marinerg-i

Marine Renewable Energy Infrastructure

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New business opportunities for MARINERG-i

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Abbreviations

ETSI	European test site installations
DRI	Distributed Research Infrastructure
ORE	Offshore Renewable Energy
RI	Research Infrastructure
TRL	Technology Readiness Level

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1. Introduction

The vast potential of offshore renewable energies (encompassing wind, wave, tidal and combined technologies) contribution to both the EU's and the global energy mix is well known. Offshore wind with fixed foundations is, to a great extent, already commerical and cost-competitive. Nevertheless, savings are still being sought, particularly considering new technical and logistical challenges of future arrays, with considerably larger turbines and deployed further offshore, in deeper water locations. This will require the development, testing and proving of innovative technologies, such as e.g. solutions for increased component reliability and new sensors to optimise monitoring and maintenance, novel vessels and equipment, floating concepts, etc..

Ocean energy (notably wave and tidal) architecture and technologies are still evolving towards a covergence of the best designs. The harsh, highly energetic marine environment creates significant challenges. Together with offshore wind, ocean energy faces such issues as deployability, reliability and survivability, maintainability and logistics, as well as compliance with regulations considering environmental, legal, economic and social constraints, which differ between regions.

Learning by doing is a critical factor to assure the technical, environmental and economic performance of technologies/devices. Together with the requirements of applying learning for innovation from research and development, technology developers are faced with the considerable challenges of learning by doing at sea in order to progress towards economic competitiveness. Private investors are not willing to solely accept the inherent risks and readily support such development costs without public commitment and support. Instead, a stepwise approach which reflects the required balance between learning by innovation and learning by doing and applying learning for innovation is commonly adopted in the offshore renewable energy sector, requiring infrastructures to support the different stages of development and to supply the controlled conditions to study different options using secure and assured processes.

Research infrastructures (RI) typically have their operations focused on research and development but provide a wide set of associated research services to industry which enable the advancement of technology. MARINERG-i will leverage these existing services provided to industry. By identifiying the current limitations and possible points for improvement associated with individual facilities, the distributed configuration will expand and optimize the spectrum of capabilities to provide enhanced services to enable technology and sub-system development and proving.

The present report identifies new business opportunities for the distributed infrastructure.

2. Research Infrastructures Services

Research infrastructures, especially those associated with higher education institutions, have been established with the primary propose of supporting fundamental and applied research activities. As such, the principal service is to support research, create knowledge and foster innovation. Furthermore, in the context of RI associated with universities, these can play an important role in the education activities and advance training of much needed high calibre employees. Education and training activities can also be offered by infrastructures not associated with academic institutions. These may also be societal services in the way of re-training and up-skilling, that can often be translated into societal benefits in terms of new technology spill-over, human capital formation, cultural benefits and scientific knowledge.

However, public and private institutions are often engaged in more commercial activities, offering services to third parties. Commercial access to the testing facilities is a service offered by the majority of RIs. This access can range from simply providing access to the equipment, usually to outside researchers, right through to a full-suite of testing support services, more directed towards specific industrial client's needs. Testing support services leverage in-house knowledge in order to provide added value to equipment access, and include:

- Test design and preparation
- Model design and instrumentation
- Experimental and technical support during testing
- Post-processing of testing data and analysis
- Validation and benchmarking of results

These services can be provided for both laboratory and open-sea testing and adapted to the technology development stage and scale. Complexity, duration and outcomes of the testing are also dependent on the development stage of the technology, and of an infrastructure's characteristics, meaning that while the service across different RIs may be analogous, the associated costs and support can differ widely. Furthermore, RI's in higher education institutions and public bodies will often be tied to a wider, and more restrictive, governance and cost structure which can limit the offer and conditions of services provided.

Computational testing, often allied with or upstream of physical testing, is also provided by RIs, with services that include:

- Concept configuration analysis
- Numerical simulation modelling
- Performance forecasting and analysis

In the context of MARINERG-i, it is envisioned that participating RIs will be those with capabilities and experience in rendering services to the sectors of offshore renewable energy (ORE), namely wave energy, tidal stream energy, and offshore wind energy, as well as cross-cutting aspects and technologies, such as material testing, moorings and electrical systems configuration and connections.

3. Distributed Infrastructure Core Services

European Test Site Installations (ETSI) are typically small to medium sized not for profit enterprises, with limited resources when compared with other energy sector leaders. Most ETSIs are under-developed, lacking highly qualified and specialised human resources in particular specialised fields. They are unable to offer a wide variety or tailored services/conditions for testing multiple or different technologies throughout a wide range of Technology Readiness Levels (TRLs). This often results in developers testing in relative isolation at a variety of different locations, with limited or short-term financing mechanisms. The lack of continuous support and momentum is an obstacle to substantially advancing knowledge and efficiently moving technologies forward through the TRLs.

Often, there is a lack of a European reference model or data archive to support, interpret and validate results obtained from testing. Furthermore, technology developers developing concepts won't find common and shared standard practices adopted across the different testing facilities to aid them when climbing the TRL ladder. Several standard methodologies and procedures have already been delivered by EU projects (e.g. EQUIMAR[1], MaRINET[2]) or implemented by test sites (e.g. EMEC), although they are not yet generally applied and consensually recognized. There is ongoing work by the IEC in adapting these practises and developing standards for the marine energy sector in general, but while the scope includes some testing laboratories, no standards related to testing have been published.

In addition, facilities have different characteristics and constraints in terms of location, topography, local infrastructures and equipment or sea conditions. The lack of strategic planning by a central coordination structure can be easily translated into unequal distribution of demand and allocated funding between different facilities. Larger and more established infrastructures will attract more clients and be able to successfully apply for funding, without a true value-added assessment being undertaken, while other infrastructures which may be more suitable for certain testing campaigns remain unknown to the industry. This tendency often results in redundancies and/or gaps across the TRL map.

Bearing the above in mind, a long-term cross-sectoral and multi-disciplinary coordinated approach is essential. Evidence of the benefits of such a coordinated approach targeting offshore renewable energy test infrastructures was first identified by the EC FP7 funded MaRINET project and subsequent provision in the EC H2020 funded MaRINET2 project (ongoing). The MaRINET projects gathered a large number of relevant offshore renewable energy infrastructures from across Europe to successfully deliver joint research to improve the quality of testing practises and outcomes, functional networks, and high demand access programmes. Though transitory in their nature, these initiatives have clearly shown the potential of a distributed offshore renewable energy infrastructure to take the sector forward by significantly improving the testing offer across all TRLs. MARINERG-i has been designed to co-substantiate this potential into a fully integrated and long-term approach,

[1] Equitable Testing and Evaluation of Marine Energy Extraction Devices in terms of Performance, Cost and Environmental Impact. FP7 project supported by EU.
[2] Marine Renewable Energy Network. FP7 Project 2011-2015

extending existing programmes and seeking additional mechanisms to support a more effective and sustainable collaboration.

The MARINERG-i distributed Offshore Renewable Energy infrastructure proposes to deliver a set of core services, which can be summarized as:

- Access to ORE research and testing facilities
- Establishing of best practises and common standards for testing
- Data, knowledge and tools archiving and access
- Data sharing, knowledge transfer and collaboration
- Operational and strategic planning of infrastructures, research and technology development
- Access to internationally leading ORE researchers
- Support ORE innovation
- Upskilling and training of staff and researchers

These services are intended to address the requirements of different user groups, which include technology developers (industrial and academic), researchers in academia and industry, funding and policy bodies, and to individual infrastructures as well.

Access to a network of infrastructure is the main service that MARINERG-i intendeds to provide in the initial phases of operations. This network will include infrastructures and facilities for the testing of offshore wind, wave and tidal energy technologies at all stages of development (TRL1-9).

This is envisioned as a main access portal, in which clients will be able to browse, search and apply to infrastructures that correspond to their needs. The access portal for MARINERG-i is intended as a one-stop shop for end-users, which facilitates and speeds-up the application process. By using a standardized application process across different infrastructures relieves the end-user of having to adapt their proposal at every step of the testing programme. Testing facilities will also benefit from the use of a streamlined application process.

Through different collaborative projects and initiatives, guidelines and procedures for the testing of offshore renewable energy technologies have been proposed by individual organisations. However, to date, general consensus is yet to be achieved for the wider adoption by both laboratory and field-site activities.

The standardisation outcomes of the MaRINET and MaRINET 2 projects together with the efforts of the individual infrastructures will be condensed, analysed and validated by MARINERG-i to produce consensual, unified Best Practice testing guidelines. These will be implemented throughout the distributed infrastructure in order to establish testing consistency across all the infrastructures that represent the MARINERG-i brand. It will be understood that testing which has been contracted through MARINERG-i will follow a set of standard procedures that ensures the reproducibility and validation of results across the entire MARINERG-i network.

The ultimate goal is that MARINERG-i is able to provide a common mechanism for developing, delivering and managing compliance with a common code of practice. This code will foster convergence and harmonisation in approaches to research design, testing methods, practices and procedures. This will eventually lead to reducing the perceived risks preventing the offshore renewable energy sector from easily accessing finance and imply higher requirements on return on investment.

Related with e-Infrastructure, MARINERG-i will provide and maintain a common portal for users to access facilities and services, and to grant structured access to publicly available data produced at test sites, including advanced metadata tools for data discovery and utility assessment.

MARINERG-i will also support sophisticated e-brokerage services to facilitate permitted access to proprietary data and data-products under secure controlled conditions, and will ensure the integrity of Intellectually Property (IP) at all times, adopting a common, trusted approach to IP management.

The creation of a MARINERG-i e-infrastructure is a vital facet of the overall distributed infrastructure, as it enables and supports the delivery of many of the other services as discussed, as well as more specific IT and data related services.

The added value of collaborative projects such as MARINET and MARINET2 is the combination of expertise of the sector towards tangible goals. The distributed RI will promote collaboration at a technical level, facilitating communication and networking between facilities through tools, people and mechanisms including an internal website and staff exchange, education and training programmes. This will enhance the availability of highly skilled and experienced staff as well as creating a coherent scientific/technical community. It would also promote knowledge transfer, an inter-disciplinary approach and transparency to facilitate learning and improvement.

Another aspect of the collaborative aspect of MARINERG-i is the development of a consistent and transferable cost structure, and of joint funding, tendering and procurement applications. Furthermore, administrative and commercial transversal activities such marketing, dissemination, group advocacy, lobbying, and standardized quality and risk management can be developed and deployed across all RIs.

Finally, through an integrated view of infrastructure availability, MARINERGI-i will be able to manage the access made available through the DRI in order to match clients' requirements to infrastructures, ensuring speedy access and helping to alleviate overbooking of well-known facilities by directing clients to equally suitable facilities available within their time-frames.

Furthermore, as MARINERG-i will be governed by clearly defined principles and objectives, it will establish a balanced view on the long-term (10-20 years) development needs of the EU infrastructure, which will best serve user needs and ORE technology development. This will be used to advocate smart and regional specialisation amongst member facilities,

influencing decisions at national/regional level about upgrading existing and building new infrastructures.

MARINERG-i will also develop a cohesive science plan, conducting targeted joint research programmes in critical and strategic areas that will produce the new knowledge and essential reference datasets required (accessible via e-infrastructure) to progress the industry. This will be flexible, based on joint learning and experience, and used to inform policy and funding agencies.

4. Distributed Infrastructure New Business Opportunities

Beyond the planned core services envisioned for the MARINERG-i distributed research infrastructure, there are a range of additional services which have been identified for development once the DRI has been implemented and is well established. While the ERIC governance framework presupposes a non-profit operation, limited commercial activity can be undertaken. These new business opportunities can also be non-commercial services that add value to existing ones, or to existing partners.

4.1. New business opportunities for infrastructures

For research infrastructures, the implementation of standardisation and best practices will represent an initial cost and resource allocation burden, while the benefits may not be immediate. However, across a multitude of sectors, standardisation has led to higher productivity, easier collaboration and lower costs. MARINERG-i activities will follow a set of defined standards, which RIs must adopt. Outside of MARINERG-i business, RIs will also be able to continue to offer standalone MARINERG-i compliant services. The value and inclusion of an official MARINERG-i branding to these services will need to be determined during the implementation of the project and according to the adopted business model, but knowledge that an infrastructure is able to provide this compliant service will increase confidence and the value of the results for both customers and investors.

Timely and streamlined access to facilities, and better management of access will allow for a new client base, as new clients may be directed to new or alternative facilities. This will create a new client-infrastructure relationship that may continue and further develop outside of MARINEG-i activities, as infrastructures can showcase their standalone related services.

The MARINERG-i e-Infrastructure can be used to facilitate the development of virtual services that may have been impossible for individual RIs to implement due to resources constraints. A framework and protocol for remote access and monitoring, webinars and other teaching resources can be developed and made available to participating infrastructures in order to provide added-value services to their clients.

Furthermore, the pan-European and global vision of the MARINERG-i distributed network can be used to identify gaps and opportunities in the sector and across regions and articulate a European strategic planning with the RIs own plan, guiding them towards filling identified infrastructure needs rather than duplicating existing and available resources.

The critical mass associated with the distributed network can provided synergies and access to opportunities unavailable to single entities/smaller groups. With common shared scientific strategic objectives, it will be possible to build a stronger research capacity and to stimulate a focus on cutting edge research and excellence, accelerating the development of the ORE industry.

Funding mechanisms, which may not be available or less likely to be successful for individual facilities, will be easier to access as a block, for funding of facilities operations or for collaborative research.

Staff exchange programmes can also be managed through a shared platform, with standardized procedures, reducing administrative costs, and fostering knowledge transfer across institutions.

4.2. New business opportunities for industry

Experience to date suggests that there is a tendency for developers tend to take a somewhat ad-hoc approach to testing. This can often involve or result in shortening the advisable stage-gate progression through TRLs by bypassing important steps. This may be because the full end–to-end service offering is not available or that it is not effectively structured and articulated as a coherent whole connecting seamlessly between initial concept formulation to the proving of commercial viability as a full-scale prototype or as part of an array.

While MARINERG-i's prime mission is to provide a more effective and complete offering of testing facilities, it will also deliver a set of complementary services, including an efficient, streamlined application process, as well as a range of additional services tailored to support users before, during and after access, namely:

- Supporting users in determining the most appropriate testing facility to be accessed according to:
  - the technology type, TRL, test scope and objectives;
  - the developer's location, timeline and available funding mechanisms; and
  - the availability and compatibility of relevant testing facilities, and technical support teams.
- Identify and solve potential issues earlier in a development and testing program, accelerating development and innovation.
- Providing relevant information on technical, financial, legal and ancillary matters related to the access of the infrastructure as well as contacts and access procedures, e.g. whether training is required, potential environmental impacts, etc.
- Delivering user training programmes and education to optimise expertise and skills as well as make the most efficient and effective use of testing facilities.
- Providing advice on request in developing long-term testing plans that will consider the most efficient and timely path to move through the TRLs.

The last point can also be associated with standardization, by including the recommendation of adequate metrics and procedures for each TRL, allowing inter-comparisons among devices and de-risking the technology assessment.

Standardization of testing and of results, along with better operational data, will allow technology developers to de-risk the technology sooner, leading to a reduction in insurance premiums and access to different financing options (e.g., lower risk financing). This will enable technologies to progress towards higher TRL testing and proving programs sooner and with lower risk.

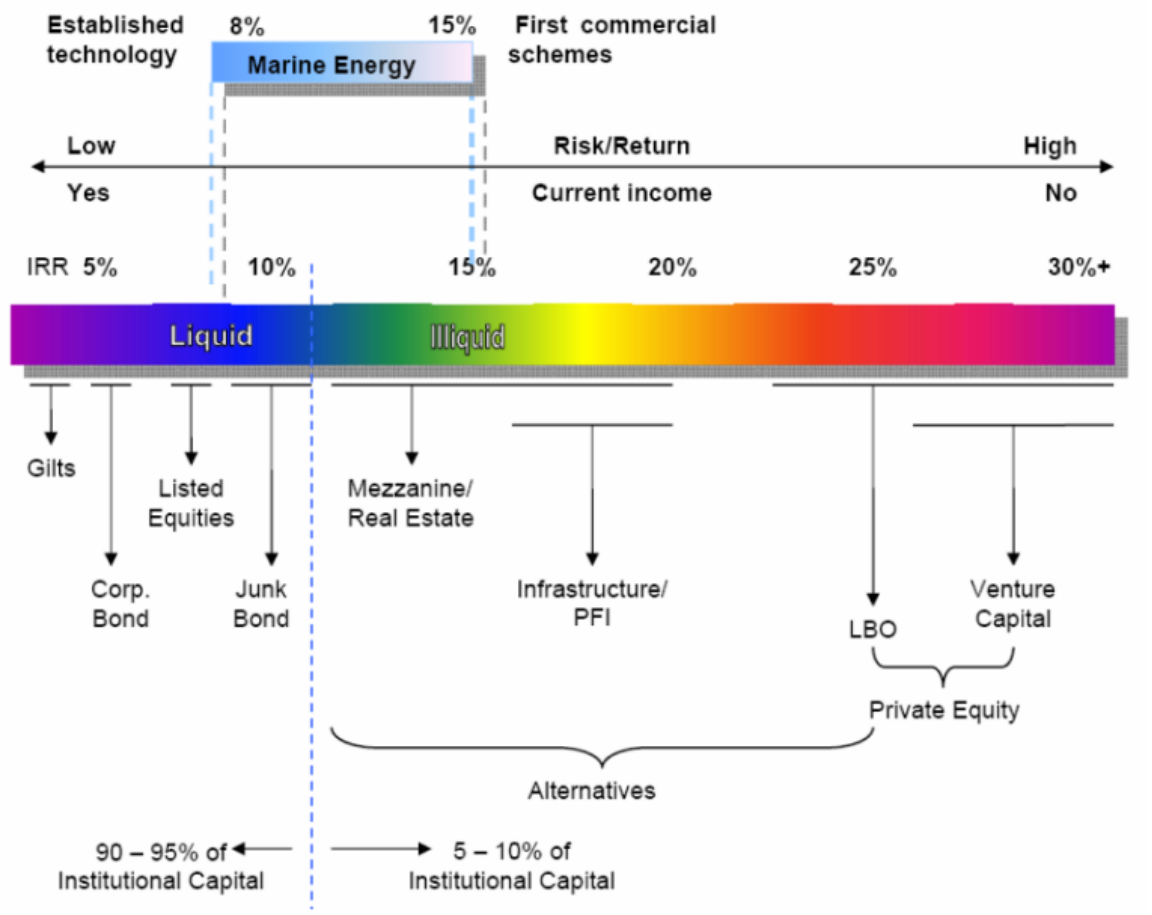

Figure 4:1 Risk financing profile [1]

4.3. New business opportunities for policy makers

The standardization of testing methods and development of metrics for technology evaluation can be of use to policy makers, from simple benchmarking metrics to compare technologies, up to detailed analysis of research gaps. MARINERG-i will both inform and act as a vector for research policies in ORE. It will be instrumental in developing a common understanding and achieving European strategic objectives and support the delivery of research agendas.

Furthermore, through a fully integrated approach, MARINERG-i will act as a European hub for maturing technologies, affirming the European global leadership position in the sector and informing development of the international ORE market.

By relying in robust standardised data, and a pan-European view of the industry status and needs, policy makers can implement targeted policies that ensure continuity of actions and targets.

4.4. New business opportunities for investors

Investments in emerging technologies have an associated risk, that investors and insurers compensate with higher interest rates and increased premiums. The quantification of risks and of possible revenues in many cases err on the side of caution as different developers will show different results, with different baseline assumptions. Standardised results in terms of performance and survivability of devices will increase investor confidence, opening a new market for more cautious investors and insurers that have yet to enter the ORE market.

4.5. New sectors and other business opportunities

Only a few RIs (and mostly test-sites) of the current offering across Europe have been developed with the prime objective of servicing the offshore renewable energy sector. Most facilities are able to cater to any industry that requires coastal and hydrodynamic modelling and study. While the primary objective of MARINERG-i is to accelerate the offshore renewable energy sector, these services can be offered to other sectors, especially those that are likely to have synergies with ORE, e.g., aquaculture, coastal protection, fundamental offshore engineering, etc.

This inclusion of new sectors within MARINERG-i services can also be developed through partnerships and agreements with other initiatives, enabling knowledge transfer, data sharing and the study of aggregate effects without a duplication of resources.

5. Conclusions

This report presented an overview of the proposed offering of services of the MARINERG-i distributed research infrastructure and new business opportunities associated with its implementation.

It is expectable that a central management hub will help reduce the beaurocratic burden by:

- offering a one-stop shop convenience to customers,
- facilitating an efficient and timely process for technology developers wishing to develop their concepts across different TRLs,
- dealing with a single entity with direct access to the talent, knowledge and excellence of a large pool of outstanding research centres, brought together under a common roof.

Furthermore, as part of the enhanced services offered by MARINERG-i as a distributed infrastructure, customers (developers) will benefit from shared standard practices developed from the methods and procedures adopted across the different testing facilities, as a result of the efforts already initiated in the MaRINET projects and expected to be formalised in MARINERG-i.

The main services that MARINERG-i proposes to deliver and the user-base associated are represented on the figure below.

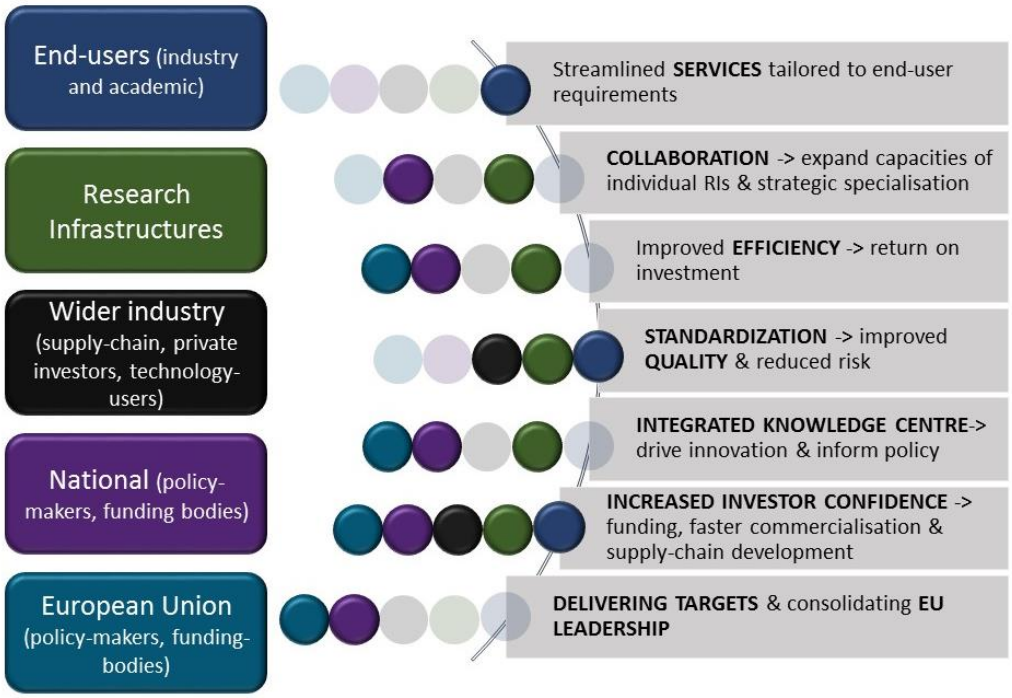

Figure 5:1 Added value according to stakeholder

Associated with these services, new opportunities can arise for the different user groups, and for the distributed infrastructure as well. These new opportunities leverage the critical

mass created, and a higher quality of services in order to offer a wider range of integrated services, with clear added-value.

Bibliography

[1] Carbon Trust, 'Cost Estimation Methodology', Carbon Trust, May 2006.