qualities of seawater and the stable and high mean sea temperature compared to the Mediterranean Sea. Considering the lack of coastal space, priority was given for the development of offshore fish farming systems (Andrade and Gouveia, 2008).

By 2004, following the success of a government pilot project, two aquaculture companies were established and started offshore production of seabream. Presently, the total output production of both enterprises reaches 500-600 tonnes per year (Fig. 17) and about 70% of the fish is shipped to mainland Portugal and other markets.

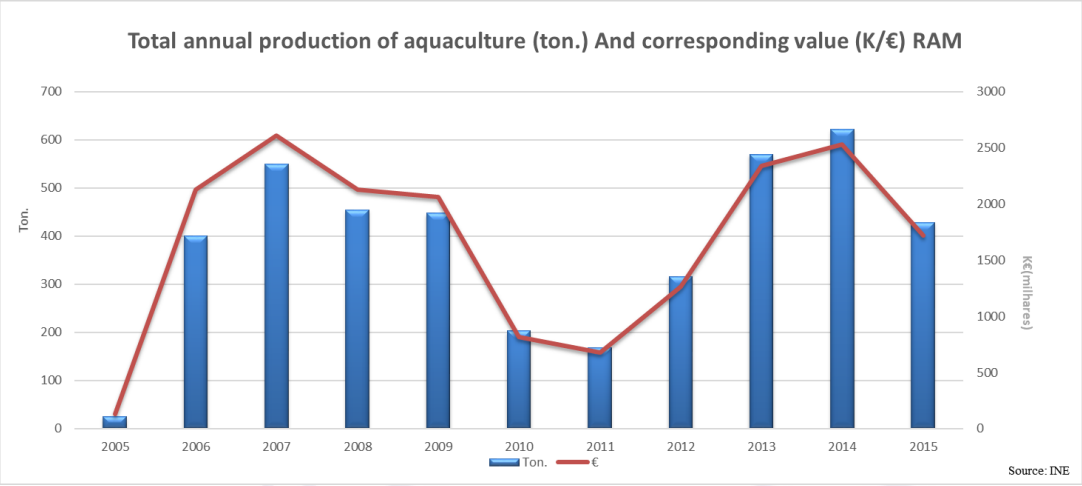



Fig. 17: Total annual production of aquaculture (ton) and corresponding value (k€) in Madeira Region. Source data: INE. Source: Lopes *et al.*, 2017.

The development of this young industry has been supported by the Mariculture Centre of Calheta. Established in 2000, this government unit assists private entrepreneurs, promotes research and innovation, and provides juvenile fish produced in its own hatchery facilities.

In 2016, the Regional Government launched new regulations concerning the selection and establishment of marine space for aquaculture enterprises – Plano de Ordenamento da Aquicultura Marinha da Madeira (POAMAR), Resolução no 1025/2016, 28 de Dezembro de 2016, Jornal Oficial, série I, no227. Five zones of aquaculture interest (ZIA) were established, each with 1 to 4 areas of 1 $km^2$ by farm, leading to a total of 11 areas available for aquaculture farms (Fig. 18).


Fig. 18: Interest zones for aquaculture in the Madeira archipelago.

Recently in Madeira there has been a growing interest in marine aquaculture, with entrepreneurs requesting the use of these areas. In 2017, a new farm of 550 tonnes capacity for seabream was installed and a previous farm was expanded from about 300 tonnes capacity per year to 800 tonnes capacity, to produce seabream and amberjack.

There are several new requests for sites under licencing procedures. Taking into account those new licences, the total production capacity of the offshore fish farms installed in Madeira is believed to increase to about 4000 tonnes *per* year by 2018, with a total market value of about 20 million euros, considering the price exfarm of 5 euros *per* kg.

# 2 Blue biotechnology

There are a few companies involved in biotechnology in Madeira, particularly dealing with marine resources and environment. The activities of these companies are mostly based in research and development projects. The UBQ, Lda. is a microenterprise, associated with a research centre of the University of Madeira - ISOPlexis Germplasm Bank - in a Horizon 2020 project, aiming at the development of macroalgae research and production (Fig. 19). The production of algae, to be used as food and iodine supplement, a pioneering project in the Region by MadBiotecH C, R&D S.A., a company established in Madeira Free Trade Area, also with the cooperation of the University of Madeira, had

a research project recently approved for the development of refined oils obtained from fisheries by-products.

In Porto Santo Island, near the port area, there is a microalgae production and processing plant using vertical photobiorectors (Fig. 20) – Buggy Power S.A. association with the Madeira Electricity Company. The plant is still at installation stages and is intended to produce biofuels and several products of interest for the chemical, pharmaceutical and food industries.

Fig. 19: Algae for food. UQB, Lda. has recently started to develop bread with algae. Photo: UBQ, Lda.


Fig. 20: Biofuel production company. Photo: Isabel Lopes.

In the field of marine biotechnology, there is a great need to increase knowledge of Madeira´s marine biological resources. The fishing resources of the archipelago are arguably the best-known living resources due to long term studies and commitments with the national and international management plans for the local species stocks, namely the Regulation (EU) no1380/2013, from 11 December 2013.

The Oceanic Observatory of Madeira (OOM) was established in 2015 as a consortium of local institutions dedicated to marine research and technical development, plus private companies from the blue economy (coastal tourism, aquaculture). Despite the scientific output of OOM and link with other scientific centres, its impact and contribution for the development of the Blue Economy will happen in the long term and is at present difficult to determine. Nevertheless, the studies carried out by OOM are of use for most areas of sea economy, such is the case of: 1) physical oceanography for the ports, fisheries and

aquaculture; 2) impact of climate changes and marine invasions in the coastal economy; 3) deep sea fishing resources for the diversification and sustainability of fisheries; 4) new candidate species and environmental studies for the aquaculture industry; etc.

# 3 Renewable ocean energy

The RAM[5], as an outermost island region, away from major continental energy networks, entails high costs of supply and conversion due to transport and to the smaller scale of markets and infrastructures. This situation has become more worrying related to the doubling of energy demand over the last 20 years, which has resulted in the appreciation of renewable energy sources.

According to the Sustainable Energy Action Plan of Madeira Island (2012) from Agência Regional da Energia e Ambiente da Região Autónoma da Madeira (AREAM), RAM is highly dependent on fossil fuels, with the transport sector (54.9%) and the tertiary sector (21.5%) as main energy consumers.

The RAM holds the conditions for the development of renewable energies in the maritime space (Lopes, 2016). The Sustainable Energy Action Plan from AREAM (2012), defines six strategic lines, which guide the actions for sustainable energy to be implemented in Madeira Island:

- Improve energy conversion and utilization efficiency.
- Increase the contribution of renewable energy resources.
- Diversify energy sources.
- Increase the capacity of energy storage infrastructures.
- Promote energy products and services that promote economic development, regional added value and qualified employment.
- Promote forms of energy with lower carbon content.

According to the same plan, the defined specific objectives aim at sustainable energy production in Madeira and Porto Santo, namely:

- Improve security of energy supply.
- Reduce dependence on the outside.
- Reduce energy intensity in Gross Domestic Product.
- Reduce carbon dioxide emissions.

The same document presented the forecasts for the evolution of the electric power system by origin until the horizon year of 2020 (Fig. 21). The increase in production based on renewable sources and microgeneration and the reduction of the production of energy of thermal origin (fuel oil) by around 20% between 2014 and 2020 is relevant. This scenario implies a reduction in the import of fuels.

The "Memorandum of Understanding (MOU) on Subnational Global Climate Leadership" (Under2 MOU)[6] which the RAM signed in 2015, aims to reduce carbon dioxide emissions by 80% to 95% by 2050.

[5] RAM stands for Região Autónoma da Madeira, which is the Portuguese for Autonomous Region of Madeira.
[6] http://under2mou.org/the-mou/

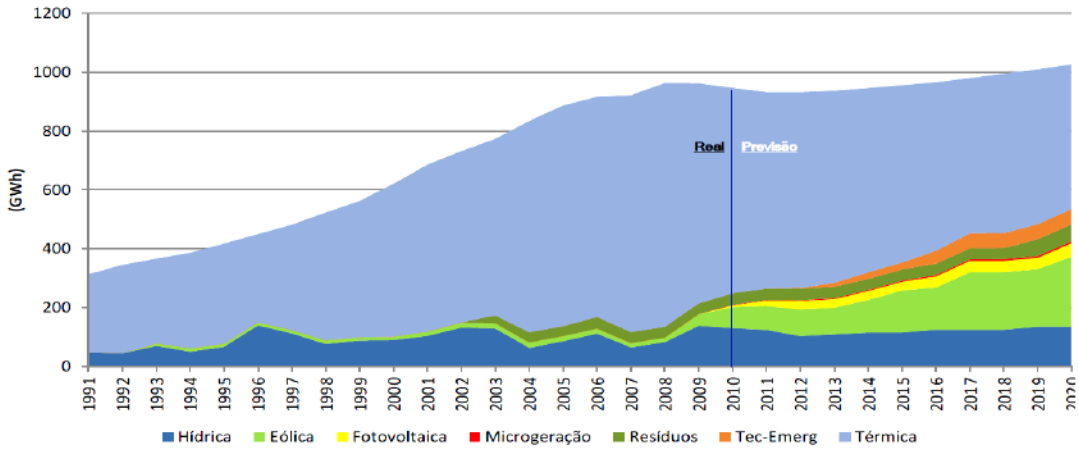



Fig. 21: Evolution of energy production by source in RAM (1991-2020). Source: PIETRAM (SRTEC, 2016).

# 4 Mineral resources

The extraction of geological resources in the Region focuses on the extraction of aggregates, an activity considered important in the context of the regional economy, since there are no sandy deposits exploitable in the terrestrial space.

Aggregates extraction is carried out in the sea bed on the south coast of the island of Madeira, particularly in the western sector, between Paul do Mar and Cabo Girão - Ponta do Leão, Madalena do Mar and Lugar de Baixo / Tabua. The extractive zones of Campanário and Ribeira Brava were decommissioned after the installation of the aquaculture area and the construction of the Ribeira Brava bathing area, respectively. These zones were reactivated for emergency reasons briefly in 2010 (figure 22).


Fig. 22: Areas for aggregates extraction. Source: Secretaria Regional do Ambiente e Recursos Naturais - Direção Regional do Ordenamento do Território e Ambiente.

Extraction of aggregates is monitored by the Direção Regional do Ordenamento do Território e Ambiente, through GPS devices installed on board and a computer platform of its own. The aggregates are discharged at the terminal of Porto Novo. Figure 23 shows the evolution of the inert discharge since 2001.

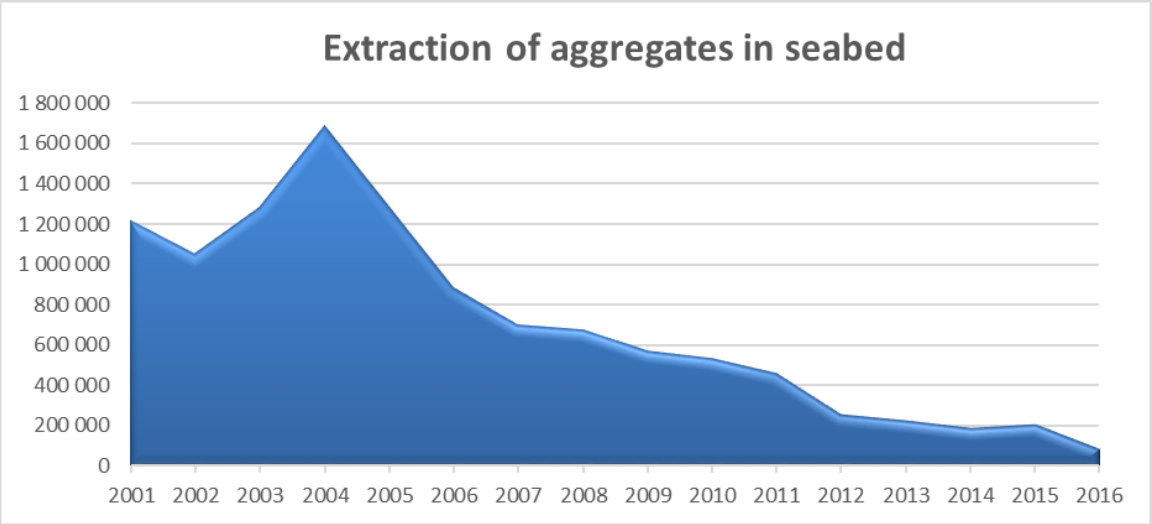



Fig. 23: Extraction of aggregates in seabed. Source: APRAM, S.A.

The aggregates volumes have declined substantially in recent years, following the boom in public works witnessed at the beginning of this century (Lopes, 2016).

Regarding the possibility of exploitation of other mineral resources, the morphology of the seabed of the Madeira subdivision, which is part of the Macaronesian sub-region, is the natural extension of the sea bottom of the other national marine waters in which the MSFD is applied. It presents a diverse morphology, since it includes several physiographic domains, namely, subsea mounts, abyssal plains and zones of fracture. But so far, it is little known.

# 5 Coastal & maritime tourism

Tourism activity is one of the pillars of the regional economy. The Tourism Management Plan of the Autonomous Region of Madeira (POTRAM) estimates that the maritime-tourism activity will have involved around 100,000 passengers per year in 2013. On the other hand, the number of tourists who visited the Region in 2013 (1.082.750) makes it possible to admit that about 10% of tourists sought organized sea trips.

**Cruise tourism** takes a prominent position in the region. In the national context, the port of Funchal and the port of Lisbon constitute the main cruise ports. According to the annual statistics of APRAM, S.A., the port of Funchal in 2015 ended up achieving the national leadership when registering with 578.492 cruise tourists and 308 scales (Figure 24). According to the Strategic and Integrated Transport Plan for the Autonomous Region of Madeira 2014-2020 (PIETRAM) (SRTEC, 2016), the average stay of vessels in the port of Funchal is 14 hours and is considered a reasonable period for a stay when compared to the same type of operations in other regions, as in the case of the Mediterranean (Lopes, 2016). It is estimated that the average cost per passenger contributes to the regional economy by around 40,6 M€.

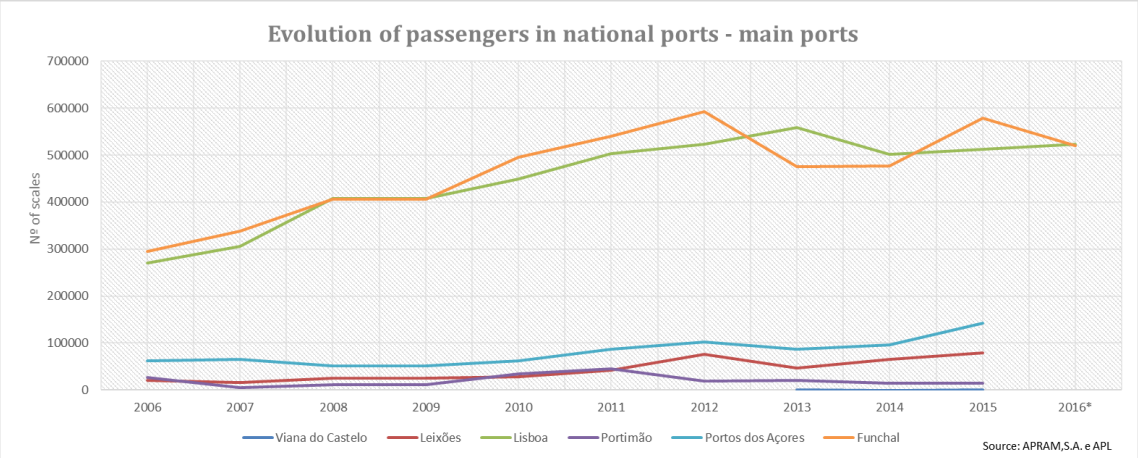



Fig. 24: Evolution of passengers in national ports – main ports. Source: APRAM, S.A. and APL.

The International Ship Registry of Madeira (RINM-Mar), is the second Portuguese registry and is among the highest quality international registrations. Until 30 April 2016, the average age of commercial vessels was 11,4 years, one of the EU's most positive averages, which puts RINM-Mar at the highest level of international maritime records.

Regarding the future perspective, the POTRAM made a projection for the evolution of the number of tourists for organized sea trips, considering the projected growth in the number of total tourists, pointing to 1,4 to 1,5 million in 2025. (table 7).

Table 7: Projections of evolution of the number of tourists involved in organized sea trips - tourist maritime activity. Source: PIETRAM (SRTEC, 2016).

| Year | Base scenario | Optimistic scenario |
|---|---|---|
| **2020** | 130 822 | 137 363 |
| **2025** | 152 855 | 160 498 |
| **2035** | 197 792 | 207 681 |

The PIETRAM (SRTEC, 2016) has estimated the future evolution of the number of cruise ship stopovers in the Port of Funchal. Taking into account the projections of the Cruise Market Watch, two growth scenarios were adopted for the projections of cruise ship stopovers in the port of Funchal up to the horizon year 2035. An optimistic scenario with an average annual growth rate of 3 %, and a base scenario with an average annual growth rate of 1.5%. In the Optimistic scenario, 91 scales are expected during the month of November of the year horizon 2035 (Fig. 25).

Relatively to the RINM-Mar, the PWC study (2016), define some of the challenges facing this subsector, namely:

- to capitalize on all the benefits that result from attracting companies related to shipping, to develop more activities related to the shipping industry in Portugal;
- continuously monitor international trends related to the registration of ships and shipping to always be at the forefront of providing ship registration services.

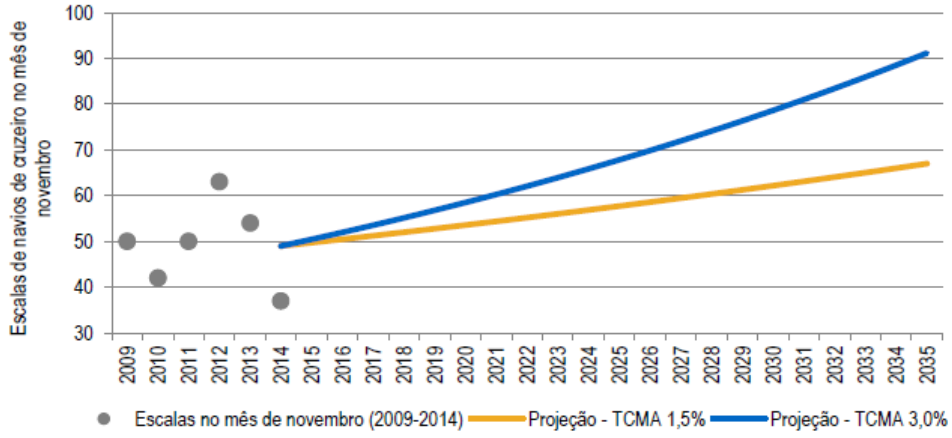



Fig. 25: Projections of evolution of the scales of cruise ships in the port of Funchal in the month of greatest demand – November. Yellow line: base scenario, average growth rate of 1,5%; Blue line: optimistic scenario, with annual growth rate of 3%. Source: PIETRAM (SRTEC, 2016).

# 6 Fisheries

The geographic, physical and biological characteristics of the Madeira Archipelago are determined by the absence of continental shelf, the reduced continental slope and an abyssal surface with an average depth of around 4,000 meters, and oligotrophic waters. Due to these conditions the resources are scarce and the fishing activity is based on a set of pelagic (tunas and tunas related species) and bathypelagic species (Black scabbardfish), that usually account for about 80% of the total catches (SRA, 2014).

The low by-catch rate, the impact of fishing on adult species as well as the low environmental impact due to the ban on trawling determine their artisanal, selective and sustainable character. The Fig. 26 in the annex, shows the fish landings in Madeira. In 2015, there were 5.641 tonnes of fresh and chilled fish traded at the ALC stock lots at an average value of € 2.84/kg, corresponding to € 15.6 million.

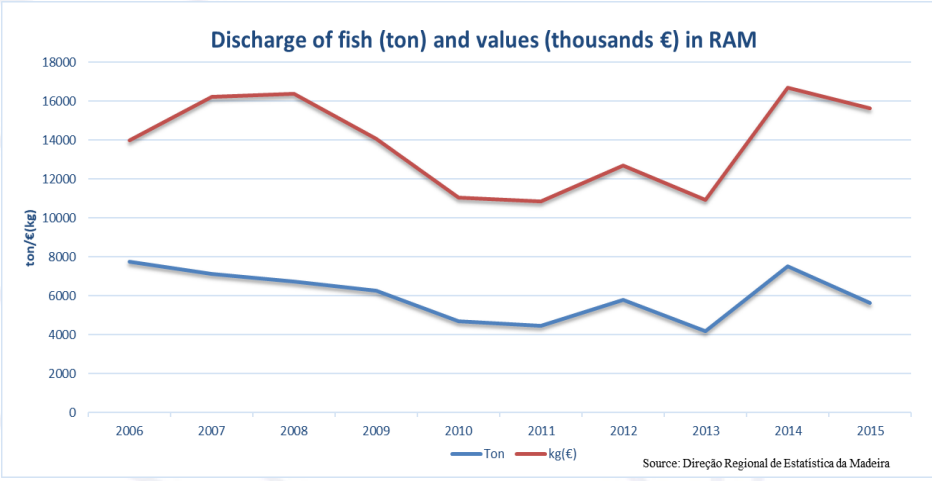



Fig. 26: Volume of landings of fish (ton) and values (thousands €) in RAM. Source: Direção Regional de Estatística da Madeira (2015).

**Deep Sea Fishing** (Black scabbardfish) is practiced in an artisanal way with the capture of adult black swordfish, with by-catch being usually small and consisting mostly of species of no commercial value, with the exception of deep-sea sharks. From 2010 on, there was stabilization of landings due to the implementation of two fishing effort

adjustment plans which reduced the number of vessels in this segment of the fishing fleet. Thus, in the last six years there were average landings of around 1844 tons per year. The economic value generated by the first sale of black scabbardfish at present is over € 7 million, marketed at average prices of € 3.56/kg for trade (fish mongers, supermarkets etc.) and 3.83 €/kg for the industry, the latter responsible for the acquisition of 79% of the landings of this species.

The **tuna harvest** in Madeira is seasonal, usually starting in March, with the appearance of bigeye tuna (*Thunnus obesus*) that reaches the maximum catch around May. In June, catches of this species decrease significantly and the skipjack (*Katsuwonus pelamis*) becomes the target species of the fishery, with maximum landings in September and October. The remaining tuna species have a sporadic, irregular occurrence with less significant catches. In 2015 there were 42 fishing vessels registered for tuna catches.

The PWC study (2016) refers some challenges facing this subsector, namely:

- adding value to the primary base product (seafood) through its conservation, transformation and diversification;
- strengthening sustainable fishing practices, certifying processes and communicating properly to the final consumer;
- replacement of imports by domestic production to meet the existing demand of the Portuguese market;
- invest in research and development for technologies and processes that minimize the costs associated with the energy needed to power fishing vessels, to cope with rising oil prices and/or decreases in the price of fish in the market;
- strengthening the brand of processed products;
- taking advantage of the potential of aquaculture;
- develop the supply chain of the markets;
- continue to develop safety conditions at sea.

The "Programa do XII Governo Regional da Madeira" (Região Autónoma da Madeira, 2015), for the fisheries sector, proposes the permanence of the main fishing port of the Region in Funchal and defines as strategic guidelines:

- The rehabilitation of the Funchal fish market and associated buildings, with a vision focused on the new surrounding typology and with tourist presence;
- The investment in the reprofiling of the Port of Caniçal improving the adjustment to loading and unloading of fish;
- The reconstruction of the Porto Moniz fish market;
- Establishment of a mobile fish market with adequate transportation and fish.

# 7 Offshore oil & gas

In Madeira, as in the rest of Portugal, there is no extraction of natural hydrocarbons (oil and natural gas), neither have permits been granted.

# 8 Maritime transport

In RAM the ports assume a relevant position, especially in an outermost island region, in order to "*constitute a door for the rest of the world and fully assume the gateway function attributed to these infrastructures*" (Figueira de Sousa, 2004: 1).

The overall movement of cargo in the ports of the RAM, for the years under review, reached its highest value in 2004, with more than 3,5 thousand tons. Between 2008 and

2012 the variables related to container shipping, freight shipping and number of ships have fallen due to economic instability that has impacted the country and the region. This trend continued in 2016 with 1,5 thousand tons of goods moved.

The analysis of the evolution of maritime traffic of inter-island passengers allows us to verify that there was a fall between 2009 and 2012, due to the economic crisis. As of 2012, the number of passengers transported remained stable, and in 2015, it was 267.541 passengers (see Fig. 27). According to PIETRAM 2014-2020 (SRTEC, 2016), the Madeira- Porto Santo line is only sustainable with a minimum traffic of 300 thousand passengers per year. This objective was reached in 2016, due to the efforts made by the Regional Government, in the design of subsidies to support of Madeira islanders.

The PIETRAM (SRTEC, 2016) carried out an analysis of the utilization rate for freight transport up to 2020 for the port of Caniçal, as it is the main commercial port of the Region. The utilization rate of 100% of a terminal should be the goal to be achieved and corresponds to the optimal use of this terminal, for which all investments were estimated, both in port infrastructure and equipment. But, for 2020, it is expected that the utilization rate for all the terminals of the Caniçal port will be low, a little more than 50%, ranging from the lowest value of 21.6% in the general cargo factorized, and the highest value of 72.7%, in the containerized cargo, with virtually no use of the Ro-Ro terminal.

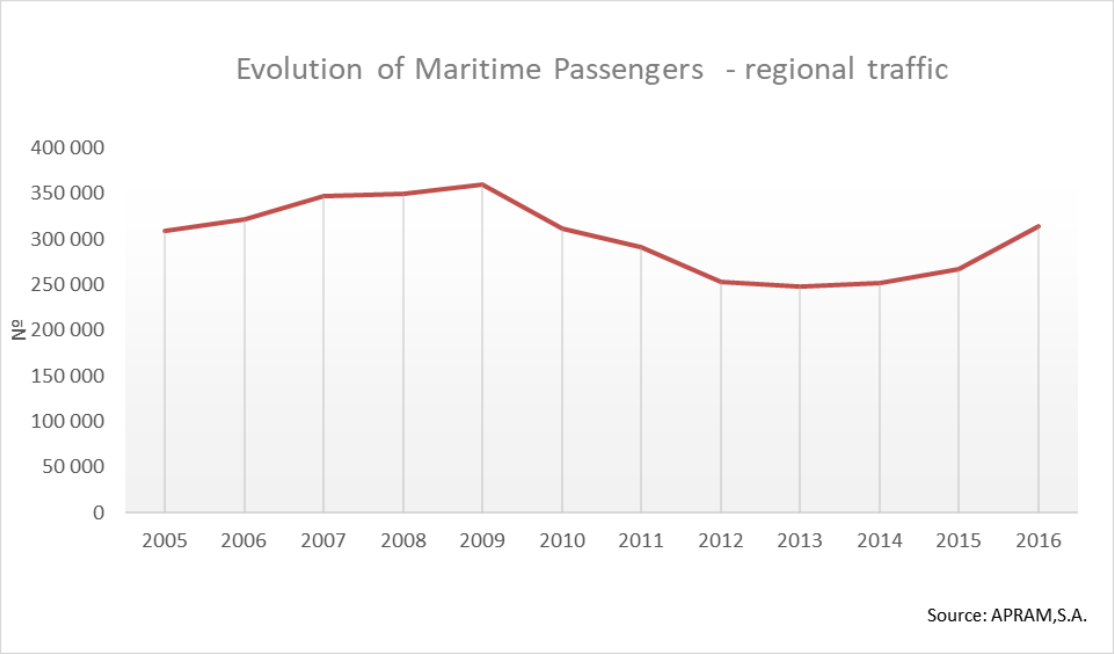



Fig. 27: Evolution of maritime passengers – regional traffic. Source: APRAM, S.A.

According to PIETRAM (SRTEC, 2016), the projection of the future evolution of the number of inter-island passengers transported by sea allows the recovery of the regional economy, with an estimated regional GDP growth of between 1,7 and 2,2% by 2025. Based on the assumptions for the future evolution of inter-island passenger transportation by sea, it is estimated that the break-even, with the current tariffs, will be reached in 2020 for the optimistic scenario or in 2022 for the base scenario (table 8 and fig. 28).

Table 8: Projections for the evolution of the number of inter-island passengers transported by sea. Source: PIETRAM (SRTEC, 2016).

| Year | Base scenario | Optimistic scenario |
|---|---|---|
| | Average anual growth rate 2014-2035 = 1,8% | Average anual growth rate 2014-2035 =2,2% |
| **2020** | 291 393 | 300 030 |
| **2025** | 328 079 | 347 817 |
| **2035** | 367 812 | 398 894 |

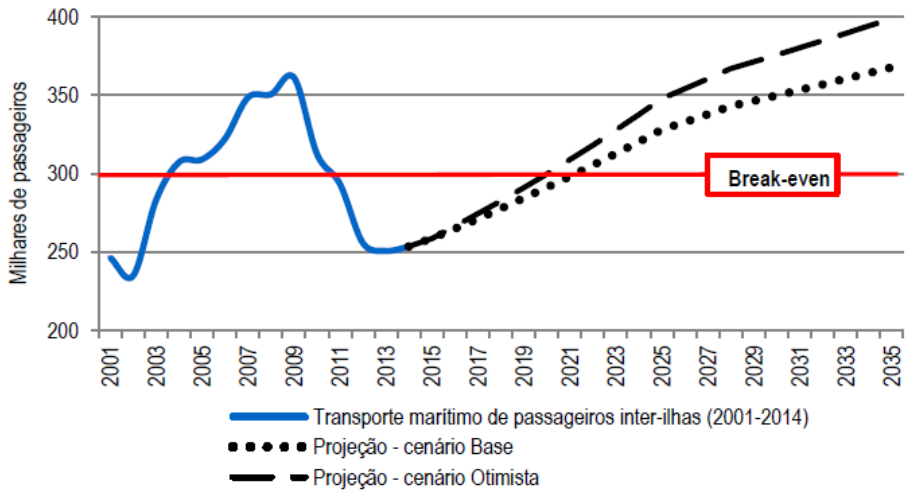



Fig. 28: Projections to 2035 for the evolution of the number of inter-island passengers (in thousands, vertical axis) transported by sea. Source: PIETRAM (SRTEC, 2016).

# 9 Desalination

In the Madeira Archipelago desalination represents an activity of major importance in Porto Santo. According to the public entity responsible for Water Supply and Waste Management sectors in that island, the desalination plant built on Porto Santo island has 3 production units, with a total production capacity is estimated at 6900 $m^3$ per day, representing the only potable water supply used and distributed to the population.

This desalination plant was built in 1980 but has gone through some enlargements in 1992 and 2004.

In Madeira Island, this process is not used in the public water supply network, but some hotel units have also started using them as a complement to the public supply.

Although it has no economic value, we also have to refer the importance of this system in the Desertas Island, where a small production unit is used, in conjunction with solar panels, allowing the constant presence of Nature Wardens on this Nature Reserve.

# IV. Overview of the maritime sectors in the Azores.

This section presents short overviews of the main maritime sectors (including both blue growth and other blue economy sectors) present in Azores Region. It has been prepared based on the report by Carreira *et al*. (2017) prepared within PLASMAR Project activity 211a.

*Carreira, G.*[1] 2017. **Maritime sectors in the Azores Archipelago** *(First draft version)*. [1]*DRAM, Azores.* Report prepared as part of PLASMAR Project (co-financed by ERDF as part of POMAC 2014-2020).

## 1 Aquaculture

Although species such as *Sparus aurata*, *Dicentrarchus labrax*, *Psetta maxima*, or salmonids, are some of the most produced in Europe's aquaculture, none of these naturally distribute in the Azores marine fauna. For that reason, the current legislation for aquaculture in the Azores does not consider any of these as target species for this activity in the region.

Given that, the development of aquaculture in the Azores implies the need of specific know-how on species that are not traditionally raised in captivity elsewhere, which implies additional efforts to gather information and to develop new technology.

On the other hand, the biological and physical characteristics of the waters of the Azores makes it difficult to locate and manage safely offshore structures at an adequate financial cost. As a result, the development of aquaculture in the Azores is, for the moment, reduced to R&D activities and has no contribution to the regional production of fish.

Nevertheless, the Azores administration is engaged in providing the necessary conditions for the development of this activity. Despite the recognized constraints for the local aquaculture development, it is expected to happen soon, either offshore or in tanks ashore. In fact, a number of applications are currently being evaluated for funding by the local authorities.

Although the sector is still underdeveloped, the administration has been preparing a comprehensive licencing and funding legislative framework, in order to facilitate its further development. Aquaculture is currently regulated in the Azores through the Regional Legislative Decree no. 22/2011/A. This legal framework for Azorean aquaculture determines the requirements and conditions related to the establishment and exploitation of aquaculture for commercial purposes, as well as the permits framework for facilities location, the operating licenses and the conditions for their transmission and cessation on the land or sea. Also, the Regional Legislative Decree no. 30/2010/A of November 15, establishes the legal regime for environmental impact assessment and environmental licensing.

A number of projects for the establishment of aquaculture production have been analysed and supported by the competent authorities, namely:

- In Graciosa an installation for the production of *Spirulina* (a micro-algae used in the food industry) was implemented.
- Three aquaculture projects that are being evaluated for Terceira, Faial and São Miguel islands, adding that there are eight candidate projects for the Scheme of Support for Innovation in Aquaculture co-financed by the European Maritime and Fisheries Fund (EMFF).

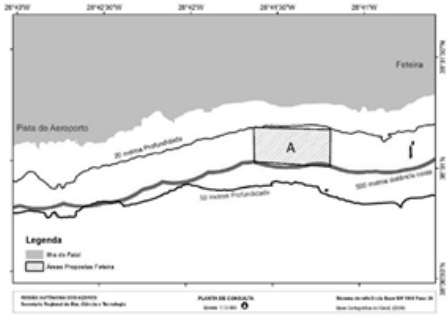
The Regional Government of the Azores has invested mainly in the production/development of knowledge, such as:

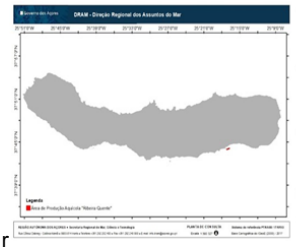
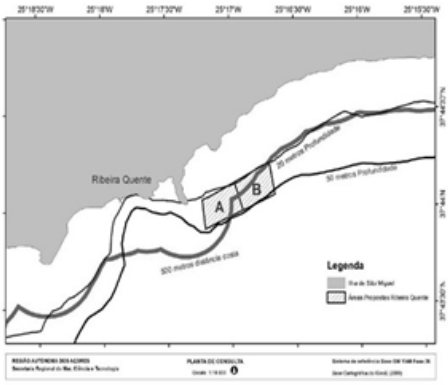
- Mapping of coastal and offshore areas with the potential to install aquaculture units in the archipelago, considering environmental, socioeconomic and administrative parameters. The creation of aquaculture production areas on Faial, Terceira and São Miguel islands (which are available free of charge to entrepreneurs and investors) follows the determinations of the Resolution of the Council of Government nº 126/2016 (Table 9).
- A package of tax benefits has been prepared with the objective of attracting investors to this activity (Regional Legislative Decree no. 3/2017/A).
- The Regional Secretariat for the Sea, Science and Technology intends to install an Aquaculture Centre in Horta, Faial Island, in a protocol of cooperation with IMAR for the execution of the AQUALAB project. In this laboratory, experiments will be carried out on species with great potential for aquaculture in the region.

The Operational Program 'European Maritime and Fisheries Fund - Portugal Operational Program' MAR2020 (EC Implementing Decision of 30.11.2015) is aimed at:

- Promotion of competitiveness based on innovation and knowledge;
- Ensuring the social, economic and environmental sustainability of the fisheries and aquaculture sector, contribute to the good environmental status of the marine environment and promote the Integrated Maritime Policy;
- Contributing to the development of coastal zones, increase employment and territorial cohesion, and increase the capacity and qualification of professionals in the sector.

Table 9: Description and location of aquaculture areas in Azores. Source: Resolução do Conselho do Governo n.º 126/2016 de 25 de Julho de 2016.

| Name / Location | Description | Detailed location |
|---|---|---|
| Aquaculture Production Area of "Feteira"<br><br>Municipality of Horta (Faial Island) | The area defined is located between the parishes of Feteira and Castelo Branco, being available for aquaculture, within the line of 500 meters to the coast, in maximum amounts of production of 100 tons per year.<br>  |  |

| | | |
|---|---|---|
| Aquaculture Production Area of "Porto Martins"<br><br>Municipality of Praia da Vitória (Terceira Island) | The area defined is located mostly outside of the 500 meters line at the coast and is available for aquaculture, within the 500 meters line at the coast, in maximum production quantities of 100 tons per year, and outside the 500 meters line at quantities of 250 tons per year.<br>  |  |
| Aquaculture Production Area of "Ribeira Quente"<br><br>Municipality of Povoação (S.Miguel Island) | The zone defined is mostly within the 500 meters line at the coast (in case of lot A) but there is a portion of the defined zone which is mostly outside the 500 meters line (Lot B). The maximum production quantities of these areas are, within the 500 meters line at the coast, 100 tons per year, and outside the 500 meters line at the coast, 250 tons per yea.<br>  |  |

Following the EU Regulation No 508/2014, the Regional Government of the Azores published the Ordinance No. 74/2016, of July 8, approving the Regulation of the Regime for Support to Innovation in Aquaculture, of the Operational Program Mar 2020, and amended by Ordinance No. 81/2017, of October 30, which modified the maximum amount of public support for some types of investment.

Also, the Regional Regulatory Decree No. 1/2016/A regulates the regime of contractual, conditioned and temporary fiscal benefits. In the particular case of investments in aquaculture, tax benefits apply to investment projects, which, regardless of their location, provide for research and development expenses in the minimum amount of 10% of the planned investment and a minimum investment value of 200 thousand euros. Investments in this sector also benefit from an increase in the deduction to the IRC taxable amount, according to the number and qualification of the jobs created.

# 2 Blue biotechnology

Being located in the Mid-Atlantic Ridge, the Azores archipelago and surrounding waters are a privileged location to study and explore the high diversity of the deep-sea and other offshore ecosystems. These include seamounts, cold coral gardens, massive sponge colonies, hydrothermal vents, island slopes, abyssal plains, among others.

These extreme environments are considered as presenting the highest potential areas to support the development of biotechnology. However, in order to fully develop its real

potential, it is essential to increase the knowledge on its biodiversity and to identify the ecological processes that are involved.

The University of the Azores has played a major role to increase the available knowledge on this matter, mainly through the IMAR-DOP/UAç research centre. The research department participates regularly in partnerships with other international institutions, establishing networks and operating international research projects, namely on the study of seamounts, hydrothermal vents, cold-water corals and sponges.

LabHorta is an important laboratory facility located in Faial Island, aiming the study of deep-sea organisms, especially from the hydrothermal vents of the Middle-Atlantic Ridge. Two research boats, which are property of the Government of the Azores and are managed by the IMAR-DOP/UAç research centre, are also available. These are the main assets that the Region has to support projects and initiatives in this area.

The Government of Azores has further approved a package of tax benefits with the objective of attracting investors to marine biotechnology (Decreto Legislativo Regional no. 3/2017/A). The tax benefits granted to this sector support the establishment of small and medium-sized enterprises, by assuring EU support for the installation of new factories and laboratories, technological incubators and the ease of accessing specialized laboratories and spaces for installation of companies, as these are considered as key requirements to enhance the blue growth.

In particular, the exploitation of algae is a growing activity in the region. Besides the possibility of consumption (with exceptional nutritional value for humans) there is a clear potential in the field of biotechnology, synthesizing numerous secondary compounds with important functional activities. As a means of diversification of fisheries to alternative activities and of promotion of new markets, Ordinance (Portaria) n.68/2016, 1 July, modifies the regulation for catch/collection of marine species approved by Ordinance (Portaria) no. 1/2014, to include marine algae both for human consumption and for other purposes.

# 3 Renewable ocean energies

The subsector of renewable energy with an impact on the sea, in the Azores, is currently non-existent. Until recently, the Pico Wave Center (Pico OWC) was an experimental unit for electricity production, located in Porto do Cachorro, on Pico Island, that was pioneer (Fig. 29).

Fig. 29: Pico Wave Center. Source: www.pico-owc.net/gallery.php

Pico OWC was built as the European Wave Energy Pilot Plant, co-funded by the EC, in order to demonstrate the technical viability of wave energy in a small Island grid. It had an installed power of 400 kW, which worked with an oscillating water column technology associated with a Wells turbine. This structure was developed by a team led by

researchers from the Instituto Superior Técnico, in collaboration with the Queen's University of Belfast and the University College Cork. This plant started working in 1999 and carried out 1300 hours of operation by 2010, producing more than 48MWh of energy. (Source: http://www.wavec.org/projectos/central_do_pico/#.WgyqfKy3BPY) (SRMCT, 2014). Since 2004, the plant was managed by the WavEC (Wave Energy Center). It was the only infrastructure open for training, R&D, innovation and demonstration. Recently, this unit become non-operational and so no further projects of this kind are expected on the sort and the medium term to be developed in the Azores.

# 4 Mineral resources

In the Azores, the extraction of non-energetic and non-metallic geological resources is currently carried out for sand (for construction) and for pebbles, being the former used for fishing or for ornamental purposes.

**Sand extraction** is carried out in pre-determined areas (Figure 30) and requires licensing by the Regional Directorate for Sea Affairs, a service that belongs to the Regional Secretariat for the Sea, Science and Technology. Sands are extracted and sold as raw material for the construction industry, being the Azores self-supporting in relation to this resource.

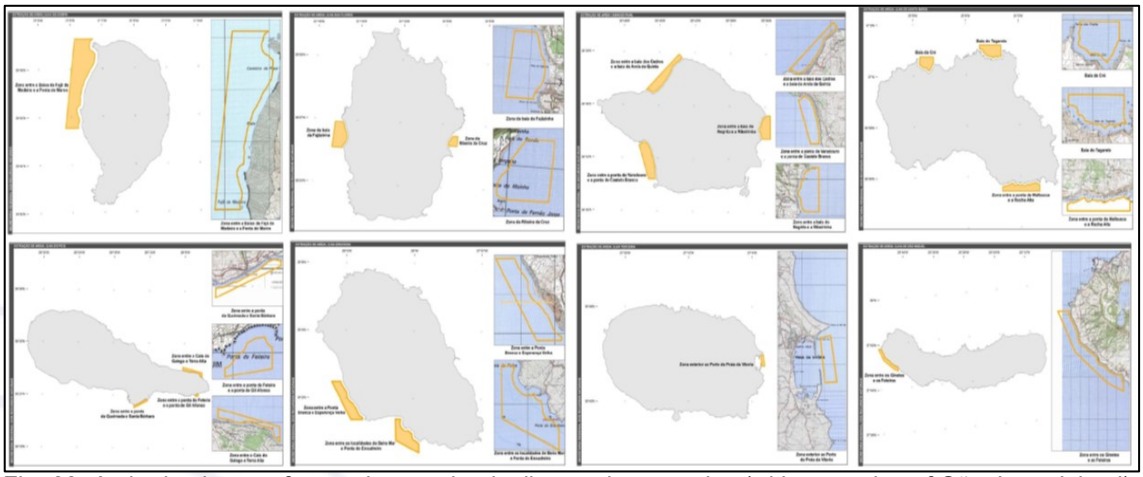


Fig. 30: Authorized areas for sand extraction by licensed companies (with exception of São Jorge Island). Source: Government Council Resolution nº 3/2014 of January 15, 2014.

The amended licensing process (Government Council Regulation Nº105/2013 of 6 November) is annual and dependent on the communication of the company's intentions, which predisposes to supply one or more islands. Licensed companies are obliged to comply with the expressed intentions. Extraction can take place in any of the zones determined by the regulations (Figure 30), which imply annual quota of each location. The limits established for the annual exploration quotas per island and location are defined by the Governing Council Resolution No. 3/2014 of January 15, 2014.

Contrary to the increasing trend in extraction licenses, there is a slightly decreasing trend in the extracted volumes for commercial purposes. It is also verified that a greater volume of aggregates has been extracted in Terceira Island, followed by São Miguel Island. The information concerning the volume extracted per island is show in figure 31.

In 2016, DRAM issued nine permits for mineral extraction, being four specifically issued for sand, through the operating three dredgers, which sums approximately 60,000 m³. Companies that engage in this activity benefit from three dredging vessels, registered in the region, which are chartered by licensed operators according to their needs.

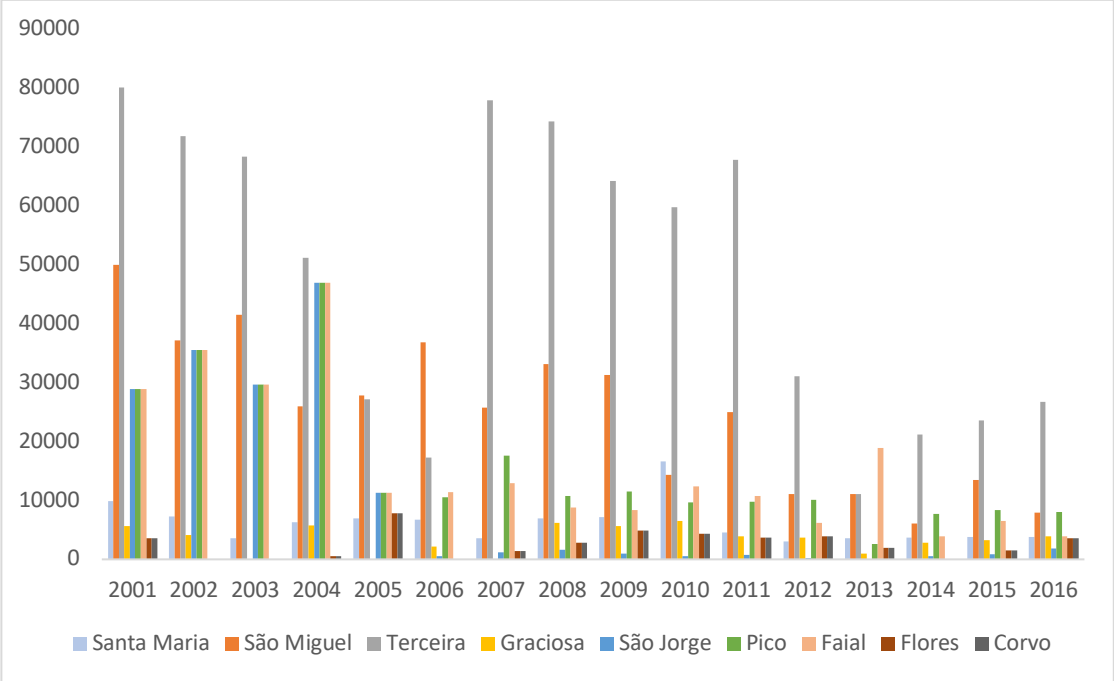



Fig. 31: Volume of sand (m³) extracted per island in the ports of the Azores until 2016. (DRAM data).

In the Azores **pebble extraction** is practiced as this material is used in fishing gears (mainly bottom longlines). This activity does not require authorization (Regional Legislative Decree no. 9/2010/A of March 8, republished by Regional Legislative Decree no. 31/2012/A of July 6), apart from the case in which the collection is to take place in areas with protection status (Ordinance No. 51/2013 of July 10, 2013). Pebbles can also be harvested for ornamental purposes, which requires authorization from the department of regional administration with competence in the matter.

The maritime continental shelf that surrounds the archipelago of the Azores has a recognized potential for the exploitation of **deep sea mineral resources** (iron, copper, nickel, zinc, gold and silver). The extensive mapping of seabed of the Azores, closely related with the Mid-Atlantic Ridge, is thus considered of vital importance. The economic potential of these resources, associated with the hydrothermal fields, can only be explored by means of a subsurface survey, in order to ascertain the extent of the deposits concerned. At present, no plans of exploitation of such resource are put into practice, but some initiatives have been developed in order to predict the possible impacts that such an activity could bring to the marine environment.

# 5 Coastal & Maritime Tourism

Tourism is a priority sector with high potential for the national and regional economy and the Azores is a recent tourist destination. Although the region receives 2% of the total number of guests at national level (INE, 2013), the sector is important in the context of the local economy. Tourist demand density was, in 2011, 148.4 tourists per km² and 139.6 tourists per 100 inhabitants, values that are similar to the national average.

The **hotel activity** is highly seasonal, showing a peak in the months of Spring and Summer. The Azores have potential for nature tourism, and maritime activities play a key role.

The **maritime-tourism activities** have registered growth since the 1990s, when they began their implantation in the region, with an important impact in several islands, mainly São Miguel, Terceira, Faial, Pico and Santa Maria. Specific niches can be attributed to the potential activities for each island.

At the end of 2013, different maritime-tourism modalities foreseen in the Regulation of the Maritime Activity of the Azores (RAMTA) were distributed in the islands (see Figure 32), adding a total of 153 tourism companies operating in the region.

| Maritime tourism activities regulated | Santa Maria | São Miguel | Terceira | São Jorge | Graciosa | Faial | Pico | Flores | Number of islans |
|---|---|---|---|---|---|---|---|---|---|
| Scheduled organized boat trips | X | X | X | X | X | X | X | X | 8 |
| Bird watching | | X | X | | | X | X | | 4 |
| Scuba diving | X | X | X | X | X | X | X | X | 8 |
| Touristic fishing | X | X | X | X | X | X | X | X | 8 |
| Tourism fishing | | | X | | | X | X | | 3 |
| Submersible | | | | | | | | | 0 |
| Boat renting | X | X | X | X | X | X | X | X | 8 |
| Taxi boat | X | | | X | | | | X | 3 |
| Platforms with no propulsory means | | | | | | X | | | 1 |
| Small boats with no need of licensing | | X | X | | | | X | X | 4 |
| Others | | X | | | | X | X | X | 4 |

Fig. 32: Modalities carried out by island until the end of 2013 (Data: Regional Directorate of Transport, information regarding the modality Fisheries and Tourism was provided by DRT).

**Whale watching** began in the Azores in 1991 and since then it has become increasingly important in the region. Although companies are obliged to report to the administration statistical information of their activity (in particular concerning the number and nationality of their clients) there is still a very high failure rate. In 2013, 53,435 clients were reported, corresponding to 81% of the operators licensed for this activity.

For the purposes of the tourist exploitation of whale watching, licensing zones and limits of this highly seasonal activity have been defined through Ordinance no.5/2004 of January 29, and are currently under revision. The activity is highly seasonal.

Other emerging maritime tourism activities of high potential are currently being developed in the Azores, such as **swimming or diving with sharks**, including whale sharks (*Rhincodon typus*), and with jamantas (*Mobula* and *Manta*), mainly near seamounts. Santa Maria has a high potential for the development of these diving modalities in the open sea, since some of the most appropriate places are located near the support infrastructures located on land. These activities still need regulation.

The Azores are located in a privileged area of the transatlantic routes of **recreational sailing**, between the European continent and the Caribbean and Bermuda. This creates a circular route that also involves the archipelagos of Madeira, Canaries and Cape Verde. The island of Faial stands out in the region as the most important island for transatlantic recreational boating.

**Cruise tourism** is currently growing in the ports of the region. The port of Ponta Delgada receives the biggest influx of tourists by this means, clearly standing out in relation to the other ports of the archipelago and is followed by the Ports of Horta and Praia da Vitória.

**Fishing tourism** allows fishermen to carry out tourism excursions, with the use of fishing vessels. It has been permitted in the Azores since 2008 (Regional Legislative Decree

no. 36/2008/A, of July 30). This activity is a way of supplementing the income of the fishing sector and at the same time providing tourists with genuine cultural experiences

Over the period 2007 to 2013, 107 **sporting or tourism events** were held through the support of public funding by the regional administration (Regional Tourism Directorate). During this period, there was a growing trend of public investment in this area, spread over areas such as underwater activities, nautical sports, or sport fishing.

According to PwC (2014), over the past few years, the increases in the indices of variables in this subsector were directly related to the investment made to attract cruises and maritime tourism activities. Cruise tourism and maritime tourism activities have revealed to be one of the most dynamic segments on tourism, showing good levels of growth. Nevertheless, there are some challenges facing this subsector:

- The stimulation of nautical tourism through sports such as surfing, windsurfing, kite surfing, water skiing, triathlon, sail charters, scuba diving, motor boating, sailing, rowing and canoeing, amongst others;
- Conditions for Azores to be part of the cruise liner routes;
- Continued the development of whale watching and other maritime tourism activities;
- Continued branding of the Azores (well positioned worldwide in terms of quality of sea water, environmental quality, underwater flora and fauna and biodiversity);
- Harnessing the economic potential associated with the vertical development of this industry (end consumers, services providers, producers of all kinds of equipment needed for leisure and sports);
- Develop a vision of an industry revitalizing the local and national economy;
- Sing all the capabilities of this subsector in supporting the development of a maritime culture;
- Develop recreational boating and marinas towards international scale levels.

# 6 Fisheries

Fisheries are a strategic pillar for the economic prosperity of the Region, as it contributes to the exportation and for food supply. This sector provides income to more than 4.000 families (~6% of the Azores population), which results in a significant social impact and in the development of coastal areas. As the Azores islands are far from the major commercial circuits of the mainland, the sector is subject to several constraints.

At present, the main concerns are related with overall catches decrease, which may be linked with a decrease in the fishing stocks. Thus, it is essential to focus on scientific research in order to assess the conservation status of the fishery resources in the Azores. Management policies within the framework of the Common Fisheries Policy are continuously established, endeavouring to promote a rational exploitation to ensure preservation in the medium and long term.

The fishing potential is also conditioned by depth, the nature and irregularity of the bottom, which make difficult the use of some fishing gears. Thus, the fishing activity practiced by the local fleet is carried out mainly in the shallower, higher productivity areas, located around the islands or on some fishing banks and in submarine hills, usually above the 600 meters depth. Only 8,618 km² (0,9%) of the ZEE of the Azores (954,496 km² in total) falls above 600 meters depth, distributed in 2% (7,870 km²) of the area within 100 nautical miles (nm) from the coastline and only 0,1% (748 km²) of the area between 100 and 200 nm.

The Azores marine environment is considered ecologically sensitive with regard to deep-sea corals and other benthic vulnerable marine ecosystems (VME) organisms, and also because of the existence of particular ecosystems such as hydrothermal vents, leading

to the establishment of specific regulation under the Marine Park of the Azores, which incorporates the threatened habitats identified by OSPAR Convention and the Habitats Directive. Also, management measures have been established, such as the Regional Ordinances defining distances from shore (0,25nm, 1nm, 3nm, 6nm, 12nm, 30nm and 100nm) for different vessel lengths and types of fishing gear, or the prohibition of the use of fishing gear such as bottom trawling or deep-sea gillnets in Azores, Madeira and Canaries defined areas (Council Regulation (EC) No 1568/2005 of 20 September). A 100nm buffer from the coast is currently reserved for the regional and national fleet beyond which other European fleets are authorized to operate (Council Regulation (EC) No 1954/2003 of 4 November 2003; Das & Afonso, 2017).

The fishing fleet that operates in the region, based in the Autonomous Region of the Azores, is composed mainly of small vessels, and the average age is of 21 years. In 2016, around 750 Azorean vessels operated within the 200 miles area. From these, 70% are less than 12 meters and fish mainly near the islands' coast or in the nearest seamounts with trips of 1-2 days and targeting small pelagic species, cephalopods, demersal and deep-sea species with selective and low impact fishing gear. About 70 vessels are more than 12 meters length, operate farther away –incl. fishing banks and seamounts between 100-200 nm–, and seasonally use pole and line to catch tuna species, and most of the year longline directed to demersal and depth fish species.

Regarding the transformation of fish products, in Azores there are six processing units for tuna, part of it caught in the Azores. The catch of tuna in the Azores by means of 'salto e vara' (pole and line) allows the canning industry working in the Region to bear the labels Dolphin Safe and Friend of the Sea (source: http://www.lotacor.pt/acores/index.php), given that the fishery benefits from POPA (Fisheries Observation Program for the Azores), which monitors the traditional tuna fisheries and its interaction with cetaceans. This monitoring program operates every year, from April to October, with 10-12 trained observers aboard tuna-fishing vessels covering an extensive geographic area within the Azorean EEZ, observation effort is limited and mostly concentrated around the islands and offshore seamounts.

Some other monitoring programs are being supported by the Regional Directorate for Fisheries, namely the National Data Collection Plan, the Program for the Observation of Fisheries in the Azores (POPA), the Demersais Campaign and the COSTA and Discard less projects. Also, a Coastal Resources Monitoring Plan is being developed in the Region[7].

Support of scientific research through programs for data collection, monitoring and validation of methodologies are considered key to enable the assessment of the environmental status of stocks of all commercially exploited fish and molluscs. The assessment of sustainable levels of fishing effort, in order to achieve the maximum sustainable yield for all stocks requires the collection of more data as there is a lack of data on many stocks. Therefore, it is essential to continue the study of the main species of economic value and other less valued or new species with potential for marketable exploitation.

The creation, by the Azorean Executive, of the Action Plan for the Control of Fisheries of the Azores (PACPA), following the diagnosis made by the Regional Secretariat of the Sea on the sector, aims to increase and improve the control of fishing activity in the archipelago.

[7] http://www.azores.gov.pt/Gra/SRMCT-PESCAS

# 7 Offshore oil & gas

In the Azores, as in the rest of Portugal, there is no extraction of natural hydrocarbons (oil and natural gas), neither have permits been granted.

# 8 Maritime Transport

The geographical location of the Azores archipelago places it in the centre of one of the main navigation zones for long-distance maritime traffic between Europe and the North American continent. The vast majority of the traffic that crosses the exclusive economic zone around the Azores archipelago does not interact directly with the local harbour structures, except when needed.

The legal regime of national cabotage, laid down in Decree n°.7/2006 of January 4, establishes in article nº5 the necessary conditions which national and community ship owners will have to meet in order to carry out the regular transport of general and containerized cargo between the mainland and the Autonomous Regions, such as making weekly calls between the mainland ports and those of the Autonomous Region of the Azores (ARA). This model of maritime freight between the ports of the mainland and the ports of the Autonomous Region of the Azores, based on the public service market without compensation, allows the market to operate in free competition, if the shipowners comply with the conditions imposed. Equity conditions are available among all ports in the Region, in terms of regularity, continuity, frequency and capacity to provide the service (SRMCT, 2014).

In an island situation, such as in the case of the Azores, land transport does not offer alternative means to air and sea transport in the inter-island communications for the region. Thus, maritime transport, accounting for about 70% of international trade, plays a key role in the development of the Autonomous Region of the Azores.

Here, the maritime traffic is relatively intense in the corridors to the north and south for in transit to Europe and America, and smaller volumes for cargo ships to supply from the mainland.

The movement of maritime transport (containers, tanks, passenger ships, bulk carriers, general cargo ships and others) remained more or less constant between 2000 and 2010 with a minimum of 3,335 movements in 2009 and a maximum of 3,829, in 2010. In recent years, movements have been progressively declining to 2589 movements in 2014 as a result of the economic crisis. (Carreira and Porteiro, 2015). Among the large number of vessels that climb the ports of the Azores, a group of 23 vessels that operate almost exclusively in the region or operate regular transport routes between the mainland and the region: 6 container carriers; 1 tanker; 6 general cargo ships; Seven passenger ships and three inert extraction vessels. With the exception of two medium-sized passenger ships, all other vessels operate throughout the archipelago throughout the year.

The volume of cargo transported also reached its minimum in 2014 with 2.088.668 tons (95.969 TEU), after having reached 3,050,112 tons in 2007 (more than 130,000 TEU). With an average capacity in terms of containers, which will be around 530 TEU (twenty equivalent unit), it is estimated that the weekly supply in terms of container shipping will be just over 1500 TEU.

The remaining external traffic is related to the transportation of bulk cargoes, whether liquid or solid, involving only some of the ports, with particular emphasis on the ports of Ponta Delgada and Praia da Vitória, which have storage capacity for these types of bulk. In the case of solid bulk, cereals and clinker (Port of Ponta Delgada) or cement (port of Praia da Vitória) stands out. For the transportation of inter-island goods, it is free, and is not subject to any type of public obligation or any public service contract, except between

Flores and Corvo. The ports of Ponta Delgada (31% of the movements and 61% of the cargo), Praia da Vitória (22% of the movements and 24% of the cargo) and Horta (10% of the movements and 4% of the cargo) are the most important.

According to PwC Indexes, between 2008 and 2014, the variables related to container shipping, freight shipping and number of ships have, in general terms, been falling due to economic instability that has affected the country and the region. In 2015, there has been an inversion of this tendency, with the increase of all the variables of this sector when compared to 2014.

Some of the challenges this subsector is facing are:

- Development of seaports as a truly integrated logistics platform in international supply chains, maximizing the interface between the highways of the sea, road, rail and airports;
- Improvement of the technical conditions of ports;
- Depth, operating conditions at the ports;
- Customer service and communication;
- Reduction of taxation and bureaucracy associated with using ports;
- Rebuilding of a merchant marine corresponding to the Portuguese maritime potential;
- Development of every opportunity of coastal shipping between various ports.

# 9 Shipbuilding & ship repair

Shipbuilding and ship repair in the Azores is based on the activity of small builders and small ship repair companies, and these activities are not very representative in the region. The builders dedicate themselves, almost exclusively, to the construction of small boats for local fishing, or for recreational boating and most of the companies are formed on an individual basis.

Data obtained from the Regional Directory for Fisheries (DRP) indicate that, in the region, there will be at least 16 shipyards mainly linked to the construction and/or repair of fishing vessels, 8 are located in S. Miguel, 4 in Pico, 3 in Terceira and 1 in Faial. Not all of the companies dedicate themselves exclusively to this activity, some may be registered in other primary CAE, other than those exclusively concerned with shipbuilding and ship repair, so it is not possible to separate this activity.

The regional autonomous administration has expressed its intention to promote this economic activity in the Azores, stimulating the reactivation of the naval yards existing in the port of Madalena in Pico island. The selection of companies registered in the company accounts database (CABSA / Informa D & B) allows the identification of a limited set of entities not constituted as individual entrepreneurs (between 5 and 7 companies). This group of companies is responsible for an average turnover of approximately € 1 million (in 2012 was € 1,556,183), with an average GVA amounting to more than € 230,000 (in 2012, a GVA of € 274,147 was obtained) (SRMCT, 2014).

# V. Overview of the maritime sectors in the Canary Islands.

This section presents short overviews of the main maritime sectors (including both blue growth and other blue economy sectors) present in the Canary Islands. It has been prepared based on the report by GMR Canarias (2017) prepared within PLASMAR Project activity 211a.

*GMR Canarias, S.A.U.* 2017. **Principales sectores del "Blue Growth" en Canarias: situación y tendencias**. Informe preparado como parte del Proyecto PLASMAR (co-financiado por FEDER en el marco de POMAC 2014-2020). 127 pp. Available at: http://www.plasmar.eu/documentos/

## 1 Aquaculture

In the Canary Islands, between 2002 and 2015, 6 species of fish and 1 crustacean were marketed through aquaculture (MAPAMA). Four fish species gilt head sea bream and European seabass (*Dicentrarchus labrax* and *Sparus aurata*, respectively, both grown in cages), Senegalese sole (*Solea senegalensis*, cultivated on land) and Rainbow trout (*Oncorhynchus mykiss*, fresh water species) and a crustacean (*Litopenaeus vannamei*, cultivated on land in closed circuit) were grown in 2015 (last year of official statistics) total of about 7,500 t and a value of about 39 million euros (Fig. 33). 99.82% of the production was *D. labrax* and *S. aurata*, which are grown in floating cages at sea (74.21% and 25.61%, respectively). The Canary Islands, at national level, are the first producer of *D. labrax* and the third of *S. aurata*. Nearly 100% of the production is intended for direct human consumption. In 2015 there were 222 full-time jobs involved with these activities.

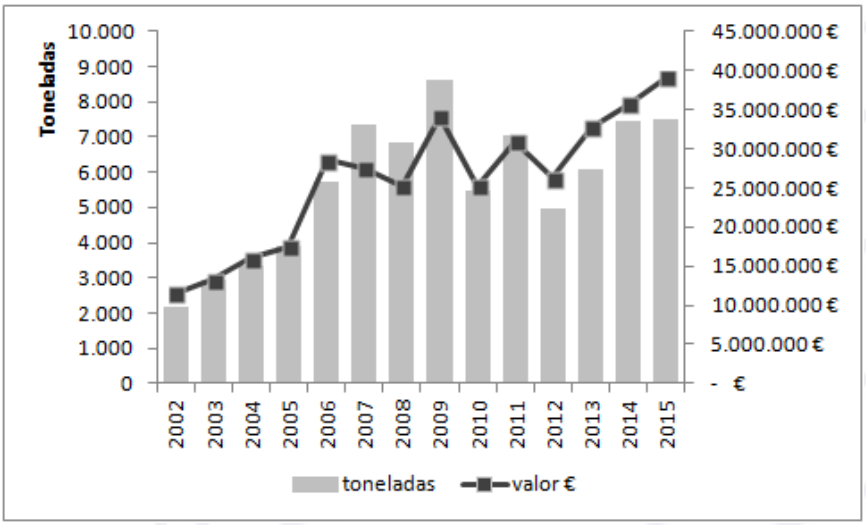



Fig. 33. Aquaculture production (tonnes) in the Canary Islands, between 2002 and 2015. Data: MAPAMA – Estadísticas pesqueras (Encuesta a establecimientos). Source: GMR, 2017.

The economic crisis of 2008 reversed the upward trend of variables such as employment and production. Although the number of operating aquaculture companies in Santa Cruz de Tenerife Province decreased dramatically from 27 (2008) to 7 (2012), for las Palmas Province figures remained more constant. This difference between provinces could be due to the lower technical and economic capacity of Santa Cruz de Tenerife's companies against the crisis impact, because they were mainly small companies (very dependent on public funds). In Las Palmas, a different business model based in bigger companies had a better performance (pers. comm. J. Macías, CANAEST).

In addition, since December 2013 no new aquaculture concessions can be granted, as the Regional Plan of Management of Aquaculture (PROAC)[8] has not been definitively approved. As indicated in the diagnosis made for the Strategic Plan for Aquaculture in the Canary Islands 2014-2020 (PEACAN)[9], although the recession of the sector is a direct consequence of the crisis, there are other weaknesses that have led to the closure of many companies; among which are the atomization and lack of business associations, the extra costs in the transport of goods outside the islands, the low diversity of cultivated species (nowadays almost a monoculture of *D. labrax*) and the current complex administrative framework, among others. Despite the above, since 2012 the general values of employment and production show a certain upward trend.

In order to understand the current situation and try to augur future trends, it is necessary to provide a more insular and less regional vision. Aquaculture is developed in 4 islands; La Palma, Tenerife, Gran Canaria and Lanzarote. The first two belong to the province of Santa Cruz de Tenerife and the last two of the province of Las Palmas.

Thus, in the province of Las Palmas (mainly Gran Canaria), between 2010-2015, there was an average annual growth in employment of 13.09% and an increase in production of 7.45%. Historically, the production was more for the European seabass *D. labrax*, with the destination of its production being more within the Canary Islands than for the peninsula and has presented few companies or establishments but these with high capacity of cultivation. On the other hand, the province of Sta. Cruz de Tenerife (especially Tenerife), in the same period, showed a growth in employment of 1.88%, and a decrease in production of -0.95%. Historically this province has grown more *S. aurata* (especially before 2008), the destination of its production has been greater for the peninsula than for the Canary Islands and has shown many companies or establishments but of smaller capacity (see Fig. 34 and 35).

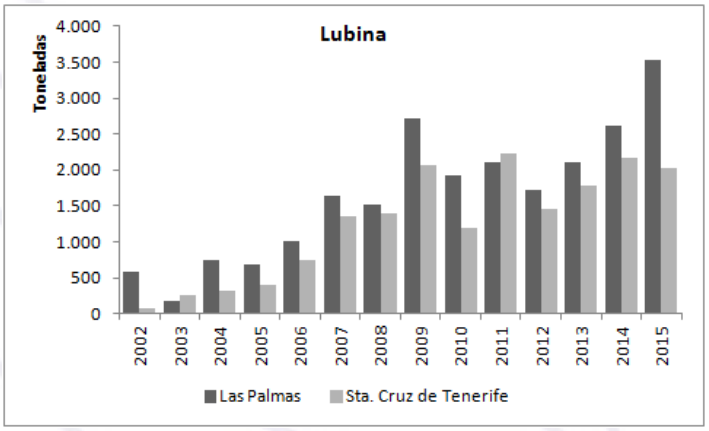



Fig. 34. Production of sea bass in tons in the Canary Islands for each province between 2002 and 2015. Data: MAPAMA – Estadísticas pesqueras (Encuesta a establecimientos). Source: GMR, 2017.

[8]Regional Plan of Management of Aquaculture (PROAC) documents awaiting approval: http://www.gobiernodecanarias.org/agricultura/pesca/temas/cultivos_marinos/proac.html

[9]Strategic Plan for Aquaculture in the Canary Islands 2014-2020 (PEACAN) is available at: http://www.gobiernodecanarias.org/agricultura/pesca/temas/cultivos_marinos/peacan.html

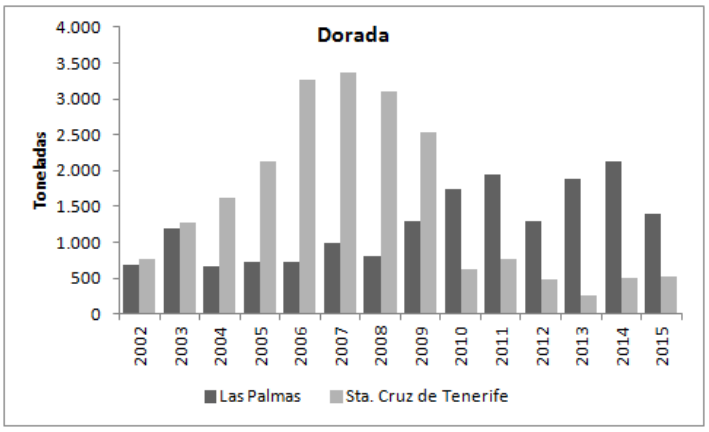



Fig. 35. Production of *S. aurata* in tons in the Canary Islands for each province between 2002 and 2015. Data: MAPAMA – Estadísticas pesqueras (Encuesta a establecimientos). Source: GMR, 2017.

For finfish and for the period 1996-2013, the average ratio between real and authorized production is 43%. For 2013, the last year of the analyses, the authorised production is of 13.971 tonnes and the real production is 5.989 tonnes. That is why, even in the absence of new aquaculture concessions, there is still margin to increase production within the framework of authorised concessions.

Given the existing situation at the end of 2014, the PEACAN provided 3 growth scenarios for 2020 (Table 10). These must be taken with caution, as they were based on a linear growth that has not occurred and the optimistic scenario was based on the assumption that the concessions which are pending since 2013 would be granted in 2015, and this has not taken place.

Table 10: Production estimates between 2014 and 2020. Estimated data: PEACAN. Data annual growth: GMR. Source: GMR, 2017.

| **Year** | **Estimate production (t)** | | |
|---|---|---|---|
| | *Realistic* | *Optimistic* | *Pessimistic* |
| 2014 | 6.008 | 9.081 | 4.191 |
| 2020 | 10.835 | 16.379 | 7.560 |
| *Annual growth* | 805 | 1.216 | 562 |

# 2 Blue biotechnology

Biotechnology in the Canary Islands is an activity that takes place mainly in the public domain, in universities and in research centres. In this sense, a number of macro and microalgae species are cultivated and used in a wide variety of applications and industrial processes, ranging from direct human and animal consumption to the generation of biofuels, through the production of high metabolites added value for use in the food, cosmetic, pharmaceutical and nutraceutical industries. This phenomenon is due not only to the advantageous environmental conditions of the archipelago (optimal conditions of temperature and illumination), which allows to maintain a stable production throughout the whole year, but also to the existence in the Canary Islands of first-class research groups in this field.

Blue biotechnology continues to be one of the most promising sectors of activity in biotechnology in the Canary Islands, both in conventional aquaculture and in the production of new species of fish and algae. Although the research and experimental development of this sector is outstanding (nationally and internationally), there has not yet been an important process of generating business initiatives in this field. The main private initiatives are developed by the companies Algalimento SL and Phyconova. Other companies such as Seaweed Canarias SL, Algae Biotech or Cleanalgae SA had good

results around year 2000 but now do not continue their activity. As a result, to date there is no regular collection of statistics related to employment or economic indicators on marine biotechnology in the Canary Islands.

Gran Canaria Island takes the lead in this field, with the establishment in 2016 of the Platform for Excellence in Algae Biotechnology (PEBA), created within the framework of the Intelligent Specialization Strategy of the Government of the Canary Islands (RIS3). Resulting from this support, there has been an influence on issues such as land planning through the increase (x5) of the area available for the mass production of microalgae on land. PEBA has recently evolved into the consortium "BIOASIS Gran Canaria", to create a governance instrument promoting blue economy activities as a key element for diversification on the island. It is a joint initiative that combines the efforts between the Gran Canaria Island Council, the Gran Canaria Economic Promotion Society (SPEGC), the Technological Institute of the Canary Islands (ITC), the Spanish Bank of Algae (BEA), and the University Institute of Sustainable Aquaculture and Marine Ecosystems (IU ECOAQUA). Main efforts will be directed to diversification of aquaculture and microalgae production, taking advantage of our geographical location and the tax benefits existent in the Canary Islands.

# 3 Renewable ocean energies

In Spain, marine renewable energies are in an incipient state. Wave and wind energies seem to be the most important in The Canary Islands. The Institute for Energy Diversification and Saving (Instituto para la Diversificación y el Ahorro de la Energía, IDAE) evaluated wind and wave potentials and established the most suitable areas for installation. This analysis was performed, according to environmental, technical (bathymetry) and technical-economic criteria. Figure 36 shows the results of the analyses for eolic potential.

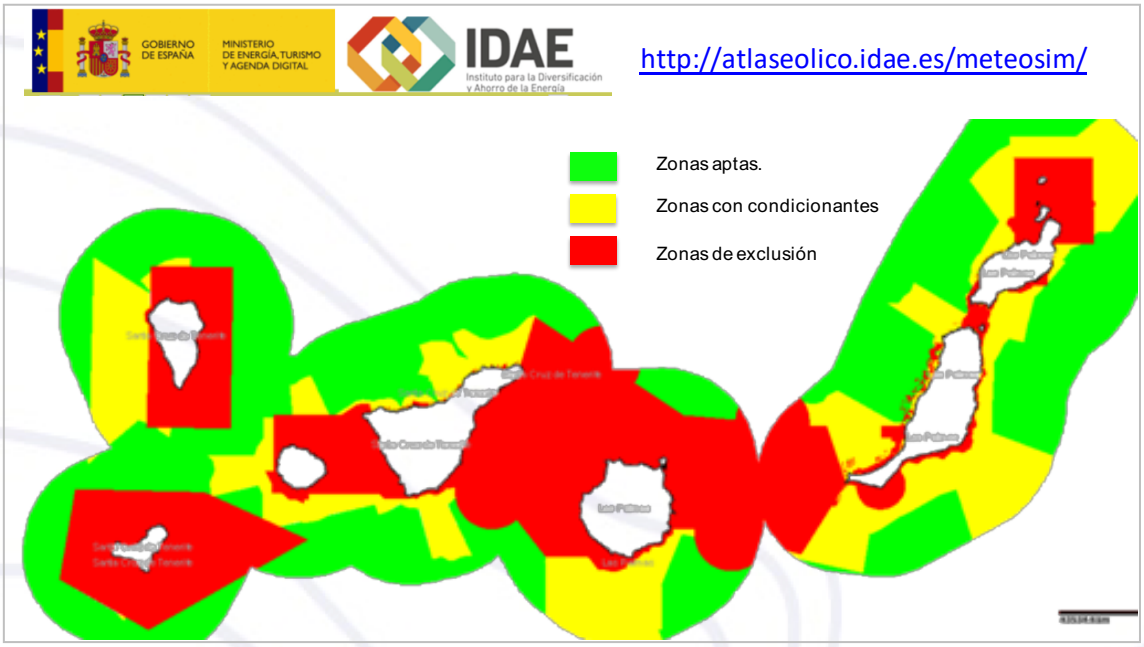



Fig. 36. Assessment of the eolic potential in marine areas of the Canary Islands. Source: IDAE, 2011.

Regarding the socioeconomic aspect, no specific data for the whole of the electricity supply sector can be found. Employment has been reduced by half between 1999 and 2006, leaving some 1,200 workers jobless for the whole Canary Islands. In addition, the

gross value added (GVA) of the electricity supply sector is included in the industrial GVA (excluding manufacturing). This GVA shows stability since 2010. The development of renewable energies (including the marine ones) is expected to have a positive impact. However, its development at sea will require more research, funding[10] and adequate local training.

With respect to research, there are at least two current R&D&I projects on offshore wind: ENERMAC (Canary partner: Instituto Tecnológico de Canarias) and ELISA (Canary partner: Plataforma Oceanográfica de Canarias). ENERMAC is dedicated in part to the study of implementation strategies, and ELISA will check the effectiveness of the MLRT system, which will test the "self-installation" of wind turbine by injection of concrete. Wave-converters have also been tested with favourable results on a small scale (UNDIGEN +). In addition, after consulting the Spanish Ministry of Environment, there are three requests for offshore wind farms in Gran Canaria (Canary Islands), which are still being processed with this ministry. One of these includes also wave-converters.

In 2015, the contribution of renewable energies in the Canary Islands was 7.9 % (in output) and 11.8% (in terms of installed capacity). However, the sector could experience an increase due to: (i) the recent presentation of the preliminary document of the Canary Islands Energy Strategy 2015-2025, which elaborates a sustainable model based on renewables (target of 45% generation for 2025) and security of supply; and (ii), the initial approval of the Sectoral Energy Management Guidelines. However, in the marine environment, development will depend mainly on the support of the State to any possible initiatives, due to its competences in the marine waters.

In relation to marine energy parks, it is also necessary to solve problems associated with the correct assessment of impacts, in addition to other general problems related to renewables, such as energy storage.

# 4 Mineral resources

Regarding the exploitation of mineral resources, the extraction of aggregates and deep-sea minerals in the Canary Islands can be considered small and inexistent (respectively). Nevertheless, this section shortly outlines the main issues, given the possibility of future development of these activities.

The aggregate extraction in Spain is allowed for the regeneration and creation of beaches, and for the dredging and landfill in ports. In the decade of the 90s started the assessment of the banks of sediments in the Canaries, and the last evaluation identified was in Tenerife Island in 2006. These works contributed to report about the sandbanks in the north and west coast of Lanzarote Island ($9{,}64 \cdot 10^6$ $m^3$ exploitable volume); all Fuerteventura coast ($90.768 \cdot 10^6$ $m^3$ evaluated volume); west ($87{,}8 \cdot 10^6$ $m^3$ exploitable volume) and east ($1{,}49 \cdot 10^6$ $m^3$ evaluated volume) coasts of Gran Canaria; and Tenerife Island ($13{,}74 \cdot 10^6$ $m^3$ evaluated volume) (DGC_MOPTMA, 1995; DGC_MMA, 2006). The reports include characteristics of these sediments (composition and granulometry) too. In spite of few utilization in the last years, sandbanks might play an important role in the future measures to relieve climate change coast effects (MAPAMA, 2016).

On the other hand, regarding deep sea mineral deposits, the Canary Islands are located in the Canary Island Seamount Province (CISP) that comprises more than 100 seamounts. However not all these mounts are inside the exclusive economic zone or the continental shelf of Spain (Fig. 37). The evaluation of the CISP shows that the thick ferromanganese crusts have high concentrations in strategic metals: cobalt, nickel, vanadium, barium, REY (Rare earth elements and yttrium) and total platinum group

[10] http://www.gobcan.es/ceic/energia/subvencionesycontratos/subvenciones/index_reno.html

elements (PGEs): platinum, rhodium, ruthenium and palladium. And although the Pacific Ocean deposits have got higher contents in nickel, copper and manganese; CISP seamounts have high concentrations in REY, vanadium and niobium. Although outside the Spanish jurisdiction, it is also important to mention the high concentration of tellurium found in Mount Tropic.

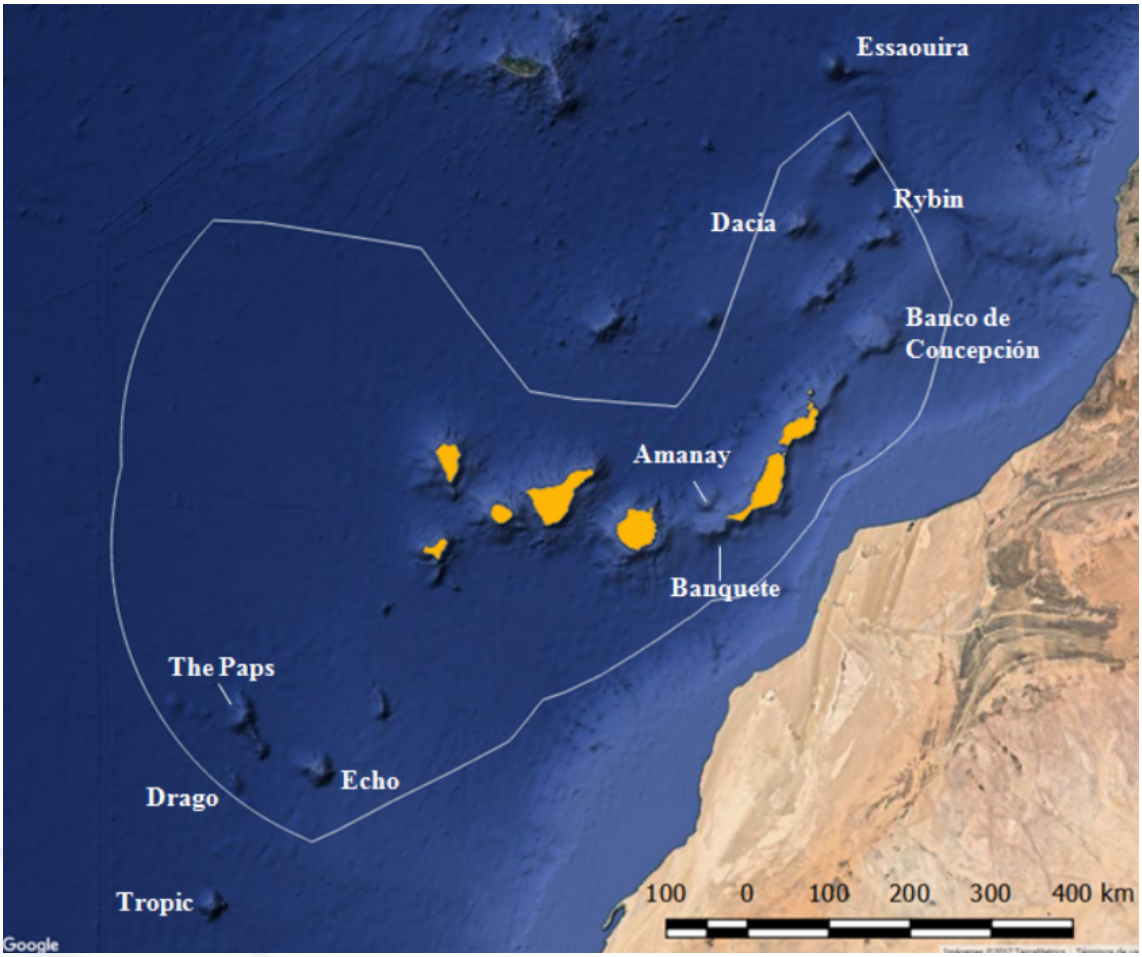



Fig. 37. Seamounts in the CISP and delimitation of the Spanish EEZ (white line taken from marineregions[11]). Drawn from googlemaps, (bathymetry) and gadm[12] (Canary Islands). Toponyms from van den Bogaard (2013).

# 5 Coastal & marine tourism

The tourism sector in the Canary Islands represents one of its main economic pillars since it is also associated with trade and restaurant business and hotel industry. Tourism has experienced a major boom from 2010 to 2016, not only because it is a mature and consolidated island sector, but also because of the confluence of various external factors, such as insecurity at foreign consolidated destinations and lower oil prices. This has allowed the GVA of the sector to contribute 34.3% to the gross domestic product of the archipelago in 2016, with employment reaching 39.7% (312,466 employees).

The general statistics on Tourism in the Canary Islands suggest a significant short-term stability, but the sector continues to work in its consolidation in the medium and long term. For this, the ERDF funds of the Canary Islands have included the rehabilitation of

[11] Marine Regions. http://www.marineregions.org/
[12] Global Administrative Areas. http://www.gadm.org/

19 tourist centres. This sector also relies on promotional and analysis work carried out by the company Promotur, and the Tourism Infrastructure Plan for the Canary Islands 2017- 2023 (PITCAN, 2017-2023), this plan has already been presented. Also, diversification is one of the tourism priorities framed in the "Canary Islands Intelligent Specialization Strategy 2014-2020" (RIS Canarias, 2013).

Finally, it must be noted that the sustainable development of this sector as a whole is highly linked to the protection of the insular environment, which is usually used as a strategy in promotional activities. Considering the high vulnerability of islands to climate change effects, SOCLIMPACT Project (funded under EU's Horizon 2020 research and innovation programme) aims at modelling downscaled climate change effects and their socioeconomic impacts in European islands for 2030–2100, in the context of the EU Blue Economy sectors, and assess corresponding decarbonisation and adaptation pathways, complementing current available projections for Europe, and nourishing actual economic models with non-market assessment (http://soclimpact.org/),

The present report focuses on the maritime and coastal aspects of the sector. According to the classification made by the Technology Centre of Marine Sciences (CETECIMA), **coastal and marine tourism** takes into account these five activities: (i) water sports, (ii) nautical charter and sea excursions, (iii) sports ports, (iv) cruises and (v) associated services. However, statistical data describing each of these activities (regarding employment and economic issues) is not accessible.

As for the description of the sectors, the figures of **cruise** passengers are the most interesting, showing a substantial increase in the last 16 years for the Ports of Santa Cruz de Tenerife (Tenerife), La Luz and Las Palmas (Gran Canaria) and Arrecife (Lanzarote). In 2016, these figures reached 1,988,326 passengers across the Canaries, according to the Canary Islands Institute of Statistics (ISTAC).

On the other hand, as for the passengers associated with **excursions** between ports under regional responsability, the company Puertos de Canarias includes them in its statistics as the category "Others passengers". In 2016, the Port of Corralejo (Fuerteventura), with 164,576 users, far surpassed the other locations. Other ports are also relevant, in short, Caleta de Cebo (80,697 users) in Graciosa, Arguineguín (71,405, island of Gran Canaria), Puerto del Carmen (58,727, Lanzarote), ports of Vueltas and Playa de Santiago (17,083 and 13,764, respectively) in La Gomera, and the Restinga (5,626) in El Hierro island.

The **nautical** sector is very diverse in terms of activities such as, for example, infrastructures and marinas, boat purchase and sale, nautical charter, nautical sports, sport fishing, auxiliary services to boats and crew, training etc. That is to say, it is an aggregate of economic activities that is not clearly represented in the official statistics, and no available data on employment or economic indicators unique to the nautical sector in the Canary Islands has been identified. In order to establish a quantitative description on the situation and trends of the sector, the number of moorings has been chosen as the most representative element of the supply and demand of marinas. The Canary Islands is currently the sixth (6.56%) Spanish region in number of moorings. By islands, in 2015 Gran Canaria and Tenerife comprised 59% of moorings (30% and 29% respectively).

Gran Canaria Island Council (Cabildo de Gran Canaria, 2009) proposed different alternatives for the increase of the number of moorings, ranging from 500 to 2.150 new moorings 5.000 moorings. Tenerife Island Council (Cabildo de Tenerife, 2011) considered the need to increase in 4.762 moorings in 2021. The need to increase the total available moorings for nautical tourism in the Canary Islands which is defended as the starting point for any future strategy of innovation and diversification in the sector (Caballero *et al*., 2015).

# 6 Fisheries

For the Canary Islands, fisheries and aquaculture add 21,2% (1.578 persons) of all direct employment in the maritime sector in the Canary Islands, second to Maritime transport and related activities (Lorenzo-Díaz & Afonso-Trujillo, 2015). Regarding its evolution on an island scale, Figure 38 shows a clear decrease for all islands until year 2009, and some stability after that. The great loss of jobs was linked to the loss of foreign fishing grounds in waters of third countries. This reduction was mainly noted in Gran Canaria, Tenerife and Lanzarote, as that loss mainly affected larger ships coming from these islands.

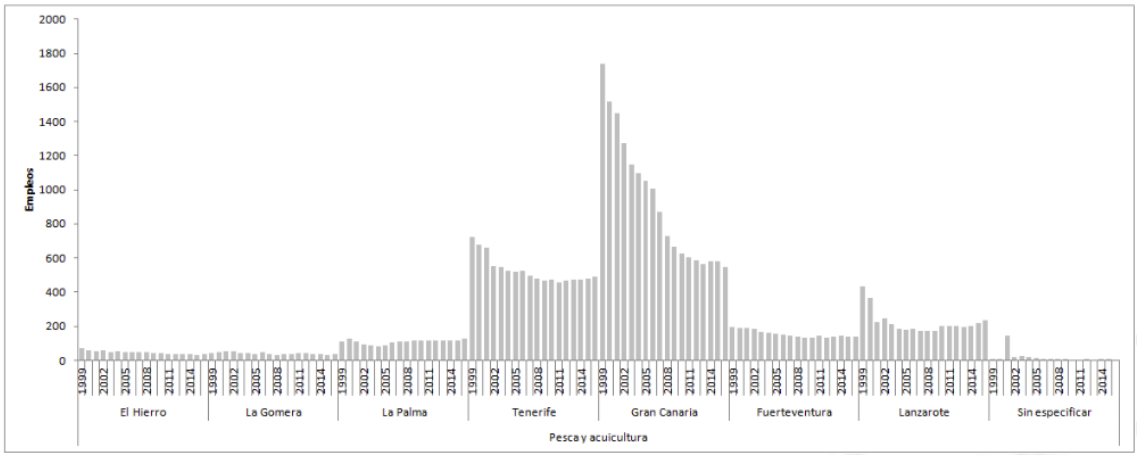



Fig. 38. Total employment in fisheries and aquaculture sectors at an island level between 1999-2016, according to trimestral data. Datos: ISTAC. Fuente: GMR, 2017.

A total of 748 vessels fish in the Canary fishing ground (MAPAMA, 2016), of which 95% are based in the Canary Islands. 94% fish with smaller gear (hook, gillnets, purse seine, traps, etc.) and 6% with longline (pole-and-line tuna vessels, bottom longline and surface longline). The fishing fleet of the Canary Islands, with an average age of 38 years is the oldest of all Spanish regions. Even more, 48% of all fishing vessels is 40 years or more. (29% for all Spain). The Canary fleet is mainly composed by small vessels being the mean length 9,92m, and most of the fleet (77%) is less than 10 m in length. Due to its characteristics, the Canary Islands fishing fleet can be considered as a Small Scale Fishery (SSF).

In relation to the state of the fish stocks in the Canary Islands, according to González (2008) the abundance and state of exploitation of the coastal pelagic resources (mackerel, sardine, etc.) is unknown, while for the oceanic pelagic species (bigeye, yellowfin, bonito, etc.), evaluated at an international level, the species relevant to the Canarian economy are at a maximum exploitation level of their populations. As for demersal and coastal shellfish resources, they are in a state of overexploitation, which is why it is necessary to adopt measures for their recovery. Deepwater resources need to be evaluated, although in some cases, already studied, they may present alternatives or complements to those currently exploited. Thus, there is high uncertainty about the future trend for the Canary fishing ground.

The impact of recreational fisheries should also be taken into consideration with regards to the state and management of fish stocks. In 2016 there were a total number of 101.434 valid recreational fishing licenses in the Canary Islands, meaning highly significant catches with very high economic importance. This increases the existing uncertainty about the trends in fisheries resources and deepens even more the need to improve fisheries management in the Canary Islands.

Following Stobberup *et al*. (2017) for Mediterranean SSF, the future development of fisheries in the Canary Islands could be oriented in three fields:

(i) increased management of fisheries (to achieve sustainable fisheries);
(ii) increased value-added of catches (improving quality and marketing) and;
(iii) development of synergies with other marine sectors, which is one of the BG goals.

With regard to fisheries management, the establishment of a continuous program of collecting and processing of catch data and fishing effort (professional and recreational) based on science and shared and discussed publicly is required.

In terms of synergies with other sectors linked to BG, it is worth mentioning some of the results obtained in the Canary Islands in the framework of the Fisheries Local Action Groups (FLAGs), oriented at the diversification of the fisheries sector, as a means of reducing the pressure on the stock is of great interest. Several initiatives (projects, workshops and pilot activities) have promoted the development of **Fish-Tourism**, as a means to provide visitors with the opportunity of experiencing the local fishermen's life and culture as a recreational activity. Although it seems to be viable from the economic viewpoint, and interesting as a means to diversify the income of professional fishermen and reduce the pressure on the natural stocks, legislative changes related to safety on board are needed, and capacity building needs to be provided to the local fishermen (pers. com. MF Marrero, Cabildo de Gran Canaria). For example, the European Fisheries Fund, through axis 4, supports projects working with these objectives.

# 7 Offshore oil & gas

Due to the presence and effect, over millions of years, of the Saharan upwelling, this area has historically been considered a location of possible energy resources derived from oil. On the other hand, the oil industry on the western coast of Africa has increased in the last decade, mainly due to the decline of traditional drilling zones in shallow waters, mainly in the North Sea. As a result, there has been an increase in the exploration of deep and ultra-deep waters, such as the West African coast.

In the Canary Islands prospecting licenses began in 2001 and, after various legal and socio-political circumstances, were authorized in 2012. In 2015, the exploration in the Canary Islands ceased after verifying that the deposit had neither the quantity nor the sufficient quality for its commercialization to be profitable. In any case, similar works continue to be developed beyond the limit that separates the marine resources of Spain and Morocco. In fact, prospection ships, drill ships and oil platforms that have been operating in Africa is stationed in Canarias due to the current price of oil and the available services.

# 8 Maritime transport

The Canary Islands, as an outermost region, possess an important external dependence from continental Europe (e.g. fuel, food, raw material, machinery, etc.), but at the same time, it is a key region in international maritime transport because of its strategic position. As a result, transport is considered a mature sector in the archipelago.

This sector has shown an increasing trend in terms of total merchandise in the main merchant ports from 1993 to 2007, the year in which the recent international economic crisis began (Figs. 39 and 40). According to the data of the provincial (NUTS 3) port authorities, the evolution between provinces has deferred since 2007. In 2015, the

province of Las Palmas (LP) stands out, being within the top 10 (8th) in terms of freight transport in Spain, while in the transport of passengers, the province of Santa Cruz de Tenerife (SC) was in 3rd place, and LP in the 5th position.

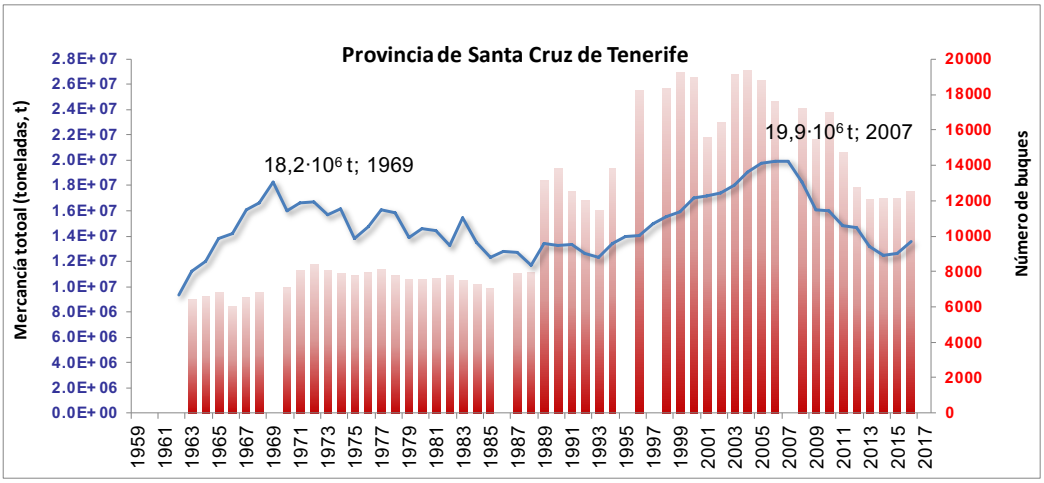



Fig. 39. Historic evolution of total registered cargo in tonnes (blue line), and number of ships in state competence ports for Santa Cruz de Tenerife Province (red bars). Data: Puertos del Estado, Min. Fomento. Source: GMR, 2017.

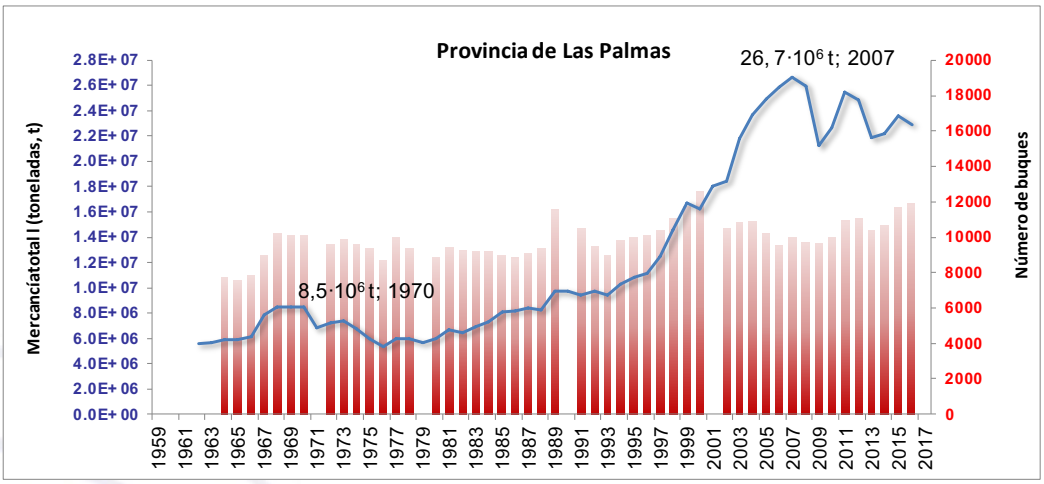



Fig. 40. Historic evolution of total registered cargo in tonnes (blue line), and number of ships in state competence ports for Las Palmas Province (red bars). Data: Puertos del Estado, Min. Fomento. Source: GMR, 2017.

Regarding employment, there has been a significant recovery from 2013 to 2017, with figures above 2.900 employees since mid-2016. No current reference to the GVA of the sector at insular level has been found. However, Lorenzo-Díaz & Afonso-Trujillo (2015) suggest the need to develop a new description that considers the economic aspects within the subsectors of the marine-maritime sector in the Canary Islands. In addition, it is necessary to support the Economic and Social Canary Council (CES).

In terms of sector support, mention must be made of the investment in port infrastructures provided by the Ministry of Development (Ministerio de Fomento), as well as the financial aid from the latest ERDF program (2014-2020), which dedicates several points to strengthen island shipping and its links with third countries. Effective use of funds in the outermost regions is key to blue growth. For example, the ERDF allocates in the Canary Islands the 8,31% of EU funds to achieve environmentally friendly transport (≈83·10$^6$ €), as well as other amounts intended for the freight transport and the aid to its implementation, the diversification of means and the access to certain ports

(Commission Implementing Decision C(2015)5853). In the Canary Islands, the companies related to the maritime sector rely on the Maritime Cluster and the recently approved plan for the internationalization of the sector. All this suggests that there is a great interest in strengthening maritime transport. It will contribute to its future development while benefiting the Canary archipelago.

Besides, the future of the maritime transport sector should aim to be less polluting and more efficient (e.g. use of renewable energy sources instead of liquefied or compressed natural gas, improvement of infrastructures, use of electricity within ports, etc.). On the other hand, the Canary Islands was declared by the International Maritime Organization (OMI) as Particularly Sensitive Sea Area (PSSA) in 2005, because of its significance for recognized ecological, socio-economic or scientific reasons and for being vulnerable to damage by international maritime activities.

# 9 Shipbuilding, ship repair, and port supplies and services

Canary ports are major repair centres of the Middle East Atlantic. The contribution of their geostrategic positioning has helped them become top-level logistics centres and capable of both dry and afloat repair of any type of vessel. The main ports offering these services are the Port of La Luz and Las Palmas and the Port of Santa Cruz de Tenerife.

The Port of La Luz and Las Palmas stands as the first port of the Middle Atlantic. It is, above all, an international port, combining its import and export traffic with the provision of all kinds of services during the ships stopovers (repairs, supplies and others), for traffic related to fishing, passage, recreational boating, etc.

The Port of Santa Cruz de Tenerife has high activity related to the traffic of tourist cruises, being the third Spanish port in this segment, adding more than one million visitors per year. It has intense coastal traffic and a high level of connectivity with international ports.

In short, the Canary port infrastructures offer a privileged geographical situation, and are leaders as a repair platform in the West Africa zone. Their infrastructures are powerful and technologically advanced, presenting a wide ecosystem of auxiliary companies and equipment, with accumulated experience and formed trained staff. In addition, they show a good evaluation of the quality and agility of the provided services. Therefore, this sector (and related sub-sectors) are key in the marine-maritime sector and are in a mature phase of development.

In general, there are no specific statistics of employment and economic indicators (pers. comm. Elba Bueno Cabrera, manager of the Canary Maritime Cluster) of these subsectors, which makes the study of situation and trends quite complex. The naval repair presented some 1.450 direct jobs and 150 M € of direct invoicing production (EDEI, 2014), the Port Infrastructures and Services some 6.283 direct jobs and 413 M € direct production (see Fig. 41) (EDEI, 2014), while the offshore services add some 3.000 direct jobs and 150 M € billing in 2014 (Robaina, 2016).

| EFECTO DE LAS ACTIVIDADES | PRODUCCIÓN | EMPLEO |
|---|---|---|
| EFECTO DIRECTO | 413.215.043 | 6.283 |
| Infraestructuras y Portuarias | | |
| Autoridades Portuarias | 19.767.000 | 333 |
| Puertos Canarios | | |
| Servicios al buque | 98.591.250 | 1731 |
| Servicios para el atraque | 30.710.891 | 400 |
| Avituallamiento | 57.119.173 | 682 |
| Provisionistas | 10.761.186 | 648 |
| Consignatarios | 14.650.602 | 1172 |
| Transitarios | 30.362.704 | 1020 |
| Agentes de aduanas | 18.047.203 | 474 |
| Manipulación de mercancías | 230.423.033 | 1520 |
| Transportistas | | |
| Inspecciones y aduanas | 1.373.252 | 32 |
| EFECTO INDIRECTO E INDUCIDO[35] | 1.004.112.554,5 | 17.404 |
| TOTAL | 1.417.327.597,5 | 23.687 |
| % REGIONAL | 3,40% | 3,05% |

*Elaboración propia. Extrapolación de las memorias de actividad de las Autoridades Portuarias de Santa Cruz de Tenerife y Las Palmas a los datos económicos planteados en el Informe de Ginés de Rus.*

Fig. 41: Economic dimension of the subsector “Port infraestructures and servicios”. Source: EDEI (2014).

# 10 Desalination

According to EDEI (2014) "the desalination in the Canary Islands assumes the guarantee of drinking water for more than 50% of the population. In islands like Lanzarote and Fuerteventura it means practically 100% of the water supply. In Gran Canaria more than 65%, and in Tenerife almost 20%. Some 340 desalination plants are operational in the Canary Islands, producing about 600,000 cubic meters per day. The value of these plants is approximately 500 million euros. At present, more than 2,000 people work in the public and private sector in the Archipelago directly in the desalination sector”.

On the other hand, according to EDEI (2014), this sector has a "long experience and consolidated know-how, a panel of highly qualified desalination experts, a large number of plants in operation that constitute a huge demonstration framework for potential applicants, proximity to territories with high potential demand and existence of companies with international presence and prestige". According to Peñate (2015) "in some of the islands, the energy used for desalination adds more than 10% of the total energy available in the electrical network.

According to the CAGPA (2013) of the total potable water production in the Canary Islands, approximately 71.75% (461,527 m3) goes to the supply, 30.93% (198.950 m3) to irrigation and 0, 46% (2,986 m3) for industrial consumption. In addition, between 2009 and 2013 production increased by approximately 29%, from a production capacity of 187,50 $hm^3$/year in 2010 to a capacity of 242,16 $hm^3$/year in 2013. Also, Peñate (2015) indicates that "the desalination has made possible in the last fifty years the population settlement, the growth of tourism and the development of arid geographical areas".

The challenges for future work include, according to EDEI (2014): continue the application of technological advances to the infrastructures of the region; improve the energy efficiency of the plants and incorporate renewable energy production; improve the quality of the water produced and the traceability of the desalinated water management; improve the management of brine in existing plants (improvement in dilution technologies, and valorisation through the production of algae and

phytoplankton); and reduction of operating costs (such as increasing the life of the membranes).

The achievements and continued efforts of the Canary Islands in the field of desalination, place the region in an excellent situation to enhance the experience and knowledge accumulated. The demonstrative effect of the infrastructures installed serve as an attraction of markets interested in the capacities developed in planning, start-up and operation of desalination plants. For this, EDEI (2014) identifies several lines of action, such as: the development of a brand image, an adapted offer of services (to meet the foreseeable demand of countries of the nearby African environment), or improve and update the training of experts regarding language experts and characteristics of nearby markets.

In the Canary Islands, the high standards in RD&I stand out. For example, the finalized 'Venturi Project' (Proyeto Venturi, 2012) aimed at the study of technical viability of the diffusers for the improvement of the dilution process, or the ongoing 'Desal+' project (Desal+, 2017) which proposes the creation and consolidation of a joint RD&I platform in the field of water desalination for the Macaronesia.

On the other hand, according to sources from the Government of the Canary Islands (Gobierno de Canarias, 2013), there are some 319 desalination plants in the archipelago (278 in the province of Las Palmas and 41 in Santa Cruz de Tenerife) with a drinking water capacity exceeding 660,000 $m^3$/day.

From an environmental point of view, the main problem of the desalination industry is the generation of discharges in the form of brine and its subsequent entry into the marine environment (Pérez-Talavera & Quesada-Ruiz, 2001).

In the Canary Islands there are 394 registered liquid discharges from land to sea, of which 52 (13%) are exclusively brine and another 18 (5%) contain brine mixed with other wastewater (Civil Port Ingenieros, 2017). The volume of brine discharges in these desalination plants can be remarkable (Riera *et al.*, 2011).

Although the hypersaline residue is dominant in the brine, discharges also include other chemical compounds (antifouling, disinfectants, etc.) derived from the chemical treatment of the water and of the cleaning and maintenance of the equipment involved in the process (Portillo *et al.*, 2014). The hypersaline residue is denser than seawater and generates a layer of brine that moves on the seabed affecting the marine benthic communities (Portillo *et al.*, 2013). In any case, the magnitude of the impact will depend on many factors such as flow rate, initial dilution capacity of the discharge systems, existing communities in the area, bathymetry, currents, mixing regime in the area, etc. (Portillo *et al.*, 2014; Portillo *et al.*, 2013).

# VI. References

**Agência Regional da Energia e Ambiente da Região Autónoma da Madeira (AREAM) (2012)** Sustainable Energy Action Plan of Madeira Island. 46p. Available at: http://aream.pt/documentacao/

**Andrade, C. A. P. and Gouveia, N. M. A. (2008).** Ten years of marine aquaculture development in Madeira Archipelago. In Pham, C. K., R. M. Higgins, M. De Girolano and E. Isidro (Eds). Proceedings of the International Workshop: Developing a sustainable Aquaculture Industry in the Azores. Archipelago. Life and Marine Sciences. Supp. 7, p. 30-32.

**APRAM, S.A** (Portos da Madeira) Estadísticas anuais. Available at: http://www.apram.pt/site/index.php/pt/estatisticas

**Caballero** Quintana A., de León Ledesma J., Lam González Y. E., Quesada Peña M., Bendou A., Boudinar B. y Sair A. **(2015)** Investigación en Turismo Náutico: Canarias Marruecos. Aportaciones del proyecto NAUCAMNET. Financiado por el Programa de Cooperación Transfronteriza España-Fronteras Exteriores (POCTEFEX), Fondos FEDER; UE -2011- 2013.

**Cabildo de Gran Canaria. (2009)** Plan Territorial Especial de Ordenación de Puertos Deportivos Turísticos e Infraestructuras Náuticas. Documento de avance.

**Cabildo de Tenerfe. (2011)** Plan Insular de Ordenación de Tenerife.

**CAGPA (2013)** Consejería de Agricultura, Ganadería, Pesca y Aguas del Gobierno de Canarias. http://www.gobiernodecanarias.org/noticias/agpa/Aguas/24759/canarias-319-desaladoras-capacidad-produccion-agua-potable-superior-660.000-m-dia

**Carreira, G. (2017)** Maritime sectors in the Azores Archipelago *(First draft version)*. *[1]DRAM, Azores.* Report prepared as part of PLASMAR Project (co-financed by ERDF as part of POMAC 2014-2020).

**Carreira, G. P.; Porteiro, F. M. (2015)** O mar dos Açores e a sua valorização estratégica: descrição do espaço marítimo e socioeconómico. *IDN Nação e Defesa* 141: 79-95.

**Civil Port Ingenieros (2017)** Actualización del censo de vertidos desde tierra al mar en Canarias. Informe final (general). 33 pp.

**Copping, A.;** Sather, N.; Hanna, L.; Whiting, J.; Zydlewski, G.; Staines, G.; Gill, A.; Hutchison, I.; O'Hagan, A.; Simas, T.; Bald, J.; Sparling, C.; Wood, J.; Masden, E. **(2016)**. State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World (Richland, WA: Ocean Energy Systems and Pacific Northwest National Laboratory, April 2016), http://tethys.pnnl.gov/publications/state-of-the-science-2016

**Cruise Market Watch (2017)** Growth of the Cruise Line Industry – Statistics. Available at: http://www.cruisemarketwatch.com/growth/

**Das, D., & Afonso, P. (2017).** Review of the Diversity, Ecology, and Conservation of Elasmobranchs in the Azores Region, Mid-North Atlantic. *Frontiers in Marine Science*, *4*, 354. https://doi.org/10.3389/fmars.2017.00354

**Desal+ Project (2017)** Programa MAC 2014-2020 (acceso 10.09.17). https://www.desalinationlab.com/es/

**DG Maritime Affairs and Fisheries (2014)** Study in Support of Impact Assessment Work on Blue Biotechnology. Final Report FWC MARE. 217p. Available at: https://webgate.ec.europa.eu/maritimeforum/en/node/3599

**DGC_MMA (2006)** Estudio de sondeos marinos, proyecto de explotación y evaluación de impacto ambiental en la costa de la Isla de Tenerife. Investigación en sedimentos en base a sondeos por vibración. Dirección General de Costas. Ministerio de Medio Ambiente. Realizado por la Empresa GEOMYTSA. Estudios geofísicos mar y tierra.

**DGC_MOPTMA (1995)** Estudio geofísico marino en las Islas de Gran Canaria, Fuerteventura, Lanzarote Graciosa y Alegranza. Dirección General de Costas. Ministerio de Obras Públicas, Transporte y Medio Ambiente. Realizado por la Empresa GEOMYTSA. Estudios geofísicos mar y tierra.

**Direção Regional de Estatística da Madeira (2015)** – *Estatísticas Demográficas da Região Autónoma da Madeira*, Funchal, ISBN 978 – 989 – 8755-23-0.

**EASME (2017).** Study on the establishment of a framework for processing and analysing of maritime economic data in Europe. Final Report (Sept 2017). MARE/2014/45. Prepared for the Executive Agency for Small and Medium-sized Enterprises (EASME) by Cogea, CETMAR & Poseidon under service contract: EASME/EMFF/1.3.1.13/SI2.718095. 122pp. Available at: https://publications.europa.eu/en/publication-detail/-/publication/9c132514-982d-11e7-b92d-01aa75ed71a1/language-en

**EC (2013)** Strategic Guidelines for the sustainable development of EU aquaculture. European Commission. COM/2013/0229. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013DC0229&from=EN

**ECORYS (2012)** Blue Growth Study 'Scenarios and drivers for sustainable growth from the oceans, seas and coasts', https://webgate.ec.europa.eu/maritimeforum/content/2946

**EDEI. 2014.** Documento de la estrategia marino marítima de Canarias. EDEI Consultores de Dirección. 83 pp.

**EEA (2015)**. State of Europe's Seas. EEA Report No 2/2015. 216 p. Available at: https://www.eea.europa.eu/publications/state-of-europes-seas

**EU Commission (2017)** COMMISSION STAFF WORKING DOCUMENT: Report on the Blue Growth Strategy Towards more sustainable growth and jobs in the blue economy. SWD(2017) 128 final. 62p.

**European Parliament (2011)** Proceedings of the Workshop on "The Assessment of potential and promotion of new generation renewable energy technologies". DG for Internal Policies. Policy Department A: Economic and Scientific Policy. 102pp. Available at: http://www.europarl.europa.eu/RegData/etudes/divers/join/2011/457366/IPOL-ITRE_DV(2011)457366_EN.pdf

**EUROSTAT (2017)**. Fishery statistics in detail. Eurostat – Statistics Explained. Available at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Fishery_statistics_in_detail

**FAO (2014)** The State of World Fisheries and Aquaculture. Opportunities and challenges. Food and Agriculture Organization of the United Nations. Rome, 2014.

**FAO (2015)** Achieving Blue Growth through implementation of the Code of Conduct for Responsible Fisheries. Policy Brief. Rome, FAO. Also available at www.fao.org/fileadmin/user_upload/newsroom/docs/BlueGrowth_LR.pdf

**FAO (2016).** The State of World Fisheries and Aquaculture 2016. Contributing to food security and nutrition for all. Rome. 200 pp. Available at: http://www.fao.org/3/a-i5555e.pdf

**FAO (2017a)** Fishery and Aquaculture Statistics, Global aquaculture production 1950-2015. Fisheries and aquaculture software (FishstatJ), - software for fishery statistical time series. In: FAO Fisheries and Aquaculture Department [online]. Rome. Updated 21 July 2016.

**FAO (2017b)** Adaptation Strategies of the Aquaculture Sector to the Impacts of Climate Change. FAO Fisheries and Aquaculture Circular, Rome Italy, 1142, 41p.

**FAO & World Bank (2015)** Aquaculture zoning, site selection and area management under the ecosystem approach to aquaculture. Policy brief Rome, FAO. Also available at www.fao.org/documents/card/en/c/4c777b3a-6afc-4475-bfc2-a51646471b0d/

**FIGUEIRA DE SOUSA, J. (2004)** *O Porto do Funchal no contexto do sistema portuário insular regional: as infraestruturas, os tráfegos e as funções portuárias*, Tese de Doutoramento em Geografia e Planeamento Territorial, Universidade Nova de Lisboa – Faculdade de Ciências Sociais e Humanas, Lisboa.

**GMR Canarias, S.A.U. (2017**) Principales sectores del "Blue Growth" en Canarias: situación y tendencias. Informe preparado como parte del Proyecto PLASMAR (co-financiado por FEDER en el marco de POMAC 2014-2020). 127 pp. Available at: http://www.plasmar.eu/documentos/

**Gobierno de Canarias (2013)** Portal de noticias del Gobierno de Canarias (acceso 10.09.17). http://www.gobiernodecanarias.org/noticias/agpa/Aguas/24759/canarias-319-desaladoras-capacidad-produccion-agua-potable-superior-660.000-m-dia

**GWEC (2017)** "Global Wind Report – Annual Market Update 2016". Global Wind Energy Council; Brussels: April 2017, 76pp. Available at: http://www.gwec.net/strong-outlook-for-wind-power/

**IDAE (2011)** Análisis del recurso. Atlas eólico de España. Estudio técnico. PER 2011-2020. 200p.

**INE (2013) P. 43**

**Instituto Nacional de Estatística** – Total annual production of aquaculture (ton) and corresponding value (k€) in Madeira Region**.** INE portal: https://www.ine.pt/xportal/xmain?xpgid=ine_main&xpid=INE

**IUCN (2007)** Guide for the Sustainable Development of Mediterranean Aquaculture 1. Interaction between Aquaculture and the Environment. IUCN, Gland, Switzerland

and Malaga, Spain. 107 pages. Available at: https://portals.iucn.org/library/taxonomy/term/36525

**IUCN (2009a)** Guide for the Sustainable Development of Mediterranean Aquaculture 2. Aquaculture site selection and site management, IUCN, Gland, Switzerland and Malaga, Spain. VIII+303 pages. Available at: https://portals.iucn.org/library/taxonomy/term/36525

**IUCN (2009b)** Guide for the Sustainable Development of Mediterranean Aquaculture 3. Aquaculture Responsible Practices and Certification. Gland, Switzerland and Malaga, Spain: IUCN. VI+70 pp. (available at: https://portals.iucn.org/library/taxonomy/term/36525)

**Lee, H.J. (2015).** Cruises seen as a new profil engine. Korea Joong Ang Daily, 8 May. Available at: http://koreajoongangdaily.joins.com/news/article/article.aspx?aid=3003921

**Levin**, L. A., Mengerink, K., Gjerde, K. M., Rowden, A. A., Van Dover, C. L., Clark, M. R., … Brider, J. **(2016)** Defining "serious harm" to the marine environment in the context of deep-seabed mining. *Marine Policy*, *74*, 245–259. https://doi.org/10.1016/J.MARPOL.2016.09.032

**Lopes, M**; Sepúlveda, P; Jorge, V; Oliveira, M; Andrade, C. **(2017)** Blue Growth – for a better development of the sea – Report from Madeira Archipelago. *ARDITI – Agência Regional para o Desenvolvimento da Investigação, Tecnologia e Inovação; Secretaria Regional do Ambiente e Recursos Naturais – Direção Regional do Ordenamento do Território e Ambiente.* Report prepared as part of PLASMAR Project (co-financed by ERDF as part of POMAC 2014-2020). 47 p. Available at: http://www.plasmar.eu/documentos/

**Lopes, M. I. (2016)** *Proposal for the Constitution of a Sea Cluster in the Autonomous Region of Madeira and the Role Performed by the Maritime Spatial Planning*, Tese de Mestrado em Gestão do Território –Território e Desenvolvimento, Universidade Nova de Lisboa –Faculdade de Ciências Sociais e Humanas, Lisboa

**Lorenzo Días DJ y Afonso Trujillo R. (2015)** Cuantificación económica del sector marino-marítimo en Canarias: propuesta metodológica del ISTAC. Revista Índice. Nº64, 19-21 p.

**MAPAMA (2016)** Estrategia española ante el cambio climático. Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente. 120 p.

**MAPAMA** (Ministerio de Agricultura, Pesca, Alimentación y Medio Ambiente) Estadísticas pesqueras. Available the 11.08.2017 at: http://www.mapama.gob.es/es/estadistica/temas/estadisticas-pesqueras/

**MIDAS Project (2016a)** Implications of MIDAS results for policy makers: recommendations for future regulations. 46 p.

**MIDAS Project (2016b)** Managing impacts of Deep Sea Resource Exploitation Research Highlights. 44 p.

**OECD (2013)**. Marine Biotechnology: Enabling Solutions for Ocean Productivity and Sustainability, OECD Publishing. DOI: http://dx.doi.org/10.1787/9789264194243-en

**OECD (2015)**, *Green Growth in Fisheries and Aquaculture*, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264232143-en

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

**OECD (2017)** Marine biotechnology: Definitions, infrastructures and directions for innovation. 51p. Available on 30.09.2017 at: https://read.oecd-ilibrary.org/science-and-technology/marine-biotechnology_9d0e6611-en#page1

**OECD/IEA (2014).** World Energy Outlook 2014. 726p. Available at: https://www.iea.org/publications/freepublications/publication/WEO2014.pdf

**Peñate Suárez, B. (2015)** Canarias y la desalación: 50 años de experiencia que permiten superar los retos del presente. Disponible en https://www.iagua.es/blogs/baltasar-penate-suarez/canarias-y-desalacion-aguas-50-anos-experiencia-que-permiten-superar

**Pérez-Talavera, J.L., J.J. Quesada-Ruiz (2001)** Identification of mixing processes in brine discharges carried out in Precipice of the Toro Beach, south of Gran Canaria (Canary Islands), Desalination 139 (2001) 277–286.

**Portillo, E., M. Ruiz de la Rosa, G. Louzara, J. Quesada, J.M. Ruiz & H. Mendoza. (2013)** Desalination and Water Treatment (2013): Dispersion of desalination plant brine discharge under varied hydrodynamic conditions in the south of Gran Canaria, Desalination and Water.http://dx.doi.org/10.1080/19443994.2013.795349

**Portillo, E., M. Ruiz de la Rosa, G. Louzara, J.M. Ruiz, L. Marín-Guirao, J. Quesada, J.C. González, F. Roque, N. González, H. Mendoza (2014)** Assessment of the abiotic and biotic effects of sodium metabisulphite pulses discharged from desalination plant chemical treatments on seagrass (Cymodocea nodosa) habitats in the Canary Islands. Marine Pollution Bulletin. Volume 80, Issues 1–2. 222-233, pp. https://doi.org/10.1016/j.marpolbul.2013.12.048.

**PWC (2014)**. LEME – PwC Economy of the Sea Barometer. Zoom Azores. 32pp. https://www.pwc.pt/pt/publicacoes/imagens/leme/leme5anexos/zoom_acores_digital.pdf

**PWC (2016)** – *LEME – Barómetro PWC da Economia do Mar, Ilhas que Brilham* – ZOOM Madeira, Portugal.

**Região Autónoma da Madeira (2015)** Programa do XII Governo Regional da Madeira. 169 pp. Retrieved from: http://www.alram.pt/regiao/hist%C3%B3ria/a-autonomia-das-regi%C3%B5es-insulares/91-outros/1304-programa-do-xii-governo-regional-da-madeira.html

**Riera, R., F. Tuya, A. Sacramento, E. Ramos, M. Rodríguez, O. Monterroso (2011)** The effects of brine disposal on a subtidal meiofauna community. Estuarine, Coastal and Shelf Science. Volume 93, Issue 4. 359-365 pp. https://doi.org/10.1016/j.ecss.2011.05.001

**RIS Canarias (2013)** Estrategia de Especialización Inteligente de Canarias 2014-2020. Gobierno de Canarias. 264 pp.

**Robaina Calderín, L. 2016.** Nota Sectorial OFFSHORE OIL AND GAS Canarias 2016. Breve descripción de la situación del sector Offshore en los Puertos de Canarias en el año 2016. PROEXCA. 10 pp.

**Ronzon**, T., M. Lusser, M. Klinkenberg (ed.), L. Landa, J. Sanchez Lopez (ed.), R. M'Barek, G. Hadjamu (ed.), A. Belward (ed.), A. Camia (ed.), J. Giuntoli, J. Cristobal, C. Parisi, E. Ferrari, L. Marelli, C. Torres de Matos, M. Gomez Barbero, E. Rodriguez Cerezo **(2017)**. Bioeconomy Report 2016. JRC Scientific and Policy Report. EUR 28468 EN

**Science for Environment Policy (2015)** Sustainable Aquaculture.Future Brief 11. Brief produced for the European Commission DG Environment by the Science Communication Unit, UWE, Bristol. Available at: http://ec.europa.eu/science-environment-policy

**SEA (2015)** *"2014 Market Forecast Report"*, SEA Europe, Ships & Maritime Equipment Association, www.seaeurope.eu/template.asp?f=publications.asp&jaar=2015

**Smith**, T. W. P., Jalkanen, J. P., Anderson, B. A., Corbett, J. J., Faber, J., Hanayama, S., … Hoen, M., A. **(2014)** Third IMO Greenhouse Gas Study 2014. International Maritime Organization (IMO). https://doi.org/10.1007/s10584-013-0912-3

**SRA (2014).** *Estratégia Marinha para a subdivisão da Madeira. Diretiva Quadro Estratégia Marinha*, Secretaria Regional do Ambiente e dos Recursos Naturais.

**SRMCT** (2014). Estratégia Marinha para a subdivisão dos Açores. Diretiva Quadro Estratégia Marinha. Secretaria Regional dos Recursos Naturais. Outubro de 2014. Available at: http://www.azores.gov.pt/Gra/SRMCT-MAR/conteudos/livres/Estrategia_Marinha_para_a_subdivisao_dos_Acores.htm

**SRTEC (Secretaria Regional da Economia, Turismo e Cultura) (2016)** Plano Integrado Estratégico dos Transportes da Região Autonoma da Madeira (PIETRAM) 2014-2020. Prepared by CONSULMAR and Figueira de Sousa 261p. Available at: http://civitas.eu/it/content/plano-integrado-estrat%C3%A9gico-de-transportes-da-regi%C3%A3o-aut%C3%B3noma-da-madeira-pietram-%E2%80%93-20142020

**Stobberup** K, Garza Gil MD, Stirnemann-Relot A, Rigaud A, Franceschelli N, Blomeyer **(2017)** Research for PECH Committee – Small-scale Fisheries and "Blue Growth" in the EU, European Parliament, Policy Department for Structural and Cohesion Policies, Brussels. 159 pp. (Disponible el 12.08.17) http://www.europarl.europa.eu/RegData/etudes/STUD/2017/573450/IPOL_STU(2017)573450_EN.pdf

**TPWind Advisory Council** (Advisory Council of the European Wind Energy Technology Platform) **(2006)**. Wind Energy: A Vision for Europe in 2030. 24pp. Available at: http://www.windplatform.eu/fileadmin/ewetp_docs/Structure/061003Vision_final.pdf

**Van den Bogaard, P. (2013)** The origin of the Canary Island Seamount Province — NewAges of Old Seamounts. Scientific Reports. 3:1-7. http://dx.doi.org/10.1038/srep02107 http://www.nature.com/articles/srep02107#supplementary-information

**Van Dover C. L.** , J. A. Ardron, E. Escobar, M. Gianni, K. M. Gjerde, A. Jaeckel, D. O. B. Jones, L. A. Levin, H. J. Niner, L. Pendleton, C. R. Smith, T. Thiele, P. J. Turner, L. Watling & P. P. E. Weaver **(2017)** Biodiversity loss from deep-sea mining. Nature Geoscience. Advance online publication. www.nature.com/naturegeoscience. Published online: 26 June 2017.

**Venturi Project (2012)** Programa Nacional Español de Proyectos de Desarrollo Experimental. Ministerio del Medio Ambiente y Medio Rural y Marino (acceso 10.09.17). http://www.proyectoventuri.com/

**WindEurope (2017a)**. Wind in power: 2016, European statistics. Published in February 2017. 24pp. Available at: https://windeurope.org/wp-content/uploads/files/about-wind/statistics/WindEurope-Annual-Statistics-2016.pdf

**WindEurope (2017b)**. The European offshore wind industry, Key trends and statistics 2016. Published in January 2017. 37pp. Available at: https://windeurope.org/wp-content/uploads/files/about-wind/statistics/WindEurope-Annual-Offshore-Statistics-2016.pdf

**World Bank (2013)** Fish to 2030: Prospects for Fisheries and Aquaculture. Washington, DC: World Bank.

# Annex 1: List of sectors and activities

| Sector | NACE & Activity |
|---|---|
| **Fisheries and aquaculture** | A.03.11 Marine fishing |
| | A.03.21 Marine aquaculture |
| | A.03.22 Freshwater aquaculture |
| | C.10.20 Processing and preserving of fish, crustaceans and molluscs |
| | C.10.85 Prepared meals and dishes |
| | C.10.89 Other food products n.e.c |
| | C.10.41 Manufacture of oils and fats |
| **Blue biotechnology** | M.72.11 Research and experimental development on biotechnology |
| **Extraction of oil and gas** | B.06.10 Extraction of crude petroleum |
| | B.06.20 Extraction of natural gas |
| | B.09.10 Support activities for petroleum and natural gas extraction |
| **Extraction of aggregates** | B.08.12 Operation of gravel and sand pits; mining of clays and kaolin |
| | B.08.99 Other mining and quarrying n.e.c. |
| | B.08.11 Quarrying of ornamental and building stone, limestone, gypsum, chalk and slate |
| | B.09.90 Support services for other mining and quarrying |
| **Extraction of salt** | B.08.93 Extraction of salt |
| | C.10.84 Manufacture of condiments and seasonings |
| | B.07.10 Mining of iron ores |
| **Seabed mining** | B.07.21 Mining of uranium and thorium ores |
| | B.07.29 Mining of other non-ferrous metal ores |
| | B.09.90 Support services to other mining and quarrying |
| **Desalination** | E.36.00 Natural water; water treatment and supply services |
| **Maritime transport** | H.50.10 Sea and coastal passenger water transport |
| | H.50.20 Sea and coastal freight water transport |
| | H.50.30 Inland passenger water transport |
| | H.50.40 Inland freight water transport |
| | H.52.29 Other transportation support activities |
| | K.65.12 Non-life insurance |
| | K.65.20 Reinsurance |
| | N.77.34 Rental and leasing services of water transport equipment |
| **Ports (including dredging)** | H.52.24 Cargo handling |
| | F.42.91 Construction of water projects |
| | H.52.22 Service activities incidental to water transportation |
| | H.52.10 Warehousing and storage services |

| | |
|---|---|
| **Shipbuilding** | C.30.12 Building of pleasure and sporting boats |
| | C.30.11 Building of ships and floating structures |
| | C.28.11 Manufacture of engines and turbines, except aircraft, vehicle and cycle engines |
| | C.32.30 Sports goods |
| **Ship repair** | C.33.15 Repair and maintenance of ships and boats |
| | E.38.31 Dismantling of wrecks |
| **Tourism** | n.a. Coastal tourism |
| | n.a. Cruise tourism |
| **Wind energy** | n.a. Offshore wind energy |
| **Other renewable energy** | D.35.11 Production of electricity |
| | D.35.12 Transmission services of electricity |
| **Public sector** | E.38.12 Collection of hazardous waste |
| | 0.84.22 Defence activities |
| | 0.84.26 Environmental protection |
| | 0.84.11 General public administration activities |
| | 0.84.24 Public order and safety activities |
| | E.39.00 Remediation activities and other waste management services |