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Comparative analysis, strategic recommendations and implementation plan for a multidisciplinary maritime innovation location in Belgium (POM)

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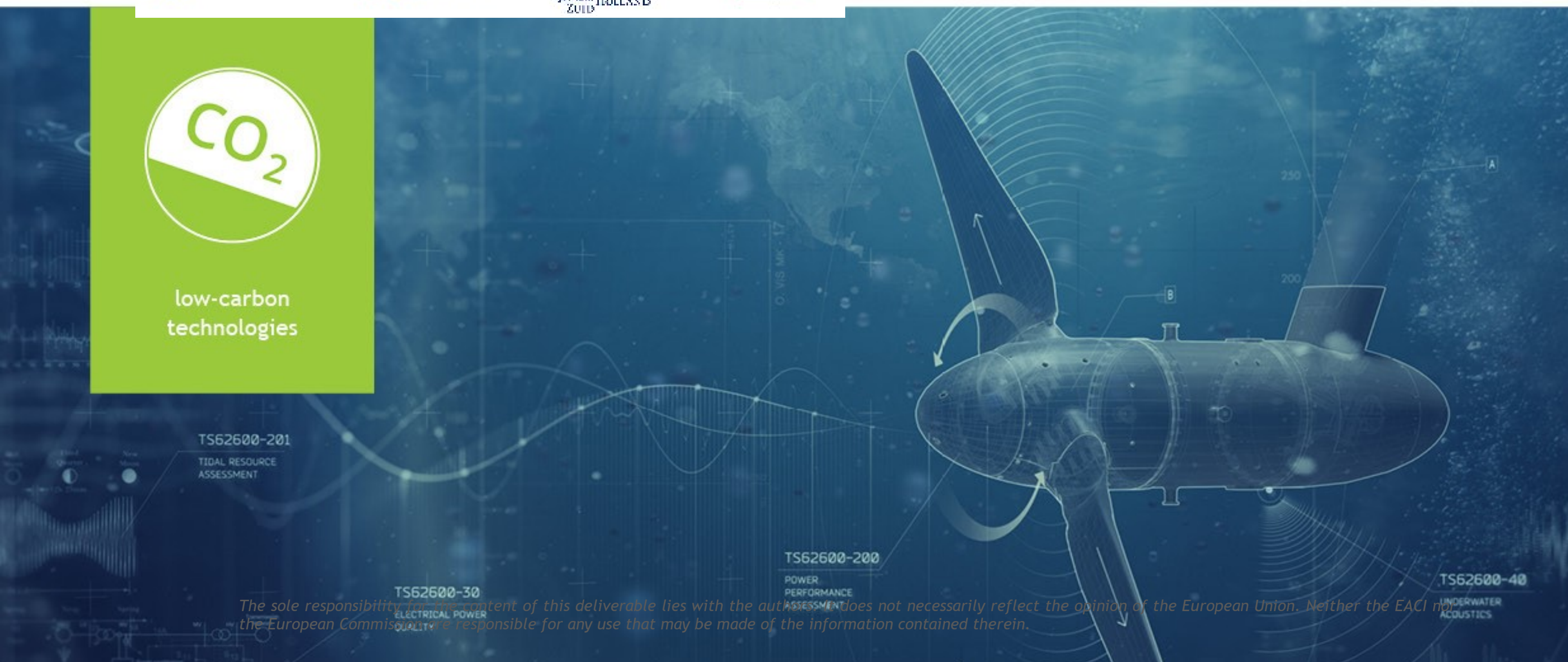

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0. Executive Summary

The assignment to provide strategical recommendations for the Blue Accelerator was approached in several steps, clustered in 3 tasks.

The first task was to assess the position of the Blue Accelerator compared to other European test facilities. This was done based on previous available studies. Moreover, SWOT analysis of each test facility was performed and the unique Selling Point (USP) was determined. For each test facility a leaflet was made and included in this report as Annex, in order to facilitate the comparison among them. Upon the identification and provision of the leaflets, a more thorough analysis was done for the 2 most relevant and comparable test facilities. As such a global view of the position of the Blue Accelerator was created. A more detailed SWOT analysis for the Blue Accelerator was carried out in order to highlight its positioning in the market of open water test facilities and to develop the basis for the identification of the USP and the formulation of recommendations.

Several strengths were identified: the Blue Accelerator is a pre-approved open water test facility with moderate metocean conditions, offering fast consenting, readiness and easy-access. POM provides a tailor-made support to its clients and is part of a strong and large network.

Supporting the users of the test platform by realising a common framework for all test facilities with relevant partners and authorities.. Other opportunities were identified: setting up academically driven innovation program, strengthening innovation in the blue energy sector, supporting offshore projects and performing environmental impact monitoring.

All these identified opportunities counterbalance the possible scarce usage of the test facility, which was identified as the main threat for the Blue Accelerator.

The weakness identified are related to the particular conditions of the Blue Accelerator and could be seen as the downside of its strengths. The Blue Accelerator location does not offer extreme offshore conditions and it is suitable only for certain developers (TRL from 4 to 7). Also, it is not grid connected, there is no pre-installed mooring available and only basic equipment is on site for the time being.

Based on the assessment carried out in Task 1, Task 2 was initiated. This task’s scope was to align the Blue Accelerator’s position towards a strategical goal. In addition to the analysis of other test facilities performed in Task 1, several additional studies were performed, aiming at formulating the right questions to assess the strategical needs of the Blue Accelerator. These questions were posed to several stakeholders, with a wide range of contributors, such as universities, contractors and developers. The answers from all these contributors were bundled and assessed. In order to verify the obtained results, an internal workshop was performed, where the previous findings were confirmed. The main outcome of these strategical assessments was that the TRL focus of the Blue accelerator should be at 6-7. Furthermore the Blue accelerator should focus on innovative technologies, requiring several small iterations, rather than a long term testing. This results in a focus domain towards ‘Technology Innovators’. These are companies that have the sole goal to develop their technology (invention). These finding are clustered around 7 strategical recommendations and are presented in the Figure 0-1.

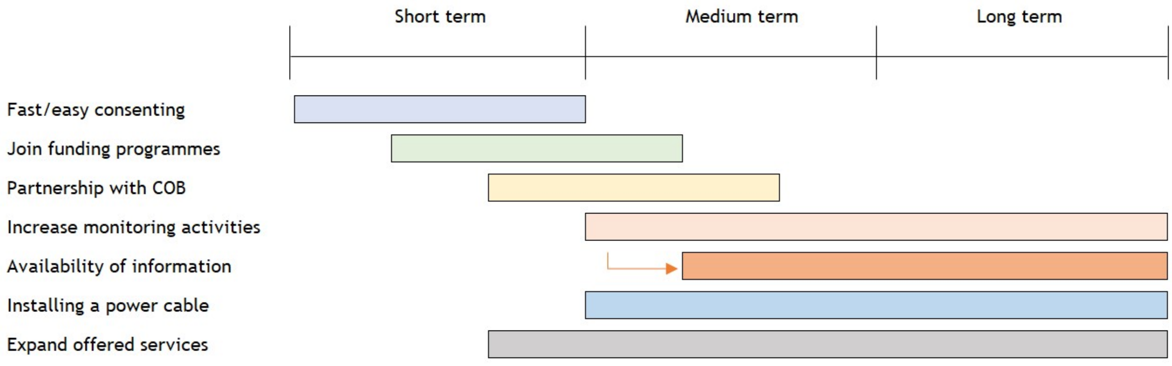

Figure 0-1: Strategical recommendations for the Blue Accelerator

The first recommendation is the “fast/easy consenting”: to allow a technology developer to move fast without any obstructions and to easily proceed all the steps towards testing offshore. In order to achieve this scope, permits should be in place and the entourage should be ready to assist in all administrative measures. These required measures should be firstly checked with the developers and aligned with the permit grantee. Upon which these can be streamlined with the objectives of the Blue Accelerator.

The second recommendation is focused on small type of developers without sufficient budget, therefore interested in having additional financial support. By being implemented in ‘Funding Programmes’ small players will be more attracted towards the Blue Accelerator. First the funding programs need to be mapped (a lot are closing in 2020), whilst other available opportunities need to be checked.

The Blue Accelerator focuses on TRL 6. All steps before going offshore should be monitored. This can be even actively approached by having a close collaboration with the coastal and Ocean Basin (COB), who focus on very early developments and prototypes. By joining forces, the Blue Accelerator can build a valuable network and forms the natural next step after indoor testing. Regular meetings with the COB will certainly encourage this close collaboration and facilitate to explore opportunities together.

The fourth recommendation concerns an increased monitoring. By having data available, developers can approach the Blue Accelerator already at an early stage. They can verify their technology towards the actual conditions. Furthermore data monitoring will allow to check the before and the after in case environment is impacted. A close collaboration with institutions should be set-up, to streamline data and ensure that correct and most relevant data is captured.

The monitored data, along with all the potentials of the Blue Accelerator, should be made available. Transparency and the strength of the diversity potential at the Blue Accelerator can be highlighted to encourage developers to approach the Blue Accelerator. A simple method is by having a transparent and very navigable website.

Also the 6th measure is envisaged to attract a different kind of players. Power and data cables are especially interesting for long term testing. This can be integrated in the testing diversity mixture to have a steady revenue stream. It was also a recommendation that was highlighted by different stakeholders. This is more a long term strategical recommendation, and the assessment of the need for such investment within the first users of the Blue Accelerator should be done.

As scarce usage is one of the main treats of the Blue Accelerator, diversification of the applicability should be encouraged. This is done by approaching Technology Innovators and assessing their need for long term testing, but should be further encouraged by expanding the offered services.

All these recommendations should be represented in the USP. It is assessed that highlighting the support services is the most important approach. It is believed that this can be summarised as **“We make your life easier!”** or **“We help you with your first steps offshore”**. This highlights the support and the TRL level, indicating that, once you are ready to go offshore, the Blue Accelerator will support your development.

In Task 3, for each strategic recommendation, an implementation plan was developed with the target, timeline, actions, remarks, assumptions and constraints, potential players and partners, references and standards, and a budget estimation.

1. Introduction

1.1. The assignment

The Regional Development Agency West Flanders (POM West Flanders, Belgium) aims to strengthen the economy of West Flanders in general and the innovative business community in particular by stimulating partnerships between the companies and their organizations, knowledge institutions, regional policy bodies and social partners. This happens under the name of the 'Factories for the Future'. The POM focuses on five sectors: New Materials, Food, Blue Energy, Machinery & Mechatronics and Care Economy.
The cluster of POM West Flanders concerning 'Blue Energy' includes, amongst others, offshore wind energy, a mature sector in full expansion, as well as the relatively new developments with regard to wave and tidal energy. Within this context, POM West Flanders is partner of the MET-CERTIFIED Interreg 2 Seas project, that aims to make marine energy projects insurable and financeable in the 2 Seas region (UK, FR, NL, BE). MET-CERTIFIED aims to increase the adoption of insurable and therefore bankable marine energy projects through the development of internationally recognised standards and certification schemes and by testing and verifying technologies against IEC standards for marine energy convertors..

POM West Flanders appointed IMDC to deliver "Comparative study Blue Accelerator with strategic recommendations and implementation plan". The study is to translate and apply the best practices regarding marine test facilities to Blue Accelerator, the offshore test platform of the POM West Flanders, and assess how it is positioned compared to these other test facilities. The second part of the assignment comprises of the future prospects the Blue Accelerator.

1.2. Scope of the study

The study comprises of three subtasks:

- Task 1: Comparison of the Blue Accelerator with other European open water test facilities. The comparative desktop study aims at mapping out the potential and positioning of the Blue Accelerator test infrastructure in relation to other existing open water test facilities in Belgium, the 2-Sea region and the wider EU. Specific information and best practices have been collected from three partners of the MET-CERTIFIED project, i.e. EMEC, PTEC, DMEC, an additional test facility in Europe, i.e. SEENEOH, and in Belgium, i.e. Coastal and Ocean Basin. For the different sites, the following aspects are described and analysed: available infrastructure and facilities, site conditions, available services and certification, management, accreditation, standards, access to users, permits, business model, HSE, intellectual ownership, marketing and promotion. In addition it is important to determine the Unique Selling Point (USP) of each facility. The analysis is based on interviews with the owners of the test facilities and on the previous study performed by IMDC for POM, Ref. [1], publicly available information.
- Task 2: Strategical recommendations for the Blue Accelerator. Based on the results from Task 1, specific strategic recommendations for the Blue Accelerator are formulated with indication / ranking based on the importance of these recommendations. A part of these recommendations needs to result in the determination of the unique selling point (USP) of the Blue accelerator. Three different levels of recommendations are considered: short term (learning from others and creating complementarity), medium term (filling gaps) and long term (in which area the future developments lie).
- Task 3: Implementation plan of the strategic recommendations. The strategic recommendations are translated in concrete measures. A distinction is made between short, medium and long term actions.

2. Task 1: Comparison of Blue Accelerator with other test facilities

2.1. Assessment of the comparable test facilities

This chapter describes other comparable test facilities.

2.1.1. Content of the leaflets

In order to detect the potential USPs and the positioning of Blue Accelerator in relation to other existing test sites, a leaflet card is prepared for each analysed test facility. Scope of these leaflets is to summarise in a quick and effective manner the main characteristics of the relevant test facilities, in order to make the comparison with Blue Accelerator as straightforward as possible. Therefore, a leaflet has been prepared for the Blue Accelerator too.

These leaflets of other test facilities should always be interpreted in relation to the Blue Accelerator, and are therefore more a tool or an aid to the comparative study and to detect any possibilities for synergies/complementarity.

The following items are included in the leaflet:

- Description of the facility;
- SWOT analysis;
- Technical Readiness Level: (TRL) of tests;
- Unique Selling Point;
- Services;
- Site conditions;
- HSE;
- Intellectual property;
- Permitting and policy;
- Business model & tariff structure;
- Marketing, promotion.

2.1.2. List of relevant test facilities

The leaflets have been prepared for the open water test facilities already analysed in the previous study performed by IMDC for POM, Ref. [1]: three partners of the MET-CERTIFIED project, i.e. EMEC, PTEC, DMEC, and two additional test facilities in Europe, i.e. SEENEOH and FaBTest. This study aims at providing a good overview of the current conditions of the marine energy test facilities, since different typologies of facilities were selected, in order to cover the widest range as possible.

In addition, a leaflet has been prepared also for Coastal & Ocean wave Basin (COB), the new maritime laboratory under construction of the Ghent University's Greenbridge science park in Ostend. The COB is not operational yet and it focuses on research project and / or developers at early TRL, therefore the COB is not directly comparable to Blue Accelerator to gain any lessons learnt. On the other side, it offers a potential for synergy and complementarity. Potential clustering of research infrastructures provides access to a wide pool of experts in the field of scale modelling, and provides synergies in optimising physical model testing in lab and large scale prototype testing in open sea..

This section provides an overview of the test facilities selected for this study, with further details provided in the leaflets (Annex A).

Each evaluated open marine test facility has its own speciality, regional relevance and market positioning. From elementary infrastructure, fast access, low risk and low cost solutions (like FabTest) for early stage developers in search of a permitted area for launching their technology, over facilities providing grid connections, mooring, assistance and accredited testing (like EMEC), to full-fledged facilities that target developers to commercially demonstrate long term running of proven devices (like PTEC). All facilities together have the full range of site conditions covered: from estuarine conditions, over dam constructions and marine sheltered conditions, to offshore extreme conditions.

Figure 2-1 Overview of selected test sites locations

The selected centres, all together, cover the **full TRL spectrum**, ranging from developments at early up to advanced stage. For example, SEENEOH offers four different testing areas, for different TRLs, starting from TRL 3-4\. FaBTest, with its nursery site[1], clearly addresses pre-commercial investment stage, with technologies at a TRL between 6 and 8 who aim to test their devices in moderate wave conditions, with an average significant wave height of 0.6 m.

The DMEC sluice gate site offers test facilities for tidal stream turbines of TRL between 6 and 9, while tidal energy devices of maturity levels from 5 to 9 can be tested at its offshore test site. All the other facilities are suitable for most advanced prototype testing: PTEC, is addressing only to developers with TRL of 8-9, having

[1] The term nursery refers to “being taken care off” and is used to define a test facility addressing early stage developers, offering simple and fast access (in terms of required permits), providing technical and administrative support and characterised by moderate environmental conditions

previously completed prototype testing at other tidal sites and also EMEC receives most offers from mature developers with high TRL (up to TRL 9). See Figure 2-2 below.

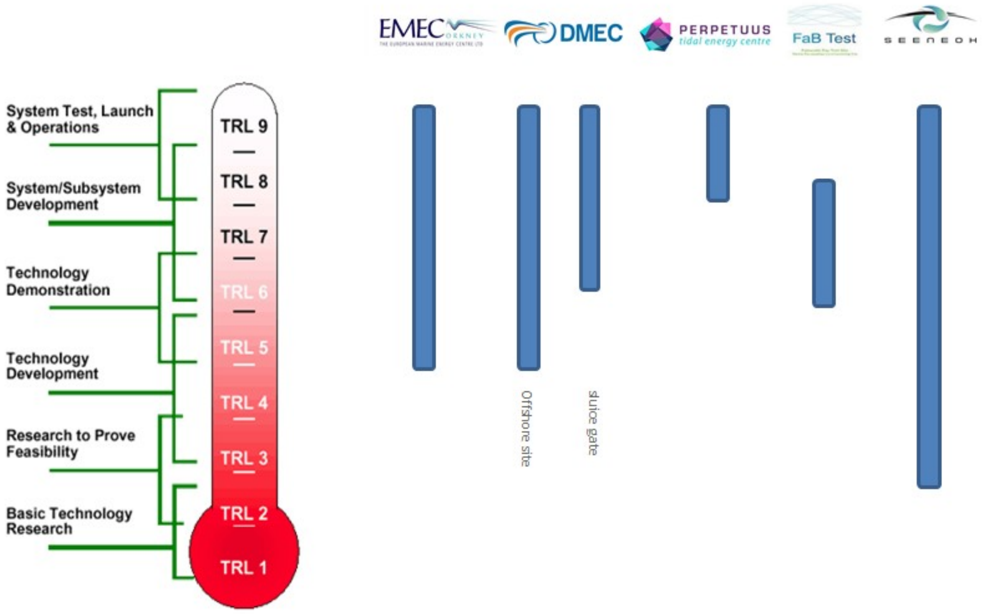

Figure 2-2 Overview of TRL offered by the centres, Ref. [1]

The **European Marine Energy Centre (EMEC)** is the only one of the two accredited open sea wave and tidal test centres (sites) for ocean energy in the world, suitable for testing multiple technologies simultaneously in harsh weather conditions. The second accredited facility is NREL in the USA. EMEC fits the needs of developers with different TRL, up to 9. In addition, it is one of the first centres in operation, since 2003, and it is also playing a lead role in many innovation projects, as FORESEA, MaRINET2, MET-CERTIFIED, SEA Wave, ITEG, Blue GIFT and many more. In recent years, EMEC has been highly active in testing and demonstrating hydrogen and energy system technologies.

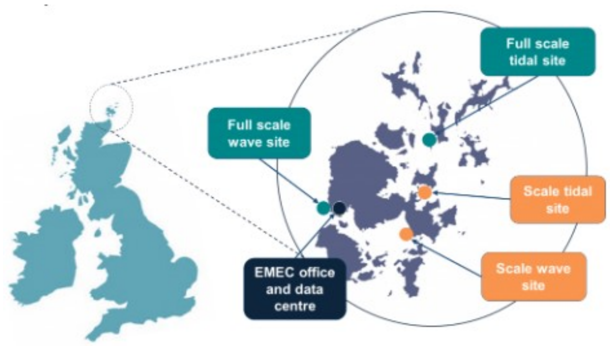

Figure 2-3 Overview of EMEC sites, Ref. [2]

The **Dutch Marine Energy Centre (DMEC)** has two test facilities (sites) for testing tidal energy devices of different types and maturity levels (TRL 6 – 9 at the onshore test site, TRLs from 5 to 9 at the offshore test site). Both test sites are part of a European-wide testing infrastructure, as further detailed in Section 2.2.2. Along with EMEC, DMEC is also playing a lead role in many innovation projects, such as FORESEA, MaRINET2, MET-CERTIFIED, MEA, OESA, OPIN and OceanDemo. DMEC is also part of a network with other test sites in the Netherlands too, as further detailed in Section 2.2.2. With its partners IFREMER and EMEC, DMEC offers testing under protocols that comply with IEC certification.

Figure 2-4 DMEC Offshore Marsdiep berth, Ref. [3]

The **Perpetuus Tidal Energy Centre (PTEC)**, at the Isle of Weight (Figure 2-5), is planned to be operational in 2021 and targets developers at an advanced stage of development with a TRL of around 8-9, having previously completed prototype testing at other tidal sites. The PTEC approach – a readymade, 'live' commercial platform run in partnership with the local council and various turbine manufacturers - presenting a potential model for the tidal energy industry.

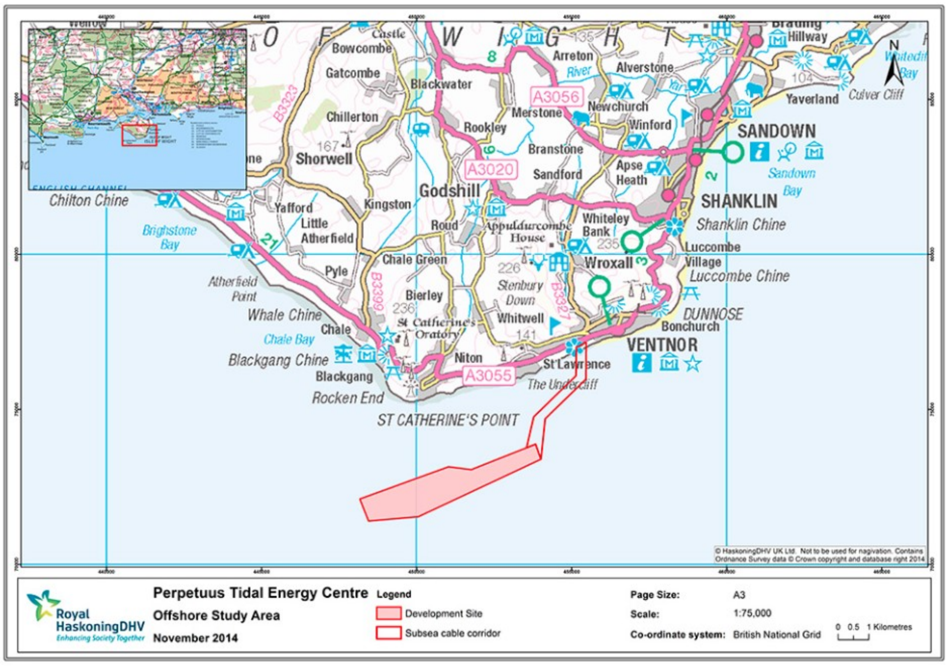

Figure 2-5 PTEC offshore site, 2.5 km south of St Catherine's Point, and subsea cable corridor, Ref. [4]

FaBTest is a facility enabling device developers to test components, concepts or full scale devices in a moderate wave climate. FaBTest offers WEC and TEC tests for developers for a TRL between 6 and 8. FaBTest's pre-consented status aims to provide a -as per their website- "fast, flexible low risk and low cost solution", which is especially appreciated by device developers at the pre-commercial investment stage.

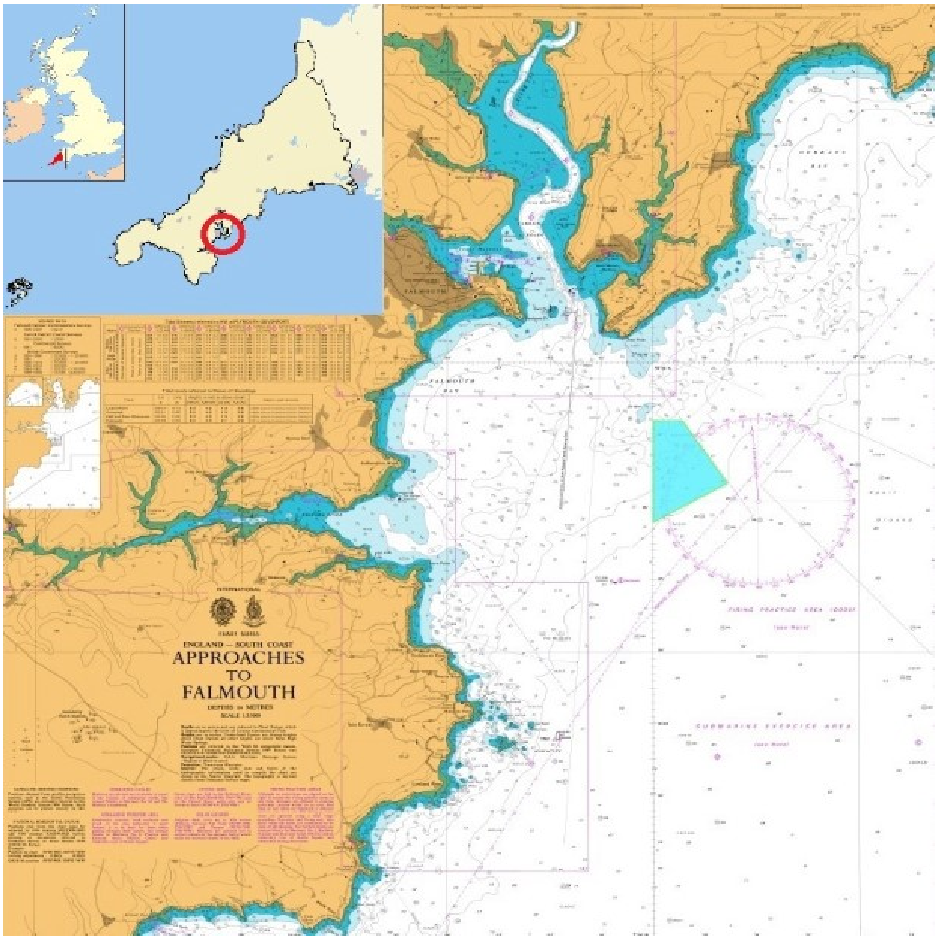

Figure 2-6 Overview of FaBTest site and facilities, Ref.[5]

The **SEENEOH** Test Site close to Bordeaux (France) is mainly locally articulated, with a strong connection to Aquitaine Region economy. Located on the river part of the Gironde estuary, it offers a landmark in estuarine environment for the development of the (tidal) river turbine industry. Demonstrators may be intended on a full scale for the fluvial and estuary market, or on an intermediary scale for the ocean market.

Figure 2-7 Location of Overview of SEENEOH site, Ref. [6]

2.2. Deep dive of 2 test facilities

This chapter intends to provide a deep dive into 2 selected test facilities

Two test facilities have been selected during the kick-off meeting in Brugge on the 12th of September 2019 for a more detailed analysis among all the ones presented in Section 2.1. The purpose of these two case studies is to gain in-depth insight into their strategic development plans and to explore collaboration with other testing facilities. The selected test sites are SEENEOH and DMEC, since they are deemed to be quite similar to Blue Accelerator.

Indeed, like the Blue Accelerator, both SEENEOH and DMEC are test facilities offering moderate environmental conditions, they are easily accessible and they are pre-consented, therefore offering a fast consenting and readiness, together with a simple and easy application process. Also, they both share a strong network with several collaborations in place, aiming at providing different services, in addition to the pure testing activity.

2.2.1. SEENEOH

SEENEOH is an estuarine tidal test site for full-scale river devices and intermediate-scale ocean devices. It is located in Bordeaux, upstream the largest estuary in Europe, the Gironde Estuary where tidal currents increase in the Garonne River. SEENEOH offers 4 different areas for testing: 1 not-grid connected nursery area and 3 grid-connected (100 kW each) locations for floating tidal devices that include moorings. One of the grid-connected location also includes a large floating platform that can accommodate different types of generators. An anchoring system is available, not grid connected, in the form of a pile fixed on the seabed.

OFFERED INFRASTRUCTURE AND FACILITIES

The test site offers four areas to test and validate up to four turbines simultaneously, three of which can be connected to the grid. These areas and associated services have been defined in order to cover all levels of maturity of technology developers, according to the criteria listed below.

Four different areas are available for testing different TRLs:

- The "Quebec" and “Bristol” areas, free area for any type of turbine with its anchor. The User is responsible for supplying the turbine and the floating platform, suited for TRL up to 9;
- The "Bilbao" area providing users with a generic floating platform and its anchors, suited for TRL around 6;
- The «Porto» area is the nursery, and would be an additional area to test subproducts of tidal turbines, offering a validation step for low-mature technologies TRL <4,

The three grid-connected berths, shown in Figure 2-9, right side, are designed to accommodate tidal devices with either mounted or floating fixation type (pre-installed mooring). The site is connected to the grid for consumption (36kVA) and injection (250 kVA).

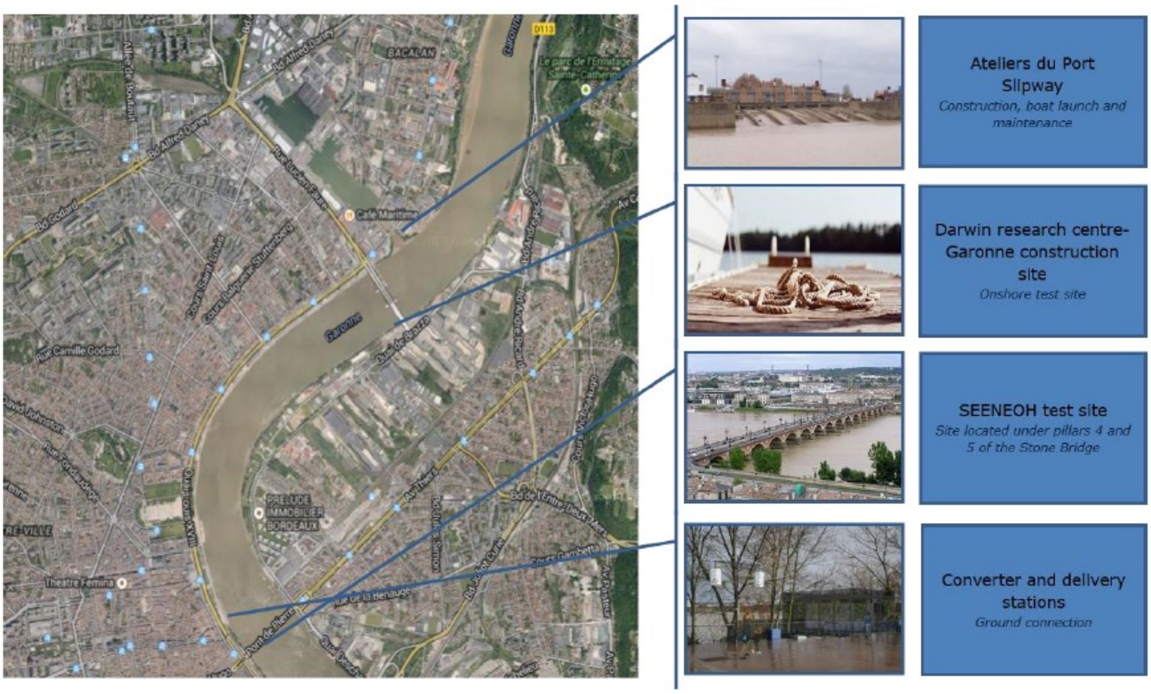

Figure 2-8 Infrastructure of SEENEOH Bordeaux test site, Ref.[7]

SEENEOH is operational since 2017. Since the opening they had only two cases/clients, with a TRL of around 3 to 5. One client had already deployed in a river without grid connection, after that SEENEOH was chosen in order to test in bi-directional flow conditions and with a grid-connection. The second client had already deployed its device at small scale.

Site Conditions

Bi-directional currents characterise the SEENEOH site. The tidal range during spring tides exceeds 5m and current velocity reach up to 3.5 m/s. Currents above 1m/s occur approximately 80% of the time. Depth at the test area ranges from 5 to 17 m. The SEENEOH Bordeaux test site is located in downtown Bordeaux on the inland part of the Gironde estuary (Figure 2-9), an area commonly called "maritime Garonne". The test site is located near the left bank of the Port of the Moon between the Stone Bridge (upstream, Figure 2-9) and the mouth of Peugue (downstream converter station (poste de conversion), see Figure 2-9).

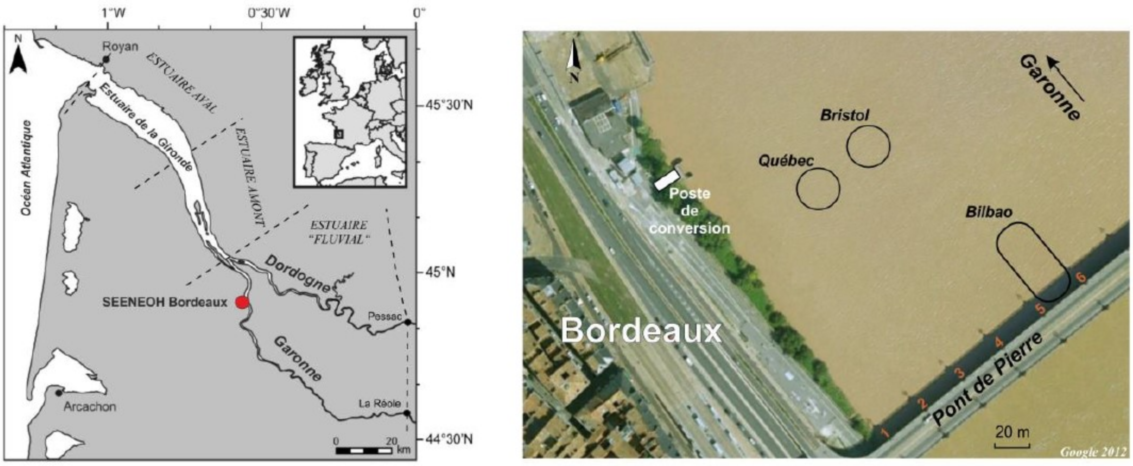

Figure 2-9 Location of SEENEOH Bordeaux test site and of tidal turbines slots, Ref.[7]

In the SEENEOH Bordeaux test site, the flood tide lasts only 4 to 5 hours and the ebb tide 7-8 hours. Thus, the test site is exposed to varying intensities of two-way currents up to 3.5 meters per second (7 knots) under the Stone Bridge (see Figure 2-10).

SEENEOH test site is located near the Stone Bridge because the current is more intense there, especially for the Bilbao site. In fact, the decrease of the wetted section of the river caused by this infrastructure consisting of 15 marine arches, combined with the coincidence of a threshold in the bathymetry, generates a high acceleration of the current.

Figure 2-10 Stone Bridge, Bordeaux, location of SEENEOH, Ref.[7]

OFFERED SERVICES

SEENEOH aims to provide a shared infrastructure and a set of services for industrial developers of tidal technologies to promote the maturation and validate technologies prior to commercial deployment.
The services offered by the SEENEOH test site to a user comprise several elements:

- Mechanical and electrical performance and reliability testing of tidal devices and their related equipment;
- Environmental data (ADCP, bathy) ;
- Environmental impacts assessment and feedbacks;
- Power performance measurements and certification by Bureau Veritas;
- 24h supervision by a remote control center.

With regards to environmental monitoring, this is regularly performed for the site characterization, and provided to developers (bathy, ADCP). Data monitoring resulted in an important part of test centre schedule, which ran in parallel to the standard testing activities.
The aim of the environmental monitoring is:

- to understand the impact on the environment as a result of the test site;
- to understand the impact on the environment as a result of the machines.

These two goals are met by monitoring the parameters related to operations of the site (currents, water depth, meteorological data, physico-chemical parameters, acoustic and interaction with the fish fauna).
Two modes of data acquisition are in place:

- Permanent acquisitions made by fixed-position sensors, whose data is transmitted to the SCADA system in real time;
- Occasional acquisitions, operated by sensors deployed from the service vessel.

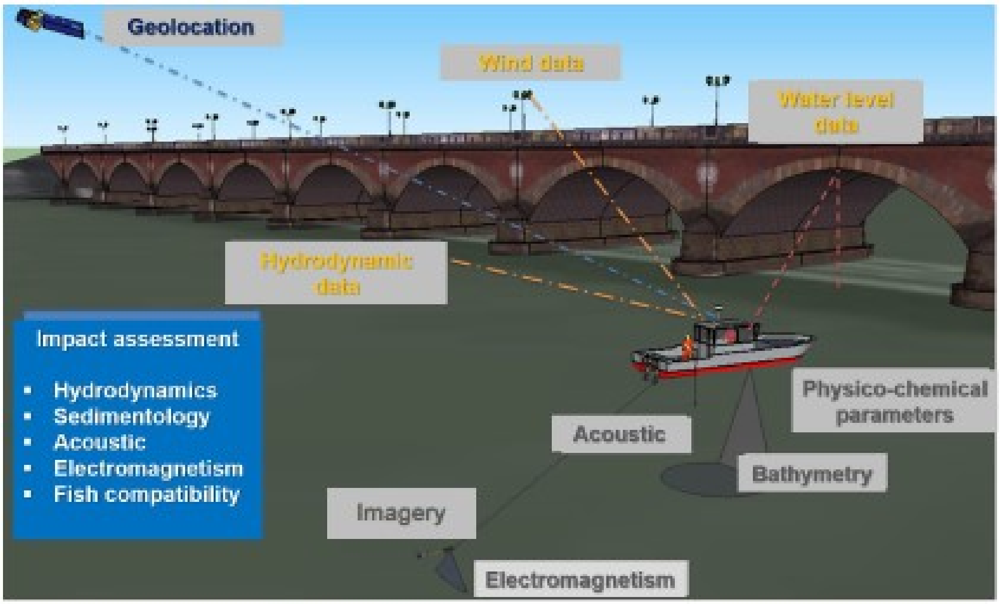

Figure 2-11 Scientific exploitation from environmental monitoring at SEENEOH site, Ref. [7]

SEENEOH has an on-going partnership with Bureau Veritas (BV) for the power curve certification. BV developed specific protocols based on IEC TC114 for tidal power curve certification in order to adapt this protocol for the particular area of the SEENEOH site. This was SEENEOH's investment in their future. In fact tidal power curve certification exists, while for river power it is still under development. The case of SEENEOH is not tidal nor river, it is an estuary, so the protocol of IEC had to be adapted.

The procedure followed by BV when SEENEOH has a client who asks for a certified power curve is:

- instrumentation check;
- data collection;
- and finally power curve verification.

Certification for power curves is done at a later stage of development, as the power curve changes when the device is modified, so the certification would not be valid anymore. Certification of the power curve assessment & design is necessary for commercial and financial purpose. The power curve certification is also fundamental to compare technologies. It can also be considered as a key element to increase the collaboration between test facilities. For example, a client can test in two different test centres with the same team, so they can check if the resulting power curve is the same when compared to the same technical specification, to gain trust.

Permitting

The implementation and operation of generators/turbines in the French river waters are subject to compliance with a number of regulations. The Port of Bordeaux is responsible for the authorization (not the French State) which makes it easier to get a permit. Main focus of the permits gathered by the Port of Bordeaux was the mooring, while the rest had marginal importance. A limited EIA has been obtained by SEENEOH and the Clients do not have to apply again. All environmental and technical commitments, upon which approvals were granted to SEENEOH, should be respected by users of the test site.

SEENEOH takes out all insurance required for the activities carried out on its test site. The user of the site will also have to prove cover for its activities.

The site is fully consented, so users do not have to submit any application for permits. Requests for accessing SEENEOH site are processed in a logic of First In First Out (FIFO) procedure.

The application procedure, available on the website, allows both to describe the test site to the prospects and specify the technical and regulatory requirements regarding the use of the site.

The entire contracting process is expected to last around 4 months. This term may also vary depending on the level of maturity of prospects and their ability to address the different points:

- Initial discussions and signature of a confidentiality agreement to exchange information related to the test site, to technology and to the user's planned tests;

- Exchanges, pre-studies and negotiations to define the technical, legal and financial terms and conditions in order to check more specifically the feasibility of the tests;
- Issuance of a technical and commercial offer by SEENEOH;
- Signature of a contract of access and services specifying the main points such as the schedule of tests, cost of delivery, draft contract, technical appendixes;
- Additional studies, presentation by the prospect of deliverables specified in the User Manual, finalization of the definition of contractual terms;
- Implementation Authorisation;
- Operation Authorisation and services delivery.

Thanks to this process it is possible to check the technical compatibility of the project, the solvency of the applicant with regard to its commitments and obligations, in particular those relating to the dismantling of its tidal turbine at the end of the testing phase, and the site's ability to meet the needs of the user and its timing.

Business model [7]

SEENEOH is a 'Société par actions simplifiée' or joint stock company, locally articulated, supported by public and private partners, established as a private company and managed by 4 different operating companies in charge of:

- environmental monitoring, by Energie de la Lune;
- performance assessment studies, by Energie de la Lune and Valorem;
- legal, administrative, financial, by SEENEOH SAS;
- mechanical/nautical aspects, by Cerenis and Valorem.

SEEENOH SAS SHARE CAPITAL	in %
ENERGIE DE LA LUNE	40,0%
CERENIS	22,0%
VALOREM	13,0%
SEML RDL	25,0%
TOTAL	100,0%

Figure 2-12 SEENEOH share capital, Ref. [7]

To date, 65% of the start investment was from France government and two Regional / Local Authorities; 35% has been charged to several private companies.

The current economic model consists of SEENEOH selling their services to users who need to foresee own budget from EU or regional funding. This method is not resulting successful enough, as developers have scarce budget availability. The plan is to increase public funding, mainly from the EU, to cover their own costs, so that users can access the site without paying any fees. The business model is based on providing power curve assessments as a key aspect for tidal energy.

Site authorisation is in place until 2022. The decision will then be made whether to extend the permit for another 7 years or to transform their business and become a real energy producer.

At the beginning, the intention was that a 'R&D Institute' would gather all French test sites and would manage all of them, but a lot of administrative issues came up during opening, when it was trying to establish itself as a R&D institute. It was too complicated from an administrative point of view that it was decided to set it up as a private company and to manage the facility themselves. The R&D institute still exists, but do not manage any test facilities.

Legal framework and policy [8]

The French government is quite supportive of offshore tidal energy, although most of the support (national and from EU) is for R&D rather than for offshore operations. While France possess the second largest European potential for tidal energy in the world, with 3.5 GW exploitable in mainland, currently there is no launch of tenders for future tidal offshore deployment. Ongoing projects issued from calls for tenders of previous years also involve wave energy converters, tidal turbine prototypes and technological bricks like subsea connectors or hubs, foundation concepts, specific dredging or installation tools, etc.

A new law is being discussed to stimulate renewable energies by simplifying their deployment. Two situations are being explored:

i) having the cost of the export cable supported by the French Transmission System Operator, for all offshore developments;

ii) streamline the legislative and legal framework by developing a so-called "permit envelope". This procedure would move most of the legal obligations (preliminary technical studies, initial environmental assessment, public debate) upstream of the actual permit issuance, thereby considerably reducing the risk for project developers as long as the technical details of the project do not diverge from the initial plan.

The relevant crash of OpenHydro has to be mentioned. French-based large industrial player, Naval Energies – the parent company of tidal stream technology outfit OpenHydro – decided to stop further investments into development of its tidal energy business, due to the "lack of commercial prospects" for tidal stream project development. As a result, the French government fears that also smaller players will not be able to succeed.

In France, most developers tested offshore in open water, not in test facilities. Basically, if developers have a vessel available (due to prior involvement in offshore wind) and marine permits are already in place, there is no need to address a test facility. In addition, development of test facilities in France came late in contrast to, for example, Scotland where EMEC gained many clients at the moment developers needed them.

2.2.2. DMEC

The Dutch Marine Energy Centre (DMEC) is a service provider without profit for the international marine energy sector. DMEC can be seen as a business support organisation providing technical and commercial services covering the entire product development life cycle; from initial concept design towards demonstration and commercialisation. DMEC builds strategic collaborations between technology companies, research institutes, and offshore companies to realise joint projects and business cases. DMEC facilitates testing and demonstration in test sites that will be developed based on the client requirements.
Besides this, DMEC operates two test facilities for testing tidal energy devices of different types and maturity levels. Both test sites are basically only permitted areas, with no real infrastructure available.

Offered infrastructure and facilities

DMEC has two test facilities:

- An inshore test site at Den Oever (Figure 2-13), located in two ducts of the Afsluitdijk, in an existing sluice that discharges water from the IJsselmeer to the Wadden Sea twice a day. The facility is suitable to intermediate scale testing of tidal stream turbines of TRL 6-9 and enables testing in sea conditions in a ducted channel. Because of its sheltered position near land, the test facility is well accessible, making installation and operation and maintenance relatively easy and cost effective. The test site has previously facilitated tests of Tocardo turbines; it is suited for small turbines of max. diameter 2.8 m;

Figure 2-13 DMEC Inshore Den Oever site [3]

- The offshore Marsdiep test site (Figure 2-14) is situated in open water. The berth is close to both the harbours of Den Helder and NIOZ on the Wadden island of Texel, and is connected to the grid through an umbilical (currently failed). The test site has been used previously to test the BlueTEC platform, which carried a Tocardo turbine. Tidal energy devices of all types and maturity levels can be tested here. It serves mainly as a showcase site, for easy access in the Netherlands and to trial all offshore operations (installation, access, inspection, service and maintenance).

Figure 2-14 DMEC Offshore Marsdiep site, showing current DMEC activity [3]

Besides that, DMEC is currently facilitating a demonstration of a tidal kite at a client specific location close to the “Afsluitdijk” and a demonstration of a floating solar device at a client specific location at the North Sea.

SITE CONDITIONS

For the two sites where DMEC owns the permits:

- The inshore test site at Den Oever is suitable for performance, installation, survival, O&M and demonstration tests. Laminar flow speeds are in the range of 1.5 and 4.5 m/s and can reach up to 6 m/s and are accurately predictable;

- The offshore Marsdiep test site (Figure 2-14) experiences bidirectional tidal flows of 1.0 – 2.0 m/s, with a typical value of 1.8 m/s. It is located in a water depth of 25 m, and it is 400 m from the shore.

Offered services

The Dutch Marine Energy Centre (DMEC) was launched in June 2016 with the aim to promote marine energy and accelerate the commercialization of marine renewable energy technologies. It seeks to create a knowledge platform for small and medium-sized enterprises (SMEs) active in the technologies for energy from waves, tides and salinity gradients, thereby facilitating collaborations between stakeholders involved in the Dutch marine energy sector.

DMEC does not have any fixed infrastructure (such as but not limited to mooring, piles or a platform), but searches the specific needed infrastructure based on client requirements, and provides assistance in setting up the permits, administrative and technical support.

DMEC's mission is to accelerate the route to market of marine energy solutions. This entails both the technical and commercial route to market. Therefore DMEC delivers services in both areas:

Technical route to market

1. Demonstration and piloting

   DMEC helps clients to realise a demonstration or pilot on a client specific location; wherever the conditions are the best and where the demonstration or pilot has the highest chance of success. They call this approach "fit for purpose". It makes DMEC flexible and lean and able to exactly match client requirements. For a specific location DMEC assists in whole trajectory of arranging capital to finance the demonstration, arranging the necessary permits, compiling the test plan, and executing the test plan.

2. Certification

   DMEC develops performance reports of demonstrations in collaboration with accredited organisations.

3. Technical advancement

   After successful demonstration, DMEC assists in implementing the results of demonstrations (e.g. design / engineering optimisation) in order to advance the current development state of the device.

Commercial route to market

1. Growth and market entry strategy

   DMEC helps to build a successful company by defining and implementing a comprehensive growth and market entry strategy. DMEC works on the definition of different international (niche) market segments and which steps are needed in time to successfully launch the company's solution.

2. Business case development

   Once the market is identified, DMEC develops the business case and attracts the necessary stakeholders to implement it.

3. Mobilising finance

   In order to realise the business case, DMEC assists in mobilising public and private finance.

Besides its support in the route to market, DMEC aligns groups of crucial stakeholders consisting of policy makers, project developers, offshore companies and investors in order to realise new projects in the water. Together with universities and research institutes in its network, DMEC offers tools that support the effective implementation of projects. These tools assess the environmental impact of technologies and plan for operation and maintenance activities. Data on impact on environment is published and shared with knowledge institutes.

Permitting

DMEC test facilities are pre-approved. DMEC reported that sometimes clients are only looking for a known name (test facility) and a 'permitted seabed area where anchors can be deployed', to avoid the permitting time. There is an access agreement that describes conditions for access and transfer of liabilities.

Before each test, DMEC informs the authorities and provides documents explaining why there will be no impact. In such cases, only 8 weeks are required to get a technology specific permit.
DMEC has extensive experience in obtaining the necessary permits for other specific locations. For each location, the profile of necessary permits is different. DMEC aligns with the relevant governmental organisations in order to arrange the right permits. During the implementation of a project, effectively managing multiple public and private stakeholders is key. DMEC assists in creating a common vision supported by all stakeholders and developing a viable public-private business case with a clear governance structure.

Business model

DMEC cannot rely on developers alone, indeed the main income results from funded projects (e.g. project for standardisation and certification without focus on a single technology, OESA project with 5 pilots, Marine Energy Alliance for early stage technology support). In addition, DMEC develops and provides technical and commercial support and services to developers via its network (for TRL 3, 4 and 5) and acts as consultant.
As there is no commercial money available to do project development (it takes a long time before developer is interested to start testing as high costs are involved), funding is the only way at this moment.
In order not to depend on this income model alone, DMEC developed commercial incomes from its other services. Indeed, the order book for testing evolved quite slowly since the facility became operational, in 2016. Therefore, DMEC decided to evolve its business model to a project office, acting as a consultancy / facilitator and running collaborative R&D projects with the industry. For this reason, at present DMEC has only a permitted site and no real infrastructure available: anchors have been removed and the power cable, after its breakdown, was not repaired. It was proven to be difficult to attract a steady stream of clients for testing and furthermore clients bring little or no funding. Indeed, DMEC's order book evolved over the last year due to its flexible and client specific approach. DMEC is currently facilitating 4 demonstrations at the same time, and it is building a larger business case with multiple device companies for a pilot around the Wadden Islands in the North of the Netherlands. DMEC has close contacts with all other open water test sites, via EU funded projects and via the "International WaTERS network". DMEC assists clients to get access to any test facility, whichever is the best for that specific client. DMEC highlighted a problem with the idea of a chain of test facilities at different levels of development (from lab to nearshore, to offshore), which a client can go through: there is a lot of time in between the different development steps, it is not a continuous chain in time and developers like to come back to facilities known to them and had experiences with.

Legal framework and policy

Although the theoretical potential of large-scale electricity generation from ocean energy is limited in the Netherlands, the Dutch considers their local deployments as showcases crucial to build an international export market. Ocean energy activity in the Netherlands reflects its long-lasting history in offshore operations and water management. Unique integrated solutions are developed where tidal energy and salinity gradient are integrated in civil infrastructures like storm barriers and bridges.
In terms of projects currently deployed in the Netherlands, a large-scale salinity gradient pilot facility of REDstack has been operating since 2014 at the Afsluitdijk.
Furthermore, new demonstration projects are planned in the Netherlands: another pilot of REDstack is being developed (1MW) in Katwijk, SeaQurrent plans to install a full-scale demonstration tidal kite system (0.5MW) close to the Wadden Islands, and Oryon Watermill is developing a hydroelectric power station (500kW) in Doesburg.
Dutch companies are also planning to deploy abroad: Tidal Bridge is developing a project in Indonesia where a floating bridge will be constructed with turbines underneath that will generate up to 30 megawatts from the tidal movements. Bluerise is developing two commercial Ocean Thermal Energy projects in Curaçao (10MW) and in Jamaica (20 MW) and Water2Energy tested tidal turbine (0.2MW) in the Port of Antwerp. Operational dates are not yet available.
All regions within the Netherlands have smart specialisation strategies in place. The development of Ocean Energy is supported both on a Provincial level as on a national level:

Provinces of North Holland and Friesland

The 'Nieuwe Afsluitdijk' is a partnership between the provinces of Noord-Holland and Fryslân and neighbouring municipalities. Several pilots are already in place in this area, such as the DMEC test facility, the Offshore Grid

Test Centre and the osmosis pilot plant of REDstack. Plans for a tidal power plant at Kornwerderzand are being developed. Both provinces have signed a policy document to list the Afsluitdijk as a Living Lab.

Provinces of South Holland and Zeeland

In 2015, BT Projects, a developer and facilitator of Ocean Energy (tidal and wave) and run-of-river energy projects, designed the Blue Barrier, as part of the Tidal Technology Center Grevelingendam (TTC-GD) for the development, testing, demonstration and certification of cost-effective and fish-friendly hydropower installations for both tidal energy and hydroelectric power. The Province of Zeeland proposed the Blue Barrier as an icon project of the Delta Program 2017 and TTC-GD was operational by the end of 2018.
The province of South Holland and the Rhineland Water Board, the municipalities of Katwijk and Noordwijk, and REDstack are researching the possibilities of the construction of a Blue Energy demo-pilot at the discharge channel in Katwijk. Besides that, the provincial authorities of Zuid-Holland and Zeeland, Rijkswaterstaat and the municipal authorities of Goeree-Over akkee and Schouwen- Duiveland are committed to building a tidal power plant in the Brouwersdam.

Cofunding on a Provincial Level

The Provinces Friesland, North Holland, South Holland and Zeeland provide co-funding to marine energy related projects, such as Tidal Testing Centre Grevelingendam (OP Zuid - ERDF), MET-Certified (Interreg 2Seas), FORESEA (Interreg NWE) and the Marine Energy Alliance (Interreg NWE).
Additionally, the Provinces have several instruments available to cover almost the whole innovation chain via participations or loans. For the Wadden region, a special grant programme is in place coordinated by the Waddenfonds. In the past they have funded several marine energy projects and new projects are currently under development.

Collaboration between regional and national governments

Regional and national governments are more and more joining forces stimulating the full-fledged integration of marine energy in the national energy and innovation policy, amongst which the top sector policy and the new comprehensive energy agreement.
The Dutch Top Sector policy is assigned to contribute to R&D and innovation in the Netherlands. Within nine designated sector programmes valued at €500 million, solutions that contribute to solving societal problems are supported. Marine Energy is seen as an important cross-over between the Top Sectors Water and Energy. More specifically, several marine energy projects are integrated within the innovation agendas of the Deltatechnology, maritime and water technology sectors as well as the offshore wind sector.
On European level there is a strong vision for marine energy (Blue Growth), several commissions and Directorates-General (DGs) encourage marine renewable energy initiatives (notably DG MARE, DR Energy).

2.3. Analysis of Blue Accelerator in comparison with other test facilities

This chapter intends to provide a comparison with all the described test facilities from Section 2.1

The maritime innovation and development platform is realised by the Blue Accelerator project, which envisage to create a "living lab" at sea. The intention is to launch innovation projects in a variety of marine and maritime sectors in real life marine conditions. It intends to focus on wave, wind and tidal energy and the broader blue economy.
It is envisaged that the following measurements, investigations and tests can be carried out on the platform (non-exhaustive): wave and tidal energy conversion, corrosion and abrasion investigations, cable manipulations, resistive resistance investigations, meteorological measurement mast, underwater substrate and marine growth investigations, offshore application of drones.
The platform is currently being used by NEMOS GmbH, which is testing its wave energy converter prototype at Blue Accelerator.

Figure 2-15 NEMOS's WEC handling prototype deployed at test location (maritime innovation and development platform on the left) [9]

2.3.1. Offered infrastructures and facilities

The maritime innovation and development platform 'Blue Accelerator', shown in Figure 2-16, consists of a foundation (monopile) and a working container (7m x 3.5m), with an engine room. Testing can take place on the test platform and 50m around it, on the seabed, in the water column, on and above the water surface. The test facility has easy access for deployment and maintenance from the Port of Ostend. The available wave climate can be continuously measured, while an antenna ensures the data connection and a camera ensures visualisations. Navigation buoys protect the test zone from unwanted marine traffic. There is no grid connection installed however, J-tubes are available in the monopile of the platform. The Blue Accelerator addresses developers at TRL between 4 and 7, with a focus on TRL 6.

EMEC and DMEC cover almost the full TRL spectrum. Only FaBTest clearly addresses a precise TRL (between 6 and 8). PTEC focusses on a TRL in the range of 8-9.

Figure 2-16 Blue Accelerator: maritime innovation and development platform in Ostende [9]

EMEC offers one scale wave site and one scaled tidal site, both not connected to the grid. EMEC has 5 grid connected berths at its full scale wave site, and 7 grid-connected berths at its full scale tidal site. Both export to the grid via onshore substations at 11kV with fibre-optic communications cables. Wave buoys are deployed at both wave sites (scaled and full scale) and a met-station at the full scale site. A test support buoy can be deployed at either scale site. On the tidal site, an ADCP can be deployed, including a met station and radar. EMEC also provides dedicated office facilities to its clients.

DMEC has two test facilities, one integrated in a dam (sluice gate, 'inshore') and one offshore berth (400 m offshore), with no fixed infrastructure.

FABTest has a licence for 3 berths, marked by 4 wave buoys. There is no cable connection to shore, power output can be measured as a 'dump-load' at one of the buoys.

PTEC develops tidal stream facilities at commercial scale, from grid connection, substation and control room up to subsea cables for long term deployments (at least 15 years).

SEENEOH offers 3 grid-connected (100 kW each) locations for floating tidal devices that includes moorings. One of them also includes a large floating platform that can accommodate different types of turbines. A new anchoring system is now available, however not grid connected, in the form of a pile fixed on the seabed.

2.3.2. Site conditions

The site is located 500 m from the Port of Ostend, in a water depth ranging from 7.0 m LAT to 12.7 m HAT, offering moderate metocean conditions, i.e. average significant wave height of 0.8 m +/- 0.6 m and mean current of 0.5 m/s +/- 0.3 m/s. Example of typical metocean conditions encountered at Blue Accelerator, in terms of current and significant wave height, is given in Figure 2-17.

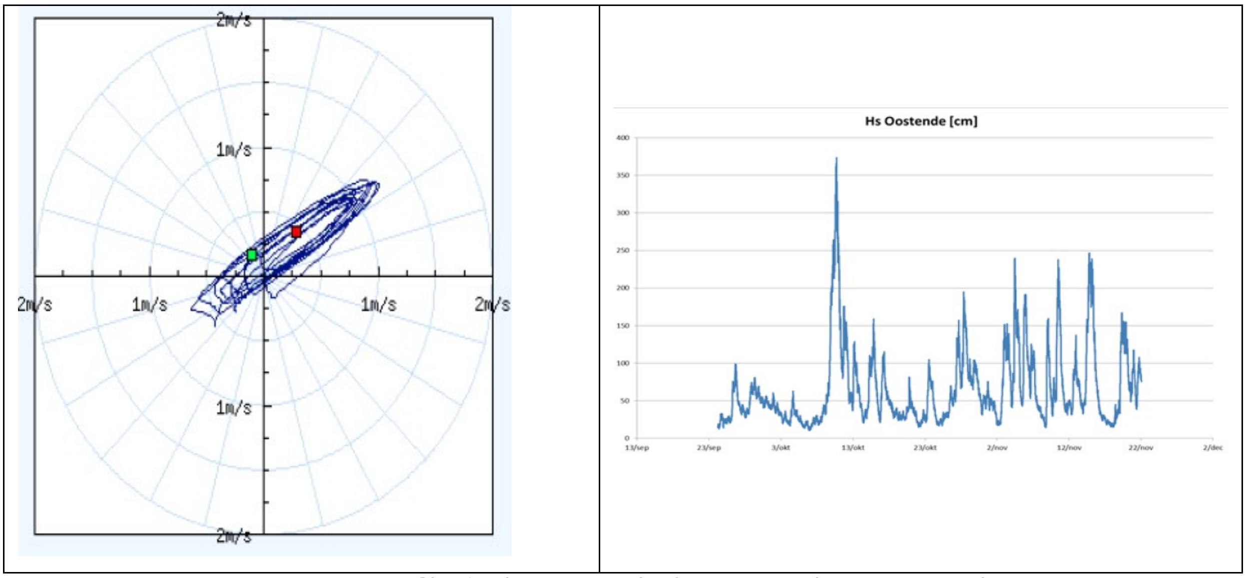

Figure 2-17 Blue Accelerator: example of metocean condition (currents and waves)

The Blue Accelerator is easily accessible: operational (500m from port) in central position in Europe, it can be easily reached through Brussel and Ostend-Bruges airport. This is a characteristic similar to DMEC and SEENEOH, where the accessibility is one of the strengths. The SEENEOH site, located in the Gironde estuary in the city of Bordeaux, can be reached in 10 minutes by SEENEOH's own boat, while DMEC's offshore site is close to a ducted structure and practically always reachable. FaBTest is also easily accessible, being located within Falmouth Port limits, and having use of the University research vessel. In terms of onshore accessibility, SEENEOH is close to the airport of Bordeaux, DMEC can be easily reached through Schiphol Amsterdam, while FaBTest is reachable through Cornwall airport.
The Blue Accelerator offers moderate environmental conditions.
The strength of EMEC and PTEC lies in the open sea conditions and thus subject to extreme conditions of their sites; as a consequence, these sites are not as easily accessed as the previous mentioned centres. Furthermore they are located quite far from an international airport. A summary of the water depth and environmental conditions, in terms of currents, encountered in the test centres under investigation is given in Figure 2-18 and Figure 2-19. It must be noted that the water depth indicated in Figure 2-18 is the one encountered at the test site, although for all sites, tests can be performed at the water level too.

Figure 2-18 Overview of water depth range at the test sites, Ref. [1]

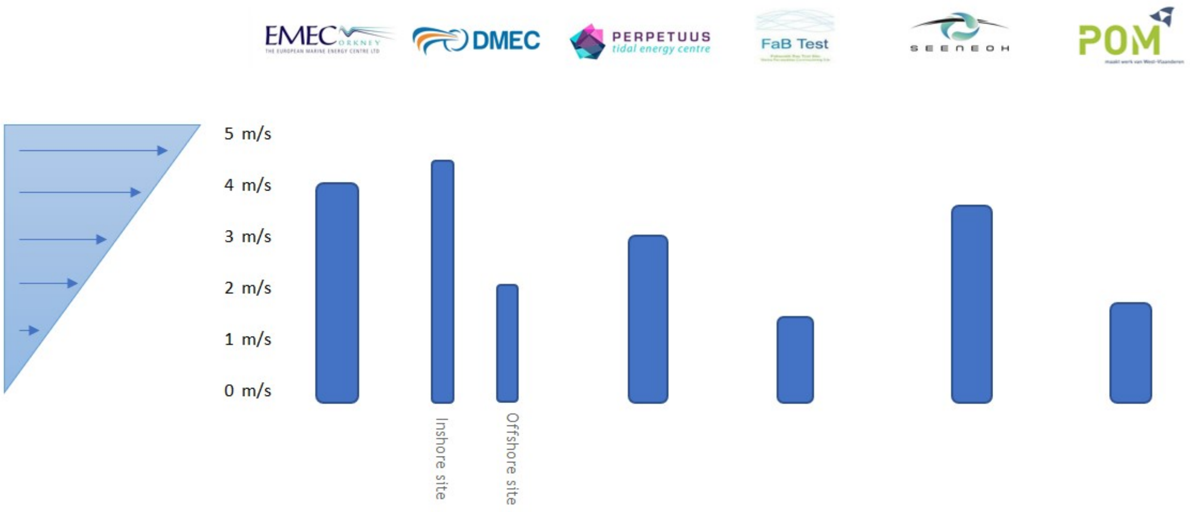

Figure 2-19 Overview of maximum current speed at the test sites, Ref. [1]

2.3.3. Offered services

The maritime platform will serve as a base for setting up tests and demonstrations at sea. The intention is to have a test in real sea conditions to launch innovation projects in a variety of marine and maritime sectors.

As an illustration the test platform could be used for the following functions (non-exhaustive list):

- Wave and tidal energy conversion;
- Corrosion and abrasion investigation, their combined effects and mitigation measures;
- Measuring mast, LIDAR, not only on the platform but also on a buoy;
- Research into substrates, incl. building with nature;
- Erosion monitoring and research, including underwater scale models;
- Offshore telecommunications, telemetry and applications of the Internet of Things;
- Solutions for installing sensors for vertical layering in the water column;
- Drones for offshore applications, including loading and unloading stations and loading stations (example shown in Figure 2-20);
- Testing of underwater ROVs, AUVs and including docking station;
- Maneuvers and operations for cable manipulations;
- Materials research for mooring boats;
- Underwater research and development in the immediate vicinity of the platform;
- Activities of NEMOS as foreseen in the permit.

Figure 2-20 Application of drone for offshore operation can be tested at Blue Accelerator [9]

In addition, POM develops and provides technical and commercial support and services to its clients via POM's knowledge base and network. Furthermore, POM supports the users of the test platform by realising a common framework for all test facilities with relevant partners and relevant authorities. POM is an active member of several groups and network of test facilities, organised in EU projects and research programmes, as detailed in Section 2.3.6, and emphasises the importance to collaborate and align with stakeholders from offshore, investors and government with the ultimate goal to accelerate the route to market. The partnership with other test facilities is an opportunity to facilitate the development of the blue energy sector, throughout mutual promotion, maintaining good relation and sharing best practise and methodology. Further details are given in Section 2.3.7.

POM supports developers during the licensing/permitting process. POM entertains the permit request and follows-up the legal process once the permit is obtained. Also, in order to speed up the process, a standardised intake form for tests is going to be arranged with BMM, such that all the information required from the client are immediately available and the assessment by BMM can happen in an efficient way. Further details are given in Section 2.3.4.

SUPPORT FINANCIAL

All the investigated test facilities offer support to their client to obtain funding too. This support can range from helping with funding applications, and providing intelligence and contacts, to setting up open access schemes such as FORESEA and Blue GIFT which technology developers can apply to.
In particular, DMEC, EMEC, PTEC and FaBTest can offer free-of-charge access to their clients for testing, through funding programme such as MARINET2 and FORESEA. POM has the ambition to join these and similar programmes and projects, but is currently not included. SEENEOH is planning to increase public funding, mainly from the EU, to cover their own costs, so that users can access the site without paying any fees.

SUPPORT TECHNICAL

In terms of services provided, POM is quite unique for its versatility. Indeed, thanks to its extensive network with other institutions, including technology developers, the supply chain, academic institutions, can offer a customised approach, supporting developers from funding, to consenting, to deployment itself.

The Blue Accelerator is the only test centre, among the ones analysed in this study, which is not specialised on testing a precise type of technology, as TEC for DMEC, SEENEOH and PTEC are focused on WECs and EMEC and FaBTest are mainly focussed on TEC.

EMEC has the largest team and offers the most services of all the studied test facilities. Apart from making its infrastructure available, EMEC assists clients with the planning (2 years ahead) and getting licences in place if needed, as parts of EMEC sites are pre-consented. EMEC has a Quality Management System which is certified to EN ISO 9001:2015 and provides guidance to developers with emergency response plans, relevant standard operating procedures and safe systems of work such as permitting. EMEC monitors the generated electricity, supports development of test programmes and offers accredited Performance Testing.

DMEC is mainly acting as a consultancy and/or facilitator, therefore these kinds of activities are DMEC's core business. In fact, as mentioned in Section 2.2.2 and 2.3.1, DMEC does not have any effective fixed infrastructure, as its test sites in the Netherlands are mainly used as showcases.

FaBTest offers guidance in the lead up to a deployment and has a rigorous application procedure for the permit, including third party verification of the device moorings.

PTEC will not only offer test facilities to external developers, but will in fact also be the project developer partnering with selected turbine manufacturers. A third party will be involved for independent validation and verification of test data (Type Testing).

DATA MONITORING

POM offers continuous monitoring of environmental and metocean conditions in cooperation with Flanders Marine Institute.

Site data monitoring and/or modelling is fundamental for a correct definition of the testing conditions, to optimise the layout and design of the facility and to provide device manufacturers with the required data to undertake performance/yield assessments.

Data monitoring is actually an important part of test centre's schedule.

SEENEOH relies upon an external private R&D institution for the data elaboration, i.e. Énergie de la Lune, while DMEC and FaBTest rely upon academical partners, respectively being TU Delft and University of Exeter. On the other side, Blue Accelerator will probably carry out this activity internally.

EMEC monitors the generated electricity, manages data acquisition and provision from instruments on site. In 2013, a bespoke environmental monitoring pod, the first of its kind pre-commercial prototype, was deployed at EMEC's Fall of Warness tidal test site to collect data used to assess potential effects tidal turbines may have on wildlife. The live data feedbacks to EMEC can be used by marine energy developers using the site.

PTEC is not operational yet, but they have a lot of site data – both raw data and analysed data, used to help layout optimisation and design of the project, as well provide turbine manufacturers with the required data to undertake performance/yield assessments.

2.3.4. Permitting

POM's permit has a duration of 15 years (i.e. until June 2034)., upon which it has to be decommissioned within 3months. POM has a permit for the further execution of wave energy tests (by NEMOS) and for the exploitation of the Blue Accelerator as a maritime innovation and development platform insofar as the measurements, research and test are not subject to authorisation. This means that every activity needs to be checked with Management Unit of the Mathematical Models of the North Sea (MUMM) to assess whether or not the requested activity is subject to authorisation, and if so, which procedure to follow (procedure with consultation or simplified procedure).

More in detail, large part of the planned activities will not be subject to authorisation, which means that POM simply has to inform BMM and after their confirmation, the test can start immediately.

Should authorisation be required, in most cases a simplified procedure can be followed (shorter in time, no public consultation needed). Only large-scale long-term test cases with high impact for which the simplified procedure is not appropriate will need to go through the full formal procedure. Both BMM and POM believe this will only be needed in a very limited number of cases. Most of the test will not be subject to authorisation, or will be possible to proceed after the simplified procedure has been completed.

In any cases, POM entertains the permit request and follows-up the legal process once the permit is obtained: POM will coordinate the process for the clients with BMM and will provide support in the whole process (check procedure, gather information needed, contact BMM,….).

The test platform can be used to test different kinds of applications and/or devices, going from drones to WEC, from corrosion tests to underwater research, therefore it is almost unfeasible to get consenting permits covering all these different activities. The approach of getting most of the permits covering more traditional devices, such as WEC and TEC, is deemed the proper one, since it is also in line with the methodology followed by other test facilities.

For example, the approach of PTEC was to obtain site-wide consents (Marine Licence and Section 36 of the Electricity Act 1989 for the construction or extension, and operation, of electricity generating stations, [10]) that covered a range of development scenarios and included the range and flexibility to attract a wide spectrum of developers and devices. This is in contrast to the licencing approach at the European Marine Energy Centre (EMEC), whereby individual developers are responsible for obtaining their own Marine Licences and Section 36 licences. In order to follow this approach, PTEC needed to build an envelope of development scenarios and establish workable limits on potential impacts. A programme of developer consultation was undertaken to carry out a review of existing device types and understand the range of device types that could be deployed at PTEC. The review also allowed the identification of realistic worst case parameters which were used to define the project envelope. This flexibility was deemed as crucial to allow PTEC to adapt to future improvements as part of ongoing efforts to maximise industry viability.

DMEC sites are also fully consented, but they can test only TEC and have many limitations and constrains on the devices themselves, for example only small turbines of max. diameter 2.8 m are allowed at Den Oever test site.

SEENEOH is similar to DMEC's case: only a certain kind of TEC devices can be tested, therefore it was easy to get the full-consented status. Thanks to this, the application procedure is fast and there is no need of particular permits from developers. The entire contracting process is expected to last around 4 months, which may also vary depending on the level of maturity of prospects and their ability to address the different points.

The same reasoning applies to FaBTest: its pre-consent status allows the following types of devices to be deployed, subject to permits issued by Falmouth Harbour Commissioners:

- Substantially buoy-shaped device (maximum diameter of 30m) and box-shaped device (maximum dimensions of 30m x 30m or equivalent area);
- Substantially tubular-shaped device with a maximum length of 180m;
- Floating platform type device with maximum dimensions of 35m x 35m or equivalent area;
- Subsystem connectors and umbilicals;
- Mooring systems are restricted to gravity and drag embedment anchors;
- Guarded underwater turbines are also permitted.

FaBTest provides its Clients with support during the application process such as navigation risk assessment. For example, FabTest can also offer a user-friendly software for navigation risk assessment, i.e. Hazman, with a screenshot given in Figure 2-21, Ref. [5].

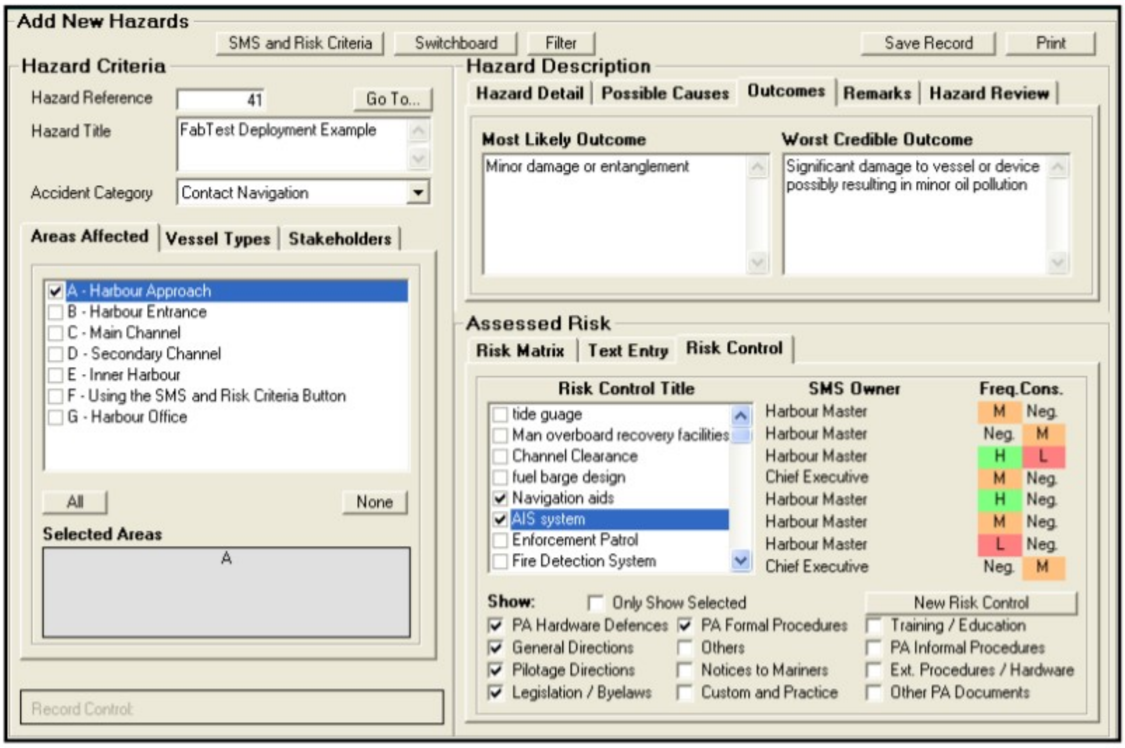

Figure 2-21 Hazman software for navigation risk assessments used by FaBTest as part of the application process, Ref. [5]

Such devices require no additional lease of licences for deployment, reducing time and cost to developers. Providing detailed specifications on the devices that can be tested in the facility, listings type and dimensions for which the consented status apply, as per FaBTest approach, is deemed to be useful to offer a fast, flexible low risk and low cost solution for the developers.

The site's pre-consented status reduces risk, uncertainty, time and cost, which is especially appreciated by device developers at pre-commercial investment stage, such as the ones targeted by the Blue Accelerator.

2.3.5. Business model

The Blue Accelerator project is funded by the European Regional Development Fund (ERDF), with co-financing by the Flemish government (Hermes Fund). The project is coordinated by the Provincial Development Agency (POM) West Flanders which is in charge of the management and operation of the test platform.

This platform should allow for accelerated testing, development and demonstration of services and products in real North Sea conditions, but at low costs and low risks.

On 19 December 2016, NEMOS GmbH applied for a permit for the construction and operation of temporary infrastructure at 500 meters from the coast of Ostend, intended to carry out a test with regard to the conversion of wave energy into electricity.

On 13 June 2017, the Belgian authorities granted the test infrastructure permit to NEMOS GmbH. The granted permit concerned the construction of the test platform and the permission to carry out the test activities for three years. The test platform itself, however, has a lifespan of 15 years.

On 12 June 2018, POM West Flanders and NEMOS GmbH entered into an agreement concerning the transfer of the test platform.

Figure 2-22 Installation works of the Blue Accelerator platform in Oostende

After the acquisition of the NEMOS platform by POM West Flanders, the platform will be operated as a maritime innovation and development platform. The NEMOS wave energy tests are continued for a minimum of 1 year and a maximum of 3 years, whereby NEMOS is considered as an user of the platform. Other simultaneous tests from different parties are of course possible, provided that the NEMOS tests are not hindered.

All the other investigated test facilities rely upon public funding too, although in different form and/or share. Most of them are non-profit companies, supported by both public and private partners.

Usually, developers at advanced TRL/commercial stages have also a higher budget available for testing, therefore test facilities addressing these kind of developers, such as EMEC and PTEC, can be funded through commercial activities more easily. On the other side, DMEC and SEENEOH cannot rely on developers alone, since most of their clients are early developers with limited budget, and depend on public funding or other form of business. DMEC has already evolved its business model, while SEENEOH is still evaluating its strategy for the next future. Further details are given below.

FaBTest, even if addressed to small developers at early stage, can rely upon both public and commercial funding, and does not feel the need to integrate its testing activity with other forms of business.

Most developers also acquire public funding to access test sites, therefore all the investigated test facilities offer support to their client to obtain funding too. In particular, DMEC, EMEC, PTEC and FaBTest can offer free-of-charge access to their clients for testing, through funding programme such as MARINET2 and FORESEA.

EMEC became financially self-sufficient in 2011, 8 years after its establishment in 2003. EMEC started with 100% public funding, and once it became independent, it was funded through commercial activities and competitive public funding. Today many of EMEC's clients acquire public funding to access EMEC's facilities.

In addition, EMEC facility provides electrical infrastructure by subsea power cables connecting the test facilities to the onshore national grid. The generated electricity inserted into the grid can be sold by EMEC's PPAs.

Most test facilities offer other commercial services in addition to the pure testing activities, with the relevant case of DMEC that evolved its business model to a project office, acting as a consultancy / facilitator and running collaborative R&D projects with the industry. **DMEC** cannot rely on developers alone, with the main income resulting from funded projects. As there is no commercial money available to do project development (it takes a long time before developer is interested to start testing as high costs are involved), funding is the only way at this moment. In order not to depend on this income model alone, DMEC developed commercial incomes from its other services.

This economic model, i.e. selling services to users who come with their own budget from EU or regional funding, is not resulting successful enough for **SEENEOH**, due to developer scarce budget availability. The plan is to increase public funding, mainly from the EU, to cover their own costs, so that users can access the site

without paying any fees. Anyway, another option under evaluation is to transform their business and become a real energy producer. The decision will be made in 2022, when the site authorisation will expire.
The test facility which is mostly focused on the technical aspects results **FaBTest**. With its nursery site, clearly addressing to certain kind of developers, at early stage, looking for fast, cheap and low risk solutions, it easily conquered its market niche, and now attracts several clients from all over the world, even in the U.S.A. and Australia. Therefore, it does not feel the need to diversify its activities and move more on the commercial aspects of the testing process. Being a small test center, the primary cost of the facility is the payment of the facility manager, with other costs including maintaining telemetry, developing assets and support staff. Although the site was established by the Harbour Commissioners and the University of Exeter with support from leading companies in the local supply chain, the site has benefitted from public investment, including £549,000 from the UK Government's Regional Growth Fund between 2013 and 2016, approved by the Cornwall and Isles of Scilly Local Enterprise Partnership (LEP). The LEP recognised FaBTest as a key investment priority and a unique asset which can create economic benefits and market opportunities.
PTEC is majority owned and funded by Perpetuus Energy Limited, in joint venture with the Isle of Wight Council. It is mainly private, with £1m from Isle of Wight Council and a very small proportion from grant funding. Business model will be revised once the project is restarted. Two options are considered:

- to enter into joint ventures with each turbine manufacturer;
- to 'rent' the infrastructure on a long term basis.

2.3.6. Legal framework and policy [8], [11]

Belgium has very limited resources, compared to France and the United Kingdom. Tidal currents coming from the Atlantic Ocean lose speed once they have crossed the Dover Strait. Similarly to tide, wave energy loses power when entering the North Sea. in 2013 there was a pilot 'Flansea' off the coast of Ostend, which was the first Belgian wave converter especially conceived for low amplitude waves, with energy density between 5 and 10 kW/m.
Since Belgium only has a moderate wave and tidal climate, the ocean energy activities are mainly focused on Research & Development rather than deploying commercial ocean energy systems. However, because of the mild climate, the Belgian offshore zones can function as a testing area for smaller scale prototypes, therefore TRL of 6, which is the target of POM.
In the past, projects like FlanSea have tested device prototypes at the Port of Ostend, before moving to other test facilities for the next steps of testing.
On the other side, Belgium is currently one of the most dynamic countries in terms of offshore wind energy; despite its comparatively small coastline, Belgium makes excellent use of its offshore wind resource: with 309 MW connected to the grid from the fully completed Rentel wind farm, represents 12% of the European gross capacity brought online in 2018, Ref. [12]

Furthermore, a remarkable network of players is available in Belgium, grouped in several partnership projects, such as Blue Cluster, Belgian Offshore Cluster, Belgian Offshore Platform, bringing together the most important Belgian players who invest in renewable energy in the North Sea. All these groups aim to create the necessary conditions for the maximum expansion of these new energy systems. At the same time, they intend:

- to inform and educate people and organizations about the production of renewable wind/blue energy in the North Sea and
- to exchange experiences at an international level with other player of renewable wind/blue energy at sea;
- and to engage in further study and research.

Also, this kind of collaborations can be useful to offer an integrated Belgian chain of services to develop new technologies and concepts. All know-how and expertise are present in West Flanders, as listed here below.

- The Ostend Science Park is a business park for international companies active in the Blue Economy with special attention to Research and Development. University of Ghent, POM West Flanders and Port of Ostend are its shareholders;
- A new maritime research centre, the Flanders Maritime Laboratory, is being established in Ostend, including the Coastal and Ocean Basin (COB) for research into the influence of wave, tides and wind on

coastal hydraulic engineering and offshore structures. University of Ghent, Catholic University of Leuven and Flemish Government are the involved parties;

- OWI-lab, a R&D initiative, including a test facility with large climate chamber, linked to VUB (Vrije Universiteit Brussel);
- VIVES, leading a centre of expertise for Smart Technologies in Bruges and Kortrijk, and VITO, an independent Flemish research organisation in the area of cleantech and sustainable development. They are already partners of POM West Flanders in the GTI project for drone applications;
- Ostend Dronehub, a knowledge centre for professional drones, linking companies that offer drone services;
- Flanders Marine Institute (VLIZ), a supporting institution for coastal and marine scientific research with several facilities available, such as a research vessel, Marine Station in Ostend, Marine Robotics Centre.

2.3.7. SWOT analysis

A SWOT analysis has been performed for each one of the investigated centres and it is part of the Leaflets in Annex A, as specified in Section 2.1.1. As a focus point, the SWOT results for the Blue Accelerator are further discussed in this Section.

Strengths

- The Blue Accelerator provides **fast consenting** and readiness: support and representation by POM;

  POM takes care of requesting the permit and following the legal process once the permit is obtained (see section 2.3.4). All the investigated centres offer assistance in the permit process, although in different forms and depending on the site status (pre-consented or not). For example, EMEC asks individual developers to obtain their own licences. POM, similar to DMEC, offers legal representation during the authorisation process. The other investigated sites are fully consented, so the legal representation offered by the test facility is not relevant in most of the cases, meaning that when the device to be tested fits the consented conditions, no additional authorisation process is needed.

- The Blue Accelerator provides **a pre-approved** facility;

  This strength is linked to the previous point, since the pre-approved status enables the consenting process to be fast; every activity needs to be checked with MUMM to assess whether or not the requested activity is subject to authorisation, and if so, which procedure needs to be followed (procedure with consultation or simplified procedure). The pre-approved status is certainly a strength, but it must be noted that other investigated centres, such as DMEC, PTEC, SEENEOH and FaBTest, offer full-consenting facilities, therefore provide more advantageous conditions. Nevertheless, the full-consenting status applies only when the device to be tested fits the consented conditions, which are quite stringent for DMEC and SEENEOH, i.e. only a very limited kind of devices complies within the approved conditions. PTEC and FaBTest developed a wide range of development scenarios, so several kinds of devices can easily fit the consented status.

- The Blue Accelerator provides **a tailor-made** support, i.e. funding, consenting, advice and support for tests;

  POM is able to offer a customised approach, supporting developers from funding, to consenting, to deployment itself, although this is not a typical trait of POM. Indeed, DMEC offers also a “fit for purpose” approach, but it must be noted that DMEC is mainly acting as a consultancy and/or facilitator, therefore this kind of activities represents DMEC’s core business. In fact, as mentioned in Section 2.2.2, DMEC does not have any effective fixed infrastructure, as its test sites in the Netherlands are mainly used as showcases.
  EMEC, being one of the biggest player of the market, can also assist its clients during the whole process, having huge expertise in a wide range of activities, i.e. funding, consenting, standards, certification, technical advice and operational support for tests. Nevertheless, especially because of its huge dimensions, EMEC cannot offer the same tailor-made and dedicated approach offered by smaller test facility, like POM or DMEC.

- The Blue Accelerator provides **a strong and large network**, with business, research and administration;

  POM strengthens the blue energy sector via close collaboration between industry, knowledge institutions at all levels and is active in three domains: product & process, research and testing, and internationalisation. Among its partners are Blue Cluster, Belgian Offshore Cluster, Flanders Marine Institute, Port of Oostende, OWI-Lab, GreenBridge, University of Ghent, Howest, Vives.
  POM is an active partner in several European projects (Inn2POWER, MET-CERTIFIED, DecomTools, COASTAL) and is a member of several European networks, such as Ocean Energy Europe; POM is also a partner in Ostend Science Park, Business park for international companies active in the Blue Economy with special attention to Research and Development.
  POM’s network is remarkably wide. Among the other investigated centres, also DMEC and EMEC have extensive networks, but they have been operational since more time. SEENEOH and FaBTest do not focus

too much on the establishment of a partnership network, for the time being, while PTEC is not operational yet.

- The Blue Accelerator provides **easy access**: operational (from port) in central position in Europe;

  The Blue Accelerator is easily accessible, operational (from Port of Ostend) in central position in Europe. This is a characteristic similar to DMEC, SEENEOH and FaBTest, that have in the accessibility one of their strengths, while EMEC and PTEC's sites are not as easily accessed as the previous mentioned centres. Furthermore they are located quite far from an international airport. Further details on the accessibility are given in Section 2.3.2.

- The Blue Accelerator provides **a versatile open water test facility with moderate metocean conditions**;

  The Blue Accelerator offers moderate metocean conditions, i.e. average significant wave height of 0.8 m +/- 0.6 m and mean current of 0.5 m/s +/- 0.3 m/s. SEENEOH, DMEC and FaBTest also have moderate environmental conditions. On the other side, one of EMEC and PTEC's strength is the extreme offshore conditions of their site.

  This can be seen as both a strength and a weakness: devices at high TRL designed for extreme offshore environment cannot be tested at POM but, because of the mild climate, the Belgian offshore zones can function as a testing platform for smaller scale prototypes, therefore TRL of 6, which is the target of Blue Accelerator. In the past, projects like FlanSea and Laminaria have tested prototypes at the Harbour of Ostend, before moving to other test facilities for the next steps of testing. Also, it must be mentioned that the Flansea pilot, off the coast of Ostend which was launched in 2013, is the first Belgian wave converter especially conceived for low amplitude waves, with energy density between 5 and 10 kW/m. Indeed, rather than targeting sites with the highest energy potential (e.g. Orkney with water flows of 4-5 m/s) a new concept has been developed for medium velocity sites, [13]. Although energy output will be lower, the sites typically are closer to shore and easier to reach, and installation is easier due to the less fierce hydrological conditions. Ultimately the optimum balance, between energy output and installation & maintenance needs to be found. In terms of potential, the number of sites with the highest water flows is limited and the market for lower speed applications could be larger.

  Another advantage linked to the mild climate at the Blue Accelerator is the reduction of standby periods. Indeed, for test purposes, standby at EMEC sites can be a week to a month or longer in order to get a favourable weather window for the devices to be attached, maintained or detached.

Weaknesses

- The Blue Accelerator is **not suitable for testing devices for extreme offshore conditions** (item already discussed in the last bullet point of the strengths).
- The Blue Accelerator is suitable **only for a smaller development segment** (TRL from 4 to 7). As the previous point, this can be also a strength: the analysis of other test facilities (especially the case of FaBTest) highlights that, for a small and modest test facility, focusing on a small but clear market segment is a winning strategy. Targeting on a precise type of client can be a limitation on the potential total number of clients, but makes the facility clearly more attractive for the selected typology of client. Further considerations are given in Task 2, Section 3.
- The Blue Accelerator is **not grid connected**. Power cable connection is a key item to consider, due to the strong desire from the customers to ultimately connect their device to the grid, in an approximately 10-year timeframe. Grid connection is therefore a critical aspect to consider to meet the future customer requirements. Amongst the other investigated centres, EMEC, SEENEOH and PTEC have grid connection. DMEC currently has no grid connection. The installed export cable broke in 2015 and it was not repaired. FaBTest does not have a grid connection either: all generated power must be consumed on site via a dump load. Further considerations are given in Task 2, Section 3.
- No pre-installed mooring available (the current moorings are owned by NEMOS). Amongst the other investigated centres, only FaBTest does not have a pre-installed mooring. It must be noted that, for SEENEOH, main focus of the authorisation permits released by the French government for the test site was the mooring, therefore a pre-installed mooring can be a time-consuming item, during the permitting process. The lack of pre-installed mooring is not necessarily a weakness. Indeed, depending on the technology, developers typically want to use their own proprietary moorings, or need to test different arrangements / layouts that pre-installed moorings could potentially prohibit. Pre-installed moorings are unlikely to be useful for every device installed so it is probably better to leave it up to the tester to design a bespoke system. POM could assist with installation. See also Refs. [14] and [15].
- Since the Blue Accelerator offshore test platform officially opened in June 2019 **only basic equipment** is available on site.

Opportunities

- Support the users of the test platform by realising **a common framework for all test facilities with relevant partners and authorities**.

  In the uniqueness of each facility and full coverage of development stages and site conditions lies the potential to form a 'chain' of test facilities which a developer can go through. Adding collaboration with onshore lab test facilities, a client can pass through each stage of technology testing: from lab testing, to nearshore sheltered conditions to offshore extreme conditions. Lessons learned from later stages can already be taken into account in early stages. Nevertheless, the FORESEA stakeholder requirements survey even mentions that partnerships with other testing facilities is in general the lowest attraction for developers, Refs. [14] and [15].

  The partnership with other test facilities is an opportunity to facilitate the development of the blue energy sector, throughout mutual promotion, maintaining good relation and sharing best practise and methodology. Sharing knowledge and engaging in collaborations between test facilities is deemed to help the development of the blue energy sector that is fundamental to achieve common renewable energy technologies and greenhouse gas reduction targets, not only in the EU but at a global scale. The conducted assessment shows that the marine test facilities face great common challenges in developing new infrastructure and upgrading existing to meet the requirements of the technology developers. Expanding towards the new markets is attractive but requires strong commercial and marketing efforts that are hard to achieve on an individual basis. The development of marine testing industry like many other emerging industries is driven by cross-cutting technologies, creativity and service innovation, and societal challenges. The industry development can particularly benefit from the collaborative opportunities provided by clustering. Sharing the gained knowledge about operations, maintenance, business development and other key aspects of test centres will lead to better standardisation internationally too. Further, understanding the capabilities of other wave and tidal testing facilities will help to provide the industry on best guidance of where to test their technologies.

- Set up academically driven innovation program.

  Given the presence of several research organisations / universities in Belgium involved in offshore innovation, see Section 2.3.6, knowledge exchange and joint research activities are being encouraged, for example by establishing a recognised educational network, where also PhD students or engineers could find the best solution to improve their expertise in the sector. Close contacts with the universities such as but not limited to UGent, KULeuven, TUDelft and University of Wagenighe should be kept in order to facilitate their step towards the Blue Accelerator.

- Strengthen innovation in the blue energy sector;

  A program could be implemented in order to create more support and stimulate the innovation process:

  1. increase the promotion of blue energy by reflecting blue energy to solar i.e. in the beginning it was considered that solar would only work in very sunny conditions, nowadays, everyone is placing solar panels. (e.g. by having a solar energy atlas from 10years ago and comparing it to the solar energy atlas today. For the time being the hindrances that exist for the broad deployment of blue energy are mainly technological, therefore a lot of funding and support is still needed to support innovation. Other hindrances identified are the scarcity of exploitable locations and the type of space at sea (limited and with several issues in terms of permits);

  2. to increase knowledge about the most challenging factor of renewable energy: constant power supply (solar and wind are characterised by peaks and drops, whereas tidal energy is stable which is necessary for the energy mix); indeed, for the time being LCOE for WEC and TEC is a lot higher than offshore wind, but tidal energy is more stable and continuous, therefore a quicker growth is expected for the tidal sector, also due to its similarities with wind turbines. Wave development is expected to grow more slowly, since it shows more issues from a technical point of view, i.e. many different technologies;

  3. To provide insights and communicate more about the techno-economic status of potential blue energy options and assess its commercial value;

  4. the final and foremost goal is to serve as a knowledge sharing platform where stakeholders from multiple disciplines and sectors will join forces and share information, knowledge and expertise.

  Blue Accelerator can act as showcases to attract attention, raise awareness, engage stakeholders, promote the industry, get government support, raise finance for clients, in order to reduce the scepticism on WEC and TEC.

  Also, other innovative ways of cooperation, such as "co-creation", learning journeys, and more usual ways like workshops, can be used to create mutual understanding and trust between the parties. The goal is to come up with solutions that prevent major hurdles for the role out of blue energy, and to create mutual benefits were possible.

- Look further than blue energy growth.

In addition to testing services, the non-utility scale markets provide an increasing opportunity for marine energy. This includes applications such as providing power to aquaculture farms, desalination or powering islands. There are opportunities to couple marine energy with storage and energy systems to provide stable power, grid services, or renewable fuels such as hydrogen

- Environmental impact monitoring;

  It is fundamental for a correct definition of the testing conditions, to optimise the layout and design of the facility and to provide device manufacturers with the required data to undertake performance/yield assessments. A desirable outcome would be the establishment of a concerted effort to collect, interpret, and share data related to any environmental effects. While the work done to date has been encouraging, far more needs to be collected. The public and regulators will need convincing evidence that any effects are both known and acceptable if the technology is moving to larger scale. Data monitoring resulted in an important part of test centre schedule, to be run in parallel to the standard testing activities. Refer to Section 2.3.3 too.

THREATS

The main threats are related to **the scarce usage** of the infrastructure and its resources. From the analysis of other test facilities, it results difficult to attract a steady stream of clients for testing and clients bring in little or no funding. Especially for a new test facility without a case history and still not well known in the market, the risk exists to face periods of under-usage.

The **maintenance costs** of the test facility could be a threat as well. More in detail, most maintenance costs are expected for the self-sustaining power system, especially to maintain it efficient over 15 years.

In addition, it must be noted that the tower was **highly specific** to a design of a WEC. It is an installation that was designed only for one purpose, and other functions were not considered. This does not withhold the fact that other activities cannot be performed at the platform, but such activities (whatever they may be) have never been tested. Therefore, when these activities will be performed for the first time, the need for adaptations or changes may arise in order to meet the requirements of these other kind of activities.

3. Task 2: Strategic recommendations for the Blue Accelerator

3.1. Methodology

To formulate the strategic recommendations for the Blue Accelerator several inputs were taken into account:

- Available information from a previous study performed by IMDC for POM Ref. [1] and from previous studies carried out for Interreg FORESEA, Refs. [14] and [15], in conjunction with the outcomes of Task 1, shown in Section 2 of this report;
- Consultation round, during which several contributors, i.e. energy developers, contractors, testing companies, universities and consultancy companies, have been contacted in order to provide their views on energy and offshore innovation;
- Internal workshop, in order to determine the insight focus point:
  - What functions, facilities and competences are required at Blue Accelerator to find synergy and complementarity and to make them part of a larger network, both in Belgium and in Europe?
  - Which functions, facilities and competencies are minimum and maximum required at Blue Accelerator to be competitive with other test facilities in the region?
  - How to make maximum use of Flemish, Belgian, European and international networks / organizations to roll out, position and profile the Blue Accelerator?
  - How do we keep our platform relevant, profitable and competitive over the next 15 years, both in terms of infrastructure and service offerings and in terms of target group and connection with local industry and knowledge. What are the possible growth scenarios?

These different steps are summarised in Figure 3-1 below and further developed in this chapter.

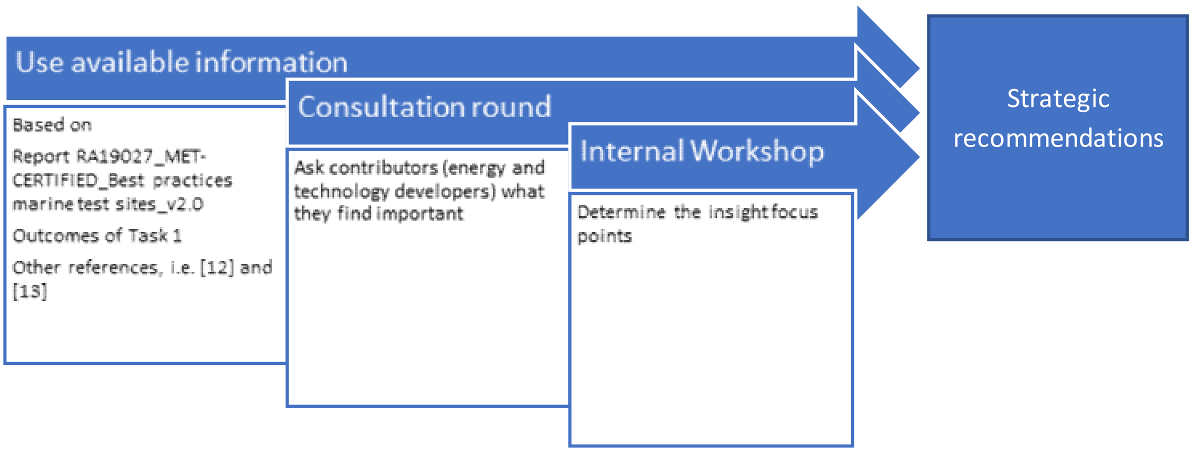

Figure 3-1 Methodology for development of strategic recommendations

3.2. Available information

The available information was analysed based on 2 focus points:

- The test facility: analysing where the test facility is located based on risk appetite and TRL (section 3.2.1);
- The customers: analysing the type of customers (section 3.2.2) and their needs (section 3.2.3)

3.2.1. Test facility segmentation

In order to analyse the Blue Accelerator properly, to categorise its main requirements and to provide a well-defined strategy, it is deemed useful to classify all the selected test facilities based on their market positioning.

The scope is to summarise the key findings and present the current positioning of the test sites with regard to the strategy, the infrastructure and the available competencies & skills in an effort to identify areas where the Blue Accelerator can contribute significantly with its specific characteristics.
In order to classify test facilities Figure 3-2 is produces based on Interreg FORESEA, Refs. [14] and [15] and is therefore for consistency and transparency reasons taken over in this report. The study presents 2 key dimensions to classify the reviewed test sites being “target testing scale” and “tolerance to risk”:

- The first proposed dimension (target testing scale) can be used to evaluate the capability of the test site to support small to large scale deployments. It can be related to e.g. the availability of grid connection and the availability of specific services, as customers at late development stages may focus on long-term, grid connected full-scale deployments (need for a long continuous production process), whereas early stage developers seek R&D and engineering support (need for fast adjustments and a lot of iterations).
- The second proposed dimension (tolerance to risk) aims to assess the capability of the test sites to host innovative technologies with a newly developed technology (high risk) and/or attract less risk tolerant developers (established technology) in a new environment. The willingness to host particular innovative technologies can be related for example to the availability of R&D/funding programmes and policy support to encourage innovative technology and early stage deployments. On the other side, less risk tolerant developers are more attracted by development support services, with the aim to follow industry best practices and to reduce/transfer risk responsibility.

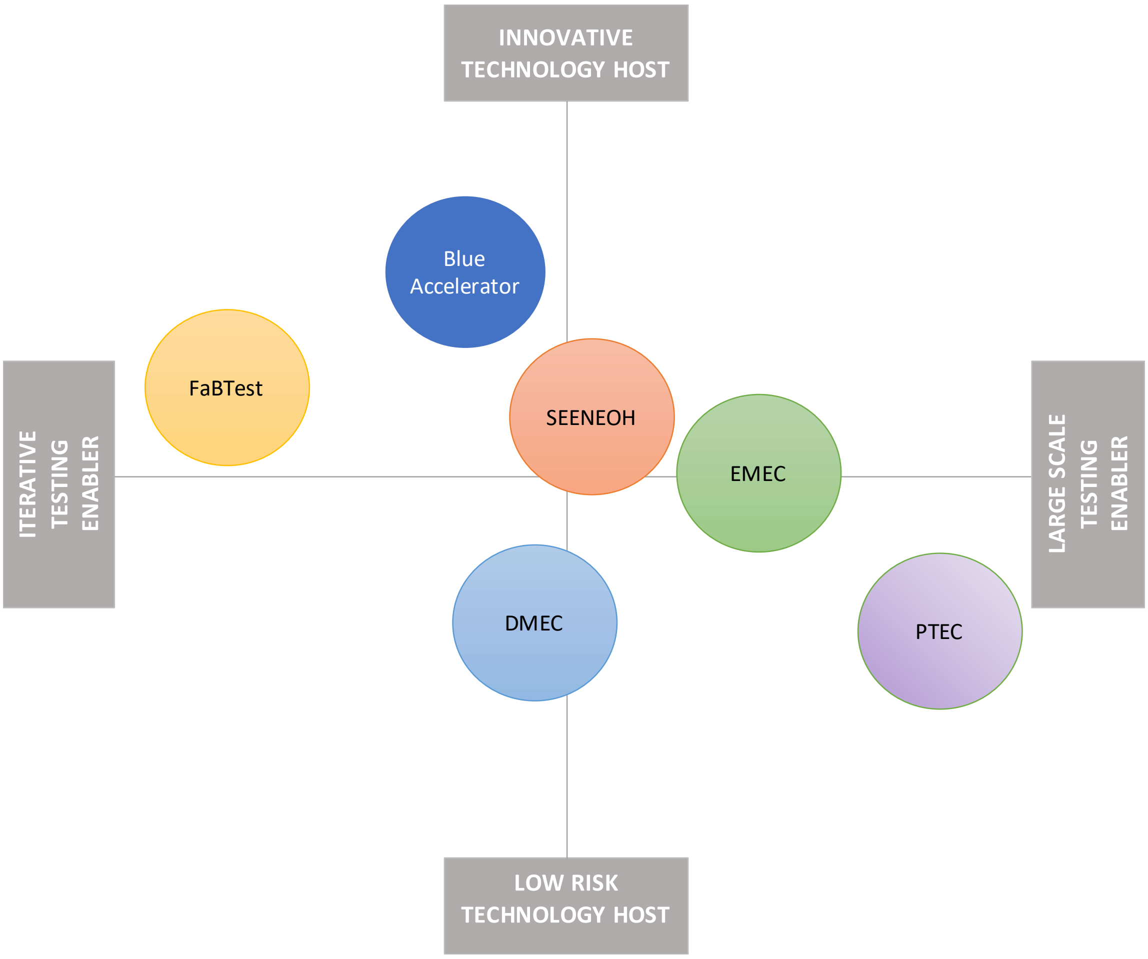

Figure 3-2 Percentual map: current positioning of the analysed test sites

Reading the graph from left to right:

- FaBTest, as a non-grid connected test site, they target mostly early stage developers, who do not need large scale testing.
- The focus of DMEC on TEC deployments exposes the test sites to less risky technologies. Nevertheless, it is worth noting that DMEC acts mainly as a consultant and facilitator, it can be involved in different kind of

testing activities and it could be positioned almost everywhere in the map. Therefore, DMEC's positioning shown in Figure 3-2 refer to the two test sites directly operated in the Netherlands only.

- Seeneoh is a very particular site, that can be used at an early stage for marine devices before going offshore, and at an advanced stage / large scale for river devices. The focus on deployments for river applications exposes the test sites also to innovative technologies.
- EMEC's offers both scaled and full-scale grid connected sites, covering both early and later stage deployments. This, along with the extent of the service offering, leads to a ranking towards the middle of the perceptual map.
- PTEC is the step between standard test facilities and pure commercial, well suited for technology deployments of more experienced developers ready to progress to full-scale / commercial deployments, therefore it is positioned in the 2nd quadrant of the map.
- In the current assessment of the Blue Accelerator, it's positioned at launching innovation projects and focuses on TRL 6, therefore it is positioned in the 4th quadrant of the map. The choice of positioning the Blue Accelerator in this area was also in line with the view of POM itself and the potential customers. It was also confirmed by all the contributors interviewed during the consultation round, described in section 3.3, and during the internal workshop, described in 3.4.

3.2.2. Customer segmentation, Refs. [14] and [15]

The same classification criteria, used in Section 3.2 for classification of the test sites, is hereafter used for the potential clients, in accordance with previous studies carried out for Interreg FORESEA, Refs. [14] and [15]. Therefore, in overall alignment with the perceptual map's axes, two key dimensions were identified to characterise the potential customers of the test centre: strategy for development and attitude towards risk. The first proposed dimension (strategy for development) can be used to assess if a customer is mostly driven by the desire to develop a commercial scale project or the desire to develop the technology itself. The second proposed dimension (attitude towards risk) can be related to the degree of novelty of the technology (established or not) and the approach in its development. According to Refs. [14] and [15], four customer segments can be justified:

- technology innovators;
- rocket path developers;
- incremental testers;
- best practice followers.

Figure 3-3 Proposed customer segmentation, Refs. [14] and [15]

The fundamental beliefs of each customer segment are conceptualised in Figure 3-4.

- Technology Innovators can be associated as early-stage technology developers, with a high tolerance for risk and a large value given to iterative testing to prove their technology.
  Technology innovators require a stage gate approach for the development plan, and support functions for the intermediate scale testing (a nursery facility). They are likely to be of interested in a short- and medium-term horizon. Technology innovators want to focus on their core engineering / design / development activities, while indirect services such as consenting support may be of interest. As early-stage developers, they can be characterised with a low TRL and low level of funding; they typically largely require R&D support and funding resources. (Examples of technology innovators are Makani with their energy kite or Nemos currently using the Blue Accelerator for their wave energy converter)
- 'Rocket Path Developers' can be characterised by a strong desire to accelerate the technology development and deployment plans to boost the market. Developers in this segment are willing to progress quickly in their TRL development, with fast progression from early-stage testing to large deployment plans. Need for grid connected deployment at full-scale test site is foreseen in a short- to medium-term horizon. This can be enabled by consenting support or access to R&D / funding programmes. (Rocket Path Developers can be for example how Equinor developed their SPAR, a floating turbine foundation. Also GE can be seen as a rocket path developer as they went from an insecure offshore turbine towards a 12MW turbine, the biggest on the current market.)
- 'Best Practice Followers' are risk-advert developers, willing to progress slowly in their development plans to ensure adherence with (perceived) best practices and ease the way to certification and commercial deployment. Iterative deployments at nursery, intermediate- and full-scale deployments are to be expected, consolidated by e.g. support to development, monitoring and operational activities from the test site. (Best practice followers are currently visible in the automotive market, where Tesla can be categorized as Rocket Path Developer, others are only making the step towards electrical vehicles now).
- 'Incremental Testers' show a strong commercial focus, and a desire to progress fast in their deployment plans, scheduled incrementally from small to large scale. They are in general risk-advert, they value support services for e.g. development, monitoring and operational activities. (Incremental testers are less visible as it is a more steady approach. A good example of incremental tester can be the turbine manufacturers Siemens and Vestas, who slowly upgraded their turbines from an initial power towards a full use of their designed platform i.e. what started as a 6MW turbine, is currently a 10MW turbine)

According to the proposed customer segmentation and the positioning shown in Figure 3-2, it results that the Blue Accelerator clearly addresses **Technology Innovators**, as explained hereafter in more detail.

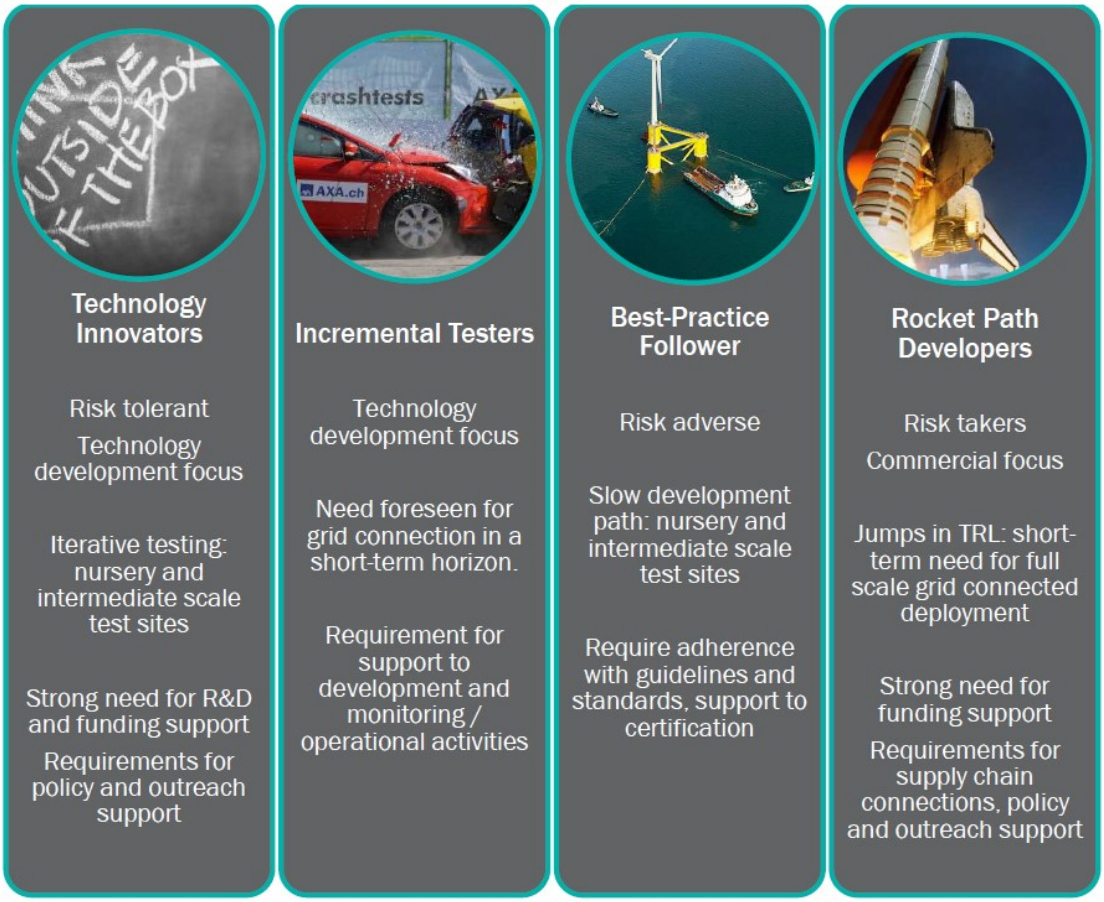

Figure 3-4 Key characteristics of the target customer segments, Refs. [14] and [15]

3.2.3. Technology Innovators as potential customers of Blue Accelerator

The Blue Accelerator should adopt a strategy focusing mainly on Technology Innovators as potential customers, for the reasons mentioned hereafter:

- As already discussed in Section 2.3.6, Belgium only has a moderate wave and tidal climate, cannot compete with countries like Scotland or France in terms of ocean resources, hence the ocean energy activities should mainly focus on Research & Development rather than deploying commercial ocean energy systems;
- The resource limitation mentioned in the bullet above can be converted in opportunity: because of the mild climate, the Belgian offshore zones can function as a testing platform for smaller scale prototypes, therefore TRL of 6, but also for higher TRL's with full scale prototypes where the outcome can be extrapolated
- One of the most relevant 'lesson learnt' from the analysis of other test facilities [1] highlighted that, for a modest test facility, focusing on a small but clear market segment is a winning strategy. The example of FaBTest is undeniable: by providing fast, flexible low-risk and low-cost solutions, it gained a good reputation in the marine energy sector and it has never faced any sensitive drops in its order book. From the assessment of other test facilities, it results that only big player as EMEC can cover both early and later stage deployments.

The study highlighted several requirements from the industry, which are not necessarily shared by the Technology Innovators, such as:

- Certification and standards: Standardisation and certification help the confidence of investors and insurers, but will always follow the developments and not lead developments or innovation. Only when the industry grows, standards are needed to look at interfaces with other technology, to have technology valid all over the world. Technology Innovators do not need certification and standards, since they are still at low TRL. Actually, they sometimes see certifications and standards as a limit, a constrains for innovation developments and a further cost. Reference can be made to [1].
- Grid connection: Technology Innovators considers a grid connection as "nice to have", but it is not an urgent requirement for their development, at least not in the short term. Once the technology gets

more and more mature, the interest for the grid connection may arise. Instead, the need for grid connected deployment at full-scale test site is foreseen in a short- to medium-term horizon from “Incremental Testers” and “Rocket Path Developers”, who are not considered the target of the Blue Accelerator. Nonetheless, a grid connection could help in attracting long term innovation projects, which could result in a steady revenue stream.

These considerations have been taken in due account for the formulation of the strategic recommendations for the Blue Accelerator, i.e. giving a “medium” priority to the recommendation about the grid connection and not including the item related to “standards and certifications” as part of the recommendations.

3.3. Consultation round

This section outlines the findings of a stakeholder consultation exercise completed to ascertain the particular requirements and interests of potential users and/or partners of the Blue Accelerator test site, as well as several well established companies with a good view on the market of innovation and blue energy, such as energy developers, contractors, testing companies, universities and consultancy companies. Each stakeholder was contacted individually in order to create an as comfortable environment as possible to address their findings.

3.3.1. Interviews and questionnaire

In order to answer the questions defined by the client and to capture current and future needs of the contributors, Various stakeholders were interviewed and asked to fill out a questionnaire as input for the strategical analysis.

In the interview, the more general assessment was discussed, while the questionnaire concerned the test facility’s requirements in more detail. Both items were compiled into one document which was communicated beforehand in order to allow the stakeholder to have sufficient preparation time.

For the interview following questions were discussed structured around 3 topics:

Market study

- What will be the focus of the energy market (new technologies) in the coming years?
- What are the market needs for blue energy production?
- What are the market needs for sustainable/ecological developments?

Innovation

- What technologies are you following/developing related to offshore (both energy as other activities)?
- Can you mention the main requirements for your current innovative projects?
- What are your main constraints in these innovation developments?
- At which stage (e.g. TRL-level) would you look for external input/verification?

Test Facility

- Where do you see opportunities in the future of test facilities in general?
- How do you see the role of test facilities in Belgium?
- Where do you see opportunities in the future of test facilities in general?
- Where do you see the main risks in the future of test facilities in general?
- Can you share any lessons learned concerning test topics?
- What type of contract with a test facility would you prefer?
- Is there currently any collaboration?
- Would you be interested in using the Blue Accelerator? For which type of innovations?
- How do you think the Blue Accelerator can differentiate from other facilities?

The questionnaire was also structured around 3 topics and is presented in following table.

	Useless	*Noted*	*Nice to have*	*Useful*	*Necessary*
General					
A test facility should be part of a broader network of multiple test facilities.					
Information from test facilities should be available.					
A test facility should provide assistance before engaging the test facility.					
A test facility should provide assistance for the steps following the test.					
Public-Private partnerships should be possible.					
Education and research programs should be coupled to a test facility.					
Focus on brand new technologies with high iterations.					
Focus on advanced technologies to prepare for commercialisation.					
Infrastructure					
Test facility should have support vessels available.					
Test facility should be close to port/shipyard.					
Test facility should be at a location close to a city with a good connectivity.					
Test facility should have a communication cable in place.					
Test facility should have a grid connection.					
Test facility should have real time measurements.					
Test facility should include onshore facilities (workshops, offices).					
Test facility should have a high rated capacity (>1MW).					
Test facility should have pre-installed anchors.					
Test facility should have pre-installed mooring points.					
Test facility's infrastructure should be flexible regarding infrastructure.					
Services					
Test facility should provide consenting support/fast consenting.					
Test facility should provide support for funding.					
Test facility should provide suitable support mechanisms.					
Test facility should perform resource monitoring activities.					
Test facility should provide support for offshore inspections at the test facility (divers, ROV).					
Test facility should have local stakeholder engagement and support.					
Test facility should provide supply chain connections.					
Test facility should perform environmental monitoring at the facility.					
Test facility should provide independent verification / certification.					
Test facility should do the operational support i.e. O&M planning					

3.3.2. Questionnaire main outcomes

The stakeholders had to complete the questionnaire and the results were processed by assigning a score from 1 (not important) to 5 (very important) to each item. In addition to this input, FORESEA study, i.e. Refs. [14] and [15], has been also taken into account. The main outcomes of this survey were scrutinized and adapted in order to make them comparable to the results of the questionnaire, i.e. assigning a score for each item in the questionnaire. Each stakeholder had a weight of 20 points whereas the implementation of the FORESEA study (due to the wide consultation round performed in that study) had a weight of 40.

The following contributors responded to the questionnaire:

- IMDC (2 different contributors);
- ENGIE;
- Colruyt Group;
- Laborelec;
- TKI;
- NEMOS;
- OCAS;
- Otary;
- DEME Offshore;
- Jan De Nul.

As each item received a score, a weighted average per item was obtained. The final score results obtained are given in Figure 3-5.

	Item	Final score
General	Partnership with other test facilities as part of a network	3.2
	Availability of information from test facility	4.4
	Providing assistance before engaging the test facility	4.1
	Providing assistance for the steps after the test	3.7
	Public-Private partnerships	3.5
	Coupled to education and research programs	3.4
	Focus on brand new technologies with high iterations	2.8
	Focus on advanced technologies (preparing for commercialisation)	3.6
Infrastructure	Support vessels	3.7
	Proximity to a port / shipyard	3.6
	Onshore accessibility (close to a city with a good connectivity)	3.1
	Communications cable link	4.4
	Grid connection point	4.6
	Availability of real-time resource measurements	4.4
	Onshore facilities (e.g. workshop, offices, etc.)	3.0
	Available capacity (MW)	3.0
	Availability of pre-installed anchor points	3.1
	Availability of pre-installed moorings	3.3
	Flexibility	4.0
Services	Consenting support / fast consenting	4.6
	Support in funding / grant applications	3.8
	Access to suitable incentives / support mechanisms	3.8
	Support to resource monitoring activities	3.9
	Specialist support for offshore inspections (divers, ROV)	3.5
	Local stakeholder engagement support	3.8
	Provision of supply chain connections	3.0
	Support to environmental monitoring activities	4.0
	Support to development (independent verification)	2.8
	Operational support (O&M planning, device monitoring)	2.7

Figure 3-5 Summary of questionnaire results

The items scoring the highest values are highlighted in green and constitute the basis to formulate the strategic recommendations.

3.3.3. Interview main outcomes

In addition to the questionnaire some stakeholders have been interviewed as well, in order to gather their views on energy and offshore innovation. A summary of the interviews per contributor is provided:

Laborelec

Function interviewee: Wind, Solar and Marine Expert and Manager of Research

Market

The main focus is currently on offshore wind and solar. Blue Energy is still at a demonstration level, but it is actively pushed by EU and Countries, therefore a growth of the sector can be expected on the long term.
A quicker growth is expected for the tidal sector, due to its similarities with wind turbines, while wave development is expected to grow more slowly, since it shows more issues from a technical point of view, i.e. many different technologies.
Secondary, a big demand for ecological measures is noted and expected to expand more and more.

Innovation

Laborelec is involved in the Internet of Things, offshore wind farm and neurological science application to waves and tidal prediction. TRL 6 is considered the level when a developer usually requires a test centre.

Test facility

Laborelec is not a developer, therefore not directly involved with test facilities. Nonetheless, grid connection, mooring and data collection are deemed the main requirements for a test centre.
Laborelec deemed Belgium suitable for nursery test facilities, addressing developers at early stage, due to its moderate wave and tidal climate.
With regards to the Blue Accelerator, a strength is seen in its network and organisation. An integration with COB and UGent was strongly recommended: everything is close and several project development phases can be carried out in a fast and structured manner.

DEME

Function interviewee: Innovation manager

Market

The focus for the next years will remain to be Offshore Wind. Floating wind will be the next 'innovative' industry. Blue energy has the potential to play a key role in the future energy mix. But due to the current low cost of offshore wind, it is deemed not to pick up pace early. A related issue however will be the transmission of energy and the storage, for which the market needs are significantly higher.

Innovation

Storage of hydrogen, aquaculture and sustainable management of the sea are seen as the main focus of the future research activities. TRL 6 is considered the level when a developer usually requires a test centre.

Test facility

Discretion is the key characteristic they expect from a test centre. Fast permit and testing are also considered the main requirements, as well as the consultancy services offered in addition to the testing. Belgium's moderate climate can be comparable to Mediterranean environmental conditions, therefore the Blue Accelerator can be used to test devices conceived for the Mediterranean Sea as well.

Jan de Nul

Function interviewee: Business development manager

Market

The main focus is currently on offshore wind and solar. In the next 10 years, improvements are foreseen on the gas storage combined with offshore wind. Also, a lot of expectations is on the "power to gas" (mainly hydrogen, but also ammoniac, methanol and ethanol.
For Blue Energy, no big market is foreseen, although some specific markets exist, i.e. for remote islands. WEC is seen as a profitable resource only in few locations, e.g. Scotland, Canada, Portugal, Galicia. A big part of the incoming innovation could happen in sustainability and ecological development.

Innovation

Jan de Nul is involved in innovations for: cable protection, scour protection and installation methods. Sustainability in one of the main concerns, surely more than technical issues. Also, a pure technical innovation is less likely to receive subsides. TRL 5-6 is considered the level when a developer usually requires a test centre.

Test facility

Accessibility is deemed the most important strength of a test facility. A relevant focus point should be to deep down in the supply chain. Belgium has a remarkable network and infrastructure. With regards to specific testing activities, great importance is given to the environmental conditions, e.g. water depth, metocean conditions, seabed status. Testing WEC at Blue Accelerator can be difficult due to the presence of the platform, causing wave diffraction. A possible solution can be to foresee the mooring far from the platform.

A strong collaboration with the Port of Ostend is recommended to POM.

It was mentioned that developers interested to test small devices and/or for a limited amount of time, might prefer to arrange a permit, go offshore and carry out the test by themselves. Also, focusing on small and fast testing might not be convenient for the Blue Accelerator as the developers could find the cost for going offshore too high. Blue Accelerator can be a valid option for testing devices that need to stay offshore for long time and should pay more attention on this kind of tests.

ENGIE

Function interviewee: Research manager

Market

There is scepticism on WEC and TEC, since LCOE is a lot higher than offshore wind. Major developments are expected for storage.

Nevertheless, tidal energy is more stable and continuous than wind and solar, therefore could play a key role in the future energy mix.

Ecological aspects, such as life-cycle assessment and circular aspects, are gaining more and more importance, from both Governments and Companies.

Innovation

ENGIE is involved in innovations for offshore wind, solar, offshore kite, corrosion protection, cable monitoring. TRL 6 is considered the level when a developer usually requires a test centre. ENGIE needs external testing/verification from TRL 7.

Test facility

ENGIE is mainly interested in testing new concept for deep waters. Belgium can be an ideal location to carry out small testing activities only, like corrosion, floating photovoltaic, cable behaviour, ecological concepts. With regards to offshore wind, there is not too much to test, only sub-components. It is recommended to have a well-defined test program from the beginning and to have a clear target.

Accessibility is deemed the most important strength of a test facility: having permits already in place, little bureaucracy and easy administration process.

The Blue Accelerator has in the easy access one of its main added value: it is close to the harbour, it is small and not subject to extreme weather conditions.

University of Antwerp

Function interviewee: economy researcher

Market

Future development in the offshore energy market is strongly dependent on policy makers, as well as market conditions. In Belgium offshore wind development is almost close to its peak. WEC and TEC could play a key role in the future energy mix. It is not necessarily true that blue energy in Belgium is limited by its moderate environmental conditions.

Scepticism for Belgium in term of offshore wind development were reported 10 years ago, while now Belgium is one of the major player of the sector. Also, solar and wind cover peak power, while a backup power from a more predictable source to fill the gap is needed, therefore tidal energy seems more promising than wave energy.

Innovation

Energy storage is seen as the sector requiring the major innovations, due to the lack of business cases available. TRL 5-6 is considered the level when a developer usually requires a test centre.
Nonetheless as solar was once suspected only to be beneficial in sunny countries, it has made a huge evolution. Notwithstanding the lower ocean resources in Belgium, an evolution of wave and tidal energy could be comparable to the solar panels.

Test facility

Belgium is positioning itself as an innovative, knowledge based economy. Test facilities in Belgium can help to achieve this scope. Indeed, the main opportunity for test facilities is considered the data monitoring, with its subsequent sharing with the community, especially the academical one. A desirable outcome would be the establishment of a concerted effort to collect, interpret, and share data related to any environmental effects. While the work done to date has been encouraging, far more needs to be collected. The public and regulators will need convincing evidence that any effects are both known and acceptable if the technology is to move to larger scale.
The main strength recognised to Blue Accelerator is its easy access.

NEMOS

Function interviewee: Offshore engineer

Market

The future of the offshore market will be led by the decarbonisation. Tidal energy has the potential to grow, but it will remain low. LCOE is the main requirement, so for the time being blue energy is not attractive for energy companies. The level/maturity of blue energy technologies is not high enough and a lot of funding is still needed, therefore a big development is not foreseen without a huge political change.
Also with regards to sustainable/ecological innovations, a significative political active participation is needed in terms of funding.

Innovation

Wave and tidal energy require a lot of testing, no mature technology is available for the time being. TRL 5-6 is considered the level when a developer usually requires a test centre.

Test facility

As current user and developer of the Blue Accelerator in Ostend, the interview on this topic was exclusively focused on the Blue Accelerator, rather than test facilities in general.
Several strengths were identified for the Blue Accelerator, mainly related to its access: closeness to shore, it can be easily reached through Brussel and Ostend-Bruges airport, network and infrastructure (everything is needed, in terms of expertise and/or technology, can be easily found in West-Flanders). It was mentioned that just sending a person at EMEC can cost more than 1000€ and, once there, the infrastructure, in terms of expertise and/or technology, is not available at the same level as in West-Flanders.
Therefore, the Blue Accelerator is tailored to early stage developers and it is actually deemed the perfect test facility for small companies and for small devices.
In order to further improve the access to the Blue Accelerator, the following recommendations were given. Onshore facilities (workshops and offices) are available to a high standard at the port of Oostende but POM could maybe market and manage such facilities. Also, it was noted that small boats are remarkably difficult to find and charter in Oostende.
In addition, two biggest technical improvements to the Blue Accelerator were suggested and hereafter reported:

- Install a shore power and data cable
  This could be done from the Radar tower on the breakwater. It is already configured for this purpose. Consent for a cable was gained by NEMOS and it should be easy to get this back. The existing electrical system could be ripped out, freeing up considerable internal space. In particular the Diesel generator, fuel tank, spares, batteries, exhaust system and 3x large inverters take up many cubic meters.
- Decommission the crane and use the space to construct flexible racks for experiments
  An ideal testing platform would be just a platform on which shipping containers could be loaded. Therefore the Blue Accelerator could be improved by decommissioning the crane (which can be difficult to use safely anyway, since any boat large and powerful enough to maintain in position whilst craning would be too large and powerful for the tower structure) and applying flexible mounts/racking for instruments.

More in details, due to the small size of the pile only very small boats can maintain position on it, and even then they do badly. It would be even more difficult to get a boat to maintain station under the crane, and, due to the cranes proximity to the pile, a slight misalignment of a few meters when lifting would result in the load pending into the tower, boat, or sea.
The existing power system is unreliable and may cause the crane to fail halfway through the lift.
With so little space inside the tower, large and heavy loads are unlikely to fit inside it.
It was reported that NEMOS uses a simple rope lift to take tools and equipment, i.e. the same method used on wind turbines for everything except heavy loads. This method results highly satisfactory, fast, and safe.

OCAS

Function interviewee: Business development manager

Market

Offshore wind and energy storage will be the main focus of the offshore energy market in the coming years. Local opportunities may be available for wave and tidal energy sector, with tidal development resulting more promising. WEC and TEC development in Belgium is expected to be very limited, although they could play a role in the future energy mix. Ecological and sustainable aspects will receive more attention.

Innovation

OCAS is currently involved in fatigue programmes for new materials and in developing programmes for innovative corrosion studies. The main constrains for these innovation developments is seen in the certification, which usually adds a lot of conservatism in the design process. TRL 6-7 is considered the level when a developer usually requires a test centre. OCAS requires external input/verification even at TRL 3, since they test material and components, therefore they require external support at early stage, i.e. low TRL.

Test facility

Full-engineering cycle is going to be more and more important. It is noted a lack of collaboration among Belgian companies of the sector: most of them work isolated or in competition for funding; Belgium is still not well positioned in the offshore market, e.g. in comparison with the Netherlands. Therefore the main risks for test facilities in Belgium are related to their fragmentation and internal competition, with a consequent lack of a sufficient scale. As a consequence, the main opportunities rely on the structure integration, i.e. offering a full-scale mechanism focusing on the bigger picture.
Indeed, Belgium is already good for small-scale projects, but the future focus should be on up-scale projects and avoid to work too much through small aspects. The same consideration applies for the Blue Accelerator, which should focus on large-scale long term tests rather than small activities. For example, it is not worth investing time and effort to prepare a small test for a new material/corrosion protection: the test is going to be short and will not bring enough money.
Also, most developers do not require a test facility for this kind of activity. On the other side, offering a testing service for the whole structure, for example a cable with a new type of corrosion requiring a monitoring of 2-3 months offshore at least, will be more rewarding and convenient for both the test facility and the developer.

3.4. Internal workshop

An internal workshop was conducted in IMDC in order to determine the insight focus points of the Blue Accelerator. The group of contributors, composed by several IMDC experts in different aspects of the offshore sector, was made aware of the results of the previous tasks and was asked to freely suggest considerations.
The main outcome was that Blue Accelerator should not necessary focus on the gaps with other European test facilities. It seems that each test facility has its own specialism and endeavours to highlight it as a strength (reference should be made to the USP identified for the other test facilities in the leaflets in Annex A).
Considering other test facilities in Belgium, the partnership with COB is strongly recommended, since it allows to follow developers from different project stages, bringing them from a lab to an offshore environment.
The mild environmental conditions characterising the Blue Accelerator are seen as a strength, since they offer a moderate context which is really suitable for early-stage developers. Indeed, early-stage developers aim to test their devices in a controlled environment and are not really interested in extreme metocean conditions, which lead to, difficult accessibility and long standby periods.

Continuous data monitoring is recognised as extremely important, since it offers the possibility to better understand the testing outcomes. A fibre optic could very helpful for the data follow-up and 24/7 availability of the data. Note that, the optical fibre can be integrated in a power cable, which is considered a critical aspect for the Blue Accelerator to meet the future customer requirements, therefore recommended as a long-term strategy.

It is worth mentioning the digital twins' concept, already experimented in the oil&gas and in the offshore wind. It allows to create holistic, real-time digital twins of large, complex assets. The sensor-enabled digital twin responds in real time to reflect the asset's current condition, enabling active control of asset integrity and operations. Used throughout the asset lifecycle, this technology enables a digital thread, a data-driven architecture that links information generated from across the asset lifecycle enabling a step-change in design and operations. This next generation simulation technology has been used for offshore wind turbines, therefore it could be transferred to wave and tidal energy sector as well. It would also improve the development chain mentioned above, i.e. office/laboratory/offshore, and will be integrated in the data monitoring process, by collecting real data from full and lab-scale experiments to validate both the designs and computer tools. The link between data and the model is very import as the software modelling is seen as a potential further service that can be offered, eventually in cooperation with UGent, to help the early-stage developers at a design phase.

3.5. Strategic plan

By compiling the three previous sections, strategic recommendations have been identified. More specifically, the provided recommendations are related to the items which scored the highest values from the questionnaire results. These results have been analysed based on the input from the literature and the interviews. Most of the finding out of the questionnaire were confirmed during the interview and the internal workshop. In addition, results from other available sources, mainly the stakeholders requirements survey of FORESEA, i.e. Refs. [14] and [15], have also been taken into account resulting in the following recommendations:

- Fast/easy consenting and readiness: the need to make the life of technology developers easy is the main focus point through a fast and easy process. See Section 3.5.1.
- Join funding programmes: this recommendation also focuses on making life easy for the technology developers as they are focused on technology and their familiarity with funding processes might be low and requires support. See Section 3.5.2.
- Partnership with COB: this is mainly based on the step approach. There is an appetite to guide technology developers from step to step. See Section 3.5.3.
- Increase monitoring activities: to know what your technology is doing, is to know what is happening. See Section 3.5.4.
- Availability of information: if technologies have success stories do not hesitate to communicate it. As success will attract other potential interested parties. Furthermore, an 'open source' approach where measured information is freely available will increase the technology developers familiarity with the test platform and will make it more known. See Section 3.5.5.
- Installing a power cable with optical fibre integrated: for certain tests, the output is the main knowledge the technology developers want. The output can be electricity (power cable) or monitoring. Furthermore the power cable 'works both ways' and will increase potential (by increasing space) in the test facility offshore itself. See Section 3.5.6.
- Expand offered services, in addition to testing: it is difficult to attract a steady stream of clients for testing. In order to deal with the risk of scarce usage of the test facility, it is recommended to add further additional services, beyond the pure and simple testing services. See Section 3.5.7.

By compiling these recommendations, it is envisaged to strengthen the Blue Accelerator on many domains: be attractive to a lot of players, and be attractive for both short term and long term testing. Furthermore, it allows to focus on multiple technologies, providing a variation or diversity on testing opportunities creating a healthy mixture of testing activities.

The individual strategic recommendations are elaborated in the next sections. For each strategic recommendation identified, a SWOT analysis is performed as part of the strategic plan. These recommendations aim at reinforcing the functions, facilities and competences of Blue Accelerator in order to

match its USP, as defined in Section 3.6. In the same section, the strategic recommendations are elaborated again in function of the identified USP.
Furthermore the recommendations have been categorised in three different timelines: short term, medium term, and long term. This is also visualised in a high-level schedule shown in Figure 3-6 below.

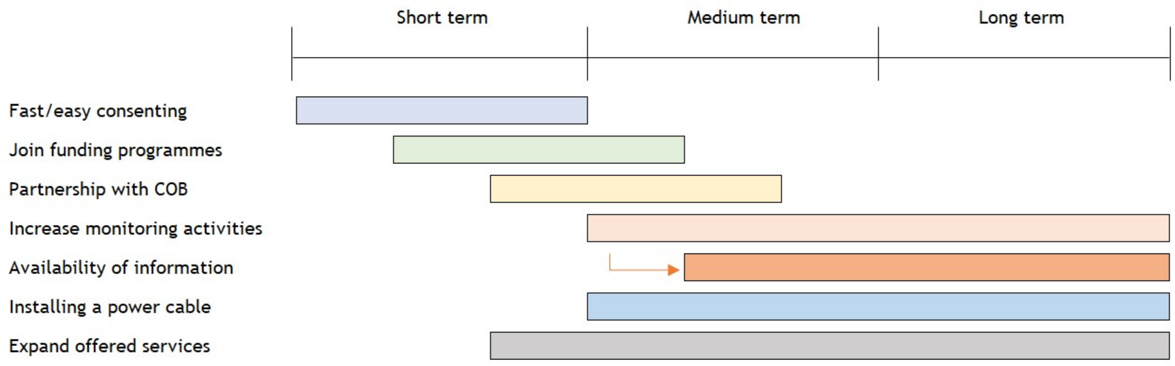

Figure 3-6 Timing of strategic recommendations for the Blue Accelerator

3.5.1. Fast/easy consenting and readiness

Target	
Obtaining a full-consented status	
Priority	
High	
Timeline	
Short term	
Strengths	**Weaknesses**
- adds flexibility; - reduces risk, uncertainty, time and cost of developers.	- Blue Accelerator can be used to test different kinds of applications and/or devices (in contrast to other test facilities such as PTEC covering only TEC), it is almost unfeasible and/or not convenient to get consenting permits covering all the possible technologies in advance; - time, effort and money required to build a proper range of development scenario and get the permits for all of them.
Opportunities	**Threats**
- to attract a wide spectrum of developers and devices (also smaller developers); - the site's full-consented status is especially appreciated by device developers at pre-commercial investment stage, such as the ones targeted by the Blue Accelerator; - it allows project developers to save time and focus on the technological challenges instead of tackling complex permitting and regulatory matters.	- Large part of the offered test activities at the Blue Accelerator will not be subject to authorisation. This measure applies mostly on large-scale long term tests, such as WEC and TEC. It is recommended to follow-up the requirements to test such technologies, before adjusting the consenting methodology. - The offshore energy industry (excluding offshore wind) is at an early stage of development and there is a wide range of possible technology designs available, which can be difficult to capture; - EIA could excessively exaggerate the impact by combining multiple worst case scenarios into a development scenario which is highly unrealistic.

3.5.2. Join funding programmes

Target	
Facilitate access to suitable incentives and support in funding / grant applications for developers	
Priority	
Medium	
Timeline	
Short/Medium term	
Strengths	**Weaknesses**
- attract more clients since, by funding programmes, free-of-charge access can be offered;	- the benefit is not directly related to the test facility, since the funding is addressed to the developers; - time/money required to join the funding programmes as a test facility; - time/money invested to facilitate clients' access to the incentive /funding mechanisms, i.e. supporting their applications; - the test itself has marginal impact on the total costs sustained by a developer, for example higher costs could be claimed during the design phase. Therefore this measure may not be sufficient to encourage the blue energy sector. See also Ref. [1].
Opportunities	**Threats**
- it is an indirect way of promoting the test sites; - availability of R&D / funding programmes and policy support are the main tools to encourage innovative technology and early stage deployments. - "technology innovators", identified as the potential clients for Blue Accelerator, typically largely require funding resources.	- Blue Accelerator's application could not be successful as most currently available funding programmes have already started and could not accept other partners; - developers' application could not be successful. It is recommended to properly evaluate the client's compliance with the incentives' requirements of the fund before starting the application. For example, EMEC has a success rate of over 50% (Ref. [2]).

3.5.3. Partnership with Coastal & Ocean Basin COB

Target	
To create a Belgian network / chain for offshore innovations	
Priority	
Medium	
Timeline	
Medium Term	
Strengths	**Weaknesses**
- COB addresses TRL 1-4, so it's the step before the Blue Accelerator; - everything is close: labs, university, nearshore, offshore; - personnel is familiar with the location - reduces risk, uncertainty, time and cost of developers; - gain precious lesson learnt from both developers and partner and share knowledge; - become a key enabler to allow innovation to happen.	- there is a lot of time in between the different development steps, it is not a continuous chain in time, and developers like to come back to facilities known to them and had good experiences with; - from the consultation, partnerships with other testing facilities was as one of the lowest attraction points.
Opportunities	**Threats**
- to establish Blue Accelerator in the network of early technology developers; - to attract a wide spectrum of developers and devices; - being part of a chain of test facilities at different levels of development (from lab to nearshore, to offshore), which a client can go through, is well perceived by developers; - providing assistance before the developer engage the Blue Accelerator; - to address the needs of clients through several project phases.	- Sharing the gained knowledge about operations, maintenance, business development and other key aspects can be difficult to get; - COB is not operational yet.

3.5.4. Increase monitoring activities

Target	
Collect and elaborate a significant amount of environmental data of the testing area	
Priority	
Low	
Timeline	
Medium term	
Strengths	**Weaknesses**
- elaboration of data scored a lot of points in the consultation exercise; - provide a targeted benefit to developers through provision of supporting data, so reducing the monitoring obligations; - allow optimisation of the testing conditions; - make life easy for developers, saving time and costs; - some sensors/equipment for data collection already in place.	- could not add any value to those potential developers who are not required to undertake full EIAs, since they do not have any environmental monitoring obligations; - need to instil environmental awareness and learning in developers who at early stages of device development tend to be more focussed on technological aspects and a swift route to deployment.
Opportunities	**Threats**
- enable the Regulator and relevant stakeholders to gain a more comprehensive view of the environmental sensitivities of the site; - has the potential to raise the overall awareness of the sector; - to join environmental monitoring programmes; - to expand the offered activities and the associated network, i.e. with other test sites or research institutes; - it is an indirect way of promoting the test sites.	- no evident, practical and direct benefits from this measure; - the results of the monitoring could be not as positive as expected, such that all the work done would result as counterproductive; - there are some issues for which monitoring may be required, for which there are no efficient available methods for gathering the necessary data.

3.5.5. Availability of information

Target	
Make the Blue Accelerator well known in the market	
Priority	
High	
Timeline	
Medium term	
Strengths	**Weaknesses**
- facilitates potential users of the platform to select the Blue Accelerator; - reduces risk, uncertainty, time and cost of developers; - the measure is easy to implement.	- time, effort and money required to build a proper communication / marketing strategy; - Clients want a known name for a test facility. The measure alone could not be sufficient to build up a significant reputation; - it could induce potential Clients to rely only upon the shared info and reduce the direct contact.
Opportunities	**Threats**
- to attract a wide spectrum of developers and devices; - engaging with the client before the test.	- Sharing too much information can have a downside effect, i.e. being too detailed can push away some clients even before getting in contact with POM due to their required discretion

3.5.6. Installing a power cable with optical fibre integrated

Target	
Offer grid connectivity and fast data communication	
Priority	
Medium	
Timeline	
Long term	
Strengths	**Weaknesses**
- Grid connection and communication cables gained the highest score in the consultation exercise; - consent for a cable was already gained by NEMOS during the application process and it should be easy to get this back; - Availability of real-time resource measurements will significantly increase. - it could attract developers interested in long term testing, allowing for a steady revenue stream.	- expensive to implement, although on the long term can be cheaper than maintaining the self-sustaining power system over 20 years; - the electricity generated in Ostend will be low.
Opportunities	**Threats**
- Fitting a grid connection would permit removal of all internal systems, freeing up considerable space, at the same time as dramatically improving potential and reliability; - Would permit higher power usage and export, leveraging the one significant advantage of the Blue Accelerator, i.e. it is close to the shore, unlike other research/testing towers.	- cable fault/damage, repair can be expensive; - some clients, especially the smallest ones, may not be interested in grid connection.

3.5.7. Expand offered services

Target	
Have a full schedule and strengthen innovation	
Priority	
Medium	
Timeline	
Medium/Long term	
Strengths	**Weaknesses**
- It is difficult to attract a steady stream of clients for testing. The additional services would cover the schedule's eventual voids; - Additional services, especially the ones aiming at setting up innovation programs and strengthening innovation, can help clients to develop their technologies. - Diversification of the present technologies at one location	- the additional services cannot be enough to deal with the scares usage of the test centre.
Opportunities	**Threats**
- It has the potential to raise the overall awareness of the sector; - to expand the offered activities implies also an expansion of the associated network; - it is an indirect way of promoting the test sites; - educating people globally on the nature of marine energy systems, the current status on development and deployment, and the beneficial impacts of such systems, improve skills and enhance research; - motivating governments, agencies, corporate and individuals to become involved with the development and deployment of marine energy systems; - facilitating research, development and deployment of ocean energy systems in a manner that is beneficial for the environment and provides an economic return for those involved.	- a continuous management and market analysis should be in place in order to understand the future needs of the market/research industry;

3.6. Determination of the Blue Accelerator USP

The study carried out in Task 2 highlighted the strengths of the Blue Accelerator, as well as the items requiring improvements and/or modifications. The recommendations provided in Section 3.5 aim at reinforcing the functions, facilities and competences of Blue Accelerator in order to match its USP.

The Blue Accelerator USP can be summarised with the slogan **"We make your life easier!"** or **"We help you with your first steps offshore"**.

Indeed, the *easy access* and available *infrastructure* is deemed one of the most relevant requirements for the Blue Accelerator, especially in comparison with other test facilities. As an example, just sending a person at EMEC can cost more than 1000€ and, once there, the infrastructure, in terms of expertise and/or technology, is not available at the same level as in West-Flanders. In fact, the West-Flanders' offered *network* is quite unique, with energy companies, cluster organisations, knowledge centres and local governments united and concentrated in a small and stimulating area: everything is close and several project development phases can be carried out in a fast and structured manner.

Belgium is very suitable for nursery test facilities, addressing developers at early stage, due to its moderate wave and tidal climate. Because of the *mild climate*, the Belgian offshore zones can function as a testing platform for smaller scale prototypes. Another advantage linked to the mild climate at the Blue Accelerator is the reduction of standby periods. This can encourage full scale prototypes as they can simply extrapolate their output.

It is known that Belgium cannot compete with countries like Scotland or France in terms of ocean resources, hence the ocean energy activities should mainly focus on Research & Development rather than deploying commercial ocean energy systems, at least on the short/medium term. For the long term, depending on the policy makers decisions, WEC and especially TEC could play a key role in the future energy mix. Although it is not necessarily true that blue energy in Belgium is limited by its moderate environmental conditions, scepticism for Belgium in term of offshore wind or solar development were reported 10 years ago, while now Belgium is one of the major player of the sector. Nevertheless, the focus on the commercial development of blue energy should be addressed on the long term only.

Therefore, rather than emulating other test facilities, the Blue Accelerator should adopt a strategy focusing mainly on *Technology Innovators* as potential customers. Focusing on a precise type of client could limit the potential total number of client, but it clearly makes the Blue Accelerator more attractive for the selected typology of client. This option is also in line with Blue Accelerator potential, and Belgium in general, due to the considerations given above.

In fact, the Blue Accelerator potentially owns all the main functions required by Technology Innovators: technology innovators require a stage gate approach for the development plan, and nursery and intermediate scale testing facilities are likely to be of interest to this segment in a short- and medium-term horizon. Technology innovators want to focus on their core engineering / design / development activities, while indirect services such as consenting support may be of interest. As *early-stage developers*, they can be characterised with a low TRL and low level of funding; they typically largely require R&D support and funding resources. A precious lesson learnt from the analysis of other test facilities highlighted that, for a modest test facility, focusing on a small but clear market segment is a winning strategy. The example of FaBTest is undeniable: by providing fast, flexible low-risk and low-cost solutions, it gained a good reputation in the marine energy sector and it has never faced any sensitive drop in its order book.

Based on the consideration above, the strategic recommendations provided in Section 3.5 aim at addressing this kind of potential clients and to further strength the Blue Accelerator USP. With the USP surrounding support as main objective in the communication, the strategic recommendations are hereafter better detailed and motivated.

- *Fast/easy consenting and readiness*: it is the most important aspect identified during Task 2 and it is also a specific priority for Technology Innovators. The Blue Accelerator is already in a strong position, due to its easy access, but it is strongly recommended to further improve this aspect;
- *Join funding programmes*: Technology Innovators are usually characterized by a low level of funding. The other investigated open water test facilities, such as DMEC, EMEC, PTEC and FaBTest, can offer free-of-charge access to their clients for testing, through funding programme such as MARINET2 and FORESEA;

- *Partnership with Coastal & Ocean Basin COB*: it will help the clients to approach the testing in the Blue Accelerator, since some activities can be carried out in the COB lab before going offshore, therefore assistance can be provided at an early stage and the needs of clients can be addressed through several project phases. Furthermore, the Blue Accelerator is in the address book of the technology developers at an early stage;
- *Increase monitoring activities*: through provision of supporting data, the monitoring obligations placed on the Clients is reduced; in addition, this data can allow optimisation of the testing conditions, making all the process much simpler, saving time and costs for developers;
- *Availability of information*: facilitates potential users of the platform to select the Blue Accelerator. Technology Innovators require large support in activities development: sharing clear information can facilitate their choice, while saving their time and money;
- *Installing a power cable with optical fibre integrated*: Although it cannot be considered the highest priority for the Technology Innovators (the need for grid connected deployment at full-scale test site is not foreseen in a short- to medium-term horizon) and some small early stage developers could not require grid connection at all, a strong desire from all the customers to ultimately connect their device to the grid was noted, in an approximately 10-year timeframe. Grid connection is therefore a critical aspect to consider for the Blue Accelerator to meet the future customer requirements, therefore is recommended as a long-term strategy. Furthermore it can easily be combined with a data cable, in which technology developers are interested.
- *Expand offered services*: Additional services, especially the ones aiming at setting up innovation programs and strengthening innovation, has the potential to raise the overall awareness of the sector and to help Technology Innovators to develop their technologies.

4. Task 3: Implementation plan of the strategic recommendations

The strategic recommendations identified and analysed in Section 3.5 are translated in concrete measures through the implementation plan, developed for each identified recommendation.

4.1. Fast/easy consenting and readiness

Target
Obtaining a full-consented status
Timeline
Short term
Actions
- to evaluated the impact of large-scale long term tests, i.e. mainly WEC and TEC, on the Blue Accelerator's schedule and the opportunity to implement this recommendation (see remark below); - to work closely with MUMM and the key statutory stakeholders to capture as much as possible of the 'generic' information pertaining to relevant applicable legislation, navigational safety and environmental risks; - to discuss with MUMM the use of a Rochdale envelope and the procedure to follow (the use of a Rochdale envelope in an EIA is allowed in Belgium); - to define a 'project envelope' describing the types and characteristics of systems likely to be deployed at the Blue Accelerator, together with the types of marine operations and activities likely to be associated with their installation, operation and maintenance; - should the device to test not be compliant with the consent conditions, to agree with MUMM which documents are required from the developers, such as Project-specific Environmental Monitoring Programme, Third Party Verification, Decommissioning Programme; - to proceed with EIA; - to prepare a document describing the consent conditions and make it available to potential test developers (eventually by publishing on the web site); - to prepare a standardised intake form for tests, in order to collect all required information from test developer quickly, to be further assessed by MUMM; - make clear to potential client / promoting the easy and fast access offered by the Blue Accelerator.
Remarks
Large part of the offered test activities at the Blue Accelerator will not be subject to authorisation. This measure applies for the activities which are not covered by the current authorisation, i.e. large-scale long term tests, such as WEC and TEC. It is unlikely that developers will be in a position to determine all design parameters prior to submitting an application for consent. It is important that consent is granted on the basis of conditions which provide the flexibility for detailed design to be finalised post-consent while also protecting the environment.
Assumptions and Constraints

Type	Description

Schedule	All the activities should take a few months. (in order to avoid the procedure of having a full EIA, which can take about 180-230 calendar days).	
Resource availability and skill sets	See potential players and partners	
Technology to be reused or purchased	N.A.	
Policy / Legislation	To be checked with MUMM	
Potential players and partners		
Name company	**Type of company**	**Description of tasks**
MUMM	Regulator / Authorising company	Providing assistance/consultancy during the permit process of the test sites
COB	Test lab	Gaining lessons learnt, partnership, assistance during the permit process
-	Other test facilities	Gaining lessons learnt
-	University	Partnership, assistance/consultancy
-	Consultancy Company	Assistance during the process, when the required knowledge is not available internally or within the network of partners, such as UGent
References and standards		
Publisher	**Document Title / Number**	
EMEC	CONSENTING GUIDANCE FOR DEVELOPERS AT THE EMEC FALL OF WARNESS TEST SITE	
MET-CERTIFIED	WP2 D 2.2.1 Pre-consented site under a 'Rochdale Envelope'	
FaBTest	https://www.fabtest.com/deployment	
Budget estimation		
Type of cost	**-**	**Description of cost**
Development cost	< 100 k€/year	Personnel, consultancy services: based on 1 half time FTE
Supply cost	N.A.	
Installation cost	N.A.	
Operational Cost	N.A.	

4.2. Join funding programmes

Target
Facilitate access to suitable incentives and support in funding / grant applications for developers

Timeline
Short/Medium term

Actions

Most of the existing funding programmes have already started, in the framework of Horizon 2020. It could be difficult/not convenient to join some of these program. Specific funding programme available from 2021, which can be of more interest for the Blue Accelerator, have not been identified. It is strongly recommended to maintain contacts with the network organisation already joined, to understand the possibility to get funding for testing. Particular attention and regular contacts should be maintained toward the Blue Cluster and Ocean Energy Europe.

Therefore the following high-level list of actions is suggested:

- mapping the potential funding programmes;

- establish a contact to capture as much as possible of the 'generic' information pertaining to relevant timing and requirements to join e.g. through EMEC and DMEC;

- for each identified programme evaluate the possibility to join (cost/benefit analysis);

- in case of positive evaluation, carry on the application process and dedicate personnel to it;

- once confirmed, make sure to properly communicate the partnership to potential clients, e.g. via website, conference,...;

- it was noted that many funding programmes' websites report limited info on the test facilities. Make sure that the Blue Accelerator is mentioned and properly described.

IMDC has identified the following programmes (high level evaluation):

- FORESEA: expires in 2019; leading partner is EMEC; try to understand if programme's extension is foreseen --> to be evaluated, low priority;
- Marinet2: Virtual applications are accepted continuously up until March 30th 2021; leading contact is IFREMER --> highly recommended;
- Ocean DEMO: Started in 2019, expiring date not found, leading partner is EMEC --> highly recommended;
- Blue-GIFT: Started in 2019, led by EMEC, it is specific for Atlantic sea. Nevertheless, Blue Accelerator can exploit its mild environmental conditions and be proposed to test prototypes before their development in the Atlantic sea, i.e. TRL <=6 --> to be evaluated;
- InnoBlueGrowth: expires in 2020; it is specific for Mediterranean Sea. Nevertheless, lack of test sites in the Mediterranean area is noticed. Since the environmental conditions at Blue Accelerator are quite similar to the ones expected in the Mediterranean, an option could be to offer the Blue Accelerator as test site --> to be evaluated, low priority;
- OESA: expires in 2021; it is an accelerator programme, so it does not finance the developers directly; it is led by DMEC --> to be evaluated, low priority.

Remarks
Application process' guidance to join funding programme is available only for technology developers. No publicly available info about the application from the test facility' s prospective was found. It is suggested that POM takes a further look, due to its better position within the test facilities' network.

Assumptions and Constraints

Type	Description

Schedule	Short / Medium term
Resource availability and skill sets	The activities can be carried out with internal resources. Since limited public info on the application process (from the test centre's prospective) are available, it is deemed useful to take advantages of contacts with other test facilities, such as EMEC and DMEC which are partners of most of the identified programmes.
Technology to be reused or purchased	N.A.
Policy / Legislation	Horizon 2020 Framework Programme (H2020), European Fund for strategic Investments (EFSI), European Structural and Investment Funds (ESI Funds)

Potential players and partners

Name company	**Type of company**	**Description of tasks**
Ocean Energy Europe	International organisation (based in Brussels)	support for the smooth roll-out of the FORESEA project, to establish contacts, to investigate possibilities to get funding
Blue Cluster	Innovation network	to investigate possibilities to get funding
FORESEA	Funding programme	
Marinet2	Funding programme	
Ocean DEMO	Funding programme	
DG Mare	Directorate-General of the European Commission	encourage marine renewable energy initiatives, to establish contacts
European Fund for strategic Investments (EFSI)	-	to investigate if any of them are relevant/ applicable to Blue Accelerator
European Structural and Investment Funds (ESI Funds)	-	to investigate if any of them are relevant/ applicable to Blue Accelerator
Horizon 2020 Framework Programme (H2020)	Framework Programme	to establish contacts in order to be aware of new funding programmes
InnoBlueGrowth	Funding programme	
Blue GIFT	Funding programme	
OESA	Accelerator programme, international partnership	

References and standards

Publisher	**Document Title / Number**
N.A.	N.A.

Budget estimation

Type of cost	**-**	**Description of cost**
Development cost		Only personnel costs, i.e. time dedicated to Blue Accelerator's application, meeting, …
Supply cost	N.A.	
Installation cost	N.A.	
Operational Cost		Only personnel costs, i.e. time dedicated to the test developers' application, meeting, …

4.3. Partnership with Coastal & Ocean Basin COB

Target
To create a Belgian network / chain for offshore innovations
Timeline
Medium Term
Actions
A mapping exercise was performed and the potential partner was identified in Coastal & Ocean Basin COB in Ostend which addresses TRL 1-4, therefore it was judged the perfect step before Blue Accelerator. Furthermore, COB was interviewed during Task 1 and was very willing to collaborate and establish a "test facility chain", proposing itself as the step before Blue Accelerator. - Planning: Identify specific activities, assess needs and best practises of both test facilities and respective responsibilities and communicate/promote to the market; for example, COB's main focus is on WEC, TEC and coastal engineering. Nevertheless, other types of testing can be mutually promoted, such as the ones offered at the Blue Accelerator. On the other side, POM could include other topics within its offer in line with tests supported at COB, such as coastal engineering and safety, climate change, sea level rise. Furthermore, WEC and TEC tests at the Blue Accelerator can be further elaborated, enhancing its partnership with COB. This clustering will help to set up innovation programs and strengthen innovation, in line with the recommendation in Section 4.7 and should not be limited to testing activities, but extended to technical, scientific, commercial and legal support. This aspect should be adequately promoted, as per recommendation developed in Section 4.5. - Make sure the partnership is a good "fit" – built on common values and mutually beneficial goals: both the Blue Accelerator and COB aim to strengthen Flanders' international research position. Nevertheless, COB has some constraints in terms of testing schedule: only 40% of time can be dedicated to commercial projects (other 40% to academic research, 20% to Flanders Hydraulics). This item should be further developed and discussed with COB; - Resources: Allocate sufficient people, budget, and other resources to allow the partnership to succeed; Identify personnel within the organization to coordinate partnership activities and communications; - Clearly define and document individual and common objectives and responsibilities: trying to get involved in European projects (especially the funding programmes, as identified in Section 4.2), joining conferences and networks and promote both centres together; - Evaluation and Evolution: Arrange to meet at specific intervals to review the effectiveness of the partnership and revise as needed; - Establish criteria for success that are easy to measure. Be willing to discontinue the partnership if it is not fulfilling expectations or meeting objectives.
Remarks
The measure is intended to build a strong partnership with the COB, based on mutual promotion and exchange of info/lesson learnt. There are of course other possible partners, but COB is deemed the natural step before testing at the Blue Accelerator. Nonetheless it should be avoided that they are seen as one entity and the Blue Accelerator should still position itself and communicate its USP on the market.

Assumptions and Constraints	
Type	**Description**
Schedule	COB will be operational hopefully in summer 2020, although a mutual promotion (high level) can already start.
Resource availability and	No need to hire extra personnel

skill sets		
Technology to be reused or purchased	N.A.	
Policy / Legislation	To be further investigated with the partner.	
Potential players and partners		
Name company	**Type of company**	**Description of tasks**
COB	Test facility	Partnership, assistance/consultancy
UGent	University	Partnership, assistance/consultancy
-	Marketing companies	Promotion, consultancy
References and standards		
Publisher	**Document Title / Number**	
-	N.A	
Budget estimation		
Type of cost	**-**	**Description of cost**
Development cost	< 100 k€	Personnel, consultancy services, marketing
Supply cost	N.A	
Installation cost	N.A	
Operational Cost	< 100 k€	Personnel, meetings, promotion

4.4. Increase monitoring activities

Target
Collect and elaborate a significant amount of environmental data of the testing area
Timeline
Medium term
Actions
- identify the key parameters to monitor, e.g. salinity, water temperature, waves, currents, tide, seabed mobility, water circulation patterns, interference with benthic habitats, artificial reef effects, water quality, noise disturbance, effects due to electro-magnetic fields, interference with marine animal movements, habitat exclusion; - map and evaluate the available equipment and monitoring already done in the Belgian nearshore (RBINS-MUMM, UGent, Afdeling Kust, etc.); - development of the different sensors, tools and techniques required must be prioritised against the main areas/parameters identified; - screening of the available best practise and methodologies; - development of a monitoring plan, which should include at least: • objectives; • monitoring and auditing requirements; • environmental reporting; • management plan; • environment enhancement; - designate resources in charge of data modelling and elaboration; an option could be to use the partnership already in place with UGent; another alternative could be to partnership with Flanders Marine Institute, which will be involved in the installation of sensors and monitoring tools; - evaluate the possibility to develop a dedicate software package for elaboration and visualisation of data collected (see FaBTest example); - ensuring that findings from all the early-stage monitoring and learning are disseminated and appropriately reviewed (by regulators, stakeholders, other test facilities); - adopt a coordinated approach towards environmental monitoring with other test centres.
Remarks
The European Commission has published a new call for grants to support the development of ocean energy in Europe. Budgeted at € 2.3 million, this call wants to attract projects that can improve environmental monitoring of tidal and wave energy devices. Deadline for applications is 15 January 2020.

Assumptions and Constraints	
Type	**Description**
Schedule	The activities should be performed on a continuous and regular basis.
Resource availability and skill sets	The activities could be done internally. If not, data elaboration and modelling could be assigned to a partner, like for example UGent (on a mutual benefit) or Flanders Marine Institute (which will be the responsible for the installation of sensors and monitoring tools)
Technology to be reused or purchased	To be evaluated based on the key environmental parameters to monitor identified.
Policy / Legislation	Regardless of size or whether or not an EIA is required, the following shall be

	considered: EC Directive 92/43/EEC, EC Directive 79/409/EEC, Marine Strategy Framework Directive (MSFD), recommendations from Equitable Testing and Evaluation of Marine Energy Extraction Devices in terms of Performance, Cost and Environmental Impact (EQUIMAR) project.	
Potential players and partners		
Name company	**Type of company**	**Description of tasks**
-	University	Partnership, consultancy services
Flanders Marine Institute	Research institute	Responsible for the installation of sensors and monitoring tools. Could be involved in data elaboration and modelling
-	Consultancy company	Consultancy services
-	Other test facilities	Joining network, sharing knowledge and undertaking collaborative projects
-	Governmental institutes	Joining projects, sharing knowledge
-	International group	Joining network, sharing knowledge and undertaking collaborative projects
References and standards		
Publisher	**Document Title / Number**	
EQUIMAR	D6.3.1 Uncertainties regarding environmental impacts	
EQUIMAR	D6.3.2 Uncertainties and road map	
Marinet2	D4.7 Best practice report on environmental monitoring and new study techniques	
Marinet2	D4.17 Report on Environmental Monitoring Protocols	
OES (Ocean Energy Development)	International database of environmental monitoring report	
Budget estimation		
Type of cost	**-**	**Description of cost**
Development cost	Optional	Develop a software package for data elaboration
Supply cost		Purchasing new tools/sensors (if not already available) must be prioritised against the main areas/parameters identified.
Installation cost		Depending on the instrumentation.
Operational Cost		Limited to personnel and regular maintenance of the instrumentation.

4.5. Availability of information

Target
Make the Blue Accelerator well known in the market

Timeline
Medium term

Actions
- It is highly recommended to create a dedicated website for the Blue Accelerator test facility. Even if it is not a dedicated domain, extend the one already existing on the POM domain. See also references below as example; - Update the website with more info (as further detailed below); - Make sure that info is provided also in English; - Prepare a brochure. Even better if more than one, in order to separate the several items. The brochure(s) should be downloadable from the website. The following info should be included at least: • Offered services and available infrastructure; • Site characteristic: wave and current data, water depth, seabed conditions; • Access procedure, with a focus on the pre-consented status (the standardised intake form foreseen for tests could be made available too); • Partnership in place, especially with other test-facilities, and funding programmes; • Certifications, QHSE. - The same info above, at higher level, shall be included in the website, therefore available without the need to download the full brochure. The following questions shall be clearly answered: "what can be tested?" and "how to access"; - Continue an active promotion via website, twitter, conferences, workshops, international events, organisation of seminars; - Inform markets about Blue Accelerator's capabilities including training sessions, branding toolkits, study visits, newsletters, innovation clubs, matchmaking missions, and B2B events; - Active member of Industry groups, such as Innovative Business Network (IBN) Offshore Energy, Blue Cluster and Belgian Offshore Cluster (BOC); - Ask most relevant partners to add a link to Blue Accelerator from their website; - Be sure that website has relevant info to POM's network and about joint funding programmes, report the right info about the Blue Accelerator. - Publish the data from the measurement campaign (if agreed with the user(s) of the platform).

Remarks
From the analysis of other test facilities, it was concluded that there is a general lack of info about many test sites, i.e. poor, and/or not updated websites, sometimes even with wrong info. Only after a direct contact, clarifications were given. A potential client does not always try to establish a direct contact, especially for a new facility like the Blue Accelerator. Therefore, providing proper, clear and simple info highlighting the USP and the characteristics of the Blue Accelerator is recommended.

Assumptions and Constraints	
Type	**Description**
Schedule	High priority, all the activities should take a few months.
Resource availability and skill sets	Updating or creating the website should be sub-contracted. Consultancy companies could be also involved.

Technology to be reused or purchased	N.A.	
Policy / Legislation	N.A.	
Potential players and partners		
Name company	**Type of company**	**Description of tasks**
COB	Test facility	Mutual promotion
UGent	Research institute	Promote COB and the Blue Accelerator together
-	Consultancy companies	Providing assistance/consultancy for the web sites
-	Other test facilities	Gaining lessons learnt, ask indirect promotion of Blue Accelerator, i.e. adding links to website, news flashes and press releases
Eurocean	Organisation	Evaluate the possibility to join
Belgian Offshore Cluster (BOC)	Organisation	Evaluate the possibility to join as knowledge partner
Marinerg-i	Organisation	Evaluate the possibility to join
Flanders Marine Institute	Research institute	Mutual promotion
Ocean Energy Europe	Organisation	Mutual promotion
Innovative Business Network (IBN) Offshore Energy	Organisation	Evaluate the possibility to join as knowledge partner
References and standards		
Publisher	**Document Title / Number**	
FaBTest	https://www.fabtest.com/	
Budget estimation		
Type of cost	**-**	**Description of cost**
Development cost	< 10 k€	Consultancy services to build / update the website
Supply cost	N.A	
Installation cost	N.A	
Operational Cost	marginal	No need of a dedicated person

4.6. Installing a power cable with optical fibre integrated

Target
Offer grid connectivity and fast data communication

Timeline
Long term

Actions
The radar tower on the breakwater is already configured for a connection to RT1 and the consent was gained by NEMOS during the application process. - Recover the permit; - Concept development: conceptual design, desktop study and cable route survey; Particular attention should be paid to the possible options for the landfall. Indeed, due to closeness to the port area, several constraints could be in place: the landfall can have a strong impact on the final length of the cable route, therefore it can invalidate one of the main strength of the Blue Accelerator, which is its closeness to the shore; - Design: cable system design (power cable, accessories **and optical fibre**), cable route, cable protection, landfall; - Cable manufacturing and testing; - Cable installation; - Operation and maintenance: monitoring, testing and inspection. Prepare tender documentation for the full scope (potentially to be done by consultancy services).

Remarks
An interesting option could be to establish a partnership with a potential client interested in grid connectivity and share the project management and costs of the cable installation. If a 5G network is established this should be closely followed-up as this already may exclude the need for a data connection.

Assumptions and Constraints

Type	Description
Schedule	6 months - 1 year. Usually cable lifetime is 20-25 years.
Resource availability and skill sets	Resource are not available internally. A partnership with a potential client experienced in cable design/installation would be highly beneficial.
Technology to be reused or purchased	Power cable, accessories and optical fibre to be purchased.
Policy / Legislation	The consent for the cable was already gained by NEMOS during the application process.

Potential players and partners

Name company	Type of company	Description of tasks
-	Cable manufacturer	Design and manufacturing phase
-	Installation Contractor	Installation phase

-	Consultancy/ Engineering company	Desktop study / Engineering studies / Consultancy
-	Developer	Possible partnership
N.B. EPCI contractor can handle all the project phases: design, manufacturing, engineering and installation		
References and standards		
Publisher	**Document Title / Number**	
DNV	Subsea power cables in shallow water, DNVGL-RP-0360	
Budget estimation		
Type of cost	**-**	**Description of cost**
Development cost	<50k€	Engineering costs
Supply cost	≈200k€	Rough estimation. Cable makers are unwilling to provide purchase costs of cable.
Installation cost	≈300k€	Rough estimation. Installation costs cannot be quantified at this stage, depending on many unknown factors and parameters.
Operational Cost	<50k€	Assuming no cable repairs during the cable lifetime.

4.7. Expand offered services

Target
Have a full schedule and strengthen innovation
Timeline
Medium/Long term
Actions
To manage the continuous evolution of the test centre. This should be achieved through careful planning, project management and consciously having one eye on the future to anticipate the needs of the industry. • Diversification of the present technologies at one location: The non-utility scale markets provide an increasing opportunity for marine energy. This includes applications such as providing power to aquaculture farms, desalination or powering islands. There are opportunities to couple marine energy with storage and energy systems to provide stable power, grid services, or renewable fuels such as hydrogen. Additional services, especially the ones aiming at setting up innovation programs and strengthening innovation, can help clients to develop their technologies. Possible actions to achieve this target are listed hereafter. • Given the presence of several research organisations / universities in Belgium involved in offshore innovation, (see Section 2.3.6), knowledge exchange and joint research activities should be encouraged, for example by establishing a recognised educational network, where also PhD students or engineers could find the best solution to improve their expertise in the sector. • The opportunity to partnership with UGent or other universities can be evaluated in order to develop a PhD program oriented towards the blue energy. • Also, offering internship opportunities to Master or PhD students can have a mutual convenience. • Facilitating research, development and deployment of ocean energy systems in a manner that is beneficial for the environment and provides an economic return for those involved. Setting up “technology challenges”, Hackathon-like event on these topic is highly recommended. • For specific project/development, more technical-oriented, organising charettes involving different partners from the network, in partnership with clients; being a long-term activity (compared to the activities at previous bullet point), the charette’s topic should be clear and the programme organised only if the client/potential developer arise this need. • Developing a Q-A platform between industry – knowledge network, where technology developers can ask R&D&I questions, via POM, to the knowledge network. • A major commitment in the preliminary or preparatory phases of technology development can be offered, therefore helping the industry in the phases before the test. This could be achieved with the support of the network. Software modelling is seen as a potential further service that can be offered, eventually in cooperation with UGent, to help the early-stage developers at a design phase. The engineering/modelling part could be coupled with the monitoring activities, described in Section 4.4. Reference could be made also to the digital twin concept mentioned in Section 3.4. • Blue energy workshop/events could be organised involving several partners and players of the sector. Indeed the main risks for the blue energy sector are related to fragmentation and internal competition, with a consequent lack of a sufficient scale. As a consequence, the main opportunities rely on the structure integration, i.e. offering a full-scale mechanism focusing on the bigger picture, which can be achieved organising regular meeting and events. Also, these workshop can motivate governments, agencies, corporate and individuals to become involved with the development and deployment of marine energy systems. • Blue energy workshop/events should not be limited to blue energy insiders. Events open to external stakeholders can educate people on the nature of marine energy systems, the current status on development and deployment, and the beneficial impacts of such systems. • Events limited to testers are also recommended. Users of Blue Accelerator can exchange experiences, which may also be useful for POM for the further development of Blue Accelerator. These events can also

help the sector in general: it came out from the consultation study that most of developers work isolated or in competition for funding.

- The involved partners/centres should also collect experimental and numerical data within a database that can be used by all the partners, becoming attractive also for private funding from Industries and SME.
- To build-up a knowledge sharing platform where stakeholders from multiple disciplines and sectors will join forces and share information, knowledge and expertise.
- Also, other innovative ways of cooperation, such as “co-creation”, learning journeys, and more usual ways like workshops, can be used to create mutual understanding and trust between the parties. The goal is to come up with solutions that prevent major hurdles for the role out of blue energy, and to create mutual benefits where possible.

Remarks

Environmental monitoring is an additional service already analysed in Section 4.4.

Assumptions and Constraints

Type	Description
Schedule	This activity should run in a continuous way, managing the evolution of the test centre
Resource availability and skill sets	The activities could be done internally. Several partnership are recommended, like for example with UGent or Flanders Marine Institute.
Technology to be reused or purchased	N.A. for the research programmes; For the non-utility scale markets, an interesting option could be to establish a partnership with a potential client interested in the activity and share the project management and costs of the technology
Policy / Legislation	To be evaluated based on the additional services selected as part of the Blue Accelerator’s offer.

Potential players and partners

Name company	Type of company	Description of tasks
	University	Partnership, consultancy services
-	Consultancy company	Consultancy services
Flanders Marine Institute	Research	Partnership, consultancy services
-	Other test facilities	Joining network, sharing knowledge and undertaking collaborative projects
-	Governmental institutes	Joining projects, sharing knowledge
-	International group	Joining network, sharing knowledge and undertaking collaborative projects

References and standards

Publisher	Document Title / Number
	N.A.

Budget estimation

Type of cost	-	Description of cost
Development cost		Only personnel costs for innovation programmes implementation; To be evaluated for non-utility scale markets, depending on the selected application.
Supply cost	N.A.	

Installation cost	N.A.	
Operational Cost		Only personnel costs for innovation programmes implementation; To be evaluated for non-utility scale markets, depending on the selected application.

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6. Glossary

Accreditation	The process in which certification of competency, authority, or credibility is presented. Organizations that issue credentials or certify third parties against official standards are themselves formally accredited by accreditation bodies; hence they are sometimes known as "accredited certification bodies". The accreditation process ensures that their certification practices are acceptable, typically meaning that they are competent to test and certify third parties, behave ethically and employ suitable quality assurance.
ADCP	Acoustic Doppler Current Profiler
BMM	Beheer van het mariene milieu
Certification	The process or action performed by a Certification Body to attest that specific Renewable Energy equipment was fully evaluated according to a Scheme including the relevant requirements of one or more applicable Standard(s) accepted for use in e.g. the IECRE System.
Compliance	Certification or confirmation that the manufacturer or supplier of a product, meets the requirements of accepted practices or specified standards.
Conformity	If the product, service or system meets the requirements of a standard
EIA	Environmental impact assessment
IEC	International Electrotechnical Commission
LCOE	Levelized Cost of Energy
Moderate environmental conditions	Usually occurring in sheltered locations and in mild climate. According to Douglas sea scale, adopted by World Meteorological Organization (WMO), moderate conditions correspond to a wind wave height (Hw) of 1.25 m and a swell height (Hswell) of 2 m.
MUMM	Management Unit of the Mathematical Models of the North Sea
Offshore extreme conditions	Defined by all offshore codes of practice as those that have a 100 years return period.
OWF	Offshore Wind Farm
PPA	Power purchase agreement
Standardisation	The process of implementing and developing technical standards based on the consensus of different parties that include firms, users, interest groups, standards organizations and governments.[1] Standardization can help maximize compatibility, interoperability, safety, repeatability, or quality.
TEC	Tidal Energy Converter
TRL	Technology Readiness Level
USP	Unique selling point

WEC	Wave Energy Converter

Annex A Leaflets

SEEENEOH

Estuarine tidal test site for full-scale river devices and intermediate-scale ocean devices

Services

-Mechanical and electrical performance and reliability testing of tidal devices and their related equipments;
-Environmental data providing (ADCP, bathy);
-Environmental impacts assessment and feedbacks;
-Power performance measurements and certification by Bureau Véritas;
-H 24 supervision by a remote control center.

Site conditions

Bi-directional currents. The tidal range during spring tides exceeds 5m and current velocity reaches up to 3.5 m/s. Currents above 1m/s occur approximately 80% of the time. Depth at the test area ranges from 5 to 17 m. Each of the three available berths are connected to the onshore substation by an export cable. The berths are designed to accomodate tidal devices with either mounted or floating fixation type (pre-installed mooring). The site is connected to the grid for consumption (36kVA) and injection (250 kVA).

HSE

All the requirements are in place. SEENEOH developed a risk prevention plan which is yearly updated. Client has to comply with it, but it does not require too much effort, since the access to the site is by Seeneoh boat. SEENEOH is continuously supervising the activities and access to the site.

Intellectual property

SEENEOH can access to user data by SCADA system, only to deliver monthly report. They cannot use client data for other purposes.
Envirnmental monitoring, ADCP, bathy and performance data of local conditions are regularly performed and usually provided to the testers.

Permitting and policy

A lot of time to get the permit, mainly because of the time needed to get a management in place, not the permit procedure itself.
The application procedure is fast: since the site is fully consented, there is no need of particular permits from developers. The entire contracting process is expected to last around 4 months, which term may also vary depending on the level of maturity of prospects and their ability to address the different points.

Business model & tariff structure

Société par actions simplifiée, established as a private company and managed by 4 different operating companies.
The current economic model, i.e. sell services to users who come with their own budget from EU or regional funding, is resulting not successful. The plan is to increase public funding, mainly from EU, to cover their own costs, such that user can access the site without paying any fees.
To date:
65% of the investment from France government and two Regional / Local Authorities;
35% has been charged to several private companies.

Marketing, promotion

Website and Twitter regularly updated.
Presence at conferences and seminars.
Collaboration with BV for the power curve certification.
Member of International WaTERS and BlueGift

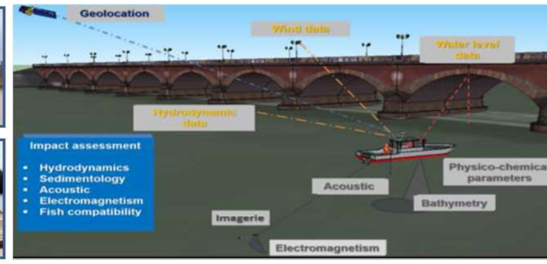
SEENEOH

Country: France

Estuarine tidal test site for full-scale river devices and intermediate-scale ocean devices







Description of facility

SEENEOH is an estuarine tidal energy test site for full-scale river devices and intermediate-scale ocean devices.
It is located upstream the largest estuary in Europe, the Gironde Estuary where tidal currents increase in the Garonne River.
SEENEOH offers 4 locations for tidal devices or floating tidal devices, 3 of which can be grid connected.
Moorings are in place and a generating platform is available if required.

Strengths	Weaknesses
Very particular site: **estuarine** **Easy access**: Located on the Gironde estuary, 10 minutes by SEENEOH's own boat; **Sheltered site**, but with high currents; **Fast**: fully consented status, no need of particular permits; **Mooring** already in place and **grid connection;** **Power curve certification.**	- Not suitable for advanced TRL; - Not suitable for testing devices for extreme offshore conditions; - Not enough assistance for clients to get funding; - It does not fit offshore or river technical standars (it's in between); - Not yet engaged in an accreditation process, do not provide accredited test reports

Opportunities	Threats
If Seeneoh could increase its (public) funding, (mainly from EU) to cover their own costs, the user could access the site without paying any fees.	- Tidal energy market still at early stage; - Small developers at low TRL, not enough money/ do not receive enough funding; - Administrative issues for setting-up as R&D company; - Time for development is very long.

Innovative level (Technical Readiness Level: TRL)

N°	Description of level	Remarks
0	Idea	4 different areas, for different TRLs. The two cases/clients they had since opening in 2017 were at TRL3-5.
1	Basic research	
2	Technology formulated	
3	Needs Validation	
4	Small scale prototype	
5	Large scale prototype	
6	Prototype system	
7	Demonstration system	
8	First of kind commercial system	
9	Full commercial system	

Unique Selling Point

Prepare for the ocean in a safe environment.

Remarks

SEENEOH is a step in between tidal river to ocean application, addressed to Clients with interest in river tidal energy and for ocean energy. Testing at Seeneoh is used to decide which way to go, river or ocean.
All permits are already in place, therefore the authorisation process is extremely fast.
In partnership with BV, SEENEOH offers a power performance certification, based on IEC.

Perpetuus Tidal Energy Centre (PTEC)

State-of-the-art tidal energy generation project

Services

PTEC will not only offer test facilities to external developers, but will in fact also be the project developer partnering with selected turbine manufacturers. PTEC will carry out a comprehensive turbine manufacturer engagement exercise. Key parameters included CAPEX, OPEX, capacity factor, availability factor, guarantees/warranties, testing/TRL, taking into account technology risk, insurance, debt and equity considerations.

Site conditions

The centre comprises an onshore site with substation/control room building and a development site for the deployment of devices, with the two sites being connected by a subsea power cables. The site location is the south of Isle of Wight, 2.5 km from shore, in 70m WD. Mean spring peak and mean neap peak current speeds around 2.5-2.9 m/s and 1.3-1.6 m/s, respectively.

PTEC facility will provide tenants with grid connection infrastructure via subsea export cables as well as navigation aids to allow developers to utilise the area to demonstrate their tidal technology. Tenants will provide the tidal energy devices and foundation/support structure.

HSE

All the requirements are in place, especially as a tenant of The Crown Estate and being part of consenting requirements. Further consent compliance and development will continue towards construction and operation.

Intellectual property

PTEC owns it 100% and will only share confidential information to selected parties under NDA.

Turbine manufacturers will own the IP relating to their designs/systems/processes.

Permitting and policy

PTEC centre is for the time being on hold pending a suitable revenue support mechanism from the UK Government. Consenting was one of the longest and most complex tasks. The project will be full consented (under a Rochdale Envelope) so that turbine manufacturers will only need to assure compliance with the consent conditions.

Business model & tariff structure

PTEC is majority owned and funded by Perpetuus Energy Limited, in joint venture with the Isle of Wight Council. It is mainly private, with £1m from Isle of Wight Council and a very small proportion from grant funding. Business model will be revised once the project is restarted. Two options are considered:

- to enter into joint ventures with each turbine manufacturer;
- to ‘rent’ the infrastructure on a long term basis.

Marketing, promotion

PTEC has the potential to be operational during 2021.

It has already put in place major partnerships with global turbine manufacturers, such as Tocardo International BV and SCHOTTEL Hydro GmbH.

Perpetuus Tidal Energy Centre (PTEC)

Country: UK

State-of-the-art multi-tidal energy generation project

Description of facility

PTEC is the largest tidal stream energy project planned in England and Wales, for devices up to 10MW and arrays.
It will start to be operational in 2021. It is for the time being on hold pending a suitable revenue support mechanism from the UK Government.
As a readymade, 'live' commercial platform run in partnership with the local council and various turbine manufacturers, PTEC will deliver a fully consented site for a range of different turbine technologies, to be deployed in large commercial arrays. The planned electrical generation capacity is 30MW.

Strengths	Weaknesses
- **Unique** design and business model; - Suitable for proven tidal devices at **advanced stage** of development; - The site characteristics are **representative** of the majority of global sites; - **Site-wide consents** covering a range of development scenarios.	- Not suitable for testing devices for extreme offshore conditions; - Not operational yet, currently on hold; - Addressed to developers at an advanced stage of TRL, having previously completed prototype testing at other tidal sites.

Opportunities	Threats
- Becoming the step between standard test facilities and pure commercial; - Getting accredited, perhaps in collaboration with other test facilities and joining working groups; - Collaborating with other test facilities.	- Political (lack of government support); - Consenting process; - Financial standing / balance sheet credibility of turbine manufacturers; - Technical; - Engagement with stakeholder and local community (a lot of consultation took place during the EIA). In terms of the trickiest stakeholders, for PTEC this is likely to be fisheries and sailing.

Innovative level (Technical Readiness Level: TRL)

N°	Description of level	Remarks
0	Idea	PTEC is addressed to developers at an advanced stage of TRL, having previously completed prototype testing at other tidal sites.
1	Basic research	
2	Technology formulated	
3	Needs Validation	
4	Small scale prototype	
5	Large scale prototype	
6	Prototype system	
7	Demonstration system	
8	First of kind commercial system	
9	Full commercial system	

Unique Selling Point

PTEC is the last step! The step that will bring your tidal energy into the energy equation.

Remarks

PTEC will fill the gap for technology and tidal array developers between testing a prototype device and installing and operating arrays of devices.
PTEC is the step between standard test site and pure commercial. It is the enabler, the springboard to commercialisation.
PTEC will be in partnership with turbine manufacturers, being effectively the project developer.

Blue Accelerator

Maritime innovation and development platform at sea

Services

The maritime platform will serve as a base for setting up tests and demonstrations at sea. The intention is to go through this lab in real lifesea conditions to launch innovation projects in a variety of marine and maritime sectors.
In addition, POM develops and provides technical and commercial support and services to clients via POM's network.
Also, POM offers continuous monitoring of environmental and metocean conditions.
It supports the users of the test platform by realising a common framework for all test facilities with relevant partners and relevant authorities.

Site conditions

The test platform consists of a foundation (monopile) with a tower with a container on top. Testing can take place on the test platform and 100m around it, on the seabed, in the water column, on and above the water surface. The site is located in a water depth ranging from 7.0m LAT to 12.7m HAT, 500m from the Port of Oostende, offering moderate metocean conditions, i.e. average significant wave height of 0.8 m +/- 0.6 m and mean current of 0.5 m/s +/- 0.3 m/s.

HSE

- All the requiremenents are in place. Client has to comply with POM's requirements and to provide the relevant maritime certifications.
- All visitors to the test platform should have received appropriate training. Every visitor is expected be medically fit and to have followed training according to the GWO standards (Global Wind Organisation). In addition training for crane lifting and rigging is required whilst operating the interior crane;
- At least 2 persons at each visit;
- Boat fit for correct boatlanding.

Intellectual property

A non-disclosure agreement is signed with the clients. Design and performance information is owned by the client/developer. Environmental and metocean data are continuosly monitored and shared with developers and/or knowledge institutes.

Permitting and policy

- The project is full consented (exploitation permit of 15 years) and POM takes care of all the legal/permits aspects, so in most cases developers will only need to ensure compliance with the consent conditions.
- As soon as the test set-ups are specific, an investigation will be carried out to determine whether additional permits or an adjustment to POM permits are required. In case of additional permits or an adjustment of POM’s permit is required, POM will coordinate actions with the relevant authorities and support users in this process.

Business model & tariff structure

The Blue Accelerator project is funded by the European Regional Development Fund (ERDF), with co-financing by the Flemish government (Hermes Fund). The project is coordinated by the Provincial Development Agency (POM) West Flanders which is in charge of the management and operation of the test platform. Depending on the test activities, several simultaneous tests from different parties can be performed too.

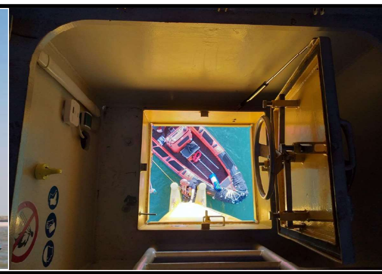
Marketing, promotion

- POM strengthens the blue energy sector via close collaboration between industry, knowledge institutions at all levels and is active in three domains: product & process, research and testing, and internationalisation. Among its partners are Blue Cluster, Belgian Offshore Cluster, Flanders Marine Institute, Port of Oostende, OWI-Lab, GreenBridge, University of Ghent, Howest, Vives,…;
- POM is an active partner in several European projects (Inn2POWER, MET-CERTIFIED, DecomTools, COASTAL) and is a member of several European networks, such as Ocean Energy Europe;
- POM is a partner in Ostend Science Park, Business park for international companies active in the Blue Economy with special attention to Research and Development;
- POM participates in exhibitions in Belgium and abroad, such as Belgian Offshore Days, WindEurope exhibitions, and organises B2B events;
- Information and news are shared via POM West Flanders website, social media,…

Blue Accelerator

Country: Belgium

Maritime innovation and development platform at sea



Description of facility

The Blue Accelerator is a maritime innovation and development platform, owned by West Flanders Development Agency (POM West Flanders), in which a "living lab" at sea is created. It consists of a monopile and a working container (7m x 3.5m) with a test zone of 100m around, located 500m outside the coast of Ostend, in a water depth of 7 m LAT. The intention is to launch innovation projects in a variety of marine and maritime sectors in real life marine conditions, with a focus on wave, wind and tidal energy and the broader blue economy.
Blue Accelerator is an open access and autonomous test facility, i.e. for all users and in principle for all tests, with no connection to land.
The first user is NEMOS GmbH, which is testing its wave energy converter prototype at Blue Accelerator.
It is envisaged that the following measurements, investigations and tests can be carried out on the platform (non-exhaustive): wave and tidal energy conversion, corrosion and abrasion investigations, cable manipulations, meteorological measurement, underwater substrate and marine growth investigations, offshore application of drones.

Strengths	Weaknesses
- **Fast consenting** and readiness: support and representation by POM ; - **Versatile** open water test facility with **moderate** metocean conditions; - **Easy access**: operational (from port) in central position in Europe; - **Tailor-made** support, i.e. funding, consenting, advice and support for tests,... ; - **Pre-approved** facility; - Strong and large **network**, with business, research and administration.	- Not suitable for testing devices for extreme offshore conditions (site conditions at Blue Accelerator: average significant wave height of 0.8 +/- 0.6 m and mean current of 0.5 m/s +/- 0.3 m/s); - Suitable only for certain developers (TRL from 4 to 7); - Not grid connected; - No pre-installed mooring available; - Currently only basic equipment on site.

Opportunities	Threats
- Support the users of the test platform by realising a common framework for all test facilities with relevant partners and authorities; - Set up academically driven innovation program; - Strengthen innovation in the blue energy sector; - Supporting offshore projects; - Environmental impact monitoring.	- Underusage of the available resources; - Mantainance costs.

Innovative level (Technical Readiness Level: TRL)

N°	Description of level	Remarks
0	Idea	For WEC and TEC, focus would probably be 5 (4-6), for other technologies the TRL scope would be broader in both ways (e.g. drones, corrosion,...)
1	Basic research	
2	Technology formulated	
3	Needs Validation	
4	Small scale prototype	
5	Large scale prototype	
6	Prototype system	
7	Demonstration system	
8	First of kind commercial system	
9	Full commercial system	

Unique Selling Point

To be determined.

Remarks

The development platform Blue Accelerator offers the possibility to test, develop and demonstrate a wide range of services and products in real North Sea conditions, at low costs and low risks, in a quick and easy manner.
Thanks to its extensive network with other institutions, including technology developers, the supply chain, academic institutions, can offer a customised approach, supporting developers from funding to consenting to deployment itself.

Offshore Wind Infrastructure Application Lab (OWI-Lab)

R&D and Innovation platform

Services

OWI-Lab offers a test facility consisiting in a climate room where several climatic conditions can be simulated.
Next to the test facility, OWI-lab offers monitoring hardware and software for offshore wind turbine field measurements: Structural Helath Monitoring (SHM) and Drivetrain Monitoring (CMS).
A third offshore service is situated in the field of wind resource monitoring.

Site conditions

The large climatic test chamber is embedded in the OWI-Lab test facility which is located in the Port of Antwerp nearby the DP World breakbulk terminal. All logistics are available on site to handle large and heavy machinery, its quay has a load capacity of 45 ton/m2. OWI-Lab's climatic test facility is used to test and verify wind turbine components and full integrated systems. The climate room can have temperatures from -60 to +60 degrees Celsius and is able to simulate other extreme weather events to test the functioning of (parts) of wind turbines.

HSE

Intellectual property

Permitting and policy

Business model & tariff structure

Marketing, promotion

Offshore Wind Infrastructure Application Lab (OWI-Lab)

R&D and Innovation platform

Description of facility

The 'Offshore Wind Infrastructure Application Lab' (OWI-Lab) is a Research Development and Innovation platform which aims to initiate and support R&D and innovation projects concerning wind energy in extreme environments as offshore, cold and hot climate conditions.
OWI-Lab gives companies access to test infrastructure and datasets based on real life measurements

Strengths	Weaknesses
OWI Lab's unique climatic test chamber marked the opening of a facility for the representative testing of large, heavy components under extreme climatic conditions (ranging from -60°C to +60°C).	

Opportunities	Threats

Innovative level (Technical Readiness Level: TRL)

N°	Description of level	Remarks
0	Idea	The test facility is testing equipment in the range of TRL 6 – 9 level although occasionally TRL 3 equipment is tested as well.
1	Basic research	
2	Technology formulated	
3	Needs Validation	
4	Small scale prototype	
5	Large scale prototype	
6	Prototype system	
7	Demonstration system	
8	First of kind commercial system	
9	Full commercial system	

Unique Selling Point

Remarks

FaBTest

Nursery test facility for WEC and TEC

Services

- data analysis (software package developed to facilitate the visualisation of data collected);
- environmental monitoring;
- facilitates world-leading, multi and inter-disciplinary research for the marine renewables sector from the University of Exeter

Site conditions

FABTest has a licence for 3 berths, marked by 4 wave buoys. The water depth of the test facilities varies between 15m and 50m, the average significant wave height is in around 0.6m, with a maximum measured significant wave height of 9m. The maximum current velocity can reach up to 1.4m /s. The test location is 4.5 km from Falmouth Harbour entrance, 7.5 km from dock area. The test location is not connected to the grid by export cables, so all generated power must be consumed on site via a dump load.

HSE

Clear requirements to be fulfilled by the developers in the application process. FaBTest, supported by the Regulatory Body, will ensure that a QHSE management plan (submitted as a part of the application process) is in line with the FHC-FaBTest Operating Policy and fully compliant with the pertinent legislation or regulation.

Intellectual property

Data collection is operated by the University of Exeter Offshore Renewable Energy group. The data collected at the site are subject to rigorous quality control procedures. For developers and collaborators, data will be accessed through the website which serves as an information hub and a data portal to the real time data store. It is accessed through password protected accounts, set up through the FaBTest team. Data are classified in: Open access data, controlled data, and commercial sensitive data. No private data may be stored, all data must have direct relevance to FaBTest.

Permitting and policy

The FaBTest site is leased from The Crown Estate and has consent for testing, subject to permits issued by Falmouth Harbour. Every tester needs its own permit issued by Falmouth Harbour Commissioners and Marine License from Marine Management Organisation. The application process is relatively straight forward, with an average duration of 8 weeks. The application requires evidence of engineering due diligence, environmental and other risk assessments, as well as deployment and decommissioning plans and evidence of required insurance and financial bonds.

Business model & tariff structure

The FaBTest site is administered by Falmouth Harbour Commissioners supported by a steering group with representatives from industry, academia, agencies and other stake holders. The core group has two permanent members, Falmouth Harbour Commissioners (FHC) and the University of Exeter (UoE). The main cost to be covered is the salary of the facility manager.

The initiation of FaBTest was supported by Regional Growth Fund. The site is leased from The Crown Estate and has consent for testing, subject to permits issued by Falmouth Harbour Commissioners.

Marketing, promotion

Site well-known in the marine energy sector, no active promotion.

Connection to research / funding programmes through University of Exeter (UoEx), Regional Growth Fund, at local and regional scale. On-going collaboration with Plymouth laboratory, WaveHub test centre, partnership with Marinet2.

FaBTest

Country: UK

Nursery test facility for WEC and TEC



Description of facility

Nursery facility (2.8km^2 area) enabling device developers to test components, concepts or full scale devices, both WEC and TEC, in a moderate wave climate. Its pre-consent status allows the following types of devices to be deployed, subject to permits issued by Falmouth Harbour Commissioners:
Substantially buoy-shaped device (maximum diameter of 30m) and box-shaped device (maximum dimensions of 30m x 30m or equivalent area);
Substantially tubular-shaped device with a maximum length of 180m;
Floating platform type device with maximum dimensions of 35m x 35m or equivalent area; and Subsystem connectors and umbilicals;
Mooring systems are restricted to gravity and drag embedment anchors. Guarded underwater turbines are also permitted.

Strengths	Weaknesses
- **Pre-consented** status, **fast** authorisation process; - Sheltered test site; - Port facilities closeby, 3-5 km from train and wharf space and deep harbour; - Flexible, low risk and **low cost** solution.	- Not suitable for testing devices for extreme offshore conditions; - Suitable only for certain developers (early stage of TRL); - Nursery site and not grid connected, so all generated power must be consumed on site via a dump load; - No pre-installed mooring available.

Opportunities	Threats
- To diversify its activities into other aspects, mainly from a technical point of view; - Major collaboration among the test centres; - Getting accredited; - supports supply chain activity in the area; - facilitates world-leading, multi and inter-disciplinary research for the marine renewables sector from the University of Exeter.	- Small developers, more focused on the design than on the testing, getting stuck at pre-commercial phase. - Many costs of testing and operations, not properly taken into account, are much higher than expected by developers. - Lack of funding to the developers, rather than the test facility itself.

Innovative level (Technical Readiness Level: TRL)

N°	Description of level	Remarks
0	Idea	FaBTest average client is usually at an early stage of the device's development
1	Basic research	
2	Technology formulated	
3	Needs Validation	
4	Small scale prototype	
5	Large scale prototype	
6	Prototype system	
7	Demonstration system	
8	First of kind commercial system	
9	Full commercial system	

Unique Selling Point

Get out of your prototype.

Remarks

FaBTest's pre-consented status aims to provide a fast, flexible low risk and low cost solution for the testing of marine energy technologies, components, moorings and deployment procedures. The site's pre-consented status reduces risk, uncertainty, time and cost, which is especially appreciated by device developers at pre-commercial investment stage.

European Marine Energy Centre (EMEC)

Independently accredited open sea wave and tidal test centre

Services

- Independent assessment of devices energy conversion capabilities, structural performance, and survivability;
- Real-time monitoring of meteorological and marine resource conditions;
- Assistance with consent and regulatory issues;
- Monitors the generated electricity, manages data acquisition, supports development of tests and offers accredited Performance Testing;
- Assists technology developers to access funding for demonstration programmes.

Site conditions

EMEC offers one scale wave site and one scaled tidal site, both not connected to the grid. EMEC has 5 grid connected berths at its full scale wave site, and 7 grid-connected berths at its full scale tidal site. Both export to the grid via onshore substations at 11kV with fibre-optic communications cables. Wave buoys are deployed at both wave sites (scaled and full scale) and a met-station at the full scale site. A test support buoy can be deployed at either scale site. On the tidal site, an ADCP can be deployed, including a met station and radar. WD reaches up to 70m. The average significant wave height is 3m, with a maximum of 18m, while current velocity reaches up to 4m/s.

HSE

Health and safety is one of the 8 key values of EMEC. Provides developers with emergency response procedures and relevant standard operating procedure. EMEC Integrated Management System (IMS) approach is adopted, integrating HSE and Quality Assurance Management.
EMEC has produced guidelines for the marine energy industry on H&S.

Intellectual property

EMEC does not collect any data from developers test. Results of SCADA are directly addressed to the developers. EMEC is allowed to monitor the amount of the generated electricity to pay each developer. A commercial confidence agreement is signed between EMEC and the developer.
EMEC has conducted extensive environmental monitoring programmes on its sites since its creation, and has also built a numerical model of the waters surrounding the Orkney Islands, including water level, complex tidal currents, wave heights etc.

Permitting and policy

EMEC site is pre-permitted, having in place Crown Estate leases covering the marine test sites, together with planning consents for substations and associated lay-down areas. Each tester needs its own specific permit for the installation and operation of its technology at EMEC site. Testers shall also comply with EMEC procedures and Quality System. EMEC is in contact with developers ca. 2 years ahead to assist the developer in planning and getting the permits in place (free of charge).

Business model & tariff structure

No profit, private company, limited by guarantee.
EMEC became financially self-sufficient in 2011, 8 years after its establishment in 2003. EMEC started with 100% public funding, and once it became independent, it was funded through commercial activities and competitive public funding. Today many of EMEC's clients acquire public funding to access EMEC's facilities.
In addition, the EMEC facility provides electrical infrastructure by subsea power cables connecting the test facilities to the onshore national grid. The generated electricity inserted into the grid can be sold by EMEC's PPAs.

Marketing, promotion

EMEC runs, or is involved in, many European funded projects.
Active member of Industry groups, website regularly updated (news flashes and press releases), frequent presence at conferences.
EMEC has been active in promoting international cooperation and has assisted other countries in establishing their own marine energy centres.
It runs the International WaTERS group that seeks to get test centres to liaise and synchronise activities. Provides support services to other test sites, in terms of procedure and personnel too; Involved in MaRINET2, METCERTFIED and Marinerg-i.
EMEC is also cooperating with other test centres for research purposes and for the establishment of common global standards.

European Marine Energy Centre (EMEC)

Country: UK

Independently accredited open sea wave and tidal energy test centre

Description of facility

EMEC can test WEC, TEC and their subcomponents over five different sites across Orkney, equipped with subsea cable for grid connection, control and switching stations, data transfer by fibre optic cables.
First and only centre of its kind in the world to provide developers with purpose-built, accredited open-sea testing facilities. EMEC has a leading role in the sector, being one of the first operative test facilities for tidal and wave energy converter. It is suitable for testing multiple technologies simultaneously in harsh weather conditions.

Strengths	Weaknesses
- Leading role in the sector (About 15 years of **experience**); - Its **instrumentation**; - The generated electricity can be inserted in to the **grid** and sold; - **Integrated Management system** approach; - Strong **marketing** side; - At the very forefront of the development of **international standards**.	- Harsh weather conditions; - Suitable only for certain developers (high budget) and devices (strong environment); - Not easy to access; - individual developers are responsible for obtaining their own licences.

Opportunities	Threats
- Offering certification; - Address towards non-utility scale markets; - Coupling marine energy with storage and energy systems to provide stable power, grid services, or renewable fuels such as hydrogen; - Improving the coordination between international test centres; - Assisting other test facilities to become and stay accredited as service; - Cooperating for the establishment of common global standards.	- Lack of UK government support, more focused on offshore wind or nuclear; - Lack of pathway to the market, get stuck at pre-commercial phase; - Lack of long-term vision, i.e. most developers prefer to focus on standard, not-innovative, devices; - Lack of a good standards regime; - Low budget from developers.

Innovative level (Technical Readiness Level: TRL)

N°	Description of level	Remarks
0	Idea	Since the centre has become more and more globally recognised, most of the orders usually come from mature developers with high TRL.
1	Basic research	
2	Technology formulated	
3	Needs Validation	
4	Small scale prototype	
5	Large scale prototype	
6	Prototype system	
7	Demonstration system	
8	First of kind commercial system	
9	Full commercial system	

Unique Selling Point

Testing facility build on experience and infrastructure

Remarks

It is the only one of two accredited open sea wave and tidal test centres for ocean energy in the world.
It offers independent technology verification on marine energy converters and their sub-system.
Strong experience and extensive network with a wide range of other institutions, including technology developers, the supply chain, academic institutions, and regulatory bodies.

Dutch Marine Energy Centre (DMEC)

Owner of two tidal test sites and facilitator in guiding new marine energy solutions to the market

Services

- develops and provides technical and commercial support and services to clients via DEMEC's network;
- monitoring of environmental impact;
- acts as consultant; together with Certification Bodies and other Test Facilities, DMEC is developing certification services for technology developers on performance assessment, loads measurements, power quality, acoustic measurements and support services such as technology qualification and mooring assessment.

Site conditions

For the two sites where DMEC owns the permits:
-Den Oever test site: a testing facility integrated in a dam (sluice 'gate') suited for TRL between 6 and 9, with flow speeds of 4.5 m/s; for small turbines of max. diameter 2.8 m
-Marsdiep test site: an offshore berth suited for all TRL, with flow speeds of 1.8 m/s, water depth of 25m, 400m from shore, with a possibility to be connected by umbilical to the grid connection to the research institute NIOZ and feeding into their main-connection.

HSE

Ongoing permit to perform demonstrations in the two DMEC sites.
For other specific locations DMCE assists its clients in whole trajectory of arranging the necessary permits, compiling the test plan, and execute the test plan in accordance with the specific HSE requirements.

Intellectual property

A non-disclosure agreement is signed with the clients. Design and performance information is owned by the client/developer. Data on impact on environment is published and shared with knowledge institutes

Permitting and policy

DMEC test facilities are pre-approved. There is an access agreement that describes conditions for access and transfer of liabilities.
Before each test, DMEC informs the authorities and provides documents explaining the impacts. In such cases, only 8 weeks are required to get a technology specific permit.
In case DMEC is involved as a consultant and developer of a new test site, the profile of necessary permits is different and cannot be generalised.

Business model & tariff structure

Partly financed by the European Regional Development Fund of the European Union, the Kansen voor West II program and the Province of the North of Holland.
DMEC can not rely on developers alone, it mainly survive by funded projects (e.g. project for standardisation and certification without focus on technology, OESA project) + give technical and commercial support to developers via DMEC's network (for TRL3-4/5) + offer monitoring of environmental impact + act as consultant.
As there is no commercial money available to do project development (takes a long time before developer is interested to start testing as high costs involved), funding is the only way at this moment.

Marketing, promotion

Strongly involved in research and funding programmes:MET-CERTIFIED project, DMEC Innovation Accelerator, Marinet, Environmental Impacts Blue Energy, FORESEA.
To date DMEC is very successful in EU funded R&D projects, being engaged with several commercial clients.
Active promotion via website, twitter, conferences, workshops, international events, organisation of seminars

Dutch Marine Energy Centre (DMEC)

Country: Netherlands

Owner of two tidal test sites and facilitator in guiding new marine energy solutions to the market

Description of facility

The Dutch Marine Energy Centre (DMEC) is a business supporting organisation operating two test facilities for testing tidal energy devices of different types and maturity levels. Both test sites are basically only permitted areas, with no real infrastructure available.
On the other side, DMEC facilitates testing and demonstration in other available test sites or in test sites that will be developed based on the client requirements. DMEC's mission is to accelerate the route (both technical and commercial) to market of marine energy solutions.
Besides its support in the route to market, DMEC aligns groups of crucial stakeholders consisting of policy makers, project developers, offshore companies and investors in order to realise new projects in the water.

Strengths	Weaknesses
- Bening an open water test facility with lower tidal flow velocities; - **Easy access** in the Netherlands; - **Funding** for test available through MARINET2 and FORESEA programmes; - **Pre-approved** facility; - Strong and extensive **network**	- No real infrastructure available (anchors and grid cable have been removed), DMEC only has a permitted site; - Not suitable for testing devices for extreme offshore conditions; - Velocities at DMEC site are relatively low.

Opportunities	Threats
- Providing certification services, such as power performance assessment; - Running collaborative R&D projects with industries; - Helping emerging developers with technical and commercial services; - Supporting offshore projects; - Monitoring environmental impact; - To deliver verified test reports. Try to comply with ICRE via self certification and ISO certification	- Cash flow, as all support (and subsidies) need upfront investment; - Keeping expertise/experience (DMEC is involved in several aspects of marine energy devices development, so several competencies in a wide range of fields are required); - Time for obtaining the right permits for a location is long and expensive.

Innovative level (Technical Readiness Level: TRL)

N°	Description of level	Remarks
0	Idea	
1	Basic research	
2	Technology formulated	
3	Needs Validation	
4	Small scale prototype	
5	Large scale prototype	
6	Prototype system	
7	Demonstration system	
8	First of kind commercial system	
9	Full commercial system	

Unique Selling Point

Through its network offer a suitable site for the developpers needs, and enables their focus on technnology.

Remarks

DMEC offers a customised "fit for purpose" approach that includes close alignment with all relevant stakeholders.
Based on its experience (over 10 years) DMEC can support developers in demonstrating their technologies in the suitable environment, from funding to consenting to deployment itself.

Coastal & Ocean wave Basin (COB)

New centre for maritime engineering research

Services

The laboratory will provide a versatile facility that will make a wide range of testing possible, including the ability to generate waves in combination with currents and wind at a large range of model scales. The COB will allow users to conduct tests for coastal and offshore engineering projects as well as for research. The COB is being built in Ghent University's Greenbridge science park in Ostend. In the same complex, in particular the "Maritime Research Center", a towing tank is also being built to test ship models in shallow water. In addition, office space is provided for the operational teams, and a ship simulator. This clustering of research infrastructure will be able to offer the COB clients several services beyond the pure testing activities, such as technical, scientific, commercial and legal support. Support to get fundings for tests will be also provided to its clients.

Site conditions

- variable water depth (0.4 - 1.4 m);
- modular multi directional wave generator in L layout (Hmax = 0.55 m);
- currents up to 0.4 m/s;
- wave current interaction in any direction;
- wind up to 15 m/s in 2 x 2 m flow section;
- exceptional quality velocity profile (<10%) based on numerically design of inlet grid vanes.

HSE

The users shall be compliant with the laboratory requirements. This will not require too much effort from the users, especially compared to open sea test centres. The personnel dedicated to the testing activity will be trained and certified.

Intellectual property

The test-facility is open to all kind of arrangments such as non-disclosure agreement or rdata sharing in relation to research programs(which is encouraged).

Permitting and policy

The centre is not operational yet, they will hopefully complete the instrumentation and sensors installations, together with training personnel and validation of the centre activities within summer 2020.
From a client prospective, the access to the test is simple, easy and fast: after getting in conctact with the Director of the centre, an application form is submitted.

Business model & tariff structure

The financing of the infrastructure for the COB has been brought together by the following partners: the Scientific Research Fund - Flanders (FWO), formerly HERCULES Foundation; the Flemish Government, through the Enterprise & Innovation Agency (VLAIO); the Department of Mobility and Public Works, Department of Maritime Access; University of Ghent; KU Leuven.
A permanent staff of scientific and technical personnel carries out the tests for the users, led by a director, and assisted by the management committee and the board of directors.
Three different usages are foreseen: academical consortiums (40% of the time), commercial Projects (40% of the time), Flanders Hydraulics (20% of the time). For fully fundamental research only (acadamies), a reduction on the fees to use the laboratory is applied.
During their application proposal to Hercules foundation project (now under FWO), COB received a long list of potential Clients interested to use the facility.

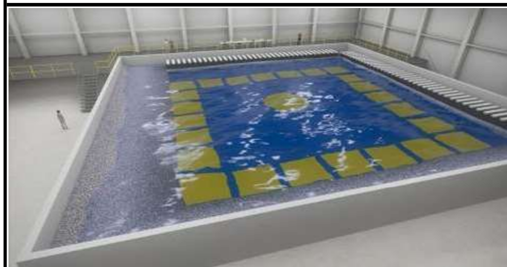
Marketing, promotion

N/A, since the centre is not operational yet.

Coastal & Ocean wave Basin (COB)

Country: Belgium

New centre for maritime engineering research



Description of facility

The Coastal and Ocean Basin (COB) is a wave tank to test scale models of coastal engineering and offshore constructions to the simultaneous effect or loading of waves, (tidal) currents and wind. The infrastructure can be widely used in various domains: wave and tidal energy, offshore wind, offshore engineering, coastal engineering, the interaction between waves / currents and vegetation.
The golf tank consists of a concrete water basin of 30 by 30 meters. Waves and currents are generated in water depth of 1.4, with a deep central pit of 4m water depth for offshore applications. Currents can be generated in 2 directions, up to 0.4 m/s. The wind load can reach up to 15 m/s and is generated by a wind generator with propellers, which is arranged above the water surface.
The facility is part of the Gen4Wave project on offshore renewable energy and coastal engineering in Flanders.
The first experiments are planned to start in 2020.

Strengths	Weaknesses
- flow rates higher than what is currently available in research facilities; - mid-size infrastructure - very scarce in Europe; - variable water depth; - wave current interaction in any direction; - advanced engineering services offered by UGent and KU Leuven; - built inside the Maritime Research Center", where also a towing tank is being built to test ship models in shallow water.	- Not operational yet; - Suitable only for certain developers (early TRL) or only for small components of higher TRL devices; - The tank is filled with fresh water.

Opportunities	Threats
- to support development of wave energy converters (influence of important design aspects can be investigated); - to study the challenges for coastal safety under the threat of climate change and sea level rise off the Belgian coast; - to create a Flemish chain dedicated to wave and tidal energy converters; - to strengthen Flanders' international research position.	- Underusage of the available resources; - Mantainance costs; - Require highly specialised (PhD) personnel; - only 40% of time can be dedicated to commercial projects (other 40% to aceademic research, 20% to Flanders Hydraulics).

Innovative level (Technical Readiness Level: TRL)

N°	Description of level	Remarks
0	Idea	COB is very willing to collaborate and establish a "test facility chain", proposing itself as the step before Blue Accelerator, which indeed addresses TRLs 5, 6 and 7.
1	Basic research	
2	Technology formulated	
3	Needs Validation	
4	Small scale prototype	
5	Large scale prototype	
6	Prototype system	
7	Demonstration system	
8	First of kind commercial system	
9	Full commercial system	

Unique Selling Point

Helps you to take your first steps in the offshore!

Remarks