Atlantic Arc Ocean Energy 5-10-Year Roadmap

WP3

BLUE-GIFT CAPITALIZATION WORK PACKAGE

TABLE OF CONTENT

INTRODUCTION

1. THE BLUE-GIFT PROJECT

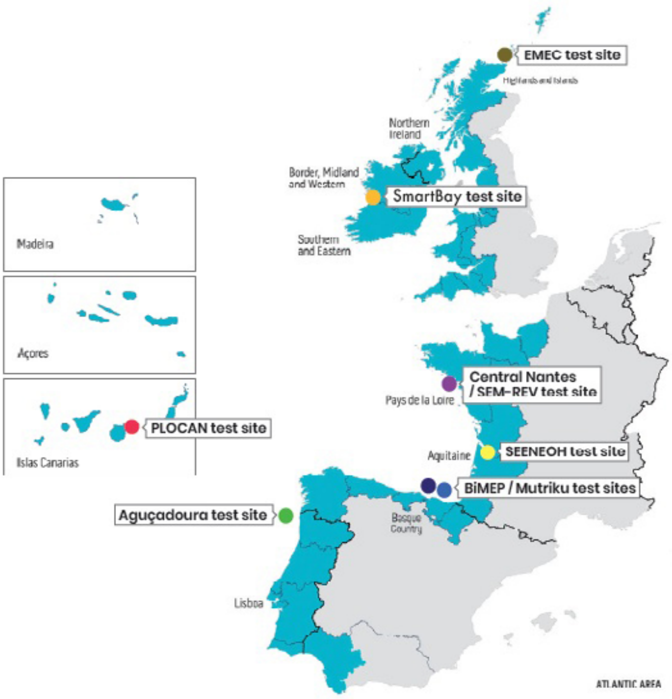

Figure 1: Maps of Interreg Atlantic Area Blue-GIFT Partners

The Blue-GIFT project is a €2.5 million European Regional Development Fund (ERDF) project that aims to help Atlantic Area companies test the next generation of marine renewable energy (MRE) technology in real marine environments. Located in the coastal regions of Spain, France, Portugal, Ireland and Scotland, the partnership represents the regions of Europe where ocean energy resources are the most important (see Figure 1).

The development of a MRE industry in these regions represents a unique opportunity to stimulate their economic development. The fight against climate change and the security of energy supply are also major challenges and MRE represents an important and still largely untapped asset that will help reduce green house gases emissions. The cost of pre-commercial testing and demonstration for MREs is high and investors are reluctant to invest until the technology has been proven in a real-world setting.

Blue-GIFT is implementing a coordinated MRE technology demonstration program that encourages long-term demonstration and risk reduction. The aim is to maximise the use of the infrastructures at our disposal to demonstrate a minimum of 8 MRE technologies, representing more than 24,000 hours of operation, working with more than 20 SMEs, supporting more than 30 jobs and helping to secure a €15 million investment.

➡ **Blue-GIFT website**

2. OBJECTIVE OF THE DOCUMENT

Public sector support will be crucial as MRE technology moves towards full market uptake. This document aims at synchronising transnational efforts to look at how regional governments can put in place supportive policies and initiatives for the sector.

This task will also build upon work that Ocean Energy Europe are doing within the Interreg Noth-West-Europe (NWE) Ocean-Demo project to create supportive policy environments with the objective of securing national level policies for commercial deployments.

In addition, it will address the challenges faced by the MRE sector in the Atlantic Area for five years following the project, namely political, regulatory, economical, research and development, financial and skills challenges.

WHY AN ATLANTIC ARC OCEAN ENERGY ROADMAP?

- Atlantic regions are home of ocean energies and floating wind energy;
- The EU Commission has set ambitious objectives for offshore wind and ocean energy meaning the main share will go to the Atlantic – The AA roadmap should give the trajectory to reach these targets;
- The Blue-GIFT partners form together a world-leading network of MRE test centres: they have a key role in the achievement of the objectives that will be highlighted in the roadmap.

3. A BRIEF OVERVIEW OF MARINE RENEWABLE ENERGIES

The ocean represents one of the largest yet least explored renewable energy sources on earth. Indeed, until today, the marine renewable energy industry is still an emerging industry.

Marine energy encompasses various means through which energy can be harnessed from our oceans. Marine renewable energy takes the form of kinetic energy (tidal currents), potential energy (tidal range), wave energy, thermal potential (temperature gradients) or even osmotic pressure (horizontal gradients of salinity). Although wind energy is not strictly a marine resource, offshore wind is included in the definition of marine energy in that it shares part of the constraints and challenges of projects carried out at sea.

The marine environment presents a relatively untapped energy source and offshore installations are likely to produce a significant proportion of future energy production. MRE are crucial in the context of the evolution of the electricity mix and the rise in electricity demands. Indeed, the global rise of renewable energies and its increasing importance in the electric mix, on the one hand, and the development of electric mobility, on the other, place electrical production at the centre of the game.

These different marine technologies are all solutions to diversify the European energy mix, thanks to their many advantages, including:

- A continuous and predictable energy resource due to the regularity of the ocean's flows and of the wind offshore,
- A limited landscape impact,
- A low environmental impact,
- An opportunity to limit land pressure.

In this report, we will focus on the following technologies:

FLOATING OFFSHORE WIND ENERGY

There are two types of offshore turbines: fixed wind turbines and floating wind turbines, which differ mainly by the type of their foundation. In the first category, the turbine is attached to a support dug into, or placed on, the seabed. Technical and economic constraints limit its deployment to areas with a maximum depth of approximately 50 m. The second category is used when the depth ranges between 50 to 300 m. The wind turbine is then fixed to a floating support, moored and anchored to the seabed. Multiple floating designs exist and are being developed but none of them prevail at this stage.

While the global levelized cost of energy (LCOE) is reaching EUR 45-79/MWh for fixed offshore wind, floating offshore wind is expected to follow the path and to reach EUR 100/MWh by 2030 if large capacity is deployed[1].

TIDAL ENERGY

Tidal power harnesses the power of sea currents, converting the kinetic energy of the current into electricity by means of a turbine immersed in the water. Tidal power can also be exploited on rivers and estuarine environments. Tidal turbines can either be fixed or mounted on a floating platform. Their rotor size can be very different depending on whether the machine is located in a river or at sea. Unlike wind, whose resource is fairly diffuse at sea, the tidal resource is extremely localised and thus exploitable sites are quite limited geographically.

In the past decade, the tidal stream industry has made significant progress and the sector has cut costs by 40% since 2015, faster than anticipated. Commercial stage is expected to be reached by 2030[2]. The current LCOE for tidal projects is approximately EUR 350/MWh[3].

WAVE ENERGY

Wave technology is still an emerging technology with a rather low maturity. Numerous concepts have been developed based on various principles of energy conversion: mechanical surface energy (oscillations/undulations), sub-surface energy (movement of water molecules under the effect of the swell), pressure variation at the passage of waves or within chambers. Energy extraction solutions can be installed onshore or offshore. The lower limit of the average annual potential expressed in watts per linear meter of wave crest is estimated at between 15 and 25 kW/m.

It is hard to quantify the LCOE due to the early stage of development of wave energy technologies. One-off prototypes currently developed indicate an LCOE in excess of EUR 350/MWh[4]. The lack of data, particularly energy generation, makes it difficult to accurately estimate the costs. However the potential for the technology to rapidly decrease its costs by volume manufacturing once design and performance are secured, will be key to reach the level of competitiveness of offshore wind.

1. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0741&from=EN
2. Ibid.
3. https://www.marineenergywales.co.uk/wp-content/uploads/2018/05/ORE-Catapult-Tidal-Stream-and-Wave-Energy-Cost-Reduction-and-Ind-Benefit-FINAL-v03.02.pdf
4. Ibid.

4. MARINE RENEWABLE ENERGY TEST CENTRES

Real-sea testing is a key milestone in the technological development process. The test in a real environment usually takes place after preliminary testing in laboratory conditions and numerical model validation. Once the prototype has been tested in a single unit configuration and has demonstrated the achievement of performance and reliability criteria, the test can be repeated in a pilot configuration, with several machines installed in an array. This makes it possible to simulate a small-scale commercial farm, before a possible industrial deployment on a larger scale (see Figure 2).

TEST SITES

A test site is an infrastructure connected to the grid, dedicated to the technical validation of demonstrators at intermediate or full scale, in order to validate or modify the design and/or the installation and intervention processes at sea. These tests are carried out over a fairly short period of time (from a few months to 2-3 years).

PILOT FARMS

A pilot farm allows several devices to be tested simultaneously in the form of an array. It enables to validate or rectified their operation similar conditions to a commercial installation. New locks are being lifted, particularly on the farm architecture. A pilot farm can operate from a few years to 20 or more years.

COMMERCIAL FARMS

Commercial farms correspond to the large-scale commercial exploitation of electricity production infrastructures.
It will stay in operation for more than 20 years. Its economic model is based on the sale of electricity to the grid.

Figure 2: Definitions of Test Site, Pilot farm, Commercial Farm

From a technological perspective, the marine energy sector is heterogeneous: while some technologies are close to commercial, others are still in their experimental phase.

Figure 3: Marine Renewable Energy maturity

In particular for wave and tidal energy technologies there have been international efforts to present a framework for technology evaluation and guidance of engineering activity, breaking the development process from concept creation to array demonstration, into 6 stages:

Figure 4 : Six-stage technology development process. Source: IEA-OES 2021

STAGE	DESCRIPTION	TRL
STAGE 0	Concept creation	1
STAGE 1	Concept development	2 3
STAGE 2	Design optimisation	4
STAGE 3	Scaled demonstration	5 6
STAGE 4	Commercial-scale single device demonstration	7 8
STAGE 5	Commercial-scale array demonstration	9

EARLY (1-3)
Analytical and numerical models

MID (3-6)
Experimental tests in controlled environment

LATE (6-9)
Experimental tests in representative environment

The six stages are correlated with means of verification and demonstration used, including test sites in controlled or in representative environment[5].

To date, only floating offshore wind, following in the footsteps of fixed offshore wind turbine, has reached the commercial stage. Tidal energy is developing its first arrays and wave energy is finishing is scale testing phase. Floating Solar has reached commercial conditions when installed in lakes or artificial basins but its maturity is much lower in sea conditions with the influence of waves and salinity conditions.

In this context the test centres have a crucial role in bringing emerging technologies to reach commercial development and driving the costs down. The Carbon Trust has highlighted that the cost between the prototype and the first-of-a-kind is expected to be divided by two for offshore floating wind technologies (see Figure 5):

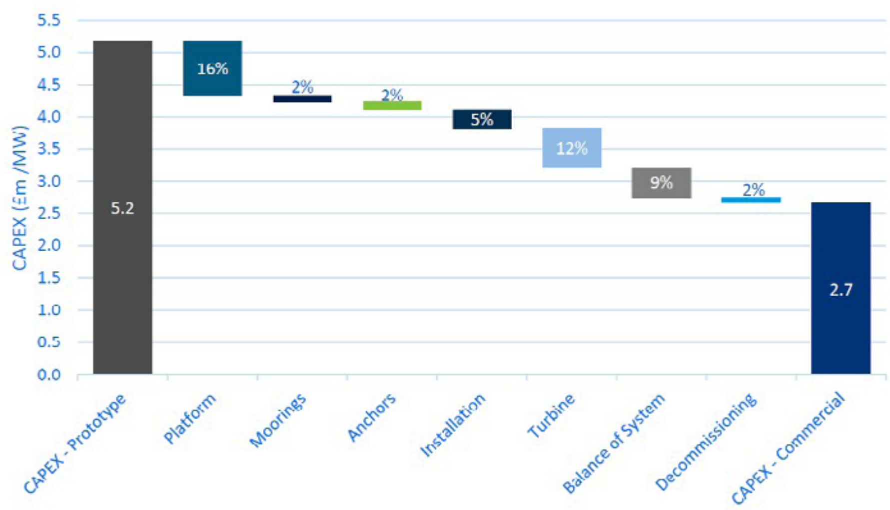

Figure 5: Costs reduction from an offshore floating wind prototype to a commercial product. Source: Carbon Trust

5. https://www.ocean-energy-systems.org/publications/oes-documents/guidelines/document/an-international-evaluation-and-guidance-framework-for-ocean-energy-technology

5. THE PROJECT PARTNERS, MAJOR MARINE RENEWABLE ENERGY TEST CENTRES

The project partners cover a comprehensive range of marine energy technologies and offer unique infrastructures to demonstrate the technologies in real sea conditions.

THE EUROPEAN MARINE ENERGY CENTRE

EMEC is the world's leading centre for testing wave and tidal energy converters at sea. To date it has hosted 20 companies and 31 prototypes, with more technologies trialed than anywhere else in the world. EMEC also runs an international group for all the wave and tidal test sites globally.

SEENEOH

SEENOH is a test site for small-scale ocean tidal devices or full-scale river devices located in the Garonne river, 100km from the Atlantic ocean in the estuary of Gironde, in the heart of the city of Bordeaux. The test site is equipped with moorings, export cable and floating platforms. In addition to its infrastructure, SEENEOH offers environmental, mechanical and electric competencies and acts as a facilitator for the user in terms of maritime operations for commissioning and maintenance. SEENEOH also operates an open sea test site in Bretagne – Paimpol-Brehat tidal turbine test site – licenced to EDF.

BIMEP

Bimep is a real sea infrastructure for the research, demonstration and exploitation of MRE devices. BiMEP has two locations: BiMEP site, an open sea test centre connected to the grid off the coast of Armintza and the Mutriku site, a testing area at the Mutriku Wave Power Plant.

PLOCAN

PLOCAN is a unique Science and Technology infrastructure that supports research in the marine and maritime sectors. It promotes long-term observation and sustainability of the ocean, providing a cost-effective combination of services (ocean observatory, marine test site, underwater vehicles and innovation hub).

WAVEC

WavEC is one of the leading research and innovation centres in this area in Europe, particularly in wave energy and floating wind energy. WavEC has a long track record of development of tools for direct support to the marine energy industry, including both technical and non-technical tools.

BLUEWISEMARINE

BlueWise Marine supports the Marine Institute in the management of Ireland's marine and renewable energy test site in Galway Bay SmartBay Test Site. The facility supports the trial and validation of wave and floating offshore wind technologies, as well as the collection of marine data and validation of other novel marine technologies.

CENTRALE NANTES / SEM-REV

Centrale Nantes is one of the top French graduate Schools of engineering. Its research centers support MRE technology by covering ocean, civil and electrical engineering and advanced manufacturing. It benefits from experimental facilities: Supercomputing, Ocean-tank, wind tunnel and offshore test site SEM-REV. More specifically, Centrale Nantes operates the test site since 2009, and owns the permits for wave and offshore floating wind energy converters. Since 2018, SEM-REV hosts the first French floating wind prototype, producing electricity to the National distribution grid.

A REVIEW OF EUROPEAN STRATEGIES AND LEGAL FRAMEWORK FOR MARINE RENEWABLE ENERGY DEVELOPMENT

Energy is one of the original components of European integration. From the European Coal and Steel Community in 1951 to the recent "European Green Deal" proposed at the end of 2019, the European Union has acquired important competencies to face a triple challenge: to ensure the supply of Member States, to guarantee competitive energy for companies and individuals, and to implement the energy transition.
Because marine renewable energies are by nature at the crossroads of different sectors (the sea, energy, industry, the environment), they are governed by numerous public policies. A general overview of the European strategies and regulations applicable to marine renewable energy is proposed below.

1. THE EUROPEAN GREEN DEAL AND THE "FIT FOR 55" PACKAGE

The European Green Deal adopted in December 2019 provides an action plan[6] to boost the efficient use of resources by moving to a clean, circular economy, restore biodiversity and cut pollution.
The plan outlines investments needed and financing tools available. It explains how to ensure a just and inclusive transition. Reaching this target will require action by all sectors of our economy, including:

- investing in environmentally-friendly technologies,
- supporting industry to innovate,
- rolling out cleaner, cheaper and healthier forms of private and public transport,
- decarbonising the energy sector,
- ensuring buildings are more energy efficient,
- working with international partners to improve global environmental standards.

In July 2021, the European Commission has adopted a package of proposals to make the EU's climate, energy, land use, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. Achieving these emission reductions in the next decade is crucial to Europe becoming the world's first climate-neutral continent by 2050. The Commission is presenting the legislative tools to deliver on the targets agreed in the European Climate Law and fundamentally transform our economy and society for a fair, green and prosperous future.

6. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu_en

2. THE RENEWABLE ENERGY DIRECTIVE RED II AND RED III

Directive 2018/2001/EU on the promotion of the use of energy from renewable sources

In December 2018, the recast Renewable Energy Directive 2018/2001/EU entered into force, as part of the "Clean energy for all Europeans" package published in 2016. The recast directive, called RED II, moves the legal framework to 2030 and sets a new binding renewable energy target for the EU for 2030 :

- Reducing greenhouse gas emissions by at least 40% (compared to 1990 levels). The Commission has proposed in September 2020 to raise the 2030 greenhouse gas emission reduction target, including emissions and removals, to at least 55% compared to 1990 (see below).
- Increasing the share of renewable energy to at least 32%.
- Improving energy efficiency by at least 32.5 %.

In July 2021, the Commission has published a proposal for a Directive amending Directive 2018/2001 (RED II) as regards the promotion of energy from renewable sources[7]. Indeed, to become climate neutral in 2050 as decided in the European Green Deal, a reduction of greenhouse gas emissions of 55% by 2030 is required. This in turn requires significantly higher shares of renewable energy sources in an integrated energy system. The current EU target of at least 32% renewable energy by 2030, set in the Renewable Energy Directive (RED II) needs to be increased to 38-40%. At the same time, new accompanying measures in different sectors in line with the Energy System Integration, the Hydrogen, the Offshore Renewable Energy and the Biodiversity Strategies are required to achieve this increased target. In addition to a higher target for renewable energy production by 2030, the Directive includes provisions for support schemes, permitting, energy communities, transport and heating & cooling.

To achieve the EU's energy and climate objectives for 2030, EU Member States were required to draw up 10-years National Energy and Climate Plans (NECPs) which were submitted in 2020. These NECPs describe how Member States intend to address, among other things, energy efficiency, the deployment of renewable energy and the reduction of greenhouse gases. They will certainly have to be amended to reflect the latest objectives.

COUNTRY	NECP	Estimated trajectories for offshore floating wind and ocean energies
UK	**NECP 2021-2030**	No breakdown for the renewable energy mix (UK is not contributing to the EU target)
FRANCE	**NECP 2021-2030**	5 to 6 GW by 2028 for offshore wind (both bottom fixed and floating) – no target for ocean energy
IRELAND	**NECP 2021-2030**	OW > 1GW by 2025 and > 3GW by 2030 | OE: 12MW by 2025 and 30 by 2030
PORTUGAL	**NECP 2021-2030**	OW: 100 MW by 2025 and 300 MW by 2030 | Wave: 30 MW by 2025 and 70 MW by 2030
SPAIN	**NECP 2021-2030**	The recent roadmap on offshore wind and marine energy of the Ministry of Industry of the Spanish government sets the following objectives to 2030: 1-3GW for offshore wind and 40-60MW for marine energy

7. https://ec.europa.eu/info/sites/default/files/amendment-renewable-energy-directive-2030-climate-target-with-annexes_en.pdf

3. MARITIME SPATIAL PLANNING

Marine Strategy Framework Directive (2008/56/EC)
Maritime Spatial Planning Directive (2014/89/EU)
The main policies on the European marine areas are the Marine Strategy Framework Directive and the Maritime Spatial Planning Directive. They aim respectively at protecting marine biodiversity and at coordinating sea-based activities. Both can have an impact on the deployment of ocean energy in European waters.
The Marine Strategy Framework Directive was adopted in 2008 and amended in 2017. It aims at protecting the European marine environment in achieving "Good environmental status" by 2020. The Marine Strategy Framework Directive requires Member States to establish a Marine Strategy for their national waters and update it every six years.

Adopted on 23 July 2014, the Maritime Spatial Planning Directive aknowledges the increasing demand for maritime space for different purposes, such as installations for the production of energy from renewable sources and many other pre-existing activities. Ocean management and maritime governance have been developed in the Integrated Maritime Policy for the European Union (IMP)[8].
The IMP identifies maritime spatial planning (MSP) as a cross-cutting policy tool enabling public authorities and stakeholders to apply a coordinated, integrated and trans-boundary approach. The application of an ecosystem-based approach will contribute to promoting the sustainable development and growth of the maritime and coastal economies and the sustainable use of marine and coastal resources.

The transposition of the EU Directives into national legislation has led to the development of spatial planning documents in the Member States:

As defined by UNESCO, MSP is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that have been specified through a political process. MSP is not an end in itself but a practical way to create and establish a more rational use of marine space and the interactions among its uses, to balance demands for development with the need to protect the environment, and to deliver social and economic outcomes in an open and planned way. Key benefits of MSP include:

- More sustainable use of marine resources and better management of maritime activities,
- Reduction of conflicts between sectors and creation of synergies between different activities, giving all marine activities a fair share of space,
- Encouragement of investments by creating predictability, transparency and clearer rules,
- Increased cross-border cooperation between EU countries to develop energy grids, shipping lanes, pipelines, submarine cables and other activities, but also to develop coherent networks of protected areas,
- Protection and preservation of the environment through early identification of impact and opportunities for multiple use of space, combining uses that are compatible with each other.

COUNTRY	National Spatial Planning Documents	Identification of suitable areas for the development of marine renewable energy
SCOTLAND	Scotland's National Marine Plan	Plan options for Offshore Wind and Ocean Energy
IRELAND	National Marine Planning Framework	Offshore wind site investigations and relevant projects are identified but no pre-allocated zones for MRE
FRANCE	Sea-basin strategies	Offshore wind areas are essentially identified
SPAIN	Royal Decree 363/2017 Planes de Ordenacion del Espacio Maritimo	Areas are mainly identified for offshore wind
PORTUGAL	Maritime Spatial Planning - PSOEM	Yes

Additionally, many EU legislations and regulations directly impact marine spatial planning. Among these are the environmental legislation that include Habitats and Birds Directive, the common fisheries policy, Aarhus Convention, EU Biodiversity Strategy, etc.

8. In October 2007, the Commission launched 'An Integrated Maritime Policy for the European Union' (COM(2007) 0575). Since then, two progress reports have been presented by the Commission – in October 2009 (COM(2009) 0540) and September 2012 (COM(2012) 0491) – describing the main achievements of the EU's IMP and corresponding maritime sectoral policies.

4. OFFSHORE RENEWABLES STRATEGY

Communication from the Commission. November 19th 2020. An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future.

The European offshore renewable energy strategy is a key file that sets a development pathway for ocean energy at an EU level. The strategy takes the form of a Communication from the European Commission published on November 19th 2020. It notes the potential of MRE, and in particular that of offshore wind, to decarbonise European electricity production and thus achieve the climate neutrality objective that the EU has set itself for 2050. It also notes the European leadership in these technologies (70% of MRE projects worldwide have been developed by companies established in the EU). However, this potential is still unevenly exploited by the various Member States and the sector faces numerous regulatory and financial obstacles at both national and European level. This is why the Commission's strategy identifies a series of objectives and actions (some legally binding, others not) to unlock investment and facilitate the large-scale deployment of MRE in all European sea basins.

The objectives for renewable electricity production from MRE are as follows[10]:

- **Offshore wind:** increase the installed capacity to 60 GW by 2030 and 300 GW by 2050 (to be compared to 12 GW of installed capacity at present);
- **Ocean energy:** increase the installed capacity to 100 MW by 2025, 1 GW by 2030 and 40 GW by 2050 (to be compared to the current production of 13.5 MW).

To reach these targets, the Commission estimates that a total of €800 billion of public and private investment will be needed by 2050, two thirds of which will be devoted to adapting the European electricity grid and one third to generating this offshore electricity itself. To unlock these investments, the Commission is first targeting Member States to encourage national authorities to support this sector more actively.

Several of the measures announced therefore concern the national level as a priority, such as encouraging States to integrate MRE into their national maritime space management plans or to put in place national support measures for emerging technologies via feed-in tariffs for example. This will be facilitated by taking better account of the specificities of the MRE sector in the future European guidelines on state aid for energy and the environment, which are currently being revised. Member States are also encouraged to use the Recovery and Resilience Facility - the main financial tool of the European Recovery Plan - to support investments in MRE projects.

Regarding specifically the Atlantic Ocean European Sea Basin, the Commision acknowledges Atlantic ocean has a high potential for bottom-fixed and floating offshore wind energy and good natural potential for wave and tidal energy. Member States are developing a strong pipeline of demonstration projects, building upon years of experience from installed and grid connected equipment and a world-leading network of test centres.

OFFSHORE RENEWABLE ENERGY TECHNOLOGIES

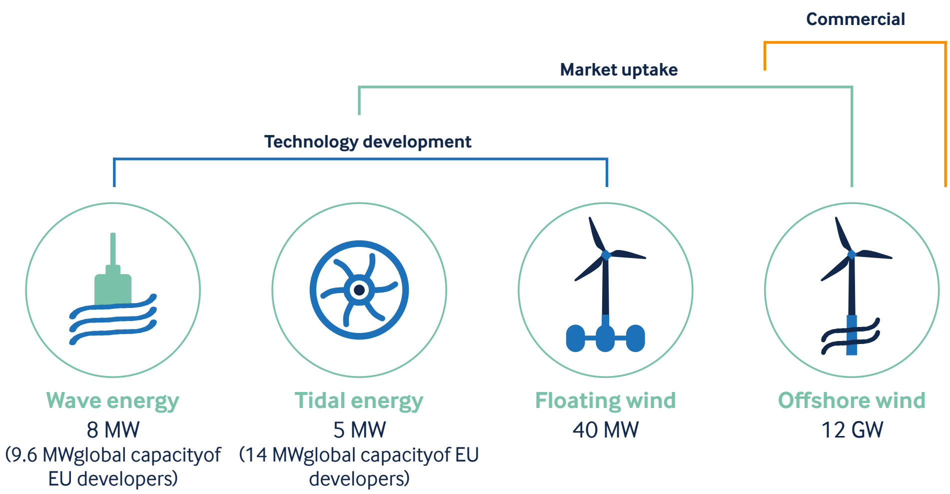

Figure 6: Installed capacity of offshore renewable energy technologies – source: JRC

10. These figures do not include the UK.

5. ATLANTIC STRATEGY AND ATLANTIC ACTION PLAN 2.0

Communication from the Commission. July 7th 2020. A new approach to the Atlantic maritime strategy – Atlantic action plan 2.0: an updated action plan for a sustainable, resilient and competitive blue economy in the European Union Atlantic area.

The revised Atlantic Action Plan 2.0 was communicated by the European Commission on 23 July 2020. Its main objective is to unlock the potential of blue economy in the Atlantic area while preserving marine ecosystems and contributing to climate change adaptation and mitigation. Its aims are in line with the global commitments for sustainable development and are fully integrated in the European Commission's political priorities for 2019-2024.

The Atlantic Action Plan 2.0 includes four pillars, the 3rd one being dedicated to Marine Energies and setting specific objectives to support the development of the sector:

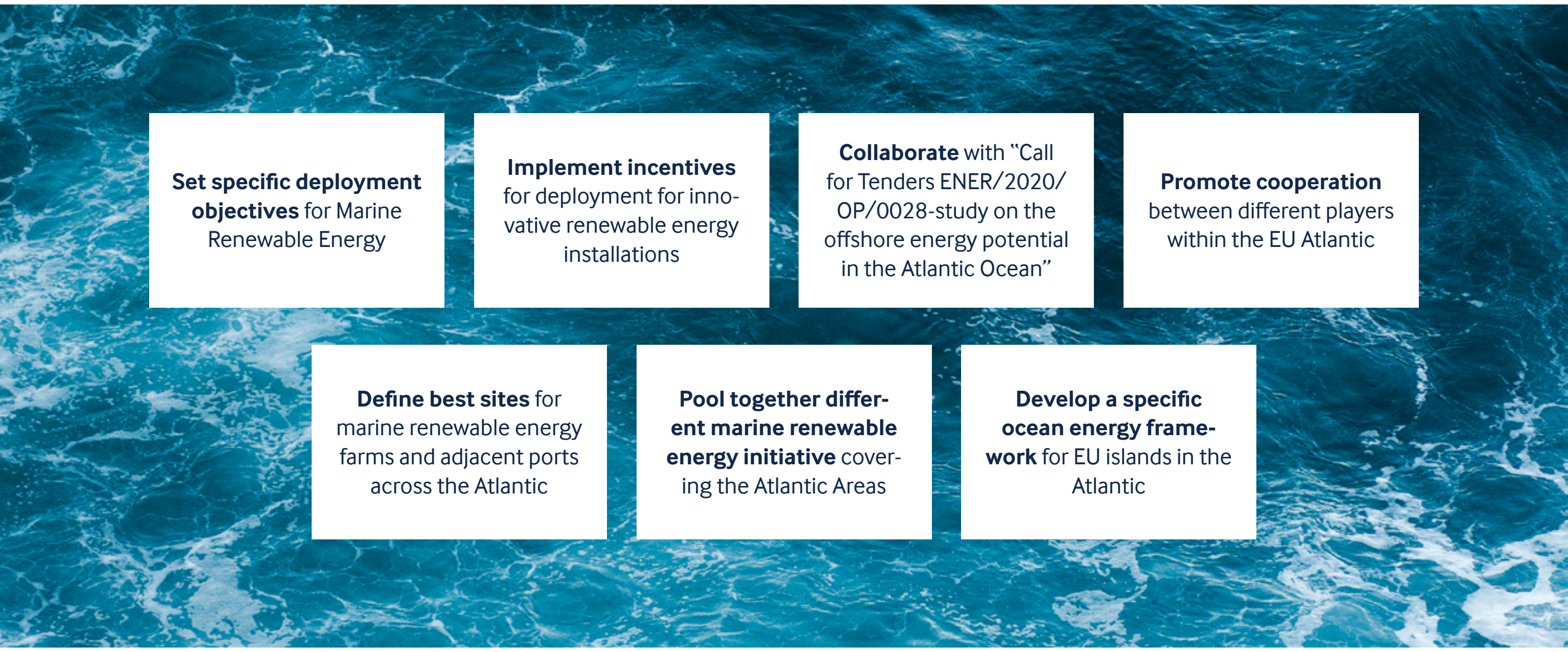

Figure 7: Atlantic Action Plan 2.0: actions for marine renewable energies in the EU Atlantic area (pillar 3)

A REVIEW OF NATIONAL AND REGIONAL PUBLIC POLICIES SUPPORTING MARINE RENEWABLE ENERGIES IN THE ATLANTIC AREA REGIONS

The public policies set up and implemented in the Atlantic regions come from both the national and the regional levels. Across the Blue-GIFT partners, the situation varies as described in the table below:

	UNITED KINGDOM *Scotland*	**FRANCE** *Pays de la Loire* *Nouvelle-Aquitaine*	**SPAIN** *Basque Country* *Canary Islands*	**PORTUGAL**	**IRELAND**
RENEWABLE ENERGY PRODUCTION TARGETS	Energy policy is reserved to the UK government, however the Scottish Government has an energy policy for Scotland at variance with UK policy, and has planning powers to enable it to put some aspects of its policy priorities into effect.	Set at national level with declinaison per region	National level and regional level	Set at national level for wave and floating offshore wind	Set at National Level, target for offshore wind only.
MARITIME SPATIAL PLANNING & CONSENTING	Devolved Marine Scotland	Legal framework set up at national level but implemented at regional level	Legal framework at national level and implemented at regional level	Geoportal Maritime Spatial Plan tool and one-stop shop procedure for the licencing process	Legal framework set up and implemented at National level
MARKET SUPPORT (AUCTION ROUND, FIT)	UK-wide: CfD AR4 in UK – Pot II includes marine renewables, with ringfence for tidal	Defined at national level only	National level	No market support mechanism available	National Level, market support for offshore wind only.
R&D SUPPORT	National and regional funding programmes	National and regional funding programmes	National and regional funding programmes	National and regional funding programmes	National funding programmes.

1. UNITED KINGDOM / SCOTLAND

POLICY:

The UK Government has a 2050 net zero target (2045 in Scotland), and commitment to 100% power from renewables by 2035[11]. The Government's Department for Business, Energy & Industrial Strategy (BEIS) retains overall responsibility for energy policy in the UK.

The Energy White Paper published in December 2020 announced a target of 40GW of offshore wind by 2030, including 1GW of floating wind[12]. Moreover, the budget announcement for 2021-2022 included the launch of a £20million programme in support of floating offshore wind development across the UK.

Marine Scotland, the Scottish administration for MRE, has prepared Scotland's National Marine Plan (2015), which provides a single framework for managing Scotland's seas. It sets out strategic policies for the sustainable development of Scotland's marine resources out to 200 nautical miles. The plan's strategic objectives are based on the EU Marine Strategic Framework Directive. Scotland's National Marine Plan is supplemented by 11 Regional Marine Plans prepared by Marine Planning Partnerships. The National Marine Plan is reviewed every three years.

MARKET SUPPORT:

The Contracts for Difference (CfD) scheme is the UK government's main mechanism for supporting the deployment of low-carbon electricity generation. CfDs incentivise investment in renewables by providing developers of projects with direct protection from volatile wholesale electricity prices. Once developers have constructed their project and start to generate electricity, they are paid a flat (indexed) rate for the electricity they produce over a 15-year period – the difference between the 'strike price' (which is determined by competitive auction) and the 'reference price' (a measure of the average market price for electricity in the GB market) for each unit of green electricity generated. There have been three auctions, or allocation rounds, to date (in 2015, 2017 and 2019), which have seen a range of different renewable technologies competing directly against each other for a CfD.

The Marine Energy Council (MEC) was created in 2018 to enhance cross-sectoral collaboration and to influence government, mobilising the industry from a cohesive, holistic perspective for greater impact. Membership includes wave and tidal technology developers, project developers, and renewables trade bodies from across the devolved regions of the UK. The MEC, working with political lobbyists, has achieved significant results in 2020/21, in particular by moving offshore wind into a separate 'pot' in forthcoming Contracts for Difference Allocation Round 4 (CfD AR4). Thus, increasing the chances for wave and tidal technologies to compete in the emerging technologies pot. The MEC and industry focus then shifted to ensuring a ring fenced minima, for the sector to achieve 1GW of deployment and £90/MWh in the 2030s. The draft budget published in September 2021[13] indicated the strike prices allocated to tidal stream, at £211, and wave energy, at £258, are highly challenging for the industry at present. However, following consistent and coordinated lobbying of Government Ministers, Members of Parliament, and civil servants (most notably those in Treasury), in November 2021, just days before publication of the final budget notice for CfD AR4, UK government finally confirmed a £20m per year ringfence for Tidal Stream projects[14].

Additionally, the sector is arguing for an Innovation Power Purchase Agreement (IPPA) to boost emerging technologies that cannot yet compete at CfD level, such as some wave developers.

MARINE RENEWABLE ENERGY POTENTIAL:

Wave and tidal stream energy has the potential to meet up to 20% of the UK's current electricity demand, representing a 30-to-50 GW installed capacity. Recent evidence[15] for tidal stream broadly supports the latest national-scale practical resource estimate, of 34 TWh/year, equivalent to 11% of the UK's current annual electricity demand. With 16,500 km of coastline, Scotland is in a strong position to make use of its abundant wave and tidal resources – sitting on the western fringes of the northwest European continental shelf, exposed to waves propagating from the north Atlantic (the main source of its wave energy resource), with numerous narrow channels, seaways and "firths" leading to the formation of some of the strongest tidal currents in the world. It is not surprising, therefore, that the majority of early wave and tidal project deployments are taking place in Scotland, particularly in Orkney, with others spread across as in Dumfries and Galloway, Argyll & Bute, Caithness, the Shetland Islands and the Western Isles.

The potential for floating offshore wind is referred to in Scotland's National Marine Plan and in the Scottish Energy Strategy, 2017, amongst others. Through the ScotWind leasing round (up to 10GW generating capacity), the Scottish Government has offered the opportunity to begin developing large-scale floating offshore wind projects, though there is no indication of the proportion of projects that might be floating as opposed to fixed.

CONSENTING:

Marine planning in Scotland's inshore waters (out to 12 nautical miles) and offshore waters (12 to 200 nautical miles) is governed by the Marine (Scotland) Act 2010, an Act of the Scottish Parliament and by the Marine and Coastal Access Act 2009, an Act of the UK Parliament, respectively. The two Acts (referred to as the Marine Acts) establish a legislative framework for marine planning to enable

11. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf
12. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/945899/201216_BEIS_EWP_Command_Paper_Accessible.pdf
13. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1016774/cfd-ar4-draft-budget-notice.pdf
14. https://www.gov.uk/government/news/uk-government-announces-biggest-investment-into-britains-tidal-power

demands on marine resources to be managed in a sustainable way across all of Scotland's seas.

Scotland's first statutory marine plan, the National Marine Plan was adopted and published in March 2015. The policies and objectives of the Plan establish how Scottish Ministers intend marine resources to be used and managed. The Plan supports development and activity in Scotland's seas while incorporating environmental protection into marine decision making to achieve sustainable management of marine resources. The policies and objectives of the Plan will also be reflected in the development of Regional Marine Plans (RMPs).

A guidance on consenting the marine energy project has been prepared by Marine Scotland for all stakeholders, including developers, regulators, statutory advisors, the public and other interested parties[16].

REGIONAL POLICIES AND SUPPORTIVE SCHEMES:

Renewables Obligations Scotland (ROS) and Offshore Wind Leasing in Scotland (ScotWind)

The world's first floating offshore wind array was deployed in Scotland, off Peterhead, supported through Scotland's Renewables Obligation legislation[17]. In 2020, Crown Estate Scotland opened a ScotWind leasing round for new developments. The aim of this leasing round is to deliver another 8-10 GW of offshore wind which will see the Scottish capacity target increase to 17-19 GW, the bulk of which should be delivered by 2030. Many of the 17 sites eligible in the leasing round have water depths in excess of 60m and therefore lend themselves to floating offshore wind projects. This first ScotWind round will therefore lead to the development of some of the first commercial scale floating wind projects in the world.

The programme leases areas of the seabed around Scotland for wind farm developments. Developers apply to the scheme and, if successful, will be granted the rights to build wind farms in Scottish waters. A lease provides a developer with the rights required from Crown Estate Scotland to construct and operate an offshore wind farm on the seabed. Other permissions are also required – a lease will only be awarded once all the key consents and permissions have been obtained from the relevant regulatory authorities including Marine Scotland. Crown Estate Scotland may award an Option Agreement to a project developer – the terms on which Crown Estate Scotland would grant such a lease in the event that the developer succeeds in obtaining all the necessary consents[18]. Once a developer has a lease and consents in place, and meets other conditions of eligibility, they can then apply to future CfD allocation rounds.

Wave Energy Scotland & EuropeWave

Wave Energy Scotland (WES) was formed in 2014 at the request of the Scottish Government and is a subsidiary of Highlands and Islands Enterprise. It is driving the search for innovative solutions to the technical challenges facing the wave energy sector. Through competitive procurement programmes, WES supports a range of projects focused on the key systems and sub-systems of Wave Energy Converters. The aim is to produce reliable technology which will result in cost effective wave energy generation.

WES recently also entered into EuropeWave partnership with test centre in Basque Country, Spain to set up a Pre-Commercial Procurement (PCP). The PCP model provides a structured approach, fostering greater openness, collaboration and sharing of risk between the public sector and technology developers. The programme focuses on the design, development, and demonstration of cost-effective wave energy converter (WEC) systems for electrical power production that can survive in the harsh and unpredictable ocean environment[19]. The first ever request for tender for this programme closed on 1 Oct 2021, and results were released in December 2021 during OEE21 event.

WHAT TO REMEMBER:

UK Marine Energy Council
Contracts for Different Allocation Round 4
Wave Energy Scotland & EuropeWave

More information

15. A review of the UK and British Channel Islands practical tidal stream energy resource | Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences (royalsocietypublishing.org)
16. Marine Licensing Applications and Guidance Document, Marine Scotland
17. Renewables Obligation Scotland (ROS) – updated (increased) year on year. the ROS obliges electricity suppliers to source an increasing proportion of the electricity they supply from renewable sources.
18. https://www.crownestatescotland.com/resources/documents/scotwind-leasing-launch-summary-1
19. https://www.europewave.eu/

2. IRELAND

POLICY:

Ireland has an Integrated Marine Plan called Harnessing Our Ocean Wealth which was published in 2012, this sets out the government's Vision, High-Level Goals and Key Enabling Actions to put in place the appropriate policy, governance and business climate to enable Ireland's marine potential to be realised. The opportunities for the development of the MRE sector in Ireland are highlighted, such as the opportunities for export potential and long-term direct and indirect economic benefit and contribute to Ireland's energy security, renewable energy policy and CO2 reduction targets.

Ireland also recognises Marine Renewable Energy as a priority area in the National Marine Research and Innovation Strategy for 2017 – 2021, and specifically mentions the role of Test Sites as key to developing this sector.

The Offshore Renewable Energy Development Plan (OREDP) sets out key principles, policy actions and enablers for delivery of Ireland's significant potential in this area. In this way, the OREDP provides a framework for the sustainable development of Ireland's offshore renewable energy resources. The OREDP, includes a ringfenced feed in tariff and support for R&D and test facilities to encourage the development of Ireland's offshore renewable energy potential (note: this feed in tariff has never been utilised). An Interim Review of the OREDP was published in May 2018 and is currently due for an update by policymakers.

Ireland's national energy and climate plan 2021-2030 was prepared to incorporate all planned policies and measures that were identified up to the end of 2019 and which collectively deliver a 30% reduction by 2030 in non-ETS greenhouse gas emissions (from 2005 levels). Under the National Development Plan, Ireland is committed to achieving a 51% reduction in greenhouse gas emissions by 2030 and to reach carbon nuetrality by 2050. The NECP was drafted in line with the current EU effort-sharing approach, before the Government committed to this higher level of ambition, and therefore does not reflect this higher commitment. Realising Ireland's potential in offshore renewables is highlighted in the National Development Plan, and seen as a key part in meeting Ireland's target to deliver at least 80% renewable electricity by 2030. The Programme goes on to support creating the right investment environment, support ocean energy research, develop and demonstrate floating wind, tidal, and wave power, together developing innovative transmission and storage technologies, such as high-voltage, direct-current interconnection and green hydrogen on an all-island basis. The plan sets out a target of achieving 5GW capacity in offshore wind by 2030 off Ireland's Eastern and Southern coasts. This plan will be delivered through the actions devised in the Climate Action Plan 2021. In which all government departments have been dedicated actions to deliver Ireland's Climate ambitions.

MARKET SUPPORT:

There is no support scheme in place in Ireland for offshore renewables, however a Renewable Energy Support Scheme (RESS2) Auction is expected in 2021, and offshore wind will be included in this round. The current scheme involves an auction-based structure based on a Floating Feed-In-Premium where the government will match the difference between the strike price and the market price.

MARINE ENERGY POTENTIAL:

Ireland's coast is one of the most energy productive in Europe, with a long-term potential of 70GW of ocean energy opportunity (wind, wave and tidal) within 100 km of the Irish coastline.

Ireland has an abundance of ocean energy resource in the form of offshore wind and waves. The resource available to fixed and floating wind is immense, with the potential for 12GW for fixed and up to 30GW for floating. Furthermore, a total of 31GW of wave energy development potential was identified in Irish waters that could be extracted without having likely significant adverse effects on the environment. The theoretical potential for both wave and wind energy off Ireland's shores far exceeds the total electricity demand representing real export potential.

CONSENTING:

Ireland's ambitions for the offshore renewable energy (ORE) sector are contingent on delivering an appropriate licensing and regulatory regime. For the future ORE regime, the development of the Maritime Area Planning Actprovides the requisite flexibility for Ireland to move, in a phased manner from the current, decentralised model, to a more plan-led/centralised regime over the course of this decade. To simplify the consenting process of marine energies, the new Maritime Area Planning Act replaces existing State and development consent regimes and streamline arrangements on the basis of a single consent principle i.e. one state consent (Maritime Area Consent) to enable occupation of the Maritime Area and one development consent (planning permission), with a single environmental assessment. The new single consent principle is designed to remove unnecessary duplication and will also play a critical role in the harnessing of the potential of our offshore renewable energy resources and the transition towards a sustainable, secure and competitive energy system and in meeting our climate change goals. A new Agency – the Maritime Area Regulatory Authority (MARA) will be established by 2023 to reside over this process.

R&D FUNDING SUPPORT:

In Ireland, ocean energy research and development is supported by the government agency Sustainable Energy Authority of Ireland. The national funding supports for ocean energy technology development include specific research topics in the broader funding programme Research, Development and Demonstration Fund. SEAI is also involved in international collaborations with OCEANERA-NET COFUND and the OceanPower Innovation Network. Unfortunately there is no specific national fund for ocean energy research and demonstration since the Prototype Development Fund closed a few years ago.

WHAT TO REMEMBER:

Offshore Renewable Energy Development Plan (OREDP)
Renewable Energy Support Scheme (RESS2)
R&D and Demonstration Fund – SEAI

More information

3. FRANCE

POLICY:

France's strategy for energy is detailed in its multiannual energy plan (Programmation Pluriannuelle de l'Energie – PPE). This document sets out the government's priorities for action in the field of energy for the continental metropolis over the next 10 years, divided into two 5-year periods (2019-2023 and 2024-2028).

The offshore bottom-fixed and floating wind benefit from an ambitious strategy with a binding calendar of tenders on French sea facades indicating target volumes and prices.

Concerning floating wind energy more specifically, four pilot farm projects of 24 MW each have been designated winners of a call for projects launched by the ADEME in 2017 within the framework of the Future Investment Programme: one in Southern Brittany, three in the Mediterranean. The first commissioning is scheduled for 2022. 750 MW of floating offshore wind are expected to be installed through two calls for tender: one in the South of Bretagne and two in the Mediterranean. After 2024, 1 GW per year will be awarded for bottom-fixed and/or floating wind, depending on price and resource.

Concerning the tidal sector, the French government considers that the conditions for launching a commercial call for tenders are not met yet. The Government monitors the demonstrator projects and pilot farms that would be pursued, as well as the development of the sector's performance in the coming years.

As far as wave energy is concerned, the government considers the sector is still at the point of demonstration and that there is no reliable estimate of the technical potential that can be exploited, given the maturity of the sector.

As part of the EU regulation, France has also set up four maritime spatial plans corresponding to the four administrative maritime areas. A mapping of activities has been realised through a comprehensive consultation and participative work. The results are available on an interactive map[28].

MARKET SUPPORT

With targets clearly set up by the PPE, offshore wind benefits from a series of competitive tenders that allow the project candidates to bid for a tariff. The consortium awarded will receive a tariff in the form of a contract for difference.

Introduced by the decree of 28 April 2017, Article D314-15 of the Energy Code provides that a feed-in tariff may be granted for a tidal or wave energy production project, once this project is designated as the winner of a call for projects of the Future Investment Programme. The tariff order must be approved by the Energy Regulation Commission (CRE) and is presented to DG Competition.

In addition, the Climate Energy Law of 8 November 2019 introduced the experimentation contract in the Energy Code in Article L 314-29. It provides that the administrative authority may use a call for projects to designate producers of electricity production facilities that use innovative renewable energy. The terms and conditions of the call for projects are defined by decree in the Council of State, issued after the opinion of the Energy Regulation Commission. The designated candidates can benefit from a purchase contract whose remuneration terms are set on a case-by-case basis.

MARINE ENERGY POTENTIAL

Continental France has an extensive and well-winded coastline. The areas theoretically exploitable with current technologies for offshore wind have an energy potential of around 30 GW, to be modulated according to local constraints (environment, conflicts of use, regulatory restrictions). In Europe, France has the second largest wind resource for offshore wind energy after Great Britain.

According to the sector's professsionals, the French Atlantic coast that represents 5 000 to 7 000km² has the potential to install an offshore wind capacity of 25 to 35 GW[29] by 2050 (both bottom-fixed and floating offshore wind). The Nouvelle-Aquitaine region has set up an objective of 1,1 GW installed by 2030 representing 3 850 GWh/an.

Regarding tidal, France which has some of the strongest currents in the world, has a technical potential that can be exploited, before taking into account the constraints of use, of the order of 3 to 5 GW, i.e. a third of the European resource. The resource is mainly located off the Raz-Blanchard in Normandy and in the passage of the Fromveur in Brittany. A potential of 100 MW has however been identified in the Gironde estuary for smaller tidal energy projects.

Considering the length of the French coastline, the potential of wave energy is huge. The ADEME (French governmental agency for energy) evaluates the theoretical capacity of the French coastline at 400 TWh with the objective of exploiting 10% of this potential, mainly on the Atlantic coast. The Aquitaine region had identified an overall 800 MW of potential installed capacity and whishes to install 20 MW by 2030 representing 40 GWh/year[30].

28. https://cerema.maps.arcgis.com/apps/webappviewer/index.html?id=3a1cc8e6d52c4c4cb85fc8fe404f5f06
29. https://fee.asso.fr/wp-content/uploads/2021/12/FEE_mer_DEF_WEB_2dec.pdf
30. Source: SRADDETT Nouvelle-Aquitaine.

CONSENTING

Developing marine energy projects in France require two different types of administrative authorizations; a licence to occupy the public domain and an environmental authorization that will be delivered on the basis of an environmental impact study. The state representatives in the regions affected by the projects are responsible for granting the licences.

A wide range of simplification measures has been adopted in the recent years to ease and streamlined the consenting process in France, in particular for offshore wind.

R&D SUPPORT

At the national level, the Future Investment Programme run by the ADEME – governmental agency for environment and energy – has funded a large number of marine energy R&D and demonstration projects.

At territorial level, the Regions have important competencies for the development of the sector. They can implement actions aimed at structuring the sector, increasing the competence of companies in the value chain, financing research and demonstration projects, as well as making investments, for example in testing infrastructures or logistics and port infrastructures.

In Pays de la Loire, many tools, institutions, associations are supporting the sector: WEAMEC, Solutions&Co, Néopolia, SEM-REV, Centrale Nantes...

WHAT TO REMEMBER:

Multi-annual Energy Plan (PPE)
Experimentation Contract
Future Investment Programme - ADEME
WEAMEC

More information

4. SPAIN

POLICY:

The Ministry for Ecological Transition and Demographic Challenge has developed a ***National Integrated Plan of Energy and Climate***[31] ***(PNIEC) 2021-2030***, released in 2020. The PNIEC plans the Spanish energy matrix to become 74% renewable for the electrical sector by 2030 and sets a trajectory to become 100% renewable by 2050. In this scenario, the combined capacity of onshore and offshore wind energy would reach 50.3GW by 2030. For Marine energies the objectives for 2030 are 1-3GW for offshore wind and 40-60MW for marine energy.

The main objectives regarding offshore wind are centered in developing technical advances that enable the reduction of the costs of this technology, with an emphasis on floating solutions and non-invasive assembly techniques in the marine environment, which increase the potential areas for the implementation of offshore wind farms and accelerate their contribution to the objectives of decarbonisation at a competitive cost.

The Institute for Diversification and Energy Saving (IDAE) will coordinate a "Spanish Strategy for Offshore Wind Technology Development", which conclusions and objectives could be included in the reviews of the PNIEC.

In April 2017 the Royal Decree 363/2017 establishing a frame for maritime space ordinance was approved. This text establishes the development of 5 Plans for Marine Spaces Ordinance (POEM), which allows the competent authorities to analize and organize the human activities in marine areas, including the analysis of areas where offshore wind farms could have a potential bigger contribution to the energy matrix and the compatibilities and interactions with other present and future uses of those areas.

In May 2017, Spain and other 13 Member States signed the political declaration on Clean Energy For EU Islands, acknowledging their potential to drive the energy transition by themselves as well as the opportunity to use these territories as labs for technologies and energy transition policies that could be later exported to the continent.

BASQUE COUNTRY

The Energy Strategy of the Basque Country 2030 (3E2030) defines the objectives and basic lines of actions for the Basque Government in terms of energy policy for the period 2016-2030. This strategy is part of a longer-term vision which envisages an increasing sustainable energy system with greater competitiveness, security of supply and lower carbon dependency.

The Energy Strategy sets a target of 50MW for offshore floating wind and 10MW of wave energy of installed capacity by 2030. The Energy Strategy of the Country was developed for the period 2016-2030, five years before the ***National Integrated Plan of Energy and Climate***, PNIEC, that was issued in 2021 for the period 2021-2030. This could explain some slight differences in the objectives set.

CANARY ISLANDS

The Canarian and 4 other Plans for Marine Spaces Ordinance (POEMs) are in draft review after public consultation during summer 2021.

The Energetic Strategy of the Canary Islands 2015-2025 (EECan25) was established in 2017. The EECan25 is a proposal for a strategic programme for energy that is based in guaranteeing safety in the supply of energy by diversifying the sources, boosting the implementation of renewable energies and strengthening the insular electrical systems.

The strategy sets a target of 310 MW of offshore wind energy by 2025, thus contributing to the goal specified in the PNIEC of reducing by 50% the use of fossil fuels in the Canarian electrical mix by 2030 compared to 2019, in which the islands depended on oil as primary energy source by 98%.

In March 2021, the Government of the Canary Islands approved a decree urging the Energy Transition Office to prepare an Energy Transition Plan[32], which the Technological Institute of the Canary Islands (ITC) is developing. The Plan will comprise various strategies, three of them being already published[33] and including a specific strategy for marine renewable energies, approved on April 2021[34]. The full Plan is expected to be published by the end of 2021 and will have a time horizon up to 2040.

In addition, the Canarian Government has developed a draft bill for Climate Change and Energy Transition[35] in order to establish political commitment and resources to fight climate change in the islands.

The draft of the Canarian Strategy for Blue Economy 2021-2030[36] takes into account the importance of developing the marine renewable energy sector in the islands, acknowledging offshore wind energy as the sector with the biggest potential, stating the need to invest in R&D for floating structures, and setting a set of goals for further development of wind and wave energy.

31. https://www.miteco.gob.es/images/es/pnieccompleto_tcm30-508410.pdf
32. http://www.gobiernodecanarias.org/boc/2021/042/011.html
33. https://www.gobiernodecanarias.org/energia/temas/planificacion/
34. https://www3.gobiernodecanarias.org/noticias/transicion-ecologica-culmina-la-estrategia-de-energias-renovables-marinas-de-canarias/
35 https://www.gobiernodecanarias.org/cmsgobcan/export/sites/participacionciudadana/iniciativas/.docs/ctelccpt/Anteproyecto-de-Ley-4-11-2020.pdf
36. https://www.gobiernodecanarias.org/cmsweb/export/sites/economia/galeria/Galeria_politica_economica_2/2020-08-31-borrador-ECEA-web.pdf

MARKET SUPPORT:

Market support is given to renewable energies through auctions and incentives following RD 1028/2007. Floating offshore wind technologies are considered in the group of high-potential developing technologies, which are subject to a calendar of auctions with a reduced power capacity that allows for demonstration or flagship projects. For the 2030 horizon, floating wind already shows a high potentiality and the support mechanisms and power volumes will adapt to its competitivity levels and synergies with other strategic sectors such as shipyards, civil engineering or electrical industries.

The PNIEC acknowledges that the developments made in tidal and wave technologies need a boost to increase the TRL to 7, 8 and 9. To this end, activities should be focused on possible demonstration projects that generate knowledge and experience in a real marine environment. The long-term strategy in ocean energy proposes the development and implementation of reliable and competitively priced generation parks.

The process to develop an offshore wind farm starts with an electric power auction, which can be specific for wind energy or general for all kind of renewable energy, set by the Spanish Government through the Ministry of Ecological Transition (MITECO). Then the promoters make its offer (number of MWs and price of the energy produced) and the projects are awarded.

BASQUE COUNTRY

There is no pre-set feed-in tariff for offshore floating wind in the Basque Country but through the MITECO's auctions the awarded projects can benefit from a specific remuneration scheme. The Ministry of Ecological Transition anounced recently an auction of renewable energy of 500 MW within which 20 MW will be awarded to other renewable energies among which offshore wind is included. In the specific case of the 50 MW targeted for the Basque Country, these will mainly be achieved through demonstration projects, promoted either by public entities or private investors.

CANARY ISLANDS

There is no specific market support in the Canary Islands for marine energies. Wind and photovoltaic installations onshore in insular systems follow the Order IET/1459/2014.

MARINE RENEWABLE ENERGY POTENTIAL:

BASQUE COUNTRY

The Basque Country has 246 kilometres of coastline. The particular geographic characteristics with a very deep seabed at short distance from the coast implies a much better potential for floating offshore wind, as the bathymetry is not well suited for bottom-fixed offshore wind.

Preliminary studies, taking into account the uncertainty around the technology maturity, and the other uses of the sea contemplated in the POEM, point to the possibility of installing around 500 MW of wave energy and 622 MW of offshore wind.

Wave energy is indeed a significant resource in the Basque country, it has been assessed that the potential can represent up to 10% of the electrical consumption of the region (1 600 GWh/year).

CANARY ISLANDS

The Strategy for Marine Renewable Energies in the Canary Islands[37], drafted by the Canarian Government, estimates that the energies with the highest potential in the region are the offshore wind, wave energy and floating photovoltaic.

The study estimates that the Islands count on areas for installation of 5 to 14 GW of offshore wind, depending on the distance between turbines. In addition, it estimates a potential of about 300 MW for wave energy and 97 MW for floating photovoltaic.

The Canary Islands hold the first installed offshore wind turbine in Spain and southern Europe, Elican, a 5 MW turbine installed at 30m depth with fixed foundation at PLOCAN's test site. Generally, the Canary Islands are characterized by a deep near shore coastline, thus turning the installation of fixed offshore foundations almost unfeasible. The development of floating structures opens the opportunity to take advantage of the high offshore wind potential of the region.

CONSENTING:

At the national level, the Spanish General Administration authorizes the installation of technologies in the Spanish territorial sea, independently of their size. The Royal Decree 1028/2007 regulates the authorization procedure for the installation of marine renewable energies with two different distinctions: a simplified procedure for ocean energies and offshore wind systems up to 50 MW following the Royal Decree 661/2007, and a general procedure (in competitive concurrence) for offshore wind farms of more than 50 MW. Within these frames, the auctions are based in offers for the price of the MW-hour for each proposed location.

The technological evolution and the development of European, Spanish and regional legal and project frames have led to the review and update of the consenting and licensing processes of offshore wind energy. An "Offshore Wind and Marine Energy Development Roadmap"[38] has been released.

There is no dedicated consenting process for ocean energy technologies. The consenting process is based on three main legal instruments that are briefly outlined here. Royal Decree 1/2008, of 11 January, governs the need for the Environmental Impact Assessment of projects located in the natural environment. According to this Decree an Environmental Impact Statement (EIS) has to be produced and evaluated by the leading agency to determine the

37. https://www3.gobiernodecanarias.org/noticias/transicion-ecologica-culmina-la-estrategia-de-energias-renovables-marinas-de-canarias/
38. https://energia.gob.es/es-es/Participacion/Paginas/DetalleParticipacionPublica.aspx?k=316

decision on project approval (or not) from an environmental point of view.

The Coast Law (28th July 1988), is the legal framework governing occupation of the territorial sea, together with issues affecting the fishing sector and safety conditions for maritime navigation. Management and surveillance competencies relating to the Maritime Public Domain on land (MTPD), which the territorial sea belongs to, rest with the General Council on Coast and Ocean Sustainability which forms part of the Ministry of Rural, Marine and Natural Environment. Coast Demarcation Departments are their representatives in each coastal province and Autonomous Community.

Royal Decree 1028/2007 establishes the administrative procedure for processing applications for electricity generating facilities in territorial waters. Although it is focused on offshore wind, it also considers (article 32) electricity generation from other marine renewable technologies. This Decree foresees a simplified procedure governed by Royal Decree 1955/2000, (from 1st December 2000), regulating energy transport, distribution, commercialisation, supply and the authorisation procedure for electrical power plants.

CANARY ISLANDS

The Law 41/2010, Protection of the Marine Territory, aims for the conservation of the marine environment establishing a Canarian marine demarcation and setting environmental objectives and monitoring programs. Thus, the foreseen actions in PNIEC that are to be developed in the marine environment inside the Canarian demarcation are subject to a compatibility report to avoid negative environmental impacts, especially for the development of new renewable electrical installations for demonstration and future offshore wind farms.

R&D FUNDING SUPPORT:

BASQUE COUNTRY

Following the commissioning of the Biscay Marine Energy Platform in 2015 and earlier on the Mutriku Power Plant in 2011, the public bodies have succeed in attracting developers and technologies in setting up aid for the development of new units or components.

The Basque Energy Agency, EVE, annually launches a grant program for investment in the demonstration and validation of emerging marine renewable energy technologies, supporting the pilot testing at the demonstration and validation phase of full scale, or almost full scale, prototypes of wave energy converters, floating offshore wind platforms, offshore wind turbines and auxiliary equipment or components considered as complementary to any of the former prototypes.

EVE has also contributed to the sector through several Public Purchase Procurements, such as Europewave, a competitive Pre-Commercial Procurement (PCP) programme for wave energy, aiming to focus on the design, development, and demonstration of cost-effective wave energy converter systems for electrical power production that can survive in the harsh and unpredictable ocean environment.

CANARY ISLANDS

Envisaged in the Energetic Strategy of the Canary Islands 2015-2025 (EECan25), the initiative E7_1.1 is based on a support program for R&D+I for renewable energies, that includes ocean energies apart from offshore wind technologies.

WHAT TO REMEMBER:

Royal Decree 1028/2007
Offshore Wind and Marine Energy Development Roadmap
Energy Strategy of the Basque Country 2030 – 3E2030
Marine Energy Strategy of the Canary Islands

More information

5. PORTUGAL

POLICY:

Portugal continues to build a strategy based on renewable energy sources on the path to a carbon neutral economy. As such, ambitious but feasible goals for 2030 have been set up in the NECP 2030[39]. For offshore wind, it is indicated that Portugal is promoting and using the infrastructure being created near Viana do Castelo, to achieve (in the first phase) 200 MW of new capacity, 25 MW of which has already been allocated to the Windfloat project. Portugal's potential to use wave energy is widely recognised and diverse measures have been initiated, with a target to achieve 70 MW in 2030.

Portugal's Industrial Strategy for Ocean Renewable Energies EI-ERO was published in 2017 and establishes guidelines for the use of renewable energy obtained through infrastructures installed or to be installed in coastal zones and in the ocean. The Portuguese government based its EI-ERO around two main goals, which are to stimulate export and value-added investment and to assist industry in reducing risks. According to EI-ERO, offshore renewable energies have the potential to supply 25% of the electricity consumed annually in Portugal and create a new export chain in these new technologies. The EI-ERO also foresees that synergies will be created with the shipbuilding industry to accelerate innovation in ocean energy.

In December 2019, the National Maritime Spatial Plan (PSOEM) was approved for mainland Portugal, Madeira, Azores and Extended Continental Shelf with a strategy for the compatibility of the different existing and potential activities in the sea, along with administrative online procedures for implementing projects in the ocean. A Geoportal Maritime Spatial Plan[40] was also created to make information easy for any type of user, with updated information on activities and constraints.

More recently, the Portuguese Government approved the document "National Strategy for the Sea 2021-2030" with the main objective of defining public policies to promote the country´s economic and social development in the next decade. One of its structural axes is the climate transition and sustainability of resources to promote a circular economy and respond to the challenge of the Energy Transition. Particular emphasis is given to offshore wind energy, promoting the installation of floating wind farms.

In 2020, the government created the "Free Zones for Technology (ZLT)" as physical environments for testing on innovative technology-based technologies, products and services. The ZLT is seen as a legal and regulatory framework that promotes and facilitates the testing of innovative technologies. In this context, the Resolution of the Council of Ministers No. 29/2020 of 21 April was published. It sets out the general principles for the creation and regulation of the ZLT and the Decree-Law 67/2021 establishes the legal basis framework for their constitution. It is expected to facilitate experimental testing of marine renewable energies.

MARKET SUPPORT:

Presently, there are no specific market support mechanisms for marine renewable energies.

MARINE ENERGY POTENTIAL:

Portugal has a vast marine renewable energy potential – wave energy and offshore wind – in the Atlantic coast.

A study done by the National Laboratory for Energy and Geology (LNEG) indicates a total capacity over 40 GW of wind power available for all the open sea confined between bathymetric depths of 40m and 200m (floating offshore wind); for fixed offshore wind (depths below 40 m) an estimate between 1.4 to 3.5 GW have been indicated[41].

A study done by WavEC in 2004 to the General Directorate of Energy and Geology (DGEG) estimates a wave energy potential between 3 and 4 GW taking into account all other uses at the sea space, in water depths between 50m – 80m.

Both figures, for offshore wind and wave energy potential, have been used as a reference for the Industrial Strategy for Ocean Renewable Energies (EI-ERO) published by the government in 2017.[42]

39. https://ec.europa.eu/energy/topics/energy-strategy/national-energy-climate-plans_en
40. https://www.psoem.pt/geoportal_psoem/
41. Ref: Costa, P.; Simões, T.; Estanqueiro, A. Sustainable Offshore Wind Potential in Continental Portugal. In: Workshop on Oceans as a Source of Energy, Academia de Engenharia, Lisboa, Maio, 2010
42. Industrial Strategy and Action Plan for Ocean Renewable Energies (in portuguese; https://files.dre.pt/1s/2017/11/22700/0617606188.pdf)

CONSENTING:

The right to use the national maritime space (including marine renewable energies) is granted by concession, license or authorization and it is formalized in the form of "permits of private use of the maritime space", known as TUPEM. The different TUPEM modalities are related with the nature of the project: the concession is granted for projects with prolonged use of an area, running uninterruptedly and lasting 12 months or more; the License is for projects with a duration less than 12 months with an intermittent or seasonal use; the authorization is used in the scope of scientific research projects and pilot projects without a commercial feature.

The request for TUPEM is done online, through the completion of a form, via the DGRM (Directorate General for Natural Resources, Safety and Maritime Services)[43].

R&D FUNDING SUPPORT:

FCT is the national funding agency that supports science, technology and innovation in all scientific domains. FCT has been supporting collaborative innovation in the ocean energy sector mainly through the Ocean Energy ERA-NET Cofund (OCEANERA-NET COFUND), an initiative of eight national and regional government agencies from six European countries, which has received funding from the European Union under the Horizon 2020 Programme for R&I. Under this funding scheme, FCT funding commitment for the call was 300.000 €.

FUNDO AZUL (Blue fund)[44] was created by the Portuguese Government in 2016, and is financing projects of various types, aiming at boosting the economy of the sea. In this context, the most relevant areas of funding are those related to scientific and technological ocean research, renewable ocean energies and the monitoring and protection of the marine environment.

WHAT TO REMEMBER:

National Strategy for the Sea 2021-2030
Industrial strategy for Ocean Renewable Energies (EI-RO)
TUPEM
Geoportal Maritime Spatial Plan
Simplified Licensing Procedure (one-stop shop)

More information

43. https://www.dgrm.mm.gov.pt/as-om-tupem
44. https://www.dgpm.mm.gov.pt/fundo-azul

OPEN SEA TEST SITES: A KEY ROLE IN THE DEVELOPMENT OF MRE

As ocean energy technologies progress, challenges must be faced and barriers still need to be overcome.

1. TEST CENTRES HELP TO BRING THE COSTS DOWN AND MAKE THE PROJECTS BANKABLE

A study realised by the Offshore Renewable Energy Catapult (OREC) in 2018[46] calculated the different costs of tidal and wave energies. The levelised cost of energy (LCOE) for tidal energy projects installed to date shows a wide range of costs as these have been installed over a variety of types of sites, using different devices at different stages of technology development (eg. single prototypes vs small arrays). Giving more weighting to the most recently deployed sites, OREC calculates that the representative current LCOE is approximately 360 EUR per MWh. For wave energy OREC aknowledges it is hard to quantify the LCOE due to the stage of development. Recent one-off prototype devices indicate an LCOE in excess of 360 EUR per MWh, but the lack of data makes a global estimation uncertain.

Like all innovative sectors, the sector is experiencing a decrease in costs as it progresses technologically and commercially. There is a 50% drop in costs between the demonstrator and the pilot farm, and a 30% further drop in costs between the pilot farm and the first commercial farm. Costs continue to fall as the sector industrialises and expands commercially, through the following mechanisms:

- Volume effects: this intuitive and observable phenomenon in all industries will occur under the same conditions thanks to mass production and standardisation of products and components.
- Economies of scale: these are achieved on the one hand by increasing the size of sites and on the other by increasing the size of machines.
- Learning effects: the experience gained has a considerable impact on the cost of projects. This is all the more important for marine energies where offshore operations have a significant weight in the overall cost.
- Innovation and reduction of the level of risk perceived by investors: improvement of reliability and availability, reduction of offshore operation costs, improvements in connectivity, etc.
- The cost of capital: reduction in the cost of financing projects.

THUS THE COST REDUCTION OBSERVED IN OFFSHORE WIND (60 TO 70%) CONSTITUTES A TRAJECTORY APPLICABLE TO OTHER RENEWABLE MARINE ENERGIES, AS IT WILL RELY ON THE SAME COST REDUCTION LEVERS.

There are investor concerns over the lack of a clear route to market in the form of revenue support. Their interest is subject to clear policy support signals. At present, ocean energy projects are forced to compete on cost with more mature offshore wind technologies at a significantly different scale. Investors are prepared to get involved in pre-commercial projects of 5-10 MW but competitive finance access really begins at a larger scale. Investors wish to see more operational data on marine technologies to reduce the risk profile of the project. To date, most projects have deployed single device only, and tend to deploy a next generation device or small arrays for the succeeding project. So, technologies still carry perceived risks, which can make them uninsurable and hence not bankable.

Experimental testing in real conditions is a fundamental step in marine renewable energies development, despite the sharp increase in available computational power and improvements in computational fluid dynamics (CfD) codes over the last few years. Testing at test sites provides the means to draw meaningful conclusions related to the device behaviour in real conditions. The results can be extrapolated to the full-scale prototype, at a small fraction of the cost, increasing the confidence in technology maturity and demonstrating its readiness towards full-scale deployment.

2. TEST CENTRES TACKLE ENVIRONMENTAL UNCERTAINTIES AROUND MRE

In 2021, very little large scale prototypes have been tested, and even more rarely in pilot farm. The feedback from single unit testing and short term prototype testing is also not sufficiently representative in order to address all aspects of environmental impacts. Therefore, the existing knowledge on tidal, wave or floating wind technologies is scarce. This could also be one of the major hindrance in the development of marine renewables.

A number of on-going european projects are adressing this issue. Funded by the European Maritime Fisheries Fund (EMFF), the WESE project and its continuation through SafeWAVE, are adressing the need to improve the current knowledge on the potential environmental effects of wave energy to better inform decision-makers and managers on environmental risks and reduce environmental consenting uncertainty.

Initiatives such as the OES-Environmental with support of the International Energy Agency's Technology Collaboration Programme on Ocean Energy System (OES) are creating a knowledge database of perceived risks and how to mitigate them. Overall, updated research on offshore infrastructure impacts on the marine environment indicate that disruptive impacts on ecosystems appear to be negligible. However, they must continue to be monitored closely, particularly as larger arrays of tidal devices are deployed. Regulatory requirements are currently high and may not always target the most useful information[45].

An overview of the environmental risks raised is provided:

- **Changes in oceanographic systems:** for small amounts of devices, changes are too small to measure. Relatively low risk. This parameter will have to be revisited with larger arrays.
- **Changes in habitats/ biofouling:** similar to effects of other offshore industries so can learn a lot. Deployments need to be carefully sited to avoid rare habitats. Reefing of fish and settle in these structures, problem for maintenance of the device, not for the habitat. Relatively low risk.
- **Risk of underwater noise:** important tools available – TC114 – international standard for measuring noise. The US have regulatory thresholds for levels of impact. Measurements of turbines and wave energy converters are below the guidelines, hence the risk is low.
- **Collision risk into turbines:** no collision was ever recorded, developers have seen fish come very close but without harm. Perceived risk remains high for collision because there is uncertainty about collision probability and the level of consequences. To lower the risk, it is key to share existing information, improve modelling, monitor data and continue research works.
- **Encounters with moorings/cables:** there is no loose ends of cables in marine renewable energy so very low risk, but it is brought up often by regulators so it remains important to have evidence to hand.
- **Electromagnetic Risk** – only some marine species are sensitive. It does not appear to be harmful, but it will be neccesary to examine effect with larger arrays. There currently are no standardised methods or thresholds. The risk is relatively low.

Test centres are pivotal for the development of ocean energy and to tackle non-technological barriers, as they offer accessibility to infrastructures, simplified permitting processes (pre-consented areas) and pre-established logistics that could otherwise be an excessive burden for pre-commercial developers that strive to start testing their devices.

Nevertheless, test centres' prominent role could be further developed by transferring data retrieved by projects to future projects, avoiding the d uplication of work and decreasing monitoring costs. Data transferability can pave the ground for an easier, streamlined impact assessment and consenting process, therefore increasing the benefits that test sites can offer.[46]

45. https://www.ocean-energy-systems.org/publications/oes-position-papers/document/the-state-of-knowledge-for-environmental-effects-2018-/
46. https://www.etipocean.eu/events/webinar-data-transferability/

HOW DO WE GO FURTHER?

In order to further develop marine renewable energies in the Atlantic Area, the Blue-GIFT consortium recommend the following:

1

SUPPORT THE DEVELOPMENT OF OCEAN ENERGY TECHNOLOGIES and their application in the Atlantic Arc by establishing a carbon-neutral zone in the Atlantic Area that includes the contribution of ocean energy
Considering the potential of the region, the Atlantic Area must be a huge contributor to the Offshore Energy Strategy.

OFFSHORE WIND
60 GW by 2030
300 GW by 2050

OCEAN ENERGY
100 MW by 2025
1 GW by 2030
40 GW by 2050

2

DEVELOP ENVIRONMENTAL MONITORING around test sites and generate shared data for the benefit of the sector
Test site R&D collaborative plan

3

UPGRADE OPEN SEA TEST SITES to respond to the need of the sector
Test Sites 5 years Investment Pan

4

FOSTER AND SUPPORT DEMONSTRATION PROJECTS in real sea conditions
Blue-GIFT has led to the attribution of 18 vouchers showing the strong interest from technology developer to get an access to the test sites

5

STRENGTHEN THE NETWORK OF TEST SITES and their collaboration across the Atlantic Arc and beyond
Projects as Blue-GIFT, OceanDemo, FORESEA are of great importance to reinforce the roles of test sites, help them to strengthen and increase their support to the sector by sharing knowledge and good practices.

Interreg Atlantic Area — European Regional Development Fund — EUROPEAN UNION — BLUEGIFT

Interreg North-West Europe Ocean DEMO

Interreg North-West Europe FORESEA

ABOUT INTERREG ATLANTIC AREA

As part of the European Union's Cohesion Policy, Interreg Atlantic Area supports transnational cooperation projects in 36 Atlantic regions of five countries: France, Ireland, Portugal, Spain and the United Kingdom, contributing to the achievement of economic, social and territorial cohesion. For further information, visit www.atlanticarea.eu