Pilot experiences assessment, lessons learnt and recommendations

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Abbreviations

BE	Blue Energy
CMU	Community of Mediterranean Universities
CCIACHPE	Chamber of Commerce of Chieti-Pescara
DURA	Dubrovnik development agency
EMFF	European Maritime and Fisheries Fund
ERDF	European Regional Development Fund
HP	Heat Pump
IRENA	Istria Regional Energy Agency
LCOE	Levelized Cost of Energy
NGO	Non-governmental Organization
NPV	Net Present Value
O&M	Operation and Maintenance
R&D	Research and Development
SDEWES	International Centre for Sustainable Development of Energy, Water and Environment Systems
SECAP	Sustainable Energy and Climate Adaptation Plan
SME	Small and Medium Enterprises
SWHP	Seawater Heat Pump
TRL	Technology Readiness Level
UNICAM	University of Camerino
UNIUD	University of Udine
WEC	Wave Energy Converter

1. Introduction

This Deliverable, produced within the framework of WP5 'Preparing the capitalization and transferring of project results', aims at assessing the pilot experiences developed within the COASTENERGY project to improve cross-border cooperation on Blue Energy.

It analyses, evaluates and compares the activities carried out within the Local Coastal Energy Hubs, in order to draw conclusions, adjust the methodology based on the results achieved at local level, and extract the main lessons learnt and recommendations for future work on project themes (in terms of advocacy, project implementation, establishment of business support services and policy design), in the Programme area and beyond.

The eight Local Coastal Energy Hubs (one per each involved region) are the local expression of a permanent multi-level network established by the project, whose international facet is represented by the Cross-border Hub. Animated and coordinated by partner organizations, they were conceived as co-design platforms and sources of support to develop Blue Energy projects, during and after the end of the project. During the project implementation, each local network met several times and worked to define a roadmap for blue energy deployment in target regions, to facilitate information sharing and innovation transfer, and to make the actors of the Quadruple Helix (public authorities, research centres, enterprises and groups of citizens) cooperate to plan concrete initiatives and set the basis for innovative start-ups and Blue Energy clusters. The main output of each Local Hub was a feasibility study for the future implementation of a Blue Energy plant integrated in coastal buildings or infrastructure, to be funded by ERDF and/or national funds after the end of the project.

2. Comparative analysis and evaluation of Local Coastal Energy Hubs: conclusions and lessons learnt

2.1. The Local Coastal Energy Hubs in figures

Though, to date, not all partners have carried out all the Local Hub meetings initially foreseen, it is still possible to draw conclusions on the experience, and to extract recommendations and lessons learnt.

The situation of the meetings is summarized in the table below.

COASTENERGY Partner	no. of hubs meetings carried out (up to 10/11/2021)	Mode		Total number of persons involved
		Live	Online	
LP - IRENA	3	1	2	10
PP1 - DURA	2	1	1	15
PP2 - SDEWES	4	4	0	29
PP3 - UNICAM	3	0	3	29
PP4 - UNIUD	4	1	3	86
PP5 - CMU	2	0	2	102
PP6 - CCIACHPE	3	1	2	47
PP7 - City of Ploče	4	3	1	67
TOTAL	**22**	**9**	**13**	**385**

2.2. Structure and organization of the meetings

The main stakeholders to involve in the COASTENERGY activities were identified by partner organizations at the beginning of the project within the following macro-categories:

- Public administrations
- Local enterprises working in the energy sector or in maritime sectors
- Business support organizations
- NGOs in the sectors of environmental protection, business development, territorial promotion
- Universities and research centres working in blue-energy related fields
- VET institutions and technical high schools
- General public

The first round of Local conferences organized within WP2 was essential to start their mobilization, provide them with general information on blue energy technologies and opportunities, and identify the major themes to address during the meetings. It also allowed each partner to identify the key stakeholders to include in the Local Hub, and to assess their interest in participating.

After the Local Conferences, each partner organized the Local Hub meetings autonomously, though common guidelines developed in WP4 provided a shared framework to harmonize the task.

Normally, the first meeting of the Hub usually pursued the participation of a wider range of stakeholders (sometimes including the general public), to present COASTENERGY objectives, share information and get insights about potential locations of the pilot projects.

The following meetings aimed at engaging more restricted groups of selected stakeholders in round tables or focus groups, for discussing in detail the pilot project, defining shared solutions and future steps (also in terms of administrative procedures), and in some cases carrying out specific practical activities (site visits, etc.).

According to this approach, the first meeting (or kick-off meeting) of the Local Hub usually had a more structured agenda, while the following ones had a more open structure, based on collective discussion on a given theme. However, it is worth stressing that there were slight differences among the partners in the approach to the meetings organization.

This mainly depended on the kind of partner (whether a university, a local administration, a public agency or a business support organization), on their networks of contacts, and on the baseline features of the involved area. For example, the partner UNIUD detected a particular lack of knowledge on Blue Energy in its territory, and, being an educational institution, decided to give its hubs a more knowledge-transfer dimension, conceiving them as short training seminars, held by the same experts already involved in the Cross-Border Hub. In this sense, this was a good example of multi-level exchange of knowledge between the international, technical-scientific scope of the CBH and the local level.

The following table summarizes the main criteria that guided the organization of the Local Hubs meetings, and the types of activities implemented therein.

Main criteria for the selection of invitees	The following entities were taken into account: - Entities included in the COASTENERGY stakeholders database (already use for organizing the first round of Local Conferences) - Entities included in existing thematic networks and associations, likely to have a role in the definition of blue energy projects - Entities based in the areas included in the blue energy potential analysis and/or in the areas where the analysis highlighted the higher potential (depending on the period in which the Hub was organized)
Main criteria for the definition of the date	The date was set by the organizing partner, normally in coincidence with significant project milestones and taking into account the best hour range and duration to effectively involve the key stakeholders. In some cases, stakeholders were involved in online polls to jointly decide on a suitable date.
Main criteria for the definition of the agenda	The agenda of the kick-off meeting was defined with the aim of making a first presentation of the project activities and themes in order to trigger an active discussion on the possible exploitation of blue energy in the Adriatic.

Main criteria for the selection of speakers and moderator	Speakers usually included project partners representatives, stakeholders involved in relevant activities in target areas, stakeholders with experience in similar projects, and external experts. The moderator was either a PP staff member or (more rarely) an external expert expressly contracted by the partner organization.
Main activities performed	- Presentations/lectures by PP staff - Presentations/lectures by external experts - Collective discussion/brainstorming

Restrictions to live meetings due to the COVID-19 pandemic obliged the partnership to organize most meetings in online mode (with the exception of SDEWES, which succeeded to hold all meetings in presence). This had both pros and cons: on one hand, virtual meetings did not allow for in-depth discussion and interaction among stakeholders; on the other hand, the advantage of the webinar form is that more participants are likely to join in since they do not need to move from their offices and can more easily conciliate multiple commitments. Additional activities had to be performed (such as the preparation of online polls or registration forms, e-mail reminders, etc.) to ensure the participation of key stakeholders.

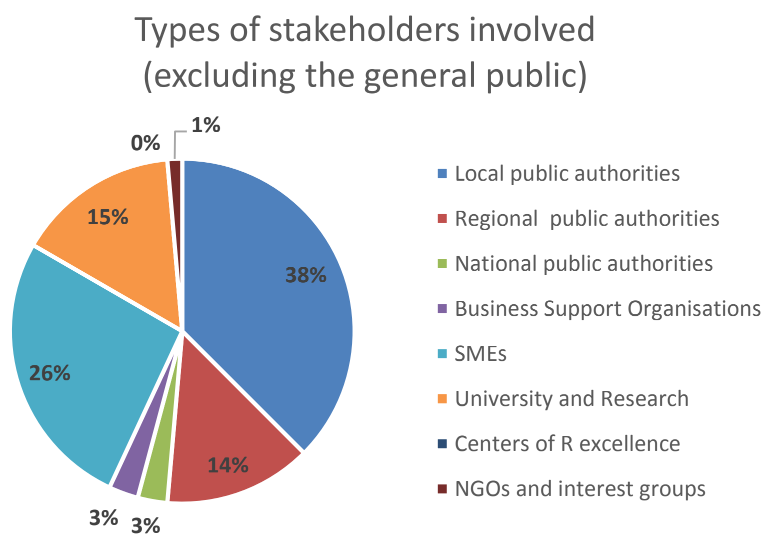
2.3. Achieved results

2.3.1. Key stakeholders involvement and collaboration

Among the more than 300 persons involved in Local Hubs (see paragraph 2.1), partner organizations succeeded in ensuring the attendance of all the key stakeholders with a potential role in the development of blue energy strategies and pilot projects. The following table and chart record the types of stakeholders involved in the meetings (excluding the general public), and the share of each category.

COASTENERGY Partner	Type of stakeholders involved in Local Hubs							
	Local public authorities	Regional public authorities	National public authorities	Business Support Organisations	SMEs	University and Research	Centers of R excellence	NGOs and interest groups
IRENA	6	1	0	0	0	2	0	0
DURA	10	1	0	0	0	2	0	0
SDEWES	14	0	0	0	3	6	1	4
UNICAM	2	3	0	2	10	2	0	1

UNIUD	2	0	0	0	7	4	0	0
CMU	3	0	1	0	8	5	0	1
CCIACHPE	19	8	0	2	8	5	0	0
City of Ploče	5	2	1	0	3	1	0	0
TOTAL	**57**	**14**	**2**	**4**	**37**	**25**	**1**	**6**



Apart from the general public (that was widely involved only by UNIUD and CMU), the categories of stakeholders that proved more interested in joining the Local Hubs were Local authorities (39% of total participants), followed by SMEs (25%). Universities (17%) and Regional Authorities (10%) were also a significant share. Therefore, the public sector, the business sector and the academic world appear well represented, while all the other categories are under the 5%.

Higher involvement of local and regional public bodies against a very low participation of national-level authorities was predictable, because of the very operational nature of the Hubs, which were supposed to work on site-specific issues. Low involvement of NGOs appears, on the contrary, as a wasted opportunity to actively include citizens in the discourse on blue energy, and to exploit the capacities of NGOs to mobilize consensus and educate the population on environmental issues.

As for Local authorities, the participation of Universities was a constant in all regions. This is not surprising, given the importance of scientific information and research for understanding the functioning and the potential of blue energy systems, assessing their feasibility and increasing general knowledge on the matter. However, this opens for a key role of Universities in the future development of blue energy initiatives, as consultants of public authorities and enterprises, and as disseminators of science-based information to the public.

The good level of involvement of SMEs (though not in all regions) can be considered a success: one could say that in most regions the Local Hubs were an occasion for public and private actors to start a fruitful dialogue on blue energy and to share their needs and objectives.

In general, all attendees to the Local Hubs meetings expressed satisfaction with the initiative, participated actively in the collective discussion and appeared willing to find shared solutions to common problems.

2.3.2. Pilot projects

The activities of the Local Hubs led to the production of 7 feasibility studies for as many pilot projects. Though the studies had different levels of detail, most of them succeeded in pointing out the main characteristics of the proposed blue energy systems (energy source exploited, type of device installed, size and potential energy production of the plant), as well as their potential impacts on the environment and on the landscape.

The table below provides basic information on the pilot projects: location (country, city/locality and building/infrastructure targeted), and type of blue energy source harnessed.

COASTENERGY Partner	Location of the pilot project	Type of Blue Energy source	
		Thermal energy	Wave energy
LP - IRENA	City Hall building, City of Poreč (HR)	✓	
PP2 - SDEWES	Town hall, Mali Lošinj (Lošinj Island, HR)	✓	
PP3 - UNICAM	Port of Ancona (IT)		✓
PP4 - UNIUD	Piazza Unità d'Italia, Trieste (IT)	✓	
PP5 - CMU	Port of Mola di Bari (IT)		✓
PP6 - CCIACHPE	Marina of Pescara (IT)	✓	✓
PP7 - City of Ploče	Sports port building, Ploče (HR)	✓	

The following paragraphs summarize the key characteristics of the pilot installations and the main findings of the studies.

Blue energy source

According to the type of energy source considered, the pilot projects produced by the partners can be divided into three different categories: 1) heat pumps (HP) using the sea as a thermal source, as in the cases of IRENA, SDEWES, UNIUD and City of Ploče; 2) wave energy converters (WEC), as in the case of UNICAM and CMU; and 3) hybrid or combined systems in which the heat exchange of the HP is combined with the production of electricity through WECs, as in the cases of the Chamber of Commerce of Chieti-Pescara.

Spatial context

A second level of diversification regards the spatial context in which the pilot projects are framed. The installation of proposed systems was either incorporated in an overall regeneration of existing infrastructure, building complexes and spaces located on the coast, or integrated in totally new construction works that are planned in the target regions.

IRENA, SDEWES, UNICAM, UNIUD and CMU have set up their pilot projects in already existing spatial contexts. The first two partners have designed the replacement of old heating/cooling systems of historic buildings in the cities of Poreč and Mali Lošinj with seawater heat pumps. UNIUD proposed the use of sea thermal energy as well, but, unlike the two previous cases, it did not focus on a single building but on the creation of a heating/cooling district, located in the Piazza Unità d'Italia in the center of Trieste, where the buildings around the square would be heated/cooled by using HP. Unlike the other three partners, UNICAM and CMU focused on wave energy: UNICAM proposed to install WECs onto a pier in the Port of Ancona, which would produce electricity for the buildings in the Port, while CMU opted for integrating an overtopping system into an existing pier of the port of Mola di Bari. CMU also studied the installation of an offshore system at a short distance from the coast, which would guarantee an additional share of energy.

The Chamber of Commerce of Chieti-Pescara and the City of Ploče have instead opted for projects in which blue energy systems would be embedded in new constructions. The Pescara pilot project would take advantage of the planned expansion of the Marina towards the sea to install two different types of WECs, while it would use the water outside the port as a thermal source to heat and cool the buildings and offices inside the port. The City of Ploče, on the other hand, does not envisage an expansion of an existing port structure but rather the construction of an entirely new complex dedicated to tourist/sports activities, using seawater HP for air conditioning, as well as PV to increase the share of energy produced from renewable sources.

Types of blue energy systems

The choice of the type of system was dictated by the characteristics of the areas chosen for the development of the pilot projects. Here, the morphological and climatic conditions of the Adriatic Sea play a very important role. In fact, the winds that generate the wave motion in the Adriatic mainly tend to form waves that from the NE and SE sectors push towards SW and NW. For this reason, the partners who have chosen WECs are those located in the part of the Italian coast that goes from the Middle to the Southern Adriatic. On the other hand, the low slope of the seabed along the Italian coast does not guarantee thermal stability at limited distances from the coast. Such stability is instead present on the Croatian shore and in the NE Italian sector, which, besides having deeper seabed at a limited distance from the coast, are rich in archipelagos and gulfs of limited size. This means that sea temperatures are more stable and with a less marked difference between the seasons, a necessary parameter for the use of HP, while the wave motion in these areas has limited potential.

Regulatory aspects

As for the legislation, on both sides of the Adriatic there are no chapters dedicated to blue energy. This may be due to a global scarce expansion of this renewable source: even in sites with higher potential such as along the oceanic coasts, the existing systems are prototypes sized specifically for the installation site, without large-scale production. For this reason, the partners referred to the existing legislation for the installation of systems for the exploitation of renewable energy and for the management of the marine space present in the two countries.

As regards Croatia, the documentation to consider is the following:

- Environmental Protection Act (Official Gazette no. 80/13, 78/15, 12/18, 118/18)
- Nature Protection Act (Official Gazette no. 80/13, 15/18, 14/19, 127/19)
- Regulation on Environmental Impact Assessment (Official Gazette no. 61/14, 3/17)
- Renewable Energy Sources and High-Efficiency Cogeneration Act (Official Gazette, no. 100/15, 111/18)
- Water Act (Official Gazette no. 66/19)
- Act on Water Management Financing (Official Gazette no. 153/2009, 90/2011, 56/2013, 154/2014, 119/2015, 120/2016, 127/2017, 66/2019)

In addition, the individual municipalities manage the maritime state property of their competence and they will also be consulted as regards ground operations for the installation of structures necessary for the construction of the plants that affect the municipal land.

In Italy, the public bodies involved and the permits to be requested vary according to the intervention site.

In fact, both local authorities, such as municipalities, and regional and national authorities must be taken into consideration. All proposed pilot projects occupy a site in the coastal area: therefore, a state concession must be requested from the state property office of the competent port authorities within a port system authority. As for Ports, chosen as sites by UNICAM, CMU and the Chamber of Commerce of Chieti-Pescara, the wave motion conversion systems must be compatible with both the municipal master plan and the port master plan. On the other hand, the location chosen by UNIUD is in the area of competence of the local port authority but not within the port of Trieste, so for the realization of the works the municipality of the city must be contacted for the approval of the project and its compatibility with the land use plan. For all sites, the designed works must comply with the requirements of the navigation code, for which the competent body is the Coast Guard.

Moreover, as with any other renewable energy plant, the approval of the network manager and of the Region having jurisdiction over regional energy policies will be required to connect to the electricity grid.

Both in Croatia and Italy, coastal areas are considered as state property. In Italy, their management (as regards spatial planning, protection and development) is under the combined responsibility of the region, of the municipality and of the port authorities. However, in the areas investigated, none of the authorities contacted currently have blue energy included in their master plans. The same goes for national and regional energy policies, where there is no clear distinction between blue energy and other energy sources.

For this reason, in Croatia reference is made to the Building Act and Technical Regulation on the Rational Use of Energy and Thermal Protection in Buildings (Official Gazette no. 128/15, 70/18, 73/18, 86/18, 102/20), which transposed the requirements of EU legislation regarding energy efficiency in buildings, the inclusion of renewable energy sources in the technical solutions of the energy supply system, as well as the construction standard according to the almost zero energy buildings concept (so-called nZEB), and which created a favorable legal environment for the implementation of heat pumps.

Also in Italy, there are currently no energy policies that incentivize blue energy. However, it can be included within energy efficiency plans or climate change mitigation plans.

Energy savings

As for the benefits in terms of energy production/saving deriving from blue energy systems, we can distinguish between the two types of systems (HP or WEC).

The heat pumps designed for the historic buildings of Poreč and Mali Lošinj have been sized on the energy needs of the building. As regards the City Palace of Poreč, currently the energy requirement to heat the structure is 234,253 kWh/y, which would drop to 55,774 kWh/y by using heat pumps. For the town hall of Mali Lošinj, the plan is to install a seawater heat pump with 36 kW electric power, 110 kW heating capacity and 130 kW cooling capacity. The new system would replace an oil boiler with a 400 kW capacity and 2 air-air heat pumps that sum up to 23 kW of electric power. In the City of Ploče, the use of a highly efficient HP sized for the new sports building in the project, with the addition of photovoltaic panels for both water heating and power production to run the HP, would be able to cover the annual heating and cooling needs of the building. As for UNIUD, the presence of too many actors did not allow a real dimensioning of the proposed district heating system.

As for the WECs, their production is directly proportional to the size of the intervention and the wave motion. As regards UNICAM, by installing along the pier a wave clapper conversion system made of 50 elements, it would be possible to produce 670 MWh/y, which will be used to supply energy to the buildings and to the lighting network managed by the Port Authority, and will cover approximately one third of the energy demand.

The Pilot project in the Pescara Marina took into consideration two different types of WEC to be installed in two different portions of the future port extension. The first (similar to UNICAM's) provides for the installation of 60 floaters that will produce 450 MWh/y, while the second foresees the installation of an 450 meters long oscillating water column system, which will produce 675 MWh/y. Since the energy consumption of the port of Pescara is 930 MWh/y, the share produced by these two WECs would cover the entire energy demand and generate a surplus of 70 MWh/y, which could be used for city mobility (i.e. to recharge electric vehicles).

CMU, too, proposed the use of two distinct WECs in the port of Mola di Bari: ISWEC (an offshore device based on an inertial system exploiting wave motion) and OBREC (an overtopping device integrated into port facilities). The total energy production of the two plants will be about 450 MWh/y (438 MWh/y for ISWEC and 13.14 MWh/y for OBREC), which could be used to power the port facilities.

Life-cycle aspects

The low TRL of Blue Energy systems and their limited use/expansion at a global level mean that there are currently no reliable data neither on the nominal/real life of the devices proposed in the pilot projects, nor on their life cycle.

As regards the SWHP, it is possible to estimate the average life and energy consumption of the heat exchange control units. However, it is difficult to know the effective durability of the circuits and the maintenance works necessary for the functionality of the system, because the use of sea water makes this calculation complex given its redox potential and the possible presence of bioturbation that could obstruct or compromise the exchangers (in the case of a closed loop system) or the system in general (in the case of open loop systems). Another factor to consider are the replacement and disposal of the fluids necessary for the operation of the heat pumps, which must be recovered and disposed of.

As for the WECs, being very young technologies, there are no data on their lifetime or on the actual maintenance operations necessary to keep them fully operational. Furthermore, the companies that own the patents, given the possible expansion of new markets, are reluctant to disclose data on their devices. However, it was possible to make some considerations on the materials used for the construction of the device, summarized in the table below. It is worth noticing that in all cases salinity is one of the critical factors influencing the periodicity and costs of maintenance operations, while extreme weather events represent a critical factor for the integrity of all devices.

Type of WEC	Raw materials	Manufacturing	Maintenance	Estimated life
OBREC and oscillating water column systems	- Reinforced concrete (for the structure) - Steel (for turbines) - Inert materials	- Construction of caissons (on site or using prefabricated modules) - Assembling (use of cranes and building machineries) - Installation of turbines and electric system (2-3 turbines in 10 m)	Periodic maintenance of turbines, caissons, and electric generators	10-15 years
Floaters and ISWEC	- Steel (for the structure and the oil-dynamic cylinders)	- Construction of floaters (as prefabricated modules or through naval construction works) - Assembling (use of cranes) - Production and installation of oil dynamic circuit, electricity generator and electric system	Periodic maintenance of mechanical components, hulls, gears and electric generators	10-15 years

Environmental and landscape impacts

Since the creation of blue energy plants entails an interaction between the devices and the marine environment, it is necessary to evaluate the environmental and landscape impacts these new plants could generate.

The HPs will not have major environmental impacts: the fluids used for the thermal cycle of the HP are inside watertight pipes that will not have direct contact with the sea and (excluding accidental spillage) will not cause any damage. The heating and cooling of marine waters will be balanced between the seasons and will not be sufficient to alter the sea conditions. From a landscape point of view, excluding the periods in which the necessary operations for the installation of the pipes and the necessary equipment will be made, the HP do not cause any impact since they will be placed inside the buildings, while the pipes can be buried and subsequently submerged without changing the state of the places. As for the pilot project proposed by City of Ploče, the possible landscape impact will not depend on the blue energy system installed but on the creation of new volumes for the realization of the Sports building.

The proposed WECs, on the other hand, have different types of impact depending on the type of system.

For OBREC and for the oscillating water column systems, there will be no impact on the landscape because they are an integral part of the breakwater piers. Therefore, if installed in replacement of existing structures they would not cause any new disturbance to the environment and the landscape, while if incorporated in new infrastructure their presence would neither alter its shape and design, nor cause any additional disturbance to the marine environment compared to that of the new infrastructure itself. On the contrary, floaters will not have an impact on the environmental matrices with which they will be in contact, but, being cantilevered with respect to the coastal/port defense works, they will have an impact on the landscape. However, since the devices are installed on the external walls of the piers and can hardly be seen from the shore, while they will certainly have a minimal impact for those who observe the coast from the sea. The ISWEC, being an offshore system, will have a limited landscape impact, comparable to that of a small boat , both for those who observe from the coast towards the sea and vice versa and, albeit to a limited extent, it could represent an obstacle to navigation in that stretch of coast. Installation distance shall therefore be carefully evaluated.

Socio-economic aspects

The analysis of socio-economic aspects resulted in various considerations on the possible impacts of these plants on local communities. It has been estimated that the population would welcome the deployment of blue energy systems: given the growing attention to environmental protection, a reduction of CO2 emissions for energy production would be positively evaluated. In addition, the opening of new markets for local companies, the development of new technologies and the creation of new jobs will also have an impact both on local economy and on the quality of life in the pilot areas. Another aspect to take into consideration is the cost of energy, both for private and public systems, since using self-produced energy or saving kWh for heating buildings thanks to higher efficiency systems, will lead to a lowering of expenses. Furthermore, the presence of blue energy plants could attract a new type of clientele to tourist resorts that is increasingly attentive to environmental protection and a low-emission future. These systems could even become a characteristic feature of the locations hosting them.

Despite the previous considerations, which would seem to result in a positive evaluation of the expansion of blue energy in the Adriatic Sea, the high costs of technologies and grid connections still represent an obstacle. As for the heat pumps, the cost is strictly related to the volume of the building they will serve: in the pre-feasibility study developed for the City Palace in Poreč, the initial cost would be € 105,000, with a payback period of 26.8 years, while for the seawater heat pump in the town hall of Mali Lošinj, the installation costs would be € 250,000 but with an estimated payback period between 7 and 15 years (considering a possible national subsidy of 40% of the investment cost). The pilot project presented by the City of Ploče has an initial cost attributable to blue energy of € 213,900. Being a new building, to calculate the payback period it was necessary to compare the cost of the new system with that of other types of plant and their operation costs. It was thus estimated that, compared with a system made of Condensing Boiler, PV and Solar thermal collectors, the payback is immediate since the installation costs are roughly the same, while considering the combination Condensing boiler + PV the payback period is estimated in one year and nine months.

Compared to HP, for WECs there is less precise information available (i.e. on ordinary maintenance costs), because, as said before, these technologies are relatively young and the plants already installed have been in operation for too little time to have reliable indications on the state of degradation of the devices. From the data collected by UNICAM and Chamber of Commerce of Chieti-Pescara for the installation of the floaters, against an investment of about 1 million euros and a maintenance cost of 60,000 € per year (with the wave conditions of the middle Adriatic), the payback period is about 11 years. For ISWEC, against an investment of 975,000 €, with the current cost of energy, the payback period would be 11 years and two months. The construction costs for the OBREC are declared by its developers to be comparable to those of a traditional breakwater, therefore they can be considered null in the case of a planned port enlargement.

However, some partners have hinted at solutions that can improve the cost-effectiveness of the pilot projects and that could be further explored in the future. In the case of IRENA, to amortize the initial price, it was decided to create a district heating system, similar to the one proposed by UNIUD, in which HP, in addition to serving the City Palace in Poreč, could be used to heat two other neighboring buildings, thus increasing savings in the face of a slight increase in the initial price. UNICAM and CMU, instead, hypothesized to increase the number of devices, to optimize some of the initial installation costs (such as the costs for the connection to the grid or for pipelines) whilst increasing energy production. In this way, the payback period would be further reduced.

Environmental benefits

What emerges from the pilot projects is that, in addition to economic savings that will repay the initial investment in the medium/long term, the environment will benefit from the development of the plants, given the reduction in the CO2 produced from these plants compared to traditional energy sources.

The following table summarizes the key features of all the above-mentioned plants.

COASTENERGY Partner	Location of the pilot project	Type of Blue Energy	Estimated energy production (MWh/y)	Estimated investment costs (euro)	Payback period (years)	CO2 emissions saved (t/year)
LP - IRENA	City Hall building, Poreč (HR)	Thermal	56	70,000	18	26
PP2 - SDEWES	Town hall, Mali Lošinj (HR)	Thermal	164	250,000	7 to 15	25
PP3 - UNICAM	Port of Ancona (IT)	Wave	670	1,000,000	11	220
PP4 - UNIUD	Piazza Unità d'Italia, Trieste (IT)	Thermal	-	-	-	-
PP5 - CMU	Port of Mola di Bari (IT)	Wave	690*	975,000**	11**	297

PP6 - CCIACHPE	Marina of Pescara (IT)	Wave+Thermal	1125	1,000,000	11	-
PP7 - City of Ploče	Sports port building, Ploče (HR)	Thermal	58	213,900	1.75	14

* Total estimated energy production of a combination of 20 OBREC modules (about 250 MWh/y) and one ISWEC device (around 440 MWh/y).

** Considering that the costs for the installation of OBREC is negligible when compared to those required for the port extension works, this value only refers to the ISWEC device.

2.4. Criticalities and lessons learnt

The main problems incurred during the implementation of the Local Hubs regarded two issues: a) the involvement of stakeholders, and b) the development of the feasibility studies, especially as regards the technological, socio-economic and procedural aspects. These two aspects are strongly interconnected, and are described in the following paragraphs.

a) Involvement of stakeholders

Apart from the already mentioned difficulties related to the pandemic, one of the mail challenges was the involvement of target groups, especially the general public and the decision-makers. For both groups, scarcity of knowledge on BE and lack of a full awareness of potential benefits of BE are an issue, especially when innovative technologies such as wave energy converters are concerned. These lacks influence the interest of stakeholders to participate in meetings and to commit in the development of pilot projects. This calls for a strong dissemination work, transparent and science-based, in which Universities, research centres and single experts can play a leading role, supported by civil society organizations such as environmental NGOs.

As for decision-makers, their awareness is essential to ensure their capacity to support investments through policies and political decisions. Their involvement is therefore crucial, though not easy to achieve (especially within the short time-span of an EU project): the pilot experiences have shown that it is often easier to arise the interest of technical officers than of decision-makers. However, the involvement of technical officers can be a first step: in some cases, it was they who transferred information to their political reference persons, thus providing also an indirect endorsement to the activities of Local Hubs (this was evident, for example, in the case of UNICAM). Predictably enough, involving decision-makers has been easier where the development of BE systems was already in line with existing projects and ongoing commitments. For instance, the partner CMU noted that the Municipality of Mola di Bari (that hosted a pilot project) had a strong interest in being a COASTENERGY stakeholder, given its commitment in the planned rehabilitation of the port area.

The involvement of technology developers proved to be another issue: it was noted that some of them could be reluctant to speak openly about their research and development processes and to disclose basic information such as prototypes costs and actual energy production – which are nonetheless essential to produce a reliable feasibility study. To overcome this problem, for example, CMU has been trying to set up a process where the municipality involved in the pilot project and developer enterprises work together to obtain mutual benefits: energy savings for the former, and availability of a testing environment for the latter. This could be even more effectively achieved through operational agreements, which are nonetheless difficult to formalize within the time-span of a cooperation project.

The level of involvement is also important: most partners opted for establishing a multi-phase process with a growing level of stakeholders' involvement. Following this approach, the first meeting of the Hub usually pursued the participation of a wide range of stakeholders, while the following meetings aimed at engaging restricted groups of selected stakeholders in operational round tables with a more detailed scope. In such a process, ensuring continuity in the participation of the key stakeholders is essential. Strategies to achieve it included strict follow-up of Local Hubs meetings (i.e. through bilateral meetings, follow-up e-mails, dissemination of local newsletters/bulletins, etc.), aimed at keeping a good level of interest and attention on project activities. In particular, bilateral meetings were especially useful also to reinforce the local network and to set the basis for future collaboration, beyond the end of the project.

b) Development of the feasibility studies

The difficulties in developing the studies varied according mainly to the type of technology selected for the pilot project. Heat pumps are a quite consolidated technology, with well-known benefits and results and several good practices to refer to. On the other hand, wave energy converters are an emerging technology, and many existing prototypes have a low TRL. Moreover, their actual energy production in the Adriatic environment would need further testing and research, even combined with the downscaling and adaptation of the devices to the peculiar local characteristics of the wave regime and of the seabed. Besides complicating the feasibility assessment, this greatly extends the deployment time, and makes any discussion on the matter quite abstract and less attractive for stakeholders. It also partly explains the already mentioned reluctance by some technology developers (especially private companies) to speak openly about their devices.

Lack of specific data on the devices, such as production costs, energy yield, quantity and nature of the materials used, and maintenance operations needed, makes it difficult to quantify the costs and benefits of the installation, and to make life cycle assessment considerations. In absence of this kind of information, interest from public authorities and enterprises often drops.

Discussion within the Local Hubs revealed that, both in Italy and in Croatia, regulatory aspects play a crucial role in hampering the feasibility of BE projects. In particular:

- In Croatia, procedure for installation of heat pumps should be simplified and defined from start to finish including provision of all necessary permits and concessions. Specific focus should be on constraints like architectural conservation, availability of needed power supply capacity, heating demand and energy efficiency of the whole building. The use of sea thermal energy does not have special treatment in Croatian legislation (special regulation, chapter or provision of law) nor are special or simpler approval procedures provided for such projects.

- In Italy, overlapping of competences in marine and coastal areas and ports complicates the permitting process. Since dedicated regulations on BE do not exist, potential investors have quite a difficult time to identify the correct procedure to undertake and the public authorities to address, and making reliable forecasts on the duration of the procedure is not easy (though it would be essential in order to plan investments and properly allocate financial resources).
- In both countries, fragmentation of local authorities complicates permitting procedures and, additionally, makes it difficult to engage relevant authorities in a particular project and encourage cooperation. There is no single info point or office in charge of issuing all relevant information and performing or coordinating administrative procedures related to the use of marine energy. Moreover, the maritime spatial planning process is still under way, so that there is still no national reference framework for the use of marine space and the regulation of marine uses (including blue energy).

This calls for procedural re-structuring and simplification, and for a stronger effort for coordination between sectors and actors involved in the use and sustainable development of marine areas.

3. Model mechanism to support blue energy projects in coastal areas

3.1. Procedures to establish and implement the Local Hubs and develop partnerships

The procedure for the establishment and implementation of Local Hubs can be structured as follows:

Step 1) Identification of stakeholders

Step 2) Organization of the meetings

Step 3) Conduction of the meetings

Step 4) Follow-up

Each step is accompanied by specific communication activities. The following paragraphs describe each step in detail.

Step 1) Identification of stakeholders

A clear identification of the stakeholders to involve shall be made at an early stage. It may be helpful to start with a very wide range of target organizations, inviting them to a preliminary local conference, e.g. a public event aimed to information and territorial mobilization. Based on the outcomes of this event, a further selection can be made, and key stakeholders can be chosen according to the concrete contribution they can bring to the discussion.

Categories to consider include:

- Public authorities at local, regional and/or national level in charge of energy policies, business development, port infrastructure, coastal management (including development agencies and energy agencies), as well as of permitting procedures
- Companies with business activities in the field of energy systems design, manufacturing and installation, particularly in the field of renewable energy.
- Manufacturing companies working in production chains that are relevant to the topic (i.e. shipyards, turbines producers, etc.)
- Companies, associations or institutions operating in the maritime sectors (fishing, aquaculture, navigation), when relevant
- Relevant economic sectors that have a strong economic capacity at the Local Hub level or have the potential to influence its future development (i.e. coastal tourism)
- Educational and R&D institutions that carry on research on topics relevant to blue energy (oceanography, maritime spatial planning, marine biology, coast geology, engineering, renewable

energy, etc.): Universities, Research Centres, VET institutes. In a limited number, they can provide scientific background to the discussion

- Environmental NGOs that can also have a role in building citizens' consensus on the pilot projects
- Business support organizations (associations, chambers of commerce, etc.)

Any other support institutions that could disseminate the initiative and involve other subjects are welcome to join (employers' associations, trade unions, employment bureaus, etc.).

It is important to ensure, as far as possible, equal representation of the different categories (especially at the beginning of the process), and to give everyone the opportunity to express their opinion freely.

Step 2) Organization of the meetings

The proposed structure of activities should include following elements:

a) definition of date, time, duration and location
b) communication
c) preparation of the agenda, selection of speakers and moderator(s)
d) sending of the invitation to a mailing list of key stakeholders

Each element is described in detail in the following paragraphs.

a) definition of date, time, duration and location

Date, time and duration should be fixed taking into account the ordinary schedule of key stakeholders (i.e. taking into account the usual working hours of public officers, etc.). If the meeting is restricted, the date can be decided jointly through an online poll. Duration of the meeting should be limited, especially when online: preferably no more than half a day for live meetings (around 4 hours, including a networking coffee break), and no more than 2 hours for online meetings.

b) communication

If the meeting is open and aims at involving as many people as possible, it should be preannounced on the communication channels of the organizer, with short press releases (for the organizer's webpage and/or local media) or posts (for social networks) providing basic information on date, time, duration, location and objectives of the meeting. The first announcement should be issued one month to two weeks before the meeting, and eventually followed by one or more recalls as the date of the meeting approaches.

For live meetings, it may be useful to prepare printed communication materials to hand out to participants, such as brochures or leaflets (also diversified by target group), as well as roll-ups and posters to display in the meeting location.

c) preparation of the agenda, selection of speakers and moderator(s)

The agenda of the meeting and the selection of speakers and interventions should be consistent with the objective that the organizer want to achieve. Interventions by influential, well-known experts can help rise the stakeholders' interest, as well as the presentation of successful case studies, funding opportunities, etc.

The first meeting could be aimed simply at describing the objectives of the Local Hub, introducing the themes of discussion and presenting relevant data (also with the contribution of one or more experts), sharing information and get insights about potential locations of BE pilot projects. The meeting should include a collective discussion resulting in the joint identification of critical aspects, priorities and needs.

The following meetings could be more specific, and engage restricted groups of selected stakeholders in discussing in detail the pilot project and defining shared solutions and future steps. They could also be thematic, with sessions focusing on the critical aspects, priorities and needs identified in the first meeting, and include round tables or working groups. The level of interaction and collaboration among the participants would likely depend on the meeting mode (live meetings provide more opportunities for effective group work) and duration.

All meetings should end with the presentation of the next steps and activities to undertake before the following meeting. It is recommended to organize the meetings at regular intervals, not putting too much time in-between, to avoid that the stakeholders' level of attention falls.

At this stage, it is necessary to identify the moderator of the meeting: it can be a project manager, a member of the project team, or an external supplier expressly contracted.

d) sending of the invitation to a mailing list of key stakeholders

Stakeholders should be invited via e-mail (specifying at least the date, location, duration, and objective of the meeting), sent with at least a 2-weeks' notice. The object of the e-mail should clearly specify the date and the contents of the message. The meeting agenda can be attached if already available, otherwise it can be sent as a draft, and the final version sent right before the meeting as a reminder.

The invitation can be preceded by a save-the-date, sent always via e-mail one month before the meeting.

Phone contacts in the days immediately before the meeting are recommended to obtain confirmation of the attendance. It is worth reminding that an optimal Hub performance can be ensured by 6-10 active stakeholders so that interaction can take place allowing for an individual approach to stakeholder needs.

Step 3) Conduction of the meetings

The conduction of the meetings is a responsibility of the moderator, who welcomes attendees, announces the speakers and the topics they will discuss, gives the floor to stakeholders during collective discussions (according to standout order) and directs the debate towards the goals and purpose of the meeting. To be more effective, the moderator should have a written text (prepared together with the organizer) following the course of the meeting; this is of particular importance if the moderator is an external supplier.

In the case of conducting a meeting through an online channel, the moderator should also ask for the stakeholders' consent for the recording.

The moderator should be supported by a staff member of the organizer, who will take notes in view of the preparation of the synthetic report (see Step 4), and distribute communication materials when available.

The outputs of the meetings can vary according to the pre-established objectives, however the production of agreements or joint documents can help motivating the participants, consolidating the collaboration among them, and set the basis for future, more structured activities. Some examples of possible outputs:

- Agreements or memoranda of understanding for an actual collaboration between technology developers and public authorities, ensuring the possibility for certain prototypes to be tested on site;
- Joint strategy, action plan and/or document of proposals/recommendations to policy-makers for facilitating the deployment of blue energy initiatives.

Step 4) Follow-up

Strict follow-up of meetings is essential to maintain a good level of interest and attention on project activities. Follow-up activities can include:

- Preparation of a synthetic report, briefly describing the activities performed and the results achieved

- Preparation and sending of media announcements and publication of a post on social media summarizing the results of the meeting, providing figures on participation, and attaching one or more significant pictures
- Sending of appreciation e-mails immediately after the meeting, preferably enclosing a synthetic report of the meeting and the materials presented (or providing a link to download them), as well as any document produced within the Hub
- Organization of bilateral meetings, to discuss particular details
- Preparation and dissemination of local newsletters/bulletins providing updates on the Local Hub activities and on other topics of interest for the stakeholders (published calls for funding, issue of useful papers and studies, international events, etc.).

3.2. Models of feasibility studies

Regardless of the legislative requirements on the structure and level of detail of feasibility studies, the activities conducted during the project led to the identification of some minimum contents that these studies, when applied to blue energy systems, should incorporate.

The basic table of contents for BE installations should therefore include the following.

a) **Resource modelling:** marine energy potential analysis referred to the selected energy source (waves, sea temperature, or other)

b) **Site selection**
   - Criteria applied for site selection (including energy potential and absence of restrictions linked to natural protection and other maritime uses)
   - Description of the site: sea coordinates, main morphologic and environmental features of the area (including bathymetry and seabed composition and morphology), population, land use, nearest manufacturing, transport and logistic facilities
   - Description of possible alternatives (if relevant)

c) **Technical considerations**
   - Description of the selected technology and device, including possible alternatives (if relevant)
   - Technical characteristics of the device: type, size per unit, array dimension, techniques used, etc.
   - Minimum environmental conditions for plant operation (wave height, sea-depth, type of seabed...)
   - Plant sizing and technical characteristics:

- Number of devices
- Device size
- Distance between devices (maximum or minimum)
- Total area occupied
- Distance from the coast (if applicable)
- Technical details (use of transformers; submerged cables; construction techniques, etc.)

d) Energy demand, production, demand coverage and consumption

- Energy consumption in the area served by the plant
- Expected annual energy production (per device and total), taking into account the production during the day and at night, as well as the operation window in each season
- Consumption profiles (self-consumption or energy input into the grid)
- Demand coverage, storage needs, auxiliary generation systems

e) Life cycle considerations

- List of all components and raw materials necessary to produce the device
- Description of all the processes involved in the production and in the installation, and the related consumption of energy and fuels (including transportation of components to the installation site, and taking into account the distance from where components are bought or built to the place in which the device will be assembled).
- Description of maintenance operations, considering their planning in time, their periodicity, the material needed, and all processes (including transport) and the related energy consumptions.

f) Non-technical constraints

- Description of the legislative and regulatory constraints (including environmental protection laws) that can affect the development of the plant.
- Description of the policy framework, specifying how the project fits into energy policies (local and regional) and into the provisions of spatial planning instruments (local urban plan, port plan, etc.).

g) Environmental and landscape impact

- Description of the sea and coastal environment within and around the installation site, including any marine or terrestrial protected areas near to the site, and the related level of protection and environmental restrictions (if applicable).
- Description of the potential impacts of the plant on the environment and the landscape, and more precisely on:

  - Air quality (including calculation of the amount of CO2eq. saved, compared to the use of energy from fossil sources)
  - Soil (for onshore installations)
  - Hydrogeology (including coastal erosion and seabed)
  - Hydrology and water quality
  - Biodiversity (benthic habitats & species, fish, marine mammals, birds, sea turtles)
  - Seascape
  - Onshore cultural heritage and/or submarine archaeology (if applicable)
  - Visual impact
- Description of impact mitigation measures foreseen.

h) Costs

- Total cost in EUR of the plant implementation, taking into account: distance from shore and nearest port, number of required maintenance operations, electrical connections, etc.:
  - Investment costs (devices manufacturing, installation, connection to the grid)
  - Maintenance costs
  - Decommitment costs
  - Other costs (design, taxes, permits, etc.)
- Payback period
- Levelized Cost Of Energy (LCOE) and Net Present Value (NPV)
- Financial feasibility (description of any financial mechanisms and funding sources that could be accessed to implement the project, specifying the necessary procedures)

i) Socio-economic impact

- Description of any relevant positive or negative impact on the population, employment and/or on other economic activities (i.e. fishing, maritime transport, tourism, etc.)
- Calculation of any economic savings on energy bills.
- Description of any issue regarding social acceptance, and how they will be addressed.

j) Permitting procedure – description of the steps to undertake to get administrative authorization of the plant, specifying the types of permits to obtain, the institutions that release them, and, if possible, the approximate time to complete the procedure.

k) Comparative evaluation. A cost-benefit analysis or a multi-criteria analysis are recommended in order to take properly into account all the aspects and long-term advantages of investing in a BE plant. An analysis of risks (environmental, technical and financial) would add useful information to evaluate the opportunity of the investment.

4. Practical recommendations to ensure the development of blue energy systems in coastal areas

The COASTENERGY highlighted that a certain potential for blue energy development exists in the Adriatic area. This potential varies according to the changes in the morphological and climatic conditions along the Adriatic coasts. In particular:

- SWHPs seem to be more suitable for the Croatian shore and the NE sector of the Italian coast, which offer more thermal stability at limited distances from the coast and a less marked seasonal difference in sea temperatures. This technology can be especially useful in islands (to reduce their energy dependence and pollution) and in new buildings (since for older buildings with high temperature heating systems, a total refurbishment of the heating system would be necessary, thus reducing the cost-effectiveness of the intervention). Special care should be paid to the inclusion of such systems in cultural heritage buildings.
- WECs are more feasible in the part of the Italian coast that goes from the Middle to the Southern Adriatic, since the winds that generate the wave motion in the Adriatic mainly tend to form waves that from the NE and SE sectors push towards SW and NW. On the other hand, the low slope of the seabed along the Italian coast does not guarantee thermal stability at limited distances from the coast, thus reducing the effectiveness of SWHPs. Though they do not reach the energy production levels of other Mediterranean areas, conversion plants that are carefully scaled and adapted to the Adriatic context could nevertheless contribute to the decarbonization of the region, also in combination with more established renewable energy sources.

Given the technical complexity and innovative aspects of blue energy systems, the aim should be to encourage as much as possible the installation of pilot plants and their testing in real conditions. The activities conducted during the COASTENERGY project led to the identification of some practical actions that could pave the way to the deployment of blue energy systems, in the Programme area and more in general along the Mediterranean coasts.

These recommended actions regard the regulatory and territorial governance system, the financing of projects and installations, and the overall improvement and dissemination of knowledge on blue energy: they should be carried out in a coordinated way, in order to create favourable conditions for BE development.

The actions are described below.

Regulatory and territorial governance actions:

1) Including blue energy in the existing framework for energy, innovation and spatial planning, for example:
   - national/regional energy plans, as a share (also in combination with other RES) of the energy mix to achieve the European, national and regional 2030 targets for energy and climate;
   - Smart Specialization Strategies , as a SS sector to be developed in the concerned country or region;
   - plans and programmes regarding the development and/or rehabilitation of port areas and waterfronts;
   - SECAPs (or similar local-level energy and mitigation plans) of coastal cities and towns, as one of the options for climate change mitigation.
2) Identifying offshore areas for the temporary installation and testing of new devices in a real environment, so as to facilitate the implementation of projects. The identification of these areas should be based on an analysis of the energy potential, similar to those conducted within the COASTENERGY project.
3) Formalizing Local Hubs according to the COASTENERGY model, in order to create a public-private entity that follows the implementation of blue energy projects, providing assistance for overcoming procedural "bottlenecks" and involving key stakeholders, and in particular:
   - bodies in charge of programming and managing the European structural funds for national/regional development;
   - entities in charge of environmental impact assessment and permitting procedures (including those in charge of cultural heritage and landscape protection), of the spatial planning of coastal areas and ports, as well as of the permitting for electrical activities;
   - decision-makers at political level, who should endorse blue energy development strategies and catalyse public consensus;
   - technology developers and/or companies producing components, which, if embedded in a value chain, can create devices from scratch;
   - coastal municipalities, which can a) promote the construction of plants (as territorially competent bodies on potentially affected stretches of coast, as subjects responsible for issuing permits for the construction of on-shore components of such plants, and/or as potential end users of the energy produced): b) act as mediators between local companies and the higher levels of territorial governance, and c) contribute to raising awareness among citizens on blue energy issues, in order to counter the NIMBY syndrome which sometimes hinders the deployment of renewable energy plants;

- universities and research institutions working not only in the energy and engineering sectors, but also in relevant research domains such as oceanography, marine biology, coastal geology, etc.
- environmental associations.

4) Creation of One-stop shops to guide the proposer in the authorization process, providing him with assistance (even remotely) to identify the necessary authorizations and quantify the duration of the related procedures, and directing him to the various public bodies responsible for issuing opinions, permits and clearances. In the medium-long term, it would be desirable to create a single authorization for all types of renewable energy exploitation systems, issued by a single office, capable of acquiring the various opinions and authorizations required.
5) Review of the authorization procedures, making them simpler, proportionate (also in terms of duration and financial commitment by the proponent) to the size, cost and potential impacts of the blue energy system. These procedural simplifications may also regard only specific areas, deemed suitable - on the basis of their energy potential - for the installation of devices for the exploitation of marine renewables.

Financial actions:

1) Creating economic and financial incentives at national or regional level. For example, in Croatia there is the National Fund for Environmental Protection and Energy Efficiency (EPEEF), which collects and invests extra-budgetary funds in programs and projects for environmental and nature protection, energy efficiency and the use of renewable energy sources. It subsidizes installation of heat pumps, and budget is even higher in the islands. The EU's Recovery and Resilience Facility (providing grants and low-interest loans) should also be considered as a potential funding source. The Italian Recovery and Resilience Plan includes e.g.:
   - the promotion of innovative energy systems, including off-shore systems, among which wave energy systems are actually mentioned (at least at programmatic level). Funding initiatives should encourage research and development actions for these niche-market and still underdeveloped technologies, and not only bigger, safer investments such as the construction of off-shore wind farms;
   - the promotion of renewable energy for small energy communities (the Plan mentions municipalities < 5,000 inhabitants). It would be advisable to specifically include small islands in the funding initiatives, see the "Clean Energy for EU Islands" experience and its implementation in the Cres-Lošinj archipelago in Croatia.

2) Including blue energy in the new calls for the ERDF and EMFF Operational Programmes 2021-2027, and in particular in the priority axes aimed at the development of RES and the innovation of SMEs, with the aim to encourage, through grants and/or guarantee funds for SMEs:
   - innovative business projects, such as the creation of start-ups working i.e. in the design and construction of devices or their components, in the development of software for their control and monitoring, or offering specific services (logistics, submarine surveys, etc.);
   - the construction of experimental plants, such as:
     - SWHP for the heating-cooling of public or private buildings or groups of buildings along the coast (resorts, offices, sports centres, etc.);
     - Wave energy converters in ports or along coastal protection barriers, to supplement or even replace the latter (combining the fight against erosion and the production of clean energy);
     - Multifunctional platforms integrating blue energy with other maritime activities, such as aquaculture, and/or with other RES technologies (photovoltaic, offshore wind);
     - Integrated systems to power ports, shipyards, marinas, fish processing facilities, etc.

In order to encourage the emergence of innovative solutions, the calls should not go into the details of the technological solutions to be adopted, but leave sufficient margin for the development of innovative systems, even "hybrid" (combining, for example, energy production with fishing, coastal defence, etc.). They could therefore be configured as Open Innovation initiatives, which select optimal solutions to complex problems.

3) Supporting research in the blue energy sector through ad hoc calls for the development of research projects and/or prototypes.

4) Introduction of economic-financial mechanisms that allow innovative companies to cover the costs of feasibility and design studies (e.g. by deducting them as research and development costs through a tax credit), which represent an important voice in the construction of blue energy plants.

5) Use of innovative procurement to encourage the implementation of blue energy projects.

Knowledge transfer, training and awareness raising actions:

1) Mobilizing (also within the Local Coastal Energy Hubs) universities, experts, and environmental associations to promote the dissemination of science-based, up-to-date information on blue energy towards all stakeholders, also by using, updating and enhancing the existing official communication channels (i.e. public authorities' websites). Contents and language used should be tailored to the different target groups, consistently with the aim of improving knowledge, especially in public authorities and the general public, and raise interest and social acceptance.

2) Training/professional refresh of public officers on blue energy issues, especially of those who can be involved in the evaluation procedures and authorizations of project proposals. In the transition phase, it would also be advisable for public authorities to create lists of external experts (valid at least for the duration of the European programming period 2021-2027), who could possibly be called upon to support public officers in the evaluation/authorization procedures of project proposals.
3) Establishing assistance services to entities interested in applying for EU funds in connection with feasibility studies for the installation of blue energy systems. For instance, EEA grants are funding projects for the installation of seawater heat pumps, covering from 40% to 85% of costs, depending on the applicant (85% for national institutions). The project budget has to be at least 200.000 EUR. Eligible costs include the necessary equipment (SWHP, heat storages and construction works), as well as costs for exchange of experiences and knowledge and the organisation of workshops with partners from EEA countries.