

Contribution to the development of a new value chain in the marine renewable energy sector

Margarida Fontes¹, Teresa Simões¹, Ana Estanqueiro¹, Felix Nieto², Maria Tsami³

¹ Laboratório Nacional de Energia e Geologia I.P. – LNEG, Lisbon, Portugal

² School of Civil Engineering | University of La Coruna, La Coruna, Spain

³ Department of Economics, School of Economics and Regional Studies, University of Macedonia, 156 Egnatia street, GR-54636, Thessaloniki, Greece

¹E-mail: margarida.fontes@lneg.pt, teresa.simoese@lneg.pt, ana.estanqueiro@lneg.pt,

² E-mail: felix.nieto@udc.es

³ E-mail: tsami@uom.edu.gr

Abstract. As part of the commitments made in the NECP2030 for Portugal, an increase in wind capacity is planned, including an additional 10.4 GW onshore and 2 GW offshore. In this sense, it is necessary to assess the conditions for the creation of a new industrial value chain that will accelerate this development and offer attractive conditions for the involvement of the industrial sector, providing conditions for the objectives recommended in the NECP 2030 to be met. Projects OffshorePlan - Planning for the Use of Offshore Renewable Energies in Portugal, and OceanTrans - Ocean energy technologies transformative potential analyzed the relevant socio-economic component for this sector, namely the process of creating a new industrial value chain to support the development of marine renewable energies. As part of this research, a questionnaire survey was conducted targeting companies in sectors with complementary skills and resources, directly or indirectly related to the development of projects in this area. The questionnaire yielded 114 responses from companies already active and 182 from companies willing to become involved in the future. The results allowed us to obtain a global view of the actual and potential involvement of the industrial sector, as well as to gain some insight into how companies view the requirements to operate in this area and the main barriers to their performance. This article presents the main findings obtained in the scope of this research and discusses their contribution to the advancement of the marine renewable energy sector and, as such, to the development of offshore wind energy in Portugal.

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1. Introduction

In recent years, Renewable Energy has gained significant momentum, driven by the release of various legislative frameworks focused on Energy and Climate, where renewables play a central role. Notably, the National Energy and Climate Plan 2030 (NECP 2030) [1] and the Roadmap for Carbon Neutrality 2050 (RNC 2050) [2] stand out as key strategic documents.

NECP 2030 outlines ambitious targets, including an expansion of wind energy capacity to 10.4 GW onshore and 2 GW offshore, after the targets' revision in 2025. To meet these goals, careful planning is required factoring in technological capabilities, resource assessments, and socio-economic and environmental considerations. These decisions should be informed by extensive datasets collected over decades of research and experience.

Portugal's vast maritime territory and high offshore wind potential position the country to benefit significantly from this renewable source. Yet, to date, only one offshore wind project is in operation. In the beginning of 2025, an Action Plan for the deployment of offshore renewables was published [3] in order to accelerate the development of these systems.

However, to unlock the development potential of offshore wind energy technologies in order to meet the 2030 and 2050 goals, it is essential to establish a robust value chain that supports the growth of offshore wind and reinforces industrial participation. In support of this, LNEG has been advancing expertise through various research initiatives. Examples are project OffshorePlan - Planning for the Use of Offshore Renewable Energies in Portugal (POSEUR - 01-1001-FC-000007) [4], launched in 2017, which focused on strategic planning for marine renewable energy deployment, including both offshore wind and wave energy, and project OceanTrans - Ocean energy technologies transformative potential (PTDC/GES-OUT/30559/2017) [5] that analysed the conditions in which the development of a new system around marine renewable energies can drive industrial transformation.

A key focus of both projects was the socio-economic dimension - especially the development of an industrial value chain to support marine renewable energies - and the results obtained provided insights into industry involvement, actual and potential, and identified key barriers faced.

This article offers an overview of the main findings from the research conducted in both projects and the conclusions drawn. The goal is to contribute to an understanding of the conditions, in Portugal, to advance the development of marine renewable energies and in particular offshore wind energy, which effectively use the capacities of the national industry.

2. State of the art

2.1 Creation of a new value chain in the area of marine renewable energies

The implementation of marine renewable energy technologies requires a very diverse set of activities associated with the development, production, installation and operation of offshore energy production systems. The creation of an industry around these technologies will therefore have to be supported by the construction of a new industrial value chain. However, not only is the configuration of this value chain not yet defined, but difficulties are expected in the mobilization and integration of some of its components [6].

In fact, the development of the new industry involves not only the emergence of companies that develop new technologies, but also the mobilization of complementary skills and resources present in the industrial fabric. The latter are necessary either to support experimental activities that already require the manufacture, installation and operation of systems at various stages of

development, or to uphold the transition from the experimental to the commercial phase, contributing to the industrialization of the systems under development [7].

This will require attracting companies from various sectors to activities into the new area. This process is far from straightforward due to the uncertainty inherent to the pre-commercial phase of the technologies, which can significantly reduce the motivation of existing companies to get involved, and also due to the need to overcome the boundaries between actors from very different sectors and organisations without previous experience of working together, aligning them around common goals [8].

Despite these difficulties, the involvement of the existing industry is seen as particularly important from a country's standpoint, as it can contribute to the revitalization of traditional or declining sectors, while also giving an additional base of support to some technologically advanced but still emerging sectors [9].

2.2 The offshore wind industrial value chain

Offshore wind is the most advanced marine renewable energy technology and the one that has achieved commercial deployment at a wide scale, in the case of bottom-fixed technologies [6]. Portugal missed this first generation of offshore technologies - whose implementation was not viable in its deep coastal waters - but was involved in the pioneering development of the next generation of floating technologies, which still are at a pre-commercial stage [10]. Nevertheless, the experimental projects conducted for the "Windfloat" technology permitted to start developing some industrial capacity, which also draw on competences created by the country's longstanding involvement in experimentation with wave energy technologies [11]. Thus, currently offshore wind is the most substantial component of the marine renewable energy value chain.

The offshore wind industrial value chain is composed of three main types of firms: technology developers, i.e., companies that have developed a particular offshore wind energy conversion technology; wind farm developers/operators; suppliers of products or services that may range from those related to the core technology (wind turbine) to those required for the installation, operation and maintenance. While firms in the first two groups are critical - as they are the main driver for activity in the area and are responsible for the investment and coordination of the industrial activity - the third group is particularly interesting from an industrial development perspective [7]. In fact, it is a country's capacity to offer a wide range of activities associated with manufacturing, installation and operation at sea, thus setting up a more complete industrial value chain [12], that enables it to fully profit from the opportunities raised by this technology.

With the exception of firms created to develop the new technologies, companies entering the offshore wind business are likely to have two types or origins. Firms already active in onshore wind may see the new area as an opportunity to redeploy their resources. Here we have a typical case of diversification into related markets [13], even if this effort may require modifications of the existing resources or the creation of new ones [14]. However, some resources that are required when wind energy moves from land to sea may substantially differ from the existing ones [15]. Thus, firms from other industries that possess these types of resources (e.g. those related with operating at sea) can see a business opportunity and enter the new area [16]. One particular case in this group are firms already involved with other marine renewable technologies - such as wave energy in Portugal - that share a significant part of the (non-core) value chain with offshore wind [6]. Firms from other industries are equally redeploying their resources, but in this case tendentially to unfamiliar markets, which may make the move more complex [17].

2.3 Conditions for the development of a value chain

As pointed out above, the engagement of existing firms in the industrial deployment of the new technology will often require more or less extensive adaptation of their competences and resources, or even the creation of new ones. These product and/or market diversification processes always face some difficulties [13], which are compound by the fact that entry is taking place when technical and market uncertainty are still present [18].

Thus, policy incentives may be necessary to call the attention of existing firms to the opportunities arising from the new technology and to promote entry [19]. Policies give direction, signalling government strategic interest in the technology, thus encouraging firms to commit under conditions of some uncertainty [20]. They also provide direct support to actions firms need to perform to operate in the new area [21]. Thus, policies are critical to address key entry requirements of firms that might be willing to engage but can be deterred by the difficulties perceived.

In order to understand the conditions for the formation of a new industrial value chain it is therefore important to investigate how firms are addressing the conditions for entering and operating in the new area.

3. Methodology

3.1 Data and methods

Empirical research was conducted to investigate how existing firms perceive the requirements of an involvement with the new technology. The research is based on a questionnaire survey of Portuguese firms from sectors identified as potential contributors to marine renewable energy technologies (MRET). The survey targeted both firms previously identified as active in MRET (e.g., as partners in funded projects or as suppliers in experimental activities), and firms with no previous known involvement, but whose area of activity indicated potential to participate in activities related to MRET. The broader focus on MRET is important, not only because there is a substantial overlap in the industrial activities required by the various marine energy technologies, but also because, in the case of Portugal, firms involved in wave energy have developed competences and resources that can be relevant for the expected take-off of offshore wind deployment, after the capacity auctions planned for 2025 [22].

The firms surveyed were inquired on: a) whether they were / had been involved in MRET activities in and, if not, whether they were considering the possibility of entering in the near future; ii) the areas in which they operate or foresee to in the future; iii) the changes on their activities and organization that were required, or are expected, in order to enter/operate in the new field; iii) the obstacles faced or expected to in doing it.

The questionnaire survey obtained 419 answers: 114 from firms already involved in MRET; 182 from firms not involved but that stated to be intending to enter MRET in the future; and 123 from firms that declared to have no interest in MRET. This research focuses on the first two groups, totalling 296 firms. The responses from the firms already active provide a first overview of the activities and perspectives of the companies that compose the emerging value chain around these technologies. They are important for understanding the existing gaps and also for identifying obstacles that must be addressed to accelerate its development. The responses from potential entrants offer some indications regarding the necessary expansion of this value chain and provide some insights into the barriers that companies interested in the area believe they may face and that may restrict their initiative.

4. Results and Discussion

4.1 Firms activity profile

The respondent firms, in both groups, were relatively diverse. In order to better contextualise their perceptions on the changes required and difficulties faced to operate in the new area, Figure 1 presents and compare the activity profiles of firms involved in MRET and potential entrants.

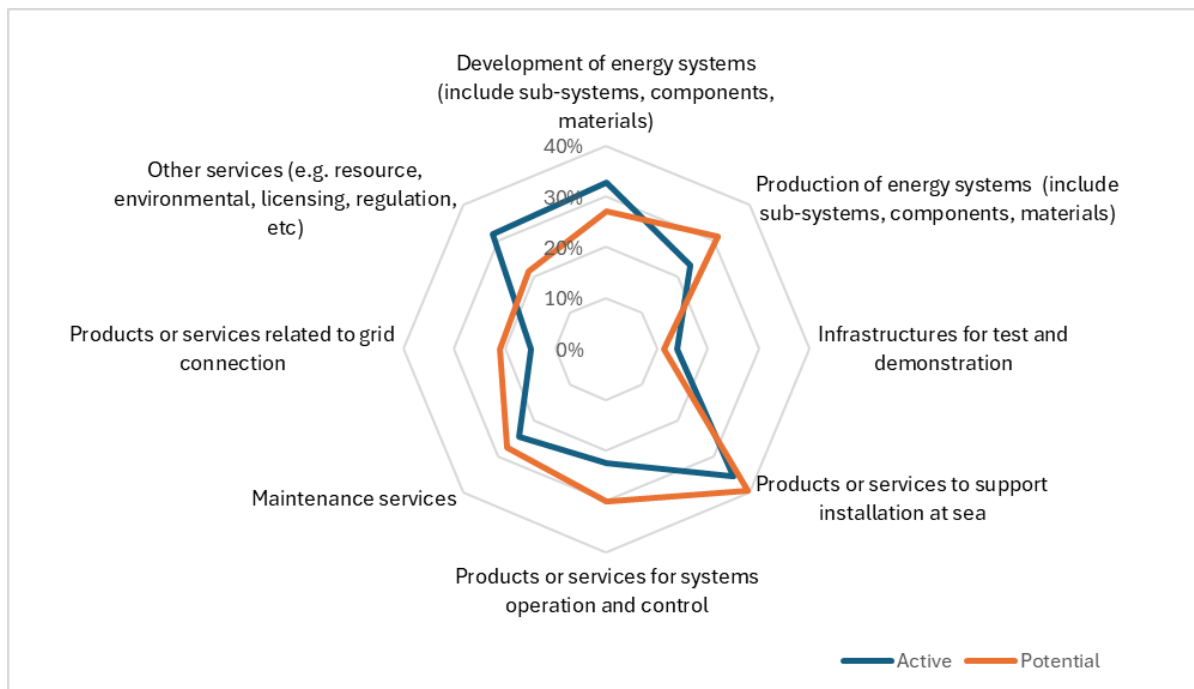


Figure 1. Areas of activity of firms already active and potential entrants (% of firms)

The most substantial number of firms, in both groups, operate (or expect to) as product or service suppliers to the installation or pre-installation phases. The development or production of the actual energy systems – especially of some of their elements, such as components, sub-systems or materials – are also important activities. But development prevails over manufacturing among active firms, while potential entrants are more frequently expecting to act as manufacturers. Supply of products or services for operation and maintenance or to grid connection is still relatively less frequent among active firms but is among the activities perceived as opportunities by potential entrants.

This profile can be complemented with data concerning the innovative nature of the products or services supplied. Over 60% of the active firms mentioned that they had to develop or extensively modify their existing products or services to answer to the requirements of the new area, while the remaining exclusively supplied current ones.

Overall, the profile is consistent with the experimental stage of technology deployment. But it also suggests a possible future specialisation along the more “downstream” parts of the value chain where local contextual conditions are more important [23], which is typical of countries with limited involvement in the innovation processes around the core technologies [24].

4.2 Firms perceptions of changes required and obstacles faced

The majority of firms, in the two groups (70 to 80%), mentioned the need to introduce some changes in the activity or organization. Moreover, as the Figure 2 shows, the perceptions of potential entrants regarding the areas where changes are to be expected are remarkably coincident with the experience of the firms already active.

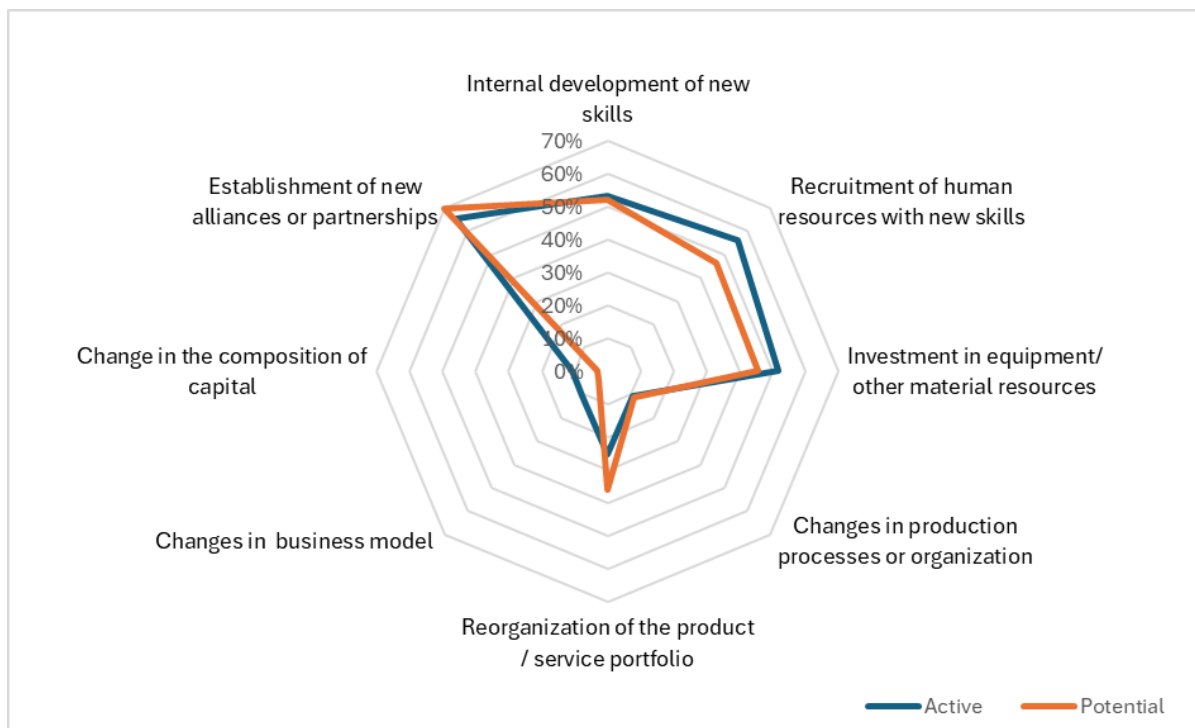


Figure 2. Changes in activities and organization introduced or expected by firms (% of firms)

Both groups give particular relevance to the establishment of new partnerships, closely followed by the need to obtain new skills, either through training of existing human resources or through new recruitment, as well as to the need to make material investments. The main difference regards the relatively greater importance attributed by potential entrants to the need to reorganize the product/service portfolio. But it is worth noticing that more in-depth changes, such as those regarding processes or modes of organisation – in particular those related with the firm business model or capital structure – were much less frequently mentioned, by both groups. This does not necessarily mean that such changes will be less important, but rather that the limited business opportunities created so far and, more generally, the uncertainty associated with this area, still recommend caution at these levels.

The effects of this uncertainty become even more visible when we consider the obstacles firms mentioned to have faced or expect to face to enter and operate in MRET. Problems were pointed out in mainly three areas: market, competences and policies. There was still great coincidence between firms already active and potential entrants, but here some differences were visible (Figure 3).

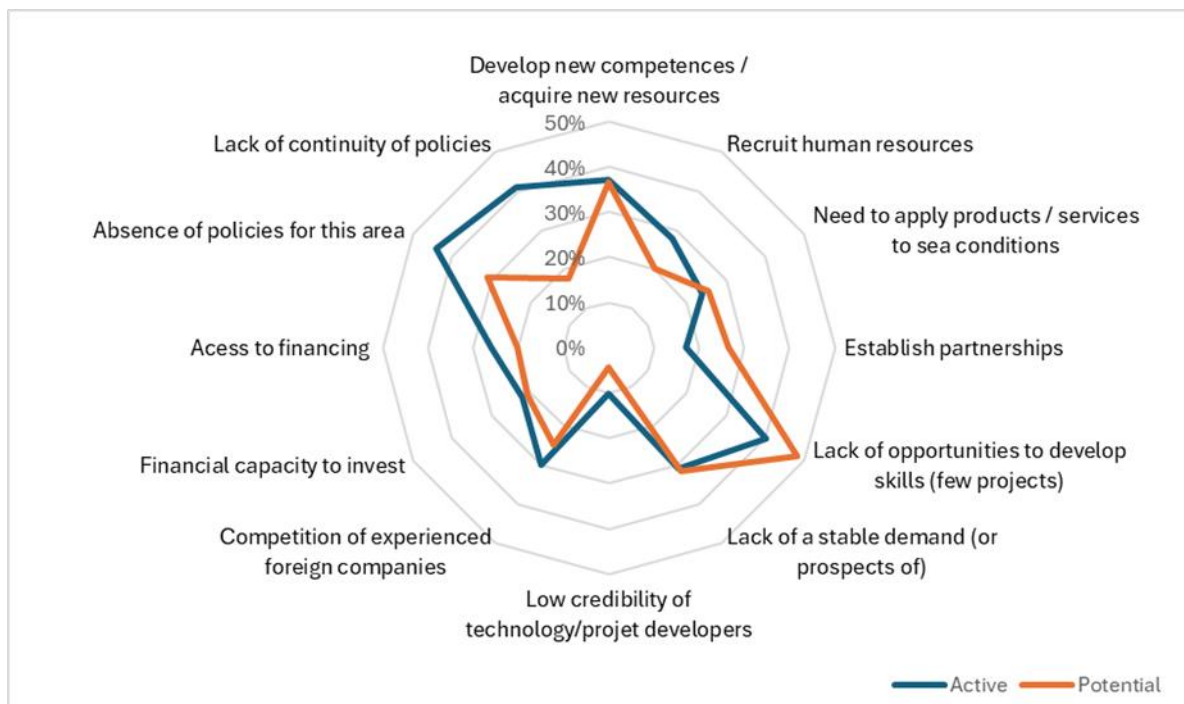


Figure 3. Obstacles faced or expected by firms (% of firms)

Concerning competences, one basic problem for both groups was the lack of opportunities to develop skills in the new area, given the limited number of projects. This obstacle was more strongly perceived by potential entrants. Both groups generally referred to difficulties in the internal development of competences, but firms already active also mentioned experiencing difficulties in recruiting human resources with new skills. For a sub-set of firms, also in both groups, the need to apply their products or services to the sea conditions was seen as a problem, given their lack of experience in that domain. The scarcity of projects also had market implications, as it was seen by both groups as not enabling a stable demand. Still in terms of market, firms (especially active ones) expressed preoccupation with the competition from foreign companies with experience in the area.

The main difference between the two groups concerned their views on policies. Both absence of policies for the area or their lack of continuity was seen as very problematic by a substantial number of firms already active but much less by potential entrants. Conversely, potential entrants referred more frequently to difficulties in establishing new alliances of partnerships, which would be critical to support entry or complement their capabilities.

Finally, financial problems – i.e. the need to access funding for the new activities and to develop additional investment capacity – were mentioned by a relatively low proportion of firms, in both groups. This suggests that most firms might not, at this early stage, have engaged in significant investments. However, an increase in activity is likely to put a greater pressure in this domain in the future.

5. Final notes and recommendations

The analysis allowed us to obtain some relevant results for understanding the process of construction of a value chain in the area of marine renewable energy that supports the advancement of offshore wind, despite the limitations inherent to the questionnaire survey mode,

which does not allow deepening the reasons for the answers given. It was possible to map the companies with activity or interest in the MRET area and gain some insights into on how they view the requirements to operate in this area and the main barriers to their performance.

The research shows that operation in the new area requires firms to make more or less substantial changes in their resources and capabilities, something that even potential entrants are clearly aware of. Similarly, it shows entry to be paved with difficulties, whose perception by firms that expressed interest in entering can be a deterrent to their future involvement. The results discussed above enable a first understanding of the areas where changes were identified by firms already active or perceived by potential entrants as more pertinent, as well as where obstacles emerged as more significant. This understanding is critical to inform policies, pointing to areas where it is necessary to act in order to promote a broader and more effective participation of companies from existing industrial sectors.

It is nevertheless important to point out that the picture depicted above reflects the early stage of development of marine renewable energy in Portugal. As technology deployment scales up, the types of firms involved and their needs may change [7], and the nature of the problems to be faced are likely to evolve. For instance, concerns about market demand may reduce while those regarding investment and financing may increase; some current difficulties may become even more pressing – e.g. those concerned with developing or gaining access to the required skills; understated issues may raise in importance – e.g. those involving reconfiguration of firms' strategies. Thus, policy makers can learn from the needs expressed by these firms but should also plan for the evolving conditions.

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