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Collaborative entry into the offshore wind power market

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1. Introduction

The world's primary energy use is predicted to increase during the next decades, reaching about 50% higher total energy consumption in 2050 than today. The key drivers behind the development are expected increases in population and gross domestic production (GDP). Energy mix visions and strategies thus have important roles in determining our future prosperity [1]. The increasing awareness of global warming due to the increased amount of greenhouse gases in the atmosphere and the finiteness of fossil fuel reserves has caused many nations to consider more sustainable energy alternatives. Wind appears virtually everywhere on the globe, and wind power technology, including offshore wind power generation, could offer a qualified solution [2]. All in all, the increased use of renewable primary energy sources and the improved overall energy efficiency have globally an important role in future energy production and consumption [3].

Firms operating in emerging industries, such as offshore wind power generation, need an appropriate array of resources and competences, and furthermore, they need to collaborate with other players in order to develop the novel business environment. A firm's resources, especially when they are valuable, rare, inimitable and non-substitutable, tend to provide sustainable competitive advantage, and thus enable the firm to find optimal product-market activities [4-6]. However, today many firms share their resources and expertise to develop new products, achieve economies of scale, and gain access to new markets and technologies, because single firms often lack the necessary resources and competences. The do-it-alone strategy has changed into an alliance strategy during the past decades. Strategic alliances can be either intra-industrial or inter-industrial, and may include licensing, supplier relations, joint ventures, collaboration, R&D consortia, industry clusters, and innovation networks [7, 8].

The purpose of this paper is to analyze the key actors in the rapidly emerging offshore wind power markets, and to evaluate how new entrants, such as spin-off firms with novel products could enter the market. The research question of the paper is: "What kind of key players operate in the offshore wind power business, and how can new entrants execute their market entry?" Case study research was chosen as the research strategy, and the evaluation was based on a literature review and financial, patent and potential partner analyses. The results reveal the leading players, newly established suppliers and challengers in collaboration with whom a new entrant with novel products, such as high power wind turbine generators, could execute further development and commercialization of the products. This study contributes to providing proof that a new small-scale entrant can potentially execute product commercialization for example by licensing or collaboration with market incumbents. The practical implications are even more significant, providing in-depth knowledge about the key players of the offshore wind power markets and revealing the potential industrial partners with whom the entrant could start to collaborate.

2. Offshore wind power

The key drivers for the growth of the wind energy market are the increasing global demand for energy, environmental concerns due to climate change, and economic considerations, as the cost of energy (CoE) generation by wind power can be quite well predicted. The world's wind resources are enormous: it was recently estimated by researchers at Stanford University that using only 20 per cent of the economically viable inland wind resources for power generation could exceed the world's electricity consumption in the year 2000 seven times over [9]. According to [10], studies by the European Environment Agency (EEA) confirm that the technical potential of offshore wind in Europe is six to seven times greater than the predicted electricity demand in Europe in 2020. The economically competitive offshore wind power potential is estimated to cover about two thirds of the electricity demand in 2020, reaching 80 per cent of the demand in 2030. All in all, offshore wind energy has several positive attributes compared to onshore investments, including large remote areas, generally higher wind speeds, and lower wind shear and turbulence [2].

Although there exist various designs, the most common design of a modern wind turbine is the horizontal axis wind turbine (HAWT), meaning that the rotation axis is parallell to the ground. The major components of a HAWT include a rotor (containing a hub and typically three or two blades), a nacelle (including a generator, the main frame, a drive train that contains rotating parts, such as the main shaft and possibly a gearbox, and control and electrical systems), and a tower and foundation [2, 11]. During the past decades, the nominal power of wind turbines has grown significantly, and today the biggest operational turbines are within the magnitude of 6 to 7 MW. Wind turbines with a power rating of 10 MW and beyond are under design. The offshore market is lucrative for high power wind turbines, in particular, as greater and remote areas enable siting large wind farm projects, and the offshore logistics of large components is smooth compared to onshore logistics. On the other hand, offshore wind power involves higher investment and operation costs than inland wind power, but the bigger power generating units diminish the cost gap [2, 9]. However, due to for examble the scale of economics the offshore wind cost of energy is expected to decline by one third beyond 2014 [12, 13].

The global installed cumulative wind power capacity was about 200 GW in 2010, and it consisted mostly of onshore installations. The cumulative market is predicted to reach 1100 GW by 2020. The biggest cumulative markets in 2010 were China and the USA, followed by Germany and Spain. The biggest turbine manufacturer in 2010 was Danish Vestas with sales of about seven billion euros. Among the top ten suppliers were four Chinese manufacturers that had grown rapidly, as had the Chinese market [14]. The offshore wind power market is still in its infancy, but the market is emerging rapidly. The world's cumulative installed offshore capacity is predicted to reach 75 GW by 2020 mostly in Europe, followed by Asia, particularly China, and the USA. The leading offshore suppliers in 2010 were Siemens and Vestas [12]. The key turbine manufacturers implement various supply chain strategies: most of the manufacturers produce at least some of the key components in-house, while the remainder is outsourced to a supply chain. However, some firms, such as GE Wind and Goldwind buy most components, while e.g. Enercon produces virtually everything in-house. Globalisation has been a general trend among the manufacturers, since it is viable to produce large-size components close to the main markets. Globalisation and consolidation among the manufacturers, meaning mergers and acquisitions, will propably remain the trend also in the future [15].

3. The significance of collaboration to new entrants

A firm's resources, especially when they are valuable, rare, inimitable and non-substitutable, i.e. when they fulfill the VRIN-conditions, tend to provide sustainable competitive advantage, and thus enable the firm to find optimal product-market activities [4-6, 16, 17]. Firms' competences are based on various resources that can be regarded as building blocks of enterprise capabilities and competencies. Core competences are a unique collection of competences that cross strategic business unit boundaries, are widespread in the firm, and are formed from the collective learning of the organization. Core competences provide access to a variety of potential markets, they contribute significantly to customer satisfaction and the company's end products, and they are difficult for others to recognize and imitate. Core competences are also rare, and typically even diversified corporations have only a few fundamental core competences. A company's long term competitiveness derives from systematically built core competences and company strategies, and the competences are also strongly interrelated [18, 19]. It is vital for companies to integrate the company strategies and core competences. As a conclusion, companies should integrate their overall business strategy, core competences and key technologies efficiently [20].

The radical geopolitical and economical changes during the past decades have meant that company and industry boundaries have blurred, and firms' legal boundaries differ considerably from their strategic boundaries. In fact, firms can achieve new innovations, growth and competitive advantage by cooperating with others in value networks [21-23]. Through collaboration and strategic alliances within the firm's external value network, a firm can gain access to required capabilities by linking its own resources to the partners' complementary ones, and thus achieve a sustainable competitive advantage [6, 17, 24, 25]. A firm's network extends both upstream and downstream in the value chain, integrating the firm's suppliers, other manufacturers, service providers and customers. The ultimate objective of the value chain is to achieve a sustainable competitive advantage for the firms within the network, and furthermore, today market competition takes place between supply chains rather than between single firms [26-28]. However, alliances have also constraints: according to [29], even 30 to 70% of alliances neither meet the set overall goals nor deliver the operational or strategic purposes of their parent companies.

After all, a broad understanding exists about the significance of business networks for emerging firms and small and medium size firms (SMEs). Business networks are beneficial particularly for SMEs, as they are thus able to acquire efficiently the resources they lack, and focus on their own core competences [30-32]. According to [33], SMEs benefit from network collaboration especially in the following ways: by gaining access to new markets and technologies, by sharing liabilities, through exchange of knowledge and competences, and by protecting their intellectual property rights (IPR). [34] complements that value chain cooperation offers a valuable opportunity, if not the only path, for SMEs to participate in commercially viable, but at the same time challenging and risky new product development (NPD). New developed products should not only meet the customer requirements and be competitive, but their time-to-market should be fast and timely [35], and appropriate partners can help SMEs with these challenges. [36] suggests that a successful partner selection requires technological, strategic and relational alignments. Technological alignment includes appropriate technical ability and resources, as well as a complementary knowledge basis and market knowledge. Strategic alignment is composed of correspondence motivation and goals. Relational alignment calls for a long-term orientation, an ability to change and a compatible culture. [29] confirms that positive partner characteristics include partner complementarity, commitment and compatibility.

4. Research design and data

The empirical study was executed as a single case study. According to [37], a case study is actually not a methodology, but rather a research strategy that concentrates on increasing the understanding of present dynamics within a single setting. Case studies also typically combine diverse data collection methods, such as interviews, questionnaires, observations and archives. [38] confirms this and defines a case study as a research strategy that investigates a contemporary phenomenon within its real world context. [39] describes a case study as an exploration of a bounded system that can be defined in terms of time and place, and through detailed, in-depth data collection, involving multiple and rich sources of information.

The analyses of the firms were based on financial data, a patent analysis, a literature review and experts' potential partner assessments, which were gathered in order to answer the research question: "What kind of key players operate in offshore wind power business, and how can new entrants execute their market entry?"

The primary source for acquiring the list of offshore wind turbine suppliers was an international consultant's report [12] that was further augmented by expert knowledge. The financial data of the firms was collected from international information providers' [40, 41] data bases, and it was augmented by a national information provider's [42] data bank. The potential industrial partner assessment was executed by a group interview of seven industry experts and academics, conducted in a group decision support systems (GDSS) laboratory using [43] software. A patent analysis, and a literature review of the firms' Internet home pages and the [44] data base complemented the experts' personal knowledge of the wind turbine players. The experts' long experience and knowhow from wind power industry and research greatly contributed to the research results.

5. Empirical analysis

The empirical results of the research are a synthesis of financial and patent analyses, a literature review and partner assessment described in the following. The firms were divided into three groups: leading players, new entrants and potential partners.

5.1. Financial and patent analyses

There were altogether 36 firms in the analysis. Adequate financial data in the data banks [40-42] was available for 18 of these firms. Some of the firms were part of a group of companies, and in case the financial figures of a subsidiary were not available in the data banks, the analyses were based on the line of business of the group or the group figures. The financial statements of the firms of the years 2006-2010 were analysed. Based on [45], while evaluating the firms' financial performance, the return on invested capital (ROIC) was regarded as good if it was over 15% and satisfactory if it was below 15%. A negative ROIC was evaluated as weak. Accordingly, an equity ratio of over 40% was regarded as good, 20 to 40% as satisfactory and below 20% as weak. The quick ratio, showing a firm's short-term liquidity, over 1 was rated good, 0.5 to 1 satisfactory and below 0.5 weak.

The results revealed that the players were large size enterprises with the net sales of all firms on average 8377 M€ and the total assets 11799 M€ in 2010. Although the average annual growth of the firms during the five-year-period was rapid (27.73%), the average annual profitability was good, yielding 8.19% earnings before interest and tax (EBIT) and 16.73% ROIC. The equity ratio (27.73%) was satisfactory, meaning relatively high leverage, i.e. a high share of loan capital. The quick ratio (0.77) was on a satisfactory level. The profitability of potential partners was the best of the different groups of firms, yielding 9.14% average annual EBIT and 23.45% average annual ROIC during the five-year period. The equity ratio (22.78%) was satisfactory, but the lowest of the studied company groups. The standard deviation (STDEV) in most of the studied factors and company groups was relatively high, revealing non-homogeneous company groups. This became evident in particular as the financial data for all subsidiaries were not available, and the data of the entire group (e.g. Areva) or the line of the business (e.g. Mitsubishi, Samsung, Hyundai) had to be used instead. All in all, the wind turbine players have grown rapidly, maintaining good profitability at the same time. The equity and quick ratios are on a satisfactory level. The financial results of the firms are summarized in Table 1.

Table 1

Financial performance and patenting activity of wind turbine suppliers

	All firms (*N*=18)	Leading actors (*N*=6)	New entrants (*N*=9)	Potential partners (*N*=8)
Net Sales 2010, MEUR, Average (STDEV)	8377 (8684)	3753 (3406)	10299 (10282)	6919 (6822)
Growth % 5 Yr Average (STDEV)	27.73 (22.20)	36.67 (27.06)	24.87 (19.94)	30.11 (26.71)
EBIT % 5 Yr Average (STDEV)	8.19 (4.92)	8.36 (5.83)	8.20 (4.74)	9.14 (5.27)
Total assets 2010, MEUR, Average (STDEV)	11799 (11904)	8178 (12576)	13183 (11844)	9623 (8990)
Equity %, 2010, Average (STDEV)	27.73 (11.06)	34.50 (11.11)	26.98 (7.26)	22.78 (13.97)
ROIC % 5 Yr Average (STDEV)	16.73 (13.38)	16.35 (9.00)	13.81 (9.09)	23.45 (16.70)
Quick Ratio 2010, Average (STDEV)	0.77 (0.28)	0.82 (0.34)	0.72 (0.21)	0.84 (0.37)
Patent count 2004-2010 (wind motors)	4983 (344)	3559 (486)	1000 (204)	424 (109)

Intellectual property (IP) has come to the front line of corporate strategies for success. Patents protect ideas, trademarks protect brands, copyright protects expression, and trade secrets protect the “secret sauce” of internal processes that have not yet been made public. Intellectual property, especially patents related to technological innovation, is at the heart of today’s wind energy. Typically the first step to mapping the IP landscape of any industry is to create a comprehensive database of patents within the technological sphere of that industry. International Patent Classification (IPC) symbols were used to identify relevant records in the databases (Table 2). IPC symbols have the advantage of being language-independent and generally assigned to patent applications in a uniform manner across different countries. According to [46-48], patents with IPC class “F03D” belong to the field of wind energy.

Table 2

International Patent Classification (IPC) system

Subdivision	Number of subdivisions	Example of an ICP code	
		Symbol	Title
Section	8	F	Mechanical engineering; Lighting; Heating; Weapons; Blasting
Subsection	21	F0	Engines or pumps
Class	120	F03	Machines of engines for liquids; wind, spring, or weight motors
Sub-class	628	F03D	Wind motors
Main group	ca. 6 900	F03D 1/00	Wind motors with rotation axis substantially in wind direction
Sub-group	ca. 70 000	F03D 1/06	… having a plurality of rotors

In the patent analysis, the leading players were complemented with the conglomerates Siemens Wind and GE Wind, which are both active in the wind energy business. Due to the difficulties of getting reliable data, some firms were excluded from the analysis. Altogether, the analysis included 4983 wind motor patents made in the years 2004-2010 (Table 2). The leading actors made over 70% of all these patents (Fig. 1).

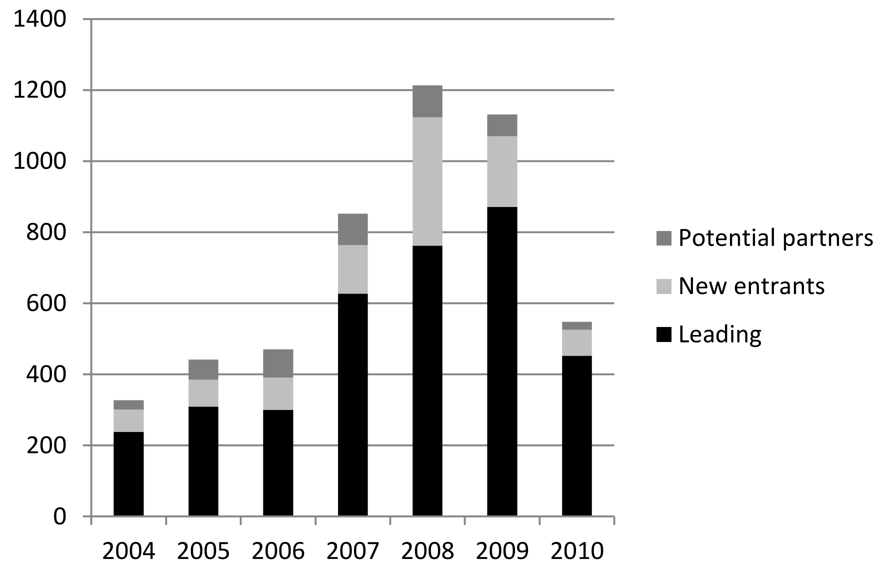

Fig. 1 Patenting activity

Of the leading actors, four major companies (GE Wind, Vestas, Siemens Wind, Repower), based in countries with highly developed wind power industries controlled the technologies as measured by patenting activity (Fig. 2). These companies had established themselves as technological leaders. The Chinese firms’ patenting activity had been extremely low.

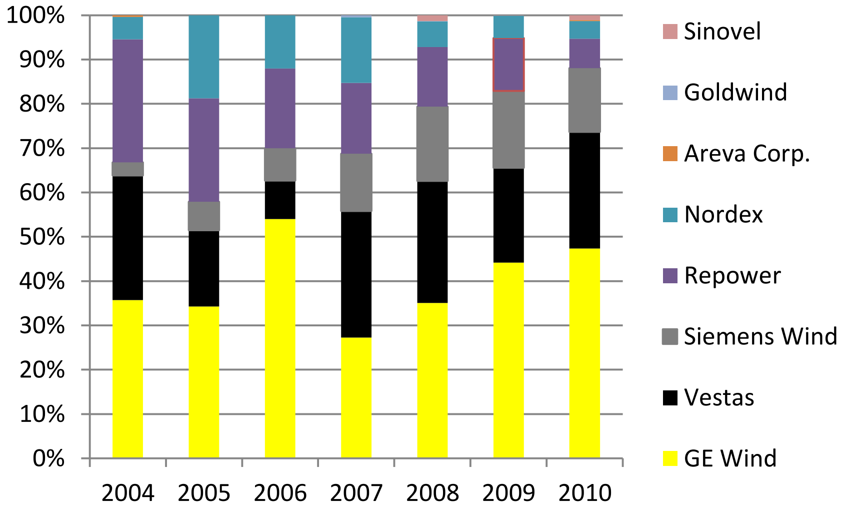

Fig. 2 Relative share of the leading actors in patenting

Overall, GE Wind had 1390 patents related to wind motor (F03D) technology in the years 2004-2010, Vestas had 840 patents, Siemens Wind 474 patents, and Repower *528* patents. The patent application count of the major actors, especially GE, Vestas, and Siemens, reveal a boom in wind technology patenting after the year 2006 that has continued to the present day.

5.2. Potential partner selection

For the new spin-off firm to be able to develop and commercialize the novel wind turbine generator further in collaboration, potential industrial partner assessment was executed in the GDSS laboratory using [43] software. Six experts from the wind turbine business, including two professors, participated in the group decision session. The financial data, the patent analysis, the literature review of the firms' Internet home pages, and the [44] data base complemented the experts' personal knowledge of the wind power market actors.

The participants' preliminary preparation for the group decision session began by getting acquainted with prepared materials. The session began by checking the components of the decision criterion – potential partner matrix, i.e. selecting the decision criterion and the potential partners to be assessed. The proposed components were discussed, justified and accepted to the matrix after a consensus was found. Totally 10 decision criteria and 12 firms (of the initial 36) were selected into the matrix, after which priorization of the criteria by the scale 10-1 (10 = highest priorization; 1 = lowest priorization) was executed. The potential partner's evaluated collaboration strategy and appropriate business culture received the highest scores, followed by a firm's strong intent to enter the offshore market and a strong financial position. Table 3 illustrates the priorization of the criteria.

Table 3

Partner decision criteria

Decision criteria	Final weighted score
Collaboration strategy	8.67
Business culture and easy communication	8.67
Strong intention to enter offshore market	8.17
Strong assets, equity, cash flow, resources	7.00
Broad international presence	6.50
Capability to carry risky investments	6.50
Appropriate technology roadmap	6.33
Extensive market and technology knowhow	6.17
Challenger in offshore market	6.17
Appropriate global production strategy	5.50

Next, voting of the whole matrix took place, and the firms were assessed by the scale 5 to 1 (5 = highest fit to a criterion; 1 = lowest fit to a criterion). The scores received by the firms, multiplied by the weighted decision criteria produced the final results. After discussions and consensus among the participants, the final results revealed that six of the 12 firms had received clearly higher overall scores than the rest. Firms 1, 2, 4, 5, 9, and 11 received in total about 250 scores or more, whereas the rest of the firms had about 200 or less overall scores. The results indicate that the expert assessment complemented by the earlier financial, patent and literature analyses suggest the six firms with high scores to be the most potential candidates to begin collaboration negotiations with. Fig. 3 illustrates the partner assessment results.

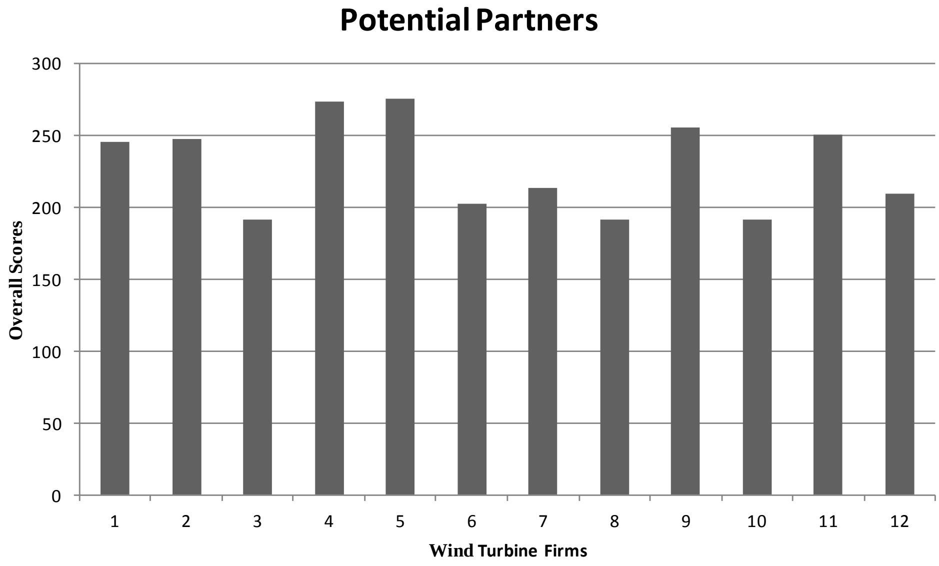

Fig. 3 Results of potential collaboration partner assessment

6. Results discussion and conclusions

The global climate change, the predicted increase in energy consumption, and the finiteness of current primary energy resources have increased the importance of improved energy efficiency, as well as the exploitation of renewable and thus more sustainable energy sources. Wind appears practically everywhere, and the world's wind energy resources are extensive, providing opportunities for exploiting both onshore and offshore wind power widely. Offshore wind power generation is still in its infancy, but the market is emerging rapidly.

The resources and competences of small spin-off firms are scarce, and therefore the commercialization of a product under development, and eventually a successful market entry is commonly rational to execute in collaboration with industry incumbents. This study found large scale wind turbine manufacturers in the offshore market that could be divided into three groups: leading players in the offshore markets, new entrants, and potential collaboration partners. In spite of the fast growth during the period 2006-2010, the firms had been capable of maintaining good profitability as well as satisfactory solvency and liquidity levels.

Intellectual property– especially patents related to technological innovation – is at the heart of today's wind energy. The results revealed a boom in wind technology patenting continuing to the present day in the patterns of patenting after the year 2006. The leading actors seemed to be dominating wind power technologies throughout the period 2004-2010.

Further, a group of wind energy experts selected the most potential industrial partners for the spin-off firm from a sample of turbine manufacturers, by utilizing GDSS software. The initial partner selection criteria emphasized the importance of an appropriate collaboration strategy and business culture of the partner, as well as a strong intent to enter the market and a healthy financial position.

The study provided evidence of the importance of collaboration, especially for SMEs that often have scarce resources and competences, and hence could benefit significantly from collaboration with other actors. As practical implications, the study indicated the key players within the industry and the most potential partners to begin collaboration negotiations with. The practical negotiations could be set in motion when the development project is in an appropriate stage and the intellectual property rights of the spin-off firm are secured. The to some extent limited financial and patent data can be regarded as the main limitations of the study. It might be beneficial to augment the partner assessment in the future by an extended number of experts, and to study the patent portfolio of the offshore wind turbine manufacturers more deeply. Further, it could be of significance to study the influences of modular design and mass customization issues on a successful market entry of a high-power wind turbine generator.

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ĮSILIEJIMAS BENDRADARBIAUJANT Į ATVIROJE JŪROJE ESANČIŲ VĖJO JĖGAINIŲ RINKĄ

R e z i u m ė

Didėjantis supratimas apie klimato kaitos grėsmę ir iškastinio kuro atsargų stoką ateityje, verčia daugelį šalių pradėti ieškoti energijos šaltinių alternatyvos. Vėjas atsiranda bet kurioje mūsų planetos vietoje ir vėjo energijos panaudojimo technologija, ypač atviroje jūroje esančiose vietovėse, vis labiau tampa patraukliu sprendimu. Šio straipsnio tikslas – analizuoti svarbiausius veiksnius realizuojant vėjo energiją atviroje jūroje esančiose rinkose ir įvertinti, kaip nauji rinkos dalyviai su savais produktais galėtų įsilieti į ją ir net tapti jos dalyviais. Šis įvertinimas grindžiamas literatūros šaltinių apžvalga bei finansinių, patentinių ir įvairių partnerių potencinės galios analize. Gauti rezultatai atskleidė šios rinkos lyderių bei naujų dalyvių ir pretendentų, ypač mažųjų, bendradarbiavimo galimybes, komercializuojant naujus minėtos technologijos gaminius.

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COLLABORATIVE ENTRY INTO THE OFFSHORE WIND POWER MARKET

S u m m a r y

The increasing awareness of climate change and the scarcity of fossil fuel reserves have made many nations consider energy alternatives. Wind appears everywhere on the globe, and wind power technology, including offshore wind power could offer a qualified solution. The objective of this paper is to analyze the key actors in the offshore wind power markets, and to evaluate how new entrants with novel products could enter the market. The evaluation is based on a literature review and financial, patent and potential partner analyses. The results reveal the leading players, new entrants and challengers, in collaboration with whom a new small-scale entrant could execute the commercialization of novel products.

Keywords: offshore wind power technology, financial assessment, patent analysis, collaboration, partner selection, renewable energy.

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